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W2NSD/1 NEVER SAY DIE editorial by Wayne Green

10-GHZ RECORD EXTENDED

Not satisfied with holding the world's record for states worked on the amateur 10-GHz band (five), the record holders have been working to extend it to six ... perhaps seven. The sixth was worked, I'm glad to report.

It all started out last fall when Chuck Martin WA1KPS got interested in the Microwave Engineering Gunnplexers and got a pair of them perking. The first contact from New Hampshire to eastern Massachusetts was relatively easy. Oh, it took us about fifteen minutes to find each other while tuning one unit and sweeping the general direction of the hill a bit over 50 miles away. Eventually, we lucked onto both the right frequency and bearing and the contact was solid

Later, Chuck made an expedition to a mountain in southern Maine, also well over 50 miles away. Again it took a lot of tuning and turning of the two transceivers before the contact was made. Both have to be on the right channel and pointed very close to the right direction. No dishes were involved at this time-just the Gunnplexers, with their little waveguide antennas.

Chuck then drove to Mt. Ascutney in Vermont, again over 50 miles from my mountain in southern New Hampshire, Pack Monadnock. It is no accident that I have a drive-up mountain within four miles of the 73 offices . . . that's what attracted me to this area when I moved here, 17 years ago. I've been a VHF and UHF nut right from the earliest days of my hamming, starting out on 21/2 meters, for those of you who remember that band. I ran a pair of 76s with their bases slotted for "efficiency" and was the terror of Troy (NY). That was before WWII . . . forty years ago!

Next we needed to work New Hampshire, so Chuck drove to the top of Mt. Washington and we made it . . . but that one was

tough. We were both freezing in the cold winds, clouds were swirling around Washington, and the transceivers were not working well at all. In the light of later improvements, they had never been working more than marginally! But we did make it for an exchange of callsigns and signal reports ... whew! That was 106 miles, with faulty transceivers and no antennas to boost the signal.

It took two tries to get Rhode Island, and we had several frustrating failures with Connecticut. Just as Chuck had the transceivers working better and a two-foot dish ready to use, snow finally blanketed my mountain and that was that for the winter. When spring finally arrived, we tried to make it to Connecticut again, with Chuck even climbing trees to try and get the few extra feet of height needed. No go. Then we tried to make it through from the New York border ... again a failure. There was no strain when we tested the system out between the Pack and Mt. Greylock in western Massachusetts, but the path to New York was just not there.

Bigger problems call for sterner measures. The Pack is about 2,500 feet high and is usually excellent for VHF contests. It has the benefit of a toll road to the top ... the very top

. plus a fire lookout tower for a few added feet. About 12 miles away is Mt. Monadnock, a 3.500-foot lump whose top half is all rock. This mountain has a slight problem in that it is a 21/2+ mile hike to the top and the going is not easy. I'm almost 60 years old, my primary exercise is sitting at a typewriter all day, and I have no business climbing a 3,500-foot rock mountain. Ă few days of skiing during the winter helps a bit, but does in no way prepare one for hard mountain climbing.

Put into perspective, world records call for that extra effort. so I agreed to make the climb.



That was not one of my better decisions. Chuck rounded up his team of Steve K1KEC and Eric WA1HON and headed for the best possible location in Connecticut ... near Somers. I rounded up our summer tech. Tim Daniel N8RK, and Sherry and we headed for Mt. Monadnock.

The first half was easy ... a dirt road. The second half was a pain. There was no scaling of rock faces-it was just a grueling climb up rocks for over a mile. It seemed to go on forever. We'd see what looked like the top just above us maybe 500 feet, but when we got there we would see another peak beyond that. Sherry, who is used to mountain climbing being like walking up Stone Mountain in Atlanta, said that this was between ten and a hundred times as difficult. Tim? At 17 years old, he went up like a mountain goat.

When I finally arrived, panting and a bit worse for wear at the top, I was greeted by a couple hams and a three-element six-meter beam! They'd packed 40 pounds apiece up there for some DXing on six meters, only to find a maximum of six contacts to be made. It was Sunday afternoon, with very little activity on six meters. There were a couple dozen hikers, all looking disgustingly fresh and rested.

Tim and I set up the 10-GHz rig and aimed it in the direction of Connecticut, coordinating the effort on 220-MHz simplex and, on occasion, on two-meter simplex. This was the easiest of them all ... contact was made almost immediately. Chuck's group was using a two-foot dish on top of a fire tower and we had the plain Gunnplexer, but mounted on a tripod this time for stability. The signal strength pin went right over full scale and then off scale! The voice was just like the other team was right with us. We did get some interference from the six-meter team breaking through on our

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TR-7625

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Squelch Sersitivity:	Lass than 0 25 µV	0 25 μV	0.3 µ*
Selectivi y:	Niore tuas 76 dB at 30 kHz or adjacent channel	SSB, CW & AM: 1.4 kHz/-6 dE, 4.8 kHz/-6C dB FM: 12 kHz/-6 dB, 24 kHz/-60 dB	20 kH:/-6 dB 40 kH:/-70 dE
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The climb down was not much easier than going up. It didn't take as much grunting and straining up through the rough places, but it took a lot of care and knee-shaking jumps to rocks. I was lame for several days afterward with knee-cap shock. The thought that Chuck and his group might want to do this all over again for another try for the New York-New Hampshire path went through my mind with each and every rock that I climbed down ... all one damned mile and a guarter of them

Fortunately, the day was reasonably cool ... perhaps around 80° ... and beautifully sunny. Visibility was only about 30 miles in the haze, but then it was a natural haze caused by the trees and not smog. There is never anything but clean air in New Hampshire.

The team down in Connecticut didn't have to cope with climbing a rock mountain, but they did have their problems. Being considerably south of us, they had much hotter weather and suffered greatly from sunstroke and heat prostration. Steve became completely prostrated in the back of their van when the time came to disassemble their setup and carry it down the tower. Oh, the agonies we have to go through to become world champeens.

BITING THE LIFERS

A recent letter from Chapman (ex-New England director) to ARRL life members on ARRL Foundation letterhead asked for donations to set up a \$100,000 slush fund for HQ to spend at Geneva this year.

For some reason, nothing was mentioned of the \$100.000 fund which has already been set up for just this type of use. I'm reminded of the League saving money for years to buy a new headquarters building ... money taken from the members as dues . . . and then, when they finally had enough money, running a building fund and collecting the same money a second time. And to cap that, they sold their old building for almost the cost of the new building. That's mainly how they built up that \$2 million-plus they have in securities and banks.

It seems to me that this begging for more money calls for some whistle-blowing. They seem to be trying to make up for the recent bad management of the League by asking for donations in the name of WARC.

The \$100,000 is still carried on the balance sheet of the League in their latest annual report... it is for "the defense of amateur frequencies." That would seem to cover WARC like

a glove. The fund was set up years ago and has been used for undisclosed purposes and then refunded by the League at the end of each year. It would seem that members of the League are entitled to a detailed accounting of the money spent from this fund down through the years. Any publicly held corporation would have to account to the shareholders for such a mysterious fund . . . particularly when there is a serious question about it being used for the personal benefit of League officials. IRS, please note.

I think I join many members in hoping that the League will be more prudent at Geneva this year. At the last WARC, they had a huge suite in one of the most expensive hotels in town and entertained lavishly. Throwing money around like that is the Ugly American way and we need friends, not resentful enemies.

To sum it up ... the ARRL Foundation is in disgrace over the resignation of most of its directors ... a fact which HQ has refused to discuss or even let members know about. They already have \$100,000 in cash set aside for just such an event as WARC, so the begging for \$100,000 more stinks. If you have money to pour down rat holes, I'm sure you can find better charities than this one.

ARRL PROBLEMS

I see that the ARRL's Central Division convention was a monumental flop ... eight exhibitors and about 400 in attendance. The magic seems to have gone out of ARRL conventions, and the active hams are staying away in record numbers. Compare this to the Atlanta Hamfestival, where, in spite of the severe gasoline shortages, the attendance was only down a bit from last year and the exhibit hall was packed solid with exhibits and people. Compare it with the St. Louis hamfest, where a first-time show filled the exhibit hall and packed the hall with attendees.

What were the differences? One was a matter of promotion, where Atlanta and St. Louis got extensive promotion in both 73 and MICROCOMPUTING magazines ... ads and editorial. Another difference was the speaker program, where one had no one of a controversial nature ... not even of any significance . . . and the others had speakers who packed 'em in. I suspect that the day is past when you can pull in a good crowd at a hamfest just by listing it in QST.

OUTLAW RADIOS

A recent attempt to amend a New Jersey law which prohibits the use of radios in cars capable of receiving police channels so that it would exempt amateurs was vetoed by Governor Byrne. Someone should make it a point to acquaint the governor with the facts of radio life and the ridiculousness of the whole charade.

Maybe a few years ago something like this could be legislated, but with the modern scanners there is no way to keep anyone who wants to from receiving police channels. Like guns, the laws only have an effect on the honest person. Criminals carry guns and are quite capable of buying and using radios which will receive police channels ... and how can a policeman know? With just about every other car sporting some sort of special antenna, a car can be set up for CB, for hamming, for any of a hundred special services . . . or to illegally receive police channels.

If the police are looking for just one more rap to lay on a criminal once he has been caught, the ramifications for hams and other honest users of radios are much too great a penalty to pay. Virtually every mobile ham rig for VHF is quite capable of being tuned to a police channel. The scanners, which are being sold by the tens of thousands, can get just about every police channel there is, high- or lowband ... and they are 12-volt jobs, just fine for mobile use.

Will someone please bring Governor Byrne up out of the 1950s? And perhaps someone should alert the New Jersey legislature that making it illegal to have radios capable of receiving police channels in cars is not going to have any effect on criminals... it will only harass non-criminals.

SPREADING THE WORD

One of the jobs that I feel a national amateur radio organization should do is lobby for us on a national level. This means organizing campaigns which will get amateur radio favorably into the media . . . articles in national magazines . . . demonstrations which are covered by television . . . promotion of ham activities during emergencies, etc. In case there is any doubt, we are not getting such a service from any of our national amateur radio organizations.

Individual clubs, in a few instances, have been doing a fine job of getting publicity, but unless you are terribly isolated from the general public, you must be aware that most people have no idea of the difference between CB and ham radio. We do need PR and we need it badly



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Bill Pasternak WA6ITF 24854-C Newhall Ave. Newhall CA 91321

The last time I went on a Field Day outing was in the early sixties. I was a member of an organization known as the Flatbush Radio Club of Brooklyn, New York, and we took to the hinterlands of New York City. The place was Prospect Park, which sits in the center of Brooklyn. OK...so it wasn't really the hinterlands. It was fun, but through the years the memories of that outing grew faint.

Since moving to California, the closest I have come to taking part in a Field Day outing was the time I went from club to club showing the PARC Field Day film, Field Day 1972. In the seven and one-half years I have been here, something has always come up to make me miss Field Day. One year I was out of town, another time I had to work ... you know the story. Well, this year it all clicked. The San Fernando Valley Amateur Radio Club was holding its Field Day operation on a hill not twenty minutes from my house. I had film in my Polaroid in addition to 600 feet of Super 8 film. Most important, I had the time and the opportunity to attend. The lure was overwhelming

If you have never experienced a real Field Day operation, you've missed something important. This is true gut-level amateur radio operation at its best. It's you the amateur versus the bands, the elements, and the odds. To me, the whole idea of Field Day is not whether I win or lose, but rather the camaraderie that is shown among amateurs during such an event. The San Fernando Valley Amateur Radio Club is an excellent example of such fellowship.

Let me tell you a bit about the SFVARC. It is a true amateur radio club with members whose interests go in many diverse directions. Unlike most clubs of this era, the SFVARC does not own or operate a repeater, nor does it ever plan to. In fact, a few years back I offered them such a device and it was rejected. It is not that SFVARC members don't like repeaters far from it. Most of the members can be found operating the myriad of two-meter and 220-MHz systems that abound in this locality. However, to the SFVARC, a repeater is nothing but a way of extending the communications range; with over 300 operational 2-meter repeaters in southern California, there is no need for yet another. So, while most members do operate VHF or 2-meter FM, they do so using the existing relay facilities.

Rather than worry about running a repeater, the SFVARC looks in other directions. It does such things as provide communications for March of Dimes walk-a-thons and work with

Ever wonder how a film is produced? Here's the secret . . . teamwork! (Photo by Bill Orenstein KH6IAF.)

"Santa" at Christmas to help bring joy to children in hospitals. The best way to describe the SFVARC is to say that they epitomize the concept of an amateur radio club in the truest and broadest sense. Perhaps that is why Field Day with SFVARC was so much fun. There were about a dozen dedicated people from the club spending almost thirty-six hours on a remote California hilltop enjoying each other's company and their amateur radio hobby. They were fulfilling a dream that could only be fulfilled once a year. Being together enjoying the experience was the point of their hilltop excursion. I could only spend Sunday with them, but it was well worth it. My memories of the past were rekindled and somehow I felt more like a "real ham."

A NEW MOVIE

Hollywood, which has brought you such epics as The Poseidon Adventure, Two For the Seesaw, Charlie, and other great moments in cinema, is now proud to announce another achievement. The World of Amateur Radio was produced by a man I consider to be a true cinema artist, Dave Bell W6AQ. I am writing this only an hour after leaving Dave's Hollywood studio. We just screened the first answer print of this new film and the consensus is that it is a superior work. With Dave Bell as the film's producer, the results were not surprising. In my opinion, he is a genius in his chosen profession. He knows his business, knows how to get a job done properly the first time out, and has the ability to lead others in the proper direction. Being able to work with someone like Dave has been a

real honor and a truly rewarding experience.

The World of Amateur Radio is fast-paced, relevant, and covers most aspects of our amateur radio world. NBC-TV News correspondent Roy Neal K6DUE is the film's host and chief narrator. There are contributions from Senator Barry Goldwater K7UGA, Arthur God-frey K4LIB, and Stu Gilliam WD6FBU, and special appearances by Dick Van Dyke and His Majesty King Hussein of Jordan JY1. The film was produced by Dave Bell Associates for the American Radio Relay League and it will soon be available from the ARRL. I am happy to say that this is one time when the League is truly serving the amateur community; it should be applauded for its fine work on our behalf. Through the cinematic expertise of Dave Bell, the ARRL is providing us with the type of visual vehicle we need in order to explain what amateur radio is all about. As this is written, the film print is en route to Geneva, Switzer-land, to be presented to those who will be deciding our future-the delegates to the World Administrative Radio Conference.

The World of Amateur Radio is our world, and now, thanks to Dave Bell and the ARRL, we will be able to share it with virtually everyone. All who worked on the project sincerely hope that you will enjoy the film. I have one request: At present, only one print of the film exists, and that print is in Geneva. It will be a few weeks before distribution prints are available. Please do not contact Dave Bell Associates or the ARRL requesting the film. Instead, keep watching for ARRL official bulletins, HR Report, the Westlink Amateur Radio News. and this column. All these sources will let you know the moment the film is ready for release. While we wait, readers of this column may want to start recruiting non-amateur groups for introductory talks about amateur radio, using the film as the focal point of the meetings. While we amateurs will enjoy viewing it, it's far more important that the film be seen by the non-amateur general public. It is time for the rest of the world to discover us and our service capabilities. Therefore, it is extremely important that the film reach as wide an audience as possible. Public schools, public television, civic groups, and church groups can all be approached. This is where you come in. The film will do no good sitting on a shelf. To be effective, it must be seen. Any takers?

New OMNI/SERIES B Filters The Crowd

The new OMNI/SERIES B makes today's bands seem less crowded. By offering a new i-f selection that provides up to 16 poles of filtering for superior selectivity. And a new Notch Filter to remove QRM. No other amateur transceiver we know of out-performs it.

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Both of these filters can be front-panel switched in series with the standard filter to provide up to **16 poles** of filtering for near-ultimate selectivity. In addition, the standard CW active audio filters have three bandwidths (450. 300, and 150 Hz) to give even further attenuation to adjacent signals. In effect, OMNI/SERIES B has six selectivity curves—three for SSB and three for CW. That's true state-of-the-art selectivity.

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OMNI owners note: Your OMNI can be converted to a SERIES B model at the factory for just \$50 (plus \$5 for packing and shipping). The notch filter replaces your present squelch control and provision is made for the two additional optional filters; a partial panel with new nomenclature is provided. Contact us for details.

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INTERESTING METHODS

The article by Jerrold Swank W8HXR, "Compact Beams for 20 or 15," in the July, '79, issue provides some interesting methods of compacting HF beams.

Swank's method of feeding, however, may cause considerable exasperation to anyone who attempts to duplicate his results, or who picks up the tidbit about using a quarter wavelength of RG-59/U as a quarterwave transformer providing a 2:1 step-up ratio and later attempts to apply the principle to a similar feed problem.

Swank states, "I used a quarter wavelength of RG-59/U as a matching section from the driven element to the RG-8/U coax lead-in. I guessed that the beam impedance would be about 20 Ohms, and this would raise it to 40 Ohms."

His first guess was probably close, but his guess about what the quarter-wave RG-59/U matching transformer would do missed by a country mile. The 20-Ohm feedpoint agrees closely with published data in several books by Orr and the ARRL Antenna Book, where driven element-to-director spacing approximates 0.11 wavelength spacing. Swank's 20-meter beam with an 8-ft. boom would provide this condition.

However, a quarter-wave matching transformer of RG-59/U (73 Ohms), will only provide a 2:1 step-up ratio where $Z_S = 106.07$ Ohms and $Z_R = 53.035$ Ohms. These conditions are not met, since he estimates Z_R to be 20 Ohms.

Given that his feedpoint resistance does, in fact, conform to textbook data, what his quarter-wave matching transformer of 73-Ohm coax will do is transform the 20-Ohm ZR up to 266.45 Ohms, presenting then a 5.124:1 mismatch to the 52-Ohm RG-8/U feeder.

This can be proven mathematically by the standard quarter-wave transformer equations: $Z_S = Z_O^2/Z_R$ and $Z_O = \sqrt{Z_R Z_S}$, where Z_O = characteristic Z of line, Z_R = resistive termination, and Z_S = input Z of the line.

From the equations, we can also calculate the correct Z_O to provide the desired match between 20 Ohms (Z_R) and 52

Ohms (ZS), the nominal Z of the RG-8/U feeder. For these impedances, the ZO should be 32.2 Ohms, which is not a standard coaxial line. It can, however, be accomplished by using parallel quarter-wave sections of RG-59/U or RG-59B/U, connecting both braids and both center conductors in parallel. This will provide an equivalent line with Zo of 36.5 Ohms (75 ÷ 2), a value close to the ideal. To calculate the mismatch into the RG-8/U using such a transformer, it is necessary to refer again to the equation: $Z_S =$ $ZO^{2}/ZR; ZS = 68.6$ Ohms.

Impedance mismatch between the RG-8/U (52 Ohms) and the quarter-wave transformer ZS (66.6 Ohms), being a function of the ratio of these two values, then becomes 1.28:1, obviously a very acceptable value and a substantial improvement over the mismatched condition presented by Swank's quarterwave of RG-59/U.

This then raises a question about how Swank obtained an swr measurement of 1.5:1 at the lowest point. This would make it appear as though the quarterwave of RG-59/U was transforming a ZR of 68.32 Ohms to a ZS of 78 Ohms, since RG-8/U terminated in a 78-Ohm load would operate with the 1.5:1 swr he indicates. With a parasitic element spaced only 0.11 wavelength from the driven element, a feedpoint resistance of 68.32 Ohms would be much higher than normal, unless the elements were severely detuned. While this is possible, it is much more likely that his indicated 1.5:1 swr is simply incorrect. This can be verified by adding another length of RG-8/U between the feeder and swr bridge. The chances are that the swr will then change, indicating that neither the 1.5:1 value nor the second value obtained present a true picture of what the mismatch actually is.

My purpose in writing this is twofold—first to correct the error in the article, since Swank's assumptions about the quarterwave transformer were totally incorrect and may lead someone astray, and second, to demonstrate that his original guess of a 20-Ohm feedpoint resistance may also have been in error.

Before applying any method of improving the impedance match, it would seem logical to actually measure the feedpoint resistance. Two of the regular advertisers in 73 offer economical equipment for this purpose: MFJ's MFJ-202 RF Noise Bridge and Palomar Engineers' RX Noise Bridge. Both will indicate feedpoint resistance in addition to the resonant frequency, eliminating the need to "guess" what these critical characteristics might be. To hang a matching system on an unknown feedpoint resistance is kind of like scooping a handful of pennies into a bag, then saying that by removing 20, only 52 will remain.

Robert G. Wheaton W5XW San Antonio TX

The chances are that my feedline was not a real half-wave multiple. Anyway, the simplest solution would be to use a pair of 59/U coax cables in parallel, which would be 37.5 Ohms. The length required is only about 10' 10'', and this would give a match of 1.4:1.

The alternative would be to use no matching section, which would give a match of 2.6:1, and, if necessary, trim the feedline for a match or use a small L network.

I wrote the article mainly to give hams ideas on how to make beams with the materials at hand. I apologize for the error.

Jerrold Swank W8HXR Washington Court House OH

MINUTES

A little research of the Minutes of the ARRL Board meetings the past six years has turned up a few interesting facts and raised a few questions, all of which might be the subject of a future editorial: expense accounts of the Directors and the President of the ARRL.

Naturally, being in the Hudson Division, I took a look at the expense account of this Division Director. It looks like this:

			Total
	Authorized	Increase	Received
1979	\$4,000.	\$(note)	\$4,000. + ?
1978	3,500.	300.01	3,800.01
1977	3,000.	204.30	3,204.30
1976	3,000.	none	3,000.00
1975	3,000.	36.23	3,036.23
1974	2,500.	none	2,500.00
Note	The increa	se in auth	orization to
	a Director	comes at	the Board
	meeting th	e followin	g year.

Now, I work for the State of New York, traveling extensively throughout the state (not just the Hudson Division), with an occasional extra trip to Harrisburg PA or to Washington DC. My expenses include lodging, subsistence, plane fare, airport limos, taxis, and car rentals. My expenses for any year haven't come anywhere *near* the Hudson Division Director's ex-

penses authorized for 1974, the minimum of those checked!

Another very interesting fact turns up when looking for the expense accounts authorized to the President. The 1979 Board (1st) meeting authorized Mr. Harry Dannals an amount not to exceed \$10,000 "for 1979." Looking at the Minutes again, I can't find any authorization for Mr. Dannals for the years 1978 and 1977. (Isn't that strange?) He was authorized \$7,500, "for 1976," though. Apparently nothing was authorized for 1975 and 1974. Question: If, indeed, as I suspect, the President did receive expense authorizations for the years 1978, 1977, 1975, and 1974, where were they hidden???

The above "gravy trains" are being financed by the membership through an increase in dues in 1977 to \$12 a year, and again in 1979 to \$18 a year. It is no wonder that they are finding it difficult to increase the membership in the ARRL at these rates.

A most significant item (Minute #74) in the Minutes of the January, 1979, Board meeting, makes me very suspicious of financial finagling in Newington. Mr. Holladay made this motion that the General Manager (Baldwin) be directed to publish the League's audited financial statements in QST. This motion was amended by Mr. Price (at whose instigation?) to have the editor of QST directed to remind members through "League Lines" of the availability upon request of the League's audited financial statements. The amended motion was adopted, over the opposition of Mr. Holladay.

It is no wonder, with all the "lulus" available, that the Directors and the President are not desirous of rocking the boat by asking for an investigation of blatant dictator management of the ARRL in Newington.

Byron H. Kretzman W2JTP Huntington NY

SACRIFICE

With mixed feelings, I wish to inform you that, in a drive to cut down my subscription list to something commensurate with my time to read, I am renewing your magazine and sacrificing the comparably laudable *Scientific American* and *Mother Earth News*. Yours has more circuits.

I have successfully resisted becoming a ham for some 35 years, and now that I am partially deaf (the National Semiconductor LM389 makes a dandy hearing-aid amplifier chip, though), it's unlikely that I'll ever succumb. I'm a longtime

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RTTY Loop

Marc I. Leavey, M.D. WA3AJR 4006 Winlee Road Randallstown MD 21133

Occasionally, a letter comes in which is so far afield from an idea I was trying to get across that I feel I must have made too many assumptions in the presentation. Such is the case this month.

Pete Buyaki K5GV is having trouble understanding my presentation of hexadecimal arithmetic. Pete writes, "[I] . . . hit a snag when I came to \$5F, etc. This seems odd since these numbers are in the middle of the ASCII table, because it's in the middle of the alphabet table . . . Looking up in the ASCII tables:

	\$ 5 F	0100100 0110101 1000110	
	\$ 2 0	0100100 0110010 0110000	Subtracting this group from the group above
the difference		0000000 0000011 0110000	- ETX (end text) SYN (synchronous idle)

"I'm sorry, but I don't understand the relation as to how the Baudot will remain in the capital letter format when ASCII is putting out lowercase letters."

Okay, Pete, there are two items of note here. First off, the convention representing one eight-bit byte in hexadecimal is "dollar sign—left nybble—right nybble." In other words, 01001110 in binary corresponds



Fig. 2.



Fig. 3. Jack strip wiring.

to 4E in hexadecimal. So, when I say \$4E, what I mean is 01001110. Now, in ASCII, that \$4E corresponds to "N". Lowercase "n" is \$6E, which is \$20 more than \$4E. That is, \$4E + \$20 = \$6E. Another way to look at that is by converting the hexadecimal to decimal. \$4E is 78 decimal, and \$20 is 32. Thus, 78 + 32 = 110, and 110 decimal is \$6E hexadecimal.

If everything is clear so far, I'll throw in one more loop. The ASCII we have been talking about is a seven-bit code, but the hexadecimal representation is eight bits. The most significant bit is frequently called the "parity bit," and we have assumed it is set to zero. Some references assume a parity bit of "1". In that case, add \$80 (1000000 binary) to the ASCII values as represented. For example, carriage return becomes \$8D rather than \$0D, and that "N" becomes \$CE rather than \$4E.

One final note before I move on. I said that the dollar sign is used to preface hexadecimal numbers. You might wonder if other bases have similar labels. They do! Binary is denoted by a percent sign, and decimal either by no sign or an ampersand. Thus, %01011010 = \$5A = 890.

Another item in the mailbag this month is from D. A. Scott W4AKQ in Cape Coral, Florida. Scotty is looking for informa-tion on "silent RTTY," that is, RTTY using video terminals or computers. Sorry to say, I know of no book devoted exclusively to the subject. More articles have been published here in 73 than just about anywhere on that topic, however, and Fig. 1 is a compilation of articles I have noted within the last several years. Little information on any of the commercial RTTY video terminals has been received by this column, despite promises and offers from several sources. I would encourage you to ask around your area and see what



"A Very Cheap I/O—The Model 15," 73, May, 1976, p. 77. "Digital Group RTTY Micro," 73, September, 1977, p. 98. "Baudot Interface Cookbook," Kilobaud, September, 1978, p. 66. 6800-based systems:

"Baudot To ASCII," 73, November, 1976, p. 172.

RTTY Loop, 73, June and July, 1978 (receiving). RTTY Loop, 73, June and July, 1979 (transmitting).

6502-based systems:

"RTTY With The KIM," 73, September, 1977, p. 110. "Try Your KIM-1 On RTTY," 73 October, 1977, p. 88. "KIM-1 Can Do It," 73, February, 1978, p. 88. "RTTY With The KIM," 73, December, 1978, p. 170.

"RTTY Transceive For The KIM-1," 73, May, 1979, p. 78. Other systems:

"Build This Exciting New TVT," 73, March, 1976, p. 76. "ASCI/Baudot With A PROM," 73, June, 1976, p. 114. "A RTTY/Computer Display Unit," 73, July, 1976, p. 118. "The XITEX Video Terminal," 73, December, 1978, p. 132.

Fig. 1. Articles on silent RTTY.

people are using. Be sure to write the manufacturers of any equipment you contemplate buying prior to investing in a unit, for information and literature. There apparently have been some problems with rf sensitivity and interfacing difficulties with some widely advertised equipment.

Another note received in the mail is from Art Santella K1VKO in East Norwalk, Connecticut. Art is using a Model 28-KSR Teletype and has added outboard paper tape equipment to provide the features of the "ASR" set. What he wants to be able to do is punch a reply tape while receiving.

I presume that you have the common Model 14 tape equipment, Art, although this will apply to any standard equipment. The tape punch you have is called a "reperforator," because it punches off of an active TTY line. Data is fed into it via the standard 60 mA [R]TTY Loop (don't mind the plug!). From what you tell me, you are using a HAL ST-6 demodulator as both the source of data and the loop supply. I assume your station hookup is something like Fig. 2.

There are many ways of hooking equipment up together, switches, tie lines, and the like, but the way that many RTTY enthusiasts have come to love over the years is with a patch panel. Diagrammed in Fig. 3, this is a series of phone jacks which are connected in series, so that any equipment plugged Into the strip is in series with anything else. Equipment may thus be switched from loop to loop with a minimum of effort. The key to the system is that the jacks are all shorted if nothing is plugged in. Thus one jack or all may be in the system at any time. Such a plug/jack system may be just what you need.

If you look into your Model 28, you should find a terminal strip, diagrammed in RTTY Loop, October, 1978, page 20, upon which are represented the leads for the keyboard. You should find a black and a brown wire on terminals seven and eight of TB-751. Bring these wires out to a plug and the terminal connections to a shorting jack. When you plug the keyboard leads into this jack, all will be as original. However, when you plug the keyboard into an auxiliary loop, which also supports the reperforator, you will be able to punch tape independent of the printer. Fig. 4 diagrams this system.

If you are going to do this, be sure that your keyboard contacts are clean and bypassed for rf. You normally do not receive while typing, and thus are unaware of the arcing that takes place on many keyboard contacts. If not conditioned, this arcing can generate severe hash in the received signal. A simple loop supply to use to run the auxiliary loop is shown in Fig. 5. Please don't forget that current-limiting resistor. Fried selector magnets do not smell very good.

That's about it for this month. With autumn approaching, conditions should be changing on many of the HF bands, and I hope to be on more and QSO many of you who have written.



Fig. 5. Simple loop supply.



Fig. 4. Sample station wiring.

20

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New Products

SON OF THE QF-1

The recently introduced Autek Research QF-1A active audio filter is a unique selectivityenhancing accessory that should be of interest to many amateurs, not only because of its quality and features, but also because of its moderate price tag (\$65 at this writing).

The QF-1A is the latest in a line of receiving filters that Autek has marketed since 1972. One could probably trace the lineage of the QF-1A and its competitors to the popular National Radio "Select-o-Ject" audio filter that was the apple of many a ham's eyes in the fifties. The current breed of solidstate filters offers a lot of improvements over the "S-o-J" and its vacuum tubes; the QF-1A, I found, has a number of special features that make it of great interest to CW and SSB operators alike.

Among these features are four filter modes of operation (peak, notch, lowpass, and highpass), continuously variable selectivity or bandwidth from "flat" down to 20 Hz, a main frequency adjustment that can be set anywhere from 250 to 2500 Hz in any of the four modes, and a second notch frequency adjustment control (added since the QF-1-more on this feature later). The filter is housed in a $6\frac{1}{2}$ " \times 5" \times 2 $\frac{1}{2}$ " gray-finish case and is designed to be plugged into the headphone or external speaker jack of the transceiver or receiver with which it is to be used. It contains a well-filtered 115-V ac power supply and a one-Watt audio power amplifier, so it does not require any additional connections to the rig for power or audio tap-in.

I have used the earlier QF-1 model filter for more than two years and have found it to be an essential station accessory – and, I might add, one which has required no maintenance at all. And, despite the reasonably sharp 600-Hz CW and 2400-Hz SSB i-f filters which my Tempo 2020 has built in as standard equipment, I have found that the QF-1 has made the transceiver's selectivity a great deal sharper. The continuously variable filter characteristics allow a much greater flexibility in combating QRM and in eliciting "armchair copy" in an extremely crowded band.

The original QF-1, written up in QST in March, 1977, is similar in design to the newer version but is simpler and has fewer front-panel controls. The QF-1 has selectivity and frequency controls, a three-position mode switch, a speaker/headphone jack, and an ac on/off switch. The QF-1A, apparently drawing on user suggestions and throwing in some "nice to have" features, has five switches and controls on the front panel: (1) an ac on/off switch, which automatically bypasses the filter when turned off; (2) a fourposition mode switch; (3) a calibrated selectivity control; (4) a frequency control; and (5) an auxiliary notch frequency control. The headphone/speaker jack is now mounted on the rear panel.

After unpacking the QF-1A from its shipping carton and reading the instructions (which were carefully prepared and complete). I hooked the unit up to my 2020, replacing the faithful QF-1. I found that overall performance was similar, although audio quality was somewhat "cleaner." Like the QF-1, the filter allowed superior "single-signal" reception of very closely spaced CW stations. The filter also worked nicely on SSB, having a very definite impact on signal readability by reducing sideband chatter, static crashes, background noise, and receiver hiss. By using the adjustable notch feature, heterodynes (beats) could be reduced or



Autek's QF-1A.

eliminated on both CW or SSB with no trouble.

So far, there was little difference between the units. I found, however, that the newer filter provided a few operating features not found in the QF-1. For example, the on/off switch now automatically bypasses the filter when it is turned off. When using the QF-1, you had to unplug the speaker or headphones and plug them back into the transceiver or receiver when you were not actually using the filter, a minor but not insignificant annoyance. The older model's controls were adjustable over a comparable frequency range, but they were not calibrated: the QF-1A's controls are calibrated at key points, a factor which is useful in resetting the filter to the "flat" position when casually tuning the band or in trying to remember "which way to go" with a control in a pileup. The controls also have a somewhat improved "feel" and bandspread. The auxiliary notch control even allows a second heterodyne to be nulled out should the occasion arise (it will!). It's also possible to use this auxiliary feature to combine operating modes so that you can simultaneously notch/ peak, notch/lowpass, or notch/ highpass to your heart's content: the instructions tell just how to set up the controls to perform all this "black magic."

The new filter, I found, really comes into its own in serious CW work under crowded contest weekend or DXpedition conditions where weak, in-thegrass signals can often be brought up to effective "599" levels even in the presence of close-by rock-crushing signals which would ordinarily obliterate them. The desired signal can be peaked with an effective bandwidth of as little as 20 Hz with minimal ringing (although such narrow bandwidths are not usually necessary and can be fatiguing to the operator). Using the notch mode, very pronounced rejection (up to 70 dB) can be attained with very little tinkering with the controls. I find that operating in the lowpass mode doesn't produce excessive "booming" and is perfectly adequate for casual CW work used in tandem with the Tempo's 600-Hz filter. When the QRM gets rough, I switch to the peak mode and use the selectivity and frequency controls to zero-in on the desired signal. It's interesting to note that even with the transceiver's sharp CW filter, it's possible to actually "tune through" the Tempo's 600-Hz bandwidth and bring up three or four separate CW signals to solid copy that were unreadable without the filter in the circuit.

My use of both filters has indicated that SSB reception is also normally best in the lowpass mode and allows one to easily cope with adjacentsignal splatter and QRM; I like to run with this mode engaged at all times, as it enhances overall audio quality. The auxiliary notch control is effective in nulling out heterodynes, and when the SSB sledding gets rough, all one has to do is to slightly "sharpen up" the selectivity by tweaking the selectivity and frequency controls.

While the QF-1A and other active audio filters work best with receivers and transmitters that have narrow, steep-skirted internal i-f filters, I have found that the filter also does a surprisingly good job on sets that have poor i-f selectivity characteristics. For example, I found that I could dramatically improve the effective selectivity of my Yaesu FRG-7 general coverage receiver. The FRG-7. as supplied from the factory, is much too broad for good SSB and CW work. It's mainly an AM-type SWL receiver, and a good one for that purpose. Its basic i-f selectivity is listed as ±3 kHz at 6 dB down, and a built-in fixed audio filter allows selection of either 3-kHz. 2500-Hz, or 1500-Hz bandwidths. When hooked into the QF-1A, I could tell little practical difference in overall CW and SSB selectivity characteristics between the FRG-7 and the Tempo 2020 with its excellent internal filters! CW signals which were completely unreadable on the barefoot FRG-7 were now a solid Q-5 copy with the filter switched in, and the improvement in SSB reception, though not quite as dramatic, was nevertheless impressive. Of interest to SWLs, I found that the filter also improved AM selectivity on both the shortwave and AM broadcast bands and allowed stations just a few kHz apart to be separated nicely with little cross-channel chatter. This ability would be of special help to the mediumwave DXer in trying to sort out split-channel AM broadcast stations (those operating between the standard 10 kHz U.S. channels), as well as foreign broadcast stations which are often but 3 or 4 kHz apart on the shortwave bands. (If you use the QF-1 with the FRG-7 or another receiver with a built-in fixed audio filter, run with the internal filter out for best results.)

Being an inquisitive sort, I tried out the new filter with some other equipment and was surprised by the results. For example, I used it quite effectively with a converted Johnson 4740 SSB transceiver on ten meters. When operated in the lowpass mode, the filter did a great deal to reduce channel "bleedover" effects and crosstalk. Also, the notch feature was handy in suppressing annoying heterodynes from the many AM stations now on the band that use converted AM CB transceivers.

I also experimented with the filter on my KLM-2800. The 2700 is designed for two meter allmode work, though the primary emphasis-as in most other "all-mode" transceivers - is on FM; it is somewhat lacking in good CW selectivity, and there are no provisions to add optional i-f filters to reduce bandwidth. Hooking up the QF-1A had much the same beneficial effect as it did when it was worked with the Tempo 2020 only more so. The filter added a great deal of selectivity to an otherwise broad set for serious CW work, and it made a difference on SSB as well. As expected, it didn't do much for FM reception.

The original QF-1 design was good one. Most of the QF-1A's changes are convenience features and minor improvements, such as the addition of the automatic bypass, the auxiliary notch control, and the calibration marks on the selectivity/frequency controls. Also, the newer version's selectivity goes down to 20 Hz, as opposed to a "mere" 50 Hz on its predecessor. Both designs are thoroughly bypassed and filtered to prevent rectified rf from your transmitted signal from getting back into the audio circuitry and causing problems; I had no difficulty from rf feedback even when running a full kilowatt on 80 through 10 meters.

When working with very narrow selectivity, you may find it convenient to connect a Y-cord adapter in the output line and run an output to an oscilloscope or ham-type monitorscope (such as the Heath SB-610 or similar Yaesu and Kenwood versions) to visually help in determining exact audio peaking. Also, one feature that could have been added to the QF-1A but wasn't is a set of switches to allow its use with two audio sources (two receivers, or a transceiver and a receiver) and two outputs (a headphone and a speaker). As it stands now, the unit must be manually plugged in and out of the equipment with which it is to be used, and the speaker and headphones must be plugged and unplugged by hand.

Also, I have found it expedient to feed the filter's output to a small "wireless FM rebroadcaster" module (I use the Ramsey module @ \$3) used in conjunction with a pair of cordless FM headphones. Doing so eliminates the need for clumsy headphone coiled cords and has the side benefit of allowing you to monitor the band anywhere in your home or yard by tuning in the rebroadcaster's signal on a nearby FM radio. You may not want to try this, but I mention it to point out the possibilities and advantages of hands-off, cordfree hamming.

Some suggestions I had for enhancing the versatility of the basic QF-1 were described in my May, 1978, 73 Magazine article, "The Super Select-o-Ject." Many of the changes I made to the QF-1, such as the switching arrangement, can be adapted to the new filter.

One caution: The QF-1 and its successor tend to emphasize any residual ac hum present in the transceiver's or receiver's audio output. This is normally caused by insufficient ac filtering in the rig and not in the audio filter. I have found this condition to be noticeable mainly when operating in the lowpass mode and feeding lowimpedance, hi-fi type headphones, which normally have a heavy bass response. This problem can be minimized by adding a 50-to-150-Ohm, 1/2-Watt resistor in series with the headphone lead to cut down the phones' sensitivity and low frequency response.

In my opinion, the QF-1A is a real jewel well worth the modest price tag. While I have not as yet made an in-shack comparison between the Autek filter and its competition, I can say that the quality of construction (steel case) and circuitry board is excellent and reflects care in design and manufacture. The QF-1A makes a modest receiver or transceiver "come alive" in the selectivity department and allows the average set-so often lacking in real CW performance-to become a winner. For further information, contact Autek Research, Box 5127, Sherman Oaks CA 91403. Reader Service number A100.

> Karl T. Thurber, Jr. W8FX/4 Ft. Walton Beach FL

Notes

1. There are a large number of audio communications filters on the market today. These include some highly competitive designs by MFJ, Waneco Radio, Dynamic Electronics, Datong, Kantronics, Electronic Research Corporation of Virginia, and others. These filters range in price from about \$30 to \$200 and more. If you are interested in building your own, a very good active filter design is shown by Donald Morar W3QVZ in the December, 1978, issue of 73. His article, "Build the Flexi-Filter – A Very Active Device," is on page 222.

References

1. Product review, Autek Research QF-1 R-C Active Filter, QST, March, 1977, p. 44.

2. Thurber, Karl T., Jr. W8FX/4, "The Super Select-o-Ject," 73 Magazine, May, 1978, p. 116.



Non-Linear System's MS-215 Miniscope.

MISSION IMPOSSIBLE? NOT WITH THE MS-215!

The manufacturer's service information reminded me of that TV series "Mission Im-possible," and for that matter, what I had to do could very well have been a script for the show. It was nothing exciting—I just had to identify one bad chip on a circuit board containing 36 chips, located in a cabinet with an access door about 18 inches square. But, not to worry, according to the manufacturer -just get into the cabinet with a dual-trace 10-MHz scope, triggered, and look for the inputs and outputs on each chip. When you don't find both conditions, you've found the bad chip. I did omit one minor consideration -the board was a part of a computer-based central station monitor at our hospital, was hardwired in, and had to remain operational during the entire test procedure.

Not to be thwarted. I reached into my tool set and removed just what the "doctor" ordered. the Non-Linear System's MS-215 15-MHz dual-trace scope. Besides being self-contained and self-powered by nicads, the Miniscope measures a mere 2.9" x 6.4" x 8.0". Its vertical bandwidth extends from dc to 15 MHz, with ac, dc, or ground coupling switch-selectable. Deflection is 10 mV/div to 50 V/div in 12 calibrated ranges (with a stated accuracy of 3% of full scale with the vernier in the full clockwise position). The horizontal characteristics include: internal timebase or external horizontal switch-selectable mode with a timebase of 0.1 usec/div to 0.5 sec/div in 21 calibrated ranges. The maximum input voltage for both horizontal and vertical sections is 350 V dc and peak ac, providing that the dc component does not exceed 250 volts. A switch-selectable trigger permits + or -, with modes of internal, external, and line (line is non-functional when operating off the nicads). A trigger-level control permits continuous adjustment of the trigger point.

While all of these technical specifications will impress a number of you, why should you or any ham want a scope this tiny? The answer is quite simple: The MS-215 Miniscope can go to the work when the work can't go to the scope! Maybe that's an oversimplification of the issue, but how many times in the last six months have you wished that you could have a piece of test equipment which was scaled down in size to the IC circuitry being examined, be it a computer CPU or the innards of a synthesized 2-meter ham rig? Better yet, how many jobs could you have done with little or no sweat if you and your scope could have been right there - on the spot rather than tied to a large scope with equally large probes further hindered by an ac power cord.

I acquired an MS-215 because with it we could locate the defective chip and remove and replace it at a total cost of perhaps \$2.00 in parts, while the new board would have cost somewhere in the area of \$1200. Considering that the MS-215 sells for around \$400 from a number of advertisers in 73, purchasing it was a very wise move in terms of dollars and cents!

What can't you do with the MS-215? Well, to be honest, very little-unless you want to display a waveform to more than two close friends. We have literally used the scope for everything and anything you could imagine-from probing the interior works of a piece of hospital gear to troubleshooting the somewhat sickly departmental HT. In all cases, it performed as well as one of the larger and considerably higherpriced scopes in the department. Considering that the small package even included a calibrator which provides a square-wave signal of 1 volt peak-to-peak, and a graticule



Nye Viking's Model 250-0046-001 phone patch.



Lunar's LT-1 modular tower.

which (while small like the CRT) is easy to read – what more can you ask for in a package you can comfortably stuff into a coat pocket?

If you are interested in what you've read thus far and want more information about the MS-215 Miniscope, drop Mr. Allan Kay a line at Non-Linear Systems, Inc., Dept. 73, Box N, Del Mar CA 92014. Be sure to tell him that you read about their products in 73 Magazine. Reader Service number N22.

> Elliot S. Kanter W4PGI Savannah GA

NYE VIKING RECEIVES FCC REGISTRATION FOR PHONE PATCH

Approval by the Federal Com-

munications Commission for official registration under Part 68 of the FCC Regulations has been granted to the Wm. M. Nye Company, Bellevue WA. This allows the Nye Viking phone patch to be plugged directly into the telephone line without the need (or cost) of a telephone company-supplied coupling device. It should be noted that users must still notify the telephone company that they are connecting the phone patch to the telephone line, and must furnish the company the official registration number and the ringer equivalence number (which are printed on an attached label).

Telephone patches may not legally be connected to party lines or pay telephone lines. Users are cautioned that they must comply with all other requirements of the FCC pertaining to amateur radio communications.

The Nye Viking phone patch comes in two models: the 250-0046-001, without speaker, which provides connection to your own external speaker, and the 250-0046-003, with built-in loudspeaker, for use with most transceiver installations.

Nye Viking phone patches manufactured prior to official FCC approval and registration can be upgraded to approved status with the necessary changes, which include a 7-foot cord and a plug to connect into the telephone company line socket. Units returned for modification should be carefully packed and contain the sender's name and address. For further information, contact the Wm. M. Nye Company, Inc., 1614 130th Ave. NE, Bellevue WA 98005. Reader Service number N4.

LIGHT-DUTY VISE

The new Model VV-1 from OK Machine and Tool Corporation is a unique vacuum-based lightduty vise for precision handling of small components and assemblies. Featuring rugged ABS construction, it has 11/2" wide jaws and 11/4" travel for maximum versatility. Also featured are an oversize knob for precise positioning and screw lugs for permanent installation. For further information, contact OK Machine and Tool Corporation, 3455 Conner Street, Bronx NY 10475. Reader Service number O5.

LUN'AR'S MODEL LT-1 MODULAR TOWER

Lunar Electronics has announced a new llne of towers. Manufactured in Lunar's San Diego plant, these towers are all-aluminum angle pieces, which bolt together to form a sturdy structure capable of supporting considerable antenna arrays. The modularity of the six-foot sections makes them a natural for site surveys, field operations, and portable communications tests of all sorts, including amateur radio EME (moonbounce) operations.

Taking advantage of a building's height, they readily mount on rooftops, flat or peaked. The use of a length of 2 x 4 under leg pairs provides a simple yet effective mount for the tower. Since it must be guyed, no bolts, nails, or other requirements are necessary. The 2 x 4s additionally serve to distribute the weight over several roof joists.

These portable units are readily UPS shipped, and may also be carried as luggage on any airline. The construction is not unlike a childhood toy erector set, with each module bolted together with supplied hardware. Optional stainless steel hardware is also available (S suffix). Rotor and thrust bearing mounting plates are included in the basic tower package (Model LT-1), which yields an 11-foot structure when erected. The 6-foot add-on modular sections (Model LT-2) increase the height up to nearly 30 feet.

Since the tower is built from angle pieces, it forms its own ladder when erected and guyed. The base is 43 inches square, and the tower sections are 9.5 inches square. For further information, contact *Lunar Electronics*, 2785 Kurtz Street, Suite 10, San Diego CA 92110; (714)-299-9740. Reader Service number L17.

INSTA-PAC

Something new has come upon the scene which promises ease and efficiency for the QSL fan. Its name is "Insta-Pac," and it affords the ham the oppor-



OK Machine and Tool's new VV-1 vise.

This NEW MFJ Versa Tuner II

has SWR and dual range wattmeter, antenna switch, efficient airwound inductor, built in balun. Up to 300 watts RF output. Matches everything from 1.8 thru 30 MHz: dipoles, inverted vees, random wires, verticals. mobile whips, beams, balanced lines, coax lines.



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INDUCTANCE



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capacitor. 208 pf.

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toroid for more watts out.

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line, and tuner bypass for dummy load.

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sitions) gives you less losses than a tapped

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coax lines direct or thru tuner, wire/balanced line, dummy load.

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Microcomputer Interfacing

Peter R. Rony Jonathan A. Titus Christopher A. Titus David G. Larsen

MULTIPLEXED LED DISPLAY

Regardless of their application, most microcomputers need peripheral I/O devices for the input and output of data. The more common output devices included seven-segment displays, 5 x 7 dot matrix displays, teletypewriters, and cathode-ray tube (CRT) displays. We shall discuss several methods that can be used to interface seven-segment displays, as well as several different programs that are typically used to "drive" such displays, which are widely used in electronic games, calculators, point-of-sale (POS) terminals, gasoline pumps, children's toys, and taxi meters.

One of the simplest methods that can be used to interface a seven-segment display to a microcomputer consists of latching the appropriate data values from the data bus under software control (Fig. 1). The latch's inputs (7475) are wired to the microcomputer's bidirectional data bus and the latch's outputs are wired to a sevensegment decoder/driver (7447). The decoder's outputs (current sinking) are wired to the sevensegment display with 220-Ohm current-limiting resistors. When an OUT 125 instruction is executed, the content of the 8080's A register is latched by the display interface and the two BCD numbers represented by D7-D4 and D3-D0 are illuminated on the two displays. The instructions listed in Fig. 2 cause a 39 to be displayed.

To display a 10-digit number using this method, ten latches, ten decoder/drivers, seventy resistors, and ten seven-seqment displays will be required. One method of reducing the "parts count" for this interface would be to use a device such as the 8255 Programmable Peripheral Interface (PPI) integrated circuit.1 This device can be used as three independent eight-bit output ports, so it is the equivalent of six 7475 latches. Therefore, two 8255 PPI chips, along with 10 decoder/drivers, seventy resistors,



Fig. 1. A simple two-digit LED display interface.

/THIS SECTION OF A PROGRAM OUTPUTS THE /BIT PATTERN 00111001 (OCTAL 071, HEX 39) /TO AN OUTPUT PORT EQUIPPED WITH TWO /SEVEN-SEGMENT DISPLAYS.

•	
MVIA	/LOAD A WITH THE FOLLOWING IMMEDIATE
071	/DATA BYTE (HEX 39, BINARY COLLICOL)
OUT	ZOUTPUT IT TO THE TWO SEVEN-SEGMENT
125	/DISPLAYS EQUIPPED WITH LATCHES
•	/CONTINUE WITH THE REMAINDER OF THE
•	/ PROGRAM

Fig. 2. Displaying a 39 on the two-digit display.

and ten seven-segment displays would be required in the interface. One obvious disadvantage of this interfacing method is the large number of integrated circuits required. However, one advantage is that the software required to drive this interface is relatively simple. Also, the microcomputer only has to output this information once to the interface for the information to be continuously displayed. This, of course, is due to the latches or the 8255 chips in the interface. Thus, the microcomputer can output numeric information once and then go on to perform any other required operations.

Another interfacing method that can be used is digit multiplexing. Multiplexing reduces the display interface electronics (number of parts) to a minimum, but at the expense of longer and more complex display driver software. Multiplexing a display consists of enabling or turning on one particular digit with a digit enable code and providing the BCD numeric information for that digit to a multi-digit display interface. In this way, each digit is turned on, one at a time, as the actual BCD data for each digit is provided. Multiplexing is usually only used with multidigit displays. As an example, suppose that the number 237 is to be displayed on a three-digit multiplexed display. To display this number, the BCD value for the digit seven would be output to the interface, along with the digit enable code for the righthand display. After a short period (1 to 10 ms), the BCD value for the three would be output, along with the digit enable code for the middle digit. Again, after a short delay, the BCD

value for the two and the digit enable code for the left-hand display would be output to the interface. By performing this sequence fifty or more times every second, each digit in the display appears to be on all of the time. This same display method is used in hand-held calculators. Even though the digits are being turned on and off, it is happening too fast for the eye to see. The interface for a 10-digit multiplexed display is shown in Fig. 3.

When an OUT 125 instruction is executed, bits D3 through D0 of the A register will determine which one of the ten digits in the display will be enabled (turned on). Therefore, these four bits constitute the digit enable code. Bits D3 through D0 are latched (7475) and are decoded with a one-of-ten decoder (7442). The decoded outputs of the 7442 are wired to the common cathodes of the individual digits in the display. Bits D7 through D4 will provide the BCD code of the value to be displayed (0 through 9). These bits are also latched (7475) and are decoded by a seven-segment decoder/driver (DS8857, National Semiconductor Corporation, Santa Clara CA). The DS8857 supplies the current required to turn on the various segments (A-G) within the enabled digit selected by the 7442 decoder chip.

A relatively simple program can be written in which five packed BCD words (two BCD digits per word) are output to the display so that a 10-digit number is displayed (Fig. 4). This program has to unpack the BCD words stored in memory, combine the BCD digits with a

Continued on page 150



Fig. 3. A 10-digit multiplexed LED display interface.

Model 6869Image: State of the state	AUXILIARY POWER for Emergency or Portable Operation
Light wt. Portable Alternator. Stand-by power for Ham Equipment, household needs during power outages or operation in remote areas. Operates lighting, refrigerators, heating systems or other appliances in- cluding freq. sensitive loads such as TV sets, induc- tion motors and fluorescent lights. Solid-State voltage regulation. 3750W rating: 25% surge capacity. 120/240V at 31.3/15.6A. 8 HP/3600 RPM B&S engine. Alternator draws just enough engine out- put to meet load resulting in up to 25% fuel savings. Low interference. Advanced design. Drip-proof con- struction protects windings from rain and dirt assur- ing long life. One year warranty by manufacturer. 30'L x 18''W x 19''H. 128 lbs. Shipped via Truck PREPAID (No extra charges) \$659.95 Electric Start \$110.00 Battery Charging. 11.00 Spark Arrest Muffler 21.00 Models available with 1350 to 7900 watt ratings. Write for our quote and additional information. Mastercharge or VISA accepted	Model 6869
CONTRACTOR DISTORTED IN CONTRACTOR	Light wt. Portable Alternator. Stand-by power for Ham Equipment, household needs during power outages or operation in remote areas. Operates lighting, refrigerators, heating systems or other appliances in- cluding freq. sensitive loads such as TV sets, induc- tion motors and fluorescent lights. Solid-State voltage regulation. 3750W rating: 25% surge capacity. 120/240V at 31.3/15.6A. 8 HP/3600 RPM B&S engine. Alternator draws just enough engine out- put to meet load resulting in up to 25% fuel savings. Low interference. Advanced design. Drip-proof con- struction protects windings from rain and dirt assur- ing long life. One year warranty by manufacturer. 30'L x 18''W x 19''H. 128 lbs. Shipped via Truck PREPAID (No extra charges). \$659.95 Electric Start \$110.00 Battery Charging, 11.00 Spark Arrest Muffler 21.00 Models available with 1350 to 7000 watt ratings. Write for our quote and additional information. Mastercharge or VISA accepted

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✓ Reader Service—see page 195



Bill Gosnev WB7BFK 2665 North 1250 East Whidbey Island Oak Harbor WA 98277

After months of planning and careful consideration, I'm particularly proud to announce this 73 exclusive—the 73 Magazine Awards Portfolio. Consisting of four domestic award incentives and four DX achievement programs, the awards portfolio promises to be a challenge and capture the interest of almost everyone on the band, whether you are a casual rag chewer or a big-time contester.

Read through the various award rules with caution. The requirements are not as easy as one might first imagine. We want our award recipients to know they had to earn their recognition and therefore designed each award to be somewhat of a challenge.

I will present each award in detail-the DX-oriented awards will be in the spotlight this month, and next month I will focus on the domestic ones.

Each of the sponsored awards will offer its own degree of difficulty. None was designed to be an overnight accomplishment, nor were any meant to duplicate any other awards in existence today.

So tune up those QRP rigs, kick in the blower on the kilowatt, rotate those beams, and fine-tune that dipole, as time's a wastin'; you've got some contacts to make and some awards to win! I plan to feature a special profile of the winner of the first award issued in each category. Subsequent recipients will be recognized in a monthly award summary.

73 DX COUNTRY CLUB AWARD

1. Sponsored by the editors of 73 Magazine.

2. Available to licensed amateurs throughout the world.

3. To be valid, all contacts claimed must be made in a single calendar year (January 1 through December 31), beginning January 1, 1979, and after. 4. This award is available for

all phone, CW, and mixed modes.

5. To qualify, a minimum of 73 DX countries must be worked and confirmed from the 73 Magazine WTW (Work the World) DX Listing. All contacts must be made in the same calendar year.

6. Annual endorsement stickers are available for each succeeding year in which a min-imum of 73 DX countries are worked.

7. To apply, prepare a list of

claimed contacts in prefix order. Include each station's full callsign, date and time in GMT, mode, and band of operation.

8. Do not send QSL cards! Have your list of contacts verified by two local amateurs, a local club secretary, or a notary nublic

9. Enclose your verified list and award fee of \$3.00 or 8 IRCs for each award or endorsement. Send to: Bill Gosney WB7BFK, 73 Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

DX CAPITALS OF THE WORLD

1. Sponsored by the editors of 73 Magazine.

2. Available to licensed amateurs throughout the world.

3. To be valid, all claimed contacts must be made January 1, 1979, or after. There are no mode or band restrictions.

4. To qualify, applicants must work and confirm fifty (50) different national capital cities located in DX countries shown on the WTW (Work the World) DX Listing.

5. To apply, make a self-prepared list of contacts made in prefix order indicating the station worked, date and time in GMT, band of operation, and the name of the capital city and DX country.

6. Do not send QSL cards! Have your list of contacts verified by two amateurs, a local club secretary, or a notary public.

7. Enclose your application list and award fee of \$3.00 or 8 IRCs to: Bill Gosney WB7BFK. 73 Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

TEN METER DX DECADE AWARD

1. Sponsored by the editors of 73 Magazine.

2. Available to licensed amateurs worldwide.

3. All contacts must be made on the 10 meter band using only channelized converted Citizens Band equipment or similar type commercial units operating a maximum of 15 Watts PEP output. External amplifiers may not be used.

4. To be eligible for award credit, all contacts must be made October 1, 1978, or after, on AM, SSB, CW, or FM. Mixed mode contacts are not valid.

5. To qualify, applicant must work and confirm at least ten (10) DX countries from the WTW Work the World) DX Listing. Endorsements will be given for 25, 50, 75, and 100 countries confirmed.

6. To apply, make a self-prepared list of contacts claimed. giving the callsign of each station worked in prefix order. Include the date and time in GMT. band, mode, and a brief description of the equipment used in making each contact.

7. Do not send QSL cards! Have your list verified by two amateurs, a local club secretary, or a notary public.

8. Forward your application list and award fee of \$3.00 or 8 IRCs to: Bill Gosney WB7BFK, 73 Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey Island, Washington 98277 USA.

WORK THE WORLD AWARD

To enhance the enjoyment of working DX, the editors of 73 Magazine take special pleasure in introducing what we feel will be one of the most sought-after awards in existence today-the Work the World Award.

1. Sponsored by the editors of 73 Magazine.

2. Available to licensed amateurs throughout the world.

3. To be valid, all contacts must be made January 1, 1979, or after. There are no band or mode restrictions. Only DX countries shown on the WTW (Work the World) DX Listing qualify.

4. The ultimate goal of this award program is the Work the World (WTW) Award, signifying excellence in DX communications. However, to qualify for WTW, applicants must first meet the requirements of the six Continental Awards, each of which is a worthy goal in itself.

5. Requirements for Continental Awards: North American Awards-work 13 North American countries; South American Award-work 12 South American countries; European Award—work 12 European countries; African Awardwork 12 African countries; Asiatic Award-work 12 Asiatic countries; Oceanic Awardwork 12 Oceanic countries.

6. The Work the World Award is issued at no cost to any applicant who meets the requirements of all six Continental Awards. The operator who earns WTW has truly "worked the world."

7. To apply for any of the six Continental Awards, prepare a separate list of claimed contacts for each continent, listing all callsigns in prefix order. Include date, time in GMT, and band

8. Do not send QSL cards! Have your list(s) verified by two amateurs, a local club secretary, or a notary public.

9. Enclose your verified list(s) and award fee of \$3.00 or 8 IRCs for each award applied for. Forward to: Bill Gosney WB7BFK, 73 Awards Editor, 2665 North 1250 East, Oak Harbor, Whidbey

Island, Washington 98277 USA.

Throughout this column, reference has been made to the new WTW (Work the World) DX Listing. In order to avoid the impossible task of having to decide what is and what is not a country, the awards editor and the staff at 73 decided to accept the decisions of the national amateur radio societies of the world. Special care has been taken to ensure that no single organization will dictate the criteria used; instead, an accumulative effort by all concerned will be recognized.

Thus, as the basis for all the DX awards sponsored by 73 Magazine, the official WTW DX Listing will be categorized by continents of the world. Within each continent, DX countries will appear in order of their callsign prefix.

Additional copies of the WTW DX Listing or rules of the various award programs are available on request. Please be sure to enclose a 41/2" x 9" SASE with all inquiries. Forward your inquiry to my home address which appears throughout this column.

If DX isn't your cup of tea, then the domestic awards featured next month will interest you for sure.

Keep the cards and letters coming. Your comments concerning this column have been well received and appreciated. Should you learn of an awards program being featured in your city, state, province, or country, please forward this information on to me. Together we can share the many achievements being offered our readers throughout the world.

WTW DX LISTING

NORTH AMERICA

C6	Bahamas
CO	Cuba
FG	Guadeloupe
FG. FS	Saint Martin
FM	Martinique
FO	Clipperton Is.
FP	St. Pierre & Miguelon
НН	Haiti
HI	Dominican Republic
J3. VP2G	Grenada &
	Dependencies
KCA KP1	Navassa Is.
KGA	Guantanamo Bay
KL7	Alaska
KP4	Desotheo
KP4	Puerto Rico
KSA KP3 HKA	Serrana Bank and
	Boncador Cav
KV KP2	Vimin Islands
OX XP	Greenland
DIAA	Saha la
VE	Canada
VE1	Sable is
VEI	St Paul le
VO	Newloundland
*0	Labrador
VD2A	Antique Barbuda
VP2D	Dominica
VP2F	Anguilla
VP2K	St Kitte
VP2I	St. Lucia
VP2M	Montserret
VP2S	St. Vincent &
	Dependencies
VP2V	British Virgin Islands
VP5	Turks and Calcos Islands
VPS	Bermuda
WKNA	United States of America
XE	Maxico
XF4	Revillagigedo Islands
ZF	Grand Cayman Islands
40	HO, United Nations
8P	Barbados



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Contests

Robert Baker WB2GFE 15 Windsor Dr. Atco NJ 08004

Please note that with this issue all award and contest announcements are being split into their respective separate columns. Please forward all information directly to the individual responsible for the particular column. Any information sent via 73 Magazine headquarters in Peterborough NH is only delayed and may not be received by the appropriate editor in time to appear in the magazine. Also, to the organizations sponsoring a contest, don't forget to send an abbreviated copy of the results for possible publication. They will be printed as space permits.

KENTUCKY QSO PARTY Starts: 0001 GMT September 15 Ends: 2359 GMT September 16

This contest is sponsored by the Bluegrass Amateur Radio Club. Only one contact per band or mode with each station. No repeater or pre-arranged contacts are allowed. Suggested frequencies are lower edge of General and Novice bands, 2 meter simplex and SSB, and 6 meters.

EXCHANGE:

RS(T), county, and consecu-

tive QSO number; non-KY stations substitute state, country, or province for county. SCORING:

Score 1 point per QSO. KY stations multiply by number of states, countries, and provinces worked. Non-KY stations use number of KY counties worked. Final multipliers are: 1.5 for all 10 meter contacts between 0200 and 1000 GMT; 2.0 for input of 15 Watts or less; 1.5 for input of 200 Watts or less; 2.0 for all VHF simplex QSOs. Novices or Technicians may take an additional 2.0 multiplier for CW only. ENTRIES:

Mail logs by October 5 to: Donald Page WD4HPL, 309 Pocahontas Trail, Georgetown KY 40324.

WASHINGTON STATE QSO PARTY Contest Periods: 0100 to 0700 GMT September 15 1300 GMT September 15 to 0700 GMT September 16 1300 GMT September 16 to 0100 GMT September 17 The 14th ceptember 17

The 14th annual Washington State QSO Party sponsored by the Boeing Employees' Amateur Radio Society (BEARS) is open to all amateurs. All bands and modes may be used. Stations may be worked once on each band and mode for contact

Calendar

Sept 8*	DAFG Short Contest—VHF
Sept 8-9	North American Sprint
	ARRL VHF QSO Party
	WAE-Phone
Sept 9*	DAFG Short Contest—SW
Sept 15-16	CAN-AM Contest—CW
oopt to to	Kentucky QSO Party
	Scandinavian Activity—CW
Sept 15-17	Washington State QSO Party
Sept 15 & 22	89'ers Run
Sept 22-23	Scandinavian Activity—Phone
Sept 29-30	Delta OSO Party
0001.0000	CAN-AM-Phone
Sept 30-31	College Radio Scrimmage
Sept 30-Oct 1	Fall Classic Radio Exchange
Oct 6-7	QRP Annual October QSO Party
	Arrowhead 50th Anniversary QSO Party
Oct 13-14	ARRL CD Party—CW
Oct 20-21	ARRL CD Party—Phone
Oct 28	Crazy Eight Net QSO Party
Nov 3-4	ARRL Sweepstakes—CW
Nov 10-11	CQ-WE Contest
	IPA Contest
Nov 11	OK DX Contest
Nov 17-18	ARRL Sweepstakes—Phone
Nov 24*	DAFG Short Contest—SW
Nov 25*	DAFG Short Contest—VHF
Dec 1·2	ARRL 160 Meter Contest
Dec 1-3	Connecticut QSO Party
	North Carolina QSO Party
Dec 8-9	ARRL 10 Meter Contest
	- described in June issue

points and more than once each band/mode if they are additional multipliers. EXCHANGE:

QSO number, RS(T), county or state/province/country.

SCORING:

Washington stations score two points for each phone contact and 3 points for each CW contact, including contacts with other WA stations. Then multiply by the total of different states, Canadian provinces, and other foreign countries worked. All others score 2 points for each phone contact and 3 points per CW QSO with Washington stations and multiply by the total number of different Washington counties worked (39 maximum). There will be an extra multiplier of one for each group of 8 contacts with the same Washington county for all non-Washington stations.

FREQUENCIES:

CW - 1805, 3560, 7060, 14060, 21060, 28160.

Phone – 1815, 3925, 7260, 14305, 21380, 28580.

Novice – 3725, 7125, 21150, 28160.

AWARDS:

Certificates will be awarded to the highest-scoring station (both single- and multi-operator) in each state, Canadian province, foreign country, and Washington county. Additional certificates may be issued at the discretion of the Contest Committee. Worked Five BEARS Awards are also available to anyone working 5 club members before, during, or after the QSO Party unless previously issued. All QSO Party entries will be screened by the Contest Committee for possible awards. The Worked 3 BEAR Cubs Award is also available for working 3 Novice members. ENTRIËS:

Logs must show dates, times in GMT, stations worked, exchanges sent and received. bands and modes used, and scores claimed. Include a dupe sheet for entries with more than 100 QSOs. Each entry must include a signed statement that the decision of the Contest Committee will be accepted as final. No logs can be returned. Results of the QSO Party will be mailed to all entrants; an SASE is not required. Log sheets and summary sheets must be postmarked no later than October 17 and sent to: Boeing Employees' Amateur Radio Society, c/o Contest Committee, Willis D. Propst K7RS, 18415 38th Ave. S., Seattle WA 98188.

> 89'ers RUN Contest Periods: Run #1: Saturday, September 15, 1400 to 1800 GMT Run #2: Saturday,

September 22, 2100 to 0100 (September 23) GMT

The object of this QSO party sponsored by the Sooner Chapter of Ten-Ten International is to collect as many 89'ers' numbers as possible and you do not have to have an 89'er number to enter. All contestants, other than local and charter members, may operate only one of the two four-hour runs listed above. Locals and charters will operate both runs. Locals and charters will not be competing for awards. Scoring will be the same as for the 89'er awards, except that contacts with people who have a Ten-Ten number only shall count one point. Send contest logs to WD5CSK by October 31. If you wish to apply for the certificate or any of the advanced awards, separate application must be made directly to WB5TKD. If you would like an information sheet and a list of awards, send an SASE to contest manager Ron Reid WD5CSK, 8832 NW 80, Yukon OK 73099. Contest logs will not be returned unless an envelope and sufficient postage is enclosed.

SCANDINAVIAN ACTIVITY CONTESTS

CW: 1500 GMT September 15 to 1800 GMT September 16

Phone: 1500 GMT September 22 to 1800 GMT September 23

Non-Scandinavian stations try to work as many Scandinavian stations as possible. The same station may be worked once on each band during the contest. Only CW-to-CW and phone-to-phone QSOs are valid, no cross-mode. Use all bands, 80 to 10 meters, but only within the following sections: CW-3505-3575, 7005-7040, 14010-14075, 21010-21125, 28010-28125; phone - 3600-3650, 3700-3790, 7050-7100, 14150-14300, 21200-21350, 28400-28700 (as legal in your country!). The prefixes used in Scandinavia are: LA/LB/LG/LJ - Norway; JW -Svalbard and Bear Island; JX-Jan Mayen; OF/OG/OH/OI-Finland: OH0-Aaland Island; OJ0-Market Reef; OX-Greenland; OY - Faroe Island, OZ - Denmark; SJ/SK/SL/SM -Sweden. All these prefixes are geographically not in Scandinavia, but they are considered so for the contest. Operator classes include: a) single operator; b) multi-op/single transmitter; c) multi-op/multi-transmitter. Club stations, even if operated by one operator during the contest, are in the multi-operator class. Multi-op/multitransmitter entries are to use separate series of serial numbers for each band. **EXCHANGE:**



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Power Line DXCC (Distant Control Circuit)

- The ac lines are already there ... why not use 'em for remote control?

Dave Brown W9CGI RR5, Box 39 Noblesville IN 46060 must first apologize somewhat for stealing this article's title from J. H. Everhart N2CX. His article, in the August, 1978, 73 Magazine, was entitled

"Power Line DX." But, I did not stop there! I stole even his circuits, almost intact. That, too, I must explain. My intent is to praise

him highly. The original ar-



Fig. 1(a). PC layout, R/T board.

ticle dealt with control of distant (DX) objects by remote control, via existing 60-Hz lines. He helped me by solving my worst problem in controlling my EME array, located on a tower building some 150 feet (by wire and zig-zag routing) from my basement ham shack. First, I built his circuits, and they worked -very well! Then I decided to lay out a PC board to speed matters up if I wanted more than one copy (I did). And then, I decided to do an article just for the PC boards, just to encourage others to try his methods using his circuits-which. as I said, work very well indeed.

While laying out the first board and mulling over his idea for remote monitoring of his ham receiver, the way of laying out the PC boards shown in Figs. 1(a) and 2(a) evolved. Figs. 1(b) and 2(b) are just loading diagrams to hasten things along for you.

Fig. 1(a) is the PC board



Fig. 1(b). Component layout, R/T board (foil side view).

layout for both transmitter and receiver, or what I call the R/T board. This is the heart of the system to allow hooking up to your power lines. Fig. 2(a) shows two boards—one that accepts up to three CD 4001 ICs and the components needed to handle the generation of up to six control tones (audio), and a second board that can be split up the middle. (See the vertical black line that appears to do nothing elec-

trically.) The left half of this layout is the audio amplifier (follower, really) and





Fig. 2(a). PC layout, tone generator and audio amplifier/ decoder-buffer boards.



Fig. 2(b). Component layout, tone generator and audio amplifier/decoder-buffer boards (foil side view).



Fig. 3(a). M = microphone. S = speaker. MA = amplifier and matching transformer, if required. TE = tone encoder. TD = tone decoder. R/T = receiver/transmitter board (Fig. 1).



Fig. 3(b). DCC = dc control unit (as required).

X #	Tone	X #	Tone
L 1	69.7 kHz	H 1	120.9 kHz
L 2	77.0 kHz	H 2	133.6 kHz
L 3	85.2 kHz	Н3	147.7 kHz
L 4	94.1 kHz	H 4	163.3 kHz

Fig. 3(c).

the low-pass filter to follow the tone generators. It is shown as an MPS5172 in Everhart's article, Fig. 2, page 53. The right half of the board is all the circuitry to decode and/or buffer/invert a received tone. It is the same type MPS5172 (Q6) and NE567 shown in his Fig. 5.

Once these Figs. 1 and 2 of my PC layout have been done in the photo negative stage, they may be cut apart and boards made in any combination or quantity. The PC board layout removes all the headaches and a lot of the work of this job, so I hope more of you will try N2CX's ideas.

I planned Fig. 1, the R/T

board, as a transceivertype item, because I, too, would like to be able to monitor gear in the ham shack while I am in other parts of the house. I thought it would be nice to be able to have it a twoway circuit, as I'm sure many hams would. The end result of my efforts can be built into a small, attractive case with a carrying handle on it. This allows use anywhere in the house or outbuildings where there is a wall outlet.

Build up two complete R/T units like that and you have one wireless intercom that can be carried about from room to room and plugged in, while the second unit babysits your child or your ham gear for you. The R/T board contains all the necessary components to take audio in and give rf output ready for, and attached to, the power line in transmitand the same in reverse, in receive. All that is needed in addition is some obvious switching and an audio amplifier. This would boost up a microphone level that is too low (1.4 V required at the NE555 input) and a received audio that may be lower than you want. Then get the speaker and microphone of your choice.

I got around the latter by using an older Motorola speaker-microphone in one unit, with a coiled cord like those used on the FM handie-talkies. Use the small transformers shown to match up impedances where and when required by what you use. My audio amplifier was a 1- to 2-Watt per channel, with one IC that you often see in a child's record player of the less expensive variety.

To give you an example of how I use all this-1 sample a small amount of audio from the speaker output lines through a shielded cable and feed it over to the one R/T board I have built into my audio control unit in my console. The audio unit allows me to add tones, touchtonesTM, and the like to my rigs, and also has decoding for the receive side of things. By adding the R/T board to the unit, I now can place any of these tones, voice from the station microphone, or audio from the receivers into the transmitter portion of the R/T board and ship it anywhere on my property

where 120 V ac, 60 Hz is run.

Out on the remote end. where you have taken the R/T unit, this audio is taken back off the power line, decoded if required, and/or amplified up to speaker level. It has been a ham shack-to-garage and towerhouse intercom, a control unit from shack to tower house for EME array control (a 150-foot unwired blessing), and even a twoway setup back to the woods almost half a mile away-where all I run out there is a low voltage, 24-V ac line to avoid electrical code (and cost) problems. See Fig. 3(b).

The two R/T units, in that case, are merely coupled into the 24-V ac secondary of the ham shack end and decoupled at the 24-V ac primary of the woods end. The woods-end transformer then transforms back up (to the 48 V ac I needed for a 30 V dc and allowing for line drop from the ham shack to the woods). Direct current control is sent down the same two wires for a one pair/three duties system.

My only concession in the R/T use was to utilize different rf frequencies each way, so that I can override receiver audio coming my way when I want to transmit either audio or a control tone. For monitoring the local repeater from anywhere in your house, it is great! A single tone is sent along with the microphone audio while you are transmitting. After the audio is demodulated from the rf carrier and leaves the R/T board at the ham shack end, it goes two ways. The audio goes through a parallel trap to reject the tone, to a onestage audio amplifier (later found to be unnecessary), and, via a pot, to the microphone input circuit. The pot allows me not to have to change levels in

the radio or station microphone setup.

The second audio direction is for the tone; it is through a series pass filter. to reject audio and pass tone, and back to the onetone filter and decoder you see in Fig. 2. That, in turn, when sensed and decoded. pulls in a relay and keys the transmitter. In the other direction, the audio mentioned earlier, from a receiver-speaker circuit, is coupled into the transmitter half of the ham-shackend R/T board and put on the ac power lines. Back where I am (remote), the receiver portion of my R/T board demodulates the audio from the rf carrier. amplifies the audio, and presents it to me at the speaker.

I have added some complications since I want to monitor more than one radio and I don't just want to listen to noise at the remote end. On FM, that is not bad, as the radio has a squelch that keeps the audio off the transmitter input line of the ham shack R/T board, but I also monitor 50.125 MHz on SSB. To get around this, I have an audio-type squelch in the audio console that, when the radio speaks, keys a tone along with the audio



Fig. 3(d).

(sort of continuous-tone squelch style). When this tone gets to my unit (remote), it is handled just like the other direction, by splitting the audio and tone. The tone also lights an LED corresponding to what tone is controlled by which radio spoke. By using more than one tone at the remote end, I can control which radio I am putting the microphone audio into and keying. That about sums up one of my dandy uses, one of the reasons for writing this article, and the prime reason for my expanding it beyond just the PC board layouts.

I have changed some of the pin numbers of the ICs due to my board layout, so I have re-drawn the entire R/T board schematic as Fig. 4. The numbering on Fig. 4 and the layout now agree.

In the original articlein case they are not caught in the reader's column - let me say that there were a few errors and omissions. The pins on the "B" tone oscillator in Fig. 2 were omitted. I completely changed these, due to my layout, but in the original article, the left part should have inputs of 8 and 9 and an output of pin 10, and the right part, inputs of 12 and 13 and an output of 11. Left for right numbering can be traded, if it makes your wiring easier, but don't accidentally trade inputs for outputs.

2 M XMTR

FREC

AC

OR FIG 3b

TYPE SET-UP

The four parts of the IC are identical in operation. In the original Fig. 5, the ICs were labeled incorrectly as 576s. They are the familiar 567s. And while I am on the 567s, beware of too much tone input. 50 mV should be maximum, if you want to preserve any narrowband characteristics. Q5, in Fig. 4, can supply much more than that. I have added limiter diodes to the circuits and a level pot that you can adjust on the PC board. If you have tone-falsing and -failing problems, act accordingly.

One other comment on the original article. Fig. 6 shows how to re-wind the rf transformer. While this worked well, it was a lot of work. I allowed, on the PC layout, for you to use a much more common coil form put out by many vendors through most supply houses. Wind the transformer on it in exactly the same manner as shown in the original article, cover with a matching small i-1 coil shield, and the results will be the same. I also left the coil pinout the same, so don't forget the jumper



Fig. 4. Mount 7812 to chassis heat sink. Choose R2 and CX for desired tone. Recommended values are R2 = 100k pot and CX = .001 to .0047. Trim pot around center and change CX for coarse range.

wires (five are required) from the transformer base to each circuit. If any of the jumpers have to cross, be sure they are insulated wire.

I'll add in here a few useful notes on Fig. 3 concerning the hookups and the parts to use. Fig. 3(a) shows the simple form of wireless intercom unit used as a transceiver extension or remote. The mA units should be whatever matching transformers the microphone and speaker require to properly couple to the R/T board. The ham shack mA units are handled the same way, properly matching your rig with respect to microphone input and audio output (phones or speaker). Since this will vary so widely, I have chosen only to blockdiagram it. Keep it as sim-

ple as possible at first, until you see what you really must have. For example, use a .1 capacitor from the speaker line to the R/T unit and from the radio audio gain-control to controllevel. Add a pot for level later, and/or come off ahead of the rig gain control, to allow a quiet rig in the house with the XYL while you monitor from out in the garage or wherever you might be. Then add the audio amplifiers where required. There are many cases where audio amplifiers might not be needed at all.

Fig. 3(b) is a special case. I have found it very useful to reduce wiring between two points when there is not already a 120-V ac, 60-Hz line. See Fig. 3(b). If you run a safe wire, like rotor cable with good insulation, not many codes would prohibit such an installation. If 120-V ac wiring were run, all kinds of codes, regulations, electricians, and costs get into the act!

Skipping over Fig. 3(c) for a few paragraphs, since it is really a part of Fig. 3(d). Fig. 3(d) concerns a special situation not covered in Fig. 3(b). It allows a simple, remote transmitter-receiver pair to be located remotely from the ham shack/antenna location. The remote site then forms the heart of my antenna test range. Provisions are made for voice to return back over the wired circuit for both checking audio quality and intercom use when someone is at the remote site. Next, one channel (rf) of the wired remote is wired to use the

buffered dc voltage from the receiver's discriminator (the VHF receiver). The buffer also shifts the level to allow direct use with the 555-modulation pin (all positive voltages), by shifting the discriminator minus 6 - 0 - plus6 V dc (approx.) over to a 9- to 11-V dc shift. When the receiver is right on, the 10 volts then represent 0 V at the discriminator. Since the transmitter end (VHF) is where you are, the frequency is used to be sure you are sending right in the center of the receiver's (VHF) passband, where the receiver has been aligned. calibrated, and measured. That is, uV antenna strength equals some arbitrary avc reading, recorded. You use your reference dipole-see Fig. 3(d)-to


TONE FILTER Tone decoder Tone generator

TONE DECODER

the remote-site dipole first each time, and if the frequency reads all right, then any differences should be in the path (not likely at 1/2 mile, but weather affects it some) or in the receiver itself, due to some factor such as temperature or aging. Then you proceed with your test antenna, compared to previous antennas, and the reference dipole using the avc voltage reading on a separate rf-wired channel.

Using the separate wired channels of rf allows continuous monitoring of all, simultaneously. 1 intend actually to monitor three voltages (plus frequency) in this measurement, along with a low-power transmitter whose output I can both accurately measure and vary continuously from 1 to 10 Watts. The remote receiver can be any FM unit on the frequency of your antenna interest, but preferably solid state to reduce power consumption on your 24-V ac line out to the site. Then you measure and send back (by three rf channels) the two limiter and avc readings.

By varying the transmitter level, you can keep the receiver down out of limiting where the avc is linear or, at least, repeatable. Remember, you are not trying to recover audio from the VHF transmitter at the VHF site at this point, but only to compare the signal strength of two antennas: the reference dipole vs. your new model. The range is approximately 1/2 mile, or 2640 feet, or 417 wavelengths on two meters, and gets better as you go up in frequency. This keeps reflections and stray ground clutter to a minimum, as

well as allowing you to plot your antenna, and any stray lobes, accurately. You require only a wellcalibrated antenna rotor and readout. My remote site is due east (90 degrees) from me; that becomes 0 degrees on the antenna plot. The north rotor stop is a pain you live with, but I avoid extra work by starting at 270 degrees plot (due north-compass) and plotting around through straight at the site and through 360 degrees in 5-degree increments.

If you try this kind of work, always allow a full 360 degrees around—and then back in 5 degree increments. Trying two or three such trips and averaging the results is even better. This allows for any rotor over-travel or coast when stopping. Whatever you do when comparing antennas, or how you do it, neverrepeat never-believe the reports of signal strength changes from antenna to antenna that you get from another station. Modulation, keying, etc., is all right, but unless you like to climb towers, changing antennas back and forth and never seeming to get anywhere, stick with a measured system. This is not to say you can never have another amateur whose setup and serious attitude matches your own or the level of confidence you want, but to suggest you don't buy the casual-type observer. He may have changed rigs, antennas, and use his deaf ear for an S-meter! Why do you think I went to the trouble of a range?

Fig. 3(c) was thrown in to show how I can control 16 channels of rf using only eight frequencies and up to as many audio tones as you can discriminate between or use without ending up in a crossfire mess. If the numbers and the control pad look familiar they should! I claim no credit for this idea, beyond acknowledging that a lot of work and research (translation: money!) went into the selection of the touchtoneTM frequencies used by the phone companies. Such things as harmonic relationships and beats were all thought out for me; I just shifted the tones up to rf frequencies and used the same 567 decoder scheme used by many autopatch setups, but at rf frequencies. The 567 is good up to 500 kHz, so I am well within limits. Add to the fact that audio down a power line would compete with the 60 Hz and be hard to separate, and the 10% bandwidth at rf is several cycles you can easily zero in on versus a few cycles at audio, and you realize why the shift up and the manner I did it.

Fig. 4, as stated earlier, is just schematics — the same, almost, as the originals electronically, but divided up as they appear on the PC boards and numbered in the PC board manner for easy troubleshooting.

I'm sure you will find at least as many uses for this terrific circuit combination as I did, so I hope the PC boards make it a lot easier for you. Any other uses or ideas using these little gems I'd like to hear about, and an SASE is required only if you need a reply. Electronics or circuitry questions should go direct to N2CX, and PC board or uses questions to me, to keep things sorted out. Give remote control a try—you'll like it, I bet! ■



from page 24

tunity to save time and money in QSLing as well as have an instant reference right at his fingertips. Duplicate QSLing will become a thing of the past. You know at a glance what you have worked, on what bands and modes, and, most important, what needs to be confirmed. Each call area of the United States is divided by state, band, and mode. An extra column is provided for new modes or notes. As an added feature, a section is provided for every country of the world. "Insta-Pac" is attractively packaged and would be an asset to any ham shack. It has been developed by KH6ITY and is offered with an unconditional money back guarantee if not completely satisfied.

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Continued on page 157



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DIVISION OF BROWNIAN ELECTRONICS CORP

Blueprint for Biofeedback Experimentation

- fertile ground for pioneers

The idea for this article came from an experiment into the capabilities of human movement and control. The main question was how it would be possible for a person to control electrical devices and effectively communicate without movement of any kind. This restriction included the use of speech, sound, or any alteration of respiration.

Upon first consideration it seemed an impossible task, as the only apparent control would be over thought. This is where the idea of control by brainwave came to mind. No, I'm not talking about ESP or psychokinesis, but biofeedback. Biofeedback is the process of monitoring and controlling certain body functions... in this case, alpha brain waves.

The main purpose of biofeedback is to provide greater relaxation and creativity by controlling certain types of brain waves. In this article, we will be concerned with alpha waves.

A device called a "biofeedback monitor" is used to amplify and detect alpha waves in much the same way as an electroencephalograph. A band containing electrodes is fitted around the head, and when the brain is producing an abundance of alpha waves, the monitor gives indication with a tone or light. By learning to control the tone or light, you learn to control your alpha waves.

At this point, I'm sure you are beginning to see the modus operandi of the alpha control. Fig. 1 shows a simple block diagram demonstrating the basic principles involved. In this diagram, a photocell light and its counterpart, a tonevoice-operated microphone, are used to show a working system in its simplest form.

While the system described would work, it was not made to replace electronic switching and logic circuits, which would be more accurate. Schematics for an actual control circuit have been omitted, as the design and construction would vary greatly with the type of monitor ouput.

There are three major types of outputs used in the majority of monitors. They are: threshold tone, frequency-modulated tone, and light or LED indicator.

As for the monitor itself, you can get it pre-assembled or in kit form. There are models with simple one-mode outputs and ones with more complex multimode outputs. The range of control can be increased by the addition of a transmitter connected to the monitor and a receiver connected to the actual control circuit. A wireless microphone and receiver would work nicely, and possibly allow the utilization of existing equipment.

The next logical step would seem to be to develop a means of controlling more than one device. One possible but untested idea would be the use of a row of lights that would flash in sequence, somewhat like a public band scanner. By having the lights represent controlled devices, or letters, any number of appliances might be controlled simply by stopping the scan on the desired light and device it represents. Of course, the speed in which one could control his alpha waves would be a factor in the speed of the scan. In such a manner, a person totally paralyzed could communicate and, to some extent, control his environment

It has been my honest effort to present these ideas in more than the light of a laboratory or scientific curiosity, and I now leave further experimentation and development to your able ingenuity.



The Scanning Memorizers





The FT-127RA, FT-227RB and FT-627RA, FM transceivers, allow scanning and expanded memory coverage for the demanding VHF FM operator. All feature up/down scanning capability with control from the microphone; the scanner will also search for a busy or clear channel. Four memory channels are available — two for simplex, three for repeater channels one for a split of up to 4 MHz. Other performance features are similar to those of the renowned FT-227R.

OPTIONAL EQUIPMENT Keyboard Microphone: YM-22 for FT-127RA and FT-627RA (YM-22 standard feature with FT-227RB) Squelch Unit • FP-4 AC Power Supply

CPU-2500R/K 2MFMTransceiver with Central Processing Unit

The age of computers has entered the amateur scene with the announcement of the CPU-2500R/K 2-meter FM transceiver. Controlled by a 4-bit central processing unit (CPU), the CPU-2500R/K contains a scanner, 4 memory channels, manual or automatic tone burst, an optional sub-audible tone squelch, and 25 watts output.

The keyboard microphone allows two-tone input for autopatch or control purposes, as well as remote programming of dial or memory frequencies.

Automatic ± 600 kHz repeater split, or program a split up to 4 MHz using the memory. Keyboard microphone allows remote programming of odd splits.

CPU scanner will search for a busy or clear channel, upon your command.

Four memory channels for simplex or repeater use, plus another memory channel for a split of up to 4 MHz.



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The History of Ham Radio

Reprinted from QCC News, a publication of the Chicago Area Chapter of the QCWA.

he Second Radio Telephone Conference, called by Secretary Hoover, convened on March 20, 1923, to solve the deplorable situation brought about by the controversy over wavelength assignments. Broadcasters, the amateurs, the Army and Navy, the ship operators, and the commercial interests could not come to a common agreement as to wavelength allocations and thereby avoid woeful interference. Clearly, from an administrative standpoint alone, the broadcast listeners were desperate. The impasse which existed required a solution.

After several months of meetings, serious discussions, and lengthy deliberations, not even the amateurs had guidance or a clear go-ahead on how to interpret their standing with the Commerce Department. The American Radio Relay League had made a series of suggestions. The amateurs in all parts of the country, now almost 21,000 in number and licensed to operate in the narrow 200meter range, found solace in the fact that they had pooled their ideas and suggestions through their respective district directors.

The ARRL Board of Directors based high hopes on all of these inputs. So, when recommendations were issued on June 28, 1923, by the Department of Commerce in the form of General Letter #252, directed to all government district radio inspectors, they read as follows:

General Letter #252

"General and Restricted Amateur Radio Station Licenses will be issued permitting the use of any type of transmitter (CW, spark, ACCW, ICW, SC, and phone) with the restriction that when using pure CW, they are authorized to use wavelengths from 150 to 200 meters. When using spark, ACCW, ICW, unfiltered SC, and phone, the wavelengths from 175 to 200 meters only can be used. The types of transmitters must be specified in the application and the license.

"Special Amateur Radio Station Licenses will be issued permitting the use of pure continuous wave transmitters only, authorizing the use of wavelengths from 150 to 220 meters.

"For the purpose of application of Amateur Stations, pure CW is defined as follows: A system of telegraphing by continuous oscillations in which the power supply is substantially direct current as obtained

C.W. Licenses

D^O you fellows know that your station license provides that the apparatus described in the application shall not be changed without permission? And that a license granted a spark station is not good for the use of C.W. equipment? It sounds queer, considering that any complaintant ought to prefer a tube set to a spark, but if anybody wants to "get" you on it they can.

A broadcast listener recently filed a complaint with a radio inspector against a well known eastern spark amateur, alleging the use of an illegally broad and too-long wave. Called upon the carpet, there was no evidence that his spark, which was good as such animals go, was not entirely legal. But he volunteered the information that he was experimenting with C.W. anyway and the interference probably would be still further reduced. Whereupon, altho his spark set was O.K., he was informed that the use of C.W. was in violation of his license, and it was suspended for three months.

Moral: If the equipment you are using is greatly different from that for which your license was issued, take up the matter with your Inspector and "get right."

QST - March, 1923

from (1) a generator, (2) a battery, or (3) a rectifier with an adequate filter. (A filter is not deemed adequate if the supply modulation exceeds five percent.)

"On licenses issued for Amateur Stations you will include the following: 'This station is not licensed to transmit between the hours of 8:00 and 10:30 p.m., local standard time, nor Sunday morning during local church service.'

"Special Amateur Stations must be operated by persons holding an extra first class grade Amateur operator's license, or a commercial extra first class operator's license. Applicants must also meet the requirements of Regulation 63.

"A new class of Amateur operator's license is hereby established, to be known as 'Amateur Extra First Grade.' Licenses of this grade will be issued to persons passing the required special examination with a percentage of at least seventy-five and code speed in sending and receiving at least twenty words per minute, five characters to the word; who have had at least two years experience as a licensed radio operator; and have not been penalized for violation of the radio laws subsequent to the date of these regulations."

The government supervisors, located in the several United States radio districts, upon receiving the new regulations, were requested to notify all amateur radio licensees, general and restricted, to submit their respective license papers to the supervisor's office and have them modified in accordance with the new regulations. After they were so certified with a copy of the new rules appended, they were returned, officially endorsed, extending the wavelengths range and specifying the quiet hours. No changes were made in their expiration date.

All amateurs who held special licenses were notified that their licenses were cancelled and new licenses would be issued in accordance with the new permits now granted. Up to the present, all amateur licenses were issued specifying the wavelength of the operating transmitter to be used. From this date on, a license permitted a station to change the operative wavelength to accord with the bandwidth permitted and as the type of emission specified.

Variable frequency transmitter circuits were not generally known among amateurs. The progress of the art and the know-how was still lacking in 1923 in this respect. Even the wellinformed and up-to-date amateur solved the changing frequency problem by having more than one transmitter available, usually a pure CW of low power and another with either ICW or ACCW plate supply. Every license issued by the Commerce Department required that the licenses specify not only the wavelength limits of the transmitter, but also the emission type and the apparatus to be used including the antenna length and construction. If an amateur qualified as an extra grade operator, he could apply for two licenses, a special and a general. The special was then given a "Z" call.

The ARRL had recommended that the amateur with two years of experience and a twenty-wordsper-minute code speed be issued an extra first grade amateur operator's license using a wave transmission length up to 220 meters. (Even at this date all authorities assumed that this stipulation was a decided advantage for DX.)

It also was understood that transmissions on wave-



Fig. 1. The 250-Watt UV204.

lengths other than 200 meters by the amateurs could be allowed on the issuance of a license specifically noted on the application. A second wavelength, perhaps somewhere between 175 to 180 meters, could be granted. The 150 to 220 meter band specified in the 1923 Regulations gave the Secretary authorization to grant licenses upon request provided the amateur could meet the stipulated requirements and so requested in his application.

How the Need for "Plate" Power Was Met

In the early wireless days, the conversion from simple spark coil to high voltage rotary-gap transmission was not difficult. But going over to the vacuum tube for CW operation was by no means an overnight accomplishment. To put continuous wave power into the antenna, the amateur initially had available a small amplifier tube and a larger five-Watter, known as the UV202. Subsequently the fifty-Watt 203 was available, followed soon by the 250-Watt UV204, a real "power-house" for most DXers (Fig. 1).

With the introduction and development of the power tubes, there naturally was need for a direct current supply to energize the plate circuit. Much of the spark gear the amateur had accumulated and used for a power source was now destined for the surplus stockpile. The new regulations specified pure CW or nearly so, and this necessitated some type of direct current source, often up to several thousand volts. Various methods to obtain this voltage were outlined in the ham literature: (1) a motor generator, or (2) a battery, or (3) a type of rectifier with filter. Much experimenting took place. This voltage was referred to as the "B" voltage supply.

The Motor Generator

Although not the most practical source of high voltage dc nor the least expensive, a generator was the easiest and simplest way to quickly come up with plate power of one- to two-thousand volts. The ESCO machine from Electric Supply Co., of Stanford CT, could be found in many ham shacks. Early commercial broadcasters also used this equipment. However, the supply required filtering to reduce the ripple modulation to a point where it would meet the specified five percent. Using a motor generator required ac starting controls, considerable power wiring, and usually a remote and out-of-the-way installation of the entire unit to reduce hum and noise when operating voice modulation. Weight and expense were



Fig. 2. A one-kilowatt transmitter.

responsible for the few installations of this kind.

Edison and Lead-Acid Batteries

Edison-type batteries were available built in small but compact units. They were kept charged with a Tungar charger-rectifier connected to house current. The lead cells could be obtained in compact assemblies giving sufficient wattage for the smaller transmitting tubes. All these units were messy and, besides giving off a gas odor, ruined many floors and carpets.

Typical of what certain amateurs were capable of and determined to build is illustrated by the enviable installation of radio NU9BHT. This beautiful layout required assembling and building one thousand individual lead-acid cells. They were contained in $4\frac{1}{2}$ " × 5 $\frac{1}{2}$ " hard rubber cases, with one positive and two negative plates per cell. Hard rubber travs contained 25 cells each and were treated with acidresistant paint to provide protection and longevity. With each bank delivering 50 volts, separate switches were used to make appropriate connections for charging each bank, either separately or in four bank series of 200 volts. A motor generator battery charger delivering 250 volts kept the batteries fully charged.

Installations of this type necessitated adequate ventilation, care, considerable

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Fig. 3. A synchronous rectifier.

service, and a separate building to house the equipment. The circuit diagram of the station transmitter adapted itself to frequent modifications and changes to keep it up-to-date.

With the development of crystal control and other experimental features added from time to time. NU9BHT established an enviable record while in service. Operating primarily on 40 meters CW and occasionally on 20, as an official ARRL relay station, it contacted all Australian districts, making five-continent QSOs in one evening. This was an exceptional accomplishment back in 1923. Not many installations of this type prevailed in hamdom. With a battery voltage source, no filtering was required. This was pure dc!

The Rectifiers, Mostly Chemical

Over the next few years, the various amateur publications carried a series of suggestions for methods of building rectifying equipment for the B supply.

How did the amateur go about putting together a chemical rectifier? He was on the lookout for—item one: chemically pure aluminum sheets; item two: chemically pure sheet lead; item three: a quantity of pint-sized jars; item four: several pounds of borax; item five: plenty of distilled water.

For each cell assembly he figured that approximately 40 volts could be rectified from a 60 cycle source. This translated to about 50 cells required for a 2000-volt output. Forming and placing such a home-built rectifier initially into operation required a great deal of experimenting to overcome a whole series of mishaps. Rectified ac output of this type was always accompanied by a 60-cycle ripple hum, which

With a half inch spark coil a hard receiving tube may be used; either the Cunningham C.301 or the Radiocorp U.V.201 is suitable. For larger coils the 5-watt C.302 or U.V.202 may be used but less filament power is consumed by the Western Electric "E" or VT-1 tube. No 50-watt tube with proper plate insulation for spark-tube work is available just now but the C.303 or U.V.203 can be made to do.

Various circuits have been described in our pages in a paper called "A Spark Coil C.W. set," by Samuel Kopelson of 2BCF (May 1922—p. 66), and in "A Spark Coil C.W. Transmitter," by F. J. L. Duffy (March 1922—p. 28). In The Modulator for January 1923 there appeared on page 17 a concise paper by M. Joffe describing his spark-tube set at 2BYO.

The best plan of all is to remove the secondary entirely and re-wind the coil with wire 6 or 8 sizes larger. Robert Kraus of 2CEI finds that for a Ford spark coil the best secondary is one having 5000 turns of number 32 A.W.G. (B&S) double-cotton-covered wire. When the secondary is re-wound in this fashion no shunt condenser is needed in Fig. 4 and even for the other circuits it can be reduced to .001 microfarad. Three sheets of 4×5 tinfoil between 5×7 -inch glass sheets $\frac{1}{18}$ inch thick is more than enough.

had to be adequately filtered before it could meet the prescribed specifications — especially if it was to be used for a near-pure CW purpose. Filters were needed to eliminate key clicks. With batteries, there was complete absence of blinking lights, buzzing, whining, vibrating generators, and many ac growls on the air.

Other Substitutes For B Supplies

A convenient and inexpensive unit known as the mercury arc rectifier, equipped with an electrolytic "keep-alive" mechanism, was extensively used to give up to 3000 volts of B supply power. Both voltage and current outputs satisfied a one-kilowatt transmitter (Fig. 2).

Also available was a synchronous rectifier, as shown in Fig. 3. A synchronous motor, 1800 rpm, carried a large-diameter split wheel, with which two husky commutator brushes made contact. In this way, the 60-cycle current was rectified and the pulsating directional output then filtered. These units were marketed under the name of Super-Sync and provided plate energy rated at up to 4,000 volts.

Some of the early plate supplies were obtained from specially-wound spark coils—see Fig. 4. Such transmitter assemblies put out an ICW signal, were extensively used, and solved the high-cost problem. It was necessary to adjust the vibrator frequently to obtain a smooth tone, the pitch being immaterial but often adjusted to satisfy the contacted operator at the other end.

Radio amateurs in the early 1920s were an experimental and ingenious lot. They solved their problems in the best amateur tradition.





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- remote control puts your Icom in the trunk

Probably one of the most versatile and easily modified radios on the market today is the Icom 225. A multitude of frequency combinations can be selected simply by soldering inexpensive diodes into one of the 22 matrix board divisions.

The purpose of this article is to look at a few easy and inexpensive modifications which can be done to allow either greater frequency selection flexibility or remote control of the lcom "Mobile Marvel."

Upon examining the Icom 22S, one of the first things one usually notices is that, although the radio is advertised as a 22-channel rig, the programming matrix board and selector switch have 23 positions. To initiate 23-channel operations, all one need do is connect a short piece of wire from switch lug 23 to the 23rd diode row and program the row with appropriate diodes for the extra frequency of your choice.

The second easy modification is the use of the 23rd position in conjunction with a few diodes and a DIP switch to allow the selection of any combination of available frequencies. Articles in the 73 Magazine issues of June, 1977 (p. 152), and May, 1978 (p. 158), showed DIP switch mounting methods which required external components subject to easy breakage, or required defacing the cabinetry of the radio. An alternate method which allows easy DIP switch programming without defacing the exterior of the radio, while providing a secure and strong DIP switch mount, is shown in Fig. 1.

All one needs to do is simply (1) remove the 24-pin accessory plug from its holder, cover it with tape to prevent shorts, and push it inside the case, and (2) glue a section of perfboard on the accessory plug support bracket, mount your DIP switch on the perfboard, and wire as shown in Fig. 2. At this point, your 22-channel radio can be programmed for any of the frequencies listed in the owner's manual, without resoldering diodes.

The final modification I will describe was inspired as much by my laziness as by security needs. Often I find myself needing to stop in town for some small item. As in most urban areas, this requires that either you remove your radio from the car or trust fate that it will be there when you return.

Not being one who enjoys disconnecting my rig and placing it in the trunk four or five times a day, I conceived the idea of remote controlling the lcom and mounting it in the trunk.

To my great surprise, this modification is both easy







and inexpensive. All that is required is some wire, two potentiometers, two knobs, one male and female 4-pin mike jack, a speaker and miniature phone jack, a rotary switch, and a small box, such as the Radio Shack #270-236.

To accomplish remote frequency selection, run a wire from an unused channel position on the matrix board (Point A in Fig. 3) to the common of the remote 23-channel selector switch, via the accessory jack, as shown in Fig. 3. Note that the previously-mentioned **DIP** switch location cannot be used with remote control. It will be necessary to mount your DIP switch elsewhere (see Leon Baldwin's article in the May. of 73 1978, issue Magazine). Next, run your return leads from the rotary switch back to the matrix board via the accessory jack. All 22 previously-programmed channels cannot be remotely selected due to the use of the accessory jack to carry volume, squelch, and duplex controls.

If you do not have a 23-position rotary switch, an alternate method may be to use a double-ganged, 12-position rotary switch and toggle switch combination, as shown in Fig. 4.



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To vary the volume and squelch level, simply install a pot in parallel with the wiper on the original controls, as shown in Fig. 3. Slight problems may arise in the volume control circuit. Usually, this is due to a pot which will not adjust to a low enough value. It may be necessary to substitute a pot other than the one specified.

Duplex-simplex control also is accomplished as shown in Fig. 3. Power for the unit is delivered from switch 1 in the control panel.

To operate remote, install the unit with the power switch on the radio in either high or low position. Turn the squelch controls on the radio to maximum, and the volume to about mid-point. Place the channel selector in position 23, and control as usual from the remote unit. I hope that this article will stimulate interest in Icom owners to build the remote unit, and possibly to try other remote control modifications to which this versatile little unit might well be suited.■







The Big Blinker — a visual signal for the deaf

A friend recently asked me for something which could be used in conjunction with an alarm clock in order to awaken his deaf nephew in the morning. The circuit which I finally came up with is shown in Fig. 1.

Basically, it works as follows: The sound of the alarm is picked up by a crystal microphone element, amplified by U1A and U1B, and detected by the full-wave rectifier consisting of U1C and diodes D1 and D2. The rectified

voltage is next applied to a comparator (U1D). When the input signal is loud enough and of a long enough duration, the rectified voltage on the inverting input of U1D exceeds the reference on the noninverting input, causing the output of U1D to go to Vee. This turns on transistor Q1, which then enables U2, a 555 timer operating as a one-second oscillator. The output of the 555 drives a triac, which in turn causes a lamp plugged into the ac socket to flash

at a one-second rate.

For best results, tape the microphone to the alarm clock and adjust the comparator threshold so that only the alarm clock sound triggers the unit. Transient noises will not enable the circuit due to the RC timeconstant at the detector output.

All of the parts are readily available at your local Radio Shack. I used an LM324 quad op amp, but any quad, two dual, or four single op amps can be used. The pin numbers shown were for my particular layout but, of course, any of the op amps can be interchanged.

This unit performs quite well, and is certainly more of an attention-getter than the original timer used. The original timer was used to simply turn on a light. The triac used can handle up to 6 Amps, so several lamps can be plugged into the unit. The lamps will continue to flash as long as the alarm is sounding.■





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Morse Converter for DMMs

- super gadget for blind hams

A digital converter which will take the binary coded decimal (BCD) output of a digital multimeter (DMM) and convert it to Morse code would surely be an asset to any blind or partially blind person's workshop.

After graduating from a CREI home study course in electronics engineering technology (minicomputers and microprocessors as the major elective), I had a strong desire to make some practical use of the knowledge.

Shortly after finishing the home study course, I was talking with my dear friend of nine years, W6LZV. He was mention-

ing that a Morse clock could be helpful to him in his daily on-the-air operations. After thinking about a Morse clock versus another type of device which could be converted to a Morse code output, I asked Jean if he could use a digital multimeter with Morse code output. Though Jean is completely blind, he is very active in the building and repairing of electronic equipment. Therefore, it was no surprise to me when he said that the DMM-to-Morse code converter would be more functional.

This article is for the person who wants the challenge of using an instrument which was originally made for the sighted person. This article can open doors that have inhibited the handicapped person in delving into a world of technical discovery—a world which can be just as satisfying for him as for the sighted person.

While researching what chips might be commercially available to handle the BCD-to-Morse code conversion in a very simplified manner, I ran across the July, 1977, issue of 73 *Magazine*, which has an article entitled "The Morse Clock." After reading and rereading the article, trying to fully understand the logic, I decided that I would use the article as a starting point for my design of the DMM-to-Morse code converter.

The digital multimeter used for this prototype project was the Sabtronics 2000 DMM. At first, I had only a schematic of the DMM to work from, but it was apparent that converting the output of the MC14433 A/D converter chip into Morse code would not be too difficult. After building the DMM and seeing how the MC14433 chip worked, I decided that since the position of the decimal point depends only upon the function button and range button selected and upon whether the X10 range switch is used, I would disregard the decimal point. Only the minus sign and the 31/2 digits were dealt with.

Features of the DMM-to-Morse Code Converter

The converter was designed to provide the following:

1. Morse code output of the $3\frac{1}{2}$ digits.

2. Morse code character "m", which signifies that a minus sign is present.

3. An audible over-range indicator.

4. A method by which the user can perform "continuity tests."

5. Three selectable code speeds.

6. A Morse code zero (0) for a "blanked" first digit.







This was done because I am not audibly providing the position of the decimal point. By giving the user the contents of all $3\frac{1}{2}$ digits, the mental determination of the decimal point's placement is made easier.

Circuit Description

The MC14433 A/D converter chip (enclosed in the DMM) is the heart of the

converter. The chip has BCD outputs available for the 3½ digits, but they must be demultiplexed "off-chip" by using the display triggering lines. Since the demultiplexing and selection of each digit is not available "on-chip," the chip count of the DMMto-Morse code converter is higher than for the Morse clock.

Since I have never tack-

led a complete project from the design stage to the building stage, various aspects of the MC14433 chip posed some minor stumbling blocks. After reading the article entitled "Super DVM" (August, 1977, issue of 73 Magazine), I selected a single 7474 (dual D flip-flop) to demultiplex the ½ (first) digit and the minus sign. The 7474 chip solved the minor stumbling blocks.

The Minus Sign

The minus sign demultiplexing, sampling, storage, and recovery circuits are made up of U10A, U15D, U26A and B, U26C and D, and U27A (respectively).

When a minus sign is present, the 7400 SR flipflop (U26A & B) provides the following actions: 1. Selects the appropriate



Table 1. Contents of the "control" ROM (U20).



Top view of completed unit.

output line (IRENABLE -) from the state-machine ROM; 2. Selects the appropriate logic used for giving the "space" between the Morse code characters: 3. Disables the BCD-to-Morse code ROM. When this ROM is disabled, all of its outputs are driven HIGH. thus providing the needed output for making the Morse code character "m"; 4. Signals the input multiplexer (U18, 74150) that the "m" and the "space" between characters has been sent (no-code condition). Spacing between the Morse character "m" and the first digit is longer than between "each" digit. This characteristic provides a distinguishable pause between the "m" and the start of the first digit.

The First Digit

The ½ (first) digit demultiplex and storage circuitry is made up of U10B and U1 (respectively). Since the ½ digit is only a zero (0) or a one (1), I tied the binary 2, 4, and 8 inputs of U1 to ground (binary zero) and let the output of the 7474 dual D flip-flop (U10B) determine whether a zero or a one is showing in the ½ digit's place.

The Over-range Indicator

A 7493 counter (U23), wired as a divide-by-10 counter, is used to provide the counter-states which make up the "ditters" when an over-range condition exists. The 7493 counter-states of 2 and 7 are decoded and driven to a 7400 \overline{SR} flip-flop, which provides the ditter sensation.

Besides providing the user with an indication of an over-range condition, the over-range indicator circuitry can also be used to provide a continuity test. When the DMM is placed in the OHM function and an OPEN condition exists between the input terminals, all digits are

blanked (to the sighted user) and the over-range ditters are HEARD. With this condition in mind, the user takes the test leads and makes the necessary connections for determining if there is an open or a shorted condition. After making the connections, if the ditters persist, an open condition exists (verified by pressing the "initiate" button and hearing "m" 19 9 9). If the ditters cease, the user either has a shorted condition or some actual value of resistance. A shorted condition can be verified by pressing the "initiate" button and hearing either "m" 0000 or just 0000.

When the function switch is in the OHM position, the user must ignore the "m" (minus sign) which is active due to the design of the DMM. During the OHM function, the minus sign shows up (for the sighted person) to tell the user that the input jack (positive jack) is in fact the negative probe, and that the DMM is in fact turned ON.

Construction/Miscellaneous Notes

Excluding the MC14433 in the DMM, the prototype project has a chip count of 31. All ICs used in the project were of the commonlyavailable type. All parts were either obtained locally or through various electronic parts catalogues.

I used the wire-wrap technique because it gave the amount of versatility in construction that I wanted. I was able to build each



Side view of completed unit.

functional section bit-bybit.

Interfacing of the CMOS 14433 with the TTL 7475 and 7408 was achieved by using two CD4050s (hex buffers).

I am sure that there are many alterations which can be made to my present design. These could include feeding the Morse code output and the overrange output through a "summing" op amp amplifier, thereby needing only one speaker. Also, U5 and U6 could be deleted if we dealt with CMOS technology throughout the converter.

The cost of the converter parts (including the cabinet and wire-wrap PC boards) was approximately \$120.00, but the cost could be brought down easily to approximately \$60.00 if the builder has a well-stocked junk/spare-parts box and if

Digit	ROM Address	ROM Contents
0	0000	11111
1	0001	11110
2	0010	11100
3	0011	11000
4	0100	10000
5	0101	00000
6	0110	00001
7	0111	00011
8	1000	00111
9	1001	01111
blank	1111	11111

Table 2. Contents of the "code conversion" ROM (U11).

he shops around.

My sincere thanks to WB3EVS for his technical assistance, to WA6DLI for his superb photographic shots of the converter, and to WA1MXV and WA5VQK for their very enlightening articles.

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How to Home-Brew Your Own Crystal Filters

- the series-string method

73 Magazine Staff

O ne of the prime limitations that discourages many amateurs from pursuing various interesting projects is the cost of good crystal filters. One example is with the construction of rf speech processors or clippers. Clippers are relatively easy to build and very effective, but they require the use of a good SSB filter.

One of the simplest forms yet of a good home brew crystal filter was recently discovered. Hopefully, it will allow many amateurs to pursue some of those projects they have been putting aside because of the expense of commercial filters.

The crystal filter to be described can be built around a group of almost any commonly available MHz-range crystals of the same frequency. The crystals which are manufactured for TV games or color TV sets are particularly suitable since they are manufactured to close tolerances and are inexpensive. For instance, the 3.579545 MHz crystals for color TV set circuits are readily available for only around \$1.00 because they are mass produced in such quantities. In fact, with a bit of hunting through sales flyers, one often can find them on sale at 6 for \$5.00.

As the title of this article implies, the circuit for the crystal filter is nothing more than a series-connection of the crystals, as shown in Fig. 1. The input and output of the filter are terminated by 1k-Ohm resistors. The trimmer capacitors are used to obtain the overall desired response. The type of response that can be obtained is shown in Fig. 2.



Y₁₋₆ = 3 579545 MHz

Fig. 1. The series-string crystal filter.

The frequency scale has been expanded somewhat on the graph, so at first glance the filter response may seem rather broad. Actually, it is quite good if one studies the response in a bit more detail. The -60-dB bandwidth is about 8 kHz. The ultimate out-of-passband rejection could not be measured much beyond -60 dB with the equipment available, but the ultimate rejection is probably -80 dB or better. Just for comparison, the response of a mediumpriced (\$40 range) imported filter is shown by the dot-dash lines inside the series-string filter



Fig. 2. Response of the series-string crystal filter (outer curve) compared to that of a moderately-priced commercial filter (inner curve).

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response. The commercial filter is better, of course, and one will notice some difference on receiving, but it is a moot point as to whether any difference would be noticed when SSB filtering is considered for transmitting purposes or when rf speech processing equipment is being considered.

In order to achieve the response described, the filter must be constructed carefully, although this is not a tedious task. The filter is constructed basically as shown in Fig. 1, so the input-output terminals are as far apart as possible. Fig. 3 shows the layout used on an approximately $1\frac{1}{2}$ " x 5¹/₄" piece of copperclad (single-side) PC board. There is no need to do any etching unless one just prefers to do this. The isolated-pad type of construction works very well, where a small hole is drilled for each crystal lead or pin (depending on the type of crystal used). The copper around the hole is removed for a small radius with an isolated-pad tool or with a sharp knife. The crystals are simply interconnected, and the few components required are soldered directly to the crystal leads or pins. The input-output cables are connected to any form of isolated terminal post. The trimmer capacitors used are Arco 423 units which have a range of 7-100 pF. but any similar units can be used. In fact, if one doesn't devote a little effort to finding reasonably-priced trimmer capacitors, they can cost more than the crystals!

The adjustment of the five trimmer capacitors will have a great deal of influence on the bandpass shape of the crystal filter. If one has fancy test gear available, such as spectrum display units, the work is, of course, relatively simple. But, even if one has only relatively simple test equipment—rf generator and a suitable oscilloscope or a receiver—the filter can be adjusted easily enough.

First, set up the filter so the middle trimmer-capacitor is at minimum value, and the other capacitors are at maximum value. Then, as one goes through the passband of the filter with the rf generator, note how the response changes as the center trimmer is increased in value and the other trimmers are decreased. If one keeps a record of the responses for each adjustment of the trimmers, it will not be difficult to discern the pattern that develops. No attempt was made to adjust the trimmers by ear when the filter was used in a receiver, but possibly, with enough patience, it could be done.

The application of the filter to a piece of equipment, or the use of the filter in an accessory item, can follow the scheme shown in Fig. 4. This little setup made use of various International Crystal Company modular mixer and oscillator units to translate the crystal filter response to another i-f frequency that was of interest. However, this setup, or one similar to it that is suitable for the frequencies involved, can be used for many applications.

For instance, one can use it just to improve the i-f selectivity in an older piece of equipment, or those who are a bit more advanced in circuit construction can build a complete outboard rf speech processor for an SSB transmitter, using two crystal filters. (See Fig. 5.) A DSB signal is first generated, and one filter used to produce an SSB signal. The signal is then clipped and passed through the second filter to clean up the distortion products. The product



Fig. 3. Layout of a crystal filter board, foil side up. (Crystals are on the non-foil side.)

detector is used to obtain the final af signal. In this application, the two crystal fitlers should have identical passband responses but this should not be difficult to achieve if they are constructed and adjusted together. During the adjustment process, one should note where the 20- to 30-dB down points are, on either the upper or lower side of the crystal filters, since either one of the two frequencies can be used as the carrier oscillator frequency.

Construction has been started on such a project, but it is not yet completed. Even using a modular approach as much as possible, by using kit-type modules of the kind shown in Fig. 4, the total cost for the project seems to be coming out in the \$25-\$30 range. That is not bad at all when one considers that it includes the cost of two crystal filters, and one can pick up several dB of extra intelligibility under QRM conditions. Even if one does not achieve the full theoretical improvement possible with rf clipping, one can easily do better than by using an outboard audio compression or clipping accessory, and at nearly the same cost.

It is possible to use the crystal filter also as part of an adapter to add rf clipping to an SSB transmitter. by connecting it into the SSB generation chain. Unfortunately, one cannot generalize on how this can be done, since the response of the filter in the outboard adapter as compared to the response of the filter in the transmitter, along with the carrier oscillator frequencies, all have to be taken into account for a specific transmitter.



Fig. 4. One example of how the filter can be used in an i-f chain by frequency translation, using readily-available mixer/oscillator modules.



Fig. 5. Block diagram of a separate rf speech processor which now can be built at low cost using two series-string filters.

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 - 11.00-16.00 MHz 20 Meter Band
 - 20.95-23.50 MHz 15 Meter Band
- The DTR-2000L will cover most MARS
- frequencies just outside the Amateur Bands. (With proper coil tap changes and band switch modification, the unit will also cover the 10 meter amateur band.)
- Modes: USB, LSB, CW, RTTY, SSTV
- Power Requirements: 234/117 VAC 50/60 Hz
- RF Drive Power: 125 Watts maximum, and 65 Watts RMS minimum for 1 KW DC input.

The GLA-1000

- DC Plate Voltage: SSB (idle + 2600V approximate), CW (Idle + 1800 V approximate)
- Duty Cycle: 100%
- Input Impedance: 50 Ohms nominal
- . Input VSWR: 1.5 to 1 average
- Output Impedance: 50 Ohms nominal
- Antenna load VSWR: 3 to 1 maximum ALC: negative going, adjustable from rear panel
- Spurious Emissions: IMD greater than 30 db down, Harmonics --- greater than 40 db down
- FCC Type Accepted
- Size: H 71/4" x W 141/2" x D 141/2"
- Weight: (including 8877) 54 pounds

The CLIPPERTON L



SPECIFICATIONS

- NEW FEATURE: HI-LO power switching
- 160 thru 15 meters
- 2000 watts PEP input on SSB
- 1000 watts DC input on CW, RTTY, or SSTV · Forced air cooling
- Self contained continuous duty power supply 2500 V idle SSB - 1800 V idle CW approx
- 4-572 B Triodes operating in grounded grid.
- Covers most MARS frequencies just outside Ham bands.
- . 50 ohm input impedance unbalanced at better than 1.5 to 1 VSWR
- 50 ohm output impedance
- . Harmonic Suppression: meets or exceeds FCC requirements
- Built-in ALC (adjustable)
- . Easily changed 117V or 234V AC 50-60 hz
- Meter (illuminated) for plate voltage or
 - plate current
- Size: 6" H x 141/2" W x 141/2" D Weight: 42 lbs.

The MLA-2500B



SPECIFICATIONS

- Size: H. 5% W. 11" D. 11"
- Weight: 24 lbs.
- Electrical Power Consumption: 117 VAC 50/60 Hz 12.5 Amps. Factory fused at 15 Amps. 234 VAC 50/60 Hz 7 Amps. Recommended fuse 10 Amps.
- Frequency Coverage 80 Mtrs 3.45 to 4.3 MHz
- 40 Mtrs 6.950 to 7.5 MHz
- 20 Mtrs 13.950 to 14.5 MHz 15 Mtrs: 20.950 to 21.350 MHz
- 10 Mtrs: With Modification by Licensed Amateur
- (Covers most MARS frequencies just outside the Amateur Bands.)
- RF Drive: Maximum 135 Watts
- DC Input: 1 KW CW and 1200 Watts PEP SSB
- Input Impedance: 50 ohms 1.5: 1 VSWR APX. Spurious Emissions:
- Ind better than 30 dB
- Harmonics down better than 40 dB Components:
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- 6 Diodes
- FCC Type Accepted

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- Harmonic Suppression: meets or exceeds FCC requirements Built-in ALC (negative going)
- Built in RF wattmeter

- Built in Hr wattmeter
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- . 65 watts minimum drive for 1 KW DC input
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Four Bands on a Bamboo Pole — try a Chinese vertical slanter on 10 through 40

William R. Stocking WØVM 1030 Weidman Road Manchester MO 63011

Any of us hams like to work DX. My friend, Harry, who lives down the street, had worked many DX stations. I had worked no DX at all! I asked Harry what I could do to work DX.

"Get a long, bamboo fishpole and build a vertical J like mine," he replied. "Get the bottom of the antenna higher than the electric light wires. Get the thing resonant, and you'll work across the big pond."

Harry was my "consulting engineer," and taking his advice usually brought good results. I purchased a 23-foot bamboo fishpole and mounted it high on the house using some lightweight 1 by 2 lumber. A vertical J antenna was suspended from the top of the fishpole. The matching stub was tuned to frequency, and the 600-Ohm openwire feedline was attached and adjusted for the best transfer of rf energy into the antenna system. As usual, Harry was right. I got a big thrill the next day when I worked my first European station!

Seeing the big bamboo fishpole, one of my friends called it a "Chinese antenna." When I mentioned this to Harry, he laughed and remarked, "Maybe we can shanghai some DX." Since that time, bamboo fishpoles have been used in most of my vertical antennas, and the "shanghaiing" has been very good. (Fiberglass fishpoles 20 feet long also work well in antenna construction, but they are more expensive and are hard to find.)

This article will present information from some books and a magazine article and explain how this information was applied in making a four-band "Chinese vertical slanter" antenna system that is the best non-beam DX antenna that I have ever used.

In the December, 1978, 73 Magazine, antenna axioms were presented.¹ Among these were: (1) The antenna system should be resonant at the frequency being used. (2) The rf from the antenna must be effectively put into the antenna. (3) There is no substitute for height; the higher the antenna, the better. (4) At easy-to-attain heights, vertical antennas have lower angles of radiation than do horizontal antennas. This makes them good for DX.

Because of their lower angles of radiation, vertical antennas have been known to outperform horizontal beams in making DX contacts, especially in cases where the horizontal beam was not any higher off the ground than the center of the vertical antenna. The value of lowangle radiation in working DX is beautifully explained in Capt. Paul Lee's book in Chapter 1, "Optimum Design For DX."² This chapter also contains other valuable information useful to antenna designers.

Vertical antennas longer than a quarter wavelength radiate rf at lower angles to the horizon than do guarter-wavelength groundplane antennas. The angles of a quarter-wavelength ground-plane antenna are from 10 to 55 degrees. For a 3/8-wavelength vertical antenna, the angles are from 8 to 40 degrees. A half-wavelength vertical's angles are from 5 to 35 degrees. The angles of a 5/8-wavelength vertical are from 3 to 27 degrees.² For 3/4-wavelength verticals, "there is some slight deterioration of the low angle vertical pattern, but this is not serious."3

Vertical antennas longer

than a quarter wavelength also have power gain as compared with a guarterwavelength ground-plane antenna.4 A half-wavelength vertical antenna has a power gain of 1.8 dB as compared with a quarterwavelength ground-plane antenna. A 5/8-wavelength vertical antenna has a power gain of 3 dB as compared with a guarter-wavelength ground-plane antenna. One can surmise also that a 3/4-wavelength antenna has some power gain as compared with the ground-plane antenna.

From this information, it is clear that vertical antenna lengths between 1/4 and 3/4 wavelengths will be better for making DX contacts than the popular coax-fed ground-plane antenna. To use these ideas in a multiband vertical antenna. tuned feeders must be used to take the rf from the transmitter to the radiating wires. When tuned feeders are used, balanced antennas can be built with wires almost any length, provided that the length each side of the tuned feeders is the same. Furthermore, such an antenna can be "loaded up" and used on several bands.

My friend Harry was' somewhat impressed with this information. He suggested, "Why don't you make a chart comparing a tuned-feeder vertical with the popular trap vertical that is about 22 feet tall? After you get that one figured out, figure out what length of wires would make the best all-around DX antenna for 40, 20, 15, and 10 meters."

My "figuring" was as follows. For all practical purposes, the trap vertical is a quarter-wavelength ground-plane antenna on all bands, with the highest frequency radiators closest to the ground. As such, the angles of radiation with respect to the horizon are from 10 to 55 degrees on all bands. Except for the 40-meter band, on which all 21½ feet radiate, the trap vertical does not have its radiating antennas as high in the air as does a 22-foot "vertical slanter." (Axiom No. 3: "There is no substitute for height.")

With the vertical slanter. all 22 feet radiate on all bands. With respect to power gain and angles of radiation. the vertical slanter has the following as compared with the 1/4-wavelength ground-plane antenna with its 10 to 55 degrees angles of radiation on all bands: On 10 meters, the vertical element is 5/8 wavelengths with a gain of 3 dB and angles of 3 to 27 degrees. On 15 meters, the vertical element is 1/2 wavelength with a gain of 1.8 dB and angles of 5 to 35 degrees. On 20 meters, the vertical element is a bit shorter than 3/8 wavelength, would have some gain as compared with the trap vertical, and the angles of radiation would be somewhat lower than those of the trap vertical.

With a ground-plane antenna using 4 equallyspaced radials, the radials do not radiate because the fields of the radials cancel out each other. Drooping the radials increases the gain of the ground-plane antenna.⁵ Therefore, it is logical that a verticalslanter tuned doublet, or a one-radial tuned groundplane antenna might have some gain compared with a guarter-wavelength ground-plane antenna because there are no other radials to cancel radiation from the lower half of the antenna.6

Another great advantage of a vertical-slanter tuned doublet is that it can be tuned to exact resonance at any frequency, phone or CW, on any band, 10, 15, 20, or 40 meters. This means that the antenna will load up equally well on phone and CW in all of



Fig. 1. Typical trap vertical and "vertical-slanter" fourband antenna fed with tuned feeders. The bottom of each vertical element is 20 feet above the ground.

these bands.

Harry made this suggestion: "When you figure the best wire lengths for your four-band DX vertical slanter, make the wires as long as you can without degrading the performance on 10 meters. Of course, if you want better performance on 40 and 20 meters and don't care about 10 meters, you could make your wires as long as possible without degrading the 15-meter performance."

With this in mind, I chose 26 feet as the wirelength for the best performance on 10, 15, 20, and 40 meters. Twenty-six feet is 3/4 wavelength for 10 meters. If I did not care to work 10 meters, I would have chosen 33 feet, 3/4 wavelength for 15 meters.

The gain and angles of radiation for the 26-foot wire vertical-slanter antenna are conservatively stated as follows: 10 meters (3/4 wavelength), "guesstimated" 2.5 dB, with angles 5 to 35 degrees; 15 meters (5/8 wavelength), 3 dB, with angles 3 to 27 degrees; 20 meters (.39 wavelength), "guesstimated" 1.4 dB, with angles somewhat less than the 10-50 degrees of a quarterwavelength ground-plane antenna. On 40 meters, 26-foot-long wires would work better than 22-footlong wires.

Since in theory a vertical-slanter antenna fed with tuned feeders seemed to be much better than a four-band trap vertical, I decided to build one and try it out. I had an old, used piece of no. 12 Romex, 25' 8" long. This was very close to 26 feet, so I took out the two wires and used them in the antenna. A bicycle whip taped to a bamboo fishpole clamped to a small sailboat mast supported by two 8' two-by-fours clamped to a fence post was used to support the vertical part of the antenna. The black wire was taped to the supporting structure as the vertical element. (The black color helped to absorb heat and melt the ice after an ice storm.) The white wire was used as the slanter which was drooped down and out towards the south. 300-Ohm twinlead was used for the tuned feedline. The "Chinese vertical slanter" antenna looked interesting, but would it really work?

I thought that 40 meters would be the band on which the antenna would be least effective. (If thought of as a one-radial tuned ground-plane antenna, the vertical element is less than a quarter wavelength long. If thought of as a center-fed tuned doublet, the total antenna length is a shortened half wavelength.)

On Friday, December 8, 1978, I decided to try out the antenna on 40 meters (worst band first!). The first station called, DI4IT (West Germany), came back with a 579 report. At the end of this QSO, SP7EJS (Poland) was calling and reported a 559 signal when contact was made. After supper, LZ1KUF (Bulgaria) was called, but he did not come back. (I was not sure whether or not he had called CQ.) The next two calls resulted in QSOs. DL7PR (West Germany) reported 569, and YU1QFX (Yugoslavia) reported 599. (I suspect that this report was exaggerated for the sake of international goodwill. Hi!) These QSOs convinced me that the antenna worked well on 40 meters. Since that time, with very little time on the air, many

DX QSOs have been made on 20, 15, and 10 meters. On several occasions, the DX station chose to answer me instead of one of the other stations calling him. This "Chinese vertical slanter" antenna is the best non-beam antenna that I have ever had. After a storm took down my quad, I could continue to have fun working DX.

Remember that a vertical slanter fed with tuned feeders will load up equally well on both CW and phone frequencies. The above-described antenna even loaded up and made a few contacts on 80 meters. However, the wires are much too short for good performance on the 80-meter band.

For even better performance, a system of radials each about 35 feet long, buried in the ground, could be added to the antenna system. The center of the radials should be under the vertical element. The more radials, the better. However, the antenna works well without radials as the above information indicates.

I have no trap vertical with which to compare the "Chinese vertical slanter" using on-the-air contacts. Certainly DX can be worked using trap verticals and other coax-fed groundplane antennas. However, antennas with more gain, lower angles of radiation, and more effective feed systems will certainly outperform any comparable coax-fed groundplane antenna when it comes to making DX contacts.

I think you'll enjoy the "Chinese vertical slanter antenna." Build one, use it, and find out for yourself how good a non-beam antenna can be for working DX.

References

1. "Tuned Feeders and Other Good Stuff," William R. Stocking W0VM, 73 Magazine, December, 1978, p. 118.

2. Capt. Paul H. Lee (USNR) K6TS, The Amateur Radio Vertical Antenna Handbook, p. 13. 3. Edward M. Noll, 73 Vertical, Beam, and Triangle Antennas, p. 35.

4. William I. Orr W6SAI and Stuart D. Cowan W2LX, Simple, Low-Cost Wire Antennas for Radio Amateurs, p. 43.

5. William I. Orr W6SAI and Stuart D. Cowan W2LX, *The Radio Amateur Antenna Handbook*, pps. 88 and 92.

6. This idea does not take into consideration ground losses. It might be that four drooping radials, each the same length as the vertical element, would enhance the performance of the antenna because there would be less ground loss. Radials buried in the ground under the vertical-slanter antenna might improve its performance, and they are suggested near the end of the article.

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The Triton IV Goes QRP - simply and efficiently

C. Stewart Gillmor W1FK Spencer Road Higganum CT 06441

y last tube rig (I sold it 20 years ago) had something like 1400 volts at 300 mA on the plates of the final tubes. It amuses me, while getting good reports on 20 meters, to glance at a meter and see that I am running 31/2 volts on the finals of my Triton IV! Basically, this is a good way to run the popular Ten-Tec Triton transceiver efficiently at very low power input levels. In this article, I will show how you can modify the Triton IV for such operation and yet drill no holes and make no changes which could not easily be redone to put the rig back into original specifications. This idea

originated with Mac Harper W1FYM, who made the same modifications to his Triton IV and suggested 1 modify mine so that our two rigs could form the basis for the portable QRP station at W1FYM/1 for Field Days 1977 and 1978. The Field Day setup was battery-powered, including our computer logging and TV monitor equipment, and it has performed quite well through 2 Field Days. But the computerized ORP Field Dav station is another story ... one that W1FYM must write.

The modifications described here allow the Triton IV not only to operate very efficiently at 10 Watts input for Field Day, but also they allow such operation any time you wish, merely with the changing of the 6-connec-



Fig. 1. Schematic of Triton IV as modified for efficient QRP operation.

tor power plug to the transceiver. The design idea could easily be altered to suit other solid-state rigs as well. Now you may say, "But my solid-state rig is easily capable of QRP operation as is. I just back down the drive to the finals until I'm drawing about 0.8 Amps at 12 volts and I'm running about 10 Watts input." "Ah, yes," I reply, "10 Watts input, but very little output!" Instead of 1 or 2 Watts out, your rig could be putting 6 or 7 Watts out for the same 10 Watts input if you ran the finals more efficiently. A good way to do this is to run them at much lower voltage. A very satisfactory choice for the 5-to-10-Watt power class is about 3.5 volts. The necessary modifications for this are described in two parts: modifications to the Triton IV and construction of an integrated circuit variable voltage regulator.

Modifying the Triton IV

Basically, what we want to do here is allow the driver and final amplifier transistors to have their own voltage feed separate from that which feeds the rest of the transceiver and auxiliary equipment. Ten-Tec uses a 6-connector

power plug and socket to run power leads and ac switching from the model 252 and 262 power supplies to the transceiver. Pins 1 and 2 are for ac switching and need not be altered. Pins 3 and 4 are grounded and likewise may be left untouched. Pins 5 and 6 are for +12 V dc. This pair is originally soldered together at the power plug to reduce pin resistance. To modify the Triton IV, proceed as follows (refer also to Fig. 1): Separate pins 5 and 6 at the power plug at the left rear of the Triton IV. Resolder the red #14 stranded wire onto pin 6 alone. Follow this red wire to its other end, through the AGC 20-Amp fuse to the cathode end of the 1N3492R diode (diode D1), at the 3-terminal strip. Disconnect this red #14 wire from diode D1 and run it in a 2-turn loop through the ferrite bead directly to the "+12 Final" terminal on the back of the final amplifier metal box; solder it securely. The "+12 Final" terminal is the large one with the solder lug. What you have now done is make pin 6 on the power plug of the Triton dedicated to providing dc solely to the driver and final amplifier transistors. For



safety, in case you mistakenly reverse your battery polarity, it might be wise to buy another 1N3492R high-power diode and install it across the line to ground in reverse-bias polarity position. This can be mounted on the opposite end of the 3-terminal strip from the other 1N3492R diode. Solder the cathode end (marked with a bar) to the #14 red wire going to the final amplifier transistors and the anode end to ground. Then, should you goof and reverse the battery leads (such as happened at 3:00 am in the middle of Field Day to yours truly), the diode will conduct, blow the 20-Amp fuse, and save vour rig.

Now, take a new (say, orange-colored) piece of #14 stranded insulated wire and solder it to pin 5 of the Triton power plug. Push it through one of the cable holes in the metal shielding around the lowpass filter section and leave a few inches extra. Now take a small screwmounting 3AG fuse holder and mount this to the outside of the low-pass filter shield. There is a screw very near coil L4 on the low-pass filter board which holds the board to the shield. The fuse holder can be mounted very easily on the back side of this aluminum shield. No holes need be drilled. Note: The toroid-core coil, L4, on the low-pass shield board is not the same coil as "L4" in my Fig. 1. The latter is a ferrite bead through which the final dc supply line is wound for 2 turns of rf shielding.

Now that you have mounted the 3AG fuse holder, connect your orange wire to one end and install a small, 2-Ampere fuse in the holder. From the other end of the fuse holder, run the same size orange wire along parallel to the back of the final-amplifier metal box until it reaches the 3-terminal strip where diode D1 is mounted. Solder the orange wire to the near end of the terminal strip: this is the same point where the cathode end of diode D1 and also 2 small #24 red wires are soldered. You have now completed the Triton modification. The orange wire from pin 5 of the power plug runs through a 2-Amp fuse and continues on to supply +12 V dc to all of the rig except the driver and final stages. Your regular 6-connector power socket from your model 252 or 262 power supply will work the same as before except that now you have the option to supply pins 5 and 6 on the power plug with different dc voltages if you choose. A way to supply different voltages is described below.

Variable-Voltage Regulation Using an IC Regulator

All you really need to do to supply the Triton final transistors with low voltage for highly efficient QRP operation is provide dc at from 2 to 6 volts at anywhere from 1 to 5 Amps. If you already have a small multi-voltage dc supply, fine. Or you can consult one of the ham handbooks and find a circuit which supplies dc at only a single voltage level. This would work perfectly well, for you can vary power input of the Triton using the drive control. 1 will describe here a variable-voltage regulated supply which provides 2 to 6 volts out and easily handles 5 Amperes (see Fig. 2). This was constructed in W1FYM's shack in one evening using some purchased and some scrap parts. The circuit was mounted on PC board. I purchased a heat sink somewhat larger than necessary, and the pass transistor (HEPS7004) is rat-

ed at 15 Amps! Since the case of this large power transistor is not at ground potential but at +12 V dc. we mounted the circuit board on the heat sink. which in turn was mounted on 2 insulating pieces of nylon scrap. The µA723 IC was mounted in a socket rather than being soldered. I always avoid soldering IC chips, if possible, because everybody ends up frying a chip now and then and it's a lot easier to test or change a chip which is socket-mounted.

Ten-Tec sells a small accessory 625-mV meter (ammeter model 207) which plugs into the various power supplies of their 250 and 260 series, using a phono plug. We wanted to monitor our current input during Field Day and other QRP operation but didn't want to buy or permanently install a meter, so we put a phono jack on the board and wound a wire shunt of about 0.7 Ohms value so that the meter reads 5 Amps full scale. Of course. vou could use a different meter movement with a different shunt value. The 1k pot is an Ohmite ANP 102K or similar and its value, as well as that of the 330-Ohm 1/2-Watt resistor, is not critical. The IC used by us was a Fairchild μ A723, but equivalents are available from firms including Motorola (MC1723), National (LM723), and Signetics (µA723). Q1 is a

1-Ampere-rated pass transistor, Texas Instruments TIP29B or equivalent; Q2 is the 15-Ampere-rated HEPS-7004. We used #12 stranded copper wire with large battery clips to supply the 12 V dc from the battery to the regulator power plug (pin 5 and pins 3-4). I would recommend using #14 or #16 stranded copper wire from the emitter of Q2 to the shunt and on to pin 6 of the power socket.

The construction and use of the regulator is straightforward. The 1k pot can easily be adjusted for output voltages from about 2 to 6 volts. W1FYM has had only to replace one fried IC chip in a year and a half of occasional use and I have had absolutely no troubles at all. Believe it or not. I've often had 579 and 599 reports on both CW and SSB into Europe and South America on 20 meters. Those reports aren't due only to the Triton IV QRP...1 use long vee-beams 6 to 8 wavelengths on a leg and multi-element wire collinear beams at my QTH. Still, I've described a fairlyeasy-to-make modification to the Triton IV and the construction of a modest voltage regulator which not only makes for a competitive Field Day rig, but also allows one to use a medium-powered solidstate rig such as the Triton in highly efficient QRP operation.



Fig. 2. QRP voltage regulator for the Triton IV.



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Experimenter's Corner: The MM5369N

— how many uses can you find for this one-chip crystal oscillator?

Charles B. Patten 4641-4 Chicago Drive Andrews AFB MD 20335

Would you like a simple, versatile, crystal-controlled oscillator? Would you like it to operate from below 500 kHz to over 16 MHz, with rich harmonic content, simply by changing crystals? Too good to be true? Read on, it gets better!

The MM5369N—see Fig. 1(a) and (b)—is a CMOS integrated circuit that is configured to provide a crystal oscillator (you supply the crystal) with a buffered output (maximum available load about 500 uA) and an internally-connected divide-by-59659 (or 215.864452175) divider chain which provides, in the manufacturer's intended use, a 60 Hz output for dc-operated digital clocks when used with an inexpensive 3.579545 MHz crystal. This, and numerous other uses, will be mentioned as we proceed.

How It Works

The crystal oscillator is biased by a crystal and RC network (Fig. 2) consisting of R1, C1, and C2. R1 is nominally 20 megohms to bias the oscillator stage for class A operation.¹ Capacitor C1 provides the necessary parallel capacitive load, which, with R1, causes the oscillator to start reliably. C2, in parallel across X1-C1, permits the oscillator output to be trimmed to an accuracy of ± 100 ppm of the desired operating frequency with an accuracy of ± 2 ppm obtainable with careful component selection.

The buffered oscillator output frequency is available at pin 7 of the IC which gives you a convenient point to monitor the oscillator output without loading, while trimming to the desired operating frequency. The buffered output is at CMOS levels, and for that reason must drive only CMOS-compatible circuits. If other than CMOS levels are required, it will

be necessary to provide the needed digital or analog buffers. Several CMOS-todigital-level buffers are available from many of the suppliers listed in the advertisements in this magazine; additionally, all parts called for in this article are available from Surplus Electronics, 9600 Baltimore Blvd. (rear), College Park MD 20740. The CMOS-to-analog-level buffer is not available as a single chip, but may be constructed in the form of a one- or two-transistor amplifier to allow the oscillator to be used in just about any circuit configuration you can imagine. These can include local oscillators, QRP transmitters, frequency counters, and so on. Note that the output



Fig. 2. Basic operating circuit.



Fig. 1. (a) MM5369N block diagram and timing.' (b) MM5369N pinout.'



Fig. 3. Output waveforms taken at 3.58 MHz from pin 7. (Note loss of rise and fall times at very reduced Vdd.)

load on the buffered oscillators output must be kept below 500 uA to avoid exceeding the manufacturer's specifications.

The divider section in the standard MM5369N is a mask-programmed, 17stage divider set to divide the input frequency by 59659. This is accomplished in conjunction with a six-input reset pulse generator which, by virtue of its mask programming, sets the internal divisor length. The MM5369 is also available with custom mask programming. Should you have the need and the bucks (kilo, no doubt), National Semiconductor would, most likely, happily mask-program a few thousand for you with any divisor from 10000 to 98000. The divided output duty cycle stays very close to 50% for a Vss of 8-15 volts and can drop as low as 20% for a Vss of 3 volts at the same frequency. The current drain is nominally 2-4 mA for frequencies of 500 kHz to about 6 MHz, with up to 20 mA drawn for frequencies up to 16 MHz.

Operational Considerations

The MM5369N is a versatile crystal oscillator chip requiring a bare minimum of supporting parts for proper operation. The oscillator is very tolerent of supply voltage variations, and the only noticeable effect of an abnormal voltage change is a possible loss of duty cycle and a degradation of the rise and fall times of the output waveform (see Fig. 3). Although the MM5369N is

specified to operate from dc to 2 MHz at 6 V dc and dc to 4 MHz at 10 V dc. I have found that the oscillator will run reliably in excess of 16 MHz at 10-15 V dc with a very good sinetype output.¹ Also, if you are inclined to experiment. you will find that the crystal can be replaced by an inductor and the circuit operating range extended to about 40 MHz. But you will pay the price-not too exorbitant-in the loss of crystal stability and output voltage level.

Although the output of the oscillator is already buffered, I feel it is advisable when using this circuit in any application to add at least an additional stage of isolation, whether it is digital or analog, to avoid undue loading of the oscillator. The output load should be limited to less than 500 uA and be as low as possible for best stability. This is not difficult to obtain with a one- or two-transistor buffer amplifier (Fig. 4). The amplifier was adapted from "Brew Up a Signal Generator" (73. January. 1978). The circuit as shown has been tested from 500 kHz to 16.5 MHz, operates quite reliably, and adds only an additional 20-25 mA to your power supply requirements. If you are planning to operate this buffer amplifier exclusively under 5 MHz, you can omit the 30 pF capacitor across R3.

Stand-Alone Crystal-Controlled Calibrator

So far you have been presented with a bunch of



Fig. 4. Modified buffer amplifier for CMOS-to-analog level translation.³

theory and "how to" and little else. Here's your chance to include all of the above plus a little more and have a reliable test instrument standard for your lab. First dig out that old 1- or 10-MHz rock you bought at the last hamfest. We're going to combine it with the MM5369N, a TTL buffer amp, a few ICs, and end up with a crystal calibrator with multiple divided outputs. It will serve you well when the time comes to calibrate your scope, and, in between, serve as the timebase for a frequency counter, if you wish. The output of pin 7 on the MM5369N (Fig. 5) is fed to the TTL buffer amp and then to the first 7490; each



Fig 5. TTL digital interface and divider chain.



20pF 33pF 22MEG 9V 8 6 5 20pF 33pF 22MEG 500 500 205mA

Fig. 7. Crystal checker schematic.

supply is just plus or just minus, then that respective leg is referenced to ground, and R2 is the control voltage divided by the control current.

> 3) The value of R1 and R3 is found by Rx=Vout (desired)-Vcontrol/Icontrol.

> 4) If you prefer an adjustable supply, R1 and R3 can be replaced by trim pots and their respective voltages set independently.

5) Include a .33-uF input and a .1-uF output capacitor for each circuit to improve the circuit's output transient response time.

If you wish, a 25-volt center-tapped transformer may be modified to provide the dual output voltages called for by Fig. 6. Take a sharp knife and carefully follow the c-t lead through the paper until you find the point where the lead is soldered to the output winding. When you find this point, carefully unsolder and split the two winding wires, attach separate output wires, and cover the connections with the proper size heat shrink or tape. Re-wrap the transformer with tape, check for shorts - and you're done.

Other Nonstandard Uses

Other nonconventional uses include a portable crystal checker (Fig. 7). Just add a 0-5-mA meter, and replace the power supply with a 9-volt transistor battery. Note and mark the

Fig. 6. (a) UA78MG and UA79MG power supply. The negative portion of the supply is not required for this project. It is provided to allow the user greater latitude in using the power supply in other projects as well. (b) UA78MG and UA79MG pinout.

divided signal is then fed to the following IC stage in turn. At each 7490 output, the signal is brought out to a TTL buffer chip where it is available for use as you please. At approximately 100 kHz you may wish to substitute 74C90s for the 7490s to keep the current drain to a minimum.

If you choose this route you should use 74C901 or 74C902 CMOS-to-TTL buffers. These outputs are fed, in turn, to a rotary switch and from there to the output. There is also a signal provided that has been divided by 59659 that is available at pin 1 of the MM5369N. This also can be buffered and used as a known signal source for a press-to-test function if you use this circuit for a frequency counter timebase. You will note that the TTL buffer is a two-stage amplifier driving a conventional 7490÷10 IC. This is necessary as it still is diffi-



The Power Source

The power source—see Fig. 6(a) and (b)—is a simple voltage-regulated source that will help eliminate the aforementioned "abnormal voltage drop." It consists of the usual transformer, full-wave diode bridge, and capacitor arrangement followed by a really neat voltage regulator chip, the UA78MG, made by Fairchild Semiconductor. The UA78MG is a 4-terminal positive voltage regulator (UA79MG is the negative version) which is adjustable from 5 to 30 volts at a current of 500 mA. This versatile device can be used with a series pass transistor for higher output currents when needed.² For those who are interested in the gory details of how to design power supplies with this chip, a few of the basic rules I have found to be useful are set forth below:

1) Set the control current through R1, R2, and R3 to 1 mA.

2) The UA78MG control voltage is 5 V, the UA79MG is 2.23 V. R2=7.23/1 mA= 7.23k Ohms. If the power



Fig. 8. Long-interval timer-option schematic.



Fig. 9. MM5369N tone or frequency burst schematic and block diagram.

current drawn without a crystal in the circuit and mark this on the face of the meter. Crystals that operate at 5 MHz and below will cause a current drop from the mark, while 7 MHz and above will cause the current to increase. If there is no charge in the amount of current drawn, then the crystal is open, or very close to 6 MHz.

The MM5369N also can be used as a long-interval timer. You can cascade the MM5369N without using the active oscillator part of the IC by feeding the output of the first oscillator (pin 1) to the input of the next oscillator (pin 5). (See Fig. 8.) By this scheme, you select the desired output period and multiply by 59659 or multiple thereof. and find the inverse to get the operating frequency needed. If you wish to have 1 Hz every 1.88 years you have to use an operating frequency of 3.579545 MHz and divide it through 3 MM5369N dividers to obtain the desired output.

Another option is to use the MM5369N as part of a tone or frequency burst oscillator (Fig. 9). The NE555 timer provides a low frequency square wave that is used to supply power to the Vdd pin of the MM5369N. Every time the square wave goes positive, the oscillator is gated on for the duration of the positive portion of the pulse. The oscillator will produce whatever frequency has been selected for it by its crystal.

Construction

These circuits can be wired either point-to-point or by printed circuits. Although my circuit debugging is started on perfboard or breadboarding strips, I have always found it more enjoyable, in the long run, to make all my test equipment on printed circuit board. Not only does it make assembly easier, but



Fig. 10. (a) MM5369N PC board layout for basic circuit and crystal checker. (b) UA78MG and UA79MG power supply PC board layout. Both PC board layouts are shown from the component side.

when properly accomplished, can add to the usefulness and longevity of a circuit. Should you also find this to be the case, PC layouts have been included (Fig. 10).

Calibration

Calibration of the MM5369N output frequency is a relatively simple matter and can be accomplished with a bare minimum of fuss. Hook the output of pin 7 on the MM5369N to an oscilloscope or frequency counter and trim C2 until the desired frequency is obtained. Do this slowly as the trim cap is small and it's easy to overshoot the desired frequency. If you opt for the counter method of calibration and your counter drifts very little, you can record the oscillator output over a period of time while recording the ambient temperature, and make a frequency vs. temperature chart that will allow you to temperaturecompensate your oscillator. This is done by finding the rate of frequency drift with temperature and selecting a replacement capacitor for C1 that has the opposite coefficient of the temperature curve. To select the proper capacitor, note the frequency and temperature at several points. Divide the difference in frequencies (desired and actual) by the desired frequency, then divide the result by the number of degrees that have

changed from your ambient setting and you should have your temperature coefficient in parts per million/degree. This is what capacitor temperature coefficients are expressed in. Simply choose the one that is closest to the opposite of your recorded findings and you will be on your way to maximum stability.

Conclusion

This article is intended to present the experimenter with a versatile, crystalcontrolled building block that proves to be useful in a wide range of circuits and is functional as a generalpurpose crystal-controlled frequency standard that is not limited to such a mundane chore as a digital clock timebase.

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Digital Readout Rotator Control

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Modernize your TR-44.

Randy Kaeding K8TMK 222 Jamesway Benton Harbor MI 49022 With almost everything switching to digital readout these days,

I decided to design a new control box for my TR-44 rotator. For my own per-



Photograph of the new control box. (The display was enhanced so that it would stand out better.)

sonal use, the new control box would have to: use LED displays, be relatively simple, interface directly to the rotator with no internal modifications, remain accurate during ac line variations, and match my other station equipment.

Research

Fig. 1 shows the schematic of the TR-44's unmodified sensing circuit. This circuit is a simple voltage divider, which causes more or less current to flow through the meter as the sensing potentiometer (inside the rotator) changes position. When the potentiometer is at the bottom end of its range (rotator fully counterclockwise, as viewed from the top of the rotator), no current flows through the meter, and the meter needle remains in the resting position. When the rotator is at the top end of its range (rotator fully



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MFJ ENTERPRISES, INC. P. O. BOX 494 MISSISSIPPI STATE, MISSISSIPPI 39762 clockwise), approximately one milliampere flows through the meter, and the needle indicates full scale.

With the above ideas in mind, I decided that a simple dc voltmeter, with proper voltage scaling, could be used to indicate the position of the rotator potentiometer. If you apply a voltage to the potentiometer so the wipervoltage changes from 0 to 3.6 volts during a complete



Fig. 1. Unmodified sensing circuit for the TR-44 rotator.

revolution, you have a voltage which changes at the rate of .01 volts per degree. A preliminary data sheet for the Motorola MC14433 integrated circuit, which is



Fig. 2. Schematic diagram of the new control box (shown connected to the original rotator assembly).
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a 3½-digit analog-to-digital converter, contained the schematic of a simple 3½-digit digital voltmeter. To suit my particular requirements, I deleted the overrange and polarity sensing circuitry to further simplify the circuit. I then modified the circuit to work with some decoderdriver ICs and LED displays that I already had. Fig. 2 is the schematic diagram of the completely redesigned rotor control box (shown connected to the rotator assembly).



Internal layout of the new control box.

Construction

With one minor exception, construction of the control box is not critical. Since the potentiometer wiper inside the rotator is mechanically grounded to the case (control cable wire #1), you must take care to keep all other circuit points isolated from ground.

If you use the same + 5volt regulator as 1 did, heat-sink it to the chassis. Be sure to use an insulator between the IC and the chassis to keep it electrically isolated from the chassis. The - 5-volt regulator IC does not need a heat sink and may be mounted on the circuit board.

Figs. 3, 4, 5, and 6 show the foil and component layout of the two circuit boards. Although the two circuit boards could have been combined into one, I used separate boards so that they could be used on future projects.

Be sure the power transformer you use in the sensing circuit has at least an 18-volt, center-tapped. secondary winding. This will allow the regulator ICs to remain within acceptable operating parameters with varying ac line voltages. With a 20-volt, center-tapped transformer, you should be able to keep an accurate display indication while the ac line voltage varies between 90 and at least 130 volts.

I mounted an extra pushbutton switch on the left side of the front panel to help balance the appearance of the panel. You



Fig. 3. Actual size foil pattern for the A-D converter circuit board (shown from the foil side).



Fig. 4. Component layout for the A-D converter circuit board (shown from the component side).

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could use this switch for brake release, if you use the control box with the Ham-M rotator.

Calibration

Calibration of the new control box is quite simple. You should not have to repeat it unless the ac line voltage changes drastically or the length of the control cable changes.

Connect the new control box to your rotator control cable and depress the POWER button. Use the **RIGHT** push-button to turn the rotator to its fullyclockwise position. The display will stop changing when you come to the end of travel. Note: If the display goes toward zero as you turn the rotator in a clockwise direction, interchange control cable wires 3 and 7. Now adjust the control on the A-D converter circuit board until the display indicates 360. The display should automatically indicate 0 when you turn the rotator to the left end of travel.

Operation

To determine the position of your antenna, simply depress the POWER button. The display will indicate the position in degrees. If you desire, you can leave the POWER button depressed for a continuous indication.

If you wish to turn the rotator to a new position, simply push the LEFT or RIGHT button until the display indicates the desired position.

Conclusion

I have been using the new control box for a few months with no noticeable problems. It is a great pleasure to hear a DX station, look up his bearing in a table, and turn the rotator to the exact position without having to interpolate between the lines on an analog meter.

In the future, I plan to

Component Number	Description
C1, C4, C5, C6, C8	.1 uF disc ceramic capacitors
C2, C3	1200 uF, 25-V electrolytic capacitors
C7	.1 uF mylar™ capacitor
C9	130-140 uF, 50 V, non-polarized capacitor
D1, D2	1N4002 silicon diode
DISP 1, DISP 2, DISP 3	FND-500 LED displays
F1	3-Ampere, 3AG fuse
IC1, IC2, IC3	9368 7-segment decoder-driver-latch ICs
IC4	MC14433 31/2 digit A-D converter IC
R1	15k Ohm, ¼-Watt, 5% resistor
R2	10k Ohm, ¼-Watt, 5% resistor
R3	470k Ohm, ¼-Watt, 5% resistor
R4	270k Ohm, ¼-Watt, 5% resistor
R5	5600 Ohm, ¼-Watt, 5% resistor
R6	5k Ohm linear control
SW1	DPDT locking push-button switch
SW2, SW3	DPDT momentary-contact push-button swite
T1	Power transformer (20 V ac center-tapped,
	34-Ampere secondary)
Т2	Power transformer (26 V ac. 2-Ampere secon

Darte Liet



Fig. 5. Actual size foil pattern for the display circuit board (shown from the foil side).



Fig. 6. Component layout for the display circuit board (shown from the component side).

redesign the control box for use with a microprocessor. This will allow me to punch in a prefix on a keyboard, for example, and then simply wait for

the rotator to reach the correct position automatically.



Tools and Techniques for Electronics (BK7348) is a comprehensive guide to the tools and construction practices used by today's electronics hobbyist. This new 73 Magazine publication should be a part of the library of anyone who has ever built or fixed any electronic gear. The text and numerous pictures and illustrations provide an easy-to-understand description of the safe and correct way to use the basic and specialized tools needed for electronics work.

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Build the KIM Keyer - with a 3-message memory

Marvin L. De Jong KØEI Dept. of Math-Physics The School of the Ozarks Pt. Lookout MO 65726

The short application program listed in Table 1 allows the KIM-1 to send any of three messages by pressing one of three keys (A, B, or C) on the KIM-1 keyboard, and, with the interface circuit shown in Fig. 1, the KIM-1 becomes an electronic keyer as well. Any microcomputer with a

650X microprocessor and one of the MOS Technology PIA or VIA chips may be used with only minor modifications to the program. An important feature of the program is the ability to precisely set the code speed between 5 and 99 words per minute by entering the speed, in decimal, at storage location 0000 in memory. The program converts this decimal number to hexadecimal, then does a division routine to convert the speed to a time duration of the basic dot element, and the interval timers on the 6530 PIA do the rest.



Fig. 1. Interface circuit. Some transmitters may require the optional relay for keying, with a 1N914 diode across the coil for protection against transient voltages. The Triton IV may be keyed directly from pin 10 of the 7402. All grounds should be the same as the KIM-1 ground, and the 5 volts may be stolen from the KIM-1 power supply.

Anyone who does much contest operating will realize how useful an automatic message sender is. Even the casual CW operator can use it for sending CQ or other routine messages. Code tests for Novices can be programmed and sent at precisely 5 wpm by storing the entire test in memory. At 5 wpm, at least 5 minutes of code may be sent. For Field Day (1977), we used a similar program to send CQ CQ CQ FD DE KØEI KØEI K as message A, then when a station responded, we sent) DE KØEI UR 599 (MO 599 MO K, where the blank was the call of the station to be keyed by the operator, after which he hit key B to give the remainder of the message. It worked very smoothly with no discernible pause between the call letters and the message. (Don't try to look up our score, because KØEI was not the call we used.) The operation of the keyer is exactly like most electronic keyers; holding the paddle in the dot position will cause a series of dots and spaces to be sent. Dashes occur with the paddle in the dash position, and the timing of all the characters is controlled by the program and the crys-

tal on the microcomputer.

Operation

Assuming the program has been loaded and the interface circuit connected. operation proceeds as follows. The code speed at which you wish to operate is loaded into storage location 0000. Any decimal number from 05 to 99 may be put into this location. Next, the starting and ending addresses of each message must be loaded into memory. Since all three messages are in page 2 of memory, only the loworder bytes of the starting and ending addresses need be given. Suppose message A starts at 0200 and ends at 0251, message B starts at 0252 and ends at 0265. while message C starts at 0266 and ends at 0278. (These are completely weird numbers chosen at random from my skull and have absolutely no other significance.) Then one would load 00, the starting address of message A, at location 0001; 52, the starting address of message B goes in at 0002; and 66 is entered at 0003. The respective ending addresses go into memory locations 0004 to 0006, that is, 51 into 0004, 65 into 0005, and 78 into 0006.

How do you load the messages themselves? For each character you want to send, you must load the corresponding hex number shown in Table 2. Suppose, for no reason whatsoever, message A is to be "DE KØEI K" and is to start at 0200. You then load the hex numbers 90 40 00 B0 FC 40 20 00 B0 from locations 0200 through 0208; 00 goes into 0001 and 08 into 0004.

Probably the best way to proceed is to first load the three messages including spaces, noting the starting and ending addresses of each message on a piece of paper. Then go back to page 0 and put the starting and ending addresses in their proper locations. Go to location 0300 and hit the GO button to start the program running. Test to make sure everything is working before you put the thing on the air.

Programming Details

The flowchart shown in Fig. 2 and the comments in the program should give the reader a good feeling

BEGIN

for the structure of the program. It consists of three principle parts: the main program, subroutine SEND, and the interrupt routine, all of which have individual flowcharts shown. Minor components are subroutine DIT (which holds PBØ at logic 0 for the dot length followed by a logic 1 for the space length), subroutine DAH (which holds PBØ at logic 0 for three dot lengths-1 dah = 3 dits - followed bya space), and subroutine TIMER (which loads the timer on the KIM-1 with the precise length of 1 dot and then waits for this time to elapse).

We now look at some specific details of the program. The speed in words per minute must be converted to hex before the computer can do any further calculations with it. This conversion may best be explained with an example. Suppose we wish to operate at 20 wpm, so 20 is entered into location 0000. What we mean by 20 is 2 in the tens place and 0 in the

ones place, but what the computer thinks this means is 2 in the sixteens place and 0 in the ones place. At least we agree on the ones place, so initially we mask the ones place out with an AND statement: later we retrieve it and simply add it to the result of our decimal-tohex conversion of the 2. To trick the computer into thinking the 2 in the sixteens place is the 2 in the tens place we intended it to be, we change the sixteen to a ten with this trick: 10 = 16/2 + 16/8. The sixteens place divided by two is accomplished by one shift-right statement (LSR), while the sixteens place divided by 8 is accomplished by three shift-right statements. So, the 2 in the sixteens place is shifted right once, stored, shifted right two more times, and these two results are added. We now have 2×10 in the computer (in hex, of course) rather than 2×16 . Adding the results from the ones place completes the conversion.

Using the keying speed definitions from The Radio Amateur's Handbook, one can calculate that the dot length in milliseconds is 1200/S, where S is the code speed in words per minute. If the divide-by-1024 timer on the KIM-1 is used, 1 count corresponds to 1.024 milliseconds. Converting the dot length to timer counts gives TIME = (1172/S) base 10 = (494/S)hex, where TIME is the number to be loaded into the divide-by-1024 timer to give a code speed of S wpm. So, the computer must divide S into 494. This is determined by successively subtracting S from 494 until the result becomes negative. The number of subtractions is the quotient of 494/S.

Pin PBØ on the KIM-1 is used as the keying output from the computer. When power is applied to the computer and the reset button is depressed, PBØ comes up in a logic 1 state. This dictates that logic 1 corresponds to the transmitter being off. Consequently, PBØ is buffered and inverted twice by the NOR gates. Inverters such as the 7404 would work, but since I needed a NOR gate in the keyer interface, I simply used the other NOR gates on the same



Fig. 2. Flowchart for the keyer and message sender. (a) Main program. (b) SEND subroutine. (c) Interrupt routine.

81 0

Address	Instruction	Label	Op Code Operand	Comments	0376	8A	SEND	TXA		
0201	70	DEGIN	SEL	Prevent interrupts.	0377	48		PHA		
0301	10 20			Binary mode.	0378	BD 00 02		LDA	MEM,X	Get code element.
0302	A9 09		LDA \$C9	Set interrupt vectors.	037B	FO 1E		BEQ	WDSP	
0304	8D FE 17		STA IRQL		037D	QA	HERE	ASL	Α.	
0307	A9 03		LDA \$03		037E	FO 10		REO	FINCH	
0309	8D FF 17		STA IRQH		0380	1.8		DUA	11101	
0300	A9 01		LDA \$01	Initialize I/O Ports A	02.01	RO 04		DCC	DACU	
030E	8D 02 17		STA PBD	and B.	0301	BU U0		DU3	DASH	
0311	8D 03 17		STA PBDD	PBØ is output pin.	0383	20 AU U3		JSR	DIT	Send dot.
0314	8D 01 17		STA PADD	PAØ is output pin.	0386	4C 8C 03		JMP	ARND	
0317	8D 00 17		STA PAD		0389	20 B9 03	DASH	JSR	DAH	Send dash.
031A	CE 00 17		DEC PAD	Togale PAØ to reset debounce	0380	68	ARND	PLA		
031D	EE 00 17		INC PAD	circuit.	038D	4C 7D 03		JMP	HERE	
0320	A 5 00		LDA SPEED	Get decimal value of speed	0390	A2 02	FINSH	LDX	\$02	
0322	19		DHA	from location 0000 and convert	0392	20 BE 03	AGN	JSR	TIMER	Character space.
0222	20 50		AND CEO	it to her	0395	CA		DEX		
0323	29 10		AND SFO	it to nex.	0396	DO FA		BNE	AGN	
0325	4A		LSR A	Multiply tens digit by ten.	0398	68		PLA		
0326	85 10		STA SCRATCH		0399	AA		TAX		
0328	4A		LSR A		0394	60		DTC		
0329	4A		LSR A		0208	42.01	LIDCD	I DV	*0	Maria
032A	18		CLC		0398	A∠ U4	WDSP	LUX.	\$04	word space.
032B	65 10		ADC SCRATCH		0390	4r: 92 03		JMP	AGN	
032D	85 10		STA SCRATCH	Result of multiplication here.		*******	*********	****	******	****
032F	68		PLA	Get SPEED again.	034.0	A2 01	חזת	TDY	\$01	
0330	29 OF		AND SOF	Add ones digit to SCRATCH.	0240	RE 02 17	DIT	DEG	301	
0332	65 10		ADC SCRATCH		U3A2	CE 02 17	BACK	DEC	PBD	
033/	85 10		STA SCRATCH	Decimal to her complete.	U3A 5	20 BE 03	SPA	JSH	TIMER	
0334	30		STR BONATON	Division multipa basing ham	0348	CA		DEX		
0330	10,000		JEC ACO	Division foucine begins here.	03A 9	DO FA		ENE	; SPA	
0337	A2 00		LDA \$00		03AB	AD 02 17		LDA	PBD	
0339	A9 94		LDA \$94		03AE	4A		LSR	L A	
033B	85 08		STA LO		03AF	BO 07		BCS	DONE	
033D	A9 04		LDA \$04		03B1	EE 02 17		INC	PBD	
033F	85 09		STA HI		03B4	E8		INX		
0341	A 5 08	UP	LDA LO		03B5	4C A 5 03		JMP	SPA	
0343	E5 10		SBC SCRATCH		03B8	60	DONE	RTS		
0345	85 08		STA LO			**********	*********	***	**********	****
0347	A 5 09		LDA HI							
0349	E9 00		SBC \$00		03B9	A2 03	DAH	LDX	\$03	
034B	85 09		STA HI		03BB	4C A2 03		JMP	BACK	
034D	ES		INX			*********	*********	****	*********	*****
034E	BO F1		BCS IIP		O3BE	45.07	TIMER	T DA	TIME	Delay for the number of
03.60	86.07		STV TIME	Division Genelate	0200	AD 07 17	1 IPEDP	CDA	TIME	1 021 - 111 - second with
02.52	20 64 15	0.000	JIX TIME	Division complete.	0300	80 07 17	0.04	DIA	IMER	1.024 millisecond units
03.5%	20 0A 1F	ru- 1	JOR GEIREI	Read Reyboard subroutine.		20 07 17	CHK	BIT	TMER	stored in TIME.
0355	58		CLT		0306	10 FB		BPL	, CHK	
0356	AO 00		LDX \$00	Test keys.	0308	60		RTS		
0358	C9 QA		CMP \$ OA			**********	**********	****	********	******
035A	FO OA		BEQ MESSA							
0350	C9 OB		CMP \$OB		0309	48	INTERPUPT	PHA		Save registers.
035E	FO 05		BEQ MESSB		03CA	8A		TXA		
0360	C9 OC		CMP \$ OC		03CB	48		PHA		
0362	D' EE		BNE RPT		0300	AD 00 17		LDA	PAD	Is PA7 = logic 1?
0364	C8		INY		03D0	30 06		BMI	PAST	Yes, dah. No, dit.
0365	C8	MESSB	INY		03D2	20 AO 03		JSR	DIT	Send dot.
0366	BE 01 00	MESSA	LDX STRT.Y	Start message.	03D5	4C DA 03		JMP	ACRS	
0369	20 76 03	CNT	JSR SEND		03D8	20 B9 03	PAST	JSR	DAH	Send dash.
0360	84	01	TXA		03DB	CE 00 17	ACRS	DEC	PAD	Toggle debounce circuit
0360	D9 0/ 00		CMP FMD V	End massage?	03DD	EE 00 17		INC	PAD	
0370	FO FO		DEO DET	1810 UC238RC:	03E0	68		PLA		Restone registers
0270	F0 E0		TARY		0351	4.4		TAY		
0372			THY CIME		0252	68		DIA		
0373	40 69 03		JMP CNT		00000	00		r LA		
	*****	****	************	****	0323	40		MIS		Return From interrupt.

Table 1. Source listing for the message and keyer program.

chip. If PBØ could sink enough current, it might drive the relay directly, but I preferred the buffering shown in Fig. 1. Mark elements of the Morse code are sent by decrementing (DEC) PBØ for the appropriate length of time,

while space elements are sent by leaving PBØ at logic 1.

The program idles in the loop starting with JSR GETKEY and ending with BNE RPT, testing each of three keys (A, B, and C) to see if they were depressed. If no key is depressed, the program remains in this loop. If a key is depressed, register Y is set to 0, 1, or 2 depending on which key was struck. Y is then used as an index to look up the starting address (low-order byte of page two of memory) of the message (STRT,Y) and later the ending address (END,Y) of the message. The starting address is used as an index to find the first code element of the message (MEM,X), and it is incremented until the ending address is enWHOLE NEW WORL

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Morse Character	Hex	V	18
		W	70
Α	60	Х	98
В	88	Y	B8
С	A8	Z	C8
D	90	1	7C
E	40	2	3C
F	28	3	1C
G	D0	4	0C
Н	08	5	04
1	20	6	84
J	78	7	C4
К	BO	8	E4
L	48	9	F4
M	E0	0	FC
N	AO	Word space	00
0	F0	SK	16
Р	68	BT	8C
Q	D8	ĀŘ	54
R	50	1	94
S	10		56
Т	C0	,	CE
U	30	?	32

Table 2. Morse character to hex conversion.

countered.

The conversion of an 8-bit word of memory to a Morse code character has been described in other references in detail and will not be repeated here. There are a number of schemes available,^{1,2} but the most efficient schemes appear to be those in references 3 and 4, and those were the techniques used here.

The keyer is implemented by the interrupt routine,

Location	Contents
0000	Speed in decimal (words per minute)
0001	Starting address of message A (low-order byte)
0002	Starting address of message B
0003	Starting address of message C
0004	Ending address of message A (low-order byte)
0005	Ending address of message B
0006	Ending address of message C
00F1	04 (Prevents interrupts while in monitor)

Table 3. Storage locations to be loaded by the operator.

which in turn uses subroutines DIT, DAH, and TIMER. It will send at exactly the same speed as the messages. The keyer interface circuit is simply debouncers which are reset at the end of an interrupt. If the key is still in the dot or dash position, the reset has no effect and another interrupt occurs. The flowchart indicates that the state of PA7 determines which element is to be sent.

One last thought: If you want to be able to key in a few characters in the middle of a message, just load a few word spaces there and key the characters in when the blank occurs. This is handy for giving signal reports and also in some contests where the number of contacts is updated after each QSO.

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4. Ockers, Stan, "Code Test," *The First Book of KIM*, ORB, Argonne, Illinois, 1977, p. 56.



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 Whole Space—Students are given the opportunity to lead an attack on an evil planet. Every time a correct answer is given to a math problem posed by the computer, he can move his ship closer to his goal. Every wrong answer gives the enemy an opportunity to fire back

Note: the Hanging program requires Applesoft II BASIC. The Whole Space and Spellbinder programs can run in integer BASIC, Order No. 0073A

Math Tutor II Applesoft II + 20K Order No. 0098A

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MANUFACTURER	MODEL	LIST	HANGE	TIME BASE	TEMPERA	100 Hz -	50 MHz -	250 MHz -	No.	SIZE IN	RESOLUTION		
		PHICE		17° - 40°C 0° - 40		0° - 40°C	25 MHz	250 MHz	450 MHz		INCHES	.1 SEC	1 SEC
DSI INSTRUMENTS	100 HH	\$ 99 95	50Hz-100MHz	тсхо	1 PPM	2 PPM	25 MV	NA	NA	8	.4	100 Hz	10 Hz
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1 KHz - 50 MHz ‡ Continental Specialties Corp.

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WILSON SYSTEMS INC. MULTI-BAND ANTENNAS



A trap loaded antenna that performs like a monobander! That's the characteristic of this six element three band beam. Through the use of wide spacing and interlacing of elements, the following is possible: three active elements on 20, three active elements on 15, and four active elements on 10 meters. No need to run separate coax feed lines for each band, as the

bandswitching is automatically made via the High-Q Wilson traps. Designed to handle the maximum legal power, the traps are capped at each end to provide a weather-proof seal against rain and dust. The special High-Q traps are the strongest available in the industry today.

-SPECIFICATIONS -

Band MHz	14.21.28
Maximum power input	Legal limit
Gain (dBd)	Lin to 9 dB
VSWR @ resonance	13.1
Impedance	50 Ω
F/B ratio	20 dB or bett

No. of elements. 6 18'6" Turning radius . Maximum mast diameter, 2" 20 dB or better Surface area 8.6 sa. ft.

Boom (O.D. x Length) . . 2" x 24'21/2" Wind loading @ 80 mph . . 215 lbs. Maximum wind survival . . 100 mph (supplied) Assembled weight (approx. 53 lbs. Shipping weight (approx.).62 lbs



Capable of handling the Legal Limit, the "SYSTEM 33" is the finest compact tribander available to the amateur.

Designed and produced by one of the world's largest antenna manufacturers, the traditional quality of workmanship and materials excells with the "SYSTEM 33".

New boom-to-element mount consists of two 1/8" thick formed aluminum plates that will provide more clamping and holding strength to prevent element misalignment. -SPECIFICATIONS -

Superior clamping power is obtained with the use of a rugged ¼" thick aluminum plate for boom to mast mounting.

The use of large diameter High-Q Traps in the "SYSTEM 33" makes it a high performing tri-bander and at a very economical price.

A complete step-by-step illustrated instruction manual guides you to easy assembly and the lightweight antenna makes installation of the "SYSTEM 33" guick and simple.

Band MHz 14.21.28 Maximum power input. Legal limit Gain (dbd) Up to 8 dB VSWR at resonance 1.3:1 Impedance 50 ohms F/B ratio

Boom (O.D. x length). . . 2" x 14'4" · · · · · 27'4'' Longest element 15'9" Turning radius . Maximum mast diameter. 2" O.D.

Wind loading at 80 mph 114 lbs. Assembled weight (approx.) . 37 lbs. Shipping weight (approx.)... 42 lbs. Direct 52 ohm feed-no balun required maximum wind survival . . . 100 mph



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WV-1A 4 BAND **TRAP VERTICAL** (10 - 40 METERS)

No bandswitching necessary with this vertical. An excellent low cost DX antenna with an electrical quarter wavelength on each band and low angle radiation. Advanced design provides low SWR and

exceptionally flat response across the full width of each band.

Featured is the Wilson large diameter High-Q traps which will maintain resonant points with varying temperatures and humidity.

Easily assembled, the WV-1A is supplied with a hot dipped galvanized base mount bracket to attach to vent pipe or to a mast driven in the ground.

Note: Radials are required for peak operation. (See GR-1 below).

SPECIFICATIONS:

- Self supporting-no guys required.
- Input Impedance: 50 Ω • Powerhandling capability: Legal Limit
- Two High-Q Traps with
- large diamater coils
- Low Angle Radiation
- Omnidirectional performance
- Taper Swaged Aluminum Tubina
- Automatic Bandswitching
- Mast Bracket furnished
- SWR: 1.1:1 or less on all Bands



The GR-1 is the complete ground radial kit for the WV-1A. It consists of: 150' of 7/14 stranded copper wire and heavy duty egg insulators, in-structions. The GR-1 will increase the efficiency of the GR-1 by providing the correct counterpoise. Prices and specifications subject to change without notice

New, Improved Wilson Towers -



Hinged Base Plate - Concrete Pad, Heavy Duty Winch



Mounting the House Bracket



The Hinged Base Plate allows tower to be tilted over for access to antenna and rotor from the ground.





- Total Weight, 350 lbs.
- Recommended base accessory: RB-61A, FB-61A

The MT-61A is our largest and tallest freestanding tower. By using the RB-61A rotating base fixture the MT-61A is ideally suited for the SY33 or SY-36. If you plan to mount the tower to your house, caution should be taken to make certain the eave is properly reinforced to handle the tower. If not, one of the base accessory fixtures should be used.

FEATURES:

- Maximum Height 45' (will handle
- 10 sq. ft. at 38') @ 50 mph
- 800 lb. winch
- Totally freestanding with proper base Total Weight, 189 lbs.

The TT-45A is a freestanding tower, ideal for installations where guys cannot be used. If the tower is not being supported against the house, the proper base fixture accessory must be selected.

GENERAL FEATURES

All towers use high strength heavy galvanized steel tubing that conforms to ASTM specifications for years of maintenance-free service. The large diameters provide unexcelled strength. All welding is performed with state-of-the-art equipment. Top sections are 2" O.D. for proper antenna/rotor mounting. A 10' push-up mast is included in the top section of each tower. Hinge-over base plates are standard with each tower. The high loads of today's antennas make Wilson crank-ups a logical choice

TILT-OVER BASES FOR TOWERS

FIXED BASE

The FB Series was designed to provide an economical method of moving the tower away from the house. It will support the tower in a completely free-standing vertical position, while also having the capabilities of tilting the tower over to provide an easy access to the antenna. The rotor mounts at the top of the tower in the conventional manner, and will not rotate the complete tower

> FB-45A ... \$ 79.95 FB-61A ... 109.95



ROTATING BASE

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Tilting the tower over is a one-man task with the Wilson bases. (Shown above is the RB-61A.)



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Wilson's Beta match offers maximum power transfer.

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SPECIFICATIONS

Model	Band Mtrs	Gain dBd	F/B Ratio	Bandwidth P Resonance 2 1 VSWR Limits	VSWR @ Resonance	Impedance	Matching	Elements	Longest Element	Boom O.D.	Boom Length	Turning Radius	Surface Area (Sq.Ft.)	Windload @ 80 mph (Lbs.)	Maximum Mast	Assembled Weight (Lbs.)
M520A	20	11.5	25 dB	500 KHz	1.1:1	50 Ω	Beta	5	36'6''	2''	34′2½′′	25'1''	8.9	227	2''	68
M420A	20	10.0	25 dB	500 KHz	1.1:1	50 Ω	Beta	4	36'6''	2′′	26'0''	22'6''	7.6	189	2''	50
M515A	15	12.0	25 dB	400 KHz	1.1:1	50 Ω	Beta	5	25'3''	2''	26'0''	17'6''	4.2	107	2''	41
M415A	15	10.0	25 dB	400 KHz	1.1:1	50 Ω	Beta	4	24'2½''	2''	17'0''	14'11''	2.1	54	2''	25
M510A	10	12.0	25 dB	1.5 MHz	1.1:1	50 Ω	Beta	5	18'6''	2''	26'0''	16'0''	2.8	72	2''	36
M410A	10	10.0	25 dB	1.5 MHz	1.1:1	50 Ω	Beta	4	18'3''	2''	12'11''	11'3''	1.4	36	2''	20

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	SY36	6 Ele. Tribander for 10, 15, 20 Mtrs.	UPS	189.95		RB-45A	Rotating Base for TT-45A w/tilt over feature	TRUCK	119.95
	WV-1A	Trap Vertical for 10, 15, 20, 40 Mtrs.	UPS	44.95		FB-45A	Fixed Base for TT-45A w/tilt over feature	TRUCK	79.95
	GR-1	Ground Radials for WV-1A	UPS	9.95		MT-61A	Freestanding 61' Tubular Tower	TRUCK	399.95
	M-520A	5 Elements on 20 Mtrs.	TRUCK	199.95		RB-61A	Rotating Base for MT-61A w/tilt over feature	TRUCK	1 79.95
	M-420A	4 Elements on 20 Mtrs.	UPS	139.95		FB-61A	Fixed Base for MT-61A w/tilt over feature	TRUCK	109.95
	M-515A	5 Elements on 15 Mtrs.	UPS	119.95		STB-50	Thrust Bearing	UPS	18.95
	M-415A	4 Elements on 15 Mtrs.	UPS	79.95			Nevada Residents Add Sales Tax		
	M-510A	5 Elements on 10 Mtrs.	UPS	84.95	CL				
	M-410A	4 Elements on 10 Mtrs.	UPS	64.95	or	iip C.O.D	. Check enclosed Charge to Visa		
	WM-62A	Mobile Antenna: 5/8 λ on 2, ¼ λ on 6	UPS	19.95	Card	#	Expires		
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No More TRS-80 Cassette Woes

- E-Z Loader does the trick

Paul L. Goelz WA9PUL 2228 Madison Place Evanston IL 60202

David F. Miller K9POX 7462 Lawler Ave. Niles IL 60648

You can eliminate most of your Level II TRS-80 cassette-loading problems once and for all! It's true, the circuit described in this article will go a long way toward eliminating your CLOAD problems. If all of the data is there on the cassette, this gadget will find it and load it into your TRS-80 Level II machine...it's the greatest thing since the Level I manual!

If you've worked with Level II for any time at all, you know that it is somewhat sensitive to playback volume on a CLOAD command (what an understatement!). Playing back a good recording through this circuit—let's call it the E-Z Loader—will allow you to set the playback volume on the Radio Shack CTR-41 recorder anywhere from 2 to 10! A not-so-good recording will have some-



what less range, but it will still be quite broad, and you will be able to load it. Even the head azimuth (vertical alignment of the record vs the playback head if not the same machine) becomes fairly noncritical, and you can even vary the playback volume up and down while loading with no adverse effect.

Sound too good to be true? It seems that in this day and age we're besieged with all manner of claims and counterclaims, but E-Z Loader really works try it and see for yourself!

The Problem

When you type CSAVE and ENTER, the TRS-80 puts out a positive- and negative-going square wave at the cassette port. However, when the audio recorder "processes" this square wave and lays it down on tape, it isn't exactly square any longer. Take a peek at Fig. 1 and see what we mean!

The output of the cassette recorder as depicted in Fig. 1(b) is more like a mostly negative-going spike, broadened out, with a small (in ratio) positive dimple on either side. This is what a good recording looks like; a bad one is downhill from that! Somehow, the TRS-80 will ac-

Fig. 1(a). Output directly from the cassette port of the computer. Sync pulses are solid lines; data pulses are dotted lines.

cept that waveform and load the data it contains into RAM, if the recorder/ playback head azimuth is quite close and the playback level is just right!

This is where the circuit of Fig. 2 comes into action. The root of the problem lies in the TRS-80's resident software. After the computer recognizes a sync pulse, it waits a short time and then looks at the input once again. If there is a pulse present, the computer interprets it as a 1 and goes through the cycle all over again. If there is no pulse present, the computer assumes this to be a 0 and repeats the cycle.

This sequence occurs until all of the data has been loaded from the tape, at which time the READY prompt reappears. The problem in all of this, however, is in the amount of time that the TRS-80 waits after recognizing a pulse, before it looks for the next pulse, and not in the input level, as many believe!

Currently, a Level II TRS-80 waits only about 250 microseconds before testing for a pulse, and therein lies the problem. A good tape will produce a pulse that is much narrower than 250 microseconds—see Fig. 1(b)—but a bad tape, or one in which the head azimuth of the record machine differs from the playback machine, can easily produce pulse widths in excess of that magical 250 microsecond figure! When that happens, the computer interprets the tail end of the initial pulse as a new pulse, and there goes your CLOAD!

The E-Z Loader corrects this by waiting for a sync pulse, triggering and producing an output pulse 150 microseconds wide and then locking-out for 750 microseconds (2/3 of the time between a sync and data pulse), triggering again if a data pulse (logic 1) is present, and outputting it as a 150-microsecond-wide pulse. Thus, no matter how wide your input pulses are, they can produce only 150-microsecond-wide output pulses.

In a nutshell, the E-Z Loader circuitry takes the rather poorly defined spike of Fig. 1(b) and regenerates it back into a nice square, narrow pulse again. Your computer will really love that narrow pulse and will



Fig. 1(b). The output from a good cassette tape after being recorded by the CTR-41 recorder. Sync pulses, solid; data pulses, dotted.

continue to reward you for your effort.

How the Circuit Works

Following the schematic diagram (Fig. 2) from the cassette player output (which is the input to the E-Z Loader), you'll notice that we transformer-couple in order to make the bridge rectifier behave properly and to eliminate the ground loop condition that exists in the Radio Shack CTR-41 recorder (in case you haven't eliminated it already by other means).

The input signal to the transformer first passes through a high-pass filter (C5 and R10) and is stepped up by a factor of at least 10. It is then applied to the bridge rectifier whose output consists of only positive-going pulses. These positive pulses are sent to the base of transistor Q1, but with a slight twist.

Locate R7 and C4 on the schematic and notice that Q1's base current must pass through C4. As pulses are rectified by the bridge, C4 charges to a voltage equal to the output of the bridge (less 0.6 V) and at the same time supplies a current spike to Q1's base, triggering the transistor. By the next time a pulse arrives, C4 has discharged slightly through R7, and again supplies a triggering current spike to Q1's base.

The net effect of all of this is that Q1, C4, and R7 form a passive level detector and trigger the rest of the circuitry only on pulse peaks, regardless of the level arriving from the recorder. The amplified and peak-detected pulses are fed to the first inverting input of the 74LS123 IC, which is a dual low-power Schottky retriggerable monostable multivibrator chip (say that three times!).

The two multivibrators in this package are connected in such a way that the output is taken from the Q output of section one, which also feeds the non-inverting input of section two. The \overline{Q} output of section two is fed back to the non-inverting input of section one, which has the effect of disabling the output of section one for a 750-microsecond duration.

The total effect of all of this can be observed on an oscilloscope at pin 13 (or pin 10) of the IC: a positivegoing square pulse, 150-microseconds wide. for every sync and data pulse leaving the tape, regardless of the width of the pulse on the tape. No hum, no noise, no miscellaneous crud to fool the TRS-80 into loading erroneous data . . . just nice, clean pulses. The buffer amplifier is an emitterfollower with a voltage gain somewhat less than unity, but it does a nice job of isolating and matching the 100-Ohm input impedance of the TRS-80 computer.

TRS-80 performance won't be affected by positive, negative or square waves (both transitions), so we chose positive pulses to keep the circuit parts count down. The pulses output to the computer are between 1 and 2 volts peak-to-peak (viewed on a scope with a 100-Ohm termination), regardless of where the CTR-41 recorder volume control is set, as long as there is at least enough volume to detect the pulses and trigger the E-Z Loader's circuitry. If the playback volume is too low, there simply will be no output (or possibly, sporadic output).

The point of minimum output for each cassette is easy to determine, however, and as long as you stay above that point, you'll get a good load. On a decent tape, this minimum can be 2 or 3 on the CTR-41's graduated volume control knob, and there



Fig. 2. TRS-80 E-Z Loader schematic diagram.

usually is no maximum level.

Precautions

One potential pitfall to properly loading with the E-Z Loader in-line (other than tape dropouts and/or bad data on the tape) would be insufficient level into the E-Z Loader, thus the optional LED driver shown in Fig. 3. The LED visually shows the operator that point at which the E-Z Loader is not receiving enough level from the recorder on playback. As long as the LED is lit and slightly flickering, the recorder output level control (volume) is set above this threshold. It also adds a nice touch in impressing visiting dignitaries.

It's an option because it has no effect on the rest of the circuitry and is for operator convenience only. To prevent occasional drops in level on the tape from causing a bad CLOAD, keep the recorder's output at least two divisions above the point at which the LED extinguishes.

Requirements

OK, we've talked you into building the E-Z Loader,

now you probably think that there will be some sort of catch such as specially selected parts, critical circuit layout, and/or fancy test equipment needed for alignment. No! All of the parts are available from Radio Shack with the possible exception of the input transformer, which is actually an output transformer with a turns ratio of approximately 10:1. You can probably scrounge one from that defunct \$9.95 portable transistor radio vou've been putting off fixing. That's called recycling and it's the "in" thing to do.

The transformer is hooked up backwards so that the low impedance (speaker) winding is accepting the audio out of the cassette recorder. Resistors are all 1/4 or 1/2



Fig. 3. Optional LED driver circuit.



Fig. 4. Optional regulated 5-volt dc supply.

Watt units, and the diodes are silicon with at least a 200 piv rating. You can use a packaged bridge rectifier unit, or you may choose to wire up four individual rectifiers as shown on the schematic (Fig. 2). All capacitors are 35-to-50-V dc rating.

C2 and C3 are timing capacitors and should be polyester or tantalum for stability and accuracy of value. The 2N2222A transistors are medium-gain devices and also are not critical. Whether you use perfboard layout (as shown in the photo) or a printed circuit board, it would be advisable to consider using a socket for the 74LS123 IC (I just hate unsoldering 16 pins all at once).

As you may have noticed, the E-Z Loader requires +5 V dc (at about 25 mA), and it should be quite close to that figure



for the TTL IC to function correctly. You could steal +6 V dc from the CTR-41 through an appropriate dropping resistor, but a better choice would be to incorporate the supply shown in Fig. 4, along with the E-Z Loader board, in one neat self-contained package. The parts for the optional power supply and the optional LED driver are also available from Radio Shack. Now you don't have any excuse for putting off building the gadget!

Putting E-Z Loader to Use

There is no alignment or parts selection required. Voltage readings and oscilloscope waveforms at various points are shown to assist in verifying that the unit is functioning properly. Simply hook up the E-Z Loader between your CTR-41 recorder's "ear" output and the TRS-80's audio input and you're all set. Incorporating a 1/8inch phone jack on its output and a 1/8-inch phone plug on its input will permit you to remove the E-Z Loader at any time and normalize your setup. But we honestly don't think that you'll be inclined to do that very often, not once you've seen how easy it is to CLOAD with the E-Z Loader in-line (except, perhaps, to demonstrate the difference to skeptical friends).

One other use for the E-Z Loader would be to clean up poor quality tapes. Using a second recorder, play the bad tape through the

Fig. 5. Peak-to-peak oscilloscope measurement within the E-Z Loader's circuitry.



The perfboard layout used in one of the units that has been constructed.

E-Z Loader and plug the E-Z Loader's output into the second recorder's aux input. The recording on the second machine will then be first quality, and should load on anyone's unmodified computer with ease. level on the tape being played back and wow (frequency instability) in the record or playback machines are other potential sources of CLOADing errors. The E-Z Loader helps in all cases, but obviously there are limits beyond

Exceptionally high hum

Parts List

C1-220-uF electrolytic, R.S. #272-1029 C2-.01-uF printed circuit capacitor, R.S. #272-1065 C3-.1-uF tantalum capacitor, R.S. #272-1401 C4-.047-uF printed circuit capacitor, R.S. #272-1068 C5-3.3-uF tantalum capacitor, R.S. #272-1408 C6-2200-uF electrolytic, R.S. #272-1020 C7, C8-.1-uF ceramic disc, R.S. #272-135 D1 to D9-200-volt silicon rectifiers, R.S. #276-1102 F1-1/2-Amp, 1/4 × 1-1/4 inch fuse, R.S. #270-1271 mounted in R.S. #270-364 holder IC1-74LS123 integrated circuit, R.S. #276-1926 IC2-7805 integrated circuit, R.S. #276-1770 J1-1/8-inch phone jack, R.S. #274-251 P1-1/8-inch phone plug, R.S. #274-286 Q1 to Q3-2N2222A transistor, R.S. #276-1617 R1, R2-33k, 1/2-W, 10 percent resistor, R.S. #271-040 R3, R5, R9-4.7k, 1/2-W, 10 percent resistor, R.S. #271-030 R4-22k, 1/2-W, 10 percent resistor, R.S. #271-038 R6-150k, 1/2-W, 10 percent resistor, R.S. #271-047 R7-100k, 1/2-W, 10 percent resistor, R.S. #271-045 R8—100-Ohm, 1/2-W, 10 percent resistor, R.S. #271-012 R10—33-Ohm, 1/2-W, 10% resistor, R.S. #271-007 R11-22-Ohm, 1/2-W, 10% resistor, R.S. #271-005 R12-1k, 1/2-W, 10% resistor, R.S. #271-023 T1-audio output transformer, 10:1 ratio or greater, such as Calectro #D1-729 (200-Ohm c-t to 8 Ohm) T2-120 V ac to 12 V ac @ 300-mA transformer, R.S. #273-1385 **Miscellaneous** Socket for IC1-16-pin DIP, R.S. #276-1998

Socket for IC1—16-pin DIP, R.S. #276-1998 LED—light emitting diode, R.S. #276-1622 Solder, hook-up wire, shielded cable, perfboard and cabinet

Note: C2 and C3 are timing capacitors and as such must be of good quality such as those listed above. Do not use disc types for this purpose.

A circuit board for the E-Z Loader and power supply is available from the authors. Send \$6 and an SASE to Paul Goelz, 2228 Madison Pl., Evanston IL 60202.

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which very little can be done.

Keeping your recorder's head, pinch roller, capstan and tape guides clean will go a long way toward helping the E-Z Loader do its job. Using fairly decent cassettes without wrinkles on the tape, fixing sticking reels and poorly placed pressure pads, and watching out for nonuniform oxide coating are also your responsibilities toward

good loading. As stated in the beginning of the article, as long as the data is on the tape, the E-Z Loader will go a long way toward digging it out and loading it into your TRS-80, but you will have to give it a fair shake at least!

It has been our intent to make public a circuit that is genuinely needed within the TRS-80 community. We intend no infringement on the rights of others, and



Fig. 6. Internal logic for the 74LS123 chip.

reproduction of the circuit is granted on a not-for-profit basis only. I will answer

all inquiries if the writers would be kind enough to enclose an SASE.



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## The Incredible Shrinking Transceiver – build it on two tiny PC boards



Both boards fully assembled.

Ray Megirian K4DHC 606 SE 6 Avenue Deerfield Beach FL 33441

ver the years, a ham's junk box can sport a pretty wild assortment of goodies, and mine is no exception. Many of the items are treasured for their sentimental value, some because they are of the oftenneeded variety, and the remainder simply because they cost a bunch. In this last category, I had stored away several Collins mechanical filters which by now had been with me so long that I couldn't remember how I had acauired them in the first place. On several occasions I had tried to sell or swap them, but no takers had appeared, so I decided I might just as well put them to use.

#### A Miniature Transceiver

If you are familiar with my Minicom series of receivers, you know I have a passion for miniaturization

and it would seem logical that the filters be used in something small. The final choice was an SSB generator and receiver combination which would ultimately form the major portion of a transceiver. The entire project occupies 2 PC boards of identical size. Both boards are 3.7" x 3" and can be stacked if desired. The receiver portion is a simplified version of the Minicom MK V and covers 3.5 to 4.0 MHz. The transmitting exciter section output is also 3.5 to 4.0 MHz. By adding a suitable amplifier, the rig could be used as is on 75 meters. For use on other bands, additional mixers and a crystal oscillator would be used to heterodyne up to the desired frequencies.

#### **Circuit Description**

The Collins filters from my junk box are all housed

100

in the Y-style case which is cylindrical and for which the PC layout is designed. Of the 2 filters from the collection which were suitable for this application, one had a bandwidth of 2 kHz and the other 3.1 kHz. Both worked well in this circuit.

A complement of 6 integrated circuits and 8 transistors provide all the needed functions. One i-f stage, the vfo, and the bfo are common to both receive and transmit modes. The input to the mechanical filter and the output from the common i-f stage are transferred from receive to transmit by means of diode switches. The upper- and lower-sideband crystals in the bfo are also switched by diodes.

All the frills such as VOX, noise blanker, CW filter, S-meter, and other goodies were left out in the interest of miniaturization. When assembled sandwich fashion, the whole rig fits in the palm of your hand.

### Speech Amplifier and Balanced Mixer

A CA3020 integrated circuit performs as both speech amplifier and balanced mixer, thus contributing substantially to our miniaturization efforts. This device, though designed for class B audio amplifier service, has a bandwidth of 8 MHz and lends itself to rf applications such as this. The chip houses an emitter-follower input stage, a differential amplifier, 2 emitter-follower drivers, and 2 output transistors. The output transistors have uncommitted collectors and emitters, which makes the device suitable for use in our circuit.

The mike feeds into pin 10 which is the base of the input emitter-follower. Input impedance is over 50k Ohms. R2 is a preset trimmer used to adjust the audio gain for the mike being used and, once set, can be left alone. The 455-kHz carrier is introduced across the emitters of the output transistors and a 50-Ohm preset pot is used to balance the signal. In some cases, cancellation of the carrier from the output may not be complete and

capacitive balancing may be necessary. The PC board has provision for a small capacitor on either side of the balance pot to ground.

A modified transistor i-f transformer is used to couple the collectors of the output transistors to the mechanical filter. The winding data for this and other transformers will be covered later.



Fig. 1. Complete schematic for the transceiver. Circled letters and numbers refer to pads on the PC boards. \*See text. Si = silicon diode. Ge = germanium diode.



Fig. 2. Coil winding table. All bottom views.

#### **I-f Amplifier**

The SPDT diode switch at the input to the Collins filter connects it either to the transmitter mixer or to the receiver mixer output. Following the filter is a JFET amplifier that stays in the circuit for both transmitting and receiving. Then comes a second SPDT diode switch that routes the output to a second i-f stage for receiving or to a mixer for transmitting. The second i-f stage uses a dual gate FET with agc applied to gate 2.

### Bfo, Vfo, and Transmitting Mixer

The bfo is crystal controlled and operates continuously since it is common to both receive and transmit modes. An SPDT diode switch selects the desired crystal for either upper- or lower-sideband operation.

The vfo tunes from 3.045 to 3.545 MHz. It is also a common circuit and operates continuously. It is actually a part of the receiver section and is the same circuit that has been used in the Minicom. The common vfo and bfo ensure that both transmitter and receiver will be on the same frequency. Since very little energy is required by the mixers, no buffers are used after the vfo. Output is taken from a 1-turn link wound over the tank coil.

The 455-kHz signal and the output from the vfo are mixed in an SG3402T IC balanced mixer. A 3.5to-4.0-MHz output is produced and the vfo signal is nulled by means of the 50k preset trimmer, R3. The output transformer, T4, is fabricated from a standard transistor i-f transformer. A PC pad is provided for connecting a small variable capacitor of 20 to 30 pF across the coil for frontpanel peaking at any frequency. A tiny solid dielectric type from a transistor FM radio is ideal for this purpose.

#### Receiver

All the circuits used in the receiver section are the same as the Minicom MK V. For those not familiar with the DMOS transistors. such as the Motorola MFE521 used in the rf and i-f stages, they require a fixed bias of around 4 volts on gate 1. This is provided by the 2.2k and 4.7k resistors which form a divider across the 12-volt supply. Gate 2 is controlled by agc voltage but, unlike the regular MOSFETs, need not go negative to attenuate the signal. The DMOS transistor works with all positive bias which simplifies the agc. R4 is adjusted so that the no-signal level on the agc line is 6 volts. The transistors will be working at close to maximum gain at this value of bias and a strong signal will drive this voltage down to 3.5 to 4 volts. A manual rf gain control is provided and would normally be mounted on the front panel.

The mixer is an SG3402T IC which provides substantial gain and, as mentioned before, places a very light load on the vfo. Output from the mixer is routed to the filter via the diode switch.

A third SG3402T is used as a product detector and feeds the LM380N-8 audio IC directly. Some of the audio output from the detector is fed to a 741 op amp where it is amplified and rectified to provide a positive dc voltage which charges the 20-uF tantalum capacitor across its output. Part of this charge is bled off by means of the two 1-meg resistors and applied to the gate of the 2N5246 agc control transistor. As the dc level increases due to strong signals, the transistor conducts more heavily and causes the voltage at the drain to drop. Since the drain is connected directly to the age line, receiver gain is decreased and the purpose accomplished.

#### Filling in the Details

There are some numbered pads on the boards and some with letter designations. These notations also appear on the schematic and should aid in keeping the external wiring straight. The pads marked capital A, B, C, D, and E on both boards have to be connected together in pairs, that is, A to A, B to B, etc. Mating pads are directly above one another with the boards properly oriented and component side up. This allows stacking if desired. Pad A is vfo

output. B is output from the common i-f, and C is bfo output. Pad D is input to the filter, while E connects 12 volts to the vfo from the other board's constant 12-volt supply connected to pads marked 12C.

Pads to accommodate a balancing capacitor if it should be needed as mentioned earlier are marked with small letters. One pair is a and b, the other c and d.

Pads marked 12R are for 12 volts applied during receive mode, and 12T designates a connection for 12 volts applied during transmit. Only one pad is needed; others are spares. There is a separate pad (12C) for the bfo, however, and it should be connected to a constant source of 12 volts along with one of the other 12C pads.

The pad marked TR is used to control the diode switches in the i-f strip. A 12-volt level is used for transmit and a ground level for receive. A TR relay would normally control this line as well as the 12R and 12T connections. The bfo crystals are similarly controlled by application of either 12 volts or ground to pad 10.

Of the other numbered pads, none needs individual explanation since the schematic clearly indicates their locations and the function becomes obvious.

#### **Coils and Transformers**

All the transformers are fabricated from regular 10-mm 455-kHz transistor i-f transformers. T1, T2, and T4 require the bare parts only, which means removing the tuning capacitor and all wire from the bobbin. Carefully salvage all the wire as it will be used to wind the new transformers.

The large winding goes on first and the link is then wound over the top. T1, T2, and T4 should be wound as per the table, making sure the pinout is correct. Views are looking at the pin end or bottom of the assembly.

For T3, carefully break off the secondary leads where they enter the bobbin. This is the side with 2 pins. Unsolder the remaining wire from the pins and clean off excess solder. Since the new winding is center-tapped, you'll have to steal a pin from a spare assembly and push it into the existing hole in the base. The new link is bifilar wound over the top of the existing winding and connected as per the table. Identify the winding in some way so you won't have trouble orienting the transformer when mounting it on the board. The new winding goes to the CA3020 output.

The vfo tank coil, L1, is pie-wound on a slug-tuned PC coil form. I used a Gowanda series 7 Velvetork form which is .209" in diameter by .625" long. A carbonyl E (red) core was used for the slug. Impregnate the winding with hot coil wax and put a single turn link over the top of the pie for L2.

#### Construction

I doubt that there will be any mad rush to duplicate this rig exactly as it stands, but parts of it may be of interest to some readers. I even debated the need to supply PC layouts, but decided they might prove helpful in some way. Just in case you do wish to copy the layout as much as possible, the following information may be useful.

All resistors, diodes, and rf chokes were mounted hairpin fashion to conserve space. Miniature low-voltage ceramic capacitors were used for coupling and bypass applications. Polarized capacitors are dipped tantalum and resistors are ¼ Watt.

Before mounting the SG3402T used as the receiver mixer, cut off pin 6. Likewise cut off pin 4 of the product detector. The same goes for pin 11 on the CA3020.

The 2 trimmer capacitors in series with the bfo crystals are subminiature (5-mm) units in case you were wondering how they squeezed into the space allotted to them. Incidentally, the exact operating frequency for the crystals will depend on the particular filter used, but this circuit will pull quite a bit and allow appreciable leeway in crystal accuracy.

Note that there are 2 silver mica capacitors across the ends of the mechanical filter whose purpose it is to tune the two transducer coils. Values will depend on the type of filter used. For the F455 Q2 that I used, I had to install a 91-pF capacitor at one end and a 110-pF capacitor at the other end.

The 3-gang tuning capacitor is the same one used in the Minicom receivers and has a range of approximately 3 to 20 pF per section. An additional padding capacitor is required across each of the first 2 gangs. Use 20- to 22-pF silver micas and solder directly to the frame before installation. When mounting this item, use #4-40 screws ¼" long. Put a toothed washer under the head to allow good contact with the copper. Place 2 flat washers over each screw on the component side before mounting the capacitor. This will leave enough space to clear the rivets that hold the compression trimmers for the first 2 gangs.

l used MPN3401 (Motorola) diodes to do the switching since they were in my junk box and are made especially for this use. Regular silicon diodes should work okay, so don't panic. No other remarks come to mind regarding components, so I'll get on with the checkout.

#### **Tune-Up and Checkout**

A DPDT toggle switch can be used for TR switching by using one section to apply 0 or 12 volts to the



Fig. 3. PC board for transmitter.



Fig. 4. Component layout for transmitter board.

TR line and the other half to transfer 12 volts between the receive and transmit circuits. An SPDT toggle can be used to switch the bfo crystals. A 10k audio gain control with log taper and a 10k rf gain control with linear taper are the only other items needed at this time. With the boards lying on the bench, make the jumpers between boards long enough so that each board can be handled freely while making adjustments. The copper border around each PC is ground and should be made common with all other grounds and power-supply return.

Connect an 8-Ohm speaker and 12-volt power supply to the rig. Set all trimmers to midpoint. Run



Fig. 5. PC board for receiver.

the screws on the 2 compression trimmers on the 3-gang capacitor up snug but not tight. Turn the variable to full mesh. Connect a dc scope or highimpedance voltmeter between the top of the rf gain control pot and ground. Switch to receive and apply power. Current drain should be between 55 and 65 mils. Turn the rf gain control all the way down and adjust R4 for a reading of 6 volts. Disconnect the meter and turn the rf gain to maximum. Turn up the audio gain and feed in some signal at 3.5 MHz. Adjust the slug in the vfo tank coil until the signal is picked up. Adjust the cores in T1 and T2 for maximum output. Run the variable capacitor up to the high end and feed in signal at 4.0 MHz. Peak the response by means of the 2 compression trimmers on gangs 1 and 2. Repeat these 2 procedures as many times as needed to achieve good tracking. T5 can be peaked on the noise present. If the band is active, you can connect an antenna and listen on the air to verify proper operation of the receiver. Also make



Fig. 6. Component layout for receiver board.

sure both bfo crystals are working. This concludes receiver checkout.

An audio generator should be connected to the mike input during tune-up of the transmitter. Turn R2 to minimum and switch to transmit mode. Current drain should be 40 to 50 mils. Connect a scope to the output side of T3. A piece of discarded pigtail can be temporarily soldered to the pad if necessary to make the scope connections. With no audio input, adjust R1 to null out the carrier. If there is still some trace of rf, tack a mica trimmer across pads a and b and then c and d to see where improvement can be made. Measure the value of the trimmer at the best setting and substitute a silver mica fixed capacitor.

Once the carrier has been nulled, turn up R2 and feed in some audio signal at around 1500 Hz. Adjust the level to a point just below where distortion occurs as observed on the scope. Transfer the scope to the output side of T5. Determine the values for the capacitors that tune the filter and install them at this time. Turn the tuning capacitor up to the high end of the band just below 4.0 MHz and transfer the scope to the transmitter output at T4. Shut off the signal generator and null the vfo signal by adjusting R3. Turn on the generator and adjust the core in T4 for maximum output. Later on, a tuning capacitor can be mounted on the front panel to allow peaking of the output as frequency is changed. That concludes tune-up of the transmitter.

I've listened to the signal from this little rig on some of my Minicoms and can report that it sounds excellent.

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DROLOGUE: About twenty years ago-no, more-it was the year the Russians blew our minds and our national ego by putting up their Sputnik 1 I found an article in an encyclopedia in the library at my high school.<sup>1</sup> The essence of the piece was that just anybody could have his own private radio station and communicate with other anybodies who had their own private radio stations. It gave detailed instructions for building a one-tube receiver. It hinted at a simple transmitter and even let on that one should get a license before transmitting.

I sent off for a hundredpound grab-box of electronic goodies. I used only one thing: a filament transformer to heat the single filament of that single tube in my first home-brew receiver. I wound one of the coils a few turns too much (using a cardboard core from a roll of paper towels), and, behold! The local broadcast stations could be tuned in. A veritable miracle on a masonite frame.

Next, from another article, I built a simple transmitter. No, I didn't get the license, and I didn't even learn the code. But I didn't break the law, either, although I intended to. This little widow-maker, 1 later learned, was high-voltage keyed. When I fired it up, it knocked me across the room as soon as I touched the key. I took it apart and let my yen for a personal radio communications station cool for fifteen or twenty years.

After 1 got out of the Army,<sup>2</sup> the yen returned. My wife drilled me in the code without ever learning it herself. I bought the first commercially-manufactured amateur transmitter I had ever seen or heard of: an Eico Model 720, for \$25.

"What will they think of

next?" I asked myself. "Somebody is saving us new amateurs a lot of trouble by building our transmitters for us."

That little jewel didn't work and it didn't have a manual or a schematic, and I didn't have a license yet, but I went right out and bought a nice brass key and a pair of coax connectors. A few days later I laid out thirty-five dollars for an Army surplus BC-348-Q receiver at a local swap meet. (Not a hamfest. I hadn't even heard of such a thing.)

WA7UKB was my "Elmer," my encourager,



This is the finished QSK unit, showing antenna jacks, ugly holes, and wooden base.



The finished QSK unit from its good side, showing mute adjustment, mute-defeat switch (the push-button), and mute and sidetone binding posts.



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my teacher. I became WN7CMZ. I was legal. I could transmit. At last. And with such modern, up-todate, ready-made equipment as I could not have imagined to exist a short time before.

world! Look out, WN7CMZ is about to transmit! Plug in the crystal. Fill out the logbook headings. Warm up the tubes. Transfabulate the franistan. Borrow W7KWJ's swr meter. Prune the dipole to the last half inch. Pull up a chair. Throw the knife switch to "receive." Listen. Throw the knife switch back to "transmit." 4...3...2...1... TRANSMIT!!

YEEOOUUP YIP YAARRK YIP – WOOOP YEAAAP YIP WAAAZHP...

"Mercy sakes, good buddy! My nice new receiver has gone to the happy hunting ground." It hadn't. When I threw the antenna switch back to "receive," the WWII surplus receiver made those beautiful seadouble-you sounds again.

I asked a lot of questions and listened to a lot of answers and bought a book about amateur radio and studied it. I built an electronic transmit-receive switch right inside the transmitter and thought I was the only ham in the world smart enough to do this, seeing that my cookbooktype instruction sheet showed it on a separate chassis with a separate power supply.

I bought another receiver. It was bigger and prettier than the BC-348, but it had no markings at all, so I could never tell anyone just what I had. Anyway, with this handy combination I could transmit by pushing the key down and listen by letting it up again. The receiver overloaded very nicely and merely woofed and grunted when I transmitted, and I actually made a few contactssome of them out-of-state.

The next summer I found out about hamfests, and I went to the one at Flagstaff. I bought a Johnson Viking Ranger because it had a built-in vfo. This transmitter didn't work, either, but it had a manual and schematic. In fact, it had two manuals-both for the Ranger II. I took out the modulator and built in a T-R switch just like the other T-R switch. It didn't work quite like the other. In fact, it didn't work at all. I built two or three different kinds, following magazine articles and friendly advice. They didn't work either.

Back to the old knife switch. Back to turning the receiver gain way down to transmit and turning it back up again to receive. Back to lost QSOs.

Back to reading about ham instead of doing ham. I bought a big pile of 73s and other amateur magazines second-hand and spent a lot of time reading them.<sup>3</sup> There are a lot of articles in the back issues that are worth reading. Some of them tell how to change from transmit to receive without having to throw half a dozen switches. Some of them tell how to do it without using noisy, old-fashioned relays. I laid out about a day's wages for PNP transistors in blister packs and proceeded to gather the other components. The day before the transistors came in the mail, I finally found what I was looking for all along: How to do it with those noisy, old-fashioned relays.

Now, I had never lost the love of surprises ever since that hundred-pound grabbox twenty years before, and sometime along then I started buying two-ton grab-piles from Department of Defense Surplus Sales.<sup>4</sup> Therefore, I had a very respectable junk box. It's about four feet deep in



Fig. 1. Schematic diagram of break-in unit. The diode across the first relay delays its release; the capacitor across the second relay delays its action. Parts values are not critical. Contacts are shown with relays not energized.

not-so-neat rows all across my back yard. There are lots and lots of noisy, oldfashioned relays in MY junk box.

It seems the problem with relays is that the contacts cannot handle nearly as much current when they are opening and closing as when they are already closed. Sparks fly. Metal melts, or even vaporizes. The contacts get rough, pitted, oxidized, non-conductive. They may even weld themselves together. But if the current does not flow except while the contacts stay closed, those nasty things don't happen. (Unless, of course, you have a lot of current flowing.)

If you key the energizing coil of a DPDT relay and have one set of contacts key the transmitter and the other set change the antenna over from the receiver to the transmitter, pretty soon you fry the antenna change-over contacts because the finals are still putting out when the antenna connection opens at the end of each dit or dah. Sparks fly, etc.

You really need two re-

lays set to operate a very small fraction of a second apart. When you close the key, the first relay should change the antenna from receive to transmit and then the second relay should key the transmitter. When you open the key, the second relay should unkey the transmitter and then the first relay should change the antenna from transmit to receive. This way, there is no rf flowing in the relay contacts while they are opening and closing.

Here is the precious secret the Guru up on the high mountain peak in Northern India imparted to me, and now I disclose it to the world. (Actually, it has been disclosed to the world many times before, in amateur radio magazines, engineering texts, electronics magazines, the Toymakers Journal, handbooks, letters to the editor, over the air, and under the counter.)

You can delay the opening of a relay by putting a diode across the coil so that the inductive 'kick' when the current is shut off has a place to go; it goes

through the diode and back around the coil, and around and around it goes until it gets tired of going around and just lies down and guits due to the resistance of the circuit. This holds the relay closed a long time-maybe a thousandth of a second. When it finally, at long last, opens, a millisecond or so later, one hopes that there is no current left at the contacts to burn them up and weld them together. If your relay opens too slowly to suit your purpose, put in a few Ohms of resistance.

You can delay the closing of a relay by putting a capacitor across the energizing coil. When the current comes to close the relay, it has to charge the capacitor to a certain extent before it can close the relay. The delay is controlled by the capacity. This delay lets the other relay close and change the antenna over to "transmit" before the transmitter is even keyed. (See Fig. 1.)

This is not a secret, not a new breakthrough. But it was new to me. And very interesting. I went looking through my rows of surplus electronic scrap.

There was an aluminum chassis, about the right size, and it took me only half an evening to get the goverment parts off it so that I could put my parts on it. There were the relays, of course, and a filament transformer with enough winding to put in series to get enough volts. There was a solid-state rectifier bridge, a diode, and lotsa connectors. No two parts came off any one chassis in my junkyard; oops, pardon me. I mean junk box. Never bought a thing for this project

Well, yes, it looks kinda funny, and there are holes in the chassis with no parts in them and circuit labels for circuits that aren't there any more. The labels that count are just stickons, and there's that big capacitor that's merely taped onto the side of a relay. There's no panel, and wires stick out of every side except the bottom. But it works. And I did it my way. No one else ever had a QSK unit just like this one.

You're smart. You're careful. You can make a better, prettier one.

About those noisy, oldfashioned relays: They clack, clack, clack. Transistors don't. When my superstable antique transmitter vfo drifts so far that I cannot hear my own sending on my super-stable antique receiver, I can still hear my sending, after a limited fashion, in the clacking of the relays.

These good government relays have extra sets of contacts and they are useful, too. Hook up one set as a mute and sidetone control. (See Fig. 1.) This thing worked the first time around. (That should prove there is nothing critical about it.) The receiver was silent when the transmitter was keyed, and it came back to life instantly when the key was raised. I actually made a contact or two that way before I tore into it to make improvements.

In order to hear the signal on the receiver, it cannot be altogether muted. (That's because I never got around to building that sidetone oscillator.) The diagram shows a variable resistor across the receivermute contacts of the first relay.<sup>5</sup> It is there to adjust the loudness of the transmitter as heard in the receiver. Now I could hear myself send, but could not zero-beat the transmitter to the incoming signal without sending out a fullstrength signal. It is a "nono" to twiddle the vfo dial around with the finals turned on. It aggravates a lot of people to hear that

horrid WAH-YOOP sound when they are copying code, especially when they're copying the DX ham's callsign. The last thing I've done (so far) to this thingie is to add the "spot" switch and a second variable resistor across the receiver-mute contacts of the first relay.5 By closing that switch, I can hear the transmitter vfo and zerobeat the guy who's calling CQ before turning on the finals. By opening it, I can hear myself send without ripping my speaker cone and my eardrums. And the relays take care of changing the antenna from the transmitter to the receiver and back and turning the gain up and down as fast as I can key.

No. I haven't achieved Nirvana. Pardon me, I mean perfect break-in. But I have had many relaxed, satisfactory communications since I built this thing. Now that I write this, it occurs to me that it is too complicated, too ugly ... maybe a single relay would do—an open frame relay where I could get at the contacts and just bend them a little so that one contact makes before another. Let's see, a triplepole, double-throw relay ... and build it right into the transmitter ... quiet it with sponge rubber, maybe ... hmmm ...

I can see now that this is not the final chapter of "Quest." In fact, it is all prologue.

#### Footnotes

1. Book of Knowledge, 1957, Vol. 14, p. 5183.

2. The United States Army, Department of Defense, Washington, D.C.

3. Lockheed Amateur Radio Club, 2814 Empire Ave., Burbank CA 91504.

4. DoD Surplus Sales, Box 1370, Battle Creek MI 49016.

5. These values were found by experiment, and are good only for my particular combination of vintage equipment.



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# The Amazing Audio Elixir — this limiting amp is a cure-all

**B** ack in the days of the Old West, there were groups of traveling salesmen who sold snake oil and other cure-alls. The claims made by these people and their medicine shows were that if you bought this wonder elixir, it would cure anything that ailed you. Here is a modern-day electronic circuit which will "cure all that ails you." The circuit presented here is a general-purpose amplifier which can be used to solve many problems and increase the performance of many audio circuits. The unique feature of this amplifier is that it will take an input of 100 mV to 10 V while the output level stays the same. The output is ad-

justable from no output up to about 8 volts peak-topeak. You are, no doubt, asking what it is used for. Let me describe a few uses which will get your mind working and then you can take it from there.

In a repeater system, a tone decoder is used for control. The tone decoder works best with some precise input level, and the users are always tweaking the pad levels to make their pads work the system reliably: Drop an audio limiting amplifier between the receiver and the tone decoder and the problem is gone. Another use is in an autopatch system. Put one of these little units be-



Fig. 1. Audio-limiting amplifier diagram. (This diagram is supplied with printed circuit boards.)

tween the phone line and the transmitter and you will always be able to hear the person on the phone at the normal level.

For you computer buffs, take this unit and put it between the output of the tape recorder and the tone input to your interface unit and get constant levels even as the tapes age. My 2-meter SSB rig does not have agc in it. When I have the volume high enough to hear a DX station and a local comes on, the level change inverts my speaker cone and my chair (with me in it). I lifted the wire from the top of the volume control and placed one of these units between it and the volume control. Now all the stations come out at the same level, at whatever level the volume control is set, and there is no more ear damage for me.

I know of one person who set up a room microphone and used this unit to record anyone talking in the room without moving the microphone or having to ride the tape recorder's input control. With touchtone<sup>TM</sup>-type signals, place a group splitting filter in front of two of these units and independently level each tone group to remove any twist or imbalance in the tones. How about a speech processor? Use this unit in a fast-agc mode and drive the input to your SSB rig at full level all the time. Another use might be as a "linear clipper" in a modulator. Drive the unit below the point where the output limits, and if the signal through it gets too high, the limiter cuts back and won't allow excess audio to pass. The advantage of this unit over normal clipping methods is that this unit does not clip, and thus it does not add clipping distortion. Enough of these ideas. Let's go on to see how it works.

### How It Works

See Fig. 1. U1 is an op amp and is simply a gain block. The gain of U1 is set by the values of R4 and R6. As shown, the amplifier is set for a gain of about 200. The output is sampled by C3, CR1, CR2, and C4. This network produces a dc voltage directly related to the ac (audio) output of the amplifier. This dc level is fed to the gate of FET Q1, which is an inexpensive Motorola MPF111. This FET is not critical and any

equivalent FET will do. R1 and R2 form a voltage divider which is used to bias the FET source and the opamp inputs at a point exactly one-half way between the power supply voltage and ground. C1 ensures that the bias point is at ac ground. With no detected voltage from C4 to the gate of Q1, the gate of Q1 is at ground, which is negative to the source, and the FET is in a "pinchedoff," or nonconducting, condition.

The incoming signal comes in through R7 and is amplified by U1. The output is detected and the dc voltage is fed back, which lifts the gate of Q1 from ground and Q1 starts to conduct. As Q1 conducts more and more, it shunts the input signal away from the op amp input. R7 and R5 act as a voltage divider and, with the FET, R5 acts as a variable resistor. The combination acts as an electronically-operated pot, with the "wiper" connected to the input of the amplifier. Once the detected output reaches a certain level, it will cut back the input signal and not allow the output to go any higher.

The purpose of C2 is to block the bias voltage from going out the input. R8 is used only to terminate the input and should be a value that the driving circuit wants to see. It can be any value because it has no effect on the operation of the circuit. Since U1 is a closed-loop amplifier with a fixed gain, the output will drive anything as long as the output capabilities of the op amp are not exceeded. Even though there is some circuit loading, I have even driven small speakers with this unit and obtained output volume which was usable for testing purposes. The amplifier is protected so you do not

need to worry about damage.

This unit is designed for 12-volt operation, which is near its lower operating voltage limits. The voltage is not critical, and as long as the voltage limits of the capacitors are not exceeded, it will work over a wide range of voltage. The lower limit is 12 volts and the upper limit is greater than 30 volts. If different agc release times are desired, the value of R3 may be changed. The larger the value of R3, the longer, or slower, the recovery time of the amplifier. When used as an agc, it has a fast attack time and a fast decay with the values shown.

In conclusion, this article was meant to be mostly an idea article and describes a building block which I have found to be very useful. Circuit boards may be obtained from the author for \$3.50 each and are top-quality glass-filled, drilled boards with silkscreened parts layouts on the surface.

#### **Parts List**

| Designation    | Description                           | Qtv. |
|----------------|---------------------------------------|------|
| U1             | TL081 BIFET op amp                    | 1    |
| Q1             | MPF111 FET                            | 1    |
| CR1, CR2       | 1N914 signal diode                    | 2    |
| R4             | 470-Ohm, ¼-Watt, 5% resistor          | 1    |
| R1, R2, R8     | 10k, ¼-Watt, 5% resistor              | 3    |
| R5, R6, R7     | 100k, ¼-Watt, 5% resistor             | 3    |
| R3             | 560k, ¼-Watt, 5% resistor             | 1    |
| R9             | 10k pot, multi-turn variable resistor | 1    |
| C2             | .1-uF mylar <sup>™</sup> capacitor    | 1    |
| C1, C3, C4, C6 | 1-uF electrolytic capacitor           | 4    |
| C5             | 10-uF electrolytic capacitor          | 1    |
|                | PCB                                   | 1    |



and a second second

# 

D. N. Ellis WA2FPT R. D. 1, Box 108A Ulster Park NY 12487

A re your bored with rotary switches in your projects? Even if by some slim chance you are not, here are a few simple remedies for replacing those tiresome rotaries with a sequentially-stepping counter that lights one of a string of LEDs each time a pushbutton momentary switch is pushed.

The cost of such a system is about as much as you would pay for a new rotary switch, but the main attraction is that it makes that "electronic wombat finder" of yours a real eyecatcher that is fun to use.

The devices described here are primarily CMOS, because I am a devoted CMOS fanatic. With proper attention to the pertinent peculiarities, however, any other logic family will work well.

A two-position, two-deck rotary switch eliminator is shown in Fig. 1. The switch portion of the circuit is a set-reset flip-flop that gives clean, bounceless low-to-

high transitions to clock the counter. The counter is a 4013 D-type flip-flop wired as a toggle. It divides the incoming clock frequency by two and transfers data from the D input to the Q output on the positive edge of the clock pulse. Each push of the button puts a low to high signal at the clock input. With CMOS, these levels are essentially ground and the supply voltage. We will call these low and high levels "0" and "1" for clarity.

The characteristics of a D-type flip-flop wired as a



Fig. 1. Two-position rotary switch eliminator.

toggle, with the  $Q_1$  output fed back into the D input, is that for every 0 to 1 transition on the clock input, the Q output changes, and then remains at that value until the next positive going clock pulse comes along. This means that it has two stable conditions. If the Q output was at a 1 level, then a single push of the button would change it to a 0. The next push would send it back to a 1. The Q output does the same, but, of course, is of the opposite polarity.

As each of these outputs assumes a 1 level, it will turn on its LED driver, the 75492. The 75492, which has six drivers per package, is a power amplifier to supply the current requirements of the LED. The LEDs current is limited by a resistor whose value will be determined by the supply voltage and the desired current. A reasonable formula for such calculations is given in Fig. 1.

Speaking of power, CMOS works fine on 3-15 volts, but the 75492, a bipolar device with CMOS compatible inputs, is limited to 10 volts. Anyway, whichever one of the outputs, Q or  $\overline{Q}$ , is at a 1 level will cause the 75492 driver to go low, which will forward bias the LED, turning it on.

So much for the indicator, but what will it indicate? We need our switch to control something. This is accomplished by the remaining 74C00 2-input NAND gates labeled Control Gates. This section of the circuit is the second "deck" of our two-deck switch eliminator.

A 1 from either the Q or Q flip-flop at one input of the 74C00 will allow an inverted replica of a signal at the other input to pass through the device. A 0 at the control input will keep the output at a 1 level regardless of the condition at the other input. As the button is pushed again, the control is shifted to Control Gate 2 and Control Gate 1 is disabled, remaining at a 1 level.

Because of the binary nature of toggle flip-flops, any number of switch positions that is a power of two can be readily made by cascading these binary dividers until the desired number of stages is reached.<sup>1</sup>

A four-position rotary switch eliminator is shown in Fig. 2. With these two flip-flops come a possible four combinations of the Q outputs, QA and QB. They are 0,0; 1,0; 0,1; 1,1. The next sequences are only repetitions of the first. The sequence is as follows: Assume both  $Q_A$  and  $Q_B$  are at a 0 level. After the button is pushed once, QA goes to a 1, but Q<sub>B</sub> is still at a 0 level. So far the count sequence is 0,0; 1,0. The next push gives a 0 at QA, but now Q<sub>B</sub> goes to a 1. The sequence is now 0,0; 1,0; 0,1. The third push of the button flips  $Q_A$  to a 1, but because Q<sub>B</sub> changes only half as often, it remains a 1. The sequence is now complete: 0,0; 1,0; 0,1; 1,1. The next push would cause QA and  $Q_B$  to become 0,1.

Now we have to decode



Fig. 2. Four-position rotary switch eliminator.

each of these pairs of outputs to light four LEDs in sequence, one at a time. The 74C02 quad 2-input NOR gates do this trick neatly.

The NOR gate is a great "zero detector" because it will give a 1 output only when all of its inputs are at a 0 level. The NOR gate fed directly with QA and QB would output a 1 level only when the count of 0,0 was reached, turning on the 75492 LED driver, illuminating LED 1. The next state in the count sequence is 1,0. This will extinguish LED 1 because the 74C02 no longer has the conditions required to turn on LED 1.

For LED 2 to turn on, we can use  $Q_B$  directly because it is a 0 level. Instead of  $Q_A$ , though, we'll use  $\overline{Q}_A$ , which is a 0 when  $Q_A$  is a 1. Now 74C02 #2 has the proper zeros on the inputs to give a 1 output to turn on LED #2. The next state of the counter results in a  $Q_A$  of 0 and a  $Q_B$  equal to a 1 level. 74C02 #3 will be activated by using  $Q_A$  and  $\overline{Q}_B$ , the exact opposite from the requirements for 74C02 #2.

The final push gives a 1,1 condition, which needs both  $\overline{Q}_A$  and  $\overline{Q}_B$  to be used as 0 inputs to 74C02 #4 to turn on LED #4.

So much for a four-position switch, but how about an odd number like three? What we'll do is to start with a four-position switch and use the fourth state of 1,1 to reset the circuit back to 0,0. The counter will think it is still a four-position counter, and only we will know the difference. The three-position rotary switch eliminator is shown in Fig. 3. The significant difference between it and the four-position counter in Fig. 2 is that the 74C02 #4, which detects and decodes the 1,1 condition, is used to reset both halves of the 4013 to zero, giving a count sequence of 0,0; 1,0; 0,1, and back to 0,0.

The point of this decoding business is to ensure that each and every combination of counter outputs results in only one LED on at a time. Otherwise, we will have the equivalent of a rotary switch with shorted contacts.

If you are interested in readable, useful information on counters, try one or more of Don Lancaster's Cookbooks. The "reci-



Fig. 3. Three-position rotary switch eliminator.

pes" satisfy most digital stuffing.<sup>2</sup> appetites without over-

Simulating any number



Fig. 4. Six-position rotary switch eliminator using a 4017 decade counter.



Fig. 5. Pinouts of the ICs used (top view).

of switch positions is possible by remembering two basic guides. One is to be certain of the sequence of the outputs of the flip-flops as you push the button. This knowledge will allow you to properly decode the outputs to control the LED lighting and whatever else you have in mind. Equally important is to be sure that all the output combinations are accounted for. either for proper decoding. or for resetting the counters, as shown in the threeposition counter. Any combination you miss will at best give the effect of a dead switch position, or, as previously mentioned, a shorted switch.3

An easy way to avoid concerning yourself with much of the above trouble is to use a resettable counter like a 4017. Any number of switch postions from 1 to 10 can directly be implemented. The 4017 is a fivestage divide-by-ten Johnson counter with ten unique decoded outputs. Johnson must have been clairvoyant, because this sixteen-pin package is just what we need.

The example in Fig. 4 is a six-position rotary switch eliminator. This circuit will count from 0 to 5, then start over again with successive pushes of the button. The two 74C02 gates and the 74C00 gates eliminate any hazard of unwanted outputs, in this case, a 6, 7, 8, or 9 count. You'll recall that the NOR gate gives a 1 output if all inputs are 0. Well, any active 6, 7, 8, or 9 output will give a 0 at the output of the one of the NORs, and this 0 will drive the 74C00 NAND's output to a 1 level, which will just happen to reset the counter to 0. Now at any count from 0 to 5 the 6, 7, 8, and 9 outputs are all 0. Following these through the NOR and NAND logic gives a 0 on the reset line, which is just what we want, that is, no reset until a 6, 7, 8, or 9 appears. The 0

through 5 outputs control the lighting of their respective LEDs through the six gates of 75492 package. These lines can also be used to control other functions, as in Fig. 1. Easy enough. The 4017 also has a carry out, which allows cascading 4017s together for long count sequences. More components, a little imagination and a calloused index finger are the only requirements.

So far, only digital controls have been discussed. By using 4066 bi-directional analog transmission gates, low level analog (or digital) signals up to 40 MHz can be faithfully controlled with minute distortion. Just substitute 4066s for the 74C00 Control Gates as in Fig. 1. Pinouts for all the devices mentioned are shown for reference in Fig. 5.4,5

As an extra attraction, these circuits also have built-in service aids. The LED indicators can act as diagnostic pointers by "illuminating" your logic and/or wiring errors. With all this in mind, "switch" to these rotary eliminators for your current and future projects. If you have the capacity, I'm sure you'll get a charge from designing and building them. You, too, can be the envy of friends and rivals alike! If I have etched them into your memory, then they will certainly be difficult to resist.

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# **Confessions of a Teenage HFer**

- the world between channel 40 and 28 MHz

### "Breaker, lawbreaker!"

Hans Peter c/o 73 Magazine

n August of 1975, while I was a long-term patient in the hospital, I received an AM mobile transceiver. This was before the FCC changed the Part 95 regulations to allow idle chitchat one month later. I did not receive my FCC call letters until October, two months later, but of course I transmitted before then.

### **Roll Your Own**

On all crystal-synthesized 23-channel CB rigs, there was a blank spot between channels 22 and 23. It was normally an inoperable channel that, I thought at the time, was the position to use when using the PA function. After meeting a few other CBers and discussing equipment, I learned that on a few rigs, by setting the dial between the blank spot and channel 23, it was possible to "roll in" a non-CB channel, commonly called 22A. There was also another channel called 22B, but this channel could only be installed by adding at least one crystal to the rig. No one really knew what these channels were for, but supposedly they were business channels.

I could not roll this channel in on my particular rig, so I wired in 2 switches to connect where the rotary switch was not making contact. It worked, and I was verv excited to discover this modification. It seemed that most people thought that if you could not roll it in, then it was not possible to get this channel. At that time it was a quiet channel and at first only a few "elite CBers" had it.

I did read in an advertisement for an 11 meter vfo that 22A and B were for business traffic, but I never did hear any, and I could not find anything about this in FCC rules and regulations.

I also started modifying other CBers' radios to get this channel. It could be done by cutting a ground wire, or adding a jumper wire, or installing a toggle switch if the manufacturer had gone to great lengths to internally defeat this channel. I charged five dollars to do this modification, although I knew of someone else with a First Class license who charged twenty dollars.

When people would get on frequency, they generally would say "break A" or "break 22A." Now this frequency has become channel 24. If you hear someone on the air saying "break A," they probably are using a 23-channel transceiver.

I met another fellow on 22A who was also interested in the electronic aspect of CB, and we became good friends. We both learned as much as we could about radio modification. We also did radio work for other CBers.

### **Moving Up**

l eventually moved on to bigger and better things, namely getting into the HF aspect of 11 meters.

I studied my crystal synthesizer and eventually figured out that by changing two master crystals I would get 23 channels just above the class D channels. At first I had no idea where to get these crystals made. Finally, in a CB catalogue, I saw I could order crystal certificates and have the crystals made. I thought perhaps the company I sent the certificates to would not grind the crystals for me because they would result in out-ofband operations, but this did not happen.

After about 3 months of waiting, the crystals arrived. I thought that by just unplugging the original master crystals and plugging in the new ones, I would be all set. However, only the transmitter would work. The receiver was dead. I eventually found out I had to retune the synthesizer cans for each set of master crystals. But it did work and I got HF capabilities. Later, I tuned the receiver for a happy medium so both sets of crystals worked, but the receiver performance suffered and I got all kinds of receiver images.

CB shops eventually

started selling HF synthesizer crystals. These would give 4 or 5 new channels per crystal. They were hot items and sold out quickly. Very few CBers even knew how to wire in these crystals, and here I was of service. The crystals sold for five dollars. I would install a 2-pole toggle switch with one empty socket and an HF crystal for twenty dollars.

### Gadgets

CBers are almost helpless when it comes to doing even simple modifications or repairs. Even when a microphone cord needs to be resoldered or a CBer buys a preamplified mike, he has to pay someone to fix or install it. This lack of technical knowledge leaves CBers open to many rip-off artists. I have seen standing-wave meters advertised as 40-channel standing-wave meters, as if the ones manufactured during the days of the 23-channel sets were inferior

I have seen an item called a crystal vfo. What is it? It's a little box with a twelve-position rotary switch connected to twelve crystal sockets with a trimmer cap for each socket. Theoretically, one of these could give a crystal-synthesized transceiver 60 new channels. All this for only \$100, less the crystals.

Other items in demand are tweety birds and pingers. The pinger produces a short feedbacklike squeal of short duration when the microphone is keyed. The Browning Golden Eagle had this built in. Because of pressure from the FCC, the new 40-channel Brownings do not have this feature. It can easily be added because the pinger is still in the radio but is not connected when the set comes from the factory. Pingers are now sold as add-on units by

an independent firm for about \$18. These can be attached to any radio.

The tweety bird produces a chirping sound. They are often used to attract attention, but can cause severe bleed-over on adjacent channels. Prices for tweety birds are around \$15 to \$20. There are full page ads for both of these noisemakers in CB magazines, even though they are prohibited by Part 95 of the FCC rules and regulations.

Regular tunable 11 meter vfos are made which plug into one of the crystal sockets in the transceiver's synthesizer. There are two very popular models.

One, made by Siltronix, has a simple two-transistor LC circuit and is inclined to drift unless the unit is left on continuously. Few CBers know that these can be adapted to any transceiver by adding or subtracting some capacitance to or from the LC circuit. The other popular model is made by PAL. These are rather complex and use a crystal-controlled reference oscillator.

I have seen used units at hamfests going for \$175 to \$200, which is the same as the retail price. The funny part about eleven meter vfos is that in advertisements it specifically states that it is illegal to transmit with vfos, as if that will stop anyone. I charged \$20 to install a vfo. I arranged it so the vfo could be disconnected from the transceiver, for obvious reasons.

The clarifier on a single sideband set could be modified into a quasi-vfo by changing some components or readjusting trimmer resistors. This increased the sliding range from  $\pm 500$  Hz to about plus 2 kHz and minus about 13 or 14 kHz. Now the clarifier could slide into RC channels which are between class D channels. In the world of CB, if something is illegal, it is even more desirable to have, and the CB consumer will pay an arm and a leg to have it.

Having a transmitter "peaked up" is another service in demand. Rarely can more than 1 extra Watt be squeezed out of an average CB transceiver and still have just a touch of upward modulation. Overdesign is not common. But a CBer usually thinks, "It may help me get out an extra mile." I usually charged \$5 to peak the transmitter. but a licensed repairman could get \$20 to \$25. Of course, he had to do this under the counter. The big money in CB is in modification, not repair.

#### HF Lingo

How do HFers refer to illegal channels? They think of the frequency in megahertz and use the first three digits after the decimal point. So 27.415 would be just 415. This is the first channel above channel 40. From channel 26 through 40, the frequency can be determined by just adding a 5 to the end of these digits. Channel 40 is actually 27.405, channel 34 is 27.345. By extrapolation then, 27.505 would be channel 50. Many AM HFers use this method of nomenclature, and you will hear "Break channel 43" on 27.435.

Eleven meter single sideband is a rather new and very different development. Almost all CB sideband is on the lower side. Upper-side users are looked down upon and sometimes even harassed when on the air.

Sideband conversations are formalized. They are very similar to ham QSOs, which they are intended to mimic. No ten codes are used as on AM—only Q codes are used. There are no AM handles either; everyone uses first names. If you are an AMer new to sideband and have picked up the habit of saying 10-4, you will often be politely asked to try not to say it. "Roger" replaces 10-4 on sideband. There is very little of the stereotyped channel 19 lingo on sideband. But when skip starts, it is funny to hear sidebanders call out "CQ DX" over and over.

To replace handles, sideband operators have club call letters. The first CB sideband clubs formed used the number designating their state's place in the order of all states' admittance to the Union, followed by a W, which stands for World. For example, California would be a 31W state because it was the thirty-first state to be admitted to the Union. Newer clubs are using an N prefix, for National, so Georgia would be a 5N state. Other abbreviations include A for America and X for X-ray. It seems like the whole alphabet is being used.

An AM operator will generally get mad when someone else uses the same handle. Sidebanders will also get disturbed when someone else has the same club call letters. How can this happen? Well, 36A3536 could be the 36 Alpha or the 36 America club (Nevada) when written down on paper.

Many sidebanders get a number from every club in the area so they can use call letters to match the person on the other end of the QSO. The use of club letters makes a neater and more efficient operation on the crowded Citizens Band.

When the DX is in, it is easy to figure out what states other operators are in. Club call letters replace FCC call letters on the HF band. During local QSOs on class D frequencies, both FCC and club call letters are generally used. An AMer might say, "This is the Hill Billy, KABC 1234, going 10-7 for the night."

A sidebander might say, "This is 36-National-1234, KXYZ 9876, QRT and QSY to bed."

### **Using Ham Gear**

Most HF gear is modified CB gear with possibly a linear amplifier, but converted amateur gear is most popular among sidebanders. It may not be apparent, but amateur equipment has distinct advantages and actually makes sense. An amateur transceiver has a dynamite receiver. Its sensitivity and selectivity will beat any piece of CB equipment hands down.

Citizens Band is far more crowded than any ham band. In the evening, signals abound as people turn on their radios to have a conversation. Adjacent channel interference is unbelievable. Look around an average suburban area sometime, and see how many CB base station antennas are on the rooftops. Citizens Band has truly become radio communications for the people.

Before CB expanded to 40 channels, FCC type acceptance rules were very lax. Very inexpensive 23-channel transceivers were junk. Not only were they severe generators of TVI, but when a preamplified microphone was added, the transmitted signal was 15 or 20 kHz wide.

And think about this: The Cadillac of CB radios is the Browning Golden Eagle. This 40-channel set now retails for about \$1000. A Drake or Yaesu has a transmitter that can be tuned and has complete range over the 11 meter band after relatively simple modification. The price is also several hundred dollars less. The cost of a moderately priced CB transceiver, external vfo,

and linear amplifier is about the same as that of a piece of amateur gear.

Amateur transceivers put out a clean signal. There is very little spurious radiation and harmonic content. If everyone ran ham equipment on eleven meters, there would be virtually no TVI and far less adjacent channel interference.

There seems to be little interference to licensed users of the HF band, mainly because the business band is FM and usually 5 kHz off from most HF traffic. Business-band licenses are not being renewed because of expansion to 40 channels, and their signals are getting fewer all the time. There are a few business-band stations between the newly allocated CB channels, but few CBers realize what the buzz from the FM signal is. As far as government use of the HF band goes, it probably exists, but I have never heard any government transmissions.

Practically no one worries about being caught by the FCC. There may be a scare now and then that the FCC is in town, but I have yet to hear of someone I know being apprehended. With so many people into CB, it just cannot be controlled easily.

HFers are generally the CBers who go for ham tickets. After obtaining a ham ticket, they generally stop HFing or curtail their activity greatly. Getting a ham license fills their DX appetite and their HFing is done less and less after that. But most never leave CB for good because they still have too many friends there.

There are some CBers operating amateur gear who will not use a nonclass D frequency. Most of these people are sidebanders. When CB had only 23 channels, only one of those channels came to be

known as a sideband frequency. This was channel 16. As the popularity of CB began to rise, so did the crowding. Occasionally, AMers strayed onto this frequency. Because of the hassle, many people held their conversations about 60 kHz or more above 23. After 40-channel expansion took place, the top 60 kHz of the present class D frequencies, channels 35 through 40, became unofficial sideband-only frequencies, mainly because they were beforehand. Because these frequencies were legalized, some sideband operators, including those running ham gear, quit operating out of band because they felt they now had a place and did not want to lose the new frequencies to AMers.

As a rough estimate, about  $\frac{1}{3}$  to  $\frac{1}{2}$  of the total CB population has probably at one time operated on illegal frequencies. Most of these operators do so when DX is in. When conditions are quiet, there is little non-Class D activity. In fact, there is more illegal AM activity when conditions are quiet. The sidebanders seem to stay put.

### **Special Activities**

There are a few unusual activities that take place in sideband HFing. Slow scan television is around 27.985, just 15 kHz below 10 meters. I have personally never viewed an SSTV signal when the DX is running.

Round table conversations happen frequently. Three or more stations from different parts of North America link up and talk for an hour or more. Virtually all of these HFers use amateur gear and beam antennas.

Phone patches are popular. If an HFer QSOs with another whose location is near his relatives, he will dial up a phone patch without a second thought.

Perhaps one of the most unusual HF clubs is the Eleven M Club. To join, you must own and operate your own business and run all Collins equipment. The club's standby frequency is 27,765, and they only want their members to use this frequency. They generally appear only when DX is running. And the Eleven M is not what you think. The club was supposedly started by eleven millionaires. A rumor circulating about them is that most of these guys are hams who want something a little different to do.

There is also illegal activity below channel 1. For some unexplainable reason, it is all AM activity. When skip starts, this spectrum of frequencies gets filled with traffic. It extends about 300 kHz or more below channel 1. The frequency 26.800 is a popular one because it is exactly 455 kHz below channel 23. A receive crystal for channel 23 put in the transmit crystal socket is a common way to get this frequency.

### **CB's Popularity**

Because CB became so popular in a short period of time, the FCC had to legalize idle chitchat. I really do not think it affected CB's growth. Psychiatrists have come up with many reasons why CB has become so popular so quickly, but I do not agree with any of these.

I think there is a little bit of a ham in everyone. Most CBers do not know how their radio works, but why is that so bad? A lot of people, including some hams, do not understand how a Polaroid camera works or understand every part of a car, but this does not prevent them from using these items and getting good results.

What attracts people to CB is the fact that they can push a button on a microphone and talk to someone



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else across town or further away. All this can be done without interconnecting wires. This is what attracted me to radio and this is what initially attracts every ham to amateur radio.

CB has proven there is strength in numbers. As more license applications came in, the FCC relaxed the rules. They allowed higher antenna placement, permitted idle conversation, changed the rules so that only the sender needed to use his call letters, and expanded the number of channels. Most of these changes happened in a relatively short period of time. No one really worked together as a group to achieve these ends, although I will admit that the EIA lobbies wield quite a bit of force.

Yet 350,000 hams, who generally know radio well

and work in unison for the most part, cannot persuade the FCC to allow phone operations in a large segment of the 20 meter band now allocated to CW.

Many CBers would like even more expansion on 27 MHz, but the FCC will not expand any further because of intermodulated products resulting from 455 kHz i-fs. Now that 220 MHz is not available, CB will probably end up around 800 or 900 MHz if there is any further expansion. Antennas with huge amounts of gain would be possible, and so would moonbounce. It would be an ideal hobby band. Skip would be all but totally eliminated, and so would interference to other devices. Skip on 11 meters is the main reason HFing exists. HF activity just is not there unless skip is present.







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# 70-Watt Shoes for the IC-502 — put some punch in that 6m signal

George Hovorka WA1PDY John Hovorka, Jr. 674 Brush Hill Rd. Milton MA 02186

The IC-502 is an excellent 6 meter transceiver for the money, but sometimes a little more power is very useful, especially during skip openings. Here is a linear amplifier that you can build at little or no cost, which runs about seventy Watts input. The heart of this amplifier is a surplus tube-type lowband Motorola FM transmitter strip. I bought mine for \$1.00 at a local hamfest. Only the final amplifier of the transmitter strip is actually used, so the condition of the strip is unimportant. The advantage of my scheme is that the critical VHF wiring, neutralizing, and shielding, as well as the procurement of rf components is all taken care of for you. Essentially, this project consists of modifying the transmitter strip, building a power supply, and creating the relay switching for the amplifier.

This amplifier will also work well with low-power AM transceivers, such as the Heathkit Sixer and the Lafayette HA-650.

## Selecting a Transmitter Strip

This conversion is based on a Motorola TA104 series low-band transmitter strip. These can be easily recognized by their long, thin appearance, and a large multi-turn tank coil. This transmitter series covers the 25-to-54-MHz range in 5-MHz segments. To find the



Completed amplifier. The power transformer is in the foreground, and C1 can be seen attached below the transmitter strip.



Power amplifier coil. Note cut-down tank coil.

frequency range of a particular transmitter, first locate its identification numbers which are stamped in black ink, usually around the final amplifier compartment. These numbers should either be TU113 or TU113-C2. After the identification number, there is a one- or two-letter suffix. This denotes the frequency range of the transmitter. Before you go out shopping for your transmitter strip, make a copy of the suffix frequency code shown in Fig. 1's caption and keep it handy.

The unit covered by this article is an MM-type (35-40 MHz). This type often shows up at low prices because it requires a major conversion job to move it up to 6 meters or down to 10 meters. This poses no problem for its use in this project, since only the final amplifier is employed and only two coils need to be modified.

One final note: If your

transmitter strip is other than the HH (50-54) type, be sure to remove the T-section harmonic filter. This filter is located next to the antenna relay which is directly underneath the final amplifier compartment. It consists of two airwound coils and three capacitors mounted on a tie lug strip. Remove this filter and run a wire directly from the output coupling coil, L2, to the antenna relay.

### Construction

A heavy chassis should be used for the base. In my prototype, I used an old dc power supply as a starting point. The main power transformer is not critical. One from an old TV set will work fine. The bias transformer is a six-volt filament transformer connected in backwards. The highvoltage diodes are from Poly Paks and cost \$1.00 for five. Be sure to use diode-protection resistorcapacitor networks across each diode. Also, be sure to use bleeder resistors across the filter capacitors. The plate milliamp meter is noncritical, but be sure that it is well insulated above ground.

To convert the transmitter final amplifier, it is necessary to use a grid-dip meter. If you don't own one, check with your local repeater group. You will probably find a ham who will loan you one.

To modify the transmitter strip, first cut the tank coil down four turns. Check for resonance at 50 megahertz by rotating the plate tune control. The resonance dip should occur with the plate tune capacitor half meshed. Next, remove T3, and take off seven turns from the top winding. With T3's top slug halfway in, connect capacitor C1 in parallel with the top winding of T3. and check for resonance at 50 megahertz. I used a variable capacitor for C1 because T3's slug is hard to tune without a special tuning tool. Now replace T3, and complete the wiring. I mounted C1 on a piece of scrap plastic, but any suitable insulation will do.

Since there are no external relay contacts provided with the IC-502. I used a simple hand switch arrangement to key the amplifier. I connected a microswitch to a ten-foot cord which runs to the amplifier. When I am using the amplifier, I hold the push-to-talk mike in one hand, and the microswitch in the other. Alternatively, a foot switch could be used for this function. During standby periods, the bottom of the bias pot is lifted above ground by opening a pair of contacts on relay RLY1. This biases the grid of the 6146 into the cutoff region, which results in cooler operation of the final tube. Relay RLY1 is a twelve-volt DPDT type.



Fig. 1. C1 is an E.F. Johnson-type 148-4, 50-3.2-pF air-variable capacitor or equivalent. Note: All parts marked with an asterisk are from the Motorola transmitter strip which is a TA234 series. The relays are shown in the receive position. L = 25-30 MHz; ML = 30-35 MHz; MM = 35-40 MHz; HL = -40-45 MHz; HM = -45-50 MHz; HH = 50-54 MHz.

and RLY2 is the original antenna changeover relay in the transmitter strip. All of the rf wiring should be done with RG-58/U coaxial cable. Except for insulating the high-voltage filter capacitors, the rest of the wiring is noncritical.

Some sort of 6 meter TVI filter should be placed on the output side of the amplifier to ensure that it meets FCC harmonic suppression requirements.

### Tune-Up

Without any rf drive applied to the amplifier, adjust the grid bias control so that the plate idle current is about twenty milliamps. Next, connect an swr bridge between the amplifier and the exciter. Adjust the exciter to the frequency you most commonly use (such as 50.11 MHz), and place it in the tune position. In the case of the IC-502, place the transceiver in the CW position, and put the key down. Then with the amplifier off. adjust C1 for the lowest swr. With the amplifier peaked for 50.11 MHz, I am able to QSY up to 50.4 MHz without any substantial drop in power.

Over the past few months, the on-the-air reports which I have gotten while using the amplifier have been gratifying. Stations that I have contacted on a regular basis report about a 4 S-unit improvement when the amplifier is turned on. Often, over long tropospheric bending paths of 400 miles or more, the amplifier has made the difference between whether I was able to make a contact or not. If you construct one of these 6 meter amplifiers, I am sure vou will find it a valuable asset to your station.

## HF SPACE



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JUNE 62. Surplus Issue! DMQ-2 Beacon TX on 220; Increasing ARC-2 transceiver selectivity; PE-97A power supply conversion, BC-348 band-spread; Inductance tester; converting BC-230 TX; beginner's RX using BC-453; receiver motor funning; transistcr CW monitor; BC-442 antenna relay conversion; mobile loading coils; increasing Two-er selectivity; TV with the ART-26 TX; TRC-8RX on 220; ARC-5 HF RX & TX; ARC-3 TX on 2m.

AUG 63. Battery-op 6m station; dioce noise generator; video modulation; magic T-R switch; antenna gain; halo mods; CW break-in; VEE beam design; cpax losses; rf wattmater; TX tube guide; diode power supply; Lunchbox" squeich; swr sxplanation; vertical antenna info; info on Windom antenna.

OCT 63. WBFW transceiver ideas; HF propagation; cheap phone patch; emotetuned yegi; construction hints; entenna coupler; \$5 vertical; filament transformer construction; 2m nuvistor conventer; Lafayette HE-35 mcds; buyer's guideto RX & TX; product detector; novel converter; compact mike amplifier.

Available issues published from 1960-1963 are listed at the end of this catalogue.



FEB 64. 2m multichannel exciter; RX design idees; magic t/r switch; loudspeaker enclosuras; 40m 2 W TX; look at test equipment; radic grounds; 40m ZL special antenna; neutralization.

Available issues published from 1964 are listed at the end of this catalogue



Available Issues published from 1965 are listed at the end of this catalogue



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MAY 67. Duad Issuel 432 quad-quad-quad; expanded HF quad; two el quac; miniquad; 40m quad; quad experiments; halfquad; three-el quad; quad bibliography; FET vfo; tube troubleshooting; HF summy load; understanding "dB"; HF SSB/CW RX; geometric circuit design; GSB-201 transcelve; FET converter for 10-20m; hipass RX "liters.

JULY 67. VE ham radio; VE0 hams; DSB adaptor; home-brew tower; transistor design; '39 World's Fair; ground plane antenna; G4ZU beam; SSTV monitor; UHF FET preemps; IC "I-I" strip; vertical antenna; VF-fUHF dipper; tower hints; scope monitoring; operating desk; S-line crossband; hi-school ham club; Heath HR-10 mods.

OCT 67. HF solid state RX; rugged totator; designing slug-tuned coils, FET converter; SSTV Jix generator; VHF log-pe lodics; rotatable dipole; gamma-match cap; oldtime DXing; modern DXing.

Available issues published from 1367 are listed at the end of this catalogue



JUNE 68. Surplus Issue! transformer tricks; BC-1206 RX; APS-13 ATV TX, lowvoltage dc supply; surplus scopes; FM rig commercial xtal types; Wilcox F-3 RX; restoring old equipment; 75A-1 RX mods; TRA 19 on 432; frequency counter uses; transceiver power supply; uses for cheap tape recorders; surplus conversion biblio graphy; RT-209 walkie on 2m; ARC-1 guard RX; RTTY TX TU.

JULY 68. Wooden tower construction; tiltover towers; erecting a telephone pole; IC AF oscillator; "dB" explained; ham club tips (part 1).

SEPT 68. Mobile VHF; 432 FET preamps; converting TV tuners; xtal oscillation stability; parallel-tee design; moonbounce rhombic; 6m exciter (corrections Jan. 69); 6m transcelver (corrections Jan. 69); 2m DSB amp; ham club tips (part 3).

NOV 68. SSB xtal filters; solid-state troubleshooting; IC frequency counter (many errors & omissions); "CV" trasformers; space communications odyssey; pulsar info; thin-wire antennas; 40m transistor CW TX/RX; BC 348M double conversion; multifunction tester; copper wire specs; thermistor applications; hi-voltage transistor list; ham club tips (part 5).

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JAN 69. Suppressor compressor; HW 12 on 160; beam tuning; ac voltage control; 2m translstor TX; LC power reducer; spectrum analysis into; 6m translstor RX; operating console; RTTY autostart; calculating oscillation stability; low-power 40 CW TX; sequential relay switching; sightless operator's bridge; ham club tips (part 7).

FEB 69. SSTV camera mod for fast scan; tri-band linear; selective AF fliter; unijunction transistor info; Nikola Tesla biography; mobile installation hints; Extra class license study (part 1).

MAR 69. Surplus Issue: TCS TX mods; cheap compressor/amp; RXZ calculations; transistor keyer; better balanced modulator; transistor oscillators; using blowers; half-wave feedline info; surplus conversion bibliography; Extra class license study (part 2).

APR 69. 2-channel scope amp; RX preamp; Two-er PTT; variable dc load; swr bridge; 100 kHz marker gen.; some transistor specs; SB-610 monitorscope mods; portable 6m AM TX; 2m converter; Extra class license study (part 3).

MAY 69. 2m turnstile; 2m slot; RX attenuator; generator filter; short vee; quad tuning; using antennascope; measuring antenna gain; phone patch regs; swr indicator; 160m short verticals 15m antenna; HF propagation angles; FSK exciter; kW dummy load; hi-power linear; Extra class license study (part 4); all-band curtain array.

JUNE 69. Microwave power generation; 6m SSB TX; 432-er TX/RX; 6m converter; 2m 5/8 wave whip; UHF TV tuners ATV video modulator; UHF FET preamps; RTTY monitorscope; Extra class license study (part 5); building UHF cavities; mini-vee for 10-20m; VHF vfo.

JULY 69. AM modulator; SSTV signal generator; 6m kW linear; 432 kW amp; 432-34 TX/RX; 6m iC converter; radio-controlled models; RTTY IC TU; audio notch filter; VRC-19 conversion; tube substitution; 2m transistor exciter; Extra class license study (part 6); HF FET vfo.

AUG 69. FET regen for 3.5 MHz up; FM crystal switching; 5/8-wave vertical; introduction to ICs; RTTY tone generator; good/bad transistor checker; 2m AM TX; measure transistor Ft; 160m propagation; triac applications; simple i-f sweep generator; transistor keyer; SB-100 on 6m; xtal frequency measurement; Extra class license study (part 7); FM deviation meter; ORP AM 6m TX; circular quads; FM noise figure; transistor parameter tracer.

SEPT 69. Tunnel diode theory; magic tee; soldering techniques; wave-travel theory;

cable shielding; transistor theory; AM noise limiter; AFSK generator transistor amp debugging; measure meter resistance; diode-stack power supply; transistor testing; 2½ W 6m TX; HX-10 neutralizing; capacitor usage; radio propagation; AM mod percentage; Extra class license study (part 8); 3-4002 linear; ATV vidicon camera; 2 transistor testers; FET compressor; rf plate choke.

OCT 69. Super-gain 40m antenna; FET chirper, telephone into; scope calibrator; thyrector surge protector; slower tuning rates; identify calibrator harmonics. FM adapter for AM TX; CB sets on 6m, proportional control xtal oven; xtal filter installation; Q-multiplier; transceiver power supply; Extra class study (part 9).

NOV 69. NCX-3 on 6m; I-1 notch filters; dial calibration; HW-32A external vfn; 6m converter; feedline info; rf 2-bridge; FM mobile hints; umbrella antenna 432-34 TX (part 1); power supply tricks with diodes; translstor keyer; transistor blas design; xtal VHF signal generation; electronic variac; SB-33 mods; Extra class study (part 10); SB-34 linear improvements.

DEC 69. Transistor-diode checker; dummy load/attenuator; tuned filter chokes; bandswitching Swan 250 & TV-2; 88 mH selectivity; math exercises; RTL xtai calibrator; transistor PA design; HV mobile p.2; 1-10 GHZ freqmeter; CB rig on 6m; Extra class license study (part 11); 1970 buyer's guide.

JAN 70. Transceiver accessory unit; bench power supply; SSTV color method; base-luned center-loaded antenna; 6m bandpass filter; Extra class license study (part 12); rectifier diode usage; facsimile info.

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FEB 70. 18-inch 15m dipole; 6m converter; high-density PC board; camper-mobile hints; 2m frequency synthesizer; encoding/decoding for repeaters; DX-35 mods; panoramic VHF RX; variable-Z HF mobile mount; Extra class license study (part 13); linear IC info; QRP 40m TX; IC Q-multiplier

MAR 70. Gdo applications; charger for dry cells; FM frequency meter; PC board construction; ham FM standards, cheap rf wattmeter; multifreq FM oscillation; "i-i" system modules (part 1); Six-er mods; gdo dip lite; Motorola 41 V conversion; CW monitor; buying surplus logic; SSO-23A sonobuoy conversion; GRC-9 RX/TX conversion; Extra class study (part 14); intro to VHF FM.

APR 70. Noise blanker; 2m hot carrier diode converter; repeater controller; understanding COR repeater; 7/8 wave 2m antenna; Extra class study (part 15); inexpensive semiconductors; renovating surplus meters; linear amp blas regulator; hi-performance 1-4 amp & agc system; SSB blo for shortwave radio; vacuum-tube load box; general FM dope & repeater guide; meggering your antenna.

MAY 70. comments on "FM docket" #18603; future of CW; FM-AM RX aligner; 5/8-wave verticals; using 2m intelligently; auto burglar alarms; power supplies from surplus components; "I-f" system modules (part 2); VHF FET preamps; educated "Idiot" lights; postage-stamp 6m TX; Extra class study (part 16); Bishop IFNL; low-band police monitor; mobile CW TX; Wichita autopatch.

JUNE 70.DDRR antenna; vto circuit; remote swr indicator; Indoor HF vertical; two RX on one antenna; environment & coax loss; 2-el trap verticals; buying surplus; two 40m QRP TX; 21 dB 2m beam; Extra class study (part 17).

JULY 70. Improved Color Slow-Scan Television; How to Build a Keyer; 450-MHz Mighty Mite—one-transistor superregenerative receiver; Cheaple 6-Meter Half-Gallon—use 811-As and be heard; A High-Performance Power Supply—using an IC voltage regulator; Latham Island DXpedition, Db to Power, Protection for Grid-Dipper Coll's; Mobile CW Receiver; QSLing... Ham Radio's Own Con Game.

SEPT 70. Integrated Circuit CW ID Generator; The Indication Oscillator—another dipper circuit; 1-400 MHz; Tuning VHF Receivers—clever infinite attenuator and oscillator unit; Repeater Antenna Separation; Diode Stacks; Deluxe Receiver Gain Control—using one transistor and a zener; Reed Relays for Coaxial Switching; Beer-Can Two Meter Coaxial Antenna; Converting 24 V Relays to 115 V ac; Versatlle 2m MOSFET Converter—low noise, high gain, ultra stable.

NOV 70. Differential J-FET preamplifier; Remote Quad Tuning; Two-Watt Six Meter Transmitter—using the crystal-heterodyne vfo; Semiautomatic FM channel Scanning; Low-cost Automatic Keyer—an excellent "first project"; Ac Switching with Self-Powered ICS—clever zero voltage switch; Ploneer Radio on the Prairies —what It was like 45 years ago; SST-I Solid-State Transceiver for 40 Meters; A Low-Cost RF Wattmeter; Calibrate That Calibrator.

DEC 70. Solid-state VHF exciter; delta frequency control for SSB; 2m transistor FM TX: HW-100 offset tuning; "little gate" dipper; 3-500Z HF linear; General class study (part 5); "transi-lest" (no good errors!); transistor p.s. current limiter.

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JAN 71. Split phones for DXing; Heath Ten-er mods; CW duty cycle; repeater zero beater; HEP IC projects; 10-15-20m parabolic ideas; lightning protection; IC RX accessory; attic antennas; double-balanced mixers; permanent marker tool; ham license study questions.

FEB 71. metal locator; varactor theory; AFSK unit: SSTV patch box; ATV hints; RTTY tuning indicator; tone encoder/decoder; 220-MHz converter; SSTV magnetic deflection; IC code oscillator; 6m TX beeper; General class study (part 6); RTTY intro; perfboard terminal; low ohmmeter.

MAR 71.IC audio filter; IC 6m converter; trap vertical ideas; digital counter info; surplus equipment identification; HF linear; simple phone patch; "epeater audio mixer; digital RTTY accessories; coathanger ground plane; General class study (part 7).

MAY 71. 75m mobile whip; 2m preamp; translstor amp design; 10m DSB TX; portable FM transcelver directory; audio compressor-clipper; transistor \_M freqmeter; 450-MHz link TX; simple Af filter; 1-tube 2m transceiver; surplus 2m power amp; General class study (part 8).

JUNE 71, 2m beam experiments; 3-el 2m quad; multi-band dipole patterns; weather balloon vertical, pocket-pager squelch; Two-er v(o; tuning mobile whips; transistor power supply; capacity decade box; 40m gain antennas; General class study (part 9).

JULY 71. IC audio processor; audio signal generator; CW filter; 2m FM oscillator; 2m collinear vertical; FM supplier directory; Motorola G-strip conversion; translstor beta tester; General class study (part 10).

AUG 71. Ham facsimile (part 1); 500-Watt linear; dimensions for July collinear; 4-tube 80/40 station; vfo digital readout; Jupiter on 15m; General class study (part 11); pink ticket wave-meter.

SEPT 71. Transformerless power supplies; solid-state TV camera; IC substitution; two rf wattmeters; IC compressoragc; multichannel HT-200, ham facsimile (part 2); causes of man-made noise; vfo with tracking mixer; General class study (part 12); transistor heatsinking; IC pulse generator; phone patch isolation; hcd wattmeters.

OCT 71. Emergency repeater COR; transceiver power supply; predicting meteor showers; digital switching; reverse-current battery charger; passive repeaters; earth grounds; audio "talloring" filters; Swan 350 mods.

NOV 71. 3-el 75m beam, motor-tuned ground plane; 2m galn vertical; transistor blasing; split-site repeater; fox-hunting; audio filter; transistor/diode tester; xtai tester; 6m kW amp; 10-15-20m quad; transistor pi-net final; antenna feedline; communications dBs; 2300-MHz exciter.

DEC 71. Convert Your 7-MHz Cubical Quad to All Bands; The Indoor Quad; Getting to Know Tee Squared Ell; More Power From 6146s; Radio Direction/Range Find-er; Morse Memory—30-letter memory for Ident, contests, etc.; SCR Mobile Thet! Alarm; DX OSOs or contacts; Code Short-bard; UKE Double Cleaberd; hand: VHF Double Sideband

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FEB 72. A Solid State High Frequency Re-generative Receiver—e cheapo using one IC; Tips for Raising Your Code Speed to 20 WPW; Why Not Try QRP2 VHF Dum-my Load Wattmeter; CW DX On ½ Watt— enjoy QRP with this 1-Watting; 20-60 W 14 Band TX— two-tube CW transmitter; Quick and Easy PNP/NPN Transistor Sort-er; Self-Contained Reflected Power and CW Monitor: Circuits, Circuits; Circuits; CW Monitor; Circuits, Circuits, Circuits The Automatic Transmission Line Tuner.

MAY 72. Quick Band Change Mobile An-tenna—with output indicator: How to Get the Stuff into the House; Anti-CW RTTY Autostart: A Modern VHF Frequency Counter—can be built for under \$100, TV Sync Generator—using ICs; Radio As-tronomy; Noise and Receiving Antennas; The Sewerpipe Antenna—2m FM, of course; Circuits, Circuits; Simple Car Anmeter—all solid state. Car Ammeter-all solid state

JUNE 72. Six Elements on Twenty Meters JUNE 72. Six Elements on Twenty Meters —eliminate QRM; Slow Scan Television— basics; Active Filter Design and Use—all kinds of filters...Part I; Radio Astrono-my for Amateurs (Part II); 20 dB Beams— design and construction of VHF anten-nas; Phasing Multiband Verticals—len thru eighty meters; 300-MHz Frequency Scaler—extends frequency counters to VHF; Circuits Circuits, Circuits, RTTY Fil-ters—elliptic function litters: Trouble -elliptic function tilters: Troubleters shooting for the Novice

JULY 72. Solid-State VHF Amplifier; The JULY 72. Solid-State VHF Amplifier; The Phase-Locked Loop; VHF Converters; Add \$15 T-Power; 1296-MHz Mixer; The VHF Specialists FM Amplifier; Meteor Shower DXIng; Tone Decoder and Carrier Relay Circuits—using the 741 op amp; Flying Spot Scanner for SSTV—solid-state unit, simple, relatively; Active Filter Design, Part II. Part II

AUG 72. SSTV ntro; speech processor; FM repeater info; test probe construction; GE Progline ac supply; 432 rf testing; pre-amp compressor; Six-er mods; phone patch; Two-er info; solar Info; SCR regu-lator for HVPS; "ideal" xtal oscillator; FM RX adapter; auto theft alarm.

SEPT 72. Plumbicon TV camera: WWV8 60-kHz RX; cigar tube signal generator; CW active filter; rf testing at 1296-3500 GHz; balun antenna feed; transistor power supply: IC 6m RX; IC FM/AM detec-tor (part 2); active filter design (part 3); 20 AW featurement context (part 3); 20 Ka tor (part 2); active filter design (part 3); K2OAW frequency counter (part 3); 2m fre quency synthesizer (part 1)

OCT 72. Corrections for Aug. FM RX adapter; 2m frequency synthesizer (part 2); 6m transistor vfo; nano-ampere meter; time-frequency measurement (part 1); acthe filter design (part 4); repeater timer; Extra class Q&A (part 3); balloon vertical; ID generator; time-delay relay; 432 filter deas; dc-ac inverter; hc-diode converter; RTL decade and nixie driver; plus-minus supply for ICs

NOV 72, HF transistor power amps: RTT) NOV 72. HF transistor power amps; RTTY Selcal; IC trf RX transistor keyer; emer-gency power; 220.MHz preamp; double-delta antenna; simple converter using modules; NF rf tester; "lumped line" pscillator; 2m frequency synthesizer (part 3); K20AW counter errata; 2m preamp; Ex-tra class 0&A (part 4); hi-2 voltmeter; Nikola Testa story; VHF swr meter; tran-sistor regen RX; 422 SSB transverter; ac arc welder; intro to computers; hybrid AM arc welder; intro to computers; hybrid AM modulator; HR-10 RX mods; 10m transis-tor AM TX; 40m ground plane; IC logic de-monstrator; overload protection; I-firf sweep generator; digital frequency count-er; aural TX tuning.

DEC 72, SSTV scope analyzer: 2m EM RX: DEC 72. SSTV scope analyzer; 2m FM RX; ione burst encoder and decoder; universal -1 amp; autopatch hookup; LM380N info; voltage variable cap info; 2m 18-Watt amp; SSB modulation monitor; xtal freq/ activity meter; 10 A var. dc supply; trans-mission line uses; radio astronomy; in-ductance meter; 75 to 20m transverter; LED Info; 40m preamp; transistor vfo; 1972 index; 2m preamp.



JAN 73. HT-220 touchtone; 3-el 20m yagi; JAN 73. H1-220 touchtone; 3-et 20m yagn, 50-MHz frequency counter; speech pro-cessor; 2-tone generator; FM test set; tilt-over tower; 2m converter using modules; tunable AF filter; six-band linear; 10m i-f tuner; diode noise limiter; CW/SSB agc; HW-22A transceiver 40m mod; HAL ID-mod.

MAR 73. A Fast-Scan Facsimile System— use It with SSTV; Six and Two Meter High Power—using a \$25 surplus amplifier; A Digital Tape Distributor for RTTY; The Am-ple Amplifler—all band, 1200 Watts; Pop-ular SSTV Circuits (Part II); Improving the Indoor Antenna System—using copper foli; FM Deviation Meters, Time Fre-quency Measuring System (Part III); An-other Use for 400-Cycle Transformers, Bandpass Filter Design.

APR 73. FM deviation meter: 2m FET pre amp; two 2m power amps; repeater con-trol (part 1); repeater licensing; European 2m FM; FM scanner adapter; RCA CMU15 mods; lightning detector; CB alignmen; gadget; transistor rf power amps (part 2); repeater economics.

JUNE 73. 220-MHz signal generator; UHF power meter; repeater licensing info, RTTY autoswitch; 40m hybrid vfo TX; an-tenna polar mount; 10-15-20m quad, K2QAW counter mods; double coax an-tenna; ham summer job; tone decoder; field strength meter; nicad battery pack ohmmeter; FCC regs (part 1).

JULY 73. Tuneable Oscillators for 2m FM Receivers; Basic ATV System—a T-44 transmitter strip does most of the work Multiple Output Frequency Standard— lets you calibrate your receiver in .0625-Hz incraments; Digital Identification Unit 450-MHz Power Divider—easily-con structed matching system for stacked ar rays; CW Filters, Bared and Compared complete with scope traces and band-width specs; 85 dB Gain 2m Antenna Compromise Multiband Antennas; Grid-Dip Tuning the Quad Antenna.

AUG 73. Log-periodics (part 1); tone burst generator; rf power amp design; transistor radio intercom; 160m antenna; SSTV mon-itor; low-cost frequency counter; VOM de-sign; ORP 40m TX; 432-MHz exciter; FM audio processing; FCC regs (part 3).

SEPT 73. Repeater control system; log pe-riodics (part 2); 2m RX calibrator; PLL IC applications; TT pad hockup; Heath HW-7 "S" meter; OSCAR-6 Doppler; 2m coaxiai antenna; 2m converter; IC keyer; measure antenna Z; FCC regs (part 4)

NOV 73. 450-MHz exciter; intro to ATV cir-NUV 73. 430-MHZ exciter; intro to A1V cr-cuits; nicad voltage monitor; autopatch connections; IC meter amplifier; TR-22 ac supply; indoor vertical; IC AF filter; mo-mentary power fallure protection; 160m antenna coupler; Motorola HT info; SSTV-ISB, Class B AF amp; FCC regs (part 6).

FEB 74. SSTV monitor info! IC audio amps; scope sweep generator; 15/20m vertical; telephone line control system; amps, scope sweep generative, vertical; telephone line control system; PC board construction; var-Q AF filter; blown-fuse indicator; 40m CW station with Ten-Tec modules; simple preamp compressor; single-IC RX; "432-34" final assembly; transistor keying circult; 7-seg men: readout with nixle driver

APR 74. VOX for repeaters; tone-operated relay; HF transverter; 10 to 200 articles; to the power-er; remote control panel for scanner; RCA FM TX tuning; subaudible tone generator; FCC regs (part 9); repeater atlas.

MAY 74. CD car ignition; audio compressor info; Interference suppression for boats; auto burglar alarms; 2m IC preamp; 10m FET converter.

JUNE 74, Poor Man's Quad; Reconciling JUNE 74. Poor Man's Quad; Reconciling the Long Squared Quad-developing a new type antenna; Antenna Load Indica-tor; Matching; Remotely tunable Antenna Coupler; A Practical Ground System for 160; Wide-Range Antenna Tuner; Old An-tennas and New Baluns-build a double zepp; A Multiband Ground Plane-10-40 meters; Mod Quad for Frustrated Cliff Dwellers.

JULY 74. 4-1000A linear; universal fre-quency generator; universal AFSK gener-ator; 555 IC timer; 80m phased array; 135kHz-432-MHz preamps; 10m QRP AM T) 3000 V dc supply; how to read diagrams TX

AUG 74. Toroidal directional wattmeters; 450-HMz FET preamp; use gdo to find "C"; Trimline TT pad hookup; R390 & R392 RX mods; tracking CW filter; aural voltmeter; universal regulated supply, SSTV scan converter; TTL logic problems; ID timer.

SEPT 74, MOSKEY electronic keyer (part SEPT 74. MOSKEY electronic keyer (part 1); WX warning system; Heath IO-103 scope mods; ORP 6m AM TX; rf speech clipper; audio noise limiter; WX satellite on SSTV monitor; universal IC tester; min-iature rig construction; tower construc-tion; infinite rf attenuator; electronic photo flash ideas; IC "select-o-ject."

Microtransistor circuits; synthe sized HT-220 (part 1); repeater govern-ment; regulated 5 V dc supply; FM Selcal; removable mobile antennas; Motorola metering; 2m vertical collinear; Motorola model code; 2m coaxial dipole; 1.6-MHz I-f strip; MOSKEY electronic keyer (part 2); carbon mike circuit; hi-power lo-pass fil-ter: 6m preamp; 3-wire dipole; ATV sync generator; NCX-5 mods; mobile whip for apartment dwellers; SSTV automatic vertical trigger

NOV 74, K2OAW counter update: regulat NOV 74. K2OAW counter update, regulat-ed 5 V dc supply, wind direction indicator; synthesized HT-220 (part 2); 20m 3-el beam; autopatch pad hookups; double-stub antenna match, Novice class instruc-tion; digital swr meter (part 1); 6m con-verter (1.6-MHz i-f); "C-bridge". MOSKEY electronic keyer (part 3); Aug. SSTV scan converter errata; repeater off-frequency indicator. indicator

DEC 74. Care of nicads; wind speed/direction Indicator; WX satellite video converter; electronic køyer; hinis for Novices; un known meter scales; SSTV tape ideas TTL logic probe; public service band converter; tuded diode best escelutere, digitis verter; tuned-diode test receivers; digital swr meter (part 2); telephone pole beam support; rhombic antennas; 1974 Index.



FEB 75. Heath HO-10 scope mod for SSTV; electronic keyer; digital satellite orbital timer; OSCAR-7 operation; satellite orbital prediction; Heath SB-102 mods; com-paring FM & AM; repeater engineering; Robot 80-A SSTV camera mod; neutraliz-ing Heath SB-110A; "Bounceless" IC switch; tape keyer for CW TX

MAY 75. IC Callsign Generator; Playing with Power on 432; Does Ether Cause Gravity? OSCARing Your FM Rig; In Pur-suit of the Perfect SSTV Picture; AP Power for the HW-202; You Can Work 75m DX The Postage Stamp Squelcher; disaster in Honduras

JUNE 75. Home Brew this SSTV Monitor; El Cheapo Superbeam; The Smart Alarm; RF Power at 432; Dirt Cheap Tunable I-F for Converters; All Band Frequency Mark er; Front Burner for Six; Three on Fifteen Presto! Transistor Checker from VOM How to Put on a Professional Slide Show

JULY 75. OSCAR Special! Antennas for JULY 75. OSCAH Special! Antennas for OSCAR-What Reality Works?; How You Can Take OSCAR's Temperature; FM Alignment Oscillator; The Audio Synthe-sizer for RTTY, SSTV and Whatever; Ham Radio In the Arctic—1925; Gee, What's a Zepp?; Vertical Antennas for the Novice; Preventing Regulator Carnage; The Ulti-mate in Variable Selectivity; Phone Patch-Ing—A Public Service. -A Public Service.

AUG 75. 146/432-MHz helical antennas (part 2); 20 minute ID timer; digital swr computer (part 1); debugging rf feedback; DVM buyer's guide; WX satelite monitor; CMOS "accu-keyer"; PC board methods; sweep-tube final precautions; compact multiband dipoles; small digital clock; ac-cessory vfo for HF transceiver; modern non-Morse codes; multi-function genera-tor; 2m scanning synthesizer errata; KP-202 walky charger; 10m multi-element beam. beam

SEPT 75. Calculating frequency counter; WX satellite FAX system (part 1); IC mill-voltmeter; three-button TT decoder; troubleshooting SSTV pix, 40m DX anten-nas; 146/432-MHz helical antennas (conclusion); digital swr computer (conclu-sion); reed relay for CW bk-in, NE555 pre-set timer; power-failure alarm; portable ORP rig power unit; precision 10 V dc re-ference standard; 135-kHz i-f strip; tele-phone handsets with FM transceivers; Motorola T-44 TX mod for ATV, 0-60 MHz swathersize foort 11 bem coding. synthesizer (part 1), ham radio PR

OCT 75. A deluxe TTY keyboard (part 1); op amps: a basic primer; an introduction to microprocessors; 2m synthesizer (conclu-sion); satellite FAX system (conclusion); regulated supplies (dispelling the mys-tery); digital logic made simple; FCC inter-view; a contest uP system; digital clock timebases; the porcelling det OPB 432 timebases; the operating desk; QRP 432; ham PR

NOV-DEC 75. Blockbuster double issue! Flip-flops exposed; breakthrough in fast scan ATV; strobing displays is cool; the tuned lunch box (antenna tuner for HF tuned lunch box (antenna tuner for HF transceivers); a deluwe TTY keyboard (part 2); the 127 rotating mast; less than \$100 multi-purpose scope for your shack (part 1); predicting third-order intermod; leed-line primer; QRMing the Third Reich, why tubes haven't died; instant circuits—build your own IC test rig; the K2OAW synthe-sizer PROM-oted; a ham's intro to micro-processing; ground fault interrupter (a keep-alive circuit for yoursell); a \$1 strip chart fecorder; an even simpler clock chart recorder; an even simpler clock oscillator; the Fun City surplus scene; up-dating the Heath IB-1101 counter; 256 pages!

76 FEB 76. Build a Starfleet Communicator Trekkies special; Synthesized IC Fre-quency Standard! You Can Make Photo PC Boards; How's Your Speech Quality?; ASCII-to-Baudot converter; RTTY Autocall -the Digital Way: improving the FT-t01; Night DXing on 10 and 15m: Really Soup Up Your 2m Receiver; Put Your SB-10 on

160m

MAY 76. Special Antenna Issue! The Magnificent Sevens Microhelix; An Aliband In-verted Vee; Closed Loop Antenna Tuning; The 75-80m Broadbander; The Magic of a The 75-80m Broadbander; The Magic of a Matchmaker; How to Coax Your Antenna; 40m DXing—City Style; The Secret 2m Mobile Antenna; An Inverted Vee for 160/80m; The Dipole Dangler; Amateur Weather Satellite Reception; Scan Your HR-212; A Very Cheap I/O—the Model 15; Code Converter Using PROMs: A Nifty Cassette-Computer Systems; The Ins and Outs of TLL; Build a CW Memory; 5/8-Wave Power for Your HT; 555 Timer Sweep Circuit for SSTV; AM Is Not Dead— It Never Existed at Alt; Computer Lan-guages—Simplified.

JUNE 76. VHF Special! Super COR-Digital, of course!; Touchtone Decoder-us-Ing a calculator readout; Simple Amateur TV Transmitter; Amateur TV Receiving System; Mobile Autodialer; Autocall '76-using a louchtone decoder; Build This Lab Type Bridge—and measure transformer impedances; How Those Triangle Things Work—a sort of op amp handbook; Those Exciting Memory Chips—RAMs, ROMs, PROMs, etc; ASCII/Baudot with a PROM —for ribboniess RTTY on computers; Aim Your Beam Right—with a programmable calculate. calculator

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I). NOV 76. Blockbuster 288-pg, issue! Cordless Iron Tips; Bicycle Mobile; Bulid a Simple Lab Scope—costs less than \$70!; Get on Six with Surplus—the el cheapo RT-70 is a natural; The Beam Saver—rotor memory system; Updated Universal Frequency Generator; The Shirt-Pocket Touchtone; Liquid Crystal Display Gulde; Self-Powered Mike Preamp; The Wind Counter; The S38 Is Not Dead! The Amazing Inverted L —antenna for 20, 40, and 80m; Battery Chargers Exposed; How Do You Use ICS (part III); Thirty Years of Ham RTTY; Big Noise Burglar Alarm; Dandy Digital Dial Decoder; Weather Satellite Display Control; Ham Time-Sharing Is Here for You!; The Soft Art of Programming (part III); OSCAR Smoke Tester—power supply tester; The Man Who Invented AC—Tesla, the greatest pioneer of them all; Baudot to ASCII—you want to learn programming?; Baudot computer; Toward a More Perfect Touchtone Decoder; Using a Wireless Broadcaster, The Quiet Spy—amateur uncovers spy ring in the US!; The Benefits of Sidetone Monitoring—and how to do it.

DEC 76. Go Tone for Ten—simple subaudible encoder; World's Simplest Five Band Receiver?; How Do You Use ICs? (part IV); A Super Cheapo CW IDer; The ZF Special Antenna; CT7001 Clockbuster; Saving a CBer; A Ham's Computer; What's All This LSI Bunk?—an ostrich's eye view of the microprocessor; The Soft Art of Programming (part III); Put Snap into Your SSTV Pictures—using a \$20 frequency standard; What's All This Wire-Wrap Stuff?—taik about cold solder joints! Exploiding the Power Myth; Exploding the SWR Myth; The IC-22 Walkle—portablization with nicads; Watch DX with a Spectrum Analyzer; DXing with a Weather Map.

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MAR 77. Pitcairn Island—an inside look at VR6TC; How Do You Use ICs?—part VI; PROM Message Generator For RTTY keyboards are obsolete; Inexpensive Variable DC Supply—easy and quick; The History of Ham Radio—part I; Versatility Plus For the HW-202—external channel mod; Making Your Own PC Boards—part I; Announcing the PCF—legal aid for ham problems; Build Your Own Car Regulator —solid state; The Happy Flyers—fun and public service. Plus 15 more.

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JULY 77. A Battery Voltage Monitor--how simple can an IC project get?; Hunting Nolse--with a grid dipper; Hams Profit From CB--how to set up a service center; Patch Up Your 101--simple mod for the HW-101; Dipole Designer Program-calculates colls and length; CB to 10--parts III, IV, and V; World's Smallest Continuity Tester--It's almost minute; Digital Synthesizer-nevitalize old xmtr strips; Phone Patch Tips-a lost art?; Digital Clock Fail-Sale -so you won't miss the train. Plus 18 more.

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JAN 78. Build a Better Phone Patch—hybrid-op amps—the works; Build a 3'z Digil DVM—replaces oid meters!; ORP Hints —for low-power freaks; Custom-Made Thermistors—for precise values; UHF Propagation—believe It; Put an ELF in Your Keyer—sneaky computer strikes again; CB to 10—part VIII; The Extreme Basics of Antennas—for pre-Novices; Versatile Transistor Tester—save expensive devices; How to dissipate 200,000 Megawatts—fool Mother Nature. Plus 36 more.

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MAY 78. Official FCC RFI Report—curing radio and TVI; Fake 'Em Out With Remote Control—TT-operated control unit; Now —A Digital Capacity Meter!—simple construction project; DMM Survival Course— "all" about using digital multimeters; Build This Excitingly Simple Receiver; Diary of a Survivor—cyberosis victim tells all; The Super Select-o-Ject—kill rotten ORM with this liliter system; The Miser's Delight Repeater Controller—the very IDI; Make Antenna Tuning A Joy—Instant swr bridge; The COR Goes Solid State—turning two Midland rigs into a repeater. Plus 18 more.

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# **The Big Bopper**

As an interested amateur, you probably have heard many on-the-air and off-the-air conversations discussing phased antennas. If you have never operated a phased array, you may have wondered with honest skepticism whether they really perform well. In particular, are they generally equivalent to other good arrays and do they have any unique advantages? The answer to both questions is yes. Obviously, there are some qualifications. No single approach to an antenna system can ever be the universal solution to every ham's radiation problem. But if what you need is an effective radiation system on multiple bands with a low physical profile and you want it to be relatively inexpensive as well as easy to construct and maintain, then you may want to consider a vertical array.

The two-tower vertical

array described here has directional radiation (and reception) characteristics which are easily rotatable. The system is sturdy, attractive, and readily usable on five bands, with no outdoor adjustments required while operating. Standing-wave ratios are



Photo A. Wiring side of the relay switch box.



Photo B. Relay switch box "buttoned up" with seven "internal" lines attached.



Fig. 1. Idealized radiation patterns. All patterns represent field intensity from 100 radiated Watts. Dots 1 and 2 represent towers 1 and 2. Capital letters represent switch positions. Circles = 61.8 millivolts/meter at one mile. This is the field intensity from a single tower with the same 100 Watts radiated.



Fig. 2. Block diagram. All notation refers to 40 meters only. All cable and delay lines are RG-8/U or a 50-Ohm equivalent. The transformer is a Palomar Engineers or equivalent (see text). Towers and trapped units on each band are Hustler 4-BTV or equivalent.

moderate under all conditions of operation. The transmission line can be any convenient length. An antenna tuner or matching network is recommended between the transmitter and the antenna system.

The effects of mutual impedance on the array operation have been determined. The radiation patterns have been calculated for typical amateur-level field intensities. Importantly, the patterns recognize the effects of any unbalanced tower currents which sometimes result. The construction of the array, and its operation, is completely straightforward and uncomplicated. It does not require great resources, either real estate or budget. It may be especially attractive if you have been denied a more conventional beam because of zoning restrictions, house construction limitations, or general appearance considerations.

Since the tower separation is fixed, the array cannot be equally directional on all five bands. Offsetting this quality is the ability of the system to operate on five bands with the turn of an indoor switch. It is emphasized that this abili-



Photo C. The desk control unit in place.

ty to operate on all major bands with variable directional enhancement on each band is a capability that is not a commonplace feature of typical antenna systems. Also, as will be seen, once the system is tuned to a pattern, it is very tolerant of frequency shifts within a band and can be characterized as having quite a flat load response.

There is no special design requirement for the individual trapped towers. For symmetry, it is recommended that they be nearly the same. Commercial units are readily available and are competitively priced. If your machine shop facilities are limited, buying the verticals may be the quickest and least expensive approach. On the other hand, if you are more venturesome, or able, various means of trapping are described in the amateur handbooks and periodicals which most of us have in our ham libraries. Actually, you may have one vertical antenna already. In this situation, the array discussed may offer you an easy extension in operating capability, with only incremental cost or effort.

This array effectively uses all of the basic lobe patterns that are intrinsic to a two-tower system with a common feedline. Intentionally omitted are some familiar two-tower patterns—perfect cardioids, for instance—that can be generated only with an elaborate feed system so as to maintain balanced tower currents.

#### The Design Approach

Vertical antennas – towers – used as the basis of the design approach have a number of appealing qualities. They are unobtrusive in residential neighborhoods. Vertical towers with tuned traps allow easy band changing and multiband operation.

# KENWOOD-

# AT-120 and AT-180

### Antenna Tuners recommended for TS-120S and TS-180S All Solid-State HF Transceivers.

Why is the use of an antenna tuner so much more important with the TS-120S and TS-180S all solid-state HF rigs than with transceivers having tube-type final amplifiers?

Tube-type final amplifiers generally handle a broader range of load impedance than a transistor final. However, RF power into the antenna system will decrease with an increasing impedance mismatch, and tube life may even be shortened if the mismatch is extreme. Transistor final amplifiers, on the other hand, require a 50-ohm nonreactive load for efficient power transfer and are not very tolerant of high SWR. Therefore, protection circuits are used in the TS-120S and TS-180S to reduce RF power output significantly under high-SWR conditions, thus preventing damage to the solid-state devices.

In the TS-120S, an SWR detection circuit detects reflected-wave voltage, which is then amplified and applied to the ALC circuit as a protective voltage to control power output. Thus, as SWR increases, RF power output decreases continuously.

In the TS-180S, the final amplifier functions normally up to an SWR of 3:1, at which point the protection circuit drops RF power output significantly.

Using an antenna tuner such as the AT-120 to match the TS-120S or the AT-180 to match the TS-180S will lower the reflected power at the transceiver to avoid detection by the protection circuit, thus enabling the transceivers to produce full RF power output and even with rigs which have tube final amplifiers, we recommend an antenna tuner (such as the AT-200 to match the TS-520 or TS-820 Series) for optimum coupling to antennas with high SWRs.

A major advantage of using an all solid-state rig such as the TS-120S or TS-180S is the elimination of final-amplifier tuning and loading. It's great to be able to switch bands, dial up any frequency, and transmit immediately, especially when operating mobile or in a contest or chasing DX. Isn't this advantage lost if an antenna tuner has to be used?

We recommend using an antenna that has a low SWR (below 1.5:1) and that presents a proper impedance match (50-ohms) to the transceiver. Then the full advantages of using an all solid-state rig can be realized. Furthermore, the antenna will be more efficient, and power will not be reflected back to an antenna tuner.

However, many antennas are not broad enough to cover an entire band, and may have an SWR below 1.5:1 in just a portion of the band. The antenna may be cut for resonance in the middle of the portion of the band that is mostly used. When operating outside this portion, where SWR exceeds 1.5:1, the antenna tuner should be switched in.





AT-120

AT-180

Therefore, with a well-designed antenna, the antenna tuner may be switched out for most operating, and the full advantage of using a notune all solid-state rig may be realized. But for those occasions when operating in the band portions where the antenna is not resonant and reactance increases or when, for some reason, the antenna develops a high SWR or a poorly matched antenna is used, the antenna tuner should be switched in to obtain full RF power output.

During those occasions when the antenna tuner is needed with an all solid-state rig, it would probably be advantageous with a tube-type rig also for optimum power transfer to the antenna system. With a tubetype final, plate tuning and loading adjustments would be required in addition to adjusting the antenna tuner. With an all solid-state transceiver, only the antenna tuner would need adjusting during those occasions when it is required.

### What are the primary features of the AT-120 and AT-180 antenna tuners?

The AT-120 antenna tuner is very compact (only 6 inches wice, 2-3/8 inches high and 6-1/4 inches deep) – perfect for mobile mounting with the mounting bracket provided – and operates on 80 through 10 meters. It consists of an antenna coupler and an SWR meter (which can be illuminated). Although much smaller, it complements the appearance of the TS-120S.

The bandswitch has a "THROUGH" position for switching the AT-120 out of the circuit. Input impedance (to the transceiver) is 50-ohms and output impedance (to the antenna system) covers 20 to 300 ohms, unbalanced. It handles 150 watts (120 watts on 80 meters). The SWR meter measures from 1.0:1 to 10.0:1.

The AT-180 antenna tuner matches the TS-180S (same height) and consists of a through-line watt and SWR meter, antenna selector switch, and, of course, an antenna coupler.

It operates on 160 through 10 meters, with a 50-ohm input impedance and an output impedance of 10 to 500 ohms (10 to 400 ohms on 160 meters), unbalanced. Switches allow up to 20 or 200 watts of forward or reflected power to be measured. (It is not intended for use at the output of a linear amplifier.) UHF-type connectors are provided for the input, two antenna outputs, and a dummy load, and a standoff connector is provided for a wire feedline.

With both tuners, the "R TUNE" (for resistance component) and "X TUNE" (for reactance component) controls are adjusted alternately with a CW carrier applied until minimum SWR or reflected power is obtained.



Fig. 3. Bird's-eye view showing the simplicity of the system.

The low-angle radiation patterns from verticals enhance DX probabilities for a given transmitter power. The absence of high-angle vertical lobes usually equates to effective use of radiated power. Properly constucted, ground-mounted verticals can have low losses and are structurally sound in almost all weather.

For 40 meter and 80 meter operation, a twotower vertical system is one of the few practical options that can be used to enhance directivity. This is especially true if rotation of the pattern is desired. Typically, at these frequencies, the beam element lengths in conventional arrays become too ponderous for most hams to cope with.

Finally, in the two-tower system, no mechanism or external rotators are required. The quick switching of the lobe patterns is especially handy for reception when operating in a net or group. Often the compass bearing between received stations is quite wide. Quick optimization of the received signal is a real operating advantage. Sometimes, too, it is helpful to be able to partially null an interfering signal.

#### How This Antenna System Operates

The two towers are physically separated by  $\lambda/4$  on 40 meters (34'5''). This is

a separation distance that will comfortably fit on many home lots. There is an eight-position switch at the operator's position that selects between the lobe patterns (Fig. 1). For example, switch position D on the 40 meter band selects a paddle-shaped pattern directed off the top end of the axis. Switch position F on the 40 meter band is an identical paddle-shaped pattern, but directed off the bottom end of the axis. The absolute geographic direction is determined by the tower axis orientation.

It is worth noting again that the division of current between the towers affects the pattern generated. Yet the current division between towers, with a common feedline, is a function of the tower self-impedances—including mutual impedance—as trans-



Fig. 4. Velocity factor versus frequency for polyethylene RG-8/U.

formed through the delay lines to the feed-in point. The individual tower impedances, in turn, for a given current phasing, are a function of the current division between them.1 Sound circular? For example, it is possible with some patterns and phasings to initiate a multivibrator-type action. As a tower current goes down, the tower impedance goes up, which causes the current to go down further ... etc. The resulting radiation pattern degenerates toward a single tower pattern or a circle. It can be speculated that such action has discouraged unsuspecting experimenters in the past when actual performance compared poorly with anticipated pattern enhancement.

These degenerative conditions have been avoided in this array. But to avoid them, some two-tower patterns, as shown in a *Radio Engineering Handbook* or similar source, are not available in practice. Uncritical referencing to tables of these patterns is a common error. Such handbook displays are normally predicated on towers which are  $\lambda/4$  high and which have equal currents in each tower. Maintaining equal currents under all conditions of operation and switching is not an easy trick. Instead, the lobe patterns in Fig. 1 are based on the unequal currents which occur normally. The patterns give good emphasis and direction selection on each band. By orientating the tower axis with care, good world coverage can be obtained.

All patterns as shown in Fig. 1 are "idealized," meaning that they are computed, not measured, and are assumed to be generated over perfectly conducting earth. For most ham installation planning jobs, these assumptions are quite acceptable. The



Fig. 5. Relay circuit. All relays are shown at rest. All wavelengths refer to 40 meters only.

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Fig. 6. Relay coil-control circuit.

charts are calibrated in millivolts/meter for a radius of one mile with a total rf radiated power of 100 Watts. To estimate the field strength for a different radiated power, P<sub>2</sub>, it is only necessary to multiply the chart reading in the chosen direction by  $\sqrt{P_2/P_1}$ . In our case, P<sub>1</sub> is 100 Watts. The circles in the charts represent 61.8 millivolts/meter at one mile, which is the field intensity that theoretically would be obtained if the 100 reference Watts were to be radiated from a single vertical tower.

### The Block Diagram

The antenna system is shown in block diagram form in Fig. 2. For consistency, all notations in Fig. 2 and throughout this article relating to wavelength or delay degrees will refer to 40 meter operation. Conversion to other bands is then straightforward.

Although the towers are physically  $\lambda/4$  apart (90°), they are separated elec-

| Electrical  | Physical length       |
|-------------|-----------------------|
| wavelength  | (vel. fac. $= 0.61$ ) |
| λ           | 84'8''*               |
| λ/ <b>2</b> | 42'4''*               |
| λ/8         | 10'7''                |
| λ/12        | 7'.5''                |
| λ/16        | 5'3.5''               |

Table 1. Physical lengths of delay line sections. \*Initially cut long and trimmed to final length with a dip meter (see text).

3'6.25''

trically by two wavelengths of delay line in nine unequal sections. The electrical centerpoint is at A. The feed-in point of the transmission line is determined by an eight-position switch.

In the D position, as shown, there is a  $13/16\lambda$ delay to tower 1 and a  $19/16\lambda$  delay to tower 2. In other words, the current in tower 2 lags the current in tower 1 by the difference in delays, or:  $19/16\lambda - 13/16\lambda$  $= 6/16\lambda = 3/8\lambda = 135^{\circ}$ . At the same switch position, consider 20 meter operation. All electrical dimensions are now doubled. The towers are physically separated by 180 electrical degrees. Tower 2 current now lags tower 1 current by twice the amount at 40 meters, or 270°.

eight-position The switch function could be done manually as is illustrated. Such manual switching would be quite awkward in most operating situations, since the switch would necessarily be outdoors. Instead, the equivalent function is done remotely with four relays. The relay circuit and the matching transformer will be discussed in a later section

The specification of trapped antennas for the towers is important. For predictable radiation pattern generation, it is desirable that each tower be an electrical quarter wavelength high for each operating band (at least no higher than 5/8  $\lambda$ ). Trapping achieves this condition. It may be tempting to try to use untrapped 40 or 80 meter quarter-wavelength towers for all bands. Such untrapped tower heights, when used on high frequency bands such as 10 or 15 meters, can cause confusion and difficulty. In effect, each tower can become a resonant "longwire" with the associated intricate radiation pattern. Lossy high-angle lobes can result. The interaction of these complex patterns in a switchable two-tower array is apt to result in unpredictable and disappointing results without careful analysis.

### **Construction Features**

One real advantage of this array is its easy and straightforward adaptation to construction. For instance, the full  $\lambda$  length of delay line to tower 2 and the  $\lambda/2$  length of delay line to tower 1 permit the physical grouping of a switch box plus seven of the delay lines conveniently away from both towers. This statement allows for the physical shortening of the delay lines to accommodate transmission line velocity factors. This arrangement flexibility is often useful for appearance or screening considerations (Fig. 3).

While on the subject of velocity factors, it may be helpful to review my own

experience. Perhaps 1 should have known better, but I was unprepared for calibrated dip-meter measurement results, which indicate that the velocity factor in polyethylene RG-8/U varies with frequency (Fig. 4). A review of the technical literature that I have, plus manufacturer's data on hand, discloses no mention of this quality. A single standard "nominal" value for the velocity factor is usually given. Other experimenters may also have this gap in their information. Obviously, knowledge of this variable is significant if the same cable is to be used for generating specific delays, but at different frequencies—as in this array. I selected a velocity factor of 0.61 obtained at 14.2 MHz. This is a compromise value. Errors introduced on other bands are within reasonable limits with this value. Table 1 lists the physical lengths I have used.

It is suggested that the  $\lambda$ length of delay line, and also the  $\lambda/2$  length of delay line, be cut a little long. Then, with all of the delay lines attached to the switch box but not connected at the towers, balance and trim the lines from midpoint A outward with a dip meter. This balancing will minimize any discontinuity effects in the switched leg due to relay points or coax hardware.

### The Relay Switching Circuit

The functional switch in Fig. 2 is replaced by the relay circuit in Fig. 5. The switching relays are conventional medium-power units and need not be the expensive coax type. They should have two sets of SPDT contact points. A compact physical design is suggested. It is important that they have sufficiently heavy-duty contact points

λ/24

to be able to handle the currents involved. A contact current rating of 10 Amps or better will be adequate in most applications. Obviously, the relays should have good insulation and a low inductance switch path. Contact resistance should not be a problem since full rf current flows through any contacts that are used.

The relay coil-control cable is a five-wire cable. Since the cable runs from the shack to the switch box outside, it is likely to either be buried or at least to touch the earth. As a result, conventional safety precautions require that the relay coils should either be of the low-voltage type or else should be isolated with a suitable transformer arrangement.

In my installation, the relays are housed in an aluminum box,  $3\frac{1}{2} \times 6 \times 10$ inches (Photos A and B). This box also serves as a mount for the SO-239 panel receptacles which make the connections to the transmission line and delay lines. This arrangement affords good shielding, short connections, and easy assembly and disassembly. Another plus is the ability to make easy substitutions of delay line lengths for experimentation. The layout is not critical and your own design should work well if attention is given to short lead lengths.

Selection of the relays is controlled from a desk control unit which basically consists of a 3-pole, 8-position rotary switch housed in a decorator metal box (Photo C). A pilot light and an on/off switch can be convenient additions. The relay coilcontrol circuit is detailed in Fig. 6.

## Radials and the Ground System

All too frequently, hams underestimate the need for a proper ground system with vertical towers and attempt to skimp by. This is false economy and wastes effort and power. An adequate radial system is a fundamental and necessary component of the total radiation array and should not be neglected. A working rule of thumb is to have a minimum of six radials per band with a minimum length per band of  $0.125\lambda$  (Photo D).

### The Transmission Line, Delay Lines, and Matching Considerations

Although simple in physical appearance, operation, and construction, there are some deceptively involved aspects to the electrical analysis of the array:

• There are two towers with mutual coupling which affects the individual tower impedance.

• Pattern switching affects the load impedance at each tower.

•The towers are not always operated at resonance with the corresponding introduction of reactance of varying magnitude and sign.

• The impedance of the system, viewed from the radial switch, is a resultant of two parallel paths — one to each tower. The length of these paths, their individual impedances, and the current division between them change with switching.

It should be clear that the system—considered as a load—varies under normal operating conditions. For the most part, these operating conditions, while

| Band | Tower 1 | Tower 2 |
|------|---------|---------|
| 10   | 1.30    | 1.25    |
| 15   | 1.45    | 1.50    |
| 20   | 1.25    | 1.15    |
| 40   | 1.20    | 1.20    |
| 80   | 1.00    | 1.05    |
|      |         |         |

Table 2. Swrs measured at tower base and at tower resonant frequency.

tedious to analyze, are quite solvable with the charts and equations of G. H. Brown, the liberal use of Smith charts, plus the determined application of patience and time with a programmable hand calculator. Fortunately, in practice, the system analysis complexity can largely be ignored while achieving excellent operating results. Anyway, the analysis is mostly needed for determining the pattern shapes when the tower currents are unbalanced. Still, it is realized that most users will want an insight into the operation without the tedium. The following discussion is intended for that purpose.

The range of impedances

at the radial switch is such that a broadband transformer can offer very suitable compromise matches to the transmission line. In short, it splits some differences. Two simplified examples will illustrate in principle the general mode of the transformer plus some system features.

Assume that the two towers are physically identical and are operating at resonance in the 20 meter band. Assume further that the resonant resistance of each antenna is a typical 40 Ohms. Assume also for simplicity that there is no mutual impedance! Now let the feed-in point of the transmission line be switch position A, or the midpoint



Fig. 7. Swrs versus frequency.

of the delay line. From switch position A, with 20 meter operation, there are two wavelengths of delay line to each tower. Since a half wavelength of transmission line repeats its input at its output, then the resonant resistance of each tower-40 Ohms-will be repeated at A. The two legs are in parallel so that there is a net resistance at A of 20 Ohms. Without a transformer, the 20 Ohms as a load would develop an swr, with the 50-Ohm transmission line of 50/20 = 2.5. However, 20 Ohms through the 1.0:1.8 ratio transformer will appear as 36 Ohms, which will develop an swr of only 1.4 – a significant improvement!

For the second example, let the switch tap move to D and keep all other assumptions constant. It may clarify the situation to note that, at 20 meters, there is a half wavelength of line between points E and A. Remembering again that a half wavelength of line repeats its input at its output, the tower 1 resistance is repeated at point H and again at point E. Similarly, tower 2 resistance is repeated at A.The electrical distance from E to D is 1/8). The electrical distance from A to D is  $3/8\lambda$ . The question now becomes what happens at D? Whipping out our handy Smith chart, we find that the resistance of tower 1 will be seen at D as 49 Ohms resistance plus 12.5 Ohms of inductive reactance. Likewise, the resistance of tower 2 will be seen at D as 49 Ohms of resistance plus 12.5 Ohms of capacitive reactance. Since the reactances are equal and opposite, they will cancel. (This action is true at any tap. Its value will be discussed later.) As in example 1, this leaves us with two resistive legs in parallel. The net parallel resistance is 24.5 Ohms. This resistance, seen



Photo D. The radial system. The aluminum box is handy, but not necessary. It is used to weather protect a PL-239, which was used for cable length experimentation.

through the transformer, will appear as 44.1 Ohms, which, in turn, will generate an swr of only 1.13.

Unfortunately, when mutual impedance is reintroduced into our assumptions, the reactive components do not always cancel at all times. Also, the self-resistance of the towers may become different, which would mean that the currents will no longer be the same in each tower. Nevertheless, the function of the transformer can be understood as an impedance leveler and, in fact, practical experimentation is easy.

The transformer itself is a ferrite core unit. I use the Palomar transformer at the nominal ratio of 28:50 Ohms. Roll-your-own transformer winders should have little difficulty achieving the 1.0:1.8 ratio or close to it.2,3 The turns ratio is not excessively critical, and some experimentation with ratios may be rewarding. It has been my experience that swrs for a favored band can be improved, but usually at some expense to another band.

### Adjustments/Tuning

The first operation in adjustment is to tune the towers individually to the same frequency on each band. Other things being equal, a midband resonant frequency will probably give better overall results than a frequency near band edge. Assuming the absence of an rf bridge, probably the most direct alignment technique is to measure the swr at the base of each tower and adjust for minimum. To avoid mutual coupling effects, the other tower should be removed from its standard and placed out of the immediate area.

It will be remembered that an ideal vertical  $\lambda/4$  tower has a resonant resis-

tance of about 36 Ohms. Thus, with a 50-Ohm transmission line, the swr for an ideal tower would be 50/36= 1.4. Some hams are confused about this point probably by advertising claims—and expect an swr of 1.0 or close to it.

The swrs that I measure on the transmission-line side of the matching transformer are shown in Fig. 7. These moderate swrs represent no threat to RG-8/U, even at full legal power. Coax losses at these ratios are insignificant. Most antenna tuners can easily cope with these ratios and will present a perfect load to the transceiver or linear amplifier.

Table 2 lists the swrs I measure at the base of each tower. Superficially, it would appear that I have the best adjustment on 80 meters where the swrs are the lowest. The contrary is the case. My towers are telling me that I have an inadequate radial system on 80 meters. In effect, I have a dissipative ground resistance in series with the radiation resistance, and, therefore, the total resistance is raised. The net resistance at 80 meters nearly matches the transmission line characteristic impedance. Although this raised overall resistance gives a nice low swr, it also indicates that I am wasting some valuable rf power heating the ground!

Perhaps of more interest is the shape of the swr curves in Fig. 7. For the most part, 80 meters excepted, they do not have the familiar lopsided, saucer-shaped, resonant curves. Instead, they tend to be gently curved and be level, or have a slight tilt. That is, the swr does not change appreciably with change in operating frequency! This is a feature of the system. Stated another way, once an antenna tuner is adjusted for a particular lobe pattern, at a particular frequency, it is usually unnecessary to readjust it much while operating across a significant band segment. For emphasis, it should be noted that the chart for the 10 meter band has a 5:1 compression in its frequency scale when compared to the other bands. Its flatness is thus even more impressive.

For an explanation of these unusual swr curve

shapes, recall that, in our second example, there was a cancelling of reactance at each switch tap, providing that there is an integral number of half wavelengths of delay line between towers. If the operating frequency is moved away from the resonant frequency of the towers, an identical reactive component will be introduced at each tower. These reactive components will tend to cancel at

the taps, leaving only resistance. It is like having a built-in compensating tuner!

In addition to matching the antenna system to the output pi network of your transceiver or linear amplifier, an antenna tuner gives added protection against spurious radiation. This antenna system is an excellent radiator on all bands at all times! It will not filter nor inhibit any undesired harmonics. An antenna tuner is an investment in tranquillity. ■

#### References

1. G. H. Brown, "Directional Antennas," *Proceedings of the Institute of Radio Engineers*, January, 1937. See equations 37, 38, 39, and 40 on page 92. 2. John J. Nagle K4KJ, "Wideband rf Autotransformers," *Ham Radio Magazine*, November, 1976.

3. Jerry Sevick, "Broadband Matching Transformers Can Handle Many Kilowatts," *Electronics*, November 25, 1976.





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#### from page 30

RS(T) and 3-digit serial number starting with 001. SCORING:

European stations count 1 point per QSO on any band; non-European stations score 1 point per QSO on 20 through 10 meters, and 3 points per 80/40 meter QSO. Count every call area in the above-mentioned countries on every band as a multiplier, e.g., LA1 = LB1 = LJ1 and SM3 = SK3 = SL3. A portable station in Norway or Denmark counts as the 10th call area, e.g., W2XXX/OZ counts for OZ0. Some countries have no geographical call areas, but count this contest as if they had. The sum of all complete QSO points from all bands multiplied by the sum of multipliers from all bands is the final score. AWARDS

Certificates awarded to the highest-scoring station in each participating country and US call area in each operating class separately on CW and phone. A special SAC-plaque will be given to the continental winners on both CW and phone. A reasonable score is requested for both certificates and plaques. Depending on the number of contestants in each country, the contest committee will consider more certificates. ENTRIES:

Write separate logs for CW and phone. The logs are to be filled in in the following order: date and time in GMT, station worked, sent and received message, multiplier, and points. Separate logs for each band are recommended. On the summary sheet the contestant will write his/her callsign, name and address, the final result, the operating class, and a signature that he/she fully agrees to the rules. The logs must be mailed no later than October 15 and sent to: SRAL, SAC Contest Committee, PO Box 306, SF-

00101 Helsinki 10, Finland, The decisions of the contest committee are final and definite and they reserve the right to change the rules. Usual disgualification rules.

#### **DELTA QSO PARTY** Starts: 1800 GMT September 29 Ends: 2400 GMT September 30

All amateurs are invited to participate in the 10th annual party which is sponsored by the Delta Division of the ARRL. Amateurs outside of the Delta Division (Arkansas, Louisiana, Mississippi, Tennessee) will attempt to contact as many stations inside of the Delta Division. Delta Division stations will attempt to contact as many stations both inside and outside of the division. Stations may be worked on each band/mode; portables and mobiles may be reworked on the same band/ mode if they change counties. FREQUENCIES:

CW-3550, 7050, 14050, 21050, 28050.

SSB-3990, 7290, 14290, 21390, 28590.

Novice - 3725, 7125, 21125, 28125,

EXCHANGE:

QSO number, RST, and QTH (ARRL section for non-Delta Division; county and state for Delta Division). SCORING:

Delta Division stations score number of QSOs times the number of ARRL sections (75 maximum); outside Delta Division score number of QSOs times the number of counties worked (316 maximum). DX stations may be worked by Delta Division stations but do not count as multipliers.

#### ENTRIES AND AWARDS:

Logs must include date/time. station worked, exchange, band, emission, and multiplier. Logs must be postmarked no later than October 21 to be eligible for award consideration. Logs will be returned if request-

ed. Send logs to Malcolm P. Keown W5XX, 213 Moonmist, Vicksburg MS 39180. All amateurs contacting 5 different stations in each of the 4 states comprising the Delta Division will receive a certificate. Section awards to the 3 highestscoring stations in each Delta Division state, 4th and 5th place if warranted; section awards to high-scoring stations in each ARRL section and country outside Delta Division, 2nd and 3rd if warranted. Plagues to highscoring stations both inside and outside of the division and to high-scoring portable and mobile stations in the division. Another plaque to the high-scoring Delta Division club station (no limit to number of operators or transmitters, but all QSOs must be made from same QTH).

#### **COLLEGE RADIO SCRIMMAGE** Starts: 1900 GMT September 30 Ends: 0100 GMT September 31

Entry classes: 1) alumni and 2) club station. Open to all amateurs; alumni may work other alumni and club stations, Entry may have one or more operators but must have only one transmitter (no distinction between single- and multi-operator). EXCHANGE:

Name of college, junior college, or university you last attended and the last two digits of the year you graduated, will graduate, or last attended. Club stations substitute the words "Amateur Radio Club" for number. Non-collegians substitute the words "High School" for college name, but are not eligible for awards and may not be counted as a multiplier. SCORING:

Stations may be worked once per band. Multiply total QSOs by number of different colleges worked (college counts once regardless of band).

FREQUENCIES:

1815, 3895, 7230, 14280, 21355, 28560.

AWARDS AND ENTRIES:

Trophy for top scorer in each entry class. Certificates as well. Logs must be received by November 1 to be eligible. Send an

that I listen to all the time, but I would be happy to talk to someone

Can anyone give me any help or advice? Raymond L. White

3341 James Avenue Fort Worth TX 76110

I am looking for meter rewinding information and/or specifications for a replacement meter for a Johnson Viking Challenger transmitter. Thank you.

George L. Smyth N8AMZ 1316 Eastern Ave. Morgantown WV 26505 SASE for results to: Penn State Amateur Radio Club, K3CR, 202 Engr. Unit E, University Park PA 16802.

#### FALL CLASSIC RADIO EXCHANGE Starts: 2000 GMT Sunday, September 30 Ends: 0300 GMT Monday, October 1

This contest is sponsored by the Southeast Amateur Radio Club, K8EMY, of Cleveland, Ohio, and is open to all. The object is to restore, operate, and enjoy older equipment with likeminded hams. A classic radio is any equipment built since 1945 but at least ten years old (an advantage, but not required in the Exchange). The same station may be worked with different equipment combinations and on each mode on each band. General call is "CQ CX" and non-contestants may be worked for credit.

EXCHANGE:

Your name, RST, state/province/country, receiver and transmitter type (home brew send PA tube type, e.g., "6L6"). FREQUENCIES:

CW-up 60 kHz from low band edges.

Phone-3910, 7280, 14280, 21380, 28580.

Novice/Tech-3720, 7120, 21120, 28120.

SCORING:

Multiply total QSOs by number of different receivers, transmitters, states, provinces, and DX countries worked on each band and mode. Multiply that total by your classic multiplier: total years old of all receivers and transmitters used, three QSOs minimum per unit. If equipment is a transceiver, multiply age by two. ENTRIÉS ĂND AWARDS:

Certificates and other appropriate memorabilia are awarded periodically for highest scores, longest DX, best excuse, and other "unusual achievements." Send logs, comments, anecdotes, etc., to Stu Stephens K8SJ, 2386 Queenston Rd., Cleveland Heights OH 44118. Include an SASE for a copy of the Classic Radio Newsletter.

I need any information I can get for a Keithley Milliohmmeter Model 502.

Will buy, copy, or pay to have copied information on batteries, operation, calibration, and schematics.

> Dave Hammer K0PCL 610 E. South King City MO 64463

I would like to form an exchange of solar, alternative energy, and anti-nuclear information with thinking hams.

James G. Coote WB6AAM 906 Dexter Street Los Angeles CA 90042

# Ham Help

I would like to correspond with any ham using a Heath HW-18-3 160-meter single sideband transceiver on CW as well as SSB.

#### William Toben W7JGL 1244 W. Schafer Drive **Tucson AZ 85705**

I have been taking 73 Magazine now for three years. I want my Novice license very much. I am 70 years old and blind-my wife reads the magazine to me. I have 73's code tape and know the code very well. However, I can't receive too well, as I don't know Braille and can't read back anything after writing it down.

I believe I could pass my theory test. I need to know just what is required for the blind to pass the test and if there is anything else I could get that might help me. I have radios



#### from page 6

... not just for our own egos, but in order to keep newcomers entering our hobby and thus keeping it alive.

Without the support of a national organization, what can we as individuals or even as clubs do to help the situation? Well, getting publicity is not difficult once you recognize how the system works ... ask your terrorist or other politically active group. No, I'm not suggesting that hams start fire bombing police cars; I'm just pointing out that a realization of how television and newspapers select what they think is news will give us some ideas which can allow us to take advantage of a seriously unbalanced situation.

Take a large parade ... maybe thousands of people and floats. That's not news. But if you add six yelling and screaming agitators in a small group jostling the parade, that's what you'll see on the news that evening ... and not the ten thousand people in the parade. No, we don't want to break up parades either ... we just want to understand what *is* news and what *is not* news.

Our getting publicity should take advantage of amateur radio's possibilities. For instance, suppose we set up a national net to check food prices and report the inequities. Then amateurs could set up cars or vans in front of grocery stores with a big report poster showing the comparison between the prices in that store and other stores around the country ... where large price differences are found.

There are plenty of these price inequities to be found, and the project would make television all over the country. Heck, right here in Peterborough you can find 10% to 20% differences in the prices of identical products just between the Grand Union and A&P stores! As long as stores end prices in a 9, we know that these prices are not honest ones . at least the chances are 90% against their being honest. We know for darned sure that a price ending in 9 is 90% of the time picked because it seems lower than one which is one cent more. If products were honestly priced, the prices would end in a random selection of numbers ... which should reflect the cost of manufacture and distribution. We also know darned well that if the honest price of a product comes out to be, say, 80¢, it will turn up on the store shelf at 89¢, not at 79¢.

There are fewer and fewer products which are not being priced in 10¢ steps, all ending in a 9. The carpet people go in dollar steps, always managing to end in 99. Bless 'em.

Ham communications could do the job, using two meters for price reports in the immediate area and perhaps 20m for longrange comparisons. And if you don't think something like that wouldn't make every television news broadcast in the country, you have another think coming. Hams working to beat down the artificially high prices on food ... hams working to bring honesty to pricing and show up the price gougers.

The gas shortage may not last very long, but we could take advantage of the tremendous interest in this situation by setting up a ham reporting network on two meters in each area which could let motorists know where gas was to be found. where the gas lines were the shortest, and gas prices . . . particularly on weekends. Temporary signboards along the major routes, manned by hams (with coordination by a local ham club), would make the news broadcasts. The gas stations could be checked by telephone for the latest news of their situation or checked out by mobile units. It would be a fun project and would provide a real service. Now that the idea is out, if you don't do it, the CBers will, and you'll have to see them on television and in the newspapers. Your choice.

Those are just a couple of ideas. I'm sure you'll be able to come up with more and possibly better ones. Those came



#### CQ...DE LEAVENWORTH

The chap in the middle, between the two police officers, has some serious problems. The photo was taken from a video monitor shortly after the arrest of the unhappy chap in the center for shoplifting.

This fellow had previously been into the store, one of the largest ham stores in the country, and had been suspected of gaining a good deal of weight during his earlier visit. This time they were waiting for him, complete with video monitoring and recording. The police were called and arrived to watch him stuffing his coat with books and parts via the TV monitor.

You see him in the Polaroid above, just after having been read his rights and as he was being carted off to the police station for booking.

ing. The monitoring system has worked well, providing the staff with some rather clear pictures of shoplifters for use during later visits, complete with police in the audience. The tape recorder allows a moment by moment replay of the surveillance at any later time... which helps in the case of any later claims of innocence.

to me while I was taking a shower this morning. Take a shower. Let's get amateur radio known and appreciated.

#### THE ARRL LINE

Every time I tune from 14,200 on up past 14,275 to where the channels are packed solid with nets and QRM, I tend to think of the dividing line at 14,275 kHz as being the ARRL line. This dividing line is there because the League forced the FCC to take away General frequencies. Before the advent of "incentive licensing," there was no such line and General Class licensees had the use of the entire band. Now they're jammed up into half the phone band, away from 99% of the attractive DX certainly away from the relatively open frequencies in the lower part of the band ... and from SSTV experimenting.

This all started in 1963 when the League, being run at the time by some old-timers who wanted the ham bands to be back the way they were before the War, pushed through a disastrous piece of legislation. Amateur reaction to the proposals was so furious that it almost stopped the League, despite their inside help via Herb Hoover, Jr. The amateur reaction brought the sale of amateur equipment almost to a halt and stopped the growth of the hobby for over ten years. Talk about disaster!

This was the time when most of the famous names in ham manufacturing disappeared . . . Hallicrafters, National, Hammarlund, Johnson, Harvey Wells, B&W, etc. Tuning past 14,275 brings back these memories of the havoc wrought by the League in the 1960s. 73 was too small then to be more than a cry in the wind, but I think that without the cry the League proposal to remove Generals entirely from the major DX bands would have gone through. The retaining of half of the bands by Generals was better than noth-

ing. The result of all this? Proof that forcing amateurs to upgrade would not work. Many of us held that the FCC should offer rewards such as better call letters rather than taking away frequencies and then giving them back if you upgraded. If you are locked above 14,275, it's something to think about.

#### SAROC ZOMBIE

That's what they call the dead brought back to life ... or at least some semblance of life... and it seems apropos for the SAROC hamfest. This is a strictly commercial venture run for profit by a chap in Nevada and it died a couple years ago of extreme neglect. I see a report that this exploitation of amateur radio has been announced again for next year in Las Vegas.

The main purpose of SAROC is to provide a legal excuse for a few of the ham manufacturers to go to Las Vegas for a vacation in January. The actual business done is a farce. For instance, one major supplier brought in a truckload of ham gear for his exhibit at the last show and over the three days of the show sold \$1,500 worth of gear. That's less than one tenth of the minimum acceptable business for him just to break even.

Now, if the show was that lousy when there was still plenty of gas for the California hams to drive over the desert to come, who will be there when gas is in short supply and a lot more expensive? Ten years ago, when FM and repeaters were firing everyone's imagination, the local Vegas FM club ran a hospitality suite. Art Householder of Spectronics also had a hospitality suite where he made everyone crazy with desire for recycled Motorola HT-220s which he pulled from his pockets and sold in a kind of under-the-table atmosphere. It was heady stuff and FMers were king of the roost.

No more. The last show, two years ago, was held together mainly by itinerant hams in town for the concurrent winter **Consumer Electronics Show** and who came over to the hamfest for a few minutes to see what their poor relatives were doing. Next year, CES will be January 5-8th. The hamfest will be the 10-12th and the Fifth Annual Ham Industry meeting will be in Aspen, Colorado, on January 12-19th. I'll probably hop out on the 7th for a couple of quick days at CES, visit the Wilson factory on the 9th in Vegas, see who was wealthy enough in the industry to "exhibit" at the hamfest, and then poop or up to Aspen for the yearly industry conference and workshops.

SAROC, being run strictly for a profit, has a tremendous charge for attending ... I think I paid \$17 last time ... and for that I got to wander around a handful of booths. It took me maybe half an hour to see everything. There was no recognizable program. ARMA held a meeting, but many of the manufacturers were unable to find the meeting room, which was very well hidden.

Now, why is Wayne Green so down on SAROC? Is it that I'm getting even because I haven't been asked to speak? No... as a matter of fact, I've been asked to speak and have refused. It's a long story and there is a lot of background. It comes down to a question of supporting what I feel are unsavory elements. I sure wish someone would take the time to write an exposé of the people behind this hamfest.

Anyway, between the gas problem and the CES show ending two days before the hamfest, it seems unlikely that the next SAROC will be any improvement over the last one ... which had CES to help and no gas problems ... and still was a disaster. Perhaps this commercial show should be put to rest and remembered for its heyday ten years ago instead of its more recent disappointments.

#### DXERS AND LISTS

A lot of true-blue DXers are very uptight over list operations. For those of you who have not enjoyed the spice of working serious DX, a list of calls is taken by some intermediary and passed along to the rare DX station, who then works the list and only the list. This can be very upsetting for some operator who comes along after the list has been drawn and finds that while he can hear the DX station easily, he can't work him. Oh, bitter anguish!

The operators of rare DX stations have several choices open to them when they get on the air. First, they know that a normal contact is out of the question because every time they stand by there will be dozens, then hundreds, of stations all calling them simultaneously. The din soon gets so great that it is impossible to hear any call distinctly and the tendency then is to wait out the caterwauling until there is just one station left to come back to him.

The encouraging of "tail-ending" quickly screws up everything. The waiting hordes quickly detect what is happening and there soon develops a two or three operator contest to see who can be the last one to call. None of them can even hear the DX station and none will guit the bedlam, so the calling can go on for several minutes. One W5 I know got steamed up at a certain K6 and the two of them refused to budge or listen on the frequency for well over an hour. The poor DX station had gone to bed long before they stopped jamming each other.

Some DX ops like the system where a DX station operates from just outside the US band and tunes for calls. I like this, too, for it doesn't take long to find out where the chap is tuning and jump in the pileup on that frequency.

Having been on the other end of the pileups, I have some observations from the viewpoint of the rare DX station. Newcomers, I've DXed from the following rare and relatively rare spots: JY, OD, 5Z, YK, YA, VU, 9N, FK, VR2, 5W, KS6, FO8, KW6, KG6, KC4, HH, PJ, 4U, OH0, VP9, VP7, and probably some more that don't come right to mind. The main problem in working a lot of stations from a rare location is not in hearing them—it's in pulling the calls apart and getting the individual calls.

After trying every known system for working 'em as fast as possible, which included working by call districts on my own frequency, working from outside the US band and listening on one frequency in it, tuning a small band of frequencies, and working from lists, there was no question... the list could beat everything by far.

Well, let me amend that. The list situation works great if you manage to get hold of some sharp operators to gather the lists for you. I somehow always managed to get one or maybe two good ops and one thoroughgoing idiot. I really hate it when I think I have everything set up for some really fast operating. I've rounded up three chaps with good signals to move off my frequency and copy down call letters for me . . . maybe ten at a time. Then all they have to do is come on my channel and read off the list quickly so I can write the calls down and give each one in turn a report. I can run through ten in one minute if I have the calls. And getting the calls shouldn't take more than one minute at best, right?

So on comes my helper with his list: "Hello, Juliet Yankee Eight Alpha Alpha. Juliet Yankee Eight Alpha Alpha, this is Kilo Baker Zero Xray Quebec Quebec. This is Kilo Baker Zero Xray Quebec Quebec in Washington, Nebraska. That's doubleyou whiskey, aye America, ess Sweden, aich hotel, eye Indiana, enn Nancy, gee George, tee Toronto, oh Oregon, enn Nancy. The name here is Wilbur ... that's doubleyou whiskey, eye Indiana, ell love, bee bravo, you Uruguay, are radio. You're certainly putting a good signal in here, Wayne, really poking the old S-meter around. I have your list for you. I sure hope everyone on the list is going to come up here and find us. Let me know if you're getting me all okay and I'll pass along the list. Juliet Yankee Eight Alpha Alpha, this is Kilo Bravo Zero Xray Queen Queen standing by.

I grunt out a terse "go ahead, quickly, please," stifling an oath. Good old Wilbur comes back, spelling out both of our calls again, apparently in the belief that I may have forgotten not only his call, but my own, too. Then he starts slowly spelling out each call, one at a time, spelling each one twice for me and standing by after each call has been sent, triumphantly. Wilbur is able to take a oneminute task and escalate it to nerve-shattering lengths for all concerned, stretching it out for maybe ten minutes or more. By this time, the other two chaps who have been scrounging calls for me are on channel wanting to give me their lists and I suddenly have thirty stations to work instead of just ten.

Ten works well. Thirty doesn't. Before I can work my way down through even twenty of the chaps, I have some breakers wanting to know who is on there, how can they get into the contact, where is the list being made . . . plus an Italian calling CQ DX with a 40 over 9 signal. When I ask him to stand by, he gives me my report, spells out his name twice, then the name of his town twice (why do most Italian towns have over twenty letters?), and refuses to get off the frequency until I give him my location and agree to QSL.

It is unfortunate that many lists are run in a much slower style. Hopefully, some of the DX operators will read this or hear about it and get moving faster. I heard YK1AA on the other evening and some OK station was running a list for him. It took maybe five minutes for each damned contact ... and all Rasheed did was swap signal reports and call letters. But it went on with excruciating slowness and drove me and a few hundred others up the wall. I didn't particularly need a contact with Syria; I just wanted an opportunity to say hello to Rasheed since I had visited him and operated from his station a few years back.

Try the live list system with perhaps three good operators, all with good signals and in separate parts of the country, taking calls for the DX station. If you can't clearly read off ten calls, spelling them out as you go for the DX op to copy, in less than one minute, then you need some practice. Once the DX op has the calls, 95% of the work is over...he can then stand by for one, get the report, give a report, and get an okay . . . stand by for the next, etc. He doesn't have to spell any calls out or even give his own call more than once every few minutes.

The purpose of most DXpeditions is to work as many stations as possible in a given time ... so why horse around with slow and frustrating systems?

#### **MAY WINNER**

"The W7GAQ Key Collection" collected an extra \$100 for author Martin Krey K7NZA, since his article was voted the best in our May issue. Make sure your favorite article gets recognized by using your Reader Service card ballot.

# Microcomputer Interfacing

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unique digit enable code, and then output these eight bits of information to the interface. For instance, the value 01010011 will cause a five to be displayed on the fourth digit from the right on the display. The digit enable code in this example is 0011, and the digit enable code for the right-hand display is 0000.

To display the number 3,163,908,332, register pair H is first loaded with the memory address where the two least-significant digits (LSDs, 32) are stored. In Fig. 4, this address is 004 120. Only five memory locations are required to store the 10-digit number, because the number is stored in a packed BCD format. The D register, which is used to store the digit enable code, is then set to zero. The content of register D, which will eventually be latched by the interface hardware, is used to turn on one and only one digit at a time. At DISPL1, the DIGIT subroutine is called, so that the content of memory addressed by register pair H is moved to the A register. Since the data values are stored in memory as packed BCD digits, this subroutine unpacks them. The digit in the four LSBs of the A register is rotated to the left four times, bit by bit. The first digit to be displayed is now in bits D7 through D4 of the A register when the OUTIT subroutine is called.

At OUTIT, the four LSBs of the A register are set to zero by the ANI instruction (the digit to be displayed is in bits D7 through D4). The digit enable code contained in the D register is then added to the BCD number in the A register and the result is output to the interface (OUT 125). When this word is output, the four LSBs determine which digit is enabled and the four MSBs represent the value to be displayed. The first time the OUTIT subroutine is executed, the A register will contain 00100000, because a two must be displayed on the right-hand digit.

At the end of the OUTIT subroutine, the content of the D register (the digit enable code)

/THIS PROGRAM DRIVES A 10-DIGIT, MULTIPLEXED, /LIGHT EMITTING DIODE (LED), SEVEN-SEGMENT DISPLAY /IN ADDITION, INSTRUCTIONS HAVE BEED ADDED SO THAT /THE INTENSITY OF EACH DISPLAY IS EQUAL.

| DI SPLA,   | L*(1H      | ZEOAD REGISTER PAIR H WITH THE MEMORY ZADDRESS WHERE THE HED DIGITS ARE STORED. |
|------------|------------|---------------------------------------------------------------------------------|
|            | 004        | 7004 120 = HEX 0450                                                             |
|            | MVID       | ZLOAD D WITH THE FIRST DIGIT                                                    |
|            | มขม        | ZTHAT WILL BE ELABLED                                                           |
| DI SPL LA  | Coll       | ZDISPLAY THE FIRST TWO PAC(FD                                                   |
|            | DIGIT      | /BCD DIGITS                                                                     |
|            | 0          |                                                                                 |
|            | 19Xit      | ZINCREMENT THE MEMORY ADDRESS                                                   |
|            | MUVAD      | /GET THE DIGIT EVABLE WORD 11TO A                                               |
|            | CP1        | /COMPARE IT TO THE                                                              |
|            | 012        | /ELEVENTH DIGIT ENABLE COUNT                                                    |
|            | JNZ        | /HAVEN'T DISPLAYED ALL TEJ                                                      |
|            | DISPLI     | /DIGITS YET, SO DO TWO MORE                                                     |
|            | U          |                                                                                 |
|            | JHP        | THAVE DISPLAYED ALL IN DIGITS,                                                  |
|            | DISPLA     | /SO DISPLAY THEM ALL AGAIN                                                      |
|            | 0          |                                                                                 |
| DIGIT      | MO VIN1    | ZGET THE PACKED BCD WORD INTO A                                                 |
|            | RLC        | ZROTATE THE FOUR LSB BITS LITO THE                                              |
|            | RLC        | 7 FOUR MSB BITS                                                                 |
|            | RLG<br>DLC |                                                                                 |
|            |            | ZTREA DISDLOY THIS DIGIT                                                        |
|            | OUTIT      | THE DISIGN THIS DIST.                                                           |
|            | 0.0111     |                                                                                 |
|            | NOVAM      | ZGET THE SAME WORD AGAIN                                                        |
| OUTITA     | ANI        | ZSAVE DILY THE FOUR MSDS                                                        |
|            | 360        | 7(360 = 4EX = 10)                                                               |
|            | ADDD       | ZALD THE DIGIT ENABLE                                                           |
|            | OUT        | ZOUTPUT THE EIGHT-BIT VALUE                                                     |
|            | 125        |                                                                                 |
|            | I IRD      | VIJERITET THE DIGIT FUMBLE                                                      |
| INTENS,    | INVIE      | ZLOAD E WITH A DUBLER                                                           |
|            | 100        | /100 = HEX 40                                                                   |
| L I TEN IA | DCKE       | ZDECKEIEIT THE NUMBER                                                           |
|            | JNZ        | ZIF IT IS NON-ZERO, EXECUTE THE                                                 |
|            | INTENI     | VING INSTRUCTION BACK TO INTERN                                                 |
|            | 0          |                                                                                 |
|            | RET        | ZVALJ E = 0, RETURN                                                             |

is incremented from zero to one, preparing it for the next digit enable code. To "intensify" the digit that has just been turned on, the computer executes a time delay at INTENS. Thus the digit is kept on for a period that allows it to be clearly seen. When the 8080 finishes the OUTIT subroutine, it returns to the MOVAM instruction just before the OUTIT subroutine.

D

Ð

The A register is loaded with the content of the same memory location addressed by register pair H, only this time the BCD digit contained in bits D7 through D4 must be displayed. This is the second digit from the right in the number 3,163,908,332. The ANI instruction at OUTIT sets bits D4 through D0 to zero and the digit enable code (one) is added to

/THIS PROGRAM DRIVES A 10-DIGIT, MULTIPLEXED, SEVEN-/SEGMENT DISPLAY. A LOOK-UP TABLE IS USED TO CONVERT /BCD NUMBERS TO THE APPROPRIATE SEVEN-SEGMENT CODE.

| I SPLA,  | LX1H<br>120<br>004                          | /LOAD REGISTER PAIR N WITH THE MEMORY<br>/ADDRESS WHERE THE BCD DIGITS ARE STORED<br>/004 120 = HEX 0450                                                                      |
|----------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ISPL1,   | 000<br>CALL<br>DIGIT                        | /THAT WILL BE EVALUED<br>/DISPLAY THE FIRST TWO PACKED<br>/DEOD DIGITS                                                                                                        |
|          | 0<br>INXH<br>MOVAD<br>CPI<br>012<br>JNZ     | /INCREMENT THE MEMORY ADDRESS<br>/GET THE DIGIT ENABLE WORD INTO A<br>/COMPARE IT TO THE<br>/ELEVENTH DIGIT ENABLE COUNT<br>/HAVEN'T DISPLAYED ALL TEN                        |
|          |                                             | /HAVE DISPLAYED ALL 10 DIGITS,                                                                                                                                                |
| _        | 0                                           | 750 DISPLAT TRET ALL AGAIN                                                                                                                                                    |
| DIGIT,   | MOVAM<br>CALL<br>OUTIT                      | /GET THE PACKED BCD WORD INTO A<br>/THEN USE THE LOOK-UP TABLE TO<br>/DETERMINE THE PROPER SEQUENCE<br>/OF ONES AND ZEROES.                                                   |
|          | MOVAM<br>RLC<br>RLC<br>RLC                  | /GET THE SAME WORD AGAIN<br>/ROTATE THE FOUR MSB BITS INTO<br>/THE FOUR LSB BITS.                                                                                             |
| UTIT,    | RLC<br>AN I<br>0 1 7                        | /SAVE OVLY THE FOUR LSBS<br>/(017 = NEX OF)                                                                                                                                   |
|          | LXIH<br>BINSS                               | /LOAD REGISTER PAIR H OV THE STACK<br>/LOAD REGISTER PAIR H WITH THE<br>/BASE ADDRESS OF THE LOOK-UP TABLE.                                                                   |
|          | 0<br>ADDL<br>MOVLA                          | /ADD THE LO ADDRESS TO THE NUMBER IN A<br>/SAVE THE RESULT IJ THE L REGISTER                                                                                                  |
|          | JNC<br>OKASIS<br>0                          | /THERE IS NO CARRY, SO LEAVE THE<br>/CONTENT OF THE H REGISTER ALONE                                                                                                          |
| KASIS,   | 1 V RH<br>M V I A<br>377<br>0 UT            | /INCREMENT THE H REGISTER BY ONE<br>/OUTPHT AN INVALID DIGIT ENABLE CODE<br>/SO THAT THE DISPLAY IS BLANKED.                                                                  |
|          | 125<br>MOVAM<br>POPH<br>OUT<br>126<br>MOVAD | /GET THE SEVEN-SEGMENT CODE INTO A.<br>/POP REGISTER PAIR H OFF OF THE STACK<br>/THEN OUTPUT THE VALUE TO THE<br>/INTERFACE (7475 AVD UDN2981).<br>/GET THE DIGIT ENABLE CODE |
|          | 125                                         | VAND OUTPUT IT TO THE INTERFACE                                                                                                                                               |
| N TEN S, | INRD<br>MVIE<br>200                         | /INCREMENT THE DIGIT EVABLE<br>/LOAD E WITH A VUMBER<br>/200 = Hey 30 = DECIMAL 123                                                                                           |
| NTEN 1,  | DCRE<br>JNZ<br>INTENI                       | /DECREMENT THE NUMBER<br>/IF IT IS NO.4-ZERO, EXECUTE THE<br>/JNZ INSTRUCTION BACK TO INTENI                                                                                  |
|          | RET                                         | /WHEN E = 0, RETURN                                                                                                                                                           |
| 3IN 55,  | 077                                         | /SEVEN-SEGMENT CODE FOR 0                                                                                                                                                     |
|          | 133<br>117<br>146<br>155                    | /SEVEN-SEGMENT CODE FOR 2<br>/SEVEN-SEGMENT CODE FOR 3<br>/SEVEN-SEGMENT CODE FOR 4<br>/SEVEN-SEGMENT CODE FOR 5<br>/SEVEN-SEGMENT CODE FOR 6                                 |
|          | 007                                         | /SEVEN-SEGMENT CODE FOR 7<br>/SEVEN-SEGMENT CODE FOR 3<br>/SEVEN-SEGMENT CODE FOR 3                                                                                           |
|          | 000                                         | SEVEN-SEGMENT CODE FOR 10                                                                                                                                                     |
|          | 000                                         | /SEVEN-SEGMENT CODE FOR 11<br>/SEVEN-SEGMENT CODE FOR 12                                                                                                                      |
|          | 000                                         | /SEVEN-SEGMENT CODE FOR 13<br>/SEVEN-SEGMENT CODE FOR 14                                                                                                                      |
|          | 000                                         | /SEVEN-SEGMENT CODE FOR 15                                                                                                                                                    |

Fig. 4. Displaying a 10-digit number on a multiplexed LED display.

Fig. 5. Using a look-up table with the multiplexed LED display.

the number and the result output. After incrementing the digit enable code to two, the 8080 again executes the INTENS delay loop, so that the three on the second digit from the right is displayed for a reasonable amount of time. When the RET instruction is executed, the 8080 returns to the INXH instruction just before DISPL1.

The 8080 increments the memory address in register pair H and then examines the digit enable code contained in the D register. If this code is less than 012 (decimal 10), the 8080 jumps back to DISPL1 so that the two BCD digits now addressed by register pair H are displayed. If the digit enable code is equal to 012, then all ten digits in the number have been displayed. If this is the case, the 8080 jumps back to DISPLA so that the memory address in register pair H and the digit enable code in the D register are re-initialized.

As you can see from this program, the 8080 is constantly updating (writing new information out to the interface) the display. New digit enable codes and data values are output to the display every millisecond.

Unfortunately, this "ties up" the microcomputer and it cannot perform any other tasks. Of course, the program listed in Fig. 4 could be converted to a subroutine. If it is called every 15 or 20 ms, the 10-digit number will still be displayed at a reasonably fast rate. However, it may be difficult to program the microcomputer so that the DISPLA subroutine is called this often.

One solution to this problem is to use an interrupt. This means that whenever the 8080 is interrupted, it outputs a numeric value to the next consecutive digit in the display. The microcomputer will have to be interrupted at least 400 times every second for the display not to "flicker." This means that our 10-digit number will be displayed 40 times every second. To interrupt the 8080 so that it "services" the display this frequently, a low frequency oscillator (400 Hz) can be wired to one of the interrupt interfaces previously discussed.2,3

The program that services the interrupt and outputs a new

eight-bit value to the display interface is very similar to the software in Fig. 3. Because of its length, we have not included a listing of it. The only difference between the two programs is that the 8080 has to store the digit enable code and the address of the memory location that contains the next digit to be displayed. These values must be stored in memory, because register pair H and the D register may be used by the program that was interrupted. Therefore, each time the oscillator interrupts the microcomputer, it has to read from memory the address for the next digit to be displayed and its corresponding digit enable code. After the number is displayed, the digit enable code and the memory address have to be incremented and stored back in memory. To keep this software as simple as possible, it is easiest to store the 10-digit number in ten memory locations, one digit per memory location, rather than "packing" the BCD data.

One feature of our interface that we have not mentioned is the fact that we are limited by the DS8857 to display only the numbers 0 through 9. This device cannot be used if we wish to display the letters A through F, as is often the case if hexadecimal numbers or message codes need to be displayed. To display the hexadecimal characters 0-9 and A-F, the DS8857 must be replaced by a device that can be used to drive individual segments in any combination we desire. The UDN-2981A (Sprague Electric Company, Worcester MA) contains eight individual drivers that can be used in the display interface. This device has eight inputs and eight outputs-each input is interfaced to an individual data bus line by means of a latch circuit and each output is wired through a current-limiting resistor to one of the segment inputs of the display (A-G). If desired, the last driver in the integrated circuit can be used to drive the decimal point in the display. Since the UDN-2981A has eight inputs, an eight-bit output port (latch) will have to be used to interface it to the microcomputer. This means

that one output port will be used to output the sequence of ones and zeroes that specifies a specific sequence of segments to be turned on or off. A four-bit output port is also required so that the digit enable code can be output and stored in the interface.

In Fig. 5, there is a look-up table used for converting BCD numbers to seven-segment codes.

The first difference between the programs listed in Figs. 4 and 5 can be seen at DIGIT. After the packed BCD word is moved from memory to the A register, the OUTIT subroutine is called. This means that the first BCD digit to be displayed is in bits D3 through D0 of the A register. At OUTIT, bits D7 through D4 of the A register are set to zero. The content of register pair H is then saved on the stack and register pair H is loaded with the base address of the look-up table. The BCD number in the A register is added to this address. The MVIA and OUT instructions at OKASIS cause the display to be blanked by writing an invalid digit enable code out to the display interface. While the display is blanked, the 8080 moves the bit pattern for the number to be displayed from memory to the A register (MOVAM). Register pair H is then popped off the stack and the seven-segment bit pattern is output to output port 126. The A register is then loaded with the digit enable code which is output to output port 125. When the OUT 125 instruction is executed, the specified digit in the display is turned on. The 8080 executes an intensifying time delay loop before returning to the MOVAM instruction just after DIGIT.

The MOVAM instruction loads the A register with the same packed BCD word that contained the previously displayed digit. However, the BCD digit in bits D7 through D4 must now be displayed. Therefore, bits D7 through D4 are rotated into bits D3 through D0 of the A register before the 8080 executes the instructions at OUTIT which cause the required bit pattern for the sevensegment display to be fetched from the look-up table. The bit pattern followed by a digit enable code is then output to the interface. The remaining instructions in Fig. 5 are the same as the instructions in Fig. 4.

One advantage of using seven or eight individual segment drivers is that you can display any combination of segments that you want. You are no longer limited to the numbers 0-9. If desired, you can display the letters A-F so that hexadecimal numbers can be displayed. For some apecial applications, some additional letters and words can be displayed, such as H, r, L, o, OIL, HELP, Error, etc.

There is one additional display method that we have not discussed-the use of an external display controller integrated circuit to control the multiplexed display. The Intel Corporation makes a number of these integrated circuits that are compatible with the 4004/4040, 8080, and 8085. These are the 4269, 8279, and 8279-5 integrated circuits. National Semiconductor Corporation also has two display controller integrated circuits that can be used with six-digit displays. One of the devices (MM74C912) can be used to display 0-9 and the other (MM74C917) can be used to display hexadecimal numbers. For additional hardware and software information about multiplexed LED displays, we refer you to reference 4.

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 C. A. Titus, P. R. Rony, D. G. Larsen.

 C. A. Hus, P. H. Hony, D. G. Larsen, and J. A. Titus, 8080/8085 Software Design, Howard W. Sams & Co., Inc.. Indianapolis IN, 1978.



# Ham Help\_

I need an operator's manual and schematic for a BC-1031 panoramic adapter. I will gladly pay for all copying and postage.

Chuck Holstein WD5CUG 4721 Lucy Dr. El Paso TX 79924 I would like to copy or purchase the manual and/or schematic for the Multi-Elmac AF-67 transmitter and power supply. Can anyone help? Thanks.

Al Christman WD8CBJ Box 44 Granville WV 26534 I have some older VHF equipment that utilizes electron tubes (remember those things?). Anyway, there doesn't appear to be a ready market for the tubes I need and I can't find a distributor who sells them.

If anyone has one or more tubes I list below, I would appreciate hearing from them, particularly those having the 6850. The tubes I need are: 5696, 5718, 5896, 5899, 5902, 5940, 6021, 6112, and 6850. Many thanks.

Bill Walston KB5GD Drawer 1418 Rockport TX 78382

Does anyone have a Geiger counter in good working condition reasonably priced? Please send me the particulars.

Leroy Lawmaster W5HOM Rt. 1 Oak Hill Westville OK 74965

# DX

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#### clerk.

Although the story seems to be changing daily, it now appears that the DXCC desk will not accept TH8JM cards for credit. If you need this one, you will probably have to work John again when he gets his trueblue TL8 license.

TR8AC and TR8GDC recently moved to Alexandria, Egypt, and should be heard signing SU any day.

Anyone needing confirmation for an ET3FMA/9E3FMA/ 9F3FMA contact from 1965 to 1968 can send an SASE to Don Murray W4WJ, 19700 NW 5 Ct., Miami FL 33169.

ON4UN recently worked CR9AJ on 75 meters to complete his 5BWAZ. Five more QSLs and it will be confirmed. 5BWAZ is easily the most difficult operating award to obtain in all of hamdom.

The correct route for ZS2MI QSLs is WA2IEN, 255 Route 17, Upper Saddle River NJ 07458.

C5ABK has reportedly received permission to operate in CR3 Guinea-Bissau for two weeks in December. He is presently assembling the necessary equipment to make the operation a success and plans to open up on December 1st. QSL to G3LQP.

If you worked HV3SJ on November 11/12 and had your QSL bounced by W6KNH, try again. Logs for that period disappeared for awhile, but now they are safely in the hands of W6KNH, all 45 pages.

As we mentioned last month, several of the deserving were surprised last June when they received a citation from the FCC for contacting HS stations in Thailand. The citation stated that Thailand was on the banned countries list. Those responding received a follow-up form letter from the FCC saying only that in view of the reply, the matter was being closed. Apparently, no form letter exists for apologizing and admitting an error.

The Panamanian government has confirmed to the ARRL that HP9 callsigns have never been issued for use on amateur bands. Communication of any type with stations signing HP9 is illegal.

VR6TC has recently acquired some SSTV gear and has been showing regularly on 14233 kHz from 0530Z. QSL to W6HS.

All KZ5 Canal Zone licenses expire September 30, 1979.

9M2FK reports needing Arkansas, Utah, North Dakota, and South Dakota for WAS and Zone 2 for WAZ. Look for him on 14020 kHz between 1000Z and 1300Z.

Those of you involved in the DX net and/or DX list business should keep in mind that it is possible to violate third-party traffic regulations when passing a list to a DX station. If you compile a list and pass it directly to a station in a non-thirdparty country, then you could be in violation. If you say "DX1DX call W5USA," then you are in violation. The correct way would be to say "W5USA call DX1DX." If you think this is just nit-picking, then be advised that some FCC monitoring types are on the prowl for just such violations.

Jim Smith P29JS finally received an answer from the Indian government concerning his application for permission to operate from Andaman. Unfortunately, the letter stated that new rules beginning in January, 1979, made it impossible to grant licenses for short stays.

Rumors floated hot and heavy that XZ2P was SP5AUC and that his was a true-blue operation. Unfortunately, the real SP5AUC denied the rumor and that sort of ended that.

While in Poland, we might mention that Polish amateurs are now allowed to work 160 meters between 1750 kHz and 1950 kHz. Maximum power is 10 Watts.

New officers of Murphy's Marauders include AI Meleg N1JW—President, Ron Grzelak K1BW—Vice President, Dan Street K1TO—Activities Manager, and Ron Nevers K1TVM—Secretary/Treasurer. Newsletter editor is Ed Kalin K1RT.

WA1SQB ran off better than 5000 contacts during his HC8 operation in March. He should be setting up in Montserrat this month where he will be signing either VP2MAY or VP2MI.

Last month we mentioned that sending currency through the mails to foreign hams could bring trouble to the recipient. If you are in doubt as to which countries can receive USA currency in the mails, ask your local post office to check through the Foreign Postal Manual for the country in question. Any illegal items are listed in this manual.

If you've worked everything else, then you might try for all the cities and districts in Japan. A full list can be obtained by sending 14 IRCs or \$8.00 to Michio Koshimizu JR1BFT, 37-3, Nakano, 1-chome, Nakanoku, Tokyo 164, Japan.

Tom Wong VE7BC recently returned from a business trip to China. While he was there, he inquired into the possibility of obtaining an operating permit for a future visit. Tom says that the current policy of the Central Government is that there will be no amateur radio operation. It seems that there will probably have to be some top-level changes made before any legitimate operation occurs. Tom feels, however, that this is entirely possible, and with the great interest in amateur radio, something might develop before the end of the year. The feeling still runs strong that when a legitimate operation does surface, it will be by the Chinese themselves and not a group of war-mongering, Imperialist, running-dog lackeys, or whomever. Keep the faith.

That Soviet ski team that was signing U0CR successfully reached the North Pole last July.

ZS5DC is Diane Cardell, formerly VQ9DC, now living in Durban. Diane was in on the big Desroches effort by VQ9D, VQ9BP, and others back in 1974.

That HB9APN/BY operation a



Jean F5FV and his nice layout in France. When not chasing DX for himself, Jean serves as QSL Manager for FB8XV.

few months back did not have official approval and is not being accepted for DXCC credit.

Several "goodies" have been checking into the WA2JUQ Net on 14240 kHz. Heard recently were TA1MB, Y11BGD, FH8YL, and ZS2MI on Marion Island. The time to listen is around 0630Z.

Another net to watch is the DX-DX Net on 21280 kHz. Listen from 1600Z.

Vendaland is the third of the nine African homelands being established by South Africa, the first two being S8 Transkei and H5 Bophuthatswana. Independence day is set for September 13 and several ZS types plan to be there for the unveiling. ZS6AK and ZS6ABO will head a contingent of eight Durban DXers planning to make the 200mile trip. DXCC status is expected to be the same as Transkei and Bophuthatswana, that is, no decision until after WARC 79 and then a favorable decision made retroactive back to the date of independence.

JF1IST/7J showed on schedule from Okino Torishima with a very good signal to most of the states. The one-man effort opened up on June 11th and ran through June 15th with WB8LDH the last station logged at 0653Z. Weather conditions cut short the expected ten-day stay, but some 5500 contacts were made on 6 through 40 meters. QSL to JA1RNH, Itaru Tomita, 1-2-9, Zaimokuza, Kamakura, 248 Japan.

This is the month (September) the ARRL begins accepting Desecheo QSLs for DXCC credit.

Reports have all 7Q7 stations being shut down and their equipment confiscated.

Slim showed from 3Y6CD in June and from 9A1VU earlier in the year.

The correct route for all FH8OM/YL QSLs is to Box 86, Dzazoudi, 97600 Mayotte...via France.

The Guatemalan Radio Society indicates that TG7AA was Slim and the ARRL is returning the cards without allowing DXCC credit.

There is a multi-national effort being planned for a fifteenday operation from 3V8 Tunisia this month. Amateurs from France, Italy, and the UK will man as many as ten different stations.

UHF marine-band applicants are being asked to make up their own callsigns until the overworked FCC can get their applications processed and the regular type licenses in the mail.

If you paid more than \$20.00 to the FCC between August 1, 1970, and December 31, 1976, you are eligible for a refund. If you are eligible, then you should obtain a copy of the "Phase One Fee Refund Program" instruction and form manual from your nearest FCC field office or Federal Information Center. Check the June QST for more information.

Remember that EI8H/anything is always Slim and you will save time and money.

Bill KA2WG writes to remind us all that even though KA stations are not recognized as amateur stations by the Japanese government, they still count as Japan for everything except the All Asia Contest, Any US ham being transferred to Japan or Okinawa as US military or a civilian employee of the

military is eligible to obtain a KA license. For more information, contact FEARL, c/o Sam Flemming, USAGH D/O, APO SF 96343.

That's about it for this month. I hope some of the information provided here will help you pick up a few new ones. If it does, let me know. In the meantime, don't forget we are always looking for DX info and pictures. Any pictures you send us can be returned if you wish. In the meantime, best DX and health.

Thanks as always to the West Coast DX Bulletin, LIDXA Newsletter, and WorldRadio Magazine for much of the preceding information

Looking West\_

#### from page 10

#### **USER RIGHTS**

Question: What rights, if any, do repeater users have when being repeated through the station of another amateur? This is a question being fiercely debated in southern California and elsewhere. It recently surfaced here in Los Angeles when one of the control operators on the WA6KOS/R system turned the repeater off on a system user because of the "content of communications." The operator in question yelled "censorship" and the controversy ensued.

One group feels that the system owner, licensee, or control station does not have the right to turn off the repeater for any reason other than a technical malfunction, and that the repeater is akin to a public utility and therefore must be kept on the air regardless of what is repeated. This group feels that the total responsibility for "content of communications" rests with the individual system user. and the use of jamming, music, and even profanity is left to his discretion. To turn a repeater off under these circumstances is an act of censorship against the originating station.

The other side yells "wrong!" The FCC rules clearly state that an amateur station may not transmit profanity, unidentified signals, or music, and that a repeater does constitute an amateur station. Therefore, not only do the system licensee and control operators have a right to terminate system operation in such circumstances as outlined above, but under the terms of Parts 97.113, 97.115, 97.116, 97.119, 97.123, and 97.125 of the FCC Rules and Regulations, they are directly obligated to take such action. To do otherwise directly violates FCC rules. This group also feels that once an amateur decides to operate through a repeater, he is, in effect, operating through the station of another amateur. Therefore, when operating through a repeater, the user gives up any First Amendment rights and is totally subject to the will of the system owner/licensee. Whatever standards, guidelines, and

regulations the licensee sets for user operation must be adhered to without question.

Where do we find the answers? Part 97? Have any of you read Part 97 lately? The FCC regulations, in relation to repeater operation, are too ambiquous. For that reason, I have written a letter to the FCC asking direct questions about repeater operation, regulatory enforcement, and other related matters. The letter was written on June 19, 1979, and was mailed to the FCC on June 23rd. It is presented below for your information. If received, the FCC's response will also be presented in this column.

Federal Communications Commission M Street Washington DC Attn: Personal Communications Division

#### Gentlemen:

I wish to ask some specific questions in regard to Part 97 of the Amateur Rules and Regulations, concerning amateur repeater operation. 1) Who is responsible for "content of communications," the system licensee or the system user?

2) If a repeater system owner permits profanity and unidentified transmissions to be "repeated" via his repeater system (while his system is operational under fully automatic remote control), is he legally responsible for the content of such communications? Can he legally censor such communications? Should he?

3) Does the FCC hold any one person legally responsible for "content of communications" and all other aspects of amateur repeater operation?

4) What constitutes an operational amateur repeater-an established repeater, known to the community, or a repeater system that happens to be operating at any given moment?

5) If an established amateur repeater is resting between transmissions and another amateur decides to operate during that time, is the established amateur guilty of jamming when he operates once again, or is the new operator considered responsible for the subsequent jamming?

6) If the conduct of any amateur is considered by his peers to be obnoxious, although he may be technically operating within the regulations of Part 97, can the amateur community, through the Commission, take any legal action to stop said amateur? 7) Why is the Commission unwilling to

heed the calls for help from amateurs

who are suffering the outrage of willful and malicious interference on both high frequency SSB and VHF FM repeater operations?

8) Is the Commission willing to en-force the terms of Part 97 of the Amateur Rules and Regulations regarding profanity and unidentified transmissions (97.116, 97.119, and 97.123)? If not, why not?

9) Why hasn't the Commission acted to suspend or revoke the amateur license of one Scott Lookholder WB6LHB? He was convicted in federal court on a charge of using foul and abusive language on the two-meter amateur band. I have copies of letters sent to the Commission by southern California amateurs requesting such action. Does the Commission intend to act in this matter?

10) What action can we amateurs take to rid the community of the individuals who, licensed or unlicensed, willfully and maliciously jam, harass, and intimidate the law-abiding ama teur's day-to-day operation? Would the Commission be willing to act if supplied documentation of such violations? Exactly what type of documentation does the Commission require before acting on such reported violations? 11) If I challenge the right of another

amateur to hold an amateur's license because he operates his amateur station in violation of the regulations as set forth in Part 97, what possible Commission action can be taken? Must I file a formal challenge with your office?

12) Please define the following (using specific examples) as they relate to our subject:

A) willful and malicious interference

B) unidentified transmissions C) profanity and indecency

I intend to publish this letter - and your response - in my "Looking West" column. Many amateur repeaters are suffering tremendous willful and malicious interference problems, and it is my hope to help guide them toward a solution. Your response to these questions will be appreciated.

Yours truly, William M. Pasternak

I wish to credit WB2MIC for arousing my interest in this subject. In the June issue of 73, a letter appeared from Jozef which relates directly to the situation out here. Jozef felt that he was treated unfairly by a repeater licensee who may have arbitrarily censored him. I must state my personal belief that, while I may not agree with arbitrary censorship by control operators and system licensees in certain situations, these people are clearly within their rights when they choose to censor. While you and I may not want to adhere to these standards, we are obligated to do so because we really have no alternative. I remember being told by one

amateur that he felt he was a "god" by virtue of the fact that he owned and operated his own repeater. If he demanded that his users "paint their radios with red stripes and operate only while standing on their heads," they had better adhere to his dictates "or else." He had absolutely no compunction whatsoever about turning off his repeater if someone even "sneezed the wrong way." He was clearly "the boss."

It sounds absurd, but that's the way he felt. Having never operated through his system, I cannot tell you how tight a ship he really runs. Jozef and many others are unhappy with this unresolved situation. The problem is spreading. Only the FCC can make a final determination of this matter, and we await their answer.

#### HANDLING MALICIOUS INTERFERENCE DEPARTMENT

A few months ago, "Looking West" ran a series of articles on the problem of how to deal with malicious interference. While the amount of response to my questions has not been overwhelming, I have received a few letters. Over the next few months, I hope to bring you some of my respondents' views.

The following letter appeared in the June issue of the Mt. Lee (CA) Repeater Association Newsletter and is relevant to our discussion:

The jammers must be getting quite a laugh out of repeater users and owners these days, because a lot of us are so easy to bait.

A jammer with nothing better to do will figure out someone's weakness and rub that person the wrong way. Often this jamming is legal, because the one doing the jamming is a ham and uses proper prodecure. The jammer, by manipulating the right people with the right words, can tie up a repeater with hours of counter-jamming, shouting matches, and arguments. Former "good guy" hams, when baited and sufficiently angered, may resort to counter-jamming the original troublemaker. The jammer's gotten what he wants: People have taken his bait. A good example of this might be the licensed ham who uses CW on a repeater. He uses correct procedure, callsigns, and breaks properly, but may be trying to bait a response. CW, RTTY, and SSTV are legal on repeaters if mode and bandwidth rules are obeyed. Instead of reacting with hostility, come back with perfect F1 30-wpm telegraphy! What rubs you the wrong way? Do you fall for the bait?

Some of us feel that high power is

the solution to jamming. Boy, it feels good to talk right over the twerp with your 150 Watts and listen to the capture effect on your duplex! Secretly, you probably hope the jammer also has duplex so that he can hear his puny signal get stomped. Although this is satisfying, it creates problems. With 150 Watts versus the 2 Watts of the jammer, the DF committee will have a hard time hearing the jammer. Many jammers don't care if they are Q-5 into a repeater or not, because they get their jollies causing discomfort to other hams.

"Sorry OM ... no copy ... you're being jammed ... 73." You, the legitimate ham, have just succumbed to a psychological defeat from the jammer. The jammer is laughing at you. Try to sign off gracefully, if you're not succeeding. Don't give him his kicks by going QSY or QRT. Try to draw the jammer out the same way he baits us. Bait the jammer, legally ... don't talk *to* him, talk *about* him to another ham. Don't get into jamming him. Instead, go to low power and allow plenty of time for breaks. It's unpleasant to hear one of these clowns and you may want to "cover" him, but be sure to leave a space for the DF committee to listen in. While drawing out a jammer, it is important not to act as he does. It's easy to get mad and jam the jammer. Aren't we better than that?

Most of us have a local repeater ... a machine we like to hang out on, meet our friends, etc. It is hard to break away from a favorite machine and go somewhere else. We are loyal to the repeater or club to which we belong. When most of us get mad at a jammer, we want to make our stand on our own machine. When the jammer is forced off our repeater or decides to hassle another group, we tend to become temporarily apathetic about our common problem.

Jammers have knobs on *their* radios, although it seems some hams don't ... and these hams should be helping the ham community by following the jammer around the dial. All repeater users should get some sense of community and try to pool personnel and equipment to beat this thing. We must be able to continue the hunt even if the jammers have left "our" repeater and moved to another. The jammers seem secure in knowing that they can change frequencies without other repeater groups following.

DFers already know what to do, and the average user can also help. When the carriers or cursing start, listen to the input to the repeater. Normally, your radio is set so that you are transmitting on 147.84 MHz (the input) and receiving on 147.24 MHz (the output). Reverse this setup, or at least find a way to listen on 147.84. (Transmitting on 147.24 is not necessary.) Now, check your S-meter; is the needle 25% over from 0? 80%? 100%? Break with your call, QTH, cross-streets, time of day, and date, and tell the "woodwork" what % reading you have. See if any other breakers would like to give their reports. (We use % of signal instead of S-units because S-meters are not standard or accurate.)

Let's hope we can end apathy on the airwaves and pool our resources. After all, the jamming is only a by-product of our apathy. The problems on repeaters affect us all, and high-power amps, private systems, and 800-channel radios are not adequate solutions to our common problem.

An Interested User

73.

# Review

#### TELEVISION HANDBOOK FOR THE AMATEUR

A large number of hams are professionals in the field of commercial television. Their daily involvement in the world of video gives them a headstart in understanding and operating a fast scan television station. The rest of the population shouldn't be discouraged, though. The book, *Television Handbook for the Amateur*, is a real help in bridging the gap between beginner and pro.

Television Handbook is published by Aptron Laboratories and a paperback edition costs \$6.50. The author, Biagio Presti, is not a ham, but as president of Aptron, he is familiar with amateur television efforts. The first two-thirds of the book is devoted to theory, while the remaining 30 pages discuss construction projects and include tables dealing with radio transmission and television standards.

By minimizing the use of mathematics and including numerous illustrations, the author is able to make the theory chapters down to earth and very understandable. The circuits used to generate a video signal are thoroughly described. To get the most benefit from these chapters, the reader should have a good background in basic transistor circuit design. If you are studying for an Extra class license, the *Television Handbook* may be helpful. Questions concerning television theory appear on some versions of the exam.

There is an abundance of information about special circuits that won't be found in the usual amateur references. Color television may be more of a dream than a reality for most beginning ATVers, but the reader's appetite is whetted by a short summary of the principles involved. The contents of these chapters will be of interest long after your first ATV QSO.

The construction chapters are similar to the theory section.

The sub circuits that comprise 450-MHz transmitters and recelvers are tackled individually. It is not like the wire-by-wire description frequently found in some ham publications. There is adequate information for the experienced home-brewer. As a bonus, you will have a good understanding of the theory behind the design.

The recent appearance of commercial equipment and beginner-oriented literature has helped to put fast scan television within the reach of many hams. *Television Handbook for the Amateur* does not give complete coverage of the subject, but for a ham who aspires to be more than an appliance operator, it is bound to be useful.

Tim Daniel N8RK/1 Peterborough NH

# **OSCAR** Orbits

Courtesy of AMSAT

The listed data tells you the time and place that OSCAR 7 and OSCAR 8 cross the equator in an ascending orbit for the first time each day. To calculate successive OSCAR 7 orbits, make a list of the first orbit number and the next twelve orbits for that day. List the time of the first orbit. Each successive orbit is 115 minutes later (two hours less five minutes). The chart gives the longitude of the day's first ascending (northbound) equatorial crossing. Add 29° for each succeeding orbit. When OSCAR is ascending on the other side of the world from you, it will descend over you. To find the equatorial descending longitude, subtract 166° from the ascending longitude. To find the time OSCAR 7 passes the North Pole, add 29 minutes to the time it passes the equator. You should be able to hear OSCAR 7 when it is within 45 degrees of you. The easiest way to determine if OSCAR is above the horizon (and thus within range) at your location is to take a globe and draw a circle with a radius of 2450 miles (4000 kilometers) from your QTH. If OSCAR passes above that circle, you should be able to hear it. If it passes right overhead, you should hear it for about 24 minutes total. OSCAR 7 will pass an imaginary line drawn from San Francisco to Norfolk about 12 minutes after passing the equator. Add about a minute for each 200 miles that you live north of this line. If OSCAR passes 15° east or west of you, add another minute; at 30°, three minutes; at 45°, ten minutes. Mode A: 145.85-.95 MHz uplink, 29.4-29.5 MHz downlink, beacon at 29.502 MHz. Mode B: 432.125-.175 MHz uplink, 145.975-.925 MHz downlink, beacon at 145.972 MHz.

OSCAR 8 calculations are similar to those for OSCAR 7, with some important exceptions. Instead of making 13 orbits each day, OSCAR 8 makes 14 orbits during each 24-hour period. The orbital period of OSCAR 8 is therefore somewhat shorter: 103 minutes. To calculate successive OSCAR 8 orbits, make a list of the first orbit number (from the OSCAR 8 chart) and the next thirteen orbits for that day. List the time of the first orbit. Each successive orbit is then 103 minutes later. The chart gives the longitude of the day's first ascending equatorial crossing. Add 26° for each succeeding orbit. To find the time OSCAR 8 passes the North Pole, add 26 minutes to the time it crosses the equator. OSCAR 8 will cross the imaginary San Francisco-to-Norfolk line about 11 minutes after crossing the equator. Mode A: 145.85-95 MHz uplink, 29.4-29.50 MHz downlink, beacon at 29.40 MHz. Mode J: 145.90-146.00 MHz uplink, 435.20-435.10 MHz downlink, beacon on 435.090 MHz.

| Orbit    | OSCAR 7<br>Date<br>(Sep) | Orbital In<br>Time<br>(GMT) | formation<br>Longitude<br>of Eq.<br>Crossing °W | Orbit   | OSCAR 8<br>Date<br>(Sep) | Orbital In<br>Time<br>(GMT) | iformation<br>Longitude<br>of Eq.<br>Crossing *W |
|----------|--------------------------|-----------------------------|-------------------------------------------------|---------|--------------------------|-----------------------------|--------------------------------------------------|
| 21928    | 1                        | 0053:46                     | 78.5                                            | 7593Jbn | 1                        | 0056:12                     | 60.0                                             |
| 21941    | 2                        | 0148:03                     | 92.1                                            | 7607Jbn | 2                        | 0101:22                     | 61.3                                             |
| 21953arp | 3                        | 0047:23                     | 76.9                                            | 7621Abn | 3                        | 0106:31                     | 62.6                                             |
| 21966    | 4                        | 0141:40                     | 90.5                                            | 7635Abn | 4                        | 0111:41                     | 63.9                                             |
| 21978X   | 5                        | 0041:00                     | 75.4                                            | 7649X   | 5                        | 0116:50                     | 65.2                                             |
| 21991    | 6                        | 0135:17                     | 89.0                                            | 7663Abn | 6                        | 0122:00                     | 66.5                                             |
| 22003    | 7                        | 0034:38                     | 73.8                                            | 7677Abn | 7                        | 0127:09                     | 67.8                                             |
| 22016    | 8                        | 0128:55                     | 87.4                                            | 7691Jbn | 8                        | 0132:19                     | 69.1                                             |
| 22028    | 9                        | 0028:15                     | 72.3                                            | 7705Jbn | 9                        | 0137:28                     | 70.4                                             |
| 22041grp | 10                       | 0122:32                     | 85.9                                            | 7719Abn | 10                       | 0142:38                     | 71.7                                             |
| 22053    | 11                       | 0021:52                     | 70.7                                            | 7732Abn | 11                       | 0004:33                     | 47.2                                             |
| 22066X   | 12                       | 0116:09                     | 84.3                                            | 7746X   | 12                       | 0009:43                     | 48.5                                             |
| 22078    | 13                       | 0015:29                     | 69.1                                            | 7760Abn | 13                       | 0014:52                     | 49.8                                             |
| 22091    | 14                       | 0109:46                     | 82.7                                            | 7774Abn | 14                       | 0020:02                     | 51.2                                             |
| 22103    | 15                       | 0009:06                     | 67.6                                            | 7788Jbn | 15                       | 0025:11                     | 52.5                                             |
| 22116    | 16                       | 0103:23                     | 81.2                                            | 7802Jbn | 16                       | 0030:20                     | 53.8                                             |
| 22128qrp | 17                       | 0002:44                     | 66.0                                            | 7816Abn | 17                       | 0035:30                     | 55.1                                             |
| 22141    | 18                       | 0057:00                     | 79.6                                            | 7830Abn | 18                       | 0040:39                     | 56 4                                             |
| 22154X   | 19                       | 0151:17                     | 93 2                                            | 7844X   | 19                       | 0045:48                     | 57 7                                             |
| 22166    | 20                       | 0050:38                     | 78.1                                            | 7858Abn | 20                       | 0050:58                     | 59.0                                             |
| 22179    | 21                       | 0144:55                     | 91.7                                            | 7872Abn | 21                       | 0056:07                     | 60.3                                             |
| 22191    | 22                       | 0044:15                     | 76.5                                            | 7886Jbn | 22                       | 0101 16                     | 616                                              |
| 22204    | 23                       | 0138:32                     | 90.1                                            | 7900Jbn | 23                       | 0106:26                     | 62.9                                             |
| 22216qrp | 24                       | 0037:52                     | 75 0                                            | 7914Abn | 24                       | 0111:35                     | 64 2                                             |
| 22229    | 25                       | 0132:09                     | 88 5                                            | 7928Abn | 25                       | 0116.44                     | 65.5                                             |
| 22241X   | 26                       | 0031:29                     | 73.4                                            | 7942X   | 26                       | 0121:53                     | 66 8                                             |
| 22254    | 27                       | 0125:46                     | 87.0                                            | 7956Abn | 27                       | 0127:03                     | 68 1                                             |
| 22266    | 28                       | 0025:06                     | 71.8                                            | 7970Abn | 28                       | 0132.12                     | 69.4                                             |
| 22279    | 29                       | 0119:23                     | 85.4                                            | 7984Jbn | 29                       | 0137:21                     | 70 7                                             |
| 22291    | 30                       | 0018:44                     | 70 3                                            | (889)pu | 30                       | 0142.30                     | /20                                              |

# Awards

ASIA

| from | page | 28 |
|------|------|----|
|      |      |    |

#### SOUTH AMERICA

| CE            | Chile                           |
|---------------|---------------------------------|
| CEGA          | Easter Is.                      |
| CEOX          | San Felix                       |
| CP            | Bolivia                         |
| CX            | Uruguay                         |
| FY<br>HC      | French Guiana<br>Ecuador        |
| нса           | Galapagos Is.                   |
| нк            | Colombia                        |
| HKO           | Bajo Nuevo                      |
| HKO           | San Andres &                    |
|               | Providencia                     |
| HP            | Panama                          |
| HRe           | Swan Is.                        |
| KZ            | Canal Zone                      |
| LU            | Argentina                       |
| PJ            | Peru<br>Bonaire                 |
| PJ            | Netherlands Antilles            |
| PY            | Brazil                          |
| PY            | St. Peter & St. Paul            |
| PYE           | Trinidade & Martim Vaz Is.      |
| PZ            | Surinam                         |
| TI            | Costa Rica                      |
| T19           | Cocos Is.                       |
| VP1           | Belize<br>Folkland to           |
| VP8. LU       | South Georgia Is.               |
| VP8, LU       | South Orkney Is.                |
| VP8, LU       | South Sandwich Is.              |
| VP8W          | South Grahamiand                |
| YN            | Nicaragua                       |
| YS            | Salvador                        |
| YVe           | Aves is.                        |
| ZP            | Paraguay                        |
| 8R            | Guyana<br>Telejidad and Telesco |
| 91            | Innidad and I Doago             |
| EURODE        |                                 |
| EUNOPE        |                                 |
| C3            | Andorra                         |
| CT2           | Azores                          |
| DA-DL         | Federal Republic of Germany     |
| EA            | Spain                           |
| EA8           | Balearic Islands                |
| EI            | Republic of Ireland             |
| F             | France                          |
| FC            | Corsica                         |
| G             | England<br>Isle of Man          |
| GI            | Northern Ireland                |
| GJ, GC        | Jersey                          |
| GM            | Orkney Islands                  |
| GM            | Shetland Islands                |
| GU, GC        | Guernsey                        |
| HA            | wates<br>Hundary                |
| нв            | Switzerland                     |
| HB®           | Liechtenstein                   |
| 1             | Italy                           |
| IC            | Ischia                          |
| 15            | Sardinia                        |
| IT            | Sicily                          |
| JW            | Bear Is.                        |
| JX            | Jan Mayen                       |
| LA            | Norway                          |
| LX            | Luxembourg<br>Bulossia          |
| MI            | San Marino                      |
| OE            | Austria                         |
| OH            | Finland<br>Aland is             |
| OJe           | Market Reef                     |
| OK            | Czechoslovakia                  |
| OY            | Faeroe Islands                  |
| oz            | Denmark                         |
| PA            | Netherlands<br>Sweden           |
| SP            | Poland                          |
| SV            | Greece                          |
| SV            | Dodecanese                      |
| SV            | Mount Athos                     |
| UA. UK1 3 4 A | European RSFSR                  |
| UA1, UK1      | Franz Josef Land                |
| UA2, UK2F     | Kaliningradsk                   |
| UC2, UK2      | White RSFSR                     |
| UO5, UK50     | Moldavia                        |
| UP2, UK2B, P  | Lithuania                       |
| UR2, UK2R, T  | Estonia                         |
| YO            | Romania                         |
| ZA            | Albania                         |
| ZB            | Gibraltar                       |
| 3A<br>411     | Monaco<br>ITU, Geneva           |
| 94            | (See M1)                        |

| A4X                                                                                                                                                                                                                                 | Oman Is.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A5                                                                                                                                                                                                                                  | Bhutan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| A6X<br>A7X                                                                                                                                                                                                                          | United Arab Emirates                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| A9X                                                                                                                                                                                                                                 | Bahrain                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| AP                                                                                                                                                                                                                                  | Pakistan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| BY                                                                                                                                                                                                                                  | Taiwan<br>China                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| CR9                                                                                                                                                                                                                                 | Macao                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| EP                                                                                                                                                                                                                                  | Iran<br>North Konne                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| HL, HM                                                                                                                                                                                                                              | South Korea                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| HS                                                                                                                                                                                                                                  | Thailand                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| HZ, 7Z                                                                                                                                                                                                                              | Saudi Arabia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| JR6 KA6                                                                                                                                                                                                                             | Japan<br>Okinawa (Ryukyu Is.)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| JD, KA1                                                                                                                                                                                                                             | Ogasawara                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| JT                                                                                                                                                                                                                                  | Mongolia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| KA                                                                                                                                                                                                                                  | US Military in Japan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| OD                                                                                                                                                                                                                                  | Lebanon                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| S2                                                                                                                                                                                                                                  | Bangladesh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| UA. UK. UV.                                                                                                                                                                                                                         | Asiatic RSFSR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| UW9-0                                                                                                                                                                                                                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| UD6, UK6C, D, K                                                                                                                                                                                                                     | Azerbaidzhan<br>Georgia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Q, V                                                                                                                                                                                                                                | Georgia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| UG8, UK6G                                                                                                                                                                                                                           | Armenia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| UHS, UKSH                                                                                                                                                                                                                           | lurkoman<br>Ilzbek                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| UJ8, UK8J, R                                                                                                                                                                                                                        | Tadzhik                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| UL7, UK7                                                                                                                                                                                                                            | Kazakh                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| VS6                                                                                                                                                                                                                                 | Hona Kona                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| VS9K                                                                                                                                                                                                                                | Kamaran Is.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| VU                                                                                                                                                                                                                                  | India<br>Andomen 8 Minutes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| VU7                                                                                                                                                                                                                                 | Laccadives                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| XU                                                                                                                                                                                                                                  | Khmer Republic                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| XV                                                                                                                                                                                                                                  | Vietnam                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| XZ                                                                                                                                                                                                                                  | Burma                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| YA                                                                                                                                                                                                                                  | Afghanistan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| YI VK                                                                                                                                                                                                                               | Iraq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| 15                                                                                                                                                                                                                                  | Spratly                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| 45                                                                                                                                                                                                                                  | Sri Lanka                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| 4X, 4Z                                                                                                                                                                                                                              | Israel                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 8Z4                                                                                                                                                                                                                                 | Neutral Zone                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
|                                                                                                                                                                                                                                     | Saudi Arabia/Iraq                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 9H                                                                                                                                                                                                                                  | Malta<br>Gozo & Coming                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 9K                                                                                                                                                                                                                                  | Kuwait                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| 9M2                                                                                                                                                                                                                                 | West Malaysia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 9M6<br>9M8                                                                                                                                                                                                                          | North Borneo                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| 9N                                                                                                                                                                                                                                  | Nepai                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 9V                                                                                                                                                                                                                                  | Singapore                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|                                                                                                                                                                                                                                     | Abu Ail, Jabal Attair                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| OCEANIA                                                                                                                                                                                                                             |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| 43                                                                                                                                                                                                                                  | Tanna Basubila                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| CR8                                                                                                                                                                                                                                 | Portuguese Timor                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| C2                                                                                                                                                                                                                                  | Republic of Nauru                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| DU                                                                                                                                                                                                                                  | Philippines<br>New Caledonia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| FO                                                                                                                                                                                                                                  | French Polynesia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| FW                                                                                                                                                                                                                                  | Wallis & Fortuna Islands                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| H4, VR4                                                                                                                                                                                                                             | Solomon Islands<br>Minami Torishima                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| JD, 7J1                                                                                                                                                                                                                             | Okino Torishima                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| KB, KH1                                                                                                                                                                                                                             | Baker, Howland, America                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| KC6                                                                                                                                                                                                                                 | Phoenix<br>Fastern Carolinas                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| KC6                                                                                                                                                                                                                                 | Western Carolines                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| KG6, KH2                                                                                                                                                                                                                            | Guam Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| KG6R                                                                                                                                                                                                                                | and the                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| KG6S                                                                                                                                                                                                                                | Sainan                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| KG6S<br>KG6T                                                                                                                                                                                                                        | Saipan<br>Tinian                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| KG6S<br>KG6T<br>KH6                                                                                                                                                                                                                 | Nota<br>Saipan<br>Tinian<br>Hawaiian Islands                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3                                                                                                                                                                                               | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4                                                                                                                                                                                    | Hota<br>Saipan<br>Tinian<br>Hawailan Islands<br>Kure Island<br>Johnston Island<br>Midway Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH5K                                                                                                                                                                       | Hota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH5<br>KP8, KH5<br>KS6, KH4                                                                                                                                                | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH4<br>KP6, KH5<br>KS6, KH8<br>KS6, KH8<br>KW, KH9                                                                                                                         | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH4<br>KP6, KH5<br>KP8, KH5<br>KS6, KH8<br>KW, KH9<br>KX                                                                                                                   | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marshall Islands                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH3<br>KP6, KH5<br>KS6, KH5<br>KS6, KH8<br>KX<br>KX<br>P2<br>T2, VR8                                                                                                                   | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Papua, New Guinea<br>Tuvalu Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH5K<br>KP6, KH5K<br>KP8, KH5<br>KK4, KH9<br>KX<br>P2<br>T2, VR8<br>VK                                                                                                     | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| KG65<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5K<br>KP6, KH5K<br>KS6, KH6<br>KX<br>KX<br>K4<br>K4<br>K4<br>K2<br>K2<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4<br>K4                      | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marshall Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5<br>KS6, KH5<br>KS6, KH6<br>KX<br>KW, KH9<br>KX<br>F2<br>YC<br>YK9<br>VK<br>VK9<br>VK9                                                                                  | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samos<br>Wake Island<br>Marshall Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| KG6S<br>KG6T<br>KH7<br>KJ, KH3<br>KM, KH4<br>KM, KH4<br>KM, KH5<br>KK8, KH8<br>KW, KH9<br>KX<br>P2<br>T2, VR8<br>VK<br>VK<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                                                 | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshall Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Christmas Island<br>Keeling, Cocos Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH5K<br>KP8, KH5<br>KS6, KH8<br>KX, KH9<br>KX<br>K2, VR8<br>VK<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                                     | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Mellish Reef<br>Nordok Listand                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5K<br>KP6, KH5K<br>KP6, KH5K<br>KP6, KH5K<br>KP8, KH5<br>KK8, KH8<br>KX, KH8<br>KX, KH8<br>KX, VK8<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9 | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Melliah Reef<br>Norfolk Island                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| KG6S<br>KG6T<br>KH7<br>KJ,K13<br>KH7<br>KJ,K13<br>KM,KH4<br>KP6,KH5K<br>KP6,KH5<br>KK86,KH8<br>KW,K19<br>KX<br>P2<br>C2<br>KK8<br>VK<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                 | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshall Islands<br>Australia<br>Lord Howe Island<br>Willis Island<br>Keeling, Cocos Island<br>Marchak Island<br>Keeling, Cocos Island<br>Macquarie Island<br>Bartlah Phoenix Islands                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| KG6S<br>KG6T<br>KH7<br>KH7<br>KH7, KH3<br>KM, KH4<br>KP8, KH5<br>KS8, KH8<br>KW, KH9<br>KX<br>P2<br>T2, VR8<br>VK<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                                    | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshall Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Mellish Reef<br>Norfolk Island<br>Macquarie Island<br>British Phoenix, Islands<br>Gilbert Island                                                                                                                                                                                                                                                                                                                                                                                                                                |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP6, KH5K<br>KP8, KH5<br>KK8, KH8<br>KX, KH9<br>KX<br>KY<br>KY<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                            | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samos<br>Wake Island<br>Marshail Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Melliah Reef<br>Norfolk Island<br>Britlish Phoenix Islands<br>Gilbert Island<br>Britlish Phoenix Islands<br>Gotha Island<br>Coraa Island                                                                                                                                                                                                                                                                                                                                                                                        |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5K<br>KP6, KH5K<br>KP8, KH5<br>KK8, KH8<br>KW, KH9<br>KX<br>P2<br>VK0<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                              | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Marshali Islands<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Melliah Reef<br>Norfolk Island<br>Britlah Phoenix Island<br>Britlah Phoenix Island<br>Cena Island<br>Christmas Island<br>Christmas Island<br>Pitcalm Island                                                                                                                                                                                                                                                                                                                                                                                       |
| KG6S<br>KG6T<br>KH7<br>KJ, KH3<br>KH7, KH4<br>KH7, KH4<br>KP8, KH5<br>K%, KH5<br>K%, KH8<br>K%, KH8<br>K%<br>YK9<br>YK9<br>YK9<br>YK9<br>YK9<br>YK9<br>YK9<br>YK9<br>YK9<br>YK9                                                     | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Midway Island<br>Midway Island<br>Marabali Islands<br>Marabali Islands<br>Australia<br>Lord Howe Island<br>Australia<br>Lord Howe Island<br>Keeling, Cocos Island<br>Macquarie Island<br>Britlah Phoenix Island<br>Britlah Phoenix Island<br>Gilbert Island<br>Ocean Island<br>Chriatmas Island<br>Line Island, South                                                                                                                                                                                                                                                                                                                                                                                                                                |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH4<br>KM7, KH4<br>KM8, KH5<br>KM8, KH5<br>KM8, KH8<br>KW, KH9<br>KX<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                                        | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Chriatmas Island<br>Keeling, Cocos Island<br>Mellish Reef<br>Norfolk Island<br>British Phoenix Islands<br>British Phoenix Islands<br>Glibert Island<br>Ocean Island<br>Chriatmas Island<br>Pitcaim Island<br>Pitcaim Island<br>Pitcaim Island<br>Chriatma Island<br>Chriatma Island<br>Pitcaim Island<br>Chriatma Island<br>Chriatma Island<br>Pitcaim Island<br>Chriatma Island<br>Chriatma Island<br>Chriatma Island<br>Chriatma Island<br>Chriatma Island<br>Chriatma Island<br>Cortal (See T2)                                                                           |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5K<br>KP6, KH5K<br>KP8, KH5<br>KK8, KH8<br>KW, KH9<br>KS4<br>KW, KH9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK                                | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samos<br>Wake Island<br>Marabali Islands<br>Australia<br>Lord Howe Island<br>Australia<br>Lord Howe Island<br>Christmas Island<br>Keeling, Cocos Island<br>Mellish Reef<br>Norfolk Island<br>British Phoenix Islands<br>Gilbert Island<br>Ocean Island<br>Cora Island<br>Christmas Island<br>Christmas Island<br>Citarin Island<br>Ditar Island<br>Ditar Island<br>Christmas Island<br>Pitcaim Island<br>Pitcaim Island<br>Pitcaim Island<br>Ditar Island<br>Christmas Island<br>Pitcaim Island<br>Ditar Island<br>Situr Island<br>Situr Island<br>Ditar Island<br>Ditar Island<br>Ditar Island<br>Ditar Island<br>Ditar Island<br>Ditar Island<br>Situr Island<br>Situr Island                                  |
| KG6S<br>KG6T<br>KH7<br>KJ,K13<br>KH7<br>KJ,K13<br>KM,KH4<br>KP6,KH5K<br>KP6,KH5K<br>KP8,KH5<br>KK86,KH8<br>KW,K19<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK                                              | rota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Willis Island<br>Keeling, Cocos Island<br>Macquarie Island<br>Britlah Phoenk Island<br>Britlah Phoenk Island<br>Christmas Island<br>Christmas Island<br>Dritalm Island<br>Christmas Island<br>Ditalm Island<br>Christmas Island<br>Line Island, South<br>and Central<br>(See T2)<br>Brunei<br>Borneo                                                                                                                                                                                                                                                                  |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ, KH3<br>KM, KH4<br>KP8, KH5<br>K%, KH5<br>K%, KH8<br>K%, KH8<br>K%, KH8<br>K%<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                                | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshall Islands<br>Papua, New Guinea<br>Tuvälu Island<br>Australia<br>Lord Howe Island<br>Christmas Island<br>Keeling, Cocos Island<br>Mellish Reef<br>Norfolk Island<br>Macquarie Island<br>Sittleh Phoenix Islands<br>Gilbert Island<br>Christmas Island<br>Pittaih Phoenix Islands<br>Gilbert Island<br>Christmas Island<br>Christmas Island<br>Christmas Island<br>Christmas Island<br>Christmas Island<br>Christmas Island<br>Christmas Island<br>Christmas Island<br>Pittaih Central<br>(See T2)<br>Brunei<br>Borneo<br>Celebes                                                                                                                                                   |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5K<br>KP8, KH5<br>KK8, KH8<br>KW, KH9<br>KX<br>VK<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                                         | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Palmyra<br>American Samoa<br>Wake Island<br>Marshali Islands<br>Papua, New Guinea<br>Tuvalu Island<br>Australia<br>Lord Howe Island<br>Willis Island<br>Christmas Island<br>Keeling, Cocos Island<br>Mellish Phoenix Islands<br>British Phoenix Islands<br>Glibert Island<br>Ocean Island<br>Christmas Island<br>Pitcaim Island<br>Dichristmas Island<br>Pitcaim Island<br>Dichristmas Island<br>Pitcaim Island<br>Dichas Island<br>Pitcaim Island<br>Dicean Island<br>Christmas Island<br>Pitcaim Island<br>Christmas Island<br>Pitcaim Island<br>Celebos<br>Borneo<br>Celebos<br>Java<br>Sumaira                                                                                                                                   |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KM, KH3<br>KM, KH4<br>KP6, KH5K<br>KP8, KH5<br>KK8, KH8<br>KW, KH9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK                                                               | nota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnaton Island<br>Midway Island<br>Kiway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marshall Islands<br>Papua, New Guinea<br>Lord Howe Island<br>Australia<br>Lord Howe Island<br>Christmas Island<br>Willis Island<br>Meiligh Reef<br>Norfolk Island<br>British Phoenix Islands<br>British Phoenix Islands<br>British Phoenix Islands<br>British Phoenix Islands<br>British Phoenix Islands<br>British Cost Island<br>Deristmas Island<br>Pitcalm Island<br>Line Island, South<br>and Central<br>(See T2)<br>Bruneo<br>Celebes<br>Java<br>Sumatra<br>West Irlian                                                                                                                                                                                            |
| KG6S<br>KG6T<br>KH6<br>KH7<br>KJ,KH3<br>KH7<br>KJ,KH3<br>KM,KH4<br>K%6,KH5K<br>K%6,KH6<br>K%7<br>K%6,KH6<br>K%7<br>K%7<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9<br>VK9                                        | rota<br>Saipan<br>Tinian<br>Hawaiian Islands<br>Kure Island<br>Johnston Island<br>Midway Island<br>Kingman Reef<br>Paimyra<br>American Samoa<br>Wake Island<br>Marabali Islands<br>Australia<br>Lord Howe Island<br>Australia<br>Lord Howe Island<br>Chriatmas Island<br>Keeling, Coccs Island<br>Willis Island<br>Chriatmas Island<br>British Phoenix Island<br>British Phoenix Island<br>British Phoenix Island<br>Chriatmas Island<br>Sitter Island, South<br>and Central<br>(See T2)<br>Borneo<br>Celebes<br>Java<br>Sumatra<br>West Irlan<br>New Hebrides<br>North Cock Island |

. American

|      | 2L<br>2L<br>2L<br>2M7<br>3D2<br>5W                                                                                                                  | New Zesland<br>Auckland & Campbell<br>Chatham Island<br>Kermadec<br>Tokelaus<br>Fiji Islands<br>Western Samos                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------|-----------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|      | AFRICA                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|      | A2<br>C5<br>C9<br>CN2<br>CR3<br>D2,3<br>D4<br>D6<br>EA9<br>EA9<br>EA9<br>EL2<br>ET3<br>FB8X<br>FB8X<br>FB8X<br>FB8X<br>FB8X<br>FB8X<br>FB8X<br>FB8X | Botswana<br>Gambia<br>Mozambique<br>Morocco<br>Tangier<br>Guinea Bissau<br>Madera Is.<br>Angola<br>Republic of Cape Verde<br>Comoros<br>Canary Islands<br>Ceuta and Melilla<br>Ifni<br>Rio de Oro<br>Liberia<br>Eritrea<br>Ethiopia<br>Crozet<br>Kerguelen Is.<br>Amsterdam & St. Paul<br>Mayotte<br>Glorioso Island<br>Juan de Nova. Europa<br>Reunion<br>Tromelin<br>Bophuthatswana<br>Lampedusa Island<br>Pantefleria Island<br>Djibouti<br>Sao Tome and Principe<br>Sudan<br>South Sudan<br>Egypt<br>Cameroon<br>Central African Empire<br>Congo<br>Gabon |
| lep. | C                                                                                                                                                   | orrect                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|      | In "So<br>Tower"<br>Photo J<br>be a ve<br>cable le<br>clamps.                                                                                       | o You Want to Rai<br>(July, 1979, page<br>shows what appear<br>rtical stacking of<br>ngths under the c<br>The cable leng                                                                                                                                                                                                                                                                                                                                                                                                                                      |

ZK2

Niue Island

TT TU TY TZ VK6 VQ9 VQ9 VQ9 VQ9

XT ZD7

708

ZD9

ZS2 ZS2 ZS3

386, 7

388

389 3C 3D6

ZE ZS1, 2, 4, 6

| 9<br>3<br>8W<br>8X<br>8Z                                    | Rio de Oro<br>Liberia<br>Eritrea<br>Ethiopia<br>Crozet<br>Kerguelen Is.<br>Amsterdam & St. Paul<br>Mayotte<br>Giorioso Island<br>Juan de Nova. Europa<br>Reunion<br>Tromelin                                    | 3V<br>3X<br>4W<br>5A<br>5H<br>5N<br>5N<br>5N<br>5N<br>5V<br>5V<br>5V<br>5X                        |
|-------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| FL8                                                         | Bophulhatswana<br>Lampedusa Island<br>Pantelleria Island<br>Dibouti<br>Seychelles<br>Transkei<br>Sao Tome and Principe<br>Sudan<br>South Sudan<br>Egypt<br>Cameroon<br>Central African Empire<br>Congo<br>Gabon | 52<br>60<br>6W<br>70<br>7P<br>70<br>7X<br>80. VS9<br>9G<br>9J<br>9L<br>9L<br>9U<br>9U<br>9U<br>9X |
| С                                                           | orrectio                                                                                                                                                                                                        | ons                                                                                               |
| In "So<br>ower" (<br>noto J s<br>a ver<br>able ler<br>amps. | You Want to Raise a<br>July, 1979, page 110)<br>shows what appears to<br>tical stacking of the<br>ogths under the cable<br>The cable lengths<br>be positioned in a                                              | Reall<br>Reall<br>cesso<br>Tha<br>ing o<br>chang                                                  |

| Chad                          |
|-------------------------------|
| Ivory Coast                   |
| Benin                         |
| Wati Materia                  |
| Heard Island                  |
| Aldabra Island                |
| Descober                      |
| Earoubar                      |
| lipper Volta                  |
| St. Helena                    |
| Ascension Island              |
| Gough Island and              |
| Tristan da Cunha              |
| Rhodesia                      |
| South Africa                  |
| Prince Edward Island          |
| Marion Island                 |
| Southwest Africa              |
| (Namipia)                     |
| Agalega & St. Brandon         |
| Mauritius<br>Dedeleuse leteed |
| Roonguez Island               |
| Equational Guinea             |
| Tunicia                       |
| Republic of Guinea            |
| Bouvet Island                 |
| Yemen                         |
| Libya                         |
| Tanzania                      |
| Nigeria                       |
| Malagasy Republic             |
| Mauritania                    |
| Niger                         |
| Togo                          |
| Uganda                        |
| Kenya                         |
| Somali                        |
| Beople's Dem Boo of Yeme      |
| Lecotho                       |
| Malawi                        |
| Algeria                       |
| Maldive Islands               |
| Ghana                         |
| Zambia                        |
| Sierra Leone                  |
| Republic of Zaire             |
| Burundi                       |
| Rwanda                        |
|                               |
|                               |

sł horizontal side-by-side arrangement such that both halves of the cable clamps contact each side of each cable.

Gene Smarte WB6TOV/1 **News Editor** 

eference to "At Last! A Simple Speech Pror," June, 1979:

anks to W5VSR for pointut the need for a circuit ge. A 10k pot should be added at the emitter of the first transistor.

Sorry about any inconvenience this may have caused.

Jeff Stadelman W9UT Pound WI

Ham Help

I just acquired an 80-10-meter amp. It's a TXL-80B made by Westcom Engineering. The problem is that the final transistors have been blown and I can't find any suitable replacements, as the transistors have a nonstandard "house number." I'd be grateful to anyone who could suggest a good replacement, or give me an address where I might find Westcom. Thanks in advance for helping. **Bob Howle WA4ZID/9** 10432 Baseline Road Lafayette CO 80026

I'm the president of the newly-formed Phoenix Honeywell Amateur Radio Club and could use some help. We have a lot of tube-type equipment and most of us would like to replace the front-end rf stage with an

FET equivalent (such as a 6HA5). We would like to build them on a direct-replacement tube socket. Does anyone have tubes-to-FET conversion circuits? Also, does anyone have any application circuits for FET noise blankers or audio noise filters? Any help will be appreciated.

#### P.J. Scola, President **Phoenix Honeywell Amateur** Radio Club **PO Box 6000** Phoenix AZ 85005

I am in need of a schematic for a Pride 150 bilinear amplifier, 80-10 meters. If anyone has one and could send a copy, it would be a great help. Francis Whittier WB1CXX RFD #1 Box 339 Madison ME 04950



#### from page 14

electronics experimenter, though, and guess I must agree with you that, in my experience, your mag is more with it in terms of construction articles than are the official publications of the ARRL. I tuned in too late to know the whole background of your seeming vendetta against this organization, but I suspect that you have some valid points, if only because too many organizations in and out of gov't (plus religions) get hardening of the arteries too soon, after which everyone wants to merely survive and not rock the boat. Being an iconoclast, I'm sympathetic.

Recalling the ARRL "pledge of allegiance," so to speak, that would have the ham saying that he owed his hobby to the ARRL, much as I owe my soul to the company store, I don't think I'd care to be represented by that "religious" denomination even if I were to become a ham.

Beyond that, there was a time when I used to buy the Handbook every few years, mainly for new test instrument circuits to build. Then I noted that it was about the last and least source of such information. Now I get the unchanging data I need (like the nice LCR resonance chart) from editions some 10 years old. The formula is still good, but magazines such as yours give me a better update on test instrument circuits, even though I scarcely need your July antenna issue, except maybe for my TV set.

> Benjamin Johnson Rochester NY

#### ECLECTICISM

It may interest the ham community to know that Sears, after seemingly abandoning ham radio in the Spring-Summer '79 catalog, has jumped back in with both feet.

On pp. 1238-9 of the Fall-Winter '79 catalog, the Sears 22-channel 2m FM xtal rig has returned, grouped with—brace yourself—the Midland (that's right, Midland—not a Sears nameplate in sight) 13-510A 2m syntho rig and the Midland (again!) 13-509 and 13-513 220 (!) FM rigs (xtal and syntho respectively). I'm not going to comment on prices (other than to say that they seem reasonable) because there is a bigger matter which this raises.

I was perusing Looking West in 73 #200 (May, 1977) which touched on the flak raised by Sears' first foray into amateur gear. This increased involvement (especially the 220 rigs) is bound to raise even more, so I thought I'd get my two cents in before inflation struck. At least Sears does point out that you must have a license, although I wish they could get it straight that it's Technician, not "Technical." I'm a Tech myself, and I like them to get my class right. What's more, the added exposure of 220 (use it or . . .) can't hurt! As for the bugaboo about "da CBer gonna getcha" -well, if we can't handle a few unauthorized signals (the price of the rigs will keep the CBboom \$39 radio crowd off the band), we are in trouble.

On other matters, keep the mag the way it is (if not better!). Don't be bullied away from the eclecticism, the controversy, and the general free attitude of the magazine! At this time, it's the only ham magazine (counting Worldradio as a newspaper) worth reading! Keep it up!!

> Edward Eastman WD9ENF Minneapolis MN

#### IGNORAMI

I cannot sit idly by any more and let some unintelligent and uneducated hams slash your wonderful magazine and enlightening editorials. I cringe every time someone says that Wayne is against ham radio (WD8DWO, Letters, 73 Mag-azine, June, '79). These people must have read his editorials with their dunce caps on! Anyone who digests them with intelligence or has read Wayne's writings for a while can clearly see that Wayne Green is one of the leading proponents of ham radio and that ham radio is one of Wayne's lifetime loves.

I have been reading his editorials since I received my Novice license in September of '75, and while there have been times when I disagreed with Wayne, I have always been impressed with his honesty and his factual unbiased reports of many situations. I admire the way he has never backed down on an issue, nor been afraid to state his opinion on any issue. I also admire the way he has succeeded in his business ventures.

So the next time you read one of Wayne's dynamic editorials, read it intelligently and you will learn about the inside happenings of ham radio, politics, business, and about devotion. I have learned about these things and more from Wayne's editorials, and so even though I know Wavne will not let a few ignorami stop him, count me as one of his supporters and keep those unabashed, interesting, and provocative editorials coming. Your magazine is the best in ham radio and better than most of the others in other fields, so continue the good work and take it easy!

> John Kerekes N9El South Bend IN

#### **GREEN PAGES**

I just received my first 73 issue on a new subscription. The article on "The KGCY Story" was worth the price of the subscription. Keep articles like this coming and I'll renew ... could do with fewer "green" pages, however.

> Ron Schwendt N3AR Douglassville PA

#### EGYPTIAN PROGRESS

As the first woman member of the Egyptian Radio Club, Inc., Granite City IL, I feel compelled to respond to the "Letter to the Editor" written by Tania Miller WB9TKC that appeared in the August, 1978, issue of 73 Magazine. Tania's letter was written as a result of the difficulty experienced by women who wished to become members of the club. At that time there were enough members who did not want women in the club to block any attempt by women to join. Since that time, however, openminded members have been responsible for changes that allow any responsible amateur radio operator to join the club.

I believe that this progress shows that old traditions and ideas must be changed when they do nothing except cause hurt feelings or give people in control a feeling of power. There is no place in amateur radio for prejudice.

My husband and I have both enjoyed being members of the Egyptian Radio Club very much. We have met and learned from a super bunch of fellow hams. We are pleased with the progress that has been shown in the Egyptian Radio Club, Inc.

> Bess J. Nelson WD9CZF Florissant MO

#### NUKES

One year ago, I was one of those people who thought nuclear power would really help. I didn't question the authority of the geniuses who gave us Three Mile Island, Brown's Ferry, and the Karen Silkwood cover-up.

Since then I have learned a lot about the poor engineering, short-term monetary greed, and media whitewashing that goes hand in hand with the nuclear industry.

On June 30, I and forty to fifty thousand people were at the Diablo Canyon rally in San Luis Obispo, California. I saw exhibits there on solar and many types of alternative energy—alternatives that have been here for years. There were people from all walks of life there, and even some fellow amateurs.

I believe this is no longer a small minority issue. I feel that we hams should-set a good example and use our excellent tinkering and engineering abilty to apply to solar and alternative electricity sources.

Let amateurs use solar power at the home QTH, at Field Day, and at outdoor fairs.

Let amateur publications show conscience and responsibility by running how-to articles on alternative energy. Let amateurs, through their global communications capabilities, exchange information on solar and other alternative electric power.

I hope you will take these ideas to heart for technical articles, parts source articles, and editorials. I am one ham who doesn't need "nukes," and I know there will be others.

James G. Coote WB6AAM Los Angeles CA

#### CONVERTING

Perhaps this information will be of interest to those of you converting 40-channel CBs to 10 meters. I received a Hy-Gain model 2681 board, less channel switch (which includes rotary dial and knob). I found that Hy-Gain parts are available through Telex Communications, Inc., 8601 Northeast Highway 6, Lincoln NE 68505, Attn: Jim Kepustka.

The parts noted above are listed as: part #700047, switch, \$0.75; 40-ch dial, \$0.50; channel knob, \$0.50; shipping (very good box), \$1.00.

The board is sold by Poly Paks, and costs about \$12.00. They will supply a schematic diagram (specifically request it). Other info is supplied but it does not have much to do with the board received. It does give info on another type of PLL which may or may not be used in another board they can furnish for more money. A complete Hy-Gain 40-channel set with all controls on the mike is available; the mike is an extra.

I haven't yet seen an SSB rig on sale through any of my contacts for less than \$65. One should be available soon, as the popularity of CB in the crowded cities is going down fast.

The big surprise is that the going price for a divider-type switch used with other rigs seems to be from \$16 to \$25. I get that from the CB repairmen, who say that they practically never have to replace them. Look at the price I paid for it (75 cents). When I figured out how to build a switch to divide by 278 or so, I thought \$20 was pretty fair.

Henry B. Plant W6DKZ San Jose CA

#### CLASSICS

Being a Novice of about three months, I find my subscription to 73 thoroughly satisfying and enlightening in all aspects. It is very gratifying to have a publication on our behalf that pulls no punches and has its cards laid out on the table instead of putting up a smoke screen and being cloaked with the "official final authority" attitude approach. In your June issue (#225, page 13) Letters department, Don Hurley VE3HAN suggested an "equipment evaluation" booklet of rigs dating back over the past twenty years. Sounds like a great idea. Obviously an enormous amount of time and effort would need to be put into a big project on that order. Consider, though, how much value such a referencetype booklet like that could be . it would be ideal to bring along to that next hamfest for when you're rummaging through those tables of used Hallicrafters, Hammarlunds, Johnsons, Nationals, etc. If an "equipment evaluation" booklet is not conceivable, then how about running a feature article in 73 on some of those more popular older classic rigs?

Speaking of so-called outdated gear, if you tune around the bands listening carefully, there are plenty out there sporting their well-maintained vintage equipment...just another facet of the art. I run those "oldies but goodies," a Viking Valiant I transmitter with a Hammarlund HQ-100 receiver. Keep up the superb work.

Bill Wolf KA2EEV Newark NJ

#### FEARL

Any hams working in the military or for the military services as civilians should definitely bring their gear along on permanent changes of station to Japan. Write to FEARL, c/o Sam Fleming KA2SF, USAGH D10, APO SF 96343, or call 228-4703 (military number in Japan) for info. Licensing is done by US Forces, Japan. All US license classes get full privileges, except that no mobile portable operation is allowed (except MARS, where we have 2m frequencies and repeaters, etc.).

SFC W. J. Graham KA2WG Signal Act-N APO SF 96343



I would like to comment on your review concerning the Daiwa CN-720 swr and rf power meter (June, page 24). Your statement, "... why someone didn't think of it before ..." left me bewildered.

On page 386 of the September, 1952, issue of *DL-QTC*—

yes, 1952—G. Blaeser DL1GX describes a standing-wave indicator which uses a crosspointer instrument similar to the one used in the CN-720.

DL1GX's work was based on the work of a Mr. Buschbeck. Mr. Buschbeck's idea and invention was published in Volume 61, April, 1943, of Hochfrequenztechnik und Elektroakustik," decimal classification DK 621.717; 621.396.61.

In the June issue of the *Technical Library* of the Northwest German Radio Network, 1949, Dr. Roland Walter describes this type of instrument again because, due to the war, most of the original material got lost or was destroyed.

Telefunken marketed a version for use on high-power BC and shortwave transmitters in the early 50s, with power handling capacities of up to 100 kW. It was called "supervisory equipment for feedlines for short, medium, and long waves." It became a standard on all major transmitting equipment in DL-land.

Ergo, the idea of the crosspointer instrument in the context of swr measurements is about 36 years old.

> Kurt U. Grey VE2UG Sept Iles, Quebec

#### **MISS AMERICA**

This is to advise of the following station activity: Special Event—Miss America Pageant, Atlantic City, New Jersey. Station K2BR will be operating from the Miss America Pageant Headquarters in Atlantic City NJ, September first through eighth, 1979. It will be sponsored by the Southern Counties Amateur Radio Association (SCARA). Approximate frequencies: CW—3560, 7060, 14060, 21060; Novice—3730, 7130, 21130; Phone—3935, 7235, 14280, 21380. QSL to K2BR, 591 White Horse Pike, Egg Harbor NJ 08215 (SASE, please). Traffic to and from the Miss America contestants will be accepted.

Henry G. Rainville K2HG Miss America Pageant/ SCARA coordinator Ventnor NJ

#### HAMMARLUND

I have been trying hard to find a replacement variable tuning capacitor for my Hammarlund HQ-170A VHF receiver and finally found one at Pax Mfg., 100 Montauk Hwy., Linden Hurst NY 11757, (516)-884-4300.

In talking with Mr. Peter Kjeldsen of Pax Mfg., he indicated that they have most replacements for Hammarlund capacitors. Maybe this information will help someone else find parts.

> Leroy Marion W8CGQ Marlette MI

#### JAMMING

As printed in "Letters" of the June, 1979, issue of 73, reader K6EGM is "... appalled that you could publish something ("The 2-Meter ECM Caper," 73, February, 1979) tantamount to sanctioning the jamming of another station..." and says that such "new" ideas are not in the best interest of amateur radio.

Apparently K6EGM is not well versed in the history and romance of amateur radio. "Jamming," intentional, accidental, or fantasized, is not a "new" idea. It has been going on for over 50 years in every and any call area.

I suggest that K6EGM read "The Templeton Case" by K9ODE which appeared in the January, 1963, issue of QST magazine.

> Byron H. Kretzman W2JTP Huntington NY

# New Products

#### from page 40

The new pocket scanner features sturdy construction, with an anodized aluminum front panel to withstand demanding on-the-go use. A flexible "rubber ducky" antenna is supplied, but the radio can also be used with a wire antenna. The radio can be operated from external power, as well as from internal batteries. Also contributing to the radio's versatility are provisions for plugging in an external battery charger, headphone, and external speaker. For further information, contact Electra Company, PO Box 29243, Cumberland IN 46229. Reader Service number E40.

#### TRAC CMOS ELECTRONIC KEYER

TRAC Electronics, Inc., has introduced an addition to its line of state-of-the-art CMOS keyers. The TRAC CMOS Electronic Keyer, Model TE133, contains all CMOS integrated circuitry. Included features are self-completing dots and dashes; both dot and dash memory; iambic keying with any squeeze paddle; 5-50 wpm; speed, vol-



TRAC's Model TE133 keyer.

ume, tune, and weight controls; and built-in sidetone and speaker. Low-current-drain CMOS allows portable battery



Heath/Schlumberger's new catalog.

operation. The rear panel contains deluxe quarter-inch jacks for output and keying. The TE133 CMOS Electronic Keyer is operated on a single 9-volt battery and keys both positive and negative keyed rigs. For further information, contact TRAC Electronics, Inc., 1106 Rand Building, Buffalo NY 14203. Reader Service number T18.

#### HEATH/SCHLUMBERGER OFFERS LATEST INSTRUMENTS CATALOG

Heath/Schlumberger has announced the publication of its latest instruments catalog. This new catalog features Heath/ Schlumberger's complete line of fully assembled and tested computers and peripherals and aives complete descriptions



Ham Radio Center's HK-3M.

and specifications for their line of electronic test instruments. Included are oscilloscopes, laboratory-grade strip and X-Y recorders, power supplies, various signal and function generators, counters, and a ful' line of multimeters (from analog to digital).

In addition, the publication contains a complete listing of Heath/Schlumberger Continuing Education Programs for industrial training, including ac and dc electronics, semiconductor devices, digital techniques, microprocessors, and test instruments.

For further information, contact Heath/Schlumberger, Dept. 350-870, Benton Harbor MI 49022. Reader Service number H5.

#### THE HK-3M KEY

Ham Radio Center has introduced a new modified straight key which replaces their popular Model HK-3 Ham-KeyTM. The new model is the HK-3M; it features a new anti-tip bracket that defies even a pump-handle type of operator from tipping over. The beauty of this new feature is that any HK-3 now in the field can be converted to an HK-3M by merely adding the easily-installed AT-B bracket.

For further information, contact Ham Radio Center, PO Box 28271, St. Louis MO 63132. Reader Service number H2.

# Ham Help

I would like a schematic and input/output impedance for an RME 80-10 preselector. The model is unknown, but I think it matched the RME 6900 receiver. Thanks.

William F. Mollenhauer N2FZ Box 3, RFD 1 Glassboro NJ 08028

I would like to receive sche-



If you have a serious problem with a ham firm, send them a letter with all the facts in detail, plainly and simply... and send a copy to Wayne Green W2NSD/1, c/o 73 MAGAZINE. 73 protects its readers more than any other magazIne. matics for any modifications to the Ten-Tec PM2/2A QRP rig. H. Goldberg VE3JBU PO Box 913, Stn. B Ottawa, Ontario Canada K1P 5P9

I would like to get in touch with amateurs who believe in UFOs, who have made a sighting or who are members of any organization that investigates UFOs. I would to like to organize an international net. Anastasios Panos SV1IG PO Box 2563 Athens, Greece

I got a flood of replies to my request in the June issue. Thanks a lot, fellows! Instead of a brlef visit in August, I have decided to come on the "HOUSA" student exchange/ work scheme from November, 1979, to February, 1980. Under this scheme, NZ students can come to the US or Canada to work and sightsee.

Ideally, I would like to work

for short periods in various parts of the US, and would appreciate information on temporary jobs and accommodations.

I would also like to hear about UHF FM repeaters, as I intend bringing along my home-brew mobile rig (cheap, but good), based on our club design. Do UHF repeaters need the special access techniques, e.g., tone burst, etc., like your 2-meter ones?

> Ash Nallawalla ZL4TBU PO Box 6159 Dunedin, New Zealand

I have been following the articles on the conversion of CB sets to 10 meters and I have been trying to convert a SBE Sidebander II mobile rig, but have run into problems.

Does anyone have any information on the conversion of this unit? I did find the article on the SBE Sidebander III model (January, 1979, 73), which is strictly sideband (no AM) and am told that the boards are entirely different.

I have changed the base crystals up 1.535 MHz to put channel 1 on 28.500, but, after complete alignment, which makes the set very hot on both receive and transmit, we find ourselves on a *lower* frequency than even 11 meters. Around 25.535.

#### James W. Barnes WB7PKR PO Box 283 Mesa AZ 85201

I need a schematic or conversion info on an ARC R-19 alrcraft receiver which tunes 118-148 MHz. Expenses will be reimbursed.

> Howard S. Robb AFØW Box 17 Bird Island MN 55310

I need a manual, or a copy, for a Gonset G-76 transceiver. I will pay costs.

#### Tim Rulon WA2KQD 12 Morahopa Rd. Centerport NY 11721

I would like to get in touch with anyone who shares my interest in model railroading for a 40m CW sked on the Novice portion.

> Rick Todd KA8AKL 14470 Basslake Rd. Newbury OH 44065

# Social Events

Listings in this column are provided free of charge on a space-available basis. The following information should be included in every announcement: sponsor, event, date, time, place, city, state, admission charge (if any), features, talk-in frequencies, and the name of whom to contact for further information. Announcements must be received two months prior to the month in which the event takes place.

#### **GEORGETOWN IL SEP 1-2**

The 1979 Danville, Illinois, Area Hamfest will be held on September 1-2, 1979, at the Georgetown, Illinois, fair-grounds, located ten miles south of Danville on Illinois Rt. 1. Gates open at noon on Saturday for vendors to start setting up their displays. Gates open to the general public at 6:00 am Sunday. Facilities will consist of a large enclosed building 50 × 150 feet with electrical hookups available at no charge. Please bring your own tables and chairs and power cords. Outside space is also available at a \$2.00 per person gate charge. Overnight camping on the fairgrounds is available at \$5.00 per vehicle. For information, contact Bob Wilson K9RBW, c/o Illiana Repeater Systems, Inc., PO Box "G", Catlin IL 61817.

#### **TEXAS CITY TX** SEPT 1-2

The Tidelands Amateur Radio Society (TARS) will hold its Hamfest '79 on September 1-2, 1979, at the Nestler Civic Center on 5th Street, Texas City, Texas. The registration and hospitality period will be held on Saturday evening, with the final prize drawing to be held on Sunday afternoon. There will be many small prizes, plus TARS will be giving away the winner's choice of a Kenwood TS-120S or Drake UV-3, a Wilson Mark II HT, and a Wilson System III beam. For further information and pre-registration, write Hamfest '79, PO Box 73, Texas City TX 77590.

#### PENSACOLA FL SEP 2

The Five Flags Amateur

Radio Association, Inc., will hold its 1979 Ham-A-Rama on September 2, 1979, at the Pensacola Municipal Auditorium, Pensacola, Florida.

#### **ROSEMONT IL** SEP 7.9

The Quarter Century Wireless Association will hold its 1979 Chicago Convention on September 7-9, 1979, at the O'Hare/Kennedy Holiday Inn, Rosemont, Illinois, The complete package for the three days is \$35.00. Special room rates will also be available. There will be the annual banquet, special ladies' program, various tours, and prizes. For reservations and information, write Phil Haller W9HPG, 6000 S. Tripp, Chicago IL 60629.

#### **BLOOMINGTON IN** SEP 8

The second annual Hoosier Backyard Hamfest will be held on September 8, 1979, at the Hensonberg School, just east of the intersection of state highway 37 and Vernal Pike, in Bloomington, Indiana. Tickets are \$1.00 per head over age 12. Features of the event will include ATV, an ATV repeater, SSTV demonstrations, a homecomputer show, inside swap area, plenty of parking, food, and some door prizes. Talk-in on 147.78/.18. Send all inquiries to HBYH, 7391 W. Hwy. 46, Ellettsville IN 47429.

#### **AUGUSTA NJ** SFP 8

The Sussex County Amateur Radio Club will hold its hamfest on Saturday, September 8, 1979. from 9:00 am to 5:00 pm, rain or shine, at Sussex County Farm and Horse Show grounds, off Rte. 206, Augusta, New Jersey. There will be a large indoor selling area and tailgating. Admission for buyers is \$1.00, which includes a chance at the door prizes. YLs, XYLs, and har-monics will be admitted free. Admission for indoor sellers is \$6.00 at the door and \$5.00 in advance. For tailgaters, admission is \$5.00 at the door and \$4.00 in advance. Talk-in on 147.90/.30 and 146.52. For registration and information, write Sussex County Amateur Radio Club, PO Box 11, Newton NJ 07860, or call Ed Woznicky AC2A at (201)-852-3268.

#### **UNIONTOWN PA** SEP 8

The Uniontown Amateur Radio Club will hold its 30th annual Pie Gabfest on September 8, 1979, starting at noon at the club grounds, Old Pittsburgh Rd., at the bypass on Rte. 51.



#### Tell them you saw their name in 73

#### **Fontana CA**

We carry the following: ICOM, Midland, Am-com, DenTron, KLM, Swan, Drake, Ten-Tec, Wilson, SST, MFJ, Hy-Gain, Lunar, Nye-Viking, B&W, Redi-kilowatt, CushCraft, Mosley, Big Signal, Pipo, etc. Full Service Store Fontana Electronics, 8628 Sierra Ave. Fontana CA 92335, 822-7710.

#### Santa Clara CA

Bay area's newest Amateur Radio store. New & used Amateur Radio sales & service. We fea-ture Kenwood, ICOM, Wilson, Yaesu, Atlas, Ten-Tec & many more. Shaver Radio, 3350 Lochinvar Avenue, Santa Clara CA 95051, 241-4270 247-4220.

#### Denver CO

Experimenter's paradise! Electronic and mechanical components for computer people, audio people, hams, robot builders, experi-menters. Open six days a week. Gateway Elec-tronics Corp., 2839 W. 44th Ave., Ibenver CO 80211, 458-5444.

#### **Columbus GA**

KENWOOD - YAESU - DRAKE The world's most fantastic amateur show-room! You gotta see it to believe it! Radio Wholesale. 2012 Auburn Avenue, Columbus GA 31906, 561-7000.

#### Preston ID

Ross WB7BYZ, has the Largest Stock of Ama-teur Gear in the Intermountain West and the Best Prices. Call me for all your ham needs. Ross Distributing, 78 So. State, Preston ID 83263, 852-0830.

#### **Terre Haute IN**

Your ham headquarters located in the heart of the midwest. Hoosier Electronics, Inc., 43B Meadows Shopping Center, P.O. Box 2001, Terre Haute IN 47802, 238-1456.

#### Littleton MA

The ham store of N.E. you can rely on. Ken-wood, ICOM, Wilson, Yaesu, DenTron, KLM amps, B&W switches & wattmeters, Whistler radar detectors, Bearcat, Regency, antennas by Larsen, Wilson, Hustler, GAM. TEL-COM Inc. Communications & Electronics, 675 Great Rd., Rt. 119, Littleton MA 01460, 486-3040.

#### Laurel MD

We stock Drake, Icom, Ten-Tec, Swan, Tempo, Dentron, DSI, KDK, Wilson, Midland and others. Call toll free 800-638-4486. The Comm Center, Inc., Laurel Plaza, Rte. 198, Laurel MD 20810.

#### St. Louis MO

Experimenter's paradise! Electronic and Experimenter's paralise: Electronic and mechanical components for computer people, audio people, hams, robot builders, experi-menters, Open six days a week. Gateway Elec-tronics Corp., 8123-25 Page Blvd., St. Louis M() 63130, 427-6116.

#### **Camden NJ**

X-Band (& other frequencies) Microwave A-Band (& other frequencies) since oward Components & Equipment. Laboratory Grade Test Instruments, Power Supplies, 1000's in stock at all times, BUY & SELL all popular makes—HP, GR, FXR, ESI, Sorensen, Singer, etc. Lectronic Research Labs, 1423 Ferry Ave., Camden NJ 08104, 541-4200.

#### North Arlington NJ

Collins, General Radio, Tektronix, Hewlett for tubes or gear. Ted W2kUW, DCO, INC., 10 Schuyler Avenue, No. Arlington NJ 07032 998-4246.

#### Syracuse-Central NY

We deal, we trade, we discount, we please! Yaesu, Ten-Tec, Cushcraft, Drake, Dentron, KLM, Midland, B&W, ICOM, Hygain, Swan, Amcom, Telco, Mirage, DSI etc. Complete 2-way service shop! Ham-Bone Radio (Ibv. Sterco Repair Shop) 3206 Erie Blvd. East, Syracuse NY 13214, 446-2266.

#### Syracuse-Rome-Utica NY

Syracuse-KOME-UICE INT Featuring: Yaesu, ICOM, Drake, Atlas, Den-Tron, Ten-Tec, Swan, Tempo, KLM, Hy-Gain, Mosley, Wilson, Larsen, Midland Southwest Technical Products. You won't be disappointed with equipment/vervice. Radio World, Oneida County Airport-Terminal Building, Oriskany NY 13424, 337-2622.

#### Scranton PA

COM, Bird, CushCraft, VHF Engineering, Antenna Specialists, Barker & Williamson, CDE Rotators, Ham-Keys, Belden, W2AU/ W2VS, Shure, Regency, CES Touch-Tone pads, Radio Amateur Callbooks. LaRue Elec-tronics, 1112 Grandvlew St., Scranton PA 18509, 343-2124.

#### Houston TX

Experimenter's paradise! Electronic and me-chanical components for computer people, audio people, hams, robot builders, ex-perimenters. Open six days a week. Gateway Electronics Inc., 8932 Clarkcrest, Houston TX 77063, 978-6575.

#### Port Angeles WA

Mobile RFI shielding for elimination of igni-tion and alternator noises. Bonding straps. Components for "do-it-yourself" projects. Plenty of free advice. Estes Engineering, 930 Marine Drive, Port Angeles WA 98362, 457-10004

#### DEALERS

Your company name and message can contain up to 25 words for as little as \$150 yearly (prepaid), or \$15 per month (prepaid quarterly). No mention of mail-order business or area code permitted. Directory text and payment must reach us 45 days in advance of publication. For example, advertising for the November issue must be in our hands by September 15th. Mail to 73 Magazine, Peterborough NH 03458. ATTN: Aline Coutu.

Uniontown, Pennsylvania. Registration is \$2.00, with a chance for a main prize of a Tempo S-1. There will also be a Swap 'n Shop.

#### MENA AR SEP 8-9

The QWHC is celebrating the 10th anniversary of the Queen Wilhelmina Hamfest on September 8 and 9, 1979, at the Queen Wilhelmina State Park lodge, atop Rich Mountain just north of Mena, Arkansas. Featured will be displays, a free flea market, a banquet, a live band, church services, activities for XYLs and harmonics, and much, much more. There will be a grand prize of a Yaesu FT-101ZD, and many more prizes. Look for WB5MFI/P5 operating from the lodge. Admission is \$2.00. Tickets for the grand prize are \$2.00 each or 3 for \$5.00. Talk-in on 3995, 146.19/.79, and 146.52. For additional information, contact Steve Myers WB5MFI, SS103 Carlson Terrace, Fayetteville AR 72701, or phone (501)-443-3489.

#### MONTGOMERY AL SEP 8-9

The 2nd annual Central Alabama Hamfest is scheduled for September 8-9, 1979, at the Montgomery Civic Center, 300 Bibb St., Montgomery, Alabama. The FCC will administer exams beginning at 8:00 am on Saturday, September 8. Bring your Form 610. All activities will be indoors in air-conditioned comfort. There will be prizes and a ladies' program. Talk in on 146.04/146.64. For more information, contact Ed Sensintaffar WA4NKU, 745 Dubuque Dr., Montgomery AL 36109 or Sam Windham WB4RGX, 1834 Shoreham Dr., Montgomery AL 36106.

#### FINDLAY OH SEP 9

The Findlay Radio Club will hold its 37th annual Findlay Hamfest on Sunday, September 9, 1979, at Riverside Park, Findlay, Ohio. There will be both commercial and amateur display space available. Ticket donation is \$1.50 in advance and \$2.00 at the hamfest site. For more information, write the Findlay Radio Club, c/o Randy Peterson, Hamfest Chairman, 6016 Marion Twp. 243, Findlay OH 45840.

#### BUTLER PA SEP 9 The Butler County Amateur

Radio Association, Inc., will

| TELREX "Tri-Band" —                                         | \$415.00      |
|-------------------------------------------------------------|---------------|
| ELECTRICAL                                                  | TB5EM         |
| Gain in DB reference 12 wave dipole                         | 8.5 dbd       |
| Front to back ratio                                         | 28 db         |
| V/S/W/R at resonant point                                   | 1.3/1         |
| Maximum Power Input                                         | 4 KWP         |
| Nominal Input Impedence                                     | 52 ohm        |
| Beamwidth to 12 power Input                                 | 60°3 bands    |
| Frequency range                                             | 10, 15, 20    |
| Side Nulls                                                  | 35 00         |
| MECHANICAL                                                  |               |
| Number of Elements                                          | Five          |
| Alum, Boom: Dia, & Lgth, approx.                            | 2,2.5"x18 ft. |
| Turning Radius approx.                                      | 20 ft.        |
| Wind Load at 100 mph (approx.)                              | 210 lbs.      |
| Wind Area                                                   | 7 sq. ft.     |
| Longest Element                                             | 36 ft.        |
| Net Weight (approx.)                                        | 49 IDS.       |
| Shipping weight (domestic pack)                             | 60 IDS.       |
| Length of shipping carton                                   | 13 11.        |
| MADISON                                                     | ₩ M35         |
| <b>FLECTRONICS SUPPL</b>                                    | Y. INC.       |
| 1508 MCKINNEY • HOUSTON, TEXA<br>713/658-0268               | S 77002       |
| W5GJ, W5MBB, K5AAD, N5JJ, AG5K, W<br>WA5TGU, WB5AYF, K5BGB. | 5VVM, W5EGP.  |
| MASTERCHARGE • VISA                                         |               |

hold "Ye Olde Fashioned Hamfest" on September 9, 1979, from 10:00 am to 4:00 pm at the Butler County Farm Show Grounds adjacent to Roe Airport on Rte. 68, west of Butler, Pennsylvania. The \$1.00 charge includes free parking and admission to the outside flea market. Children under 12 are admitted free. Overnight campers are welcome. Tables for the indoor flea market are \$3.00 for an 8-foot table provided by us. or \$2.00 for an 8-foot table provided by you. Food and refreshments will be available. Mobile check-ins on .52 and 147.90/.30 (W3UDX). Fly-ins welcome (80 100 aviation gas will be + available). YL, mobile, and fly-in prizes will be awarded. There will be six main prizes plus other prizes to be drawn every 15 minutes. For more information, contact Fred Young WB3HGC, 195 Robbie Way, Portersville PA 16051, or phone (412)-368-3386.

#### PECATONICA IL SEP 9

The Rockford Amateur Radio Association will hold its second annual Rockford Hamfest and **Illinois State ARRL Convention** on Sunday, September 9, 1979, at the exhibition hall at the Winnebago County Fairgrounds at Pecatonica, Illinois, just west of Rockford on US Rte. 20. Tickets are \$2.00 in advance or \$2.50 at the gate. Tickets are available by mail by writing RARA, PO Box 1744, Rockford, Illinois 61110. Please include an SASE for tickets by mail. Prizes include a Kenwood TS-520S transceiver and an Atlas receiver. Campsites are available on site. with electric and sanitary hookup available. There are 300 flea-market tables available at a nominal charge. Plenty of free parking is available. Featured will be speakers, forums, demonstrations, and discussions. A hamfest menu, including hot dogs, BBQ, and soft drinks will be available at reasonable prices. Talk-in on 146.01/.61 or 146.52.

#### PENNSAUKEN NJ SEP 9

The South Jersey Radio Association will hold its hamfest on September 9, 1979, at Pennsauken Senior High School, Hylton Rd. at Rtes. 3, 130, and 70. Admission is \$2.00, tailgating is \$3.00, and an inside table is \$5.00. For further information, contact Bruce Eichmann WA2NBM, Hamfest Chairman, 204 E. Lake Blvd., Marlton NJ 08053, or phone (609)-983-0106.

#### VALPARAISO IN SEP 9

The Porter County Amateur

Radio Club will hold its annual hamfest on September 9, 1979, at the Porter County Fairgrounds, Valparaiso, Indiana. Featured will be a flea market, prizes, and technical sessions. Admission is \$2.00. There will be no charge for a flea market space but do bring your own tables. Talk-in on 147.96/.36 and 146.52. For advance tickets and information, write Art Cushman N9FB, 944 N. 100 W., Valparaiso IN 46383.

#### HUDSONVILLE MI SEP 15

The Grand Rapids Amateur Radio Association, Inc., will hold its annual Swap 'n Shop on Saturday, September 15, 1979, at the Hudsonville Fairgrounds, Hudsonville, Michigan. Gates open at 6:00 am; sales begin at 8:00 am. Talk-in on .16/.76, .63/.03, and .52/.52.

#### PEORIA IL SEP 15-16

The 21st annual Peoria Superfest 1979 will be held on September 15-16, 1979, at Exposition Gardens, W. Northmoor Rd., Peoria, Illinois. Advance tickets are \$2.00. Door tickets are \$3.00. Camping will be available Friday night on the grounds. There will be free indoor and outdoor flea market space available. Tickets will be sold on the grounds for hourly prize drawings. Main prize drawing will be at 3:00 pm both days. Continuous demonstrations of the latest equipment and technology will be given by major manufacturers and dealers. All dealers, distributors, and manufacturers write or call for info on free commercial table space. There will be movies, forums, talks, and displays of interest to all given daily. For the ladies: There will be a free bus trip to the Northwoods Mall on Sunday at 12:00 noon, plus daily displays and demonstrations and also a ladies' flea market. An informal get-together will be held at the Heritage House smorgasbord, 8209 N. Mt. Hawley Rd., (Rte. 88) at 7:30 pm Saturday, September 15th. No reservations are necessary. Price will be approximately \$5.75 per person. Talk-in on 146.76 W9UVI and .76, .85, and .97. For advance tickets, write Peoria Hamfest, 5808 N. Andover Ct., Peoria IL 61614, or phone (309)-692-8763.

#### ROSS OH SEP 16

The Greater Cincinnati Amateur Radio Association, Inc., will hold its 43rd annual Cincinnati Hamfest on Sunday, September 16, 1979, at Strickers Grove on Ohio Rte. 128, one mile west of Ross (Venice), Ohio. Exhibits, prizes, food, and refreshments will be available.

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Featured will be a flea market with radio-related products only, music and good fellowship, a hidden transmitter hunt, and a sensational air show. Admission and registration are \$4.00. For further information, write Lillian Abbott K8CKI, 1424 Main St., Cincinnati OH 45210.

#### MT. CLEMENS MI SEP 16

The L'Anse Creuse Amateur Radio Club will hold its 7th annual Swap and Shop on September 16, 1979, at the L'Anse Creuse High School, Mt. Clemens, Michigan. Take I-94 eastbound to the Metro Parkway exit. Then take the Metro Parkway to Crocker. Go left on Crocker to Reimold and then right on Reimold to the last school, L'Anse Creuse High School. Admission is \$2.00 at the door, or \$1.00 in advance. There will be plenty of food and parking plus hourly prize drawings. Prizes include a first prize of \$200.00, a second prize of \$100.00, and a third prize of \$50.00. Talk-in on 147.69/.09 and 146.52. For more information, send an SASE to WD8ITS, 3488 Ashley, Pontiac MI 48055.

#### HARRISBURG PA SEP 16

The Central Pennsylvania Repeater Association, Inc., will hold its 6th annual High Rise Hamfest on Sunday, September 16, 1979, from 8:00 am until 3:00 pm at the Park and Shop Garage, 200 block of Walnut Street, Harrisburg, Pennsylvania. Admission is \$3.00, with tailgating, wives, and kids free of charge. There will also be door prizes.

#### QUEENS NY SEP 16

The Hall of Science Amateur Radio Club, Inc., will hold its 2nd annual indoor/outdoor, rain or shine electronics hamfest on September 16, 1979, from 9:00 am to 4:00 pm at the municipal parking lot, one block off Queens Blvd. at 80-25 126th St., Queens, New York. There will be free parking, refreshments, and free prizes. Admission is \$2:00 for sellers and \$1:00 for buyers. Talk-in on. .52/.52 and .96/.36.

#### WHITESTONE NY SEP 20

The Tu-Boro Radio Club will hold its auction on Thursday, September 20, 1979, from 6:00 pm to 10:00 pm at the Odd Fellows Hall, 149-14 14th Avenue, Whitestone, New York. Donation is \$1.00. Talk-in on 145.62 and 146.52.

#### ELMIRA NY SEP 22

The Elmira Amateur Radio Association will hold its fourth annual International Hamfest on September 22, 1979, from 8:00 am to 5:00 pm at the Chemung County Fairgrounds, Elmira, New York. There will be prizes, programs, a free flea market, and dealers' and manufacturers' displays. Talk-in on .52, .96/.36, and .10/.70. For more information, contact John Breese WA2FJM, 340 West Avenue, Horseheads NY 14845.

#### ADRIAN MI SEP 23

The Adrian Amateur Radio Club will hold its 7th annual hamfest on Sunday, September 23, 1979, at Lenawee County Fairgrounds, Adrian, Michigan. Featured will be prizes, games, and programs. Tables are available at \$5.00 per 8 ft. space, \$3.00 per 4 ft. space, \$1.00 per 8 ft, trunk space, and \$2.00 for an inside space. Talk-in on 146.31/ .91 and 146.52. For ticket and table information, write Adrian Amateur Radio Club, Inc., PO Box 26, Adrian MI 49221, or call Bob or Sally Fay of Sword Enterprises at (517)-263-3597.

#### FLINT MI SEP 23

The Genesee County Radio Club, along with the Bay Area Radio Club, the Lapeer County



Radio Club, the Saginaw Valley, and the Shiawassee County Radio Club, will hold their 2nd annual 5-County Swap 'n Shop on September 23, 1979, from 7:30 am to 4:00 pm at Southwestern High School, Flint, Michigan. Take 1-69 to the Hammerberg Rd. exit, turn south to 12th St., then left on 12th to the high school, Admission is \$2.00 for adults, with children under 12 free. There will be refreshments, prizes, and fun for all. Talk-in on 146.52, 147.27, and 146.91. For information, contact Don Williams WD8QPM, 5114 Knapp Dr., Flint MI 48506.

#### BEREA OH SEP 23

The fourth annual Cleveland Hamfest will be held on Sunday, September 23, 1979, at the Cuyahoga County Fairgrounds, Berea, Ohio. The hamfest will be an all-indoor operation. There will be 10-foot booths available with an 8-foot table and two chairs for \$30.00.

#### GAINESVILLE GA SEP 23

The Lanierland Amateur Radio Club will hold its sixth annual Hamnic at the Lake Lanier Islands Dogwood Pavilion on September 23, 1979. There will be two large covered pavilions and a large parking area for the swap shop and exhibits. Food will be available. There will be no entry fee for Hamnic; however, Lanier Islands charges a \$2.00 entry fee per car. There will be picnicking, hiking, and swimming available for the kids. Trailer hookups and camping are also available on site. First prize will be a KDK FM2015R: there will be many other prizes. Talk-in on W4IKR .07/.67. For further information, write Bob Cochran W4DNX, 607 East Lake Drive, Gainesville GA 30501.

#### BOULDER CO SEP 23

The Boulder Amateur Radio Club will hold Barcfest '79, on September 23, 1979, beginning at 9:00 am at the Boulder National Guard Armory, North Broadway, at the city limits, Boulder, Colorado. There will be an auction and a snack bar. Admission is \$2.00 which includes a door prize drawing. Talk-in on 146.10/.70 and .52/.52. For further information, contact Mark Call N@MC, 4297 Redwood Ct., Boulder CO 80301, or phone (303)-442-2616.

SUTTON NH SEP23 The Connecticut Valley FM

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Association will hold its hamfest on September 23, 1979, from 9:00 to 5:00 pm at King Ridge ski area, Exit 11 off I-89, Sutton, New Hampshire. Admission at the gate is \$2.00 per person over 16. Advance admission is \$1.50. Send to C. A. Breuning, 54 Myrtle Street, Newport NH 03773. Festivities include an indoor/outdoor flea market, a florist exhibit, a frisbee toss, a horseshoe competition, dealers' exhibits, food, overnight camping available for self-contained units only, and a consignment room. Door prizes will be awarded, including a grand prize of a handheld, portable synthesized 2-meter rig, plus a raffle of a 19" color television at 5:00 pm. Talk-in on .52/.52 and .16/.76.

#### ERIE PA SEP 23

The Radio Association of Erie, Inc., will hold its annual Ham Jam '79 on September 23, 1979, between the hours of 8:00 am and 4:00 pm at Rainbow Gardens, Waldemeer Beach Park, at the head of Presque Isle Bay, Erie, Pennsylvania. Tables can be reserved on a first-come, first-served basis, at a cost of \$5.00 per table. There will be plenty of free parking and lots of indoor display area. Admission is \$3.00 at the gate and includes a door-prize ticket, a YL ticket, a main-prize ticket, and a free coffee. Commercial displays will also be available. There will be a \$1.00 charge per car for display space in the flea market area. Refreshments will be served on the premises. Talk-in on 146.34/.94, 146.34 simplex, and 7,250 kHz. For additional information or advanced tickets, send an SASE to Ham Jam '79, c/o the Radio Association of Erie, PO Box 844, Erie PA 16512.

#### LOUISVILLE KY SEPT 29-30

The ninth annual Greater Louisville Hamfest and Kentucky State ARRL Convention will be held on September 29-30, 1979, at the West Hall of the Kentucky Fair and Exposition Center in Louisville, Kentucky. Follow QSY signs off either I-65 or I-264. There will be a gigantic indoor air-conditioned exhibitors' area and flea market plus meetings, forums, and ladies' program. FCC exams will be given on Saturday with a banquet on Saturday night. Admission is \$3.00 in advance, \$3.50 at the door, and \$9.75 for the banquet. Exhibitors and flea market vendors should write for a special information sheet. For other information, contact the Greater Louisville Hamfest, PO Box 34444, Louisville KY 40232, or phone (502)-634-0619.

#### WARNER ROBINS GA SEP 30

Central Georgia ARC's first annual hamfest will be held on September 30, 1979, from 8:00 am to 5:00 pm at the City Recreation Center, on Watson Boulevard, Warner Robins, Georgia. Dealers and flea market will be indoors. The Georgia Single Side Band Association and Georgia CW Association both plan their annual meetings with us. Talk-in on 3,975 LSB and 146.25/.85 and 146.52. For more information. call or write Bill Atkins WD4ASB, 201 Avalon Drive. Warner Robins GA 31093, or phone (912)-923-3454.

#### GAITHERSBURG MD SEP 30

The Foundation for Amateur Radio will hold its annual hamfest at the Gaithersburg Fairgrounds, Gaithersburg MD, on Sunday, September 30, 1979, rain or shine. Featured are a large flea market, food service, exhibits, ladies' events, a supervised children's program, and many prizes. The main events are all indoors. Picnic grounds and free parking are available. Participation fee is \$2.00, sales space for flea market is \$6.00, and for tailgate, \$5.00 (spaces available on a first-come basis). Commercial exhibitors' spaces are \$15.00 with pre-registration required. Talk-in service provided and nearby motel rooms available. For information, write or call Ron Levin W3GBU, 802 Greenview Court, Reisterstown MD 21136, or telephone (301)-833-1816.

#### BLACKSBURG VA OCT 1-6

Two expanded workshops on 8080/8085/Z80 microcomputer design, microcomputer interfacing, software design, and digital electronics are being given by the editors of the popular Blacksburg books. Participants have the option of retaining the equipment used in these courses. Dates are October 1-6, 1979. For more information, contact Dr. Linda Leffel, C.E.C., VPI and SU, Blacksburg VA 24061 or phone (703)-961-5241).

#### SIOUX FALLS SD OCT 5-7

The '79 ARRL Dakota Division Convention will be held from October 5-7, 1979, at the Sioux Falls Airport Ramada Inn, located off Exit 81 on I-29, Sioux Falls, South Dakota. Featured will be technical and operating forums, a ladies' program, an ARRL forum, a large exhibit area, and a banquet. Prizes include an advance-registration prize of a DenTron GLA-1000 amplifier, a grand prize of a Kenwood TS-820S and a second grand prize of a Wilson System OneTM antenna and WR-500 rotor. Registration is \$15.00 (\$16.00 after September 1) or \$6.00 for the convention only (\$7.00 after September 1). Talkin on 146.16/.76. For further information and convention-rate hotel accommodations, write Sioux Falls Amateur Radio Club, Box 91, Sioux Falls SD 57101.

#### HOUSTON TX OCT 5-7

The Houston Area Amateurs will host the ARRL West Gulf Division Convention on October 5-7, 1979, in Houston, Texas. For further information, contact Houston Ham Conventions, Inc., PO Box 79252, Houston TX 77024, or phone (713)-466-0518 or (713)-223-3161.

#### WARRINGTON PA OCT 6

The Mt. Airy VHF Radio Club Inc., will hold its Hamarama '79 and Mid-Atlantic States VHF Conference on Saturday and Sunday, October 6-7, 1979, The conference will be held on Saturday, October 6, from 9:00 am to 5:00 pm at the Warrington Motor Lodge, Rte. 611, Warrington, Pennsylvania. Featured will be an all-day VHF program, a cocktail hour and get together, and a buffet dinner. Registration is \$3.00 in advance, or \$4.00 at the door, which includes the flea market. The buffet dinner is \$9.00. The flea market will be held on Sunday, October 7, from 8:00 am to 4:00 pm, rain or shine, at the Bucks County Drive-In Theatre, also on Rte. 611. Registration is \$2.00 with tailgating \$2.00 per space (bring your own table). Featured will be amateur radio equipment, electronic parts, surplus, and door prizes. Talk-in on 146.52 W3CCX. For information, write Ron Whitsee WA3AXV, Chairman, PO Box 353, Southampton PA 18966, or phone (215)-355-5730.

#### CORNWALL NY OCT 6

The Orange County Amateur Radio Club will hold its annual auction on Saturday, October 6, 1979, at Munger Cottage, Cornwall, New York. Admission is \$1.00 and includes a chance on a door prize. The auction begins at 1:00 pm and sellers should arrive at noon. Talk-in on .52. For further information, contact Bill Lazzaro N2CF, 11 Jefferson St., Highland Mills NY 10930.

#### ROME GA OCT 7

The Northwest Georgia Amateur Radio Club will hold its annual Rome Hamfest on October 7, 1979, at the Coosa Valley Fairgrounds, Rome, Georgia. Gates will open at 9:00 am. Talk-in on 146.34/.94 and 146.085/.685. For further information, contact WB4AEG, Box 274, Adairsville GA 30103.

#### ROCK HILL SC OCT 7

The York County Amateur Radio Society will hold its 28th annual hamfest on Sunday, October 7, 1979, starting at 8:00 am, at Joslin Park, Rock Hill, South Carolina. Registration is \$2.75 each, or 2 for \$5.00 in advance, or \$3.00 at the gate. The main prize is a Yaesu FT-901DM. A barbecue dinner is available at the park, Talk-in on 146.43/147.03 and 146.52. For more information, write York County Amateur Radio Society. Inc., PO Box 4141 CRS, Rock Hill SC 29730.

#### BERRIEN SPRINGS MI OCT 7

The Blossomland Amateur Radio Association will hold its fall Swap Shop on Sunday, October 7, 1979, at the Berrien County Youth Fairgrounds, north of Berrien Springs, Michigan, on US 31, beginning at 8:00 am. There will be commercial exhibits, prizes, refreshments, plenty of free parking, and display space. Space for self-contained campers, at \$3.50 including electricity, is on the grounds. Talk-in on 146.22/.82. Advance tickets are \$1.50; \$2.00 at the gate. Eight-foot tables are \$2.00 and are restricted to electronic items. For advance tickets and information, write Charles White, 1940 Union Ave., Benton Harbor MI 49022.

#### TAYLOR MI OCT 7

The 3rd annual Radio and Electronic Equipment Swap & Shop will be held on Sunday, October 7, 1979, from 9:00 am until 3:00 pm, at Kennedy High School, Taylor, Michigan. Admission is \$2.00. Featured will be door prizes and food. Talk-in on .93/.33, .52/.52, and .99/.39. For information, write RADAR, Inc., PO Box 1023, Southgate MI 48195.

#### OTTAWA ONT CAN OCT 12-14

The Radio Society of Ontario will hold its 11th annual convention at the Skyline Hotel, Ottawa, Ontario, Canada. On Friday evening, there will be a buffet and dance. On Saturday, there will be demonstrations, forums, technical sessions, a women's program, and a banquet and dance. On Sunday, there will be a flea market and delegates' meeting. For information, write PO Box 5076, Station F, Ottawa, Ontario, CAN K2C 3H3.

ASHEVILLE NC OCT 13 The Western Carolina Amateur Radio Society will hold its Asheville Autumnfest on Saturday, October 13, 1979, at the Asheville Civic Center, Asheville, North Carolina. There will be ample space for manufacturers, dealers, and the flea market, which will be in another part of the arena. A concession stand will be operated by the Civic Center. All manufacturers and dealers will have separate booths. And it will be possible to drive directly to your booth for unloading.

#### SYRACUSE NY OCT 13

The Radio Amateurs of Greater Syracuse will hold its annual hamfest on October 13. 1979, from 9:00 am until 6:00 pm at the New York State Fairgrounds, located adjacent to I-690, 3 miles southeast of the New York State Thruway, Exit 39, one mile northwest of Syracuse, New York. For commercial exhibitors, a fee of \$15.00 will include a booth with a display counter ten to fifteen feet in length or a table and two chairs. Included in the \$15.00 fee will be two tickets to the hamfest. Accommodations are available at nearby motels or travel trailer and motor home space will be available on the grounds. Commercial exhibitors will be able to set up their displays Friday night from 7:30 to 10:00 pm or on Saturday morning from 7:30 to 9:00 am. For more information, contact Bod Edgett or Paul Dunn, exhibitor chairmen, c/o Radio Amateurs of Greater Syracuse, PO Box 88, Liverpool NY 13088.

#### MEMPHIS TN OCT 13-14

The Mid-South Amateur Radio Association and participating Memphis-area clubs will sponsor the Memphis Hamfest and Tennessee State ARRL Convention on October 13-14. 1979, at the Youth Building at the Mid-South Fairgrounds, Memphis, Tennessee, Featured will be forums, exhibits, a giant flea market, FCC exams, a hospitality party, and commercial and manufacturer exhibits. The display area will be open from 9:00 am to 4:00 pm on Saturday, and from 9:00 am to 2:30 pm on Sunday. Fifty trailer hookups are on the premises, which the Memphis Park Commission will rent for \$5.00 per night.

#### BEAVER OK OCT 14

The Beaver Hamfest will be held on October 14, 1979, at the Fairgrounds Building in Beaver OK. Doors open at 8:00 am, with registration at 10:00 am. Tickets are \$2.50 each. There will be a covered-dish luncheon, a short program at 1:30 pm, swap tables, and door prizes. Camper hookups are nearby and the event is airport-close. Talk-in on .01/.61 and .52. For details, contact Stella Shaw WB5VUN, Box 310, Beaver OK 73932, (405)-625-3368.

#### LIMA OH OCT 14

The Northwest Ohio Amateur Radio Club will hold its annual hamfest on October 14, 1979, at the Allen County Fairgrounds, Lima, Ohio. Two large heated buildings will house the hamfest where tables will be available for \$3.00 each. A flea market will be held outside for free. Advance tickets are \$2.00 each. For information, send an SASE to NOARC, PO Box 211, Lima OH 45802.

#### WEST GHENT NY OCT 14

The Northeastern States 160-Meter Amateur Radio Association will hold its annual election and banquet on Sunday, October 14, 1979, at Kozel's Restaurant, Rte. 9H, West Ghent, New York. There will be a flea market in the rear parking lot at 1:00 pm and a roast beef dinner at 5:00 pm. All hams and XYLs are welcome. For reservations and details, contact William Derby WA5IOD, Secretary/Treasurer, 14 Plain St., Medfield MA 02052.

#### ISLIP LI NY OCT 14

The Long Island Mobile Amateur Radio Club, Inc., will hold its Hamfair '79 on Sunday. October 14, 1979, from 9:00 am until 4:00 pm at the Islip Speedway, Rte. 111 (Islip Ave.), one block south of Southern State Pkwy., Exit 43, or come south from the Long Island Expressway, Exit 56, Islip, Long Island, New York. There will be free parking, door prizes, and several contests. Admission is \$1.50 (non-hams are free) and \$3.00 per seller's space, which permits one person to enter. For information, call Hank Wener WB2ALW, nights, at (516)-484-4322, or Sid Grossman N2AOI, nights, at (516)-681-2194.

#### ANAHEIM CA OCT 19-21

The ARRL Southwestern Division Convention will be held on October 19-21, 1979, at the Sheraton-Anaheim Hotel, located at Ball Rd. and 1-5, Anaheim, California. The convention will begin on Friday evening with registration and exhibits from 4:00 pm until 9:00 pm. On Saturday, registration will begin at 8:00 am and exhibits and technical sessions will run from 9:00 am until 3:30 pm. FCC testing will continue until 3:30 pm also. The ARRL Forum will be held from 4:00 pm until 5:30 pm, with a no-host

cocktail party being held until the 7:30 pm banquet. The Wouff Hong pageant will be held at 00:01 am PST on Sunday morning. At 9:00 am Sunday morning the various breakfasts will be held and the exhibits will again be open until noon. The preregistration deadline is September 15, 1979. Advanced registration price, which includes complete program, banquet, exhibits, and technical sessions, is \$17.00, and \$19.00 at the door. The charge for the banquet only is \$12.00, and for exhibits and technical sessions, the charge is \$5.00, pre-registration; \$6.00 at the door. The ladies' program and luncheon is \$6.00, preregistration only. For more information and pre-registration. contact Hamcon, PO Box 1227, Placentia CA, or phone (714)-993-7140.

#### CEDAR RAPIDS IA OCT 19-21

The 1979 ARRL Midwest Division Convention and CVARC Hamfest will be held on October 19-21, 1979, at the Five Seasons Center, Cedar Rapids, Iowa. Tickets are \$4.00 in advance or \$5.00 at the door. Forums will include FCC. ARRL, DX, antenna, AMSAT/ OSCAR, FM and repeaters, microprocessors, modern CW, and more. A flea market will be held at \$5.00 per table with 150 tables available. Reservations are good for Saturday and Sunday and must be paid in advance. Pre-registrations will be taken through October 1, 1979. Setup begins at 6:00 am Saturday. FCC exams also will be given on Saturday. (Send Form 610 and copy of license two weeks in advance.) There will be many prizes, including a grand prize of a deluxe HF transceiver, a TH6DXX antenna, a HAM III rotor, and a 60-ft Rohn 25G tower. There will be a Saturday-evening banquet, with Senator Barry Goldwater K7UGA as guest speaker. There are many hotels and motels available. Talk-in on 146.34/.94. For information, write Convention, Cedar Valley Amateur Radio Club, Box 994, Cedar Rapids IA 52406.

#### BILOXI MS OCT 20-21

The Gulf Coast Ham/Swap Fest will be held on Saturday and Sunday, October 20 and 21, 1979, at the International Plaza, located at the west end of the Biloxi-Ocean Springs bridge on Highway 90 in Biloxi MS. Tables are \$3 per day or \$5 per weekend. Talk-in on 146.13/73 and 146.52. For information, advance tickets, and tables, contact AI Williams WD5GNR, 311½ DeMontluzin Ave., Bay St. Louis MS 39520.

#### READING MA OCT 20

The Quannapowitt Radio Association will hold its annual auction on October 20, 1979, at the Knights of Columbus Hall in Reading, Massachusetts. Doors will open at 10:00 am and the auction will start at 11:00 am. Food and refreshments will be available. Talk-in on 146.52. For information, call Bob Reiser AA1M at (617)-272-6219.

#### NORFOLK VA OCT 20-21

The fourth annual Tidewater Hamfest-Computer Show-Flea Market will be held on October 20-21, 1979, starting at 9:00 am at the Norfolk, Virginia, Cultural and Convention Center SCOPE. Norfolk, Virginia. There will be 60,000 square feet of air-conditioned exhibit and flea market tailgating space available. Featured will be ARRL meetings, DX and traffic forums, and a CW contest. FCC exams are planned for amateur upgrading on Saturday from 9:00 to 12:00 am. A special feature will be a dinner cruise and banquet on the Spirit of Norfolk cruise ship on Saturday night for \$16 per person, or \$30 per couple. Advance registrations are \$2.50 (include an SASE) or \$3.50 at the door. Flea market tailgate spaces are \$3.00 per day. For tickets and information, write TRC, PO Box 7101, Portsmouth VA 23707.

#### LONDON ONT CAN OCT 28

The London Amateur Radio Club will hold its 2nd annual Swap and Shop on October 28, 1979, from 8:00 am until 4:00 pm at Lord Dorchester High School in Dorchester, just off 401. Admission and tables are both \$2.00. Featured will be displays and prizes. Talk-in on .78/.18. For more information, write VE3CSK, RR #1, Ailsa Craig, Ontario, Canada NOM 1A0.

#### FRAMINGHAM MA NOV 11

The Framingham Area Radio Association will hold its indoor electronic flea market on Sunday, November 11, 1979, from 10:00 am until 2:00 pm at the Framingham Police drill shed behind the police station, Framingham, Massachusetts. From Rte. 9, take Rte. 126 south to the center of Framingham. Sellers' setup time is from 9:00 am to 10:00 am. Advance table reservations will be \$5.00, with tables available at the door for \$7.50. Refreshments will be served outside the flea market area. Talk-in on .75/.15 and .52. For information or reservations, write Framingham Area Radio Association, PO Box 3005, Framingham MA 01701.

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A 24 key HEX keyboard includes 16 HEX keys plus load, reset, run, wait, input, memory pro-tect, monitor select and single step. Large, on board displays provide output and optional high and low address. There is a 44 pin standard connector slot for PC cards and a 50 pin connecr slot for the Quest Super Expansion Board. Power supply and sockets for all IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pos. of software info, including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. OEM's use it for training and research and development.

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A IK Super ROM Monitor \$19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader. editor and error checking multi file cassette read/write software, (relocatible cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the Super Expansion Board and Super Monitor the monitor is up and running at the push of a button

Other on board options include Parallel Input and Output Ports with full handshake. They allow easy connection of an ASCII keyboard to the input port. RS 232 and 20 ma Current Loop for teletype or other device are on board and if you need more memory there are two S-100 slots for static RAM or video boards. A Godbout 8K RAM board is available for \$135.00. Also a 1K Super Monitor version 2 with video driver for full capa billty display with Tiny Basic and a video Interface board, Parallel I/O Ports \$9.85, RS 232 \$4.50 TTY 20 ma I/F \$1.95, S-100 \$4,50. A 50 pin connector set with ribbon cable is available at \$12.50 for easy connection between the Super Elf and the Super Expansion Board.

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2N5179 Transistor

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10.7MHZ Narrow Band Crystal Filter

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|                                       | MORA                    | Model S               | SFD-455D                   | nə                    |              | 19.2 KC<br>31.5 | 2,2395 MC         | 2 854 MC | 1 31 AL3 34.95  | 6 752 MO    | 20.1MC    |
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|                                       | Type: C                 | SEE.10 7              | 107 MH7 \$                 | 5.95                  |              | 96              | 2.2925            | 2.8725   | 3.4675          | 6.77625     | 25.47667  |
| TEXTRONIX                             | . , po                  |                       |                            | 0.00                  |              | 225             | 2.2975            | 2.887    | 3.5             | 6.910       | 25.9      |
| 585A Oscilloscope                     |                         |                       | HEWLET                     |                       |              | 250             | 2.320             | 2.889    | 3.579545        | 6.940       | 26.66667  |
| with 82 dual trace p                  | olug-in                 |                       | Model 14                   | 0A Oscilloscope       |              | 576             | 2.326             | 2.894    | 3.64            | 7.0057      | 26.8965   |
| DC-100 MHz \$8                        | 00.00                   |                       | W/1402A,                   | 1400A                 | \$495.00     | 720             | 2.32885           | 2.920    | 3.80            | 7.15        | 26.9      |
| TEKTRONUY                             |                         |                       | (also avai                 | lable 1415A \$300)    |              | 1.0000MC        | 2.3525            | 2.925450 | 3.805           | 7.390       | 27.7778   |
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| 925MHz-10.25GHz                       | yzer pruł               | \$899.0               | n                          |                       |              | 1.4             | 2.374             | 2.931    | 3.901           | 7.473       | 28.728    |
|                                       |                         |                       | -                          |                       |              | 1.455           | 2.375             | 2.945    | 3.9168          | 7.5<br>7.81 | 28.88889  |
|                                       |                         |                       |                            |                       |              | 1.689600        | 2.38725           | 2.94875  | 4.0000          | 8.00764     | 28.93888  |
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| HEWLETT PACK                          | ARD UHI                 | F, VHF, /             | AND MICRO                  | WAVE SIGNAL           |              | 1.77125         | 2.42              | 2.973    | 4.26            | 8.075       | 29.9      |
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| MODEL 434/                            | Ą                       | м                     | ODEL 416A                  | MODEL 41              | 3AR          | 1.78675         | 2.44275           | 2.981    | 4.57            | 8.364       | 31.0000   |
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| \$450.00                              |                         |                       | \$125.00                   | \$112.50              | D            | 1.845125        | 2.4585            | 2.9989   | 4.7             | 8.8285      | 31.00067  |
|                                       | _                       |                       |                            |                       |              | 1.84375         | 2.46125           | 3.001    | 4.7175          | 8.8455      | 32.0000   |
| MODEL 400D                            | )R                      | MO                    | DDEL 616B/A                | MODEL 61              | 8B           | 1.040020        | 2.482             | 3.0235   | 4.7245          | 8.854       | 32.22222  |
| \$79.95                               | linetei                 | 0                     | niv \$399.00               | 3.0 10 7.0 G          | 901Z         | 1.846           | 2.5               | 3.049    | 4.765           | 8.8625      | 32.9      |
|                                       |                         | Ŭ                     |                            | A Model \$29          | 9.00         | 1.8425          | 2.51375           | 3.053    | 4.89            | 8.879500    | 33.33333  |
|                                       |                         |                       |                            |                       |              | 1.84975         | 2.56              | 3.062    | 5.0000          | 8.888       | 33.9      |
| MODEL 606A                            | u                       | MOD                   | EL 683C                    | MODEL 61              | 2A<br>MU-    | 1.908125        | 2.604             | 3.074    | 5.13125         | 8.905       | 34.0000   |
| .1mV to 3V into 50                    | ohms                    |                       | \$299.00                   | -1uv to -5uv into     | 50 ohms      | 1.925           | 2.6245            | 3.1125   | 5.147917        | 8.9305      | 34.4444   |
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| MODEL TS510/U HP                      | 2608D                   | MODEL                 | 620A                       | 302A with a 297       | 7A           | 1.985           | 2.639             | 3.1435   | 5.436636        | 9.65        | 35.55555  |
| .1V to .5V                            | nz                      | 223V to               | Griz wave                  | 20 H7 to 50 k         | eep Drive    | 1.9942          | 2.63575           | 3.144    | 5.456           | 9.7         | 36.21750  |
| \$399.95                              |                         | \$699                 | .99                        | \$799.00              |              | 1.995975        | 2.64325           | 3.145    | 5.4675          | 9.75        | 36.66667  |
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| WISPER FANS                           |                         |                       |                            |                       |              | 2.0285          | 2.650750          | 3.158    | 5.515           | 9.9         | 37.385    |
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|                                       | 100 ; IIIp              |                       | 0100100, 00/01             | ONLY \$9.95 o         | r 2/\$18.00  | 2.12795         | 2.660             | 3.1625   | 5.5515          | 9.999       | 38.00000  |
|                                       |                         |                       |                            |                       |              | 2.1315          | 2.662             | 3.166    | 5.559           | 10.021      | 38.33333  |
| TRW BROADBAND A                       | MPLIFIEF                | MODEL                 | CA615B                     |                       |              | 2.133275        | 2.66575           | 3.16975  | 5.5665          | 10.20833    | 38.77778  |
| Gain                                  | 40 10 500               |                       | 300 MHZ 160                | B MIN.                |              | 2.136825        | 2.677             | 3.181    | 5.5815          | 10.80375    | 38.88888  |
|                                       |                         |                       | 17.5dB MAX                 | 4 40 4 000 MI         |              | 2.1425          | 2.68075           | 3.1825   | 5.589           | 11.1805     | 38.88889  |
| Voltage                               |                         |                       | 24 volts DC                | at 220ma MAX          | 12           | 2.144625        | 2.681             | 3.18475  | 5.604           | 11.228      | 39.160    |
| · · · · · · · · · · · · · · · · · · · |                         |                       |                            | ON                    | LY \$14.95   | 2.148875        | 2.68825           | 3.2035   | 5.6115          | 11.2375     | 40.00000  |
|                                       | CIRCU                   |                       |                            | 2                     |              | 2.151           | 2.69575           | 3.20725  | 5.6265          | 11.3565     | 41.11111  |
| Siz                                   | ze                      | Price                 | Size                       | Price                 |              | 2.153125        | 2.7               | 3.2105   | 5.6415          | 11.535      | 43.33333  |
| 35                                    | 5 9                     | \$2.15                | 58                         | \$1.85                |              | 2.155           | 2.702             | 3.2175   | 5.675           | 11.69626    | 45.       |
| 42                                    | 2 9                     | 2.15                  | 59                         | \$1.85                |              | 2.15525         | 2.71075           | 3.2315   | 5.680           | 12.99       | 47.48     |
| 41                                    |                         | 2.15                  | 61                         | \$1.85<br>\$1.85      |              | 2.157375        | 2.715             | 3.23275  | 5.695           | 13.09       | 49.95     |
| 50                                    | j j                     | 2.15                  | 62                         | \$1.85                |              | 2.16375         | 2.723             | 3.23775  | 5.7105          | 13.2155     | 53.45     |
| 51                                    | 1 1                     | 2.15                  | 63                         | \$1.85                |              | 2.165875        | 2.730             | 3.23775  | 5.733333        | 13.2455     | 57.45     |
| 52                                    | 2 9                     | 2.15                  | 64                         | \$1.85                |              | 2.170125        | 2.7315            | 3.2385   | 5.8968          | 13.2745     | 59.45     |
| 54                                    |                         | 1.05                  | 60<br>88                   | \$1.85                |              | 2.17225         | 2.732625          | 3.23925  | 6.210           | 13.2945     | 61.95     |
| 55                                    | 5 5                     | 1.85                  | 1.25 mm                    | \$1.85                |              | 2.1765          | 2.733             | 3.24     | 6.321458        | 13.3045     | 63.80833  |
| 56                                    | 5 5                     | 1.85                  | 1.45 mm                    | \$1.85                |              | 2.17925         | 2.737             | 3.24025  | 6.380833        | 13.3145     | 72 855    |
| 57                                    | 7 1                     | 1.85                  | 3.20 mm                    | \$3.58                |              | 2.18575         | 2.73975           | 3.2403   | 6.427083        | 13.3345     | 75.185    |
|                                       | 16.1                    | TEODAT                |                            |                       |              | 2.194125        | 2.7425            | 3.2425   | 6.47            | 13.3445     | 76.66667  |
| MC1303L                               | rrs.                    | \$ 2.00               | MC1460R                    |                       | \$ 5.40      | 2.207063        | 2.744             | 3.244    | 6.4711          | 13.3545     | 83.       |
| MC1461R                               |                         | 6.90                  | MC1463R                    |                       | 5.15         | 2.208313        | 2.7445<br>2.74475 | 3.240075 | 6.510           | 15.016      | 84.       |
| MC1469G<br>MC1550G                    |                         | 2.05                  | MC1469R                    |                       | 3.55         | 2.210812        | 2.746875          | 3.4975   | 6.567           | 15.036      | 85.833330 |
| MC1560R                               |                         | 12.40                 | MC1563R                    |                       | 10.20        | 2.210813        | 2.751             | 3.2515   | 6.582           | 17.2800     | 93.1346   |
| MC1568G                               |                         | 5.31                  | MC1568L                    |                       | 5.00         | 2.212063        | 2.754             | 3.255    | 6.612<br>6.6845 | 17.9065     | 93.535    |
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    2/4.305.5         10           MIX-980-5         124.45         2/3.005.5         10         2/4.305.5         10         2/4.305.5                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| 74CO4 39<br>74C10 39<br>74C10 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C22 195<br>74C22 39<br>74C24 29<br>74C24 29<br>74<br>74C24 29<br>74<br>74C24 29<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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 12/1.00         1H1184         200 PV135           1H4601         50 PV1         1AMP         12/1.00         1H1184         200 PV135           SCR         AND FW BRIDGE RECTIFIE         C380         154.40         500V         SCR           C380         154.40         600V         SCR         MRDGE RE         C400V         SCR           MDA 980-3         124.46         300V         PW BRDGE RE         2H305         100         2H305           MF5A05         5/1.00         2H3305         100         2H3305         100         2H4133           T1597         6/1.00         2H3305         3/1.00         2H4133         11         2H4101           158/7         6/1.00         2H3305         3/1.00         2H4434         100         PH3449           11597         6/1.00         2H3305         3/1.00         2H4434         100         PH4349      <t< th=""><th>AMP 1 70<br/>AMP 1 70<br/>AMP 1 80<br/>AMP 1 80<br/>AMP 3 00<br/>RS<br/>\$1 95<br/>50<br/>1 95<br/>5 1 95<br/>5 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 1/1744/H         1           1/1744/H         1           1/1744/H         1           1/1744/H <th>RCA         LINEAR         Calculation           CA0311         215         CA302*         200         20         20           CA0311         215         CA302*         200         CHES/SORTVERS           CA0311         215         CA302*         100         CHES/SORTVERS           CA30317         256         CA303*         160         MM5775         812           CA30367         136         CA3090*         375         DM866*         1           CA3064*         CA3060*         139         DM866*         1           CA3064*         CA306*         139         DM866*         1           CA306**         725         CA308**         139         DM866*         1           CA306***         725         CA308***         139         DM865*         1           CA306****         725         CA308****         149         1477         749         149         140         14         14         15        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     2-43         3-64           36 pm IP         6-91         2-44         4-50           DARD (TIN)         0-pm IP         5-2         2-49         50-100           22 pm IP         5-37         5-30         50         50           DARD (TIN)         0-pm IP         5-2         5-10         5-10</th> <th>1H458         25         40m         6/1.00         1H1184         100 PV33           1H458         150         7m         6/1.00         1H1184         100 PV33           1H458         150         7m         6/1.00         1H1184         100 PV33           1H458         150         100         1H1184         200 PV33         200 PV33           SCR AND FW BRIDGE RECTIFIE           C380         154 /r 400 V         SCR           2H222         1 64 /r 400 V         SCR           MDA 680-3         124 /r 500 V         PW BRIDGE RECTIFIE           C1681         50 TRANSISTORS         2H300           MF5406         501 0         PM3392         5/1 00 2H4038           MF5406         210 0 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     136         CA3090*         375         DM866*         1           CA3064*         CA3060*         139         DM866*         1           CA3064*         CA306*         139         DM866*         1           CA306**         725         CA308**         139         DM866*         1           CA306***         725         CA308***         139         DM865*         1           CA306****         725         CA308****         149         1477         749         149         140         14         14         15         16         15         16         15         16         15         16         15         16         15         16         15         16         16         17         16         17         17         17                                                                                                                                                                                                                                                                                      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        SCR         SCR         AND         FW BRIDGE RECTIFIE           C381         354 6 m 607         SCR         SCR         MDA BBO-2         RCR           MCA 880-3         124 m 507         FW BRIDGE RECTIFIE         MBMDA BBO-2         RCR           MD5A66         2         23325         S11 00         RCR 3005         RCR 24338           MF5A66         71 00         243386         S11 00         244433         71 00         PH4250           1558         6/1 00         243386         S11 00         244443         244400         7400         74444           40409         175         PH3556         4/1 00         244440         244440         244440         244440</th><th>AMP 170<br/>AMP 170<br/>AMP 180<br/>AMP 300<br/><b>RS</b><br/>\$195<br/>195<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50</th></td<>                                                                                                                                        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  35           LM34047         1         55           LM34047         1         56           LM3407         1         56           LM3407         1         56           LM3407         1         56 </th <th>740(17)         2         80           740(182)         2         49           740(183)         2         49           740(185)         2         49           740(185)         2         49           740(185)         6         25           740(255)         8         95           800(55)         1         50           800(51)         1         50           800(51)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         1           800(57)         1         2           800(57)         1         2           800(57)         1<!--</th--><th>Control         Control         Control         Control         Call         Call</th><th>Obs: 7:50         4 / 7 30         Oper-Prediate Control         0 00         22 30           S         MIS300         5 40 55         MOTOROLA           S         MIS301         4 65         MIC1408/7         5 4 55           S         MIS301         4 65         MIC1408/7         5 4 55           S         MIS311         4 65         MIC1408/7         5 4 55           MIS316         6 55         MIC302/7         3 50           MIMS317         6 56         MIC302/7         3 50           MIMS317         9 55         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC404/9         6 50           DFILE (TIN) SOCKETS         2 2 m LP 3 37         36         35           2 8 m LP         3 6         36         35           3 8 pm LP         80         58         50         50           DARD (TIN)         40 pm LP         53         26         51           3 8 pm LP         80         52         51         36         35</th><th>1H455         25         40m         67.00         1H1184         100 PY135           1H455         150         7m         67.00         1H1184         100 PY135           1H455         150         7m         67.00         1H1184         100 PY135           1H4600         50 PY1 I AMP         72.00         1H1185         200 PY135           SCR AND FW BRIDGE RECTIFIE           C380         154 tr 400V         SCR/201491           2014         164 dr 300V         SCR           M0A 980-1         124 tr 50V         PW BRIDGE RE           M0A 980-3         124 tr 20V         PW BRIDGE RE           1156         50         71.00         1H1184           MPSA05         51.00         2H3055         10           MPSA05         51.00         2H3055         10           MPSA05         51.00         2H3055         100         2H305           MPSA05         51.00         2H3055         100         2H4013           11596         67.100         MH35358         41.00         2H4401           40409         17.00         2H3558         41.00         2H4401           40410         175         PH3558</th><th>AMP 1 70<br/>AMP 1 70<br/>AMP 1 80<br/>AMP 3 00<br/>RS \$1 95<br/>1 95<br/>5 90<br/>5 1 95<br/>1 95<br/>1 95<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>5/1 00<br/>5/1 00<br/>5/1 00</th></th>                                                                                                                                                                                                                                                                                                             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800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         50           800(57)         1         1           800(57)         1         2           800(57)         1         2           800(57)         1 </th <th>Control         Control         Control         Control         Call         Call</th> <th>Obs: 7:50         4 / 7 30         Oper-Prediate Control         0 00         22 30           S         MIS300         5 40 55         MOTOROLA           S         MIS301         4 65         MIC1408/7         5 4 55           S         MIS301         4 65         MIC1408/7         5 4 55           S         MIS311         4 65         MIC1408/7         5 4 55           MIS316         6 55         MIC302/7         3 50           MIMS317         6 56         MIC302/7         3 50           MIMS317         9 55         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC404/9         6 50           DFILE (TIN) SOCKETS         2 2 m LP 3 37         36         35           2 8 m LP         3 6         36         35           3 8 pm LP         80         58         50         50           DARD (TIN)         40 pm LP         53         26         51           3 8 pm LP         80         52         51         36         35</th> <th>1H455         25         40m         67.00         1H1184         100 PY135           1H455         150         7m         67.00         1H1184         100 PY135           1H455         150         7m         67.00         1H1184         100 PY135           1H4600         50 PY1 I AMP         72.00         1H1185         200 PY135           SCR AND FW BRIDGE RECTIFIE           C380         154 tr 400V         SCR/201491           2014         164 dr 300V         SCR           M0A 980-1         124 tr 50V         PW BRIDGE RE           M0A 980-3         124 tr 20V         PW BRIDGE RE           1156         50         71.00         1H1184           MPSA05         51.00         2H3055         10           MPSA05         51.00         2H3055         10           MPSA05         51.00         2H3055         100         2H305           MPSA05         51.00         2H3055         100         2H4013           11596         67.100         MH35358         41.00         2H4401           40409         17.00         2H3558         41.00         2H4401           40410         175         PH3558</th> <th>AMP 1 70<br/>AMP 1 70<br/>AMP 1 80<br/>AMP 3 00<br/>RS \$1 95<br/>1 95<br/>5 90<br/>5 1 95<br/>1 95<br/>1 95<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>4/1 00<br/>5/1 00<br/>5/1 00<br/>5/1 00</th>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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        MIS311         4 65         MIC1408/7         5 4 55           MIS316         6 55         MIC302/7         3 50           MIMS317         6 56         MIC302/7         3 50           MIMS317         9 55         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC4016/7 4/16)         7 50           MIMS37/1998.4         9 56         MIC404/9         6 50           DFILE (TIN) SOCKETS         2 2 m LP 3 37         36         35           2 8 m LP         3 6         36         35           3 8 pm LP         80         58         50         50           DARD (TIN)         40 pm LP         53         26         51           3 8 pm LP         80         52         51         36         35                                                                                                                                                                                                        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BRIDGE RE           M0A 980-3         124 tr 20V         PW BRIDGE RE           1156         50         71.00         1H1184           MPSA05         51.00         2H3055         10           MPSA05         51.00         2H3055         10           MPSA05         51.00         2H3055         100         2H305           MPSA05         51.00         2H3055         100         2H4013           11596         67.100         MH35358         41.00         2H4401           40409         17.00         2H3558         41.00         2H4401           40410         175         PH3558                                                                                                                                                                                                                                                                                                                                                                                                                                         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00<br>4/1 00<br>4/1 00<br>5/1 00<br>5/1 00<br>5/1 00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| 74C04 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C20 39<br>74<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74<br>74C20 39<br>74<br>74C20 39<br>74<br>74C20 39<br>74<br>74<br>74C20 39<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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  165           74031         165           74033         165           74034         165           74035         165           74017         15           74017         20           74015         200           74015         200           74015         200           74016         249           74016         135           1.034047-6         135           1.034047-6         125           1.034047-6         125           1.034047-15         125           1.034047-15         125           1.034047-15         125           1.034047         15           1.034047         15           1.03407         100           1.03407         125           1.03407         100           1.03407         125           1.03407         125           1.03407         125           1.03407         125           1.03407         125           1.03407         125           1.03407         125           1.03407         125           1.031070                                                                                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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | OBC: 7-90         4 / 7-30         COPPENDIATION         OU         C2 20           CLDCK CHIPS         M0300780LA         54         55         M045301         46         54         54         54         54         54         54         54         54         54         54         55         55         M03301         49         54         54         54         55         55         M03311         49         54         56         161/1409.1         57         54         55         56         M03311         49         56         M01409.1         51         50         16         56         160         160         73         50         16         56         160         160         74         73         50         16         56         160         160         73         50         160         16         55         160         16         55         50         160         16         35         24         17         16         22         17         16         22         17         16         135         16         16         16         16         16         16         16         16         16         16         16         16 <td< th=""><th>1H455         25         40m         6/1.00         1H1184         100         101           1H455         150         7m         6/1.00         1H1184         100         PV13           1H455         150         7m         6/1.00         1H1184         100         PV13           1H455         150         7m         6/1.00         1H1185         200         PV13           1H4600         50         PV1         1AM         71.00         1H1185         200         PV13           1H4600         50         PV1         1AM         P21.00         1H1184         200         PV3           C38D         154.4m         400V         SCR         SCR</th><th>A AMP 1 70<br/>A AMP 1 70<br/>A AMP 1 80<br/>A AMP 1 80<br/>A AMP 3 00<br/>RS<br/>50<br/>50<br/>51 95<br/>51 95<br/>51</th></td<>                                                                                              | 1H455         25         40m         6/1.00         1H1184         100         101           1H455         150         7m         6/1.00         1H1184         100         PV13           1H455         150         7m         6/1.00         1H1184         100         PV13           1H455         150         7m         6/1.00         1H1185         200         PV13           1H4600         50         PV1         1AM         71.00         1H1185         200         PV13           1H4600         50         PV1         1AM         P21.00         1H1184         200         PV3           C38D         154.4m         400V         SCR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       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| 74COH 39<br>74C10 49<br>74C10 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 29<br>74C20 89<br>74C20 89<br>74C21 15<br>LM30CH 10<br>LM30CH                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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  1         95           74034         1         95           74035         1         95           74034         1         20           74017         2         15           74013         2         90           74015         2         10           74016         2         19           74016         2         19           74016         1         35           1M3407-6         1         25           1M3407         1         15           1M3407         1         10           1M3407         1         10           1M3407         1         2           1M3407         1         2           1M3407         1         2 <tr< th=""><th>740173         2 60           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740282         5 65           00018         6 25           00018         6 26           00018         10           LM7171H         79           LM723H         10           LM733H         10           LM74144         39           LM1436CM4         39           LM1436CM4         39           LM1436CM54         39           LM1436CM54         39           LM1436CM54         30           LM1436CM54</th><th>Control         Control         Control         Control         Call         Call<th>CLOCK CHIPS         CUOR         Sec. 7 - 90         4 / 1 - 30         Opportunition         O OU         C2 - 20           S         MIS300         5 - 495         MIC1400L7         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         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     IN-1186         200 PH/3           CBM         IS56 PH/1 AMP         F2/1 00         IN-1186         200 PH/3         IN-1186         200 PH/3           CBM         IS56 PH/1 AMP         12/1 04         6/1 000         200 PH/3         SCR         PM BRIDGE RE         PM 320 PH/3208         PM 320 PH/320 PH/321</th><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 105<br/>1 95<br/>2 1 95</th></th></tr<>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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6/1 000         200 PH/3         SCR         PM BRIDGE RE         PM 320 PH/3208         PM 320 PH/320 PH/321</th> <th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 105<br/>1 95<br/>2 1 95</th> | CLOCK CHIPS         CUOR         Sec. 7 - 90         4 / 1 - 30         Opportunition         O OU         C2 - 20           S         MIS300         5 - 495         MIC1400L7         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 605         3 - 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| 74COH         39           74COB         49           74COB         39           74COB         269           74COB         90           74COB         90           74COB         90           74COB         90           74COB         10           1M300H         100           1M300H         10           1M300H         10           1M300H         10           1M300H         10           1M300H         10           1M300H         10           1M300H         12           1M300H         10           1M30H         10           1M310H         50           1M310H         50           1M310H         13           1M310H         13           1M30H         13           1M320H × 13                                                                                                                                                                                                                                                                                                                                     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Control         Control         Control         Call Culuator           CA30311         215         CA3002W         200         Call         Call <td< th=""><th>OBC: 7-90         4 / F 3g)         Opportmittation         000         2 2 30           CLOCK CHIPS         M0300         5-40 55         M01408L0         5-4 55           MM5301         4-95         M14108L1         5-4 55         M01408L1         5-5 5           MM5301         4-95         M14108L1         5-7 5         M0302F         2-5 50           MM5301         4-95         M14031F         3-5 5         3-5 5         3-5 5           MM5314         4-95         M14031F         3-5 5         3-5 5         3-5 5           MM5316         9-95         M14031F         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5           MM3317         9-95         M140404F         4-5 3         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5         3-5 5 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95<br/>1 95</th></td<>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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          74/15         2         90           74/15         2         10           74/15         2         10           74/16         2         19           74/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3           11/14/16         1         3 <th>740173         2         60           740182         2         49           740185         2         49           740185         2         49           740185         2         49           740185         2         5           740255         8         55           80051         150         0           00007         150         0           00007         150         0           047334         100         147334           0474104         30         1474104           047334         100         147334           0474104         31         0           0474104         19         14140           0474104         139         141464           04744644         139         141569           0474594         175         145567           0474594         139         141569           0474594         139         141569           0474594         150         14030534           0474594         150         14030534</th> <th>Control         Control         Control         Call         Call</th> <th>OBJ: 7-90         4 / F 30         Opposite         Opposite</th> <th>1H455         25         40m         67.00         1H1184         100 PY33           1H455         150         7m         67.00         1H1184         100 PY33           1H455         150         7m         67.00         1H1184         100 PY33           1H4600         50 PY1 I AMP         72.00         1H1185         200 PY1 33           SCR AND FW BRIDGE RECTIFIE         CSBU         154 tr 4007         SCR4/2014B1           CSBU         154 tr 4007         SCR         SCR4/2014B1           2846 tr 6007         SCR         SCR         MBDGE RE           281228         1 64 tr 4007         SCR         218005           124 tr 507         7W BRDGE RE         218005         10         218005           MDA 980-3         124 tr 507         7W BRDGE RE         218005         10         218005           MDS405         51         0         218055         10         218005         10         218005           MD5406         17         2         216055         10         218005         10         218005           MD5406         110         75         218305         10         218005         10         218005           MD5406<th>A AMP 1 70<br/>A AMP 1 70<br/>A AMP 1 80<br/>A AMP 3 00<br/>RS<br/>1 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 154 tr 4007         SCR         SCR4/2014B1           2846 tr 6007         SCR         SCR         MBDGE RE           281228         1 64 tr 4007         SCR         218005           124 tr 507         7W BRDGE RE         218005         10         218005           MDA 980-3         124 tr 507         7W BRDGE RE         218005         10         218005           MDS405         51         0         218055         10         218005         10         218005           MD5406         17         2         216055         10         218005         10         218005           MD5406         110         75         218305         10         218005         10         218005           MD5406 <th>A AMP 1 70<br/>A AMP 1 70<br/>A AMP 1 80<br/>A AMP 3 00<br/>RS<br/>1 95<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50<br/>50</th>                                                                                                                                            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| 74COH 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C22 95<br>74C4C 29<br>74C4C 29<br>74C4C 39<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4C 30<br>74<br>74C4<br>74<br>74C4<br>74<br>74C4<br>74<br>74C4<br>74<br>74C4<br>74<br>74C4<br>74<br>74C4<br>74<br>74<br>74C4<br>74<br>74C4<br>74<br>74C4<br>74<br>74<br>74C4<br>74<br>74C4<br>74<br>74<br>74C4<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74                                                                                                                                                                                                                                                                                                                                                                                                                                               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    75           1.03407-1         1         75           1.03500         1 </th <th>740173         2 60           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740182         2 49           740202         5 85           80026         8 5           80026         9 5           80027         15 0           80711         9           81/1701         79           81/1701         19           81/1701         19           81/1701         19           81/1701         19           81/1701         19           81/1701         17           81/1701         17           81/1701         17           81/1701         17           81/1701         17           81/1701         19           81/1701         19           81/1701         19           81/1701         19           81/1701         19</th> <th>Control         Control         Control         Control         Call         Call&lt;<th>Call         <th< th=""><th>Bits: 7-90         4.1 F.30         Open-Preductional         0.00         22.30           S         MIS300         5-4 95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95           MIS301         6-95         MIC3002F         7.5           MIS318         995         MIC400L7         5-0           MIS318         995         MIC4000F741617         7.5           MIS319         2.65         MIC4004F741617         7.5           MIS319         995         MIC40404740         4.50           DFILE (TIN) SOCKETS         1.24         25-49         50-100           MIS411         9.95         MIC40440         4.43           35 pm LP         6.44         3.3         36           36 pm LP         6.3         9.5         1.5         3.6           36 pm LP         6.3         9.6         15         3.6           36 pm LP         6.3         7.0         2.6         1.5           36 pm LP         6.5         7.0         1.45</th><th>IN-58         25         40m         6/1 00         INI III III 100         ID0 III IIIII 100         ID0 IIIIIIIIIIII 100         ID0</th><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 105<br/>1 195<br/>2 1 95<br/>2 1 9</th></th<></th></th>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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       995         MIC4000F741617         7.5           MIS319         2.65         MIC4004F741617         7.5           MIS319         995         MIC40404740         4.50           DFILE (TIN) SOCKETS         1.24         25-49         50-100           MIS411         9.95         MIC40440         4.43           35 pm LP         6.44         3.3         36           36 pm LP         6.3         9.5         1.5         3.6           36 pm LP         6.3         9.6         15         3.6           36 pm LP         6.3         7.0         2.6         1.5           36 pm LP         6.5         7.0         1.45</th><th>IN-58         25         40m         6/1 00         INI III III 100         ID0 III IIIII 100         ID0 IIIIIIIIIIII 100         ID0</th><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 105<br/>1 195<br/>2 1 95<br/>2 1 9</th></th<></th>   | Call <th< th=""><th>Bits: 7-90         4.1 F.30         Open-Preductional         0.00         22.30           S         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        9.95         MIC40440         4.43           35 pm LP         6.44         3.3         36           36 pm LP         6.3         9.5         1.5         3.6           36 pm LP         6.3         9.6         15         3.6           36 pm LP         6.3         7.0         2.6         1.5           36 pm LP         6.5         7.0         1.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        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| 74CO4 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C10 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C21 89<br>74C21 80<br>74<br>74C21 80<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74<br>74                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   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    MIC1008.7         5-4 55           MIS301         4-95         MIC1008.7         5-4 55         MIC1008.7         5-4 55           MIS301         4-95         MIC1008.7         5-4 55         MIC1008.1         5-1 55           MIS301         4-95         MIC1008.1         5-1 55         MIC3021P         3-5           MIMS301         9-95         MICA0167.474.16         7-3 05         MICA024P         3-5           MIMS301         9-95         MICA044.074.474.16         7-3 05         MICA044.9         6-5         50           MIMS307.1992.8         4-95         MICA044.9         6-50         50         50         MICA044.9         6-50         50         50         50         50         MICA044.9         6-50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50         50    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       IN-600         SD PIV I AMP         12.100         IN-1184         200         PV-3           CBB0         154 m 4007         SCR         AND FW BRIDGE RECTIFIE         CCR           CBB0         154 m 4007         SCR         NM-106         SCR         NM-106           2x1222         1 64 m 3007         SCR         NM-106         RE         NM-106         RE           MCA 880-1         1 24 m 507         FW BRIDGE RE         PM BRIDGE RE         NM-106         N                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| 74CO4 39<br>74C10 39<br>74C10 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 39<br>74C20 49<br>74C20 49<br>74C20 49<br>74C20 49<br>74C21 49<br>74<br>74C21 49<br>74<br>74C21 49<br>74<br>74<br>75<br>14<br>14<br>17<br>17<br>17<br>17<br>17<br>17<br>17<br>17<br>17<br>17<br>17<br>17<br>17                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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| 74COH         39           74CDB         49           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C201         39           74C42         39           74C43         39           74C43         39           74C43         39           74C44         39           74008         15           143004         10           1430054         10           1430054         10           1430054         15           143104         150           143104         150           143104         150           143104         150           143104         150           143104         150           143204                                                                                                                                                                                                                                                                                                                                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Open-Predictional         0.00         2.2 so           S         Mid:300         5-4 95         Mid:1408.1         5-4 55           Mid:301         4-95         Mid:1408.1         5-7 5           Mid:314         4-95         Mid:1408.1         5-7 5           Mid:316         6-96         Mid:302.2         2-5 5           Mid:316         6-96         Mid:302.7         2-5 5           Mid:316         95         Mid:400.000         6-5 5           Mid:317.7990.0         2-5 5         50         Mid:400.000         6-5 5           Mid:3911         9-96         Mid:400.000         6-5 3         3-3 3           Mid:3911         9-97         9-95         1-4 3         3-3 3           DARD (TIN)         20 pm 12-8         2-7 33         3-3 3           30 pm 50         1-7 3         1-9 14-5         1-30           Mid:400.1         2-7 3         9-9 35         1-0 100         3-7                                                                                                                    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| 74COH         39           74COB         49           74C10         39           74C10         39           74C11         39           74C11         39           74C11         39           74C11         39           74C11         39           74C11         39           74C12         39           74C21         39           74C21         39           74C21         39           74C23         89           74C24         89           74C25         89           74C73         89           74C74         89           74C73         89           74C74         89           74000         10           LM3040         10           LM3020         10           LM3020         10           LM3020         15           LM3104         10           LM3104         10           LM3104         10           LM3104         10           LM3104         10           LM3104         10           LM3104         10 <th>74/203         1         85           74/203         1         85           74/203         1         85           74/203         1         95           74/203         1         95           74/203         1         95           74/2017         2         10           74/2017         2         15           74/2018         2         49           74/2018         1         35           1.0340/07-24         1         35           1.0340/07-61         1         25           1.0340/07-61         1         25           1.0340/07-7         1         25           1.0340/07-10         1         25           1.0340/07-24         1         25           1.0340/07-24         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25</th> <th>740173         2.60           740173         2.60           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           740182         2.49           7401714         10           LM71714         10           LM7234         10           LM7334         10           LM74144         39           LM1456074         <t< th=""><th>Image         Control Contecontrol Control Contecontecontrol Control Control C</th><th>CLOCK CHIPS         CLOCK CHIPS         MC100R0LA           S         MIS301         4.95         MC1008.7         5.4 95           MIS301         4.95         MC1008.7         5.4 95         MC1008.7         5.4 95           MIS301         4.95         MC1008.7         3.5 0         5.4 95         MC1008.7         3.6 0           MIS301         4.95         MC1008.7         3.6 0         5.4 95         MC1008.7         3.6 0           MIS301         4.95         MC1008.7         3.6 0         3.6 0         3.6 0         3.6 0           MIS314         4.95         MC302.2 P         3.6 0         MC302.2 P         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         &lt;</th><th>Initials         20         40m         6/1 00         111114         100 PV33           Initials         150         70m         6/1 00         111114         100 PV33           Initials         1800         70m         6/1 00         111114         200 PV33           SCR         AND         FW BRIDGE         RECTIFIE         200 PV33           Initials         180 PV1 IAMP         12/1 00         111118         200 PV33           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           MCA 800-1         12/4 re 50V         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MCA 800-1         12/4 re 50V         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MFSA05         0         2/40305         10         2/40305         10           MFSA05         10         2/40305         10         2/40305         10         2/40305           11589         6/1 10         2/43388         5/1 00         2/4404         2/4110         <td< th=""><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 100<br/>RS<br/>\$1 95<br/>1 95<br/>195<br/>195<br/>195<br/>195<br/>195</th></td<></th></t<></th> | 74/203         1         85           74/203         1         85           74/203         1         85           74/203         1         95           74/203         1         95           74/203         1         95           74/2017         2         10           74/2017         2         15           74/2018         2         49           74/2018         1         35           1.0340/07-24         1         35           1.0340/07-61         1         25           1.0340/07-61         1         25           1.0340/07-7         1         25           1.0340/07-10         1         25           1.0340/07-24         1         25           1.0340/07-24         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25           1.0340/07-10         1         25                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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740182         2.49           740182         2.49           740182         2.49           7401714         10           LM71714         10           LM7234         10           LM7334         10           LM74144         39           LM1456074 <t< th=""><th>Image         Control Contecontrol Control Contecontecontrol Control Control C</th><th>CLOCK CHIPS         CLOCK CHIPS         MC100R0LA           S         MIS301         4.95         MC1008.7         5.4 95           MIS301         4.95         MC1008.7         5.4 95         MC1008.7         5.4 95           MIS301         4.95         MC1008.7         3.5 0         5.4 95         MC1008.7         3.6 0           MIS301         4.95         MC1008.7         3.6 0         5.4 95         MC1008.7         3.6 0           MIS301         4.95         MC1008.7         3.6 0         3.6 0         3.6 0         3.6 0           MIS314         4.95         MC302.2 P         3.6 0         MC302.2 P         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         &lt;</th><th>Initials         20         40m         6/1 00         111114         100 PV33           Initials         150         70m         6/1 00         111114         100 PV33           Initials         1800         70m         6/1 00         111114         200 PV33           SCR         AND         FW BRIDGE         RECTIFIE         200 PV33           Initials         180 PV1 IAMP         12/1 00         111118         200 PV33           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           MCA 800-1         12/4 re 50V         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MCA 800-1         12/4 re 50V         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MFSA05         0         2/40305         10         2/40305         10           MFSA05         10         2/40305         10         2/40305         10         2/40305           11589         6/1 10         2/43388         5/1 00         2/4404         2/4110         <td< th=""><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 100<br/>RS<br/>\$1 95<br/>1 95<br/>195<br/>195<br/>195<br/>195<br/>195</th></td<></th></t<>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Image         Control Contecontrol Control Contecontecontrol Control Control C                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | CLOCK CHIPS         CLOCK CHIPS         MC100R0LA           S         MIS301         4.95         MC1008.7         5.4 95           MIS301         4.95         MC1008.7         5.4 95         MC1008.7         5.4 95           MIS301         4.95         MC1008.7         3.5 0         5.4 95         MC1008.7         3.6 0           MIS301         4.95         MC1008.7         3.6 0         5.4 95         MC1008.7         3.6 0           MIS301         4.95         MC1008.7         3.6 0         3.6 0         3.6 0         3.6 0           MIS314         4.95         MC302.2 P         3.6 0         MC302.2 P         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         3.6 0         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       FW BRIDGE         RECTIFIE         200 PV33           Initials         180 PV1 IAMP         12/1 00         111118         200 PV33           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           Callo         154 re 400V         SCR RAND FW BRIDGE RECTIFIE         SCR RAND FW BRIDGE RECTIFIE           MCA 800-1         12/4 re 50V         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MCA 800-1         12/4 re 50V         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MFSA05         0         2/40305         10         2/40305         10           MFSA05         10         2/40305         10         2/40305         10         2/40305           11589         6/1 10         2/43388         5/1 00         2/4404         2/4110 <td< th=""><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 100<br/>A AMP 3 100<br/>RS<br/>\$1 95<br/>1 95<br/>195<br/>195<br/>195<br/>195<br/>195</th></td<>                                                                             | A AMP 1 70<br>A AMP 1 100<br>A AMP 1 100<br>A AMP 3 100<br>RS<br>\$1 95<br>1 95<br>195<br>195<br>195<br>195<br>195                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                                                                                                                                                                           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| 74COH         39           74COB         49           74COB         39           74COB         269           74COB         90           10000CH         10           LM300CH         10           LM3010CH         10           LM3                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    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       15           74/0154         2         49           74/0154         1         3           1         14         3           1         14         3           1         14         1           1         14         1           1         14         1           1         15         1           1         14         1           1         15         1           1         14         1           1         15         1           1         14         1           1         15         1           1         14         1           1         14         1           1         15         1           1         14         1                                                                                                                                                                                                                                                                                                                                                                                                   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 MIS317         995         MC401674416         730           MIS317         995         MC401674416         730           MIS317         995         MC40404         65           MIS317         995         145         36           20 m1 LP         337         36         35           20 m1 LP         373         36         35           20 m1 LP         337         36         35           20 m1 LP         33         36         35           20 m1 LP         37                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | IN-55         25         40m         67.00         111.114         100         101         111.114         100         100         111.114         100         IN1.114         100         IN1.114<                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| 74C0H         39           74C10H         39           74C10H         39           74C10H         39           74C10H         39           74C10H         39           74C10H         39           74C20H         39           74C20H         39           74C42         195           74C47         89           74C47         89           74C47         89           74C47         89           74C47         89           74C47         89           74040H         35           1.M100H         99           1.M302H         10           1.M302H         10 <td< th=""><th>74/303         1         85           74/033         1         95           74/035         1         95           74/035         1         95           74/035         1         95           74/035         1         95           74/015         2         90           74/15         2         10           74/15         2         10           74/15         2         10           74/15         2         10           74/16         1         3           11         12         14           11         13         14           11         15         15           11         15         15           11         15         15           11         15         15           11         15         15           11         15         10           11         15         10           11         15         10           11         10         12           11         10         14           11         10         14           11         <t< th=""><th>740173         2         60           740182         2         49           740182         2         49           740185         2         49           740185         2         49           740185         2         49           740185         8         55           80018         150         8           80019         150         8           80019         150         150           1.W7110         78         1.W7110           1.W7110         78         1.W7111           1.W7110         78         1.W7111           1.W7111         10         1.W7111           1.W7111         10         1.W7111           1.W71111         13         1.W71111           1.W71111         13         1.W71111           1.W71111         13         1.W71111           1.W711111         13         1.W71111           1.W711111         13<!--</th--><th>Image: Second Second</th><th>OBJECT-POIN         4 / F - 20         Open-Predicational         0.00         2.2         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00<!--</th--><th>IN-58         25         40m         67.00         11114         100         101           IN-685         25         7m         67.00         11114         100         101         101         100         101         101         100         101         101         100         101         100         100         101         100         100         100         101         100         100         101         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         <td< th=""><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 80<br/>A AMP 3 00<br/>RS<br/>\$1 95<br/>1 95<br/>1</th></td<></th></th></th></t<></th></td<>                           | 74/303         1         85           74/033         1         95           74/035         1         95           74/035         1         95           74/035         1         95           74/035         1         95           74/015         2         90           74/15         2         10           74/15         2         10           74/15         2         10           74/15         2         10           74/16         1         3           11         12         14           11         13         14           11         15         15           11         15         15           11         15         15           11         15         15           11         15         15           11         15         10           11         15         10           11         15         10           11         10         12           11         10         14           11         10         14           11 <t< th=""><th>740173         2         60           740182         2         49           740182         2         49           740185         2         49           740185         2         49           740185         2         49           740185         8         55           80018         150         8           80019         150         8           80019         150         150           1.W7110         78         1.W7110           1.W7110         78         1.W7111           1.W7110         78         1.W7111           1.W7111         10         1.W7111           1.W7111         10         1.W7111           1.W71111         13         1.W71111           1.W71111         13         1.W71111           1.W71111         13         1.W71111           1.W711111         13         1.W71111           1.W711111         13<!--</th--><th>Image: Second Second</th><th>OBJECT-POIN         4 / F - 20         Open-Predicational         0.00         2.2         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00      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       7m         67.00         11114         100         101         101         100         101         101         100         101         101         100         101         100         100         101         100         100         100         101         100         100         101         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         100         <td< th=""><th>A AMP 1 70<br/>A AMP 1 100<br/>A AMP 1 80<br/>A AMP 3 00<br/>RS<br/>\$1 95<br/>1 95<br/>1</th></td<></th></th></th></t<>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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F - 20         Open-Predicational         0.00         2.2         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         2.4         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00         0.00     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| 74COH         39           74CDB         49           74C10         39           74C10         39           74C10         39           74C11         39           74C12         39           74C13         39           74C14         39           74C12         39           74C12         39           74C13         39           74C14         97           74C17         89           74C17         89           74C17         89           74C18         97           10000H         99           10100H         90           10302H         10           10302H         10           10302H         10           10302H         10           10302H         10           10303H         10           10303H         10           10303H         10           103102H         10           103102H         10           103102H         10           103102H         10           103102H         10           103102H                                                                                                            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       LM3407-1         1         75           LM3407-1         1         75           LM3407         1         75           LM3407         1         75           LM3407         1         79           LM3407         1         79           LM3407         1         79           LM3407         1         79           LM3204         1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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        2         9           740182         2         9           740182         2         9           740182         2         9           740185         2         9           740205         9         5           800207         15         0           101         14         7           117101         78         10           1171201         10         11           1171201         10         11           1171201         17         10           1171201         17         10           1171201         17         10           1171201         17         10           1171201         17         10           1171201         10         10           1171201         10         10           11171201         10         1                                                                                                                                                                                                                                                                                             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MIS300         5-4 95         MIC1400L7         5-4 95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95         MIC1400L7         5-4 95           MIS301         6-96         MIC302F         7-5         3-5         3-5           MIS314         4-95         MIC1400L7         5-4 95         MIC1400L7         5-4 95           MIS318         99         MIC400F0/F41617         7-50         3-5         3-5         3-5           MIS314         4-95         MIC302F0         6-5         3-5         3-5         3-5           MIS314         4-95         MIC404L7         7-5         3-5         3-5         3-6         3-6           MIS314         95         MIC404L7         7-5         3-6         3-6         3-6         3-6         3-6           MIS314         95         MIC404L7         7-6         3-3         3-6         3-6         3-6         3-6       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200 PV 33         200 PV 33           C380         154 m 400         SCR (AND FW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RECTIFIE           C380         154 m 400         SCR (AND FW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RECTIFIE           C380         154 m 400         SCR (AND FW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RECTIFIE           C102         164 m 500         SCR (AND FW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RECTIFIE           MCA 880-3         124 m 500         PW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RECTIFIE           MFSA05         3         24003         124 m 500         PW BRIDGE RECTIFIE         SCR (AND FW BRIDGE RE                                                                                                                                                                                                                                                                                                             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| 74COH         39           74COB         49           74COB         39           74COB         249           74COB         249           74COB         249           74COB         249           74COB         249           74COB         249           74COB         99           74COB         90           74COB         90           74COB         90           74COB         90           100         100           10300         100           10300         100           10300         100           10300         100           10300         100           10300         100           10300         100           10300         100           10300         100           10300         100           10300         1                                                                                                                                                                                                                                                                                                      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 13         14           1414362044         14         14           1414362044         14         14           1414362044 <t< th=""><th>Image: Display Control - Modernal - Display - Displa</th><th>Obs. 7-90         4.1 F.30         Opport - Mail and Constrained         OUT         2.2 store           S         MISSOD S4 05         S4 05         MISSOD S4 05<!--</th--><th>IN-58         25         40m         6/1 00         IN-1184         100 PH/35           IN-685         25         7m         6/1 00         IN-1184         100 PH/35           IN-685         150         7m         6/1 00         IN-1184         100 PH/35           IN-685         150         IN-1184         200 PH/3         200 PH/35         200 PH/35           SCR         AND         FW BRIDGE RECTIFIE         C         C         C         C           C380         154 re 4007         SCR         SCR AND FW BRIDGE RECTIFIE         C         C         C         C         C         C         C         C         C         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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Image: Display Control - Modernal - Display - Displa                                                                                                                                                                                                                                                                                                                                                                                                                                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   150         IN-1184         200 PH/3         200 PH/35         200 PH/35           SCR         AND         FW BRIDGE RECTIFIE         C         C         C         C           C380         154 re 4007         SCR         SCR AND FW BRIDGE RECTIFIE         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C         C</th>                                                                                                                                                                      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| 74COH         39           74COB         49           74COB         39           74COB         269           74COB         90           74COB         10           74COB         10           74COB         10           74COB         10           74COB         10           74COB         10 <th>74/303         1         85           74/033         1         96           74/033         1         96           74/033         1         96           74/033         1         96           74/015         2         90           74/115         2         90           74/115         2         90           74/115         2         10           74/0154         1         3           174/0161         2         49           74/0164         1         3           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017         1         5           11/143/017</th> <th>740173         2         60           740182         2         49           740182         2         49           740182         2         49           740182         2         49           740182         2         49           740182         5         8           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           00027         1         50           0028         1         10           00247         1         10</th> <th>Image: Second Second</th> <th>Bits         CLOCK CHIPS         Bits         Bits</th> <th>IN-55         25         40m         67.00         IN-1184         100         IN-1184         200         200         200         200</th> <th>A A HP 1 70<br/>A A A P 1 80<br/>A A A P 1 80<br/>A A P 1 80<br/>A A P 1 95<br/>1 195<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 1 95<br/>1 1 95<br/>1 1 95<br/>1 1 1 1<br/>1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</th>                                                                                                                                                                                                                                                                                                                                          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95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 1 95<br>1 1 95<br>1 1 95<br>1 1 1 1<br>1 1 1 1 1 1 1 1 1 1 1 1 1 1 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| 74COH         39           74CDB         49           74CDB         49           74CDB         39           74CC3         89           74CC3         89           74CC3         89           74CC4         80           100         10           1000000         10           1000000         10           1000000         15           1000000         15           1000000         15           1000000         15           1000000         15           10000000         15           10000000         15           10000000         15           100000000         15           10000000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 74/203         1         95           74/203         1         95           74/203         1         95           74/203         1         95           74/203         1         95           74/203         1         95           74/203         1         2           74/203         2         97           74/215         2         90           74/215         2         19           74/215         2         19           74/215         2         19           74/215         2         19           74/215         2         19           74/215         1         2           1         1         1         1           1         1         1         1           1         1         1         1         1           1         1         1         1         1         1           1         1         1         1         1         1         1           1         1         1         1         1         1         1         1           1         1   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        1.07171         73         10           1.07171         73         10           1.07171         73         10           1.07171         73         11           1.07171         73         11           1.07171         73         10           1.07171         73         10           1.07171         73         10           1.07171         173         10           1.07171         173                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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BRIDGE RECTIFIE         SCR AND FW BRIDGE RECTIFIE           C180         ISA (H-400)         SCR AND FW BRIDGE RECTIFIE         SCR AND FW BRIDGE RECTIFIE         SCR AND FW BRIDGE RECTIFIE           MISA06         S0         2/120 Stress         SCR AND FW BRIDGE RECTIFIE         SCR AND FW BRIDGE RECTIFIE         SCR AND FW BRIDGE RECTIFIE           MISA06         S0         2/120 Stress         SCR AND FW BRIDGE RECTIFIE                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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| 74COH         39           74COB         49           74C10         39           74C10         39           74C11         39           74C11         39           74C11         39           74C11         39           74C11         39           74C12         39           74C12         39           74C13         39           74C14         36           74C15         36           74C12         39           74C13         39           74C14         39           74C15         39           74C14         39           74C15         15           143020H         10           143020H                                                                                                                                                                                                                                                                                                                                                                                                                                       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15         CA3002W         2 00         Call Culu Aron         Call Culu Aron           CAO3013         2 15         CA3003W         1 60         MMS775         92           CAO3037         1 36         CA3007         1 60         MMS775         92           CA03037         1 36         CA3009W         3 75         DMM664         5           CA3064W         CA3007         1 39         DMM665         1           CA3064W         3 25         CA34071         1 25         DMM867           CA3008W         3 25         CA34101         1 25         DMM867         1           CA3008W         3 25         CA34101         1 25         DMM867         1         1           CA3008W         3 25         CA3401W         48         877.7 3xg         2         0         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1         1 <th>Sec. 7-90         4.1 F 30         Opport - Mathematication         0 00         2.2 sol           S         MIS300         5-4 95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         3-5           MIS311         4-95         MIC1400L7         3-5           MIS311         4-95         MIC1400L7         3-5           MIS311         9-95         MIC1400L7         3-5           MIS3041         9-95         MIC1400L7         4-59           DERLE (TIN) SOCKETS         1-24         1-3         3-6           DARD (GLD)         2-9         9-9         6-1         1-3</th> <th>IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         25         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         200 PH/3 Simplement           SCR         AND FW BRIDGE RECTIFIE         ECTIFIC         Simplement         Simplement         Simplement           C380         154 re 400V         Simplement         Simplement         Simplement         Simplement           C380         154 re 400V         Simplement         Simplement         Simplement         Simplement           C380         154 re 400V         Simplement         Simplement         Simplement         Simplement           MP5A06         10         24:0305         10         24:0305         10         24:0305           MP5A06         10         24:0305         10         24:0405         10         24:0405           11587         6/1 10         24:0398         5/1 10         24:0405         10         24:0405           24:010         1157         PH/3589</th> <th>A AMP 1 70 AMP 1 70 AMP 1 70 AMP 1 80 AMP 1 70 AMP 1 80 AMP 1 30 OF THE STATE STATE</th>                                                                                               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Simplement           IN-685         150         70m         6/1 00         IN-1184         200 PH/3 Simplement           SCR         AND FW BRIDGE RECTIFIE         ECTIFIC         Simplement         Simplement         Simplement           C380         154 re 400V         Simplement         Simplement         Simplement         Simplement           C380         154 re 400V         Simplement         Simplement         Simplement         Simplement           C380         154 re 400V         Simplement         Simplement         Simplement         Simplement           MP5A06         10         24:0305         10         24:0305         10         24:0305           MP5A06         10         24:0305         10         24:0405         10         24:0405           11587         6/1 10         24:0398         5/1 10         24:0405         10         24:0405           24:010         1157         PH/3589                                                                                             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| 74COH         39           74CDB         49           74CDB         39           74CDB         26           74CA         89           74C24         89           74CA         80           74CA         80           14000H         10           LM300H         10           LM302H         10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         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pm ST         1.9         1.45           36 pm ST         1.9         1.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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    120         7m         6/1 00         IN-1184         100 PP/3 3           IN-685         180         100         IN-1184         200 PP/3 3         200 PP/3 3           SCR         AND FW BRIDGE RECTIFIE         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)           C280         154 /r/4 4007         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)           2012         1 54 /r/4 4007         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)           2012         1 54 /r/4 4007         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)         SCR (NH-607)           2012         1 54 /r/4 4007         1 24 /r/4 507         YH BNDCE RE                                                                                                                                                                                                                                                                        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| 74COH         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C102         39           74C12         39           74C13         39           74C14         39           74C17         89           74C17         89           74C17         89           74000         99           1.M30001014         35           1.M3000014         10           1.M30000014         10           1.M3000014         10           1.M300001         15           1.M310000         15           1.M310000         15           1.M32000000         10           1.M320000000         10           1.M320000000         10                                                                                                                                                                                                                                                                                  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                                                                            | Bits: 7-90         4.1 F.30         (BP) - PM         0.00         2.2 so           S         MIS300         5-4 95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95           MIS301         4-95         MIC1400L7         5-4 95           MIS301         6-95         MIC3002F         2-50           MIS316         9-95         MIC400F741619         5-95           MIS316         9-95         MIC400F741619         5-95           MIS317         9-95         MIC4040F741619         5-95           MIS318         9-95         MIC4040F741619         5-95           MIS317990AL         4-50         MIC4040F741619         5-95           MIS31799DL         5-95         MIC4044P         4-50           DFILE (TIN) SOCKETS         2-4 97         5-95         1-4           DARD (TIN)         40 pm LP         5-3         3-3           JBARD (TIN)         2-97         1-50         1-45         1-30           JBARD (TIN)         2-97         1-90         1-45         1-30           JBARD (COLD)         2-4 97                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           SCR         AND         FW         BRID GE         RECTIFIE         200 PH/3 Simplement           C380         154 m 4000         SCR         SCR AND FW         BRID GE         RECTIFIE           C381         154 m 4000         SCR         SCR AND FW         BRID GE         RECTIFIE           C380         154 m 4000         SCR         SCR AND FW         BRID GE         RECTIFIE           C380         154 m 4000         SCR AND SW         SCR         PM BRD GE RE         RECTIFIE           C1021         154 m 4000         SCR AND SW         SCR AND SW         PM BRD BE RE         PM BRD BE RE           MISA06         SCR AND SW         SCR AND SW         PM BRD BE RE         PM BR                                                                                                                                                           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70<br>A A A P 1 80<br>A A A P 1 80<br>A A A P 3 00<br>RS<br>\$1 95<br>1                                                                                                                                                                                                                                                                                                                                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            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| 74C04         39           74C10         39           74C10         39           74C10         39           74C10         39           74C11         39           74C11         39           74C12         39           74C13         39           74C14         39           74C14         39           74C15         39           74C14         39           74C14         39           14000H         9           14030CM         10           14330CM                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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    5-4 95           MIS311         4-95         MIC1400L7         5-4 95         MIC1400L7         5-4 95           MIS311         4-95         MIC1400L7         5-4 95         MIC1400L7         5-4 95           MIS311         4-95         MIC1400L7         5-95         MIC1400L7         5-95           MIS311         4-95         MIC1400L7         5-95         MIC1400L7         5-95           MIS311         9-95         MIC1400L7         5-95         MIC1400L7         5-95           MIS311         9-95         MIC1400L7         5-95         MIC1400L7         5-95           MIS311         9-95         MIC1400L7         5-95         MIC1400L7         5-95           MIS511         9-95         MIC1400L7         5-95         MIC1400L7         5-95           DFLE         (TIN)         SOCKETS         1-24         2-49         5-90         1-4         1-30           DARD (GUD)         20 pm CP         8-3         70         8-3         57         2-90         1-4 <td>IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         200 PH/3 Simplement           IN-665         154 m 4000         SCR         SCR AND FW BRIDGE RECTIFIE         SCR           C380         154 m 4000         SCR         SCR         SCR           MCA 880-1         124 m 500V         SCR         MBRADE RECTIFIE           MCA 880-1         124 m 50V         PM BRADE RECTIFIE         MBRADE RECTIFIE           MCA 880-1         124 m 50V         PM BRADE RECTIFIE         MBRADE RECTIFIE           MFSA05         100         240305         100         240305           MFSA05         100         240305         100         240305           MFSA06         1100         240305         100         244402           11587         6/1 00         240338         5/1 00         244402           201115         71 100         2407774         5/1 00         244402&lt;</td> <td>A AMP 1 70<br/>A AMP 1 80<br/>A AMP 1 80<br/>A AMP 1 80<br/>A AMP 1 9 100<br/>RS 1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95<br/>1 95</td>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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IN-665         154 m 4000         SCR         SCR AND FW BRIDGE RECTIFIE         SCR           C380         154 m 4000         SCR         SCR         SCR           MCA 880-1         124 m 500V         SCR         MBRADE RECTIFIE           MCA 880-1         124 m 50V         PM BRADE RECTIFIE         MBRADE RECTIFIE           MCA 880-1         124 m 50V         PM BRADE RECTIFIE         MBRADE RECTIFIE           MFSA05         100         240305         100         240305           MFSA05         100         240305         100         240305           MFSA06         1100         240305         100         244402           11587         6/1 00         240338         5/1 00         244402           201115         71 100         2407774         5/1 00         244402<                                                                                                                                                                                                                                   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1 80<br>A AMP 1 80<br>A AMP 1 80<br>A AMP 1 9 100<br>RS 1 95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 95<br>1 95                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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| 74COH         39           74COB         49           74COB         39           74COB         249           74COB         249           74COB         249           74COB         249           74COB         249           74COB         249           74COB         90           100         100           10300         10           10300         10           10300         10           104300         10           104300         10           104300         10           104300         10           104300         10           104300         10 <td>74/303         1         95           74/033         1         95           74/035         1         95           74/035         1         95           74/035         1         95           74/015         2         90           74/115         2         90           74/015         2         90           74/015         2         15           74/015         2         14           74/015         2         14           11         2         49           74/016         1         35           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000</td> <td>740173         2         60           740182         2         49           740182         2         49           740182         2         49           740182         2         49           740182         2         49           740182         2         62           740252         5         5           740253         6         5           740253         6         5           740253         6         5           740253         10         5           100265         15         5           107373         10         10           10747444         30         10           10747444         30         10           10747444         30         10           10747444         30         10           10747444         30         10           10747444         30         10           10747444         30         10           1074444         30         10           1074444         30         10           10414560044         13         10           10414560044         <t< td=""><th>Image of the second second</th><td>CLOCK CHIPS         CUDCK CHIPS           S         MIS301         4.9 5           MIS301         4.9 5         MIC1080.7           S         MIS301         4.9 5           MIS301         4.9 5         MIC1080.7           MIS301         4.9 5         MIC1080.7           MIS301         4.9 5         MIC1080.7           MIS301         6.9 5         MIC302P           MIS301         6.9 5         MIC302P           MIS301         6.9 5         MIC4080.7           MIMS301         9.9 5         MIC4040.9           MIMS301         9.9 5         MIC4040.9           MIMS301         9.9 5         MIC4040.9           MIMS307.9900.4         9.9 5         MIC4040.9           MIMS307.9900.4         9.9 5         MIC4040.9           Spectram         2.2 pm (P.9.37.3.9         3.5 35           ZP pm (P.9.37.3.9         9.9 50.10         1.0 9.9 1.4 5           DARD (TRN)         40 pm S1.1.9 1.45         1.0 9.9 1.4 5           MIMS307.9900.100         1.9 9.9 51.1.9 1.45         1.0 9.9 1.4 5           MIMS07.00000000000000000000000000000000000</td><td>IN-58         25         40m         6/1.00         IN-1184         100         IN-1184         200         200         200         200         200         200</td><td>A A A P 1 70<br/>A A A P 1 80<br/>A A A P 1 80<br/>A A P 1 90<br/>A 1 95<br/>1 95</td></t<></td>                                                                                                                                                                                          | 74/303         1         95           74/033         1         95           74/035         1         95           74/035         1         95           74/035         1         95           74/015         2         90           74/115         2         90           74/015         2         90           74/015         2         15           74/015         2         14           74/015         2         14           11         2         49           74/016         1         35           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000         1         75           11.11/1000        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MIC4040.9           MIMS307.9900.4         9.9 5         MIC4040.9           MIMS307.9900.4         9.9 5         MIC4040.9           Spectram         2.2 pm (P.9.37.3.9         3.5 35           ZP pm (P.9.37.3.9         9.9 50.10         1.0 9.9 1.4 5           DARD (TRN)         40 pm S1.1.9 1.45         1.0 9.9 1.4 5           MIMS307.9900.100         1.9 9.9 51.1.9 1.45         1.0 9.9 1.4 5           MIMS07.00000000000000000000000000000000000</td><td>IN-58         25         40m         6/1.00         IN-1184         100         IN-1184         200         200         200         200         200         200</td><td>A A A P 1 70<br/>A A A P 1 80<br/>A A A P 1 80<br/>A A P 1 90<br/>A 1 95<br/>1 95</td></t<>                                                                                                                                                                                                                                                                                          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| 74C04         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C102         39           74C12         39           74C42         39           74C42         97           74C42         97           1M100H         99           1M100H         99           1M302H         10           1M302H                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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| 74C04         39           74C10         39           74C10         39           74C10         39           74C10         39           74C11         39           74C11         39           74C12         39           74C13         39           74C14         39           74C12         39           74C13         39           74C14         9           74C13         39           74C14         9           74C13         97           74C14         99           74C13         97           74C14         99           74C15         75           1.M000H         99           1.M300H         10           1.M300H         10           1.M300H         125           1.M300H         15           1.M310CM         10           1.M310CM         10           1.M310CM         10           1.M310CM         10           1.M310CM         10           1.M310CM         125           1.M310CM         12           1.M320H<                                                                                                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4-95         MIC1000F7         3-5           MIS301         2-96         MIC100F7         3-5           MIS301         95         MIC100F7         3-3           MIS301         95         1-2         1-2         1-3           DARD (TIN)         90 m IP         1-3         10         1-5           <t< th=""><th>IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         IN-1184         200 PH/3 Simplement         Simplement         Simplement           CABO         TSCR         AND         FW BRIDGE RECTIFIE         Simplement         Simplement         Simplement         Simplement           CABO         TSA re-8000V         Simplement         Simplement         Simplement         Simplement         Simplement         Simplement           MICA 880-3         124 re-500V         PH BRDGE RE         PH2025         Response         PH3005         <td< th=""><th>A AMP 1 70<br/>A AMP 1 70<br/>A AMP 1 80<br/>A AMP 1 80<br/>A AMP 1 80<br/>81 95<br/>1 95<br/>1</th></td<></th></t<></th></t<>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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                                                                 | IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         IN-1184         200 PH/3 Simplement         Simplement         Simplement           CABO         TSCR         AND         FW BRIDGE RECTIFIE         Simplement         Simplement         Simplement         Simplement           CABO         TSA re-8000V         Simplement         Simplement         Simplement         Simplement         Simplement         Simplement           MICA 880-3         124 re-500V         PH BRDGE RE         PH2025         Response         PH3005         Response         PH3005 <td< th=""><th>A AMP 1 70<br/>A AMP 1 70<br/>A AMP 1 80<br/>A AMP 1 80<br/>A AMP 1 80<br/>81 95<br/>1 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| 74C04         39           74C01         39           74C01         39           74C01         39           74C11         39           74C11         39           74C11         39           74C11         39           74C11         39           74C11         39           74C12         39           74C13         39           74C14         24           74C13         39           74C14         30           74C15         39           74C14         39           74C15         39           74C14         39           74C15         39           74C14         39           74C15         10           1.M3004         10           1.M3044         10           1.M3045         15           1.M3045         15           1.M311MM         90           1.M311MM         10           1.M3204         10           1.M3204         10           1.M3204         10           1.M3204         12           1.M3204                                                                                                          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54 95         MICHOBUT         54 95           MISSOB         4 95         MICHOBUT         4 95         MICHOBUT         54 95           MISSOB         56 95         MISSOB         99000         4 95         MICHOBUT         35 95           MISSOB         99000         2 96         MICHOBUT         35 95         35 95         35 95           50         MISSOB         99000         2 96         MICHOBUT         4 95 90         36 95         36 95           50         MISSOB         99000         4 95 97         36 95         36 96         36 97           50         MICHOUT         99000         1 93 97         36 97         35 97         36 97           20 pm LP         53 97         63 77         63 77         63 77         63 77           20 pm SG 170         10 100 90         10 98         14 13 13         10 10 90         10 98           20 pm SG 170         10 100 90</th><th>IN-58         25         40m         6/1 00         101 118         100 PV3           IN-685         150         77m         6/1 00         101 118         100 PV3           IN-685         150         77m         6/1 00         101 118         100 PV3           IN-685         150         100         111 118         200 PV3         200 PV3           SCR         AND         FW BRIDGE RECTIFIE         ECTIFIC         500 PV1 INT         500 PV1 INT           C380         154 re 400V         SCR         RMRADB         SCR         RMRADB         SCR           C380         154 re 400V         SCR         PM BRIDGE RECTIFIE         RMRADB         SCR         PM BRIDGE RECTIFIE           C380         154 re 50V         PM BRIDGE RECTIFIE         PM BRIDGE RECTIFIE         PM BRIDGE RECTIFIE         PM BRIDGE RECTIFIE           MADA 800-1         124 re 50V         PM BRIDGE RECTIFIE         PM BRIDGE</th><th>A A HP 1 70<br/>A A A P 1 70<br/>A A A P 1 80<br/>A A A P 1 80<br/>A A A P 1 9 100<br/>A 1 00<br/>A 1 1 00<br/>A 1 1 10<br/>A 1 1</th></t<>                                                        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 1 93 97         36 97         35 97         36 97           20 pm LP         53 97         63 77         63 77         63 77         63 77           20 pm SG 170         10 100 90         10 98         14 13 13         10 10 90         10 98           20 pm SG 170         10 100 90                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              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| 74C04         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C102         39           74C103         39           74C104         249           74C12         99           74C12         99           74C13         39           74C13         99           74C13         99           74C14         90           1.M100H         99           1.M302H         10           <                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  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  35         10           04712014         13         11           04714114         19         10           0471458         13         15           0471458         14         14           0471458                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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                                                              | IN-58         25         40m         6/1 00         IN-1184         100 PV33           IN-685         120         77m         6/1 00         IN-1184         100 PV33           IN-685         120         77m         6/1 00         IN-1184         100 PV33           IN-685         180         100m         5/1 00         IN-1184         200 PV33           SCR         AND FW BRIDGE RECTIFIE         SCR(NH-607)         SCR(NH-607)         SCR(NH-607)           28100         154 m 4007         SCR(NH-607)         SCR         NM-6070         SCR           282521         1.64 m 300V         MCR         NM-7000         SCR         NM-7000           MCA 880-1         1.24 m 300V         FW BMDOE RE         NM-7000         NM BMDOE NE         NM-7000           MFSA05         30         2.83055         10         7.1000         244132         100         PH4250           1759         6/1 00         2.83358         4/1 00         2.94402         2.94402         100         244401           1759         1700         2417056         5/1 00         244401         2.94209         2.9400         2.94002         2.94202           270221A         2/1 00         2100                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                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| 74COH         39           74C101         39           74C102         39           74C12         39           74C12         39           74C12         39           74C12         39           74C12         39           74C13         39           74C14         39           74C13         39           74C14         39           74C17         50           1.M300H         10           1.M3010H         10           1.M301                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     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96 MC302P 25<br/>0 MIS316 9 96 MC1408L 75<br/>MIS301 6 96 MC302P 25<br/>0 MIS316 9 96 MC1408L 75<br/>MIS301 6 96 MC302P 25<br/>MIS316 9 96 MC1408L 75<br/>MIS301 6 96 MC302P 25<br/>MIS316 9 96 MC1408L 75<br/>MIS301 9 95 MC1404P 45<br/>DFILE (TIN) SOCKETS<br/>22 pm LP 4 3 37 38 35<br/>35 pm LP 40 34 46<br/>35 pm LP 40 32 44<br/>35 pm LP 40 32 45<br/>36 pm LP 40 34 46<br/>36 pm LP 40 32 45<br/>36 pm LP 40 34 46<br/>36 pm LP 40 34 37<br/>36 pm S0 175 150 145<br/>150 145<br/>36 pm W1 10 30 56 15<br/>140<br/><b>SSOORTMEENTS – 5%</b><br/>15 J 44<br/><b>SSOORTMEENTS – 5%</b><br/>15 J 45 130<br/>16 pm W1 59 145 130<br/>17 4 2 S0 PC3 1.75<br/>19 1 S0 PC3 1.75<br/>19 1</th><th>IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           SCR         AND         FW         BRID GE         RECTIFIE         200 PH/3 Simplement           C380         154 m 4000         SCR         SCR AND FW         BRID GE         RECTIFIE           C380         154 m 4000         SCR         SCR AND FW         SCR AND FW         SCR AND FW           C380         154 m 4000         SCR AND FW         SCR AND FW         SCR AND FW         SCR AND FW           C380         154 m 4000         SCR AND FW         SCR AND FW         SCR AND FW         SCR AND FW           MIDA 800-3         124 hr 500         YW         SCR AND FW         SCR AND FW         SCR AND FW           MIPSA06         5/1 00         2H/305         10         2H/305         10         2H/305           11587         6/1 00         2H/305         10         2H/305         10         2H/402           MIPSA06         175 PH/3574         5/1 00         2H/402         <td< th=""><th>Akap 1 70<br/>Akap 1 70<br/>Akap 1 80<br/>Akap 3 00<br/>T 1 95<br/>5 1 1</th></td<></th></th> | 740173         2         80           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740185         2         9           740185         2         9           740205         6         5           740205         5         5           740205         5         5           740205         10         10           1.017101         7         3         10           1.017111         39         1.01         11           1.017231         1         10         1.01           1.017331         1         10         1.01           1.017331         1         10         1.01           1.0174111         13         11         1.01           1.01741111         13         11         11           1.01410491         13         11         1.01           1.01410491         13 <th>Image of the second second</th> <th>CLOCK CHIPS<br/>CLOCK CHIPS<br/>MIS301 4 95 54 95 MC1408L 54 55<br/>MIS301 4 96 MC1408L 54 55<br/>MIS301 4 96 MC1408L 54 55<br/>MIS301 6 96 MC302P 25<br/>0 MIS316 9 96 MC1408L 75<br/>MIS301 6 96 MC302P 25<br/>0 MIS316 9 96 MC1408L 75<br/>MIS301 6 96 MC302P 25<br/>MIS316 9 96 MC1408L 75<br/>MIS301 6 96 MC302P 25<br/>MIS316 9 96 MC1408L 75<br/>MIS301 9 95 MC1404P 45<br/>DFILE (TIN) SOCKETS<br/>22 pm LP 4 3 37 38 35<br/>35 pm LP 40 34 46<br/>35 pm LP 40 32 44<br/>35 pm LP 40 32 45<br/>36 pm LP 40 34 46<br/>36 pm LP 40 32 45<br/>36 pm LP 40 34 46<br/>36 pm LP 40 34 37<br/>36 pm S0 175 150 145<br/>150 145<br/>36 pm W1 10 30 56 15<br/>140<br/><b>SSOORTMEENTS – 5%</b><br/>15 J 44<br/><b>SSOORTMEENTS – 5%</b><br/>15 J 45 130<br/>16 pm W1 59 145 130<br/>17 4 2 S0 PC3 1.75<br/>19 1 S0 PC3 1.75<br/>19 1</th> <th>IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           SCR         AND         FW         BRID GE         RECTIFIE         200 PH/3 Simplement           C380         154 m 4000         SCR         SCR AND FW         BRID GE         RECTIFIE           C380         154 m 4000         SCR         SCR AND FW         SCR AND FW         SCR AND FW           C380         154 m 4000         SCR AND FW         SCR AND FW         SCR AND FW         SCR AND FW           C380         154 m 4000         SCR AND FW         SCR AND FW         SCR AND FW         SCR AND FW           MIDA 800-3         124 hr 500         YW         SCR AND FW         SCR AND FW         SCR AND FW           MIPSA06         5/1 00         2H/305         10         2H/305         10         2H/305           11587         6/1 00         2H/305         10         2H/305         10         2H/402           MIPSA06         175 PH/3574         5/1 00         2H/402         <td< th=""><th>Akap 1 70<br/>Akap 1 70<br/>Akap 1 80<br/>Akap 3 00<br/>T 1 95<br/>5 1 1</th></td<></th> | Image of the second                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | CLOCK CHIPS<br>CLOCK CHIPS<br>MIS301 4 95 54 95 MC1408L 54 55<br>MIS301 4 96 MC1408L 54 55<br>MIS301 4 96 MC1408L 54 55<br>MIS301 6 96 MC302P 25<br>0 MIS316 9 96 MC1408L 75<br>MIS301 6 96 MC302P 25<br>0 MIS316 9 96 MC1408L 75<br>MIS301 6 96 MC302P 25<br>MIS316 9 96 MC1408L 75<br>MIS301 6 96 MC302P 25<br>MIS316 9 96 MC1408L 75<br>MIS301 9 95 MC1404P 45<br>DFILE (TIN) SOCKETS<br>22 pm LP 4 3 37 38 35<br>35 pm LP 40 34 46<br>35 pm LP 40 32 44<br>35 pm LP 40 32 45<br>36 pm LP 40 34 46<br>36 pm LP 40 32 45<br>36 pm LP 40 34 46<br>36 pm LP 40 34 37<br>36 pm S0 175 150 145<br>150 145<br>36 pm W1 10 30 56 15<br>140<br><b>SSOORTMEENTS – 5%</b><br>15 J 44<br><b>SSOORTMEENTS – 5%</b><br>15 J 45 130<br>16 pm W1 59 145 130<br>17 4 2 S0 PC3 1.75<br>19 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | IN-58         25         40m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           IN-685         150         70m         6/1 00         IN-1184         100 PH/3 Simplement           SCR         AND         FW         BRID GE         RECTIFIE         200 PH/3 Simplement           C380         154 m 4000         SCR         SCR AND FW         BRID GE         RECTIFIE           C380         154 m 4000         SCR         SCR AND FW         SCR AND FW         SCR AND FW           C380         154 m 4000         SCR AND FW         SCR AND FW         SCR AND FW         SCR AND FW           C380         154 m 4000         SCR AND FW         SCR AND FW         SCR AND FW         SCR AND FW           MIDA 800-3         124 hr 500         YW         SCR AND FW         SCR AND FW         SCR AND FW           MIPSA06         5/1 00         2H/305         10         2H/305         10         2H/305           11587         6/1 00         2H/305         10         2H/305         10         2H/402           MIPSA06         175 PH/3574         5/1 00         2H/402 <td< th=""><th>Akap 1 70<br/>Akap 1 70<br/>Akap 1 80<br/>Akap 3 00<br/>T 1 95<br/>5 1 1</th></td<>                                                                                                                                                                                                                                                                                                                                                                          | Akap 1 70<br>Akap 1 70<br>Akap 1 80<br>Akap 3 00<br>T 1 95<br>5 1 1                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |                                                                                                                                                                                                                                                                                                                                                                                                                                                    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| 74C04         39           74C01         39           74C10         39           74C10         39           74C11         39           74C11         39           74C11         39           74C11         39           74C11         39           74C12         39           74C12         39           74C13         39           74C14         30           74C12         39           74C13         39           74C14         30           74C13         39           74C14         30           74C13         39           74C14         39           74C15         15           14430000         10           14430000         10           14430000         10           14430000         10           14430000         10           14430000         10           1443000         10           1443000         10           14430000         10           1443000         10           1443000         10           1443000 <th>74203         1         85           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74213         2         90           74215         2         90           74215         2         15           74215         2         19           74215         2         19           74215         2         19           74215         1         15           111         143407-8         1         15           111         143407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           11143407         1         25         1<th>740173         2         60           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           7402020         0         5           7402021         0         5           7402021         0         5           807007         15         0           101         14         7           117014         39         10           11473201         10         11           11473201         11         11           11474301         39         11474301         39           11474301         13         11414360001         139           11474301         139         1414360001         139           11474301         139         14143600001         125           114143600001         125         140000000         125     <th>Image: Second Second</th><th>CLOCK CHIPS<br/>CLOCK CHIPS<br/>MISSOB 54 05 MICHOBIT 000 22 0<br/>CLOCK CHIPS<br/>MISSOB 54 05 MICHOBIT 54 05<br/>MISSOB 54 05 MICHOBIT 55 4<br/>MISSOB 75 MISSOB 54 05 MICHOBIT 75<br/>MISSOB 79000 4 05 MICHOBIT 75<br/>MISSOB 79000 20 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 700 MICHOBIT 75<br/>MISSOB 7</th><th>IN-58         25         40m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         200 PT/35           SCR         AND         FW BRIDGE RECTIFIE         ECTIFIC         CON PT/35           CABO         IS4 6/4 000         SCR         SCR AND FW BRIDGE RECTIFIE           CABO         IS4 6/4 000         SCR         SCR AND FW BRIDGE RECTIFIE           CABO         124 6/6 3007         SCR         PM BRIDGE RECTIFIE           MCA 880-1         124 6/6 3007         SCR         PM BRIDGE RECTIFIE           MFSA06         10         24/305         10         24/305           MFSA06         10         24/305         10         24/308           MFSA06         11         24/6305         10         24/402           11597         6/1 00         24/308         5/1 00         24/402           11597         6/1 00         24/308         5/1 00         24/402           24/219         10</th><th>A A HP 1 70 A A A P 1 70 A A A P 1 70 A A A P 1 80 A A A P 1 80 A A A P 1 80 A A A P 1 80 A A A A A A A A A A A A A A A A A A</th></th></th>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 74203         1         85           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74213         2         90           74215         2         90           74215         2         15           74215         2         19           74215         2         19           74215         2         19           74215         1         15           111         143407-8         1         15           111         143407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           111         13407         1         15           11143407         1         25         1 <th>740173         2         60           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           740182         2         9           7402020         0         5           7402021         0         5           7402021         0         5           807007         15         0           101         14         7           117014         39         10           11473201         10         11           11473201         11         11           11474301         39         11474301         39           11474301         13         11414360001         139           11474301         139         1414360001         139           11474301         139         14143600001         125           114143600001         125         140000000         125     <th>Image: Second Second</th><th>CLOCK CHIPS<br/>CLOCK CHIPS<br/>MISSOB 54 05 MICHOBIT 000 22 0<br/>CLOCK CHIPS<br/>MISSOB 54 05 MICHOBIT 54 05<br/>MISSOB 54 05 MICHOBIT 55 4<br/>MISSOB 75 MISSOB 54 05 MICHOBIT 75<br/>MISSOB 79000 4 05 MICHOBIT 75<br/>MISSOB 79000 20 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 700 MICHOBIT 75<br/>MISSOB 7</th><th>IN-58         25         40m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         200 PT/35           SCR         AND         FW BRIDGE RECTIFIE         ECTIFIC         CON PT/35           CABO         IS4 6/4 000         SCR         SCR AND FW BRIDGE RECTIFIE           CABO         IS4 6/4 000         SCR         SCR AND FW BRIDGE RECTIFIE           CABO         124 6/6 3007         SCR         PM BRIDGE RECTIFIE           MCA 880-1         124 6/6 3007         SCR         PM BRIDGE RECTIFIE           MFSA06         10         24/305         10         24/305           MFSA06         10         24/305         10         24/308           MFSA06         11         24/6305         10         24/402           11597         6/1 00         24/308         5/1 00         24/402           11597         6/1 00         24/308         5/1 00         24/402           24/219         10</th><th>A A HP 1 70 A A A P 1 70 A A A P 1 70 A A A P 1 80 A A A P 1 80 A A A P 1 80 A A A P 1 80 A A A A A A A A A A A A A A A A A A</th></th>                                                                                                                                                                                                                                                                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139         1414360001         139           11474301         139         14143600001         125           114143600001         125         140000000         125 <th>Image: Second Second</th> <th>CLOCK CHIPS<br/>CLOCK CHIPS<br/>MISSOB 54 05 MICHOBIT 000 22 0<br/>CLOCK CHIPS<br/>MISSOB 54 05 MICHOBIT 54 05<br/>MISSOB 54 05 MICHOBIT 55 4<br/>MISSOB 75 MISSOB 54 05 MICHOBIT 75<br/>MISSOB 79000 4 05 MICHOBIT 75<br/>MISSOB 79000 20 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 7000 10 MICHOBIT 75<br/>MISSOB 700 MICHOBIT 75<br/>MISSOB 7</th> <th>IN-58         25         40m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         200 PT/35           SCR         AND         FW BRIDGE RECTIFIE         ECTIFIC         CON PT/35           CABO         IS4 6/4 000         SCR         SCR AND FW BRIDGE RECTIFIE           CABO         IS4 6/4 000         SCR         SCR AND FW BRIDGE RECTIFIE           CABO         124 6/6 3007         SCR         PM BRIDGE RECTIFIE           MCA 880-1         124 6/6 3007         SCR         PM BRIDGE RECTIFIE           MFSA06         10         24/305         10         24/305           MFSA06         10         24/305         10         24/308           MFSA06         11         24/6305         10         24/402           11597         6/1 00         24/308         5/1 00         24/402           11597         6/1 00         24/308         5/1 00         24/402           24/219         10</th> <th>A A HP 1 70 A A A P 1 70 A A A P 1 70 A A A P 1 80 A A A P 1 80 A A A P 1 80 A A A P 1 80 A A A A A A A A A A A A A A A A A A</th>                                                                                                                                 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   MFSA06         10         24/305         10         24/305           MFSA06         10         24/305         10         24/308           MFSA06         11         24/6305         10         24/402           11597         6/1 00         24/308         5/1 00         24/402           11597         6/1 00         24/308         5/1 00         24/402           24/219         10                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             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| 74C04         39           74C101         39           74C101         39           74C101         39           74C101         39           74C101         39           74C102         39           74C103         39           74C104         29           74C10         39           74C12         99           74C12         99           74C13         99           74C13         99           74C13         90           1.M100H         99           1.M302H         10           <                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               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       1         95           74203         1         95           74203         1         95           74203         1         95           74213         2         90           742117         2         15           74213         2         90           74213         2         10           74213         3         10           74213         1         3           113007         1         3           1143407         1         35           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75           1143407         1         75                                                                                                         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| 74C04         39           74C10         39           74C11         39           74C12         39           74C2         39           74C2         90           74C2         90           74C7         89           74000H         9           1.0000H         9           1.0000H         9           1.0000H         10           1.0000H         10 </th <th>74203         1         85           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74203         1         95           74213         2         90           74213         2         90           74213         2         15           74213         1         2           1         2         49           74214         1         35           1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.</th> <th>740173         2         80           740182         2         80           740182         2         90           740182   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                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Image         Call         Call <t< th=""><th>CLOCK CHIPS       MOTOROLA         MIS301       4.9 50       MOTOROLA         MIS301       4.95       MIC1080.7       54.95         MIS301       6.95       MIC0017       7.14.93         MIS301       9.95       1.94       MIC302P       2.55         MIS3017/9900.4       9.95       1.95       MIC4040.74.97       3.95         50       T.24       25.49       MIC4040.74.97       3.95       3.55         50       T.24       25.49       MIC4040.74.97       3.95       3.55         70       MIS 3.97       9.90.06       1.95       3.57       3.56       3.57         71       P.5       3.73       3.6       3.57       3.66       3.57         71       MIS 3.67       R.90       S.0       8.1       1.45       1.00         72       P.97 S5       1.61       1.00       9.0       1.45       1.00       1.00         72</th><th>IN-58         25         40m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         200 PT/35           SCR         AND         FW BRIDGE         RECTIFIE         200 PT/35           CBI0         154 m 4007         SCR         SCR AND FW BRIDGE RECTIFIE           CBI0         154 m 4007         SCR         SCR         SCR           ADA 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE</th><th>A A HP 1 70 A A A P 1 70 A A A P 1 70 A A A P 1 80 A A A P 1 80 A P 1 1 80 A P 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1</th></t<>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | CLOCK CHIPS       MOTOROLA         MIS301       4.9 50       MOTOROLA         MIS301       4.95       MIC1080.7       54.95         MIS301       6.95       MIC0017       7.14.93         MIS301       9.95       1.94       MIC302P       2.55         MIS3017/9900.4       9.95       1.95       MIC4040.74.97       3.95         50       T.24       25.49       MIC4040.74.97       3.95       3.55         50       T.24       25.49       MIC4040.74.97       3.95       3.55         70       MIS 3.97       9.90.06       1.95       3.57       3.56       3.57         71       P.5       3.73       3.6       3.57       3.66       3.57         71       MIS 3.67       R.90       S.0       8.1       1.45       1.00         72       P.97 S5       1.61       1.00       9.0       1.45       1.00       1.00         72                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      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IN-685         150         77m         6/1 00         IN-1184         100 PT/35           IN-685         150         77m         6/1 00         IN-1184         200 PT/35           SCR         AND         FW BRIDGE         RECTIFIE         200 PT/35           CBI0         154 m 4007         SCR         SCR AND FW BRIDGE RECTIFIE           CBI0         154 m 4007         SCR         SCR         SCR           ADA 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE         FW BRIDGE RECTIFIE           MAD 880-1         124 m 507         FW BRIDGE RECTIFIE                       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|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------|
| PL259's/SO 239's<br>Quality American Made<br>10/\$5.00 100/\$35.00<br>50/\$20.00 1000/\$300.00                                                                                                                                                                                                                                                                                                                                                      | <b>CB SPECIAL</b><br>Brand new printed circuit board assembly. Used in all<br>HyGain 40 channel CB transceivers. Fits many other<br>manufacturers' units also. Squelch pot/volume control/<br>channel selector switch not included.                                                                                                                                                                                                                                                                                                                                              |                                                                                         |                                                                                                                                   |                                                                                                                                                                                                                                              |                                                                                           | <b>Gold F</b><br>14 pin<br>16 pin                                                                 | C SOCKET<br>Cambion<br>Plated Wire<br>.35 ea<br>.38 ea                                                    | <b>S</b><br><b>Wrap</b><br>10/\$3.00<br>10/\$3.30                                               |
| <b>E. F. Johnson NICAD</b><br>12.0 V. 1.2 AH @ 10 hr rate                                                                                                                                                                                                                                                                                                                                                                                           | E. F. Johnson NICAD         1- 9-7.50 ea.         50           12.0 V. 1.2 AH @ 10 hr rate         10-49-6.50 ea.         100                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                         |                                                                                                                                   |                                                                                                                                                                                                                                              | -6.00 ea. Board<br>-5.50 ea 6'' x 6' ?                                                    |                                                                                                   | SIGNAL DIODE                                                                                              |                                                                                                 |
| 41/2 X17/0 X13/4 \$14,35ea.                                                                                                                                                                                                                                                                                                                                                                                                                         | NEW Hy-Gain Remote 40ch CB Less Case. Speaker & Control Mic<br>(a5 i5) \$14 95 ea                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                         |                                                                                                                                   |                                                                                                                                                                                                                                              |                                                                                           | :                                                                                                 | \$5.00 PER 10                                                                                             | 0                                                                                               |
| E F Johnson External Battery<br>Charger Model 239-0206-001, Output                                                                                                                                                                                                                                                                                                                                                                                  | Serviceman Special                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                                                         |                                                                                                                                   |                                                                                                                                                                                                                                              |                                                                                           | 2                                                                                                 | 8.00 PER 100<br>R 15 FOR \$1.                                                                             | 00<br>.00                                                                                       |
| 14.5 V dc @ 50 mA. \$3.50 ea.                                                                                                                                                                                                                                                                                                                                                                                                                       | New Hy dam worn o                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | D 1035 0                                                                                |                                                                                                                                   | \$14                                                                                                                                                                                                                                         | 1 95 ea                                                                                   | MODEM CABLE                                                                                       |                                                                                                           |                                                                                                 |
| E. F. Johnson S Meter<br>Edge Meter 250 UA. Fits in 5/8" x 1-3/8" hole.<br>MTG holes on each end 1-1/4" behind panel.<br>Black scale 0-5 bottom 1-20 top                                                                                                                                                                                                                                                                                            | ASTATIC T-UG8-D104<br>PREAMP Desktop microphone<br>w/crystal element 3 Pin Plug \$35 ea.         NEW E.F. Johnson Power Mic/Lic<br>Cord. Desktop Style           New 40 CH CB Boards<br>1-9 \$10.50 ea<br>10-49 \$9.50 ea<br>w/40 ch SW<br>50-99 \$9.00 ea<br>100-up \$8.50 ea         SOLDER LUG-TYPE CAP<br>50 UF @ 350V 1" D x 3" L<br>50 UF @ 450V 1" D x 3" L<br>50 UF @ 450V 1" D x 2½" L<br>50 UF @ 450V 1" D x 2½" L<br>50 UF @ 450V 1" D x 3" L<br>60e EA. 5 FOR \$2.50           22 pins/Double Row/Dipped Solder<br>.156         22 pins/Double Row/Wire Wrag<br>.156 |                                                                                         | NEW E.F. J<br>Cord. Deskto                                                                                                        | lohnson Power<br>pStyle                                                                                                                                                                                                                      | Mic/Less<br>\$19.95 ea                                                                    | s 50° cable contains<br>13 # 22 ga. wire DB-25p<br>DB-51226-1 cover on one end<br>\$6 50 ea 10/\$ |                                                                                                           | ains<br>B-25p with<br>ne end<br>10/\$50.00                                                      |
| \$1.25 ea.     5/\$5.00       Edge meter same as above with silver scale and reads SWR 1-10     5/\$5.00                                                                                                                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         | SOLDER LUG-TYPE CAPS<br>50 UF @ 350V 1" D x 3" L<br>50 UF @ 450V 1" D x 2½" L<br>50 UF @ 450V 1" D x 3" L<br>60e EA. 5 FOR \$2.50 |                                                                                                                                                                                                                                              | CAPS<br>3"L<br>½"L<br>3"L<br>.50                                                          | EFJ CRYSTAL OVENS<br>6V/12V 75°<br>\$5.00 ea.                                                     |                                                                                                           |                                                                                                 |
| E. F. Johnson Signal Strength<br>Meter 200 UA 21/211 × 21/211 Sq mounts in<br>11/411 hole 111 behind panel Scale 1-30 db top<br>0-5 bottom<br>\$4.95ea 5/\$20.00                                                                                                                                                                                                                                                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         | <b>Wrap</b><br>0/\$19.00                                                                                                          | Double<br>6 pins<br>15 pins<br>22 pins<br>43 pins                                                                                                                                                                                            | Row/Solder E<br>\$1.10 ea<br>\$1.55 ea<br>\$2.08 ea<br>\$3.66 ea                          | Eyelet .156<br>10/\$ 9.00<br>10/\$12.50<br>10/\$17.00<br>10/\$30.00                               |                                                                                                           |                                                                                                 |
| PANEL METERS<br>\$4.00 ea 2 for \$7.00                                                                                                                                                                                                                                                                                                                                                                                                              | MINI TOGGLE SW<br>C&H<br>SPDT<br>\$1.00 Pa 6/\$5.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | V 2 SIDED Sony RK64A<br>2 conductor mini phono<br>9'. * 10 %<br>\$2 00ea 3/\$500 second |                                                                                                                                   | 100 ASSORTED DISC CAPS<br>(FULL LEADS) 20 EA OF 5<br>DIFFERENT VALUES \$2.00                                                                                                                                                                 |                                                                                           | SC CAPS<br>EA OF 5<br>ES \$2.00                                                                   |                                                                                                           |                                                                                                 |
| 25-0-25 dc Volts 2 ¼ " x 3"<br>0-25 dc Volts 2 ¼ " x 2"<br>0-50 ac Volts 2 ¼ " x 2 ¼ "<br>-Shunt Required-                                                                                                                                                                                                                                                                                                                                          | F. Johnson<br>40ch Selector<br>Switch<br>\$3.50eaPOLYFOAM COAX - 50<br>Equal to RG174<br>Low Loss<br>Polyfoam<br>Coax Cable                                                                                                                                                                                                                                                                                                                                                                                                                                                      |                                                                                         | 0 RG 174<br>5/100'<br>Loss<br>foam<br>Cable                                                                                       | nm                                                                                                                                                                                                                                           | RECEIVER FRONT ENDS<br>Made by EFJ<br>132-174 MHz<br>\$12.00 ea.                          |                                                                                                   |                                                                                                           |                                                                                                 |
| Double Row/Wire Wrap .100           25 pins         \$3.49 ea         10/\$30.00           30 pins         \$3.96 ea         10/\$32.00           50 pins         \$5.43 ea         10/\$45.00           C & K SWITCHES           PART # MOVEMENT                                                                                                                                                                                                   | 12 Vdc RELAY<br>SPST Open Frame<br>5 Amp Contacts<br>Mfg-Magnecraft<br>\$1.50 ea 4/\$5.00<br>12 Vdc RELAY<br>SPST 35 Amp Contacts<br>Open Frame<br>Rugged, great for mobile use<br>\$4.50 ea 5/\$20.00<br>Coax Connectors<br>UG-273/U BNC-F/UHF-M 2.50<br>UG-255/U BNC-M/UHF-F 3.00<br>UG-146A/U N-M/UHF-F 4.50<br>UG-175 RG-58 Adapt20<br>UG-176 RG-59 Adapt20                                                                                                                                                                                                                  |                                                                                         | S<br>TRAN<br>STEP-I<br>CON<br>GSD 200<br>@ 200<br>@ 200<br>@ 200<br>@ 200<br>@ 400<br>@ 400                                       | STANCOR           TRANSFORMERS           STEP-DOWN AUTO (3)           COND LINE CORD           W/RECPT           GSD 200 (230V In/115V Out           @ 200 Va) \$12.00 ea           GSD 400 (230 In/115 V Out           @ 400 Va) \$14.50 ea |                                                                                           | TF<br>Si<br>\$.                                                                                   | RIMMER C<br>mall enough<br>in your watcl<br>3.5 to 20 pl<br>5 to 30 pF<br>75 ea., 2 for 5<br>5 for \$3.00 | <b>APS</b><br>to fit<br>F<br>\$1.25                                                             |
| 7101         ON/NONE/ON         SPST           7103         ON/OFF/ON         SPST           7107         ON/NONE/ON         SPST           7108         ON/NONE/(ON)         SPST           7201         ON/NONE/ON         DPDT           \$1.00 EA         6 FOR \$5.00                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         | CRYSTAL FILTERS<br>10.7 3/Lead<br>Can Type<br>\$3.00 ea.<br>CERAMIC IF FILTERS<br>EFC L455K<br>\$3.50 ea.                         |                                                                                                                                                                                                                                              | CAPS<br>2200 UF @ 16V<br>Radial Leads<br>.25 ea. 10/\$2.00                                |                                                                                                   | 6V<br>1s<br>.00                                                                                           |                                                                                                 |
| 6 TV GAMES ON (1) CHIP<br>Gen Instr AY-3-8500-1<br>28 Pin Plastic Case<br>EVERYDAY LOW PRICE \$7.50 ea                                                                                                                                                                                                                                                                                                                                              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |                                                                                         |                                                                                                                                   |                                                                                                                                                                                                                                              | White Porcelain           Egg Insulator           1½" x 1" 50¢ ea.           3 for \$1.25 |                                                                                                   |                                                                                                           |                                                                                                 |
|                                                                                                                                                                                                                                                                                                                                                                                                                                                     | ASSOR                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                                         | LECTROL                                                                                                                           | YTICS                                                                                                                                                                                                                                        |                                                                                           |                                                                                                   |                                                                                                           |                                                                                                 |
| VALUE/MFD         VOLTS         D           250,000         @         5V         33           30,000         @         15V         33           63,000         @         15V         33           10,000         @         20V         1           2,700         @         25V         1           2,900         @         25V         1           3,000         @         25V         1           18,000         @         25V         2           | $\begin{array}{c cccc} \textbf{HA} & \textbf{LENGTH} \\ \hline & x & 53/4'' \\ \hline & x & 4'y_1'' \\ \hline & x & 5'y_1''' \\ \hline y_2'' & x & 53/4''' \\ \hline y_4'' & x & 2'y_4''' \\ \hline y_4'' & x & 2'y_4''' \\ \hline & x & 4'y_5''' \\ \hline & x & 4'' \\ \hline \end{array}$                                                                                                                                                                                                                                                                                     | PRICE<br>\$4.00 ea<br>4.00 ea<br>3.00 ea<br>2.00 ea<br>2.00 ea<br>2.00 ea<br>3.00 ea    | 21,000<br>39,000<br>1,000<br>34,800<br>450<br>500<br>240<br>50<br>140                                                             | 6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6<br>6                                                                                                                                                  | 25V<br>45V<br>50V<br>75V<br>100V<br>300V<br>450V<br>450V                                  | 2½" x<br>3" x<br>1¼" x<br>3" x<br>1¼" x<br>1½" x<br>1½" x<br>1¼" x<br>1¼" x                       | 3''<br>53/4''<br>5½''<br>2¼''<br>3½''<br>3½''<br>3¼''<br>2''<br>3''                                       | 3.00 ea<br>3.00 ea<br>3.00 ea<br>3.00 ea<br>2.00 ea<br>2.00 ea<br>2.00 ea<br>2.00 ea<br>2.00 ea |
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| UG-260B/U            | 1.59    | 2N4877                | 2.57     | MFE120     | 1.00 or  | 10/ 8.50       |                    | ••••••          | <b>•</b>      |
| UG-1094/U            | .90     | 2N4957                | 3.50     | 2N3436     | 2.25 ea  | ch             | KILOVAC            | <b>: H-8</b> /5 | i4            |
| UG-701/U             | 3.00    | 2N5108                | 3.90     | 2N4416     | 1.00 ea  | ch             | VACUUN             |                 | V             |
| UG-212C/U            | 3.00    | 2N5109                | 1.55     | MFE131     | 1.05 ea  | ch             | VAUGUN             |                 |               |
|                      |         | 2N5179                | .59      |            |          | 0050           | 26 VC              | It coll \$2     | 9.95 each     |
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| 572B/T160L           | 34.00   | 2N5590                | 6.30     | 1N21C      |          | 1.05           | SOCKET             | <b>S</b> for 3- | 400Z and      |
| 6146                 | 5.09    | 2N5591                | 10.35    | 1N21WE     |          | 2.00           | 3-5000Z tub        | es \$29.9       | 5 per pair    |
| 6146A                | 5.99    | 2N6080                | 5.45     | 1N23B      |          | 1.05           |                    |                 |               |
| 6-46W                | 7.95    | 2N6081                | 8.80     | 1N23C      |          | 1.05           | TOROID             | AL CUP          | (ES           |
| 811A                 | 12.95   | 2N6082                | 10.75    | 1N23CR     |          | 2.00           | T-37-6             |                 | 6/1.00        |
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| 11       | N914         | 100v        | 10m         | A            | .05      | CPU's E-PF             | ROMS      | QTY.          |                 | QTY.         | - , ,    | QTY.    |           | , QTY.           |          |
| 11       | N4005        | 600v        | 14          | A            | .08      | QTY.                   |           | 741           | .20             | 7492         | .45      | 74      | H20 .25   | 74LS76           | .70      |
| 11       | N4007        | 1000v       | 1/          | ۹            | .15      | 8T13                   | 2.50      | 74            | .20             | 7493         | .35      | 74      | H21 .25   | 74LS86           | .95      |
| 11       | <u>14148</u> | 75v         | 10m         | A            | .05      | 8T23                   | 2,50      | 741           | .20             | 7494         | .75      | 74      | H22 .40   | 74LS90           | .85      |
|          | <u>14733</u> | <u>5.1v</u> | 1 W Z       | enner        | .25      | 8T24                   | 3.00      | 741           | 3.20            | 7495         | .60      | 74      | H30 .30   | 74LS93           | .85      |
|          | 17524        | 24V         | 1V          | V<br>1.7     | ,25      | 8197                   | 1.75      | 74            | 14 .2U          | 7490         | .80      | 74      | H4U .35   | 74LS96           | 2.00     |
| 1        | 1759A        | 104         |             | Zener        | .25      | 74S188                 | 3.00      | 74            | 6 25            | 74100        | 35       | 74      | H50 ,30   | 74LS107          | .90      |
| 10       | 1759A        | 12v         |             |              | .25      | 1488                   | 1.25      | 74            | 7 .55           | 74121        | .35      | 74      | H52 .20   | 74LS123          | 1.95     |
| 10       | 15243        | 13v         |             |              | .25      | 1489                   | 1.25      | 741           | 8 .20           | 74122        | .55      | 74      | H53 .25   | 74LS138          | 2.00     |
| 11       | 15244B       | 14v         |             |              | .25      | 1702A                  | 4.50      | 74            | 9.25            | 74123        | .55      | 74      | H55 .25   | 74LS151          | .95      |
| 11       | N5245B       | 15v         |             |              | .25      | ICM 7207               | 6.95      | 741           | 0.20            | 74125        | .45      | 74      | H72 .35   | 74LS153          | 1.15     |
| 11       | 15349        | 12v         | 31          | V            | .25      | ICM 7208               | 13.95     | 741           | 1.25            | 74126        | .45      | 74      | H74 .35   | 74LS157          | 1,15     |
| 0714     | 500          | VETO        |             | EC           |          | MPS 6520               | 10.00     | 741           | 2 .25           | 74132        | .75      | 74      | H101 .95  | 74LS160          | 1.15     |
| QIY.     | 8 000        | REIJ        |             | EO           | 35       | MM 5314                | 4.00      | 74            | 3 .45           | 74141        | .90      | 74      | H103 .55  | 74LS164          | 2.90     |
|          | 0-pin        | pco         | 20          | VVVV         | .35      | MM 5316                | 4.50      | 74            | 4 ./5<br>6 26   | 74150        | .83      | 74      | 100 30    | 7415193          | 2.00     |
|          | 16 pin       | pcb         | .20         |              | .40      | MM 5387                | 3,50      | 74            | 7 .40           | 74153        | .95      | 74      | 102 .30   | 741 \$244        | 2.90     |
|          | 19 pin       | pcb         | 30          | ****         | .45      | MM 5369                | 2.95      | 74:           | 0 .25           | 74154        | 1.15     | 74      | L03 .35   | 74LS259          | 1.50     |
|          | 20 pin       | pcb         | .30         | VVVV         | 1.05     | TR 1602B               | 3.95      | 743           | 6 .25           | 74156        | .70      | 74      | L04 .40   | 74LS298          | 1,50     |
|          | 20-pin       | peo         | .55         | <b>VV VV</b> | 1.05     | UPD 414                | 4.95      | 74:           | 7.25            | 74157        | .65      | 74      | L10 .30   | 74 LS367         | 1.95     |
|          | 22-pin       | pco         | .40         | ww           | 1.15     | Z 80 A                 | 22.50     | 74:           | .20             | 74161/9      | 316 .75  | 74      | L20 .45   | 74LS368          | 1.25     |
|          | 24-pin       | pco         | .40         | ww           | 1.25     | Z 80                   | 17.50     | 74:           | 2.30            | 74163        | .85      | 74      | L30 .55   | 74LS373          | 2.50     |
| L        | 28-pin       | pcb         | .50         | ww           | 1.35     | Z 80 P10               | 10.50     | 74            | .20             | 74164        | .75      | 74      | L47 1.95  | 74\$00           | .45      |
| <u> </u> | 40-pin       | pcb         | .55         | ww           | 1.45     | 2102                   | 1.45      | 74:           | 8.30            | 7416         | 1.10     | 74      | L51 .65   | 74S02            | .45      |
|          | Molex pin    | IS .01      | 10-3 500    | kets         | .35      | 2102L                  | 4.95      | 744           | U .2U           | 74100        | 1.75     | 74      | 172 65    | 74503            | .35      |
|          | 2 Amp Br     | ldge        | 100-p       | rv           | .95      | 21078-4                | 9.50      | 74            | 2 55            | 7417         | .50      | 74      | 173 70    | 74504            | .35      |
|          | 25 Amp E     | sridge      | 200-р       | rv           | 1.50     | 2513                   | 6.25      | 74            | 3 .45           | 7417         | 1.10     | 74      | L74 .75   | 74508            | .45      |
| OTY      | TRANS        | SISTO       | RS, LED     | S, etc.      |          | 2708                   | 11.50     | 744           | 4 .45           | 74180        | .95      | 74      | L75 1.05  | 74\$10           | .45      |
| Ger 17.  | 2N2222M      | (2N22       | 222 Plastic | .10}         | .15      | 2716 D.S.              | 34.00     | 744           | 5.75            | 74181        | 2.25     | 74      | L85 2.00  | 74S11            | .45      |
|          | 2N2222A      |             |             |              | .19      | 2716 (5v)              | 69.00     | 744           | 6.70            | 74182        | .75      | 74      | L93 .75   | 74S20            | .35      |
|          | 2N2907A      | PNP         |             |              | .19      | 2758 (5v)              | 26.95     | 74            | 7 .70           | 74190        | 1.25     | 74      | L123 1.95 | 74\$22           | .55      |
|          | 2N3906       | PNP         | (Plastic)   |              | .19      | 3242                   | 10.50     | 744           | 8 .50           | 74191        | 1.25     | 74      | LS00 .40  | 74\$40           | .30      |
|          | 2N3054       | NPN         | (Plastic)   |              | .19      | 4116                   | 11.50     | 74            | 0.25            | 74192        | .75      | 74      | LS01 .40  | 74\$50           | .30      |
|          | 2N3055       | NPN         | 15A 60v     |              | .60      | 6800                   | 13.95     | 74            | 2 20            | 7419         | .83      | 74      | LSUZ .45  | 74551            | .35      |
|          | T1P125       | PNP         | Darlington  |              | 1.95     | 6850                   | 7.95      | 74            | A 25            | 7419         | .55      | 74      | 1504 45   | 74574            | .15      |
| <u> </u> | LED Green,   | Rec         | d, Clear,   | Yellow       | .19      | 8080                   | 7.50      | 74            | 0 .40           | 74196        | .95      | 74      | LS05 .45  | 74\$112          | .60      |
|          | D.L.747      | 7 seg       | 5/8" High c | com-anode    | 1.95     | 8212                   | 2 75      | 74            | 0.45            | 74197        | .95      | 74      | LS08 .45  | 74S114           | .85      |
|          | MAN3610      | 7 seg       | com-anode   | (Orange)     | 1.25     | 8214                   | 4.95      | 74            | 2.40            | 74198        | 1.45     | 74      | LS09 .45  | 74\$133          | .85      |
|          | MAN82A       | 7 seg       | com-anode   | (Yellow)     | 1.25     | 8216                   | 3.50      | 74            | 3.25            | 74221        | 1.50     | 74      | LS10 .45  | 74S140           | .75      |
|          | MAN74        | 7 seg       | com-cathod  | e (Red)      | 1.50     | 8224                   | 4.25      | 74            | 4 .30           | 74298        | 1,50     | 74      | LS11 .45  | 74\$151          | .95      |
|          | FND359       | 7 seg       | com-cathod  | le (Red)     | 1.25     | 8228                   | 6.00      | 74            | 5.35            | 74367        | 1.35     | 74      | LS20 .45  | 74S153           | .95      |
| 1        |              | 9000 \$     | SERIES      |              |          | 8251                   | 7.50      | 74            | 6 .40           | 7549         | .05      | 74      | LSZ1 .45  | 745157           | .98      |
| QTY.     |              |             | QTY.        |              | 05       | 8253                   | 18.50     | 741           | 1 85            | 73452        | .03      | 74      | 1 522 .45 | 745158           | .00      |
| 9        | 301 .        | 85          | 932         | 2            | .65      | 8255                   | 8,50      | 741           | 2 .95           | 74H0         | .30      | 74      | LS37 .45  | 745196           | 2.00     |
| 9        | 309          | 50          | 960         | 12           | 45       | TMS 4044               | 9.95      | 741           | 3 .95           | 74H0         | .30      | 74      | LS38 .65  | 74\$257 (81      | 23) 2.50 |
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|          |              |             |             | C MOS        | S        |                        |           | 74            | 6.55            | 74H0         | .35      | 74      | LS42 .95  |                  |          |
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| 4007     | .25          | 40          | 22 ./       | 5            | 4042     | 50 4512                | 1.50      | MC MC         | т2              | 951          | LM3      | 0624    | 1.65      | 1. M373          | 3.05     |
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| 4010     | .35          | 40          | 25 .2       | 5            | 4046     | 1.25 4519              | ,85       | LM            | 201             | .75          | LM3      | OT12    | 1,65      | 78L05            | .75      |
| 4011     | .30          | 40          | 26 1.9      | 5            | 4047     | 2.50 4522              | 1.10      | LM            | 301             | .45          | LM3      | OT15    | 1,65      | 78L12            | .75      |
| 4012     | .25          | 40          | 27 .3       | 5            | 4048     | 65 4526                | .95       |               | 308             | .05          | LM32     | 3K      | 5,95      | 78L15            | .75      |
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| 4015     | .75          | 40          | 30 .3       | 0            | 4052     | .75 MC144              | 09 14,50  | LM            | 310             | .85          | 7805     | (340T5) | 1,15      | LM709 (8-14 Pin) | .45      |
| 4016     | .35          | 40          | 33 1,5      | 0            | 4053     | .95 MC144              | 19 4.85   | LM            | 311 (8-14       | Pin) .75     | LM34     | OT12    | .95       | LM711            | .45      |
|          |              |             |             |              | 4066     | .75 74C1               | 51 2,50   |               | 318             | 1.50         | LM34     | OT15    | .95       | LM723            | .40      |
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| -        | 9 <b>N I</b> | EGK/        | AIED U      | JIKUU        | IISU     | INLIMITED              |           | LM            | 320H24          | .79          | LM34     | 0K12    | 1.25      | LM741 (8-14)     | .45      |
| 788      | 9 Clairen    | nont l      | Mesa Rh     | d Sar        | Diego    | California 9           | 2111      | 7905          | LM320K          | 5) 1.65      | LM34     | 0K15    | 1.25      | LM747            | 1,10     |
| Out o    | f State 1-8  | 00.854.     | 2211        | ahle Δd      | dram IC  |                        | 97.827    | LM            | 320K12          | 1.65         | LM34     | 0K18    | 1.25      | LM1307           | 1,75     |
| 1 (7     | 14) 278-4    | 394         | Califor     | nia Re       | sidents  | 1.800.542.6            | 5230      |               | 320115          | 1.05         | LM34     | UKZ4    | 1,25      | LM1458           | .65      |
| 1        | , _, .       |             | Gaino       | ind ite      | 31001113 | 1.000.042.0            | 1233      |               |                 |              |          |         |           | 1 LM75451        | .65      |
| NAME     |              |             |             |              |          |                        |           |               |                 |              |          |         |           | NE555            | .45      |
| I MANE   |              |             |             |              |          |                        |           |               |                 |              |          |         |           | NE556            | .85      |
|          |              |             |             |              |          |                        |           |               |                 |              |          |         |           | NE565            | 1.15     |
| STREET   | ADDRESS .    |             |             |              |          |                        |           |               |                 |              |          |         |           | NE567            | .25      |
|          |              |             |             |              |          |                        |           |               |                 |              |          |         |           | TA7205           | 6.95     |
| CITY_    |              |             |             |              |          | STATE                  |           |               | ZI              | P            |          |         |           | 76477            | 2.95     |
|          |              |             |             |              |          |                        |           |               |                 |              |          |         |           | 95H90            | 9.95     |
| PHONE.   |              |             | CI          | HARGE        | CARD #   | BA MC                  |           |               |                 |              | EXP.     | DATE    |           | PECIAL DICC      | TIALTO   |
|          |              |             |             |              |          |                        |           |               |                 |              |          |         | 3         | CUAL DISCI       | 10412    |
| C.O.D.   | WIL          | L CALL      |             | UPS          | _ POST   | NET 101                | h OF THE  | MONTH         | PO #            |              |          |         |           |                  |          |
|          |              | 10055       | 00504       |              |          |                        |           |               |                 |              |          |         |           | otal Urder       | Deduct   |
| ALLO     | RUERS SH     | IPPED       | PREPAIL     | J = NO       | MINIMU   | JM - COD ORDI          | EHS ACC   | EPIED - A     | LL ORE          | ERS SHIPP    | D SAI    | VE DAY  | \$        | 32-228           | 10%      |
| OPEN /   | ACCOUNTS     |             | IED - Ca    | litornia     | Hesident | ts add 6% Sales T      | ax. PRICI | ES SUBJEC     | I O CH          | ANGE WIT     | TUUT     | NOTICE. | \$        | 100-\$300        | 15%      |
| 1        | 24 Hour      | Phor        | ie Servic   | :e —         | We ac    | cept Americar          | Expres    | is / Visa / E | lankAn          | nericard / N | aster    | Charge  | \$        | 301-\$1000       | 20%      |

| VADIADLE DOWED OUDDIN 1/1T A4495                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | IC or FET's WITH                                                                                                                                                                                                                                    |
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|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | \$5 & \$10 ORDERS.                                                                                                                                                                                                                                  |
| Continuously Variable from 2V to over 15V                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | DATA SHEETS                                                                                                                                                                                                                                         |
| Continuousiy variable from 2 v to over 15 v                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | WITH MANY ITEM                                                                                                                                                                                                                                      |
| • Short-Circuit Proof                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |                                                                                                                                                                                                                                                     |
| • Typical Regulation of 0.1%                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | DIODES   TRANSISTORS   TRANSISTORS   TRANSISTORS   LINEAR IC'S                                                                                                                                                                                      |
| Electronic Current Limiting at 300mA                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | ZENERS & 2N706 \$0.24 2N4001 3/81 2N5638 2/81 LM340K-5 \$                                                                                                                                                                                           |
| Very Low Output Ripple                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | HELEFIERS 20/10 .24 20002 30.75 20000 2231 U03001-0<br>10450 to 6/01 2020 40 200121 3/51 CP043 \$4.00 L03401-0                                                                                                                                      |
| Fiberglass PC Board Mounts All Components                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 10458 20918 3/51 204122 3/51 CP669 35 88 U L8348112<br>10443 te see 201613 3828 204124 5/81 CP661 \$4.66 L8348115                                                                                                                                   |
| Assemble in about One Hour                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 19486 0737 2N1711 .20 2N4248 5/51 E100 4/51 LM340T 24<br>19746 to                                                                                                                                                                                   |
| Makes a Great Bench or Lab Power Supply                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | 1N759 4/31 2N1093 .38 2N4250 4/31 E102 3/31 LN3779<br>1N914* 15/31 2N2219 .24 2N4274 5/31 E175 3/31 LN300N                                                                                                                                          |
| Includes All Components except Case and Meters                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 10962 to 4/51 202222 0/51 204302 50 29 MPF102 to 3/51 NE565V*                                                                                                                                                                                       |
| ADD \$1.25 FOR FOSTAGE/MANDEING                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 1H3064 6/S1 2H2308 5/S1 2H4338 S1 MPF112 4/S1 LM700CH<br>1H3668 6/S1 2H2365 to 2H4338 2/S1 MP55515 3/S1 LM700CH                                                                                                                                     |
| SPECIALS THIS MONTH ONLY                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 1844001* 12/51 282500 52 284301 51 5E1001 4/51 LM723H                                                                                                                                                                                               |
| 18/34A Germanium Dinde 68V 19mA 16/51   LM306H Leve Bits Certrent Op Amp-Super 709 \$0.54                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 184003 12/51 282006A 24 284016 2/51 552001 4/51 LM7398 5                                                                                                                                                                                            |
| 10/270 Germansom Diede 88V 200mA 4/81 L01300K 5 Veit Regulatar TD-3 84<br>10/16/ 001/16-8 50/11 L01370K 45/state Value 2.7/V 3.50                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 104005 10/21 202563 51.50 204050 to 51 555001 to 3/31 LM741C0*                                                                                                                                                                                      |
| 19819 Januardo Unider Under (Under Lindon L.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 184000 18/51 283843 0/51 284007 22/51 \$55020 \$3.00 LM747CH                                                                                                                                                                                        |
| F7 Power Varactor 1-2W Dat #4328Mrz ME585A Phone Locked Leep DIP .394<br>(Sases & Crustic Incided with F7) \$2.00 (M1592M Bunchistic Varians Bauelons DIP 3/83                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 104148 16/31 283565 to 6/31 284568 2/31 115/3 to 3/31 746CJ DIP<br>104156* 25/31 283568 6/31 284681 \$2.68 T15/3 to 3/31 746CJ DIP                                                                                                                  |
| DHODE GRAB BAG-Mined zeners, mctifiers, etc. 58/51 LW747 Deal /41 Componented Op Amp Dip 2/51                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | 104370 to 2/81 203636 6/81 204666 81 BIGITAL IC's 844CP mDIP<br>104372 2/81 203836A 5/81 204965 3/81 300057380 52.85 LM13040                                                                                                                        |
| 28/396 NPM Magh Spaced Swrtch 756ns 4/351 27182 1924-881 Statis MARK (1024 × 11) 01P 31,75<br>28/318 UMF Transister — Osc/Ama as to 1 GM z 4/351 274600 E FET-1aport D p Amo-like K 53/6,474 1.55                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | 104554 15/51 203641 5/51 205007 4/51 50000 16 LM145800 16 LM145800 16 LM145800                                                                                                                                                                      |
| 2012069 P-Channel FET Amplifier 2500,mbes \$1,00 CA3018A 4-Transitier Array/Darkington                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 184753 3751 283643 6/51 285129 ta 5/81 58174208 .18 XR2656CP 2740 0E 2740 0E                                                                                                                                                                        |
| 2163248 MPH JOHN FINANCIA J 100 40V 200mA 0/51 CA3075E FM IF Amp/Limiter/Detector DIP 1.45                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | 1N5236 4/31 2N3646 4/31 2N5138 5/81 3H /44000 10 CA3828A<br>2N3585 to 2005139 5/81 5H /451H 18 CA3846                                                                                                                                               |
| 21401222 PMP R F Ampelifier & Switch 2/81 RC4556 Qual Migh Gen Op Amp mD4P 2/81<br>20402602 B Churced Advis E T Semant Learning Manage 2/81 M5556V Precisione Fet Q A Amp mD4P 2/81                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | VARACTORS 20000 3/31 200163 3/31 50/4/30 -36 LM307501<br>VARACTORS 2005010 2005107 55.00 50/74750 40 CA3005*                                                                                                                                        |
| 2444888 156 Veht PHT Frankter for Kryer 2751 e9558V Dual Hi Gain 0p Ang- Comp. m0HP 3/81<br>244488 156 Veht PHT Frankter for Kryer 2751 e9558V Dual Hi Gain 0p Ang- Comp. (2010) 1271                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 1N5139 to 203004 4/S1 2N5199 2.50 SN7476N 35 LM39004 4/S1 2N5199 2.50 SN7490N 44 850 SN7490N 44                                                                                                                                                     |
| E112 R. Channel FET WH FAme J351 ease for the control of the contr       | D5 144MHz \$5 2N3822 .78 2N5308 2/81 LINEAR IC'S RC4194TK*                                                                                                                                                                                          |
| LP-10 LOGIC PROBE MH-TTL, CMOS, etc.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | NY538 to 51 203066 .76 205432 1.50 LM100H S7.90 NC41950H                                                                                                                                                                                            |
| SEND FOR ADVA'S NEW 1979 CATALOG                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | MVBJ2 ************************************                                                                                                                                                                                                          |
| NEARLY 1000 SEMICONDUCTORS, KITS, CAPACITORS, ETCSEND 254 STAMP.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | MV1634 203819 \$5.66 205484 3751 LK308K .54 W5566V                                                                                                                                                                                                  |
| MORE SPECIALS:                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | MV1872 32 203954 3.28 205643 \$3.00 LM320K 5 1.35 μA7005UC<br>MV2201 to 203056 1 15 205644 2 50 LM320K 12 1.36 0038 DIP*                                                                                                                            |
| OTHER ADVA KITS: RC4195DN ·15V @ 50mA VOLTAGE REGULATOR IC. Very easy to                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | MV2206 31 283976 1 00 206661 12 00 L83284-16 1 35 D875482                                                                                                                                                                                           |
| LOGIC PROBE KIT-Use with CMOS, TTL, DTL, RTL, HTL, H/NL and most MOS IC's use. Makes a next Highly Regulated *15V Supply for OP AMP's, etc. Requires only unresulated DC (18-30V) and 2 bytess capacitors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                     |
| Built-in protection spanst polarity reversal and overroitage Dreve only a few mA from circuit<br>under test. Dual LED readout Complete kin uncludes case and cip beach. ONLY \$7.25 With Data Sheet and Schematics. 8-pin mDIP \$1.25 or of<br>a complete state of the state of | SUPER SPECIALS:                                                                                                                                                                                                                                     |
| FIXED REGULATED POWER SUPPLY KITS—Short croxit proof with themal current IKCR136 Quad 741 Low-Noise Up Amp mDIP 30.55<br>Invitine Conserver tax and browned research and the state these take from set become L LM1304 FIM Multiplex Stereo Demodulator DIP 0.99                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 1N34 Germanium Diode 10/\$1 FSA2501M Olode Array                                                                                                                                                                                                    |
| project. Available for 5 V of 500mÅ, 5 V of 500mÅ, 12 V of 400mÅ, 15 V of 10 Ministration of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation Directory 10 Ministration of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creation of the Subsystem (IF Amp, Det, Limiter) DIP 0.99 INCERS for Creatio       | 1N914 100V/10mA Diode 20/\$1 MPF102 200MHz RF Amp 3<br>1N4001 50V/10 Restrict 15/\$1 40673 MOSEET RE Amp \$                                                                                                                                         |
| 300nA. Specify voltage when ordering Bullo sa.<br>ZENERS—Specify Voltage 3, 3, 9, 4,3, 5,1, 6,8, 8,2<br>400mW 4(\$1.00                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | 1N4001 5007 1A Rectifier 15/31 6032 1A Construction 15/31 1003 10001 21 1A Construction 15/31 1003 10001 21 1A Construction 15/31 1003 10001 21 1A Construction 15/31 1003 1003 10001 21 1A Construction 15/31 1003 1003 1003 1003 1003 1003 1003 1 |
| There says to assesse at a solution of the sol       | BR1 50V %A Bridge Rec 4/\$1 LM376 Pos Volt Reg mDIP<br>2N2222 NPN Transistor 6/\$1 NE555 Timer mDIP                                                                                                                                                 |
| postage and handling.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | 2N2907 PNP Transistor 6/\$1 LM723 2-37V Reg OIP                                                                                                                                                                                                     |
| TMAIL NOWI FREE DATA SHEETS supplied with many tems from this of FREE ON                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | 2N3055 Power Xistor 10A \$0.75 LM741 Comp Op Amp mOIP 0<br>2N3904 NPN Amp/Sw β100 6/\$1 LM1458 Dual 741 mDIP                                                                                                                                        |
| REQUEST-141 Op Amp with every order of 85 or more-149 Dual Op Amp or two E100<br>EFT's with every order of 100 r more, oscitarised arour of 12/31/18, One traine term per order                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | 2N3906 PNP Amp/Sw β100 6/\$1 CA3086 5 Trans Array DIP                                                                                                                                                                                               |
| ORDER TODAY-All dams subject to prior sale and prices subject to change writhout notice                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | UPDOU FOWER FET SAMP 30 HUA29 PWT AISTOR TA JUN                                                                                                                                                                                                     |
| All terms are new surprus parts-trutys functionary (1978)<br>WRITE FOR FREE CATALOG #79 offering over 700 semiconductors carried in stock                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | RF391 RF Power Amp Transistor 10-25W @ 3-30MHz TO-3 \$                                                                                                                                                                                              |

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| A2   | B8   | C106 | G12 | 132 | M35  | 012 | S3   | Т3   | U13 |               |
| A6   | B23  | C115 | G22 | 143 | M36  | P2  | S8   | T18  | V5  | MICROCOMPUTIN |
| A21  | B42  | D6   | H2  | 144 | M48  | P20 | S10  | T34  | V24 |               |
| A24  | B54  | D23  | H3  | J1  | M52  | P41 | S18  | T48  | V75 |               |
| A40  | C3   | D25  | H5  | J2  | M69  | P44 | S33  | T52  | W2  |               |
| A46  | C5   | D29  | H8  | J7  | M95  | P64 | S43  | T55  | W18 |               |
| A60  | C6   | D35  | H16 | K14 | M109 | Q3  | S44  | T64  | W33 |               |
| A92  | C21  | E40  | H24 | L9  | N4   | R1  | S63  | U2   | X3  |               |
| A100 | C58  | F1   | H44 | L17 | N22  | R8  | S81  | U8   | Y1  |               |
| A106 | C88  | F5   | 19  | L25 | O5   | R27 | S100 | U9   |     |               |

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# ALL NEW **FT-101ZD**

## **HIGH-PERFORMANCE HF TRANSCEIVER**

Today's technology, backed by a proud tradition, is yours to enjoy in the all-new FT-101ZD transceiver from YAESU. A host of new features are teamed with the FT-101 heritage to bring you a top-dollar value. See your dealer today for a "hands on" demonstration of the performance-packed FT-101ZD.

Diecast front panel, plus heavy duty case

Built-in, fully adjustable, VOX circuitry

Built-In RF speech processor for more "talk power" when you need it

Built-in, threshold adjustable, noise blanker

Equipped for SSB and CW operation. Choice of wide or narrow bandwidth for CW (with optional CW filter installed)



Digital plus analog frequency readout. Digital display resolu-tion to 100 Hz

Rugged 6146B final amplifier tubes with RF negative feedback

RF and AF gain controls located on concentric shafts for operator convenience

Full band coverage: 160 through 10 meters, plus WWV/JJY (receive only)

TX, RX, or transceive frequency offset from main dial frequency

width: 300 Hz to 2.4 KHz

### TRANSMITTER

PA Input Power: 180 watts DC Carrier Suppression: Better than 40 dB Unwanted Sideband Suppression: Better than 40 dB @ 1000 Hz, 14 MHz **Spurious Radiation:** Better than 40 dB below rated output Third Order Distortion Products: Better than -31 dB Transmitter Frequency Response: 300-2700 Hz (-6 dB) Stability: Less than 300 Hz in first 30 minutes after 10 min. warmup; less than 100 Hz after 30 minutes over any 30 min. period Negative Feedback: 6 dB @ 14 MHz Antenna Output Impedance:

50-75 ohms, unbalanced

## SPECIFICATIONS

## GENERAL

Frequency Coverage: Amateur bands from 1.8-29.9 MHz, plus WWV/JJY (receive only) **Operating Modes:** LSB, USB, CW **Power Requirements:** 100/110/117/200/220/234 volts AC. 50/60 Hz; 13.5 volts DC (with optional DC-DC converter) **Power Consumption:** AC 117V: 75 VA receive (65 VA HEATER OFF) 285 VA transmit; DC 13.5V: 5.5 amps receive (1.1 amps HEATER OFF), 21 amps transmit

Size: 345 (W)×157 (H)×326 (D) mm Weight: Approximately 15 kg.

COMPATIBLE WITH FT-901DM ACCESSORIES Select switches for use with FV-901DM synthesized scanning VFO (option). FV-901DM provides scanners plus 40 frequency memory bank.

### **RECEIVER**

Sensitivity: 0.25 uV for S/N 10 dB Selectivity:

2.4 KHz at 6 dB down, 4.0 KHz at 60 dB down (1.66 shape factor): Continuously variable between 300 and 2400 Hz (-6 dB); CW (with optional CW filter installed): 600 Hz at 6 dB down, 1.2 KHz at 60 dB down (2:1 shape factor)

Image Rejection:

Better than 60 dB (160-15 meters); Better than 50 dB (10 meters)

IF Rejection:

Better than 70 dB (160, 80, 20-10 m); Better than 60 dB (40 m)

Audio Output Impedance: 4-16 ohms

Audio Output Power: 3 watts @10% THD (into 4 ohms)



Price And Specifications Subject To Change Without Notice Or Obligation





YAESU ELECTRONICS CORP., 15954 Downey Ave., Paramount, CA 90723 

(213) 633-4007 YAESU ELECTRONICS Eastern Service Ctr., 9812 Princeton-Glendale Rd., Cincinnati, OH 45246



## TS-180S with DFC\*

1S-180S, featuring DFC \*(Digital Frequency Control, with four digitally tuned memories), is an all solid-state HF transceiver specially designed for the DXer, contest operator and other Amateurs who enjoy working the 160 through 10-meter hands. Also available is a full line of matching accessories, including the PS-30 base-station power supply, SP-180 external speaker with selectable audio filters, VFO-180 remote VFO, AT-180 antenna tuner/SWR and power meter/antenna switch, DF-180 digital frequency control, YK-88CW filter and YK-88SSB filter. Stand-up microphone shown above is optional. TS-120S, popularly referred to as "a blg little rlg," is a compact, up to 200 watts PEP Input, all solid-state HF transceiver with such standard features as built-in digital readout. IF shift, new PLL technology and requires no tuning. It's ideal for car or ham shack use. Accessories available include the PS-30 base-station power supply, SP-120 external speaker. VFO-120 remote VFO, AT-120 antenna tuner/SWR meter, MB-100 mobile mounting bracket and YK-88CW filter. Hand microphone shown above is optional.

See the exciting TS-180S and TS-120S at your Authorized Kenwood Dealer!

