

Radio- Electronics

HOW TO CONNECT YOUR VCR
TO MORE THAN ONE TV SET

\$1.25 NOV. 1981

VIDEOTEX DELIVERY

Next TV revolution

VIDEOTEX

Information explosion

BROADCAST

1. approx. 100 pages/TV channel
2. CD times to refresh interval
3. 16:9-24:1 ratio pages on dual channel (TV channel)
4. FM radio channel (FM)

INTERACTIVE

1. Telephone system
2. Two way cable
3. Hybrid cable/telemetry
4. Optical fiber



Press 1: This car's specifications
2: Your Carfax report
3: To leave Carfax



Press 1: Educational

Build this

EXPANDED SCALE VOLTMETER

For your workbench

All about

TEMP MEASUREMENT

Circuits and systems

Easy to build

RUMBLE FILTER

For your hi-fi

CBS's new

CX NOISE REDUCTION

For phono records

Superscope's

PIANOCORDER

Turn your piano
into a player piano



Press 1: Europe, Mid-east & N Africa
2: Nations of the world



Alexander The Great

356-323 BC

A pupil of the Greek philosopher Aristotle, at the age of 20 he succeeded his father, Philip II of Macedon, to the throne. He united the Greek city-states and conquered the Persian empire, Egypt and Northern India. Alexander ruled over the greatest empire of the time and founded the city of Alexandria.

Press 1: People who made history
2: World Book

MR ROBERT DAHM
997 266
RURORA
11 60506
3DG
11
390736 DHM 09970093 G4 R NOV81

71896 48783

In one year our **K40**™ antenna has become the largest selling CB antenna in the world!

1. It's more expensive...

2. It's made better...

3. It's proven best!

\$42.50

suggested retail

And when you pay more, you expect more!

MORE PERFORMANCE:

The K40 is guaranteed to transmit further or receive clearer than any antenna it replaces. We know it will. We've tested it with 771 CB'ers just like you for one year.

MORE FLEXIBILITY:

You can fit your K40 to any mounting surface. It will fit any vehicle you'll ever own! That includes choppers, dune buggies, gutters, mirror mounts, luggage racks, trunks, hatchbacks, through roofs, semis, pick ups and RV's.

MORE QUALITY:

It's not imported. It's not made in Taiwan, Korea or Japan. It's American made in an American town. It's made with better materials that cost more and by professional people we pay more. And we designed it right here in the U.S.A.

*Including optional mounts at extra cost.

... This Antenna is so DYNAMITE you receive a ...

DOUBLE GUARANTEE

GUARANTEE I: The K-40 will transmit farther and receive more clearly than the antenna it replaces or the customer will receive a prompt and full refund from the Registered K-40 Dealer who installed and tuned it.

GUARANTEE II: Unconditionally guaranteed for 12 months. Guaranteed against cracking, chipping, or rusting. Guaranteed against mechanical failure. Guaranteed against electrical failure. Guaranteed against accidental breakage. No exclusions. No gimmicks. For a full 12 months.



...Here's what the leading CB publications said.

CB TIMES: "... it's not often that a product bursts onto the market scene, dominates and improves CB'ing for everyone. American Antenna and the K40 are doing it—repeated tests showed the K40 could out-perform the major competitive brands."

RADIO-ELECTRONICS: "The results of our tests showed that, in three different positions of the monitoring receiver, the model K40 equaled or out-performed the competitive antenna. Apparently, American Antenna's advertising is not merely Madison Avenue showmanship."

PERSONAL COMMUNICATIONS: "... an impressive 95% of the trials, the K40 out-performed the existing mobile antennas. We had to try one for ourselves. "... in every case, the K40 either equaled or out-performed its competitor.

"No ifs, ands, or buts! The K40 Antenna from American Antenna would have to be just about the best antenna around.

CB MAGAZINE: "Introduced in October, 1977, the K40 quickly became the top seller and in mid 1978, became the number one selling antenna in the nation."

...Here's what CB'ers all across the country said.

ANTENNA SPECIALISTS: "... truck driver and CB'er for 10 years ... 50% further than my M410 'Big Momma'."

—J.H. Collett, 207 McFee, Bastrop, LA

AVANTI: "I'm an electronic technician with a Second Class FCC license ... I was able to transmit 70% further and tune the SWR 75% lower than my Avanti."

—H.R. Castro, VRB, Monserrate D-67, Salinas, Puerto Rico

PAL: "... 20% better in transmission and reception than my 5/8 wave Pal Firestick."

—John A. Blum, Box 446, Zelenople, PA

SHAKESPEARE: "... I've been a CB'er for three years and the K40 is the best I've ever had. Better in reception and transmission than my Shakespeare."

—H. Bacher, Jr., 15 King Rd., Park Ridge, NJ

HUSTLER: "Compared to my Hustler XBLT-4, the K40 can consistently transmit 40% further and the reception was better. The K40 is the perfect way to complete a CB system."

—Jerome R. Brown, 7800 S. Linder, Burbank, IL



(SPECIAL NOTE) IF YOU'RE A BEGINNER:

Our K40 Dealers will be happy to sell you any of the older style and less expensive antennas that are great bargains for any beginning CB'er.

AMERICAN ANTENNA
ELGIN, IL 60120

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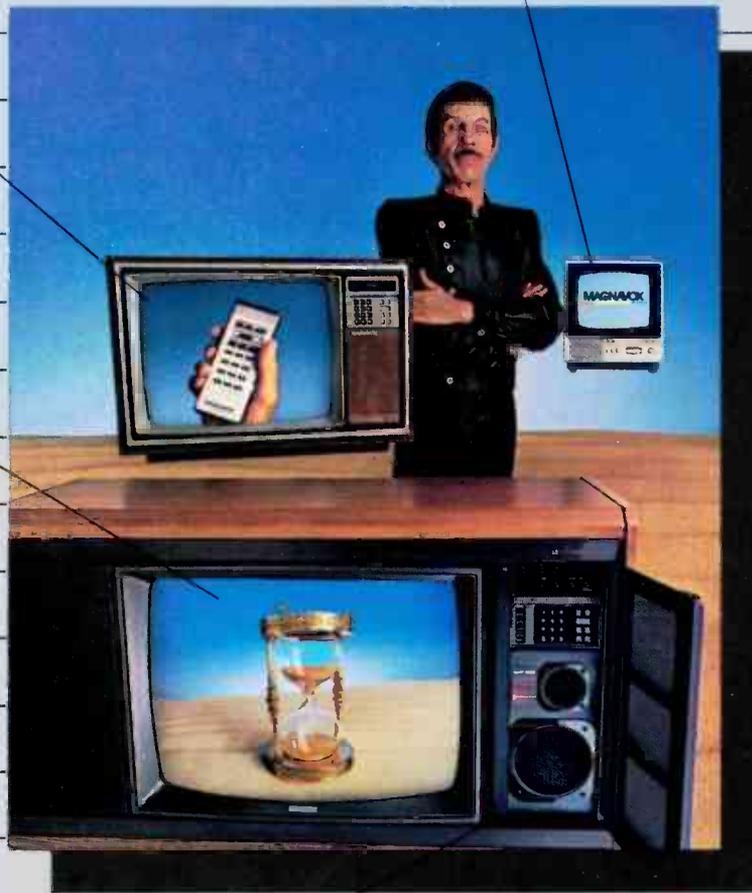
K40
POWER!

... Sold exclusively by 3500 American K40 Dealers throughout the U.S. & Canada.

*Magnavox model 4012,
9-inch diagonal measurement
AC/DC color portable
with electronic tuning wheel
and dial scale indicator.*

*Magnavox model 4265,
19-inch diagonal measurement
Star System. All Star System
sets give you infrared remote
control, 105-channel capability,
automatic switching between
two channels, display time
of day and channel number
on TV screen.*

*Magnavox. A picture you
can rely on time after time.*



*Magnavox model 5260,
25-inch diagonal measurement
Star System. This set even
has expanded range
high-fidelity sound.*

TV pictures and wood-grain cabinets simulated.
All models shown are Star Systems except model 4012.

TELEVISIONARY.

Magnavox sees the next stage of televiewing with you as the participant as well as the recipient.

For that, you will need the most reliable color television possible.

And now Magnavox Star[®] System color television sets combine advanced design concepts, high technology and new manufacturing systems to deliver the highest level of reliability in Magnavox history.

Magnavox. Television as visionary as tomorrow. With a picture as reliable as it is bright and clear.

Time after time.

MAGNAVOX

The brightest ideas in the world are here today.

More ways to C the value... with B&K-PRECISION

Now you can choose the capacitance measurement instrument you need from the industry's most complete line. For high-speed sorting, there's the 835 Digital Capacitance Comparator; and for less specialized applications, the 830 Autoranging C-Meter and the 820 Manual Ranging C-Meter. All are GSA listed.

The 835 is a rugged production tool for isolating out-of-tolerance capacitors in the shortest possible time. Program-in acceptable high and low capacitance limits and then start testing. The 835 indicates "LO," "GOOD" or "HI." It also indicates capacitance values on an autoranging C-meter.

Combining autoranging and portability, the B&K-PRECISION 830 C-meter offers features that are tough to match at any price. Resolution is 0.1 pF, with readings

displayed on a large 3-1/2-digit LCD display. Basic accuracy is 0.2%, much greater than the tolerance of most capacitors. Ease of operation is another strength of the 830. Even untrained workers can quickly learn its operation, though its performance also makes it ideal for engineering lab use. A selectable "range hold" is also featured.

For field or bench applications suited to manual ranging, B&K-PRECISION offers the 820—the industry's best C-meter value. The 820 displays readings to a full 1 Farad on a 4-digit LED display. Accuracy is within 0.5%.

All of the B&K-PRECISION C-measurement products are protected against charged capacitors. They all

also allow you to measure unmarked capacitors, verify capacitor tolerance, measure cable capacitance, select and match capacitors for critical applications, perform quality assurance, measure complex networks, set trimmer capacitors and check capacitance in switches and other components. Options include the CF-10 test fixture for volume sorting; and for the 830 and 820, rechargeable batteries, AC charger and carrying case.

For immediate delivery or more details, see your local distributor, and see why B&K-PRECISION continues to be the leading supplier of digital capacitance measurement instruments. For the name of your nearest distributor call toll-free 800-621-4627.

B&K PRECISION DYNASCAN CORPORATION

6460 W. Cortland Street • Chicago, IL 60635 • 312/389-9087

International Sales, 6460 W. Cortland Street, Chicago, IL 60635 USA: TELEX: 25-3475

Canadian Sales, Atlas Electronics, Ontario



Model 820 \$185
Model 830 \$229
Model 835 \$675

CIRCLE 58 ON FREE INFORMATION CARD

SPECIAL FEATURE

- 43 **VIDEOTEX**
How your TV will be able to supply you with all the information you need, when you need it. **Richard Larratt**

BUILD THIS

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ON THE COVER

Television has already revolutionized the way we live. A second TV revolution is now under way with the introduction of videotex. Videotex will allow you to use your TV set to receive information on almost any subject you desire—news of all sorts, local special events, and even restaurant menus. In addition, it will permit you to transact much of your personal business—shopping, banking, etc.—from home. For a look at what's in store, turn to page 43.



VIRTUALLY ALL STEREO records contain very-low-frequency signals that can be annoying to listen to and, potentially, can damage your sound system. A low-frequency filter will remove those signals, and plans for such a device begin on page 47.



SOMETIMES IT'S DESIRABLE to connect several TV sets to the same VCR. If you have a master-antenna setup, you can use it for that purpose. Several methods for taking advantage of your MATV facilities are described, starting on page 72.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Second-Class Postage Paid at New York, N.Y. and additional mailing offices. One-year subscription rate: U.S.A. and U.S. possessions, \$13.00. Canada, \$16.00. Other countries, \$20.50. (Cash orders only, payable in U.S.A. currency.) Single copies \$1.25. © 1981 by Gernback Publications, Inc. All rights reserved. Printed in U.S.A.

Subscription Service: Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Box 2520, Boulder, CO 80322.

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VIDEO ELECTRONICS

DAVID LACHENBRUCH
CONTRIBUTING EDITOR



MONITORS FOR THE HOME

The day when the output of a home video device must be placed on an RF carrier for playing through a TV set may be rapidly drawing to a close, as more TV set manufacturers add video input jacks to their products. Sony's *Profeel* video components have been widely publicized, as has RCA's 19-inch *Monitor Receiver* (see jack-panel in left-hand photo), but video jacks are creeping into many more home-TV sets with screen sizes from 3.7 to 25 inches. Among those now featuring video input jacks in at least one TV model in addition to RCA and Sony are General Electric, JVC, Liberty, Magnavox, Panasonic, and Toshiba, as well as Teknika (1633 Broadway, New York, NY 10019), which, like Sony, has introduced a component video system.

SLIPPED DISC

Introduction of the third videodisc system—the JVC-developed VHD (see right hand photo above)—has been postponed for six months to April in Japan and June in the United States. Originally scheduled for introduction here in January, and October 1980 in Japan, VHD was called back because of problems arising at high temperatures in the compound used to manufacture the discs, according to JVC officials in Japan. JVC said the problems have been solved, and the tool-up period for introducing the new disc compound will be used to redesign the players so they can play discs recorded in any color-TV standard. When introduced, according to JVC, an NTSC player will be able to play back a PAL or a SECAM disc, and so forth.

STEREO VIDEOCASSETTES

Although only one VCR on the U.S. market can play or record in stereo—Akai's high-end model—MVC (*Magnetic Video Co.*), the world's biggest source for pre-recorded videocassettes is quietly recording stereo soundtracks on all video programming (including movies) which is available in stereo. For the time being, this fact is not mentioned by MVC in its advertising or on the cassette album covers, but the company is preparing for the onslaught of stereo-sound VCR's that could start late this year.

In Japan, where stereo sound is being broadcast on TV, stereophonic VCR's are widely available. The compatible stereo system used on Japanese VCR's could easily be used here, and probably will. It's a good guess that stereo sound could be the high-end VCR feature for 1983.

MORE DISCS ON THE WAY

Both videodisc systems may well float or sink on the availability of discs, and proponents of both concede there aren't enough titles on the market now. At press time, there were 125-150 titles available for each system, not enough of an attraction when you consider there are at least 3,000 titles available to the consumer on videocassette. However, this shortage is beginning to ease. There are now two plants stamping out LV discs—the original DiscoVision Associates factory in California, now joined by the massive Universal Pioneer plant in Japan, scheduled to be producing 200,000 discs monthly by the end of this year and with a capacity of 5,000,000 for 1982. And before the year is over, 3M is scheduled to be pressing LV discs in a Wisconsin facility.

In the CED camp, RCA has increased its disc-production estimate for 1981 to 3,000,000 from 2,000,000 and is expanding its Indianapolis plant to support a 10,000,000 level in 1982. RCA is now custom-pressing the first 20 CBS/MGM videodiscs, and CBS's own CED disc plant is scheduled to be in operation next January.

Facts from Fluke on low-cost DMM's

Our new 4½-digit bench/portable: You've never seen anything like it.

Take a close look at the face of this instrument. Notice anything new? If you just realized you've never seen *words* on a low-cost DMM display before, you're on the right track.

This is the new 8050A from Fluke, the *lowest* priced 4½-digit multimeter available that uses microprocessor technology.

The legends on the LCD are clues to what makes the 8050A unique.

dB: You're right. The 8050A delivers direct readouts in dBm, referenced to any of 16 impedances. Use the "REF Z" button to scroll through the memory and locate the zero dBm reference you need,

then set it and forget it. No more tedious calculations or conversions.

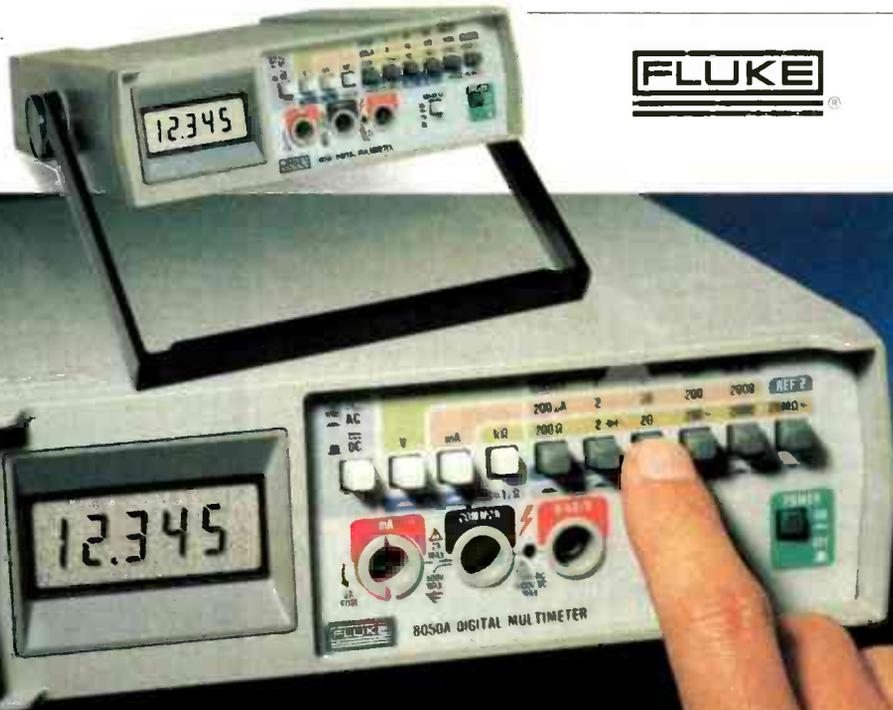
REL: For relative references in the dB mode or offset measurements in all other functions. Lets you store any input as a zero value against which all others are automatically displayed as the difference. Another timesaving convenience.

HV: Just a reminder when your input is over 40V, so you won't forget about safety while in the dB or relative modes.

Of course there's much more to the

8050A. True RMS measurements to 50 kHz. Conductance for measuring resistance to 100,000 Megohms and leakage in capacitors, pcb's, cables and insulators. Diode test, 0.03% basic dc accuracy and full input protection. Plus a large family of accessories. Just \$369 U.S.

For all the facts on the versatility and value of the new 8050A, call toll free 800-426-0361; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.



IN THE U.S. AND NON-EUROPEAN COUNTRIES:	IN EUROPE:
John Fluke Mfg. Co., Inc. P.O. Box C9080, M/S 250C Everett, WA 98206 (206) 356-5400 Telex: 152662	Fluke (Holland) B.V. P.O. Box 5053, 5004 EB Tilburg, The Netherlands (013) 673 973 Telex: 52237

- Please send 8050A specifications.
- Please send all the facts on Fluke low-cost DMM's.
- Please have a salesman call.

RE-11/81

Name _____

Title _____ Mail Stop _____

Company _____

Address _____

City _____ State _____ Zip _____

Telephone () _____ Ext. _____

For technical data circle no. 43

WHAT'S NEWS

Small business computers to follow economy line

Business computers priced under \$20,000 will show a higher rate of growth between now and 1984 than any other segment of the business computer line, according to Venture Development Corp., a market research concern of Wellesley, MA. Shipments of those systems, says VDC, will increase 35.5% annually, accounting for 45% of shipments by 1984. Systems priced between \$20,000 and \$50,000 will increase by 26% annually, amounting to 35% of the market, and those between \$50,000 and \$100,000 are expected to increase about 27% each year, holding 20% of the market in 1984.

According to Karen Horowitz, VDC analyst, future technological advances, lower-priced printers, and less expensive storage devices will enable the owner of one of the lower-priced computer setups to obtain the performance of today's middle-priced systems.

Home satellite TV well under \$4,000

Downlink, Inc., of Putnam, CT, has announced a reduction of its home-satellite TV system to \$3595.00, "the lowest price in

the industry." At the same time, the company announced expanded production capabilities and a distributor program aimed at marketing a thousand systems a month.

The system includes a 12-foot spherical antenna, a low-noise amplifier, the Downlink model D2X receiver, and all of the required cabling.

Downlink introduced other models and combinations, including the model D-2S and model D-3 receivers, as well as the Skyview III parabolic antenna, at the Chicago Consumer Electronics Show that was held last June.

Information, control: 1995 market leaders?

The growth of home information services, video, and control electronics will completely alter the face of the consumer electronics industry by 1995. The market, now \$7.8 billion annually, will reach \$28 billion by 1995. Thus believes Venture Development Corp., of Wellesley, MA. The home electronics field, once dominated by radio, and now getting most of its revenue from television, will find itself chiefly involved with the hardware and software of home information services, says the

Massachusetts market research firm.

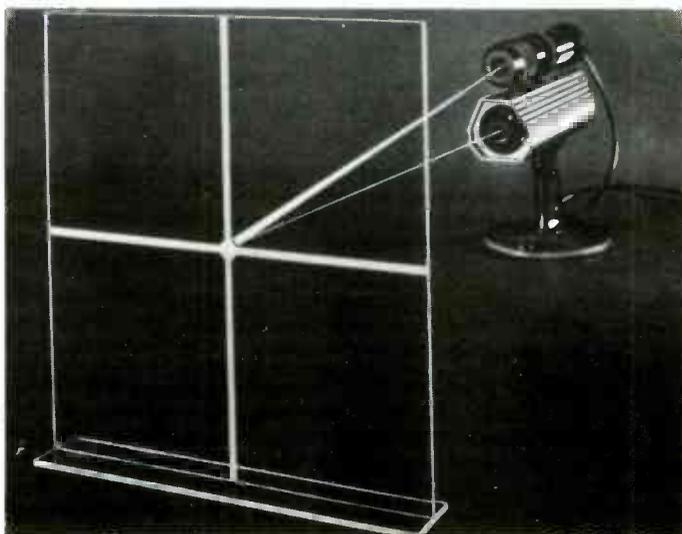
The key challenge facing manufacturers will be to orchestrate product development and introduction to coincide with

evolving consumer demand, says Venture Development. Correct calculation of consumer demand, and especially the timing of a product's introduction, will be critical.

Laser sight improves infrared thermometer

A new handheld portable infrared (IR) thermometer uses a laser sight for fast, precise focal-distance range-finding. The model 44L infrared thermometer

primary concave reflector. It is then focused on a secondary reflector and transmitted from there to an IR detector. A digital readout is calibrated in either Celsius (0° to 600°) or Fahrenheit (0° to 1000°) with 5% accuracy.



THE TELATEMP'S LASER SIGHT not only makes focal-distance range-finding precise and rapid, but also facilitates temperature measurement by illuminating the target, a great aid under poor light or no light.

from Telatemp, is equipped with a 0.5-milliwatt laser, mounted on top of the basic housing. The laser beam is split in two. The primary beam is projected parallel to the thermometer's IR optics to form an intense red spot on the target. A secondary, more diffused beam intersects the primary beam at the thermometer's preset focal distance.

By properly aligning the two beams the user can measure the temperature of a precisely known area of the target. The illumination provided by the beam also aids sighting, particularly when lighting conditions are poor or if the target is in darkness.

The infrared radiation emitted by the target is captured by a

Focal distances are 24 inches to infinity, preset at the factory.

With laser sighting, unlike using rifle-type sights, the user can literally "shoot from the hip." The temperature detected while the trigger is depressed is held on the digital readout for the operator to read after the trigger is released.

Howard Sams Photofacts publishes Set No. 2,000

The Howard W. Sams company reached a milestone this past July with the publication of their 2000th *Photofact* folder. Sams *Photofact* folders first appeared in 1946, introducing a

continued on page 12



DOWNLINK'S SKYVIEW I TV ANTENNA AND D-2 RECEIVER

ODYSSEY²

THE EXCITEMENT OF A GAME. THE MIND OF A COMPUTER.

ALL FOR THE PRICE OF AN ORDINARY VIDEO GAME.

Some video games are exciting but short on challenge.

Odyssey², on the other hand, lets you choose your excitement from more than 40 arcade, sports, education and new Master Strategy games that are full of challenges as well as fun, so they keep you coming back for more.

And some video games have an abundance of brainpower, but cost an arm and a leg. Only Odyssey² includes, *at no extra cost*, a full 49-character alphabet and number computer keyboard that gives you access to the mind behind the games.

And now there's The Quest For The Rings™ from Odyssey²? It's the first in our new Master Strategy Series™ of video games that combine computer technology, your TV set and an advanced game board to transport you to a startlingly realistic alternate world.

Odyssey² Video game fun. Computer keyboard challenge. All for the price of an ordinary video game. It's waiting for you now, at your Odyssey² dealer.

Odyssey² games include:

- The Quest For The Rings • Speedway*
- Spin-Out* • Crypto-Logic* • Las Vegas Blackjack • Armored Encounter • Sub-chase • Football • Bowling • Basketball
- Math-A-Magic • Echo • Computer Intro
- Matchmaker • Logix • Buzzword • Baseball • Computer Golf • Cosmic Conflict • Take The Money And Run • I've Got Your Number
- Invaders From Hyperspace • Thunderball • Showdown in 2001 A.D. • War Of Nerves • Alpine Skiing
- Helicopter Rescue • Out Of This World • Hockey
- Soccer • Dynasty • Volleyball • Electronic Table Soccer
- Pocket Billiards • Pachinko • Blockout • Breakdown
- Casino Slot Machine • UFO • Alien Invaders—Plus.

*Included with original Odyssey² purchase.



The excitement of a game.
The mind of a computer.

Simulated TV picture
© 1981 N.A.P. CONSUMER ELEC. RADIO'S CORP.



CIRCLE 28 ON FREE INFORMATION CARD

Everybody's making money selling microcomputers. Somebody's going to make money servicing them.

New NRI Home-Study Course Shows You How to Make Money Servicing, Repairing,
and Programming Personal and Small Business Computers





Training includes the new TRS-80 Model III microcomputer, 6-function LCD Beckman multimeter, and the NRI Discovery Lab with hundreds of tests and experiments.

Seems like every time you turn around, somebody comes along with a new computer for home or business use. And what's made it all possible is the amazing microprocessor, the tiny little chip that's a computer in itself.

Using this new technology, the industry is offering compact, affordable computers that handle things like payrolls, billing, inventory, and other jobs for businesses of every size... perform household functions including budgeting, environmental systems control, indexing recipes. And thousands of hobbyists are already owners, experimenting and developing their own programs.

Growing Demand for Computer Technicians

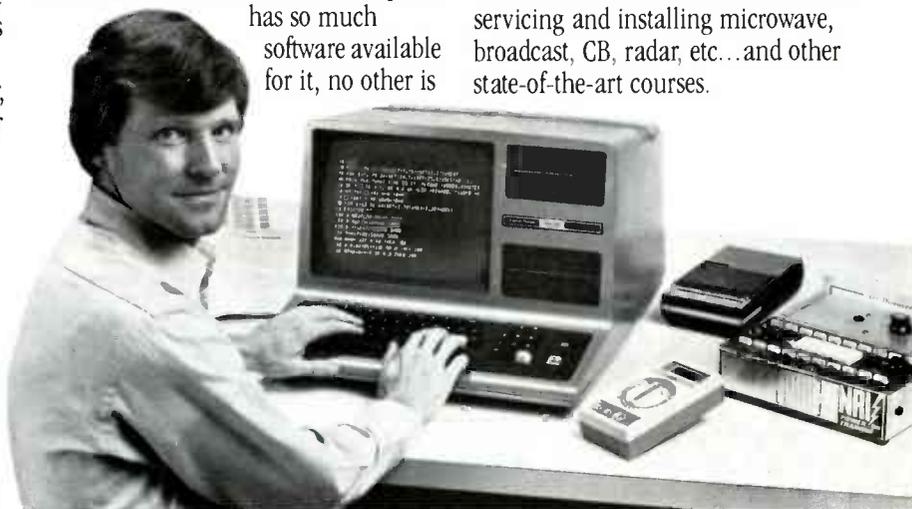
This is only one of the growth factors influencing the increasing opportunities for qualified computer technicians. The U.S. De-

partment of Labor projects over 100% increase in job openings for the decade through 1985. Most of them *new* jobs created by the expanding world of the computer.

Learn at Home in Your Spare Time

NRI can train you for this exciting, rewarding field. Train you at home to service not only microcomputers, but word processors and data terminals, too. Train you at your convenience, with clearly written "bite-size" lessons that you do evenings or weekends, without going to classes or quitting your present job.

Your training is built around the latest model of the world's most popular computer. It's the amazing TRS-80™ Model III, with capabilities and features to perform a host of personal and business functions. No other small computer has so much software available for it, no other is



used and relied on by so many people. And it's yours to keep for personal or business use.

You get plenty of practical experience. Using the NRI Discovery Lab® that also comes as part of your course, you build and study circuits ranging from the simplest to the most advanced. You analyze and troubleshoot using the professional Beckman LCD digital multimeter you keep to use later in your work. Then you use the lab and meter to actually access the interior of your computer... build special circuits and write programs to control them. You "see" your computer at work and demonstrate its power.

Become the Complete Computer Person

You're also trained in writing and debugging both BASIC and advanced machine language programs... gain hands-on experience in the operation and application of computers to business and personal jobs. You're trained to become the fully rounded, new breed of technician who can interface with the operational, programming, and service facets of today's computers. You're ready to take your place in the new electronic age.

Other Opportunities

NRI has been giving ambitious people new electronic skills since 1914. Today's offerings also include TV/Audio/Video Systems servicing with training on our exclusive computer-programmable 25" diagonal color TV... Communications Electronics for servicing and installing microwave, broadcast, CB, radar, etc... and other state-of-the-art courses.

Free Catalog... Mail Card No Salesman Will Call

Send the postage-paid card for our 100-page catalog showing all courses with equipment and complete lesson plans. There's no obligation other than to yourself. See how NRI can help you grow with the most exciting and important new field of the 80's. If card has been removed, please write to us.



NRI SCHOOLS
McGraw-Hill Continuing
Education Center
3939 Wisconsin Ave.
Washington, DC 20016

We'll give you tomorrow.

(TRS-80 is a trademark of the Radio Shack division of Tandy Corp.)

WHAT'S NEWS

continued from page 6

revolutionary new type of service information. Each piece of equipment described was disassembled, so that all data would be complete and accurate for the parts and circuits actually appearing in the equipment. (The "official service manuals" of the time—Gernsback's, Rider's, and Beitman's—merely reprinted the manufacturer's schematic, often with extracts from manufacturers service information.



PHOTOFACT FOLDER NO. 2000 has a gold cover, to mark an era in service information publishing.

The Sams approach resulted in the *Photofact* Standard Notation schematic; complete alignment and adjustment instructions; chassis and waveform photographs; comprehensive parts lists with replacement parts, and test measurements. The sequence and format of the information has been presented in the same consistent, standardized and clear manner from Folder No. 1.

Number 2,000 was reached with a folder containing information on the Hitachi *NPX-L* and the Sears 564-44150050/4200050 color-TV receivers, and on the Realistic 12-1524 *Chromatic 219* radio. The cover for this special set is printed in gold to mark the occasion.

Initially, *Photofact* folders provided service information for radios; their coverage was later expanded to include television receivers, as well as a variety of other consumer electronics equipment. Recently, coverage has been expanded to include video-cassette recorders, and

videodisc players will soon be covered. Currently, seven *Photofact* sets are published every month. Some technicians have been members of the *Photofact*-of-the-Month Club from the beginning and have received all 2000 sets. Beginning with No. 2000 the publisher states that *Photofacts* has been updated and streamlined graphically.

RCA, Columbia, uniting to market home video abroad

RCA Corporation and Columbia Pictures Industries, Inc., have formed a joint venture to market home-video entertainment programs throughout the world, excepting the United States and Canada. The participants will develop an organization with offices in all principal countries, to market existing and future theatrical and television programs produced by the two companies and other producers,

as well as original productions created specifically for the home-video market.

Japan has a new weather satellite

Japan's second weather satellite, launched last August, is called *GMS-2* (the second Geostationary Meteorological Satellite). Its position in space is just south of Japan, at 140° East longitude, where it will replace *GMS*, launched in 1977. Its area of operation extends over China and Korea in the north, Australia and New Zealand in the south, Burma and Tibet on the east, and Hawaii on the west.

The most important instrument aboard *GMS-2* is a visible/infrared spin-scan radiometer. It detects visible and invisible radiation from the earth and transmits it to ground for analysis by weather forecasters. The information helps them to deter-

mine the intensity and direction of storms.

GMS-2 also provides information on tidal, tsunami ("tidal wave"), and ice conditions, by gathering data from sensors on buoys and at fixed land locations, and relaying the data to ground.

Another instrument, a Space Environment Monitor (*SEM*), takes measurements of energetic protons in space, for use in scientific studies. The satellite also supplies the usual TV-like images of cloud patterns.

GMS-2 was developed and built by Hughes Aircraft Company for Nippon Electric. It is the first U.S.-produced geosynchronous satellite to be launched by a foreign country. The *SEM* system was built by Nippon Electric, which also assembled a number of the satellite's electronic units. Sharp Corp. of Japan provided solar cells for the spacecraft.

The *N-II* rocket, developed in Japan, can carry a 350-kg (772-lb) geostationary satellite. It stands 35 meters (115 feet) high and develops 170,000 pounds of thrust with its main engine and nine strap-on boosters.

Electronic mail system to begin in 25 cities

The United States Postal Service has placed a \$31-million contract with RCA to provide an Electronic-Computer Originated Mail (*E-COM*) system, to begin operation in 25 U.S. cities early in 1982. The new system will offer mailers high-speed delivery of notices, statements, and other computer-originated letters.

The system will accept information from a customer's computer-generated magnetic tape or from a computer via private telecommunications carriers. This will be printed at the electronic mail center designated by the customer, then entered into the First Class mailstream.

Pages will be trimmed to 8½ × 11 inches, folded and placed in envelopes, all automatically. The address printed on the letter will be displayed through a window in the envelope, and delivery made by the U.S. Postal Service. **R-E**



THE JAPANESE GMS-2 UNDERGOES TESTS at Hughes Aircraft in El Segundo, CA. It will collect weather pictures from an area of some 65 million square miles in the Western Pacific.

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7-Band, 50 Channel • Alpha-Numeric • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC Bands. 30-50, 118-136 AM, 144-174, 421-512 MHz. The new Bearcat 350 introduces an incredible breakthrough in synthesized scanning: Alpha-Numeric Display. Push a button—and the Vacuum Fluorescent Display switches from "numeric" to word descriptions of what's being monitored. 50 channels in 5 banks. Plus, Auto & Manual Search, Search Direction, Limit & Count, Direct Channel Access, Selective Scan Delay, Dual Scan Speeds, Automatic Lockout, Automatic Squelch, Non-Volatile Memory. Reserve your Bearcat 350 today!

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List price \$549.95/CE price \$349.00

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NEW! Bearcat® 350

Bearcat® 250

List price \$429.95/CE price \$279.00

6-Band, 50 Channel • Crystalless • Searches Stores • Recalls • Digital clock • AC/DC Priority Channel • Delay • Count Feature Frequency range 32-50, 146-174, 420-512 MHz. The Bearcat 250 performs any scanning function you could possibly want. With push button ease you can program up to 50 channels for automatic monitoring. Push another button and search for new frequencies. There are no crystals to limit what you want to hear. A special search feature of the Bearcat 250 actually stores 64 frequencies and recalls them, one at a time, at your convenience.

NEW! Bearcat® 20/20

Allow 30-60 days for delivery after receipt of order due to the high demand for this product.

List price \$449.95/CE price \$289.00

7-Band, 40 Channel • Crystalless • Searches AM Aircraft and Public Service bands • AC/DC Priority Channel • Direct Channel Access • Delay Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz. The Bearcat 20/20 automatic scanning radio replaces the Bearcat 220 and monitors 40 frequencies from 7 bands, including aircraft. A two-position switch, located on the front panel, allows monitoring of 20 channels at a time.

Bearcat® 210XL

List price \$349.95/CE price \$229.00

6-Band, 18 Channel • Crystalless • AC/DC Frequency range: 32-50, 144-174, 421-512 MHz. The Bearcat 210XL scanning radio is the second generation scanner that replaces the popular Bearcat 210 and 211. It has almost twice the scanning capacity of the Bearcat 210 with 18 channels plus dual scanning speeds and a bright green fluorescent display. Automatic search finds new frequencies. Features scan delay, single antenna, patented track tuning and more!

Bearcat® 160

List price \$299.95/CE price \$189.00

5-Band, 16 Channel • AC only • Priority Dual Scan Speeds • Direct Channel Access Frequency range: 32-50, 144-174, 440-512 MHz. Would you believe...the Bearcat 160 is the least expensive Bearcat crystalless scanner.

This scanner presents a new dimension in scanning form and function. Look at the smooth keyboard. No buttons to punch. No knobs to turn. Instead, finger-tip pads provide control of all scanning operations, including On/Off, Volume and Squelch. Of course the Bearcat 160 incorporates other advanced Bearcat features such as Priority, Direct Channel Access, Dual Scan Speeds, Lockout, Scan Delay and more.

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Allow 60-180 days for delivery after receipt of order due to the high demand for this product.

List price \$449.95/CE price \$299.00

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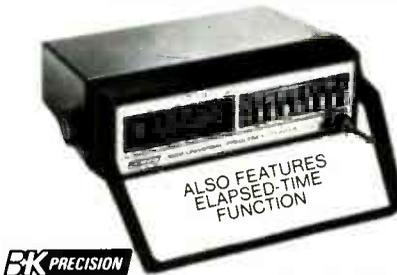
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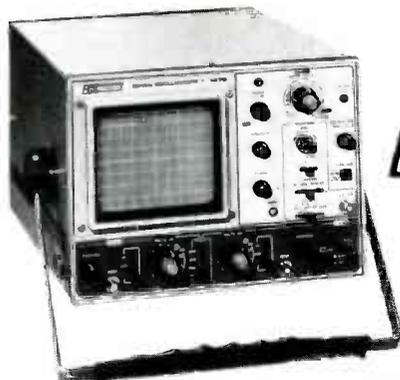


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EDITORIAL

Just Another Technological Advance?

Electronics technology plays a vital role in almost every industry. Every day, in medicine and energy conservation, to name just two, electronics is making an important and continuing contribution.

One industry greatly changed and influenced by electronics is photography. The portable all-in-one video camera/VCR combination is encroaching upon and often replacing home-movie camera/projector/screen combinations. Photographic still-picture cameras have also felt the impact of electronics. Integrated circuits have made possible such features as automatic exposure, LED metering, and even auto-focusing.

Now Sony has announced the all-electronic still camera. Called the MAVICA (MAGnetic Video CAmera), it looks very much like a conventional 35-mm SLR. It weighs 1³/₄ lbs. and measures 5¹/₈ × 3¹/₂ × 2¹/₁₆ inches. It is a single-lens reflex camera with interchangeable lenses. Shutter speeds range from 1/60 to 1/1000 on manual and 1/60 to 1/2000 on automatic.

Here the similarity ends. The MAVICA does not use photographic film. Instead, it uses a CCD image sensor with about 280,000 picture elements (570 horizontal and 490 vertical). The images are recorded on a magnetic disk that rotates inside a flat cassette (very much like a floppy disk). The magnetic cassette sits inside the camera and records up to 50 color pictures. Pictures can be selectively erased and re-recorded.

To see the pictures you've taken, the cassette is removed from the camera and placed into a viewer that is connected to a TV set. A transmitter/receiver combination will be available that attaches to the viewer. With this, pictures can be transmitted over telephone lines. In addition, the camera provides output signals for direct connection to a VCR. Now when the camera is switched to a continuous mode, it becomes a video camera.

Specifications include a 1-MHz bandwidth, an image S/N ratio of 45 dB and a horizontal resolution equivalent to 350 TV lines. The price of the camera will be around \$650 and the viewer about \$230. Each magnetic cassette is expected to sell for \$2.65.

Commercial introduction is scheduled for the fall of 1983. Although I haven't seen any pictures from this camera, Sony claims that they are somewhat disappointed in the picture quality and resolution. However, they are working feverishly to improve the quality before introduction. Sony is also working on a hard-copy color printer for the system.

Although this latest development won't have a profound effect on our day-to-day lives, it is one more reason why I feel proud to be a member of the electronics industry. It also prompts me to ask why this, like so many other recent advances, comes from abroad instead of from our own research and development labs?



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Managing Editor

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Cover photo by Robert Lewis

Radio-Electronics is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature*.

Gernsback Publications, Inc.
200 Park Ave. S., New York, NY 10003
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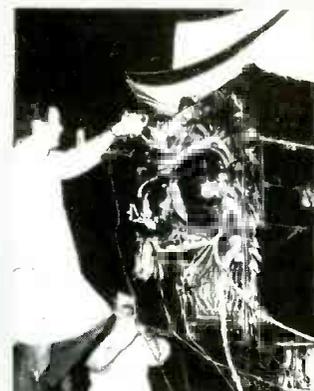
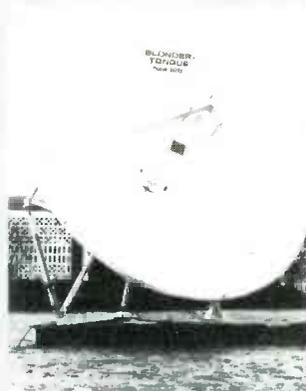
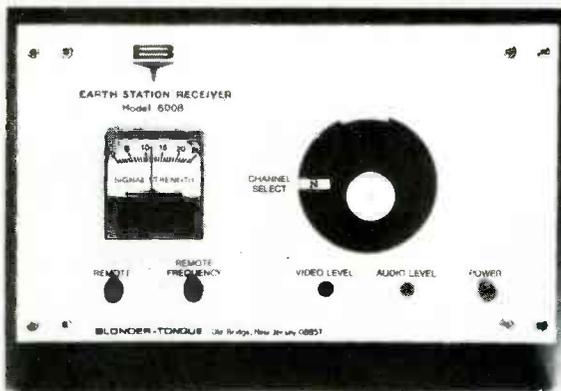
Apt. _____ City _____

State _____ Zip _____

- Check if interested in G.I. information.
 Check if interested ONLY in classroom training in Los Angeles.

SATELLITE/TELETEXT NEWS

GARY ARLEN
CONTRIBUTING EDITOR



NEW TVRO EQUIPMENT

Blonder-Tongue Laboratories has introduced its first TVRO earth-station devices, intended especially for the master-antenna TV market (see left-hand and center photos above); it includes three antenna systems (3, 3.65, and 4.6 meters), three low-noise converters, and receiving equipment. B-T's new LNC's (Low-Noise Converters) allow satellite signals to be carried from the antenna to the receiver over UHF-type coaxial cable. The LNC is a combination low-noise amplifier and block downconverter and is mounted directly on the antenna. Satellite signals from the LNC are low-noise amplified, and the entire 500-MHz band is block-converted down from 3.7- to 4.2-GHz, to frequencies in the 270- to 770-MHz range for input to the receiver. (Blonder-Tongue Labs. One Jake Brown Road, Old Bridge, NJ 08857.)

Downlink Inc. has developed a \$2650 *EP-2000 Electronics Package* that includes everything for a TVRO except the antenna. The equipment group includes remote-control console, 120° LNA, RF modulator, and cabling. In addition, Downlink is selling a *Skyview I* system for \$3595, a package of devices which includes a 12-foot parabolic antenna. The firm also has a new *Skyview III* modular fiberglass parabolic antenna. (Downlink Inc., 30 Park St., Putnam, CT 06260.)

SATCOM III-R READY FOR LAUNCH

RCA Americom is completing plans for the launch of Satcom III-R (see right-hand photo above), the 24-transponder bird that will become the primary satellite for cable-TV programming. Satcom III-R will be placed in geosynchronous orbit at 132° West longitude, and will, in general, have transponder assignments identical to the current assignments on Satcom I, which is currently RCA's CableNet One satellite. The 2385-pound satellite, which replaces the bird that was lost in space shortly after launch in December 1979, was scheduled for launch in October aboard a Delta 3910/PAM-D rocket. Satcom III-R's footprint will cover all 50 states.

COMING UP

USA Network and Home Box Office, both carried aboard Satcom I, are joining the trend toward 24-hour-per-day programming. USA Network was scheduled to begin full-time transmission in October, and add three new series, "Better Homes and Gardens Idea Notebook," "Scholastic Sports Academy" and "The Wall Street Journal Evening News." HBO will expand to 24-hour daily service on January 1, after Satcom III-R is in place. At that time, HBO will shift its western time-zone feed to transponder 13 on the new satellite.

Satellite Syndicated Systems, which now transmits Satellite Program Network on Westar III transponder 9 and retransmits Superstation WTBS on Satcom I, has taken lifetime leases on three transponders on Southern Pacific Communications' hybrid Spacenet I satellite, due to be launched in 1984. SSS's lease on Spacenet calls for three fully protected 36-MHz transponders for the life of the satellite. The programming will probably be some form of special interest shows.

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LETTERS

TELEVISION MODULATION

In reference to two letters you published on television modulation (Mr. Davis, January 1981; Mr. Rogers, May 1981): Neither letter is correct, although I would give Mr. Rogers credit for coming close.

Mr. Rogers stated that tip of peak sync is 100% modulation. That is incorrect. Tip of sync is 100% of peak carrier level, which is also 0% modulation. Thus, 100% of peak carrier level corresponds to 0% modulation and -40 IRE units; 75% of peak carrier level (blanking level) corresponds to 25% modulation and 0 IRE units; 12.5% of peak carrier level (reference white) corresponds to 87.5% modulation and +100 IRE units, and 0% of peak carrier level (carrier cutoff) corresponds to 100% modulation and +120 IRE units. Increasing depth of modulation of the luminance signal beyond 87.5% (i.e., below 12.5% of the peak carrier level) is prohibited by FCC regulations. That's Title 47 CFR, Section 73.682 (a) (13), in

case you're interested.

Mr. Rogers properly points out the confusion between the IRE scale (which runs from 0 to -40 IRE units and 0 to +120 IRE units, with 0 being clamped at the blanking level), and the percent scale. However, one must also differentiate between percent of peak carrier level and percent modulation; they are complements of each other.

Mr. Roger's comments on television output power are well taken. For an all-black picture, the ratio of peak power to average power for an NTSC system M television signal is 1.68 to 1; but for an all-white picture the ratio is different; it changes to 5.99 to 1.

DANE E. ERICKSEN,
FCC Field Operations Bureau,
San Francisco, CA

"ILLEGAL" DEVICES

In response to D.T. Horn's letter in the June *Radio-Electronics*, wherein he deplored the manufacture and possession

of devices like radar detectors and pay-TV decoders, I wonder if he would also include VCR's that can play back a tape without generating royalties. And what about "commercial-killer" devices? Once you start on that kind of list, it's hard to stop.

Yes—probably some rules do need changing. But where some rule-changes, like baseball's "designated hitter" rule, are intended to enhance the game, others are just "oh-poor-me" reactions, like casinos excluding card-counters (dear me, they're likely to win!) or restrictions on imported cars.

Not that we should all be lawyers, but perhaps *Radio-Electronics* can keep us posted on these interminable issues.
ALEX ESTEVE

THE "FREEDOM PHONE"

I just finished the July 1981 issue of *Radio-Electronics* and was, of course, pleased to see the cordless-phone cover feature with the inclusion of material

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CIRCLE 13 ON FREE INFORMATION CARD

about Electra's "Freedom Phone."

However, there's a technical error in the story that needs correction. It is absolutely not true that "Freedom Phone" cordless phones use "one channel in the 49-MHz band...". That implies, of course, that Electra's phones are of the low-cost simplex variety. Not true! Electra uses 1.7 MHz and 49 MHz for its "Freedom Phone" phones, just like all other full-duplex systems on the market.

The big news we've been trying to tell is the development of a brand new cordless phone with full-duplex operation within the 49-MHz band using two frequencies. The significance of that breakthrough is that it eliminates the limitations of 1.7 MHz in terms of range and noise. That technological feat was totally lost in the story, I'm afraid.

ROBERT A. HANSON, Vice President,
McKinney/Mid America

SUBSCRIPTION TV

I admire your editorial on "subscription" TV (*Radio-Electronics*, December 1980) and public ownership of the airways. However, I believe that one further logical step remains to be stated in your development of that issue. If, indeed, the airways belong to the public (which I most certainly believe), then those using the airways do so with the "consent" of the public. Therefore, is it not those (subscription-TV broadcasters) who charge for the use of the public airways that are guilty of theft of service? Are not those broadcasters the real "pirates" rather than the decoder

builders and the microwave receiver builders? Maybe "we, the people" should prosecute them (subscription-TV broadcasters) instead of they us.

MELVIN L. WILLIS, Jr.
Mesquite, TX

OOOOOOOPS!

In reference to the article entitled "The Incredible Shrinking IC" in the August 1981 issue, I believe that the caption for Fig. 2 is incorrect. The circuit is indeed TTL logic, but it is an open-collector three-input NAND gate. The schematic (Fig. 1) for

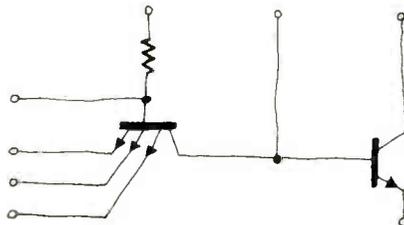


FIG. 1

that circuit is shown here. Note that the base of each transistor is brought out for external connection to bonding pads. That was common in early circuits, especially experimental ones, as transistor parameters varied widely and were often measured to provide better quality control in manufacturing.

BARRY L. ORNITZ
Kingsport, TN

CABLE TV

Although I see the advantage of a cable-ready TV with its built-in converter and decoder (editorial, *Radio-Electronics*, June 1981), I do not share your hope that the cable companies will necessarily reduce their subscription fees, just because they no longer have to supply such equipment themselves. Do telephone rates go down because one is able to buy a telephone set from other manufacturers than Ma Bell?

As for the consumer having a "choice," the problem is not whether the converter comes with the TV set or from the cable company—or whether the cable company attaches some gizmo to the subscriber's set. The problem arises from the manner in which free competition for the viewer's dollar is hindered by local governments which give monopoly rights to cable companies in their jurisdictions. Such cable companies should no more have monopolies on rights to sell electric signals than *McDonalds* have to sell hamburgers.

In my view, the only consumers who now have a real choice are those who construct their own decoders and intercept signals from pay-TV, because they recognize that the idea of a private company charging a fee for picking up electromagnetic waves from the air, which is public property, is not too different from the idea of allowing some private profit-making firm to set up toll booths along interstate highways.

BUD DAMNJANOVITCH,
Utica, MI

R-E

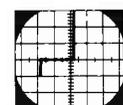
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component tester
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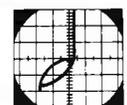


Why buy just an oscilloscope? For just \$405, you can buy the Hameg 307, a high quality 10 MHz oscilloscope, with the added bonus of being able to test electrical components. With the press of just one button, you can test transistors, diodes, zeners, capacitors (in circuit or not!!) and more. The HM 307's light weight (8 lbs.) and sturdy construction make it equally at home in field or on the test bench, ideally suited for T.V. repair work. Bandwidth DC → 10 MHz (-3dB) ● Y amp range 5mV/cm to 20V/cm ● Max. input voltage 500V (DC + peak AC) ● Timebase .5 μs/cm to .2s/cm ● Trigger sens. 3mm (2Hz to 30MHz) ● Built-in square wave generator 1kHz for probe alignment (.2V ± 1%). The HM 307...more than just an oscilloscope.

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Capacitor 33 uF



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EQUIPMENT REPORTS

Creative Electronics ESR Meter



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Creative Electronics ESR Meter	
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EASE OF USE	10
INSTRUCTION MANUAL	10
PRICE/VALUE	10
	1 2 3 4 5 6 7 8 9 10
	Poor Fair Good Excellent

WHETHER IT IS A CAPACITOR, INDUCTOR, or something else, every electronic component causes a voltage drop across it when it is used in a circuit. That means that every component has a measurable resistance associated with it (in addition to its capacitance, inductance, etc.). The *ESR Meter* from Creative Electronics uses that resistance, called ESR (*Equivalent Series Resistance*), as the means of testing electrolytic capacitors.

This is *not* just another capacitor tester: It is one of the few really new pieces of test equipment to be introduced in many years. Perhaps the best way to explain the advantages of using a component's ESR for troubleshooting is to quote a few lines from the unit's instruction manual:

"...We have yet to find an electrolytic capacitor with normal ESR whose circuit failure was due to capacitance change alone... The real problem with electrolytics isn't capacitance change, it's ESR change!"

The *ESR Meter* will uncover circuit defects resulting from defective electrolytic capacitors that might otherwise go undetected, and can be used without

removing the component under test from the circuit (although you should be sure to switch the power off to eliminate any possible shock hazard).

I had a TV set on the bench at the same time that I was evaluating the *ESR Meter* for this report. The symptoms indicated a bad electrolytic. A quick check with the meter showed that one section of a four-section filter capacitor was bad. (How would you like to try finding that by trial and error!) Bridging an electrolytic into the circuit eliminated the problem, confirming what the meter had indicated. What could be easier? The meter had successfully discovered the problem in a minimal period of time, and I didn't even have to turn the set on!

The meter can also be used to check a capacitor for loose leads. Simply connect the suspect component to the meter and flex the capacitor's leads. A loose connection will be revealed by a change in the capacitor's ESR reading. The meter will also detect and reveal a "dry" electrolytic.

The *ESR Meter* has a range of 1 to 10,000 μF . Its circuit uses two IC's and two transistors, and is constructed on a single epoxy-glass PC board mounted in a case measuring $6\frac{1}{4} \times 3\frac{3}{4} \times 2\frac{1}{2}$ inches; a schematic diagram is included with the instructions. The layout is not crowded, and that should make servicing a snap—if it's ever required. The unit requires two "C" cells for operation and the expected battery life is about 200 hours.

The device is covered by a 60-day guarantee. It is quite easy to use, but, as with any other new piece of equipment, be sure to read the instructions carefully first so that you get the most out of it.

If you're in the market for a capacitor tester, be sure to keep this one in mind. While the way it tests capacitors may be unconventional, it works, and works well. Once you discover this little device, it is sure to become one of the most useful instruments on your workshop or service bench.

The *ESR Meter* sells for \$99.00 and is available only from the manufacturer: Creative Electronics, 1417 N. Selfridge, Clawson, MI 48017. R-E

Realistic Model TV-20 High-Fidelity TV Tuner



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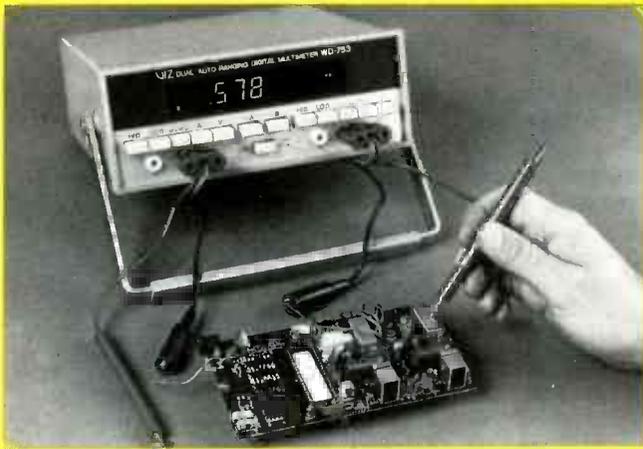
Realistic		TV-20											
OVERALL PRICE													
EASE OF USE													
INSTRUCTION MANUAL													
PRICE/VALUE													
		1	2	3	4	5	6	7	8	9	10		
		Poor	Fair	Good	Excellent								

TELEVISION VIEWERS HAVE LONG HAD to endure the poor sound-quality that is typical of most home receivers. While most TV sound is now transmitted with the same frequency response as FM radio, reproducing that sound faithfully has not been a prime concern of most manufacturers. A new product from Radio Shack (1400 One Tandy Center, Fort Worth, TX 76102) now offers you an alternative. Intended as an addition to your home component-sound-system, the Realistic *model TV-20* is a complete 12-channel high-fidelity monophonic tuner.

Its circuit consists of a bipolar VHF-TV turret tuner with an active mixer (most TV tuners use a simple diode mixer) followed by a 41.25-MHz IF stage. Two ceramic filters shape the IF passband, and an LA1150 FM limiter/discriminator IC detects the audio for a single-stage preamplifier.

The tuning knob is located on the front panel. A fine-tuning ring lets you center the sound carrier for a TV channel much as you would adjust for the sharpest picture on a standard TV. The 41.25-MHz IF provides a 500-kHz AFC holding-range and a signal-to-noise

continued on page 28



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EQUIPMENT REPORTS

continued from page 26

ratio of 60 dB (using a 1-millivolt input on channel 8). Primary image rejection on channel 8 is 58 dB; IF rejection is 45 dB. The IF limiter's AM suppression is rated at 46 dB.

Distortion from the unit is claimed to be less than 0.5% within 3 dB. IHF (Institute of High Fidelity) sensitivity is rated at 7 microvolts, with a 3-dB limiting sensitivity of 3 microvolts. Maximum signal-handling capacity is given as 200 millivolts. A front-panel OUTPUT

LEVEL control varies the audio-output level from zero to 1.5 volts for a 1-millivolt input.

Rear-panel terminals include two F-type TV connectors for coaxial cable; screw terminals are also available for twin-lead. Don't be misled by the separate left-channel and right-channel output jacks—this is not a stereo unit. The jacks are connected in parallel and merely assure that the input signal to your amplifier is balanced.

Housed in a wood-grain-finish plastic cabinet with an anodized-aluminum front panel, the unit measures 6½ × 27¼ × 5½ inches and weighs 2½ pounds. It requires 117-volts AC for operation.

If you are interested in high-quality television audio, the Realistic *model TV-20* merits your consideration. It sells for \$79.95, and is available at Radio Shack. **R-E**

ADVANCE IS PROUD TO INTRODUCE the KEITHLEY Line of High Quality Digital Multimeters Featuring The New 130 Hand-Held DMM



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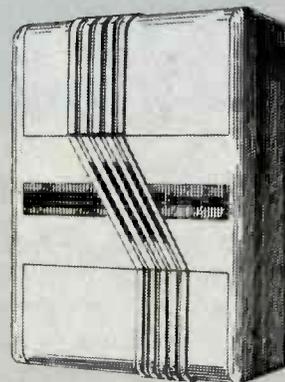
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MODEL	ACCURACY					SENSITIVITY				
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130	0.5%	1%	1%	2%	0.5%	100μV	1μA	100μV	1μA	100mΩ
131	0.25%	0.75%	1%	2%	0.2%	100μV	1μA	100μV	1μA	100mΩ
135	0.05%	0.5%	1%	1.5%	0.2%	100μV	10μA	100μV	1μA	100mΩ

Case \$10.00 Shipping \$3.00

Chromatics Chroma Chime Electronic Door Chime



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Chromatics	Chroma Chime											
OVERALL PRICE												
EASE OF USE												
INSTRUCTION MANUAL												
PRICE/VALUE												
	1	2	3	4	5	6	7	8	9	10		
	Poor			Fair			Good			Excellent		

THE *CHROMA CHIME* ELECTRONIC DOOR chime does a lot more than its name implies, as I recently discovered when my old doorbell gave up the ghost and had to be replaced.

It doesn't just go "ding-dong," like my old one (that one actually only went "clunk", which is one reason I replaced it), but can play several bars of any of 24 different melodies—from the standard Westminster chimes to "God Save the Queen" ("My Country 'tis of Three") or Rossini's "William Tell Overture"—with 21 more still to choose from.

The *Chroma Chime* also features two inputs; it will play one tune if there's someone ringing at the front door, and a different one if there's someone at the back.

It can be operated from two nine-volt batteries ("standby" current drain is less than 0.5 μA) or, if a 12-to-16-volt bell transformer is already available—as would probably be the case if an old unit were being replaced—that power source can be used. If the *Chroma Chime's* built-in speaker isn't adequate for you (and I can hear it throughout

continued on page 32

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It includes a 3-meter Satellite Antenna with a single-axis adjustable mount that lets you direct your antenna to receive signals from the entire satellite arc. It's a heavy-duty, commercial-quality antenna, made by Scientific-Atlanta and designed for long, reliable performance.

Special Low-Noise Amplifier and Down-Converter converts signals to 500 MHz band for transmission on ordinary TV cable.

The Receiver features electronically-synthesized tuning for stable, drift-free reception, and 24 channel selections for a broad variety of programming. It even includes a special Zerith Space Command Remote Control so you can change programs without leaving your easy chair.

Special Earth Foundation Kit anchors your antenna firmly to withstand winds of up to 100 mph.

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You can trust Heath to do it right. The first step in establishing your station is the purchase of a special Site Survey Kit that includes everything you need to determine a clear line-of-sight to the satellites. So you know your location is correct before you buy the Station.

Easy-to-follow, step-by-step assembly

Like all Heathkit products, the Satellite Earth Station includes a clearly written manual that guides you every step of the way through assembly and installation. And over-the-phone assistance is always available.

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Heathkit

EQUIPMENT REPORTS

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my house), an external speaker is available as an option.

How it works

The heart of the *Chroma Chime* is a Texas Instruments TMS1000 microprocessor. That IC not only provides the logic needed to play the tune that is selected, but also carries all 24 tunes in its on-board ROM.

When a doorbell button is pressed, the microprocessor checks the melody-selector switches to see which tune is required. Having determined that, it then looks up the selected tune in its ROM and generates the appropriate audio output.

That signal is then amplified and processed to remove some of its square-wave characteristics and make it sound more like a chime or other musical instrument.

The user can select the tempo of the melody (how fast it will be played) and, by means of the DECAY control, how quickly the tones die away. The tempo circuitry also enriches the sound by generating a tremolo effect.

The audio output can be made to sound like anything from the output of

a signal generator to a sharply-plucked violin string. I've set mine to approximate the sound of a harpsichord.

The microprocessor automatically shuts off the device when the selection is ended, whether or not the doorbell button is still depressed. There is an exception to this, though. Several pieces ("The Star Spangled Banner," for example) have an "extended-play" option—if the button is still depressed, a few more bars will be played. Then the microprocessor shuts the unit off, extending battery life.

Design and assembly

Although the *Chroma Chime* is available as an assembled unit, I chose to build the kit version.

The assembly manual is better written than average, and is well illustrated. The PC board is screened with the outlines of the components, to make things still easier for the builder.

Although the IC used is manufactured by TI, the unit itself was designed, and the manual written, in England. Here are a few hints that may simplify matters for those unfamiliar with life abroad:

First, English technology sometimes differs from our own. For example: a "skeleton pot" is a trimmer pot. Those pots are referred to as "RV1," "RV2," etc. "RV" probably stands for "resis-

tor, variable."

Also, transistor pinout is frequently "CBE" or "ECB," while ours is usually "EBC." It's possible that any of several transistors may have been included in your kit (all the types are illustrated) and it's necessary to check the part numbers against the pinouts shown in the manual to make sure that you're installing the components correctly.

(My kits contained several transistors whose numbers were identical, *except* for the last letter. Naturally, I ignored that letter and installed everything backwards. Fortunately, no harm was done. The transistors were removed and reversed, and the unit functioned as promised.)

The switches used to select the tunes are a bit unusual. The switch contacts are part of the PC-board foil pattern, and are contacted by spring-loaded wipers. Although unorthodox, the system works well.

The case is white plastic with concealed, but easily accessible, adjustment and battery compartments, and will blend in with most decorating schemes. Installation instructions are detailed and easy to follow.

The *Chroma Chime* is a clever application of LSI technology and, whether you buy it "ready to go," or as a kit, is

continued on page 36

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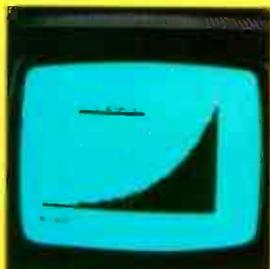
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EQUIPMENT REPORTS

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a worthwhile investment for the homeowner.

The *Chroma Chime* kit sells for \$39.95, postpaid, from Chromatics, River Way, Harlow, Essex, England. An assembled version can be ordered for \$49.95 from Timely Products Corp., 222 W. Adams St., Chicago, IL 60606. **R-E**

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A TOOL-HAPPY TECHNICIAN LIKE MYSELF always enjoys finding something that really does the job. The *model 4000 Hot Vac* desoldering system from Ungar (Division of Eldon Industries, Inc., PO Box 6005, Compton, CA 90220) is just such a device. In operation, the solder is first melted, and then sucked into a reservoir by a built-in vacuum pump. The whole operation is very fast, and speeds up bench work considerably.

The system consists of two units: a small cabinet that houses the vacuum pump and motor, and the desoldering gun. The gun is connected to the cabinet by the vacuum line and the control wiring. The gun's heating element is set to the desired temperature by a control knob on the front of the cabinet.

The gun's screw-on tip is hollow. To desolder, simply place the tip of the gun over the solder you wish to remove, and when the solder has melted, push the button on the left side of the handle. That button starts the vacuum pump, and the solder is removed very quickly.

In a second or two, you're left with a clean lead and pad.

The melted solder goes through the tip of the iron into a reservoir at the top of the gun. The reservoir has a clear "window" on each side of the gun so that you can tell when it needs emptying. The maintenance required for the unit is minimal. A cotton ball is used to catch most of the solder in the reservoir. When it becomes clogged, all you do is unscrew a cap on the rear of the gun and remove and replace the ball—the unit comes with an ample supply of them. The gun tip should be cleaned after every 50-60 desoldering operations (that should cover a couple of days' average work) using a rod (more on that later) supplied with the unit. Cleaning, which serves to remove any solder not caught by the cotton ball, should be done with the tip hot. A secondary filter, near the cabinet in the vacuum line, should be cleaned with alcohol once a week.

Five different-sized tips are included with the unit. The tips can be changed even when hot—but I recommend using a pair of pliers, not your fingers! Everything you need to use the desoldering system comes with it: extra cotton balls, a spare fuse (3 amps), a cleaning sponge, and a kit of the cleaning rods. The cleaning rods (one for each tip size) and a small file are stored in a metal case that is attached to the cabinet by a chain, so that the rods are always there when you need them.

Using the *Hot Vac* is simple. The same knob is used to turn it on and to set the operating temperature. A red pilot light on the cabinet's front is lit when the unit is on. When you first turn the unit on, set the operating temperature to maximum and let the iron heat up for about 10 minutes; then select the temperature range you require. When the gun is not in use, it is slipped in the ceramic-lined holder on the side of the cabinet.

The only thing that is the least bit tricky about using the desoldering system is that you have to be careful not to hold the vacuum control-button down too long. If you do that, the air stream cools off the tip, and you have to wait until it heats up again before going on. One quick push is all you need; try it for yourself and you'll see.

Of course, the only way to see if something really works is to try it out. I set up the *Hot Vac* on a bench and located a discarded PC board from a junked TV-set. I was able to remove about 80 components in 45 minutes. They included everything from transistors and capacitors up to a couple of controls and a heavy-lugged transformer. I did have some trouble with the transformer: its lugs were 1/4-inch

continued on page 95

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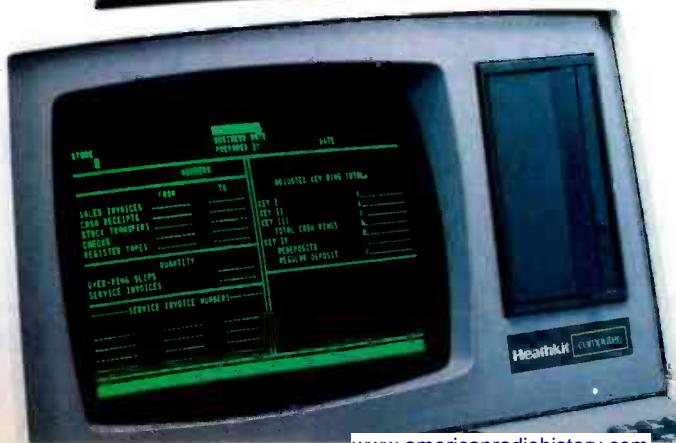
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- I can't afford any more education.
- I have a family now.
- I'm here. You're there. I've never learned that way before. I'm not sure it will work for me.

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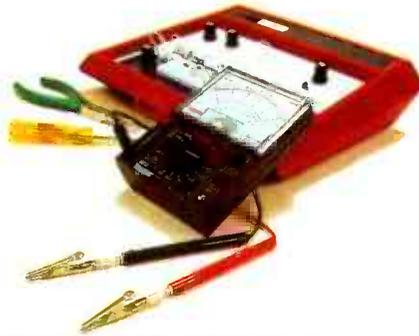
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- Analog output cord can be attached to recorder for continuous AC monitoring
- Data Hold switch to freeze reading in dimly lit areas.
- Warranted for six (6) months

RANGES

SPM-2011	
ACV 0-600 Vrms	2-Autoranges
ACA 0-20 Arms	2-Autoranges
AC Power 0-20kW	2-Autoranges
SPM-2012	
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ACA 0-200 Arms	2-Autoranges
AC Power 0-200kW	2-Autoranges

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NEW TECHNOLOGY

VIDEOTEX

INFORMATION EXPLOSION FOR TV

RICHARD LARRATT



You'll soon be able to receive a lot more on your TV set than news, movies, and soap operas. Videotex will bring you information that you want and need, and make a considerable impact on your life-style.

IN CASE YOU HADN'T HEARD, WE'VE BEEN CAUGHT UP IN AN INFORMATION revolution. We've already become accustomed to receiving news from around the world—and even from beyond it—instantaneously on our television sets via satellite. Fifteen years ago that was almost a miracle.

In many parts of the country we are becoming a wired society—with news, movies, sporting events, etc. available to us on any number of television channels, 24 hours a day. Only a few could conceive of such a thing just ten years ago!

Those of us with home computers can now avail ourselves of all sorts of information utilities—news, data bases, whole libraries of information. Farmers can get the latest on soybean futures; investors, the current state of the stock market. *Five* years ago, that was just the beginning of a dream.

Today, as you read this, there is more information, on more subjects, available more rapidly and readily through electronic communications to anyone with considerably less than a thousand dollars to spend on personal computing equipment than was available to the President of the United States not too long ago.

In the next few years all that information—and more—will be accessible, in one form or another, to anyone who cares to do more with his TV set than just watch movies. The name of the game is: videotex.

"Videotex" is a term applied to any system that uses several of the "unused" lines of a video field (actually the vertical blanking-interval—the dark

band you see when your TV picture starts to roll) to send information that can be decoded to appear as text or illustrations on a TV screen. If you were to watch it, a line used for videotex would appear to sparkle as the data was transmitted on it.

Perhaps the closest thing to videotex with which we are familiar is the closed-captioning service for the deaf currently provided by the ABC, NBC, and PBS television networks. Closed captioning provides deaf viewers with subtitles for selected programs. The information is transmitted





FIG. 1—BY REQUESTING THE APPROPRIATE page number, you can receive detailed weather and travel information—including weather maps.

on one of the unused lines in the TV picture and, through a decoding device, is superimposed over the image being viewed.

Videotex uses several lines from the vertical blanking-interval to carry both video and textual information in digitized form for decoding and use by viewers equipped with devices designed to extract that information and display it on the screen. How it is done will be described in detail in the second part of this article.

What makes videotex different from closed captioning is the fact that the data is transmitted at a much more rapid rate—typically 5.727272 MHz—and is not tied into the “real-time” image normally seen. Not just one or two lines of text are available, but whole *pages*—up to several hundred of them—can be selected by a viewer with a videotex decoder. And that includes not only text, but pictures, as well; detailed weather information (Fig. 1) is as easy to receive as the words “RAIN TOMORROW.”

Through videotex, the viewer can have over-the-air access to local or international news; information of special interest to him, such as weather or financial reports; or even local shopping information. The Sears catalog, currently being distributed in test areas on videodisc, could be available nationwide by means of videotex.

And that last item leads us into the other application of videotex, for, if the system is interactive, the user can not only look at the items in the catalog, but also *purchase* them.

As we described videotex originally, any one of a number of “pages” could be selected for viewing, for the information of the user. While, in many instances, that type of service would be all that was required, it would frequently be convenient for the user to be able to respond to the information he received.

For example, let’s say that you wanted to know who had flights from your airport to New York (or from New York to somewhere else) on a

given date, and what the rates were. With videotex that would be easy.

Suppose that you found a flight that was convenient for you and wanted to make a reservation. With *interactive* videotex, you could request a reservation on that flight, pay for it with a credit card, and receive a confirmation...all in a minute or so!

Similarly, you could look through a catalog, or the video flyer from a local market, and make your purchases—for delivery, or to be picked up later when it was more convenient for you.

Interactive videotex

Obviously, you can’t talk back to your TV set—otherwise you’d have done it long ago! Even with a simple videotex decoder, the best you can do is select the page(s) of information you want. What’s needed is something more.

Fortunately, digital-computer communications created the need for a device known as the *modem* (for *MOD*ulator/*DEM*odulator). That device allows



FIG. 3—ANTIOPE, THE FRENCH videotex system, uses a parallel-attribute system that permits higher-quality graphics.



FIG. 2—THE BLACK LINES between different-colored areas are characteristic of the serial-attribute system used by Prestel.



FIG. 4—TELIDON ALLOWS shapes and special character-sets to be defined and then recalled by a single command.

you to transmit digital information over telephone lines as audio tones. So, by adding a keyboard and modem to your videotex setup, you can talk back to a computer connected to a videotex system.

For example, if you find a flight to New York that meets your requirements, you can dial a telephone number connecting you with your nearest videotex center and request a reservation on that flight...and receive immediate confirmation. And, if that flight is booked-up, you can make the next-best choice. All on the spot.

Perhaps that sounds a bit familiar to you—like the two-way *Qube* system currently in use over cable-TV in the Columbus, OH area. *Qube* does allow viewer response, but only to a limited degree—both as regards the degree of response and the subjects to which you can respond. Also, it is available *only* over cable. *Qube* is pre-programmed to look for simple “yes” or “no,” or numerical, responses. Videotex can offer a lot more.

Equipment needed

To receive non-interactive videotex the only thing that needs to be added to your existing TV receiver is a *decoder*. The decoder can be considered to have five main sections: a data-acquisition unit, RAM (Random Access Memory), ROM (Read Only Memory), a video generator, and a means for the user to control the decoder. A representative videotex system is shown in Fig. 5.

The data-acquisition unit performs two functions. First, it “tunes in” on the vertical-blanking lines carrying the videotex information—acting like a very selective TV receiver, as it were. Second, it takes that information and translates it from the analog format used to send it over the air (or cable) into a digital format (a series of logic 1's and 0's) that can be used by the decoder's digital circuitry.

In the process it also converts the incoming data from serial to parallel format. (That is necessary because, while the data is originally in parallel format—with all the bits making up a single character or picture element (*pixel* or *pel*) arranged side-by-side in one block—the bits have to be sent serially, one after the other, if they are to be transmitted on a video line.)

The RAM is used to store the data, since it is received at a rate different from that at which it will be displayed on the TV screen.

The ROM is pre-programmed with the information necessary to translate the digital information containing the characteristics of a character or pixel into a video image. In more sophisticated units, it may also contain a program for overall control of the entire decoder. In that context, a micro-

processor would be involved.

The video generator takes the data output by the character/pixel-generator ROM and turns it into a composite-video signal, similar to that from a TV camera. The signal can either be fed directly to a video monitor, or can be superimposed on a carrier generated by a RF-modulator and fed to the antenna terminals of a TV receiver.

Finally, the controller, usually in the form of a numeric keypad in receive-only installations, allows the user to select which page of videotex information he wishes to see.

While it sounds complex, an installation of that sort would fit easily into a case the size of a cable-TV translator.

A two-way installation would not require much more. The added element would be a communications interface—and possibly a typewriter-style keyboard—that would allow the user to

Most cable-TV systems whose applications are under consideration today will provide two-way communications, when they are put into service. A dedicated cable channel (or over-the-air channel) can transmit enormously more videotex information than can a few lines of the vertical blanking-interval.

The cable-system operators are aware of what the future holds, and the communities whose franchises they are competing for also know that they will want more than just piped-in entertainment. They will want to have the ability to use their cable systems to get information *out* of their homes as well as into them.

What's available today

To date, videotex systems are still in the testing stage, with much of the testing having been done outside the United

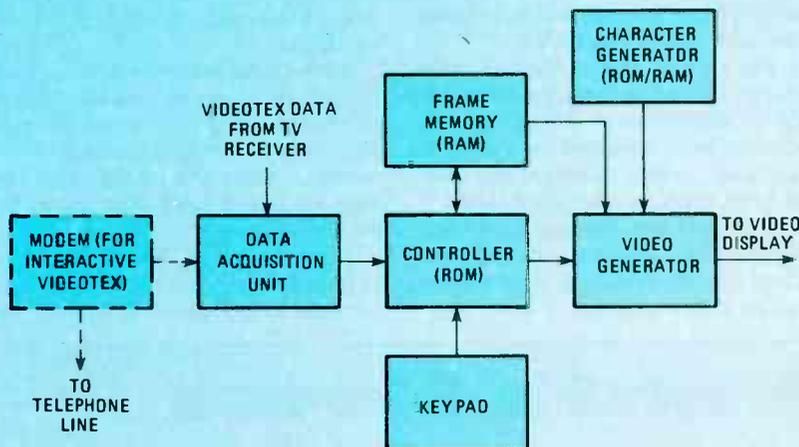


FIG. 5—THE MODEM shown at left is required for interactive videotex using telephone lines. Two-way cable service would use an interface between the user's keypad or keyboard and the cable line.

become more than a viewer and talk back to the system in more than simply “Show me page such-and-such” terms.

With an over-the-air videotex system, that communication would have to be via telephone. Such an arrangement would require a modem, the device that allows digital information (as opposed to speech) to be transmitted over telephone lines. The modem would allow the videotex user to interact with the information he had requested from over-the-air transmissions through his decoder.

By dialing a phone number and giving his access code to a computer, he could say, in effect, “I see that flight 901 is open to San Francisco. Please book me one first class seat on that flight.” The airline-booking computer would accept his request, make the reservation (if it were still available), and charge the flight to his credit card. If the flight were booked up, the computer might suggest several alternates.

States. A number of tests have taken place, or are now under way in this country, as well. Among the TV stations involved are WFLD in Chicago, WETA in Washington, DC, and KCET in Los Angeles.

There are three major systems competing for acceptance, with several others in use in various parts of the world such as Germany and Japan. All offer one-way or interactive service, but differ in the way information is transmitted, decoded, and displayed on the video screen.

The British *Prestel* (*PRESs TELEphone*) uses what's called a *serial attribute* system (no relation to the serial-transmission format referred to earlier). It can transmit both text and images. The images, however, are rather low in resolution (see Fig. 2), being made up of rather large pixels. A version of *Prestel*, called *Picture Prestel* allows full-color still video-frames to be transmitted. (Other systems also have this capability. The drawback, as

we'll see later, is the length of time it takes to transmit the picture.)

Antiope, from France, uses a *parallel-attribute* system. It permits somewhat more detailed images, without some of the limitations inherent in the Prestel system. An example of Antiope is shown in Fig. 3.

The third system, *Telidon* (from a combination of Latin and Greek for "distant image"), was developed in Canada, and is more flexible than either of the others. It also uses a parallel-attribute system but, instead of relying on shapes stored in the decoder's ROM, can *download* (transmit from the system's master memory to the memory of the user's decoder) specific shapes that can be used for the application at hand and called up by a single command. An example of Telidon's capabilities is shown in Fig. 4.

Detailed descriptions of the formats of each of those systems will be covered in the next part of this article.

In Britain and France (and in other countries related to them by culture or video standards) over 100,000 households have been equipped for videotex. In addition, *public* videotex terminals have been tried on a limited basis.

Both Prestel and Antiope have been sampled in this country, but the general and specific results of the tests are yet to be fully evaluated.

The Canadian Telidon system is just starting to make its presence known here, although it has seen use in other parts of the world. Trials of Telidon are underway by organizations such as Time, Inc., the Times Mirror Cable Co., and AT&T. The first intends to make as many as 24 "magazines" available over the system. AT&T has petitioned the FCC to make the Telidon system the U.S. videotex standard.

Currently the EIA (Electronic Industries Association) is developing a set of standards which it hopes will be adopted for use in this country. The FCC is expected to start evaluating that proposal this year.

What's coming

While it was probably conceived with the general public in mind, most applications of videotex to date have been directed to the businessman, who, it was felt, could well afford its services.

As personal computers have proven, though (through the introduction and increasing use of the Source, MicroNet, and other, smaller, computer networks), there are many *individuals* who want and need interactive information utilities.

The "magazine" format would seem to indicate the response of large organizations to the public's wishes. Also,

banks, whose managers previously felt that their computers might be "invaded" by personal computers, are beginning to open their doors to videotex transactions, seeing the videotex system as a protective buffer between their systems and the users'.

Along those same lines, owners of personal computers will soon be able to use local videotex systems (in both the interactive mode and the *creative* mode—where data, and not just responses, can be entered into the system) with a simple addition to their own systems. Norpak of Canada has announced a plug-in board for the *Apple II* computer for Telidon. Even better, there should be a module available soon for Radio Shack's *TRS-80 Color Computer*, since it uses the same microprocessor (the 6809) as the terminal that was originally designed for the Telidon system. You may soon be able to walk into your local Radio Shack store and walk out with a plug-in videotex system for under \$500!

As it proliferates, videotex will be the means by which you'll obtain the information *you* need, and transact your personal business—as well as, perhaps, earn your living—without leaving home. It's part of the information revolution.

Next month we'll discuss the technology behind the various videotex systems. **R-E**

What's News

Electricity from coal, without pollution

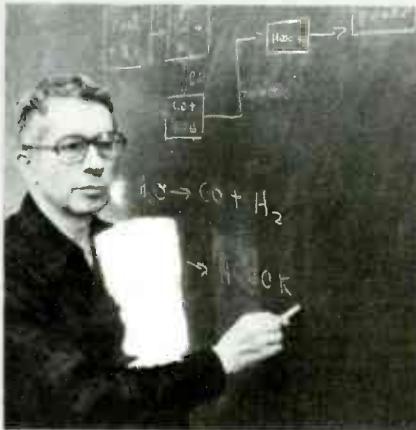
Dr. Richard Williams, Fellow of the technical staff of RCA Labs, Princeton, NJ, has patented a process that uses coal to produce electricity, without burning the coal, eliminating the air pollution that is normally caused by common coal-burning generators.

The conversion is not direct. The process starts with passing steam over hot coal, producing carbon monoxide and hydrogen. (This process is used to make the so-called "water gas" used in many cities.)

The carbon monoxide is then reacted with hot sodium hydroxide to form sodium formate that can then be used in a fuel cell to generate electricity. The remaining hydrogen is also usable in a fuel cell.

Originally conceived about 150 years ago, fuel cells—in which the oxidation of a gaseous fuel produces electricity in a continuous process—have been used to provide energy for spacecraft. Now, because of the energy shortage, they may be able to produce electricity economically for many earthbound applications.

Dr. Williams points out that a coal-fired steam plant can convert only about 30 percent of the coal's energy to electricity, while producing undesirable pollution. The fuel cell can convert as much as 50 percent of the coal's energy to electricity,



Dr. RICHARD WILLIAMS of RCA shows the steps in his method of using steam and coal to produce electricity efficiently.

without producing pollutants during the process.

RCA will grant non-exclusive licenses to use the Williams patent.

Cellular system for mobile two-way phone

The FCC has granted approval to "cellular" mobile radiotelephony. In cellular communication, a service area—such as a city—is divided into small areas, called "cells," each with its own low-

power transmitter. Thus, a taxi company or other service would not need to cover an entire city with just one station; instead, it would use several small ones. Each of those stations would be designed to cover its own "cell" efficiently while causing as little interference as possible in adjoining cells. As vehicles move from cell to cell, communications would be switched electronically from one transmitter to the next.

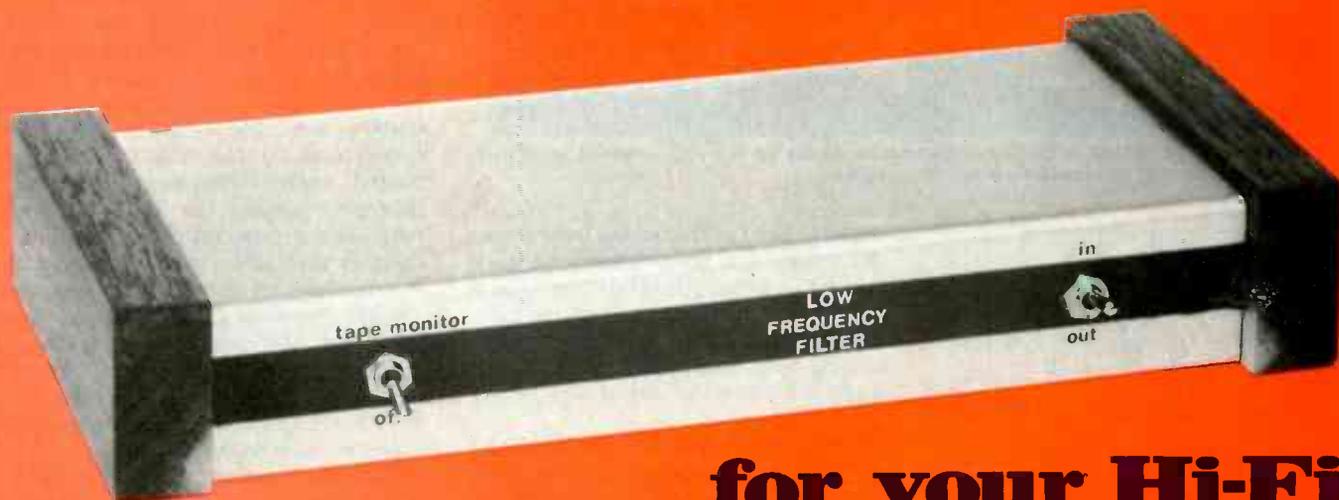
The cellular approach will allow many more telephone calls to be handled at the same time than is possible with the present two-way phone service. Highly successful tests of the cellular system have been carried out under preliminary FCC rules by Illinois Bell in Chicago and by Motorola in Washington, DC.

Radio common carriers are looking forward to the coming system with a mixture of anticipation and concern. Says Bernard Kahn, of a large Chicago communications service: "Cellular is so efficient that by the year 2000—at the least—it will carry practically all forms of portable communications. We've been waiting for this moment for more than 10 years."

Yet he expressed the fear of possible wire-line company domination that is worrying many independent common carriers. "Our greatest concern," he said, "is that the Bell System—directly or indirectly—might be handed a virtual monopoly on cellular systems. The FCC's own Common Carrier Bureau and the Justice Department have also gone on record with the same concern." **R-E**

BUILD THIS

Low Frequency Filter



for your Hi-Fi

As your sound system gets better you can hear more—sometimes more than you want to. This simple, low-cost filter will get rid of rumble and acoustic feedback without affecting the quality of the audio.

By JOSEPH M. GORIN

IMPROVING AUDIO SYSTEMS ELECTRONICALLY is what signal processors are all about; the LFF (Low Frequency Filter) described here can improve the quality of reproduction from the low-frequency end of your sound system. The LFF helps eliminate three types of low-frequency problems: subaudible (too low in frequency to be heard) rumble, audible rumble, and acoustic feedback. By taking advantage of modern recording practices, and the characteristics of stereo discs, the LFF can filter out those annoyances without affecting the music.

Stereo recording conventions

A stereo phonograph record uses both walls of a groove to carry the right- and left-hand channel information. The continuously-changing positions of those walls relative to the position of the stylus of your cartridge cause it to move and to generate electrical signals which eventually are heard as sound. Figure 1-a shows the cross-section of a groove when only the right channel is modulated. Notice how the left wall remains stationary while the right wall moves. Also note that the stylus not only moves from side to side, but vertically, as well.

In the days before stereo, both walls moved together *horizontally*, as shown in Fig. 1-b. To permit stereo

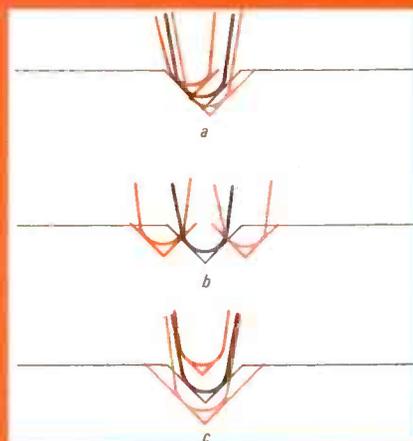


FIG. 1—CROSS SECTION OF a stylus in a record groove during right-channel, horizontal (mono), and vertical (out-of-phase) modulation.

equipment to play monophonic recordings, a monophonic signal was defined as one having equal strength in both channels, causing the left wall to recede while the right wall advanced (and vice versa), moving the groove only horizontally.

Consider what would happen if the walls were to converge, as shown in Fig. 1-c. A large signal could easily make the groove disappear, or cause distortion when the contact point of the stylus changed as the groove got smaller. Fortunately, that can only hap-

pen with large out-of-phase signals, which, because phono pickups are velocity sensitive, tend to occur only at low frequencies.

When high-quality recording techniques—such as direct-to-disc—are used, long-wavelength, low-frequency signals occur only in-phase, since the microphones used are closely spaced in comparison with the wavelength of the sound. Large vertical excursions of the stylus will not take place under these conditions.

When multi-track recording is used, though, many signals having a multitude of phase relationships are mixed together. To eliminate the possibility of out-of-phase low-frequency signals finding their way onto a record produced using multi-track equipment, a circuit similar to that of the LFF is used to make the low frequencies monophonic (in-phase) and avoid that situation. Pure-vertical audio signals are not found on most records.

Vertical noise, though, is another matter. There are two kinds of low-frequency noise on a record—warp and rumble. All records, even the best, are warped to some degree. As the stylus tracks a warped record, it follows the vertical excursion of the warp and passes that on to your system. Much warp energy lies below audible frequencies and cannot be heard (al-

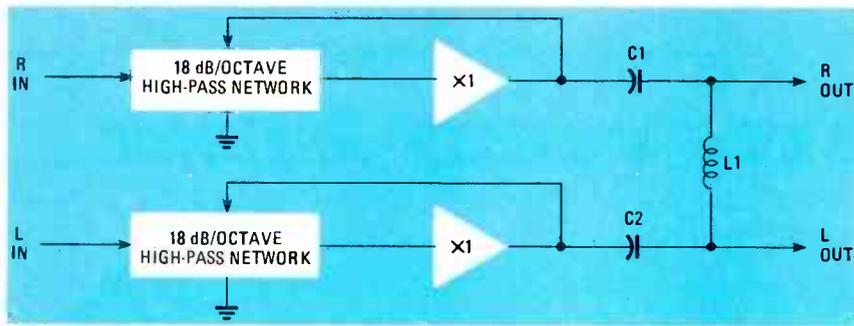


FIG. 2—THE L-C NETWORK in this block diagram shorts the left and right channels together at frequencies below 140 Hz, cancelling out-of-phase signals.

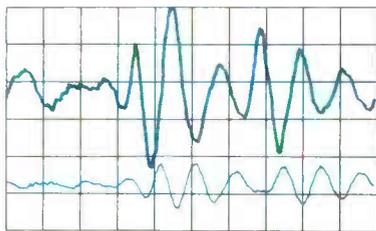


FIG. 3—SPECTRUM ANALYSIS of the "silent" groove of a record with considerable rumble. The upper curve is the input to the LFF, the lower curve is the output.

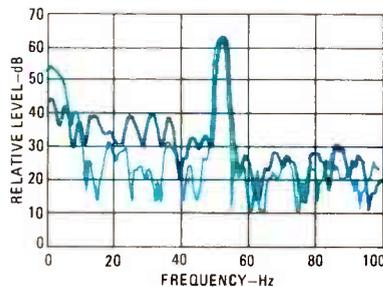


FIG. 4—THIS IS A spectrum analysis of the low-level, low-frequency introduction to a song. The upper curve is the input to, the lower curve the output from, the LFF. Note how audio peak is unchanged by filter.

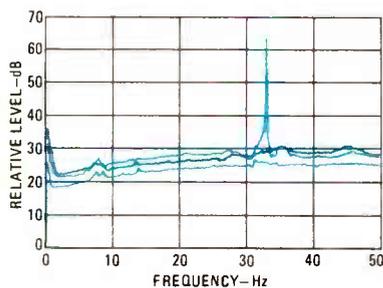


FIG. 5—FREQUENCY RESPONSE OF THE SYSTEM. Note how thoroughly the 30-dB peak (middle curve) is removed by the LFF (upper curve).

though it can affect your speakers), but many warps have an audible component as well.

All turntables have rumble. It usually results from noisy motor bearings and its vertical component is picked up by the stylus. However, with a good turntable, rumble is usually insignificant and is outweighed by the rumble cut into most records. That rumble exists because it is very hard to move the

massive head of the cutting lathe across the master disc (known as the *lacquer*) when it is being prepared. The vertical component of the noise from the bearings in the lathe is transmitted to the cutting head, and to the lacquer. Eventually it winds up as part of your record.

Direct and indirect effects of noise

The direct consequence of the vertical modulation of the record groove that we have been discussing is low-frequency noise that detracts from the quality of the sound (and our enjoyment of it). This direct effect, however, is quite rare. It is noticeable only in high-end systems that are capable of

reproducing the bottom octave of the audio spectrum.

The indirect effects arise from the larger-amplitude subaudible signals. They can cause very large excursions of the speaker system's woofer. When the woofer's cone is displaced significantly, the sensitivity of the speaker changes. The result is intermodulation distortion caused by a mixing of the (normal) audio signal and the subaudible one. The effect is especially bothersome in high-efficiency and/or ported speaker-systems. In high-efficiency systems, the voice-coil/magnetic-field overlap drops quickly as the cone is displaced, causing significant intermodulation distortion. In a ported system, because of the reduced "air load" on the woofer, rumble components below the system's resonant frequency cause very large cone excursions, especially when compared to acoustic-suspension systems.

A second indirect effect is reduced power reserves in the power amplifier. That is because a significant portion of the amplifier's output capability is being used to reproduce the subaudible signal. If the amplifier is driven into clipping, further intermodulation distortion will be introduced.

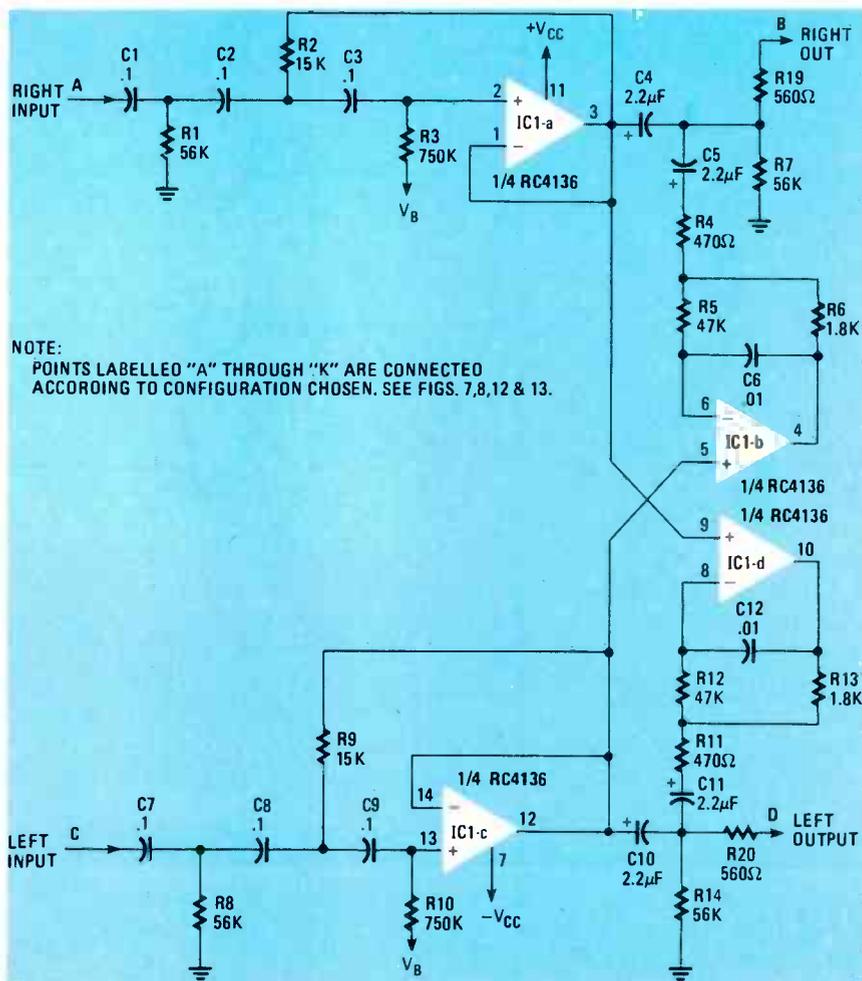


FIG. 6—THE KERNEL section of the LFF contains all of the filter circuitry. It can be installed in an existing piece of equipment, or used as part of a stand-alone unit.

PARTS LIST

Resistors ¼ watt, 5% unless otherwise noted

R1, R7, R8, R14—56,000 ohms
 R2, R9—15,000 ohms
 R3, R10—750,000 ohms
 R4, R11—470 ohms
 R5, R12—47,000 ohms
 R6, R13—1800 ohms
 R15-R17—220,000 ohms
 R18—220 ohms
 R19, R20—560 ohms

Capacitors

C1-C3, C7-C9—.1 μ F, 5%, polyester film
 C4, C5, C10, C11—2.2 μ F, 10%, tantalum
 C6, C12—.01 μ F, 10%, polyester film
 C13, C14, C17—.1 μ F, 50 volts, ceramic disc
 C15, C16—10 μ F, 25 volts, aluminum electrolytic
 C18—220 μ F, 35 volts, aluminum electrolytic

Semiconductors

IC1—RC4136 quad op-amp
 D1-D4—1N4002
 J1-J8—chassis-mount phono jacks
 S1-S8—DPDT miniature toggle switch
 T1—wall plug transformer, 12-24 volts AC, 100 mA

Miscellaneous: PC board, chassis, hardwood end panels, hardware, wire, etc.

Note: The following are available from Symmetric Sound Systems, 912 Knobcone Place, Loveland, CO 80537. Complete kit, model LFF-1 with unfinished walnut end panels; \$50.00 (Canada, \$55.00 U.S. funds); model LFF-Kernel with R1-R20, C1-C12, IC1, PC board, and miscellaneous wire and hardware, \$15.00; model LFF-PC printed-circuit board only, \$7.00. All prices include UPS shipping in the U.S. on prepaid orders. Visa and M/C, add \$1.00 handling and all shipping charges. U.S. mail, add \$3.00 for the LFF-1 only. Colorado residents, add 3% sales tax.

The obvious solution

There is a simple remedy for the problems just described—make the system monophonic at low frequencies and, for added protection, roll off its response below the range of normal hearing. This will have no effect on the program material—just on the noise. If the circuit is well-designed, it will not alter the stereo effect either, because a listener's perception of localization (imaging—the stereo effect) is based on frequencies much higher than the ones that will be filtered out. The LFF switches from stereo to mono at about 140 Hz, with a moderately rapid transition.

Figure 2 is a block diagram of the LFF. Both channels have 18-db/octave rapid-cutoff filters for subaudible signals

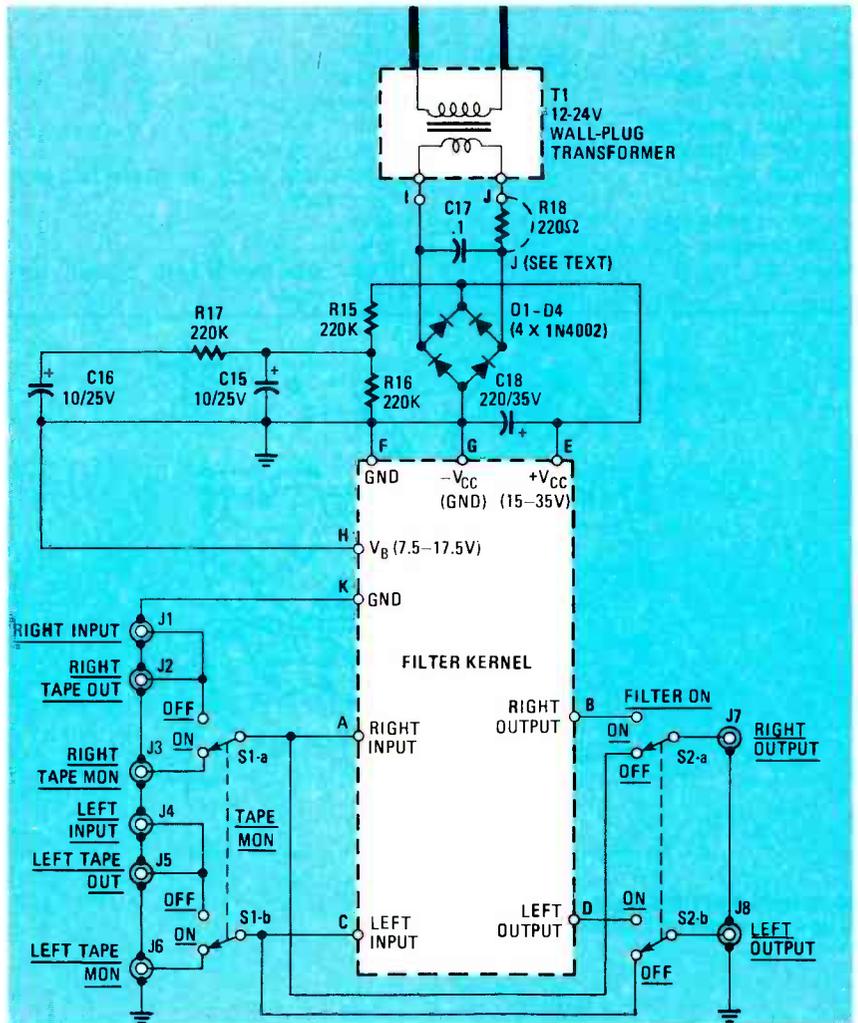


FIG. 7—FULL-WAVE BRIDGE POWER supply for a stand-alone LFF. The bias voltage (half the supply voltage) is connected to pin H of the kernel.

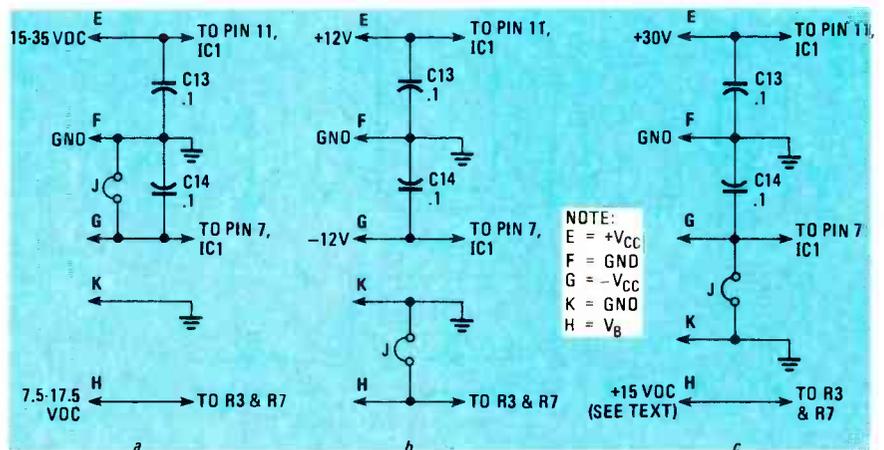


FIG. 8—HOW A POWER SUPPLY is connected to the kernel section of the LFF. Connections for a stand-alone unit are shown in a. The LFF can also be built into an ASRU using the connections shown in b, or a graphic equalizer using the connections shown in c.

below 45 Hz. The right and left channels are then combined by a network made up of C1, C2, and L1. At low frequencies, the impedance of the capacitors is large and that of the inductor is small, so that the two channels mix into one and out-of-phase signals cancel each other. At higher frequencies, the relative impedances

reverse and the channels remain separate. The result is effective filtering of only the noise.

To get an idea of what the LFF does to subaudible noise, remove the grille cloth from one of your speakers and watch the cone of the woofer while switching from stereo to mono. You'll be able to see the rumble disappear.

TABLE 1

Crossover frequency:	140 Hz
Subaudible filter:	18 dB/octave below 20 Hz
Frequency response:	20Hz-20 kHz ± 1 dB, both channels driven.
Differential rumble rejection:	20 dB @ 20 Hz
Separation:	25 dB above 1 kHz; 35 dB above 3 kHz
Rated output:	.5-volt RMS
Signal-to-noise ratio:	100 dB
Total harmonic distortion, 20 Hz - 20 kHz:	.02%
Maximum output:	Greater than 5-volts RMS; depends on power supply.

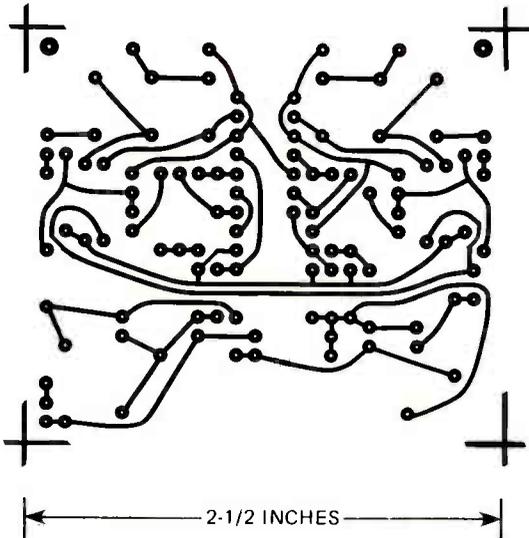


FIG. 9—FOIL PATTERN required for the small PC board is shown here full size.

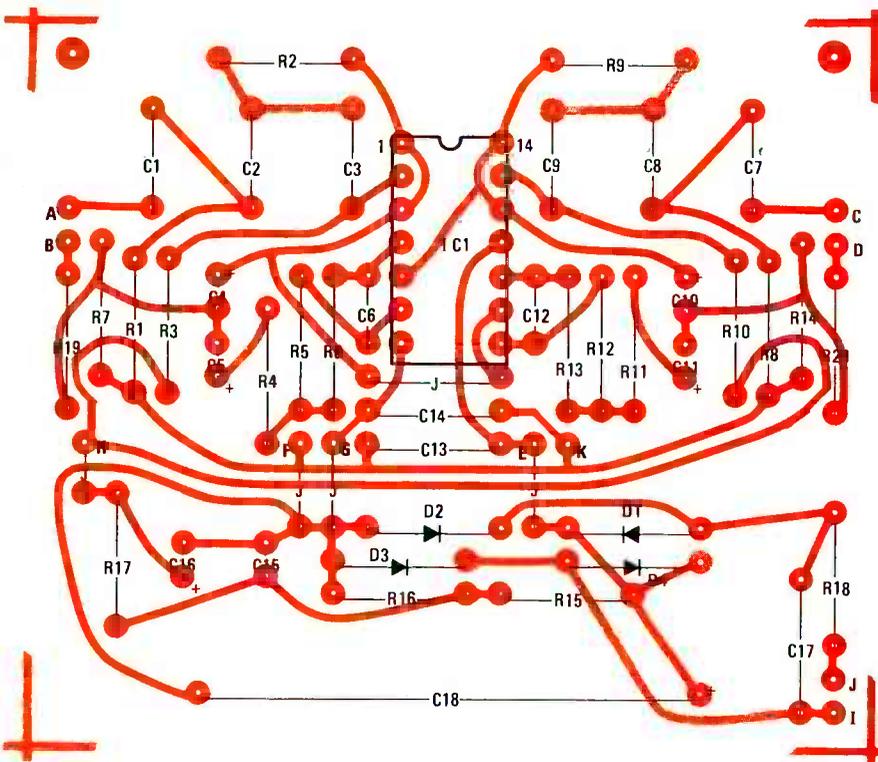


FIG. 10—ALL PARTS except the wall-plug transformer, switches, and jacks are mounted on the PC board as shown.

Acoustic feedback

The LFF can also reduce the effects of acoustic feedback. Acoustic feedback is caused by sound from the speak-

ers causing the pickup to vibrate. The vibrations are treated like a signal and are fed back to the amplifier. In serious cases, the system will "take off" and

go into oscillation when the volume is turned up. Even when the sound level is well below the point where oscillation would take place, the feedback can cause aberrations in a system's frequency response that result in an "overhang" or "ringing" effect on bass transients and dull their impact and muddy the sound.

The main component is usually vertical and can be reduced by the LFF. You can simulate the effect of the filter by placing a record on your turntable—with the turntable turned off—and lowering the stylus onto the disc. Tap the base of the turntable with your finger as you increase the setting of your amplifier's volume control. Feedback should occur. If you put the amplifier in the "mono" mode, the feedback should disappear.

Performance

Figure 3 shows a spectrum analysis of the signal generated by a "silent" record groove that contains a significant amount of cutting-lathe-induced rumble. The upper curve is the signal input to the LFF and the lower one the output. The difference between the two is quite dramatic.

Figure 4 is another spectrum analysis showing the low-frequency, low-level, introduction to a song. The sound peak is reproduced equally well at both the input and the output; the noise that would normally be bothersome is greatly attenuated by the filter.

The frequency-response curves for a sound system are shown in Fig. 5. The lowest curve shows the results of a measurement made with the volume control turned down. The next higher curve (displaced for clarity) shows a 30-dB peak at the edge of oscillation. The narrowness of the peak implies that the system will ring for *seconds* after the end of the transient. The top curve shows the nearly complete removal of that peak by the LFF.

Table one lists the LFF's performance characteristics.

Circuit description

Schematics for the LFF are shown in Figs. 6 and 7. Figure 6 shows the main circuitry, or "kernel," suitable for installation in existing equipment. A power supply and other circuitry needed to construct a stand-alone unit are shown in Fig. 7. Figure 8 shows power-supply connections to the kernel. Use the connections shown in Fig. 8-a for a stand-alone unit and those shown in Figs. 8-b and 8-c for use as part of another piece of equipment. Those connections will be discussed in more detail later in this article.

The subaudible-noise filter is made up of R1-R3, C1-C3, and IC1-a. The use of three R-C pairs allows a steep 18-dB/octave rolloff; the controlled amount

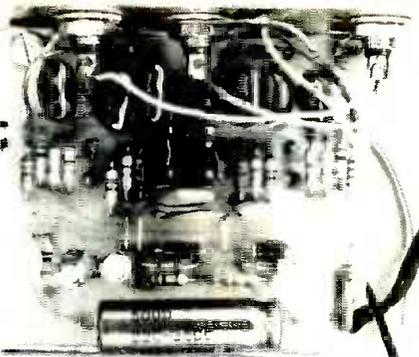


FIG. 11—THIS IS HOW the PC board should look when all components are in place on the board.

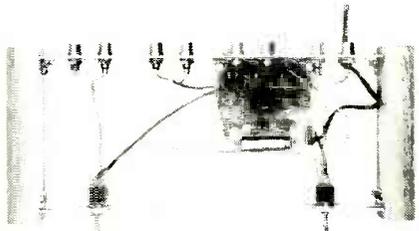


FIG. 12—AN UNDERSIDE VIEW of the LFF stand-alone unit. The kernel board can also be installed inside a piece of existing equipment.

of positive feedback through R2 helps keep the response of the device very flat down to 20 Hz.

Capacitors C4-C6, resistors R4-R6 and IC1-b perform the functions of C1, C2, and L1 shown in the block diagram in Fig. 2. Capacitor C4 is the diagram's C1, and C5 is the diagram's C2. The inductance represented by L1 is supplied by R5, R6, C6, and IC1-b in a circuit configuration known as a *gyrator*. It simulates an inductor with a value of $L = 1/R5 \times R6 \times C6$ between pin 12 of IC1-c and the junction of resistors R4-R6, with a resistance equal to $(R5 \times R6)/(R5 + R6)$ across the inductance. That configuration offers an inductance of 1.2 henries without the typical problems of saturation, poor tolerance, hum pickup, and high cost. The resistance of the inductor, together with that of R4 in series with it, damps the L-C resonant circuit to prevent ringing.

Construction

Figures 9 and 10 are the foil pattern and parts-placement diagram for the

LFF. The kernel (on the upper part of the board) is attached to the power supply on the bottom part by jumpers to the holes marked "H," "F," "G," and "E."

Assembly is quite simple. To build a stand-alone unit, refer to Figs. 10 and 11 and mount all the components on the board. Install the finished board in a plain enclosure and wire it to the jacks, switches, and wall-plug transformer as shown in the schematics. Any wall-plug transformer with an output of 12-24 volts AC can be used—short out R18 if the transformer supplies 18 volts or less. Be careful to observe the polarities of the electrolytic capacitors and the diodes, and to position the IC correctly. The completed unit is shown in Fig. 12.

The LFF can be connected to any sound system with a TAPE MONITOR switch. Connect the LFF's inputs to TAPE RECORD or TAPE OUT on your amplifier and its outputs to TAPE PLAY or TAPE MONITOR. Anything that had been connected to these jacks can now be connected to the corresponding jacks on the LFF, maintaining your sound system's full capability and flexibility.

Installation in existing equipment

The LFF is such a simple circuit that the overhead of a chassis, end-panels, power supply and switches begins to look ridiculous. The board can easily be installed in existing equipment; the graphic equalizer and ASRU noise-reduction units, which were presented in *Radio-Electronics* in May 1978 and March-April 1981 respectively, will be used as examples.

A dual-supply connection is shown in Fig. 13, which uses the ASRU as an example. The bias voltage, V_B , is connected to ground and op-amp IC1 uses the ± 12 -volt supplies. Figure 8-b shows the connections to points "E," "F," "G," "H," and "K."

Figure 14 shows how the LFF can be installed in an equalizer with a single-ended power supply. The connections for that arrangement are shown in Fig. 8-c. In that example, V_B (+15 volts) can be obtained from the equalizer. In other circuits, where no V_B exists or can be located, R15-R17, C15, and C16 can be used to derive V_B from V_{CC} . It is important that the LFF be connected *ahead* of the equalizer, since mismatches in the low-frequency band settings of an equalizer produce phase shifts that can reduce the effectiveness of the filter.

There you have it—a simple, inexpensive circuit to help wipe out warps, rumble, and the howl and muddiness caused by acoustic feedback; it is equally effective as a stand-alone unit, or when incorporated into an existing piece of equipment.

R-E

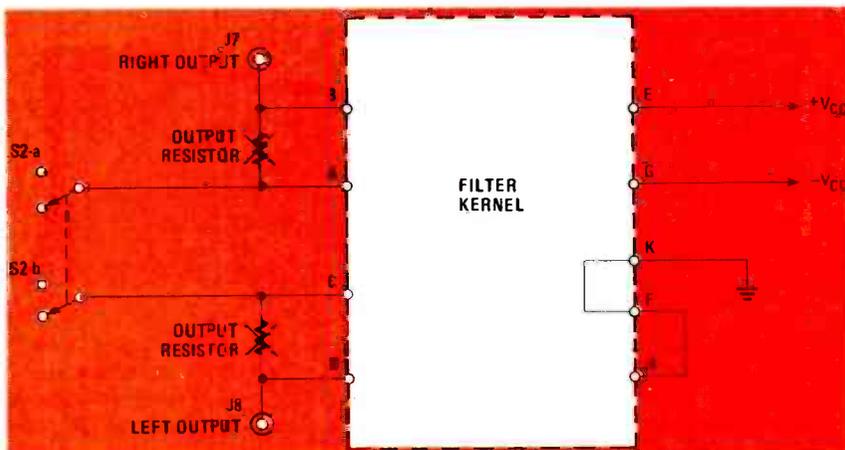


FIG. 13—THE LFF can be installed in an ASRU using the connections shown above and in Fig. 8-b. If that is done, the power-supply circuit is not required.

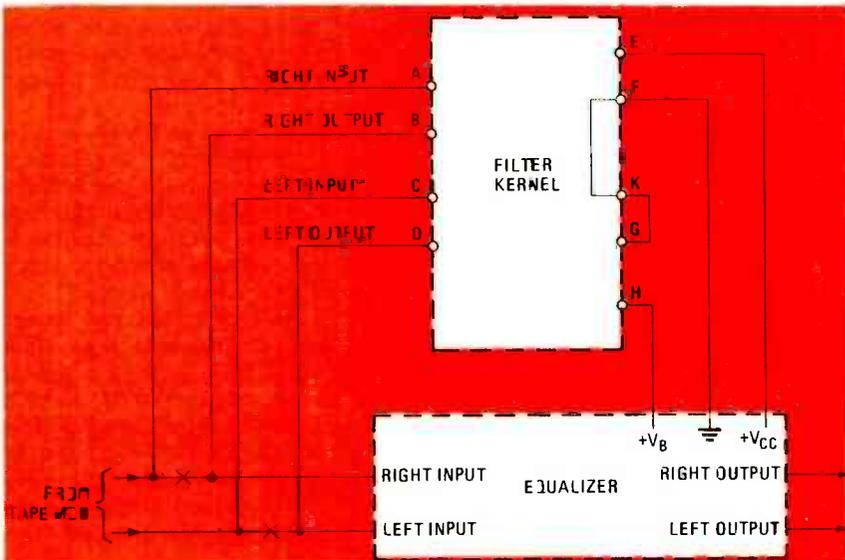


FIG. 14—IF THE LFF IS INSTALLED in a graphic equalizer, be sure to connect the LFF ahead of the equalizer.

BUILD THIS

IS IT POSSIBLE FOR AN ANALOG METER to rival digital accuracy, yet not cost an arm and a leg? Sure—with a nearly forgotten technique known as expanded-scale operation.

As a matter of fact, here's a scale expander you can build for less than the price of the cheapest DVM. Easily constructed and easier to operate, it'll put an ordinary VTVM to shame. Besides being accurate, it's smart. It will tell you if you are "over-ranging" and protect the movement from damage if you are. It will even recognize AC voltage and DC polarity-reversal.

Expanded-scale theory

A major drawback of conventional instruments is the necessity of selecting the most appropriate scale to measure a particular voltage. If you wish to measure 55 volts, let's say, it gets a bit tricky.

The 50-volt scale is too small—the needle pegs—so, you have to switch to the next range—150-volts. Unfortunately that places your reading in the bottom third of the meter—the most inaccurate portion.

Why put up with this, when all you're really interested in is a portion of the scale—not the whole 150-volts worth? Why not start at 50 volts and set the upper limit at 60, for a total range of only 10 volts? In other words, the pointer won't budge until the input exceeds a minimum value, and then will be read against a much more accurate scale?

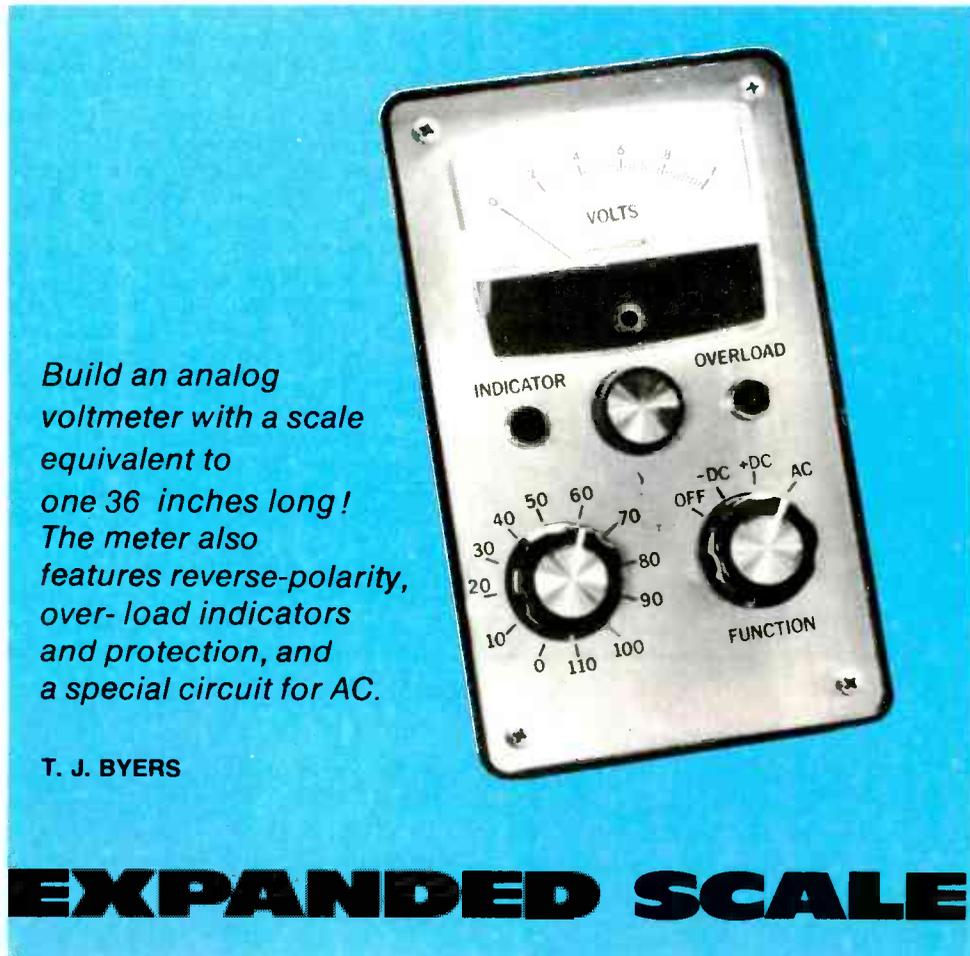
The always-useful op-amp will permit you to do just that. Using the amplifier in a standard inverting configuration, as shown in Fig. 1, you'll have a voltmeter...nothing fancy, but the basic building block of our unit.

Apply a voltage and the meter will respond. When it gives a full-scale reading, then that's the limit...right? Wrong! We can "zero" the meter and measure higher voltages by a method called junction summing. A summing amplifier is shown in Fig. 2.

The output of a summing amplifier is the algebraic sum of *all* the inputs. So, when the output reaches maximum, we can inject a voltage of the opposite polarity into one of the summing resistors...just enough to make the sum of the inputs equal to zero. Now we can increase the input voltage and still obtain an on-scale meter reading.

After reaching the next plateau, we can connect another summing resistor, re-zero the meter, and be able to read still-higher voltages.

We now have an input voltage three times that of the meter's full-scale capacity; yet we are still using the



Build an analog voltmeter with a scale equivalent to one 36 inches long! The meter also features reverse-polarity, over-load indicators and protection, and a special circuit for AC.

T. J. BYERS

EXPANDED SCALE

original, more precise, scale. That can continue indefinitely since the inputs don't interact. (Of course there's a practical limit!)

How it works

Basically that's how our meter works—but we've added a few improvements. Resistors R6 and R7 (see Fig. 3) determine the gain of the stage, with R6 also providing the input impedance. Resistors R1 through R5 are the summing resistors.

The upper limit of our instrument has been set at 120 volts, with 10-volt increments. (150 volts is the absolute maximum; beyond that, you run the risk of damage to the op-amp.) This means that 11 summing resistors are necessary for proper operation. Although that would be true *ordinarily*, we can reduce the component count by taking a hint from binary math.

Resistor R1 is selected to match one unit exactly, and R2 to match two units, of reverse voltage—which means that the combination will be three units (sound familiar?).

Accordingly, R3 is four units, and R4 (which is actually two resistors in parallel—R4 and R5) is eight. (The sche-

matic refers to R4-R5 as R4). Now, by paralleling different combinations of those resistors, we can develop any summing current from one to sixteen units. That's exactly what the range switch, S1, does.

This leaves us with one *small* problem. Let's assume we've input 70 volts and properly compensated for it with the biasing inputs—and then remove the input. Zap! There goes the meter movement...backwards!

To prevent that, we'll include a transistor, Q1. It is normally reverse-biased and doesn't enter in the performance. But let the voltage go just a little negative and the transistor saturates—shunting the op-amp's output to ground and saving the meter's life.

We've also protected our monitor from forward overloads with diodes D1, D2 and LED1. As long as the output from the op-amp is under about 2.5 volts, the diodes won't conduct. Once it exceeds the diodes' combined forward voltage, the LED lights—indicating overload—and clamps the output, again rescuing the movement from harm.

Resistors R28 and R11 are for calibration. Potentiometer R27 is mounted on

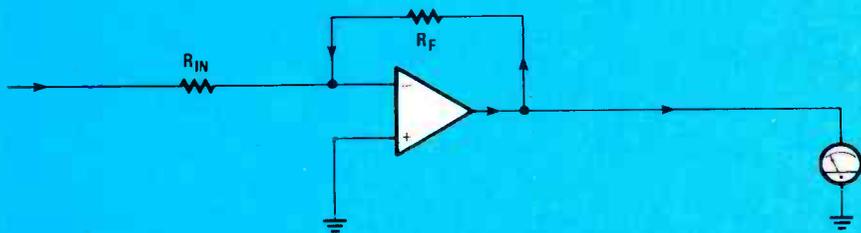


FIG. 1—AN ORDINARY OP-AMP is the heart of the expanded-scale voltmeter. Resistors R_{IN} and R_F set the gain.

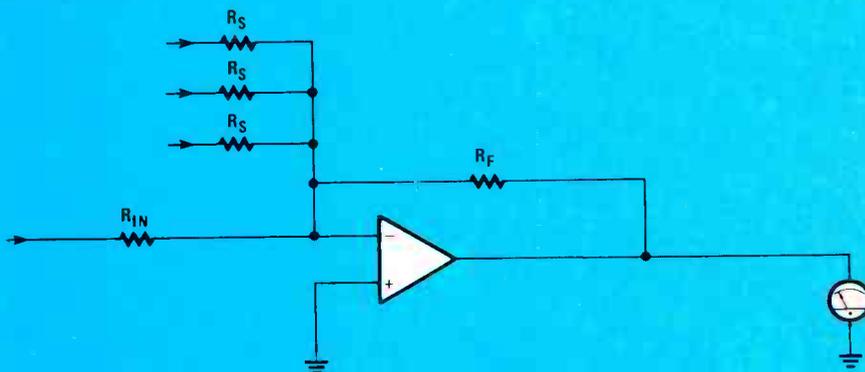


FIG. 2—A SUMMING AMPLIFIER works on the basis that the total input is the algebraic sum of the individual inputs.

from the output, allowing it to charge to the peak voltage—but as the input voltage decreases, D3 becomes reverse biased, thus making it impossible for the capacitor to follow the decline. The capacitor remains charged at the peak input voltage and slowly discharges through R30 and R26, the calibration resistors which, we should add, are adjusted for RMS—not peak—reading.

That fact requires the addition of another bias supply for the summing resistors, since our range per step has changed—it's 1.4 times that of the indicated value on the AC ranges. The AC-bias supply is IC2-c and works in the same way as the DC supply. (Zener diode D5, R21, and R32 are the associated parts.)

Because the forward voltage on the base of the transistor must be exceeded before clipping begins, AC voltages in this area are non-linear. (That only happens on the first portion of the lowest range.) A transistor was selected instead of a diode because once the transistor saturates, it effectively shorts the signal to ground while a diode would still carry the forward offset voltage, permitting the output to dip below ground.

Construction

Layout isn't critical, so you can duplicate the unit in almost any manner that pleases you. A printed-circuit board layout and parts placement diagram are shown in Figs. 4 and 5 for those wishing to go that route; however, the prototype was fabricated on perforated construction board.

If you elect not to use the PC board, try to keep the calibration pots along the edges for easy access. The case is large enough so that crowding isn't a problem. We suggest using sockets for the IC's.

Even though IC1's input impedance is fairly high (about 1 megohm), it might not be high enough to satisfy your requirements. Unplug the 1458 IC and replace it with an LF353N—it has FET inputs. Change R15 to 2 megohms and R16 to 10 megohms. You may have to change (reduce) the value of R7 to restore the original amplification. Voila! This is liable to out-perform any voltmeter you'll run across for some time!

Resistors R4 and R5 are two 750K units in parallel to obtain the non-standard value of 375K. Any combination will work: 300K and 75K in series, 360K and 15K in series, etc.

The meter mounts on the front panel, and is then bolted to the foil side of the circuit board, so make sure when positioning it that everything lines up. Speaking of meters, the accuracy of the system is limited only by the meter.

the front panel and nulls the input amp.

The voltage for the summing resistors is obtained from IC2-b, a Norton amplifier operating from only one supply voltage—positive. Resistor R19 limits the Zener current, which is used to reference the inverting input. Potentiometer R29 controls the output.

In order to educate our machine, an amplifier, IC1-b, is used as a comparator. Resistor R13 provides an input impedance. If the input is negative (negative, in our case, is proper operation), it swings the comparator's output positive—to the limit.

Light-emitting diode LED2 is a special tri-color device with two lamps in one case. Internally, the diodes are connected in parallel with opposite polarities. The device works in the following manner: with current flowing in one direction the unit glows green; reverse the flow and it's red. Light both diodes and it's yellow!

So, we connect the LED so it glows green with a negative input. If we apply a positive input, the comparator swings negative...lighting our red lamp. That signals that the leads are reversed. An AC voltage will cause the LED to glow yellow.

AC too?

You bet! The expanded voltmeter will also measure AC. Our clever clamping device, the transistor, also serves as a rectifier by clipping the negative peaks.

Because the expanded function offsets the input voltage the way it does, it distorts the AC waveform. As the input voltage increases, the half sine wave narrows—you're sampling closer and closer to the top.

A simple solution: Use a peak detector. The peak value is independent of the pulse width, eliminating the problem of the meter's averaging the pulses and giving erroneous readings.

The Norton amp (IC2-a) receives the pulsating DC from the main amplifier through R24, which, in conjunction with R25, sets the gain at unity. As the level of the input waveform rises, so does the voltage across C1, until a peak is reached.

Diode D3 performs two functions. First, it references the output to ground; in other words, it removes the offset voltage...with a little help from R22 and R23 (R31 is zero adjust).

Secondly, it isolates capacitor C1

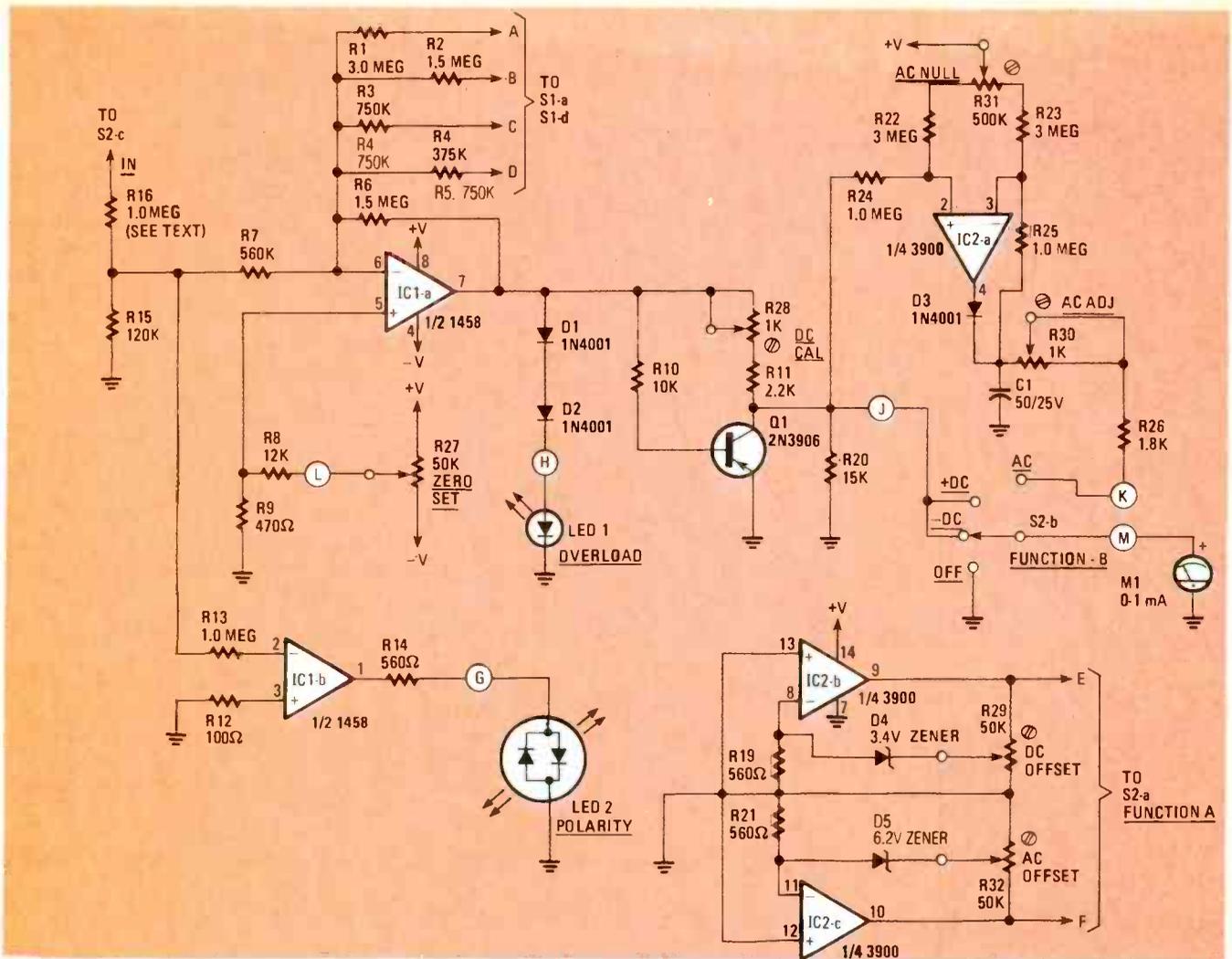


FIG. 3—SCHEMATIC OF EXTENDED-RANGE VOLTMETER. Circled letters refer to connection points on board.

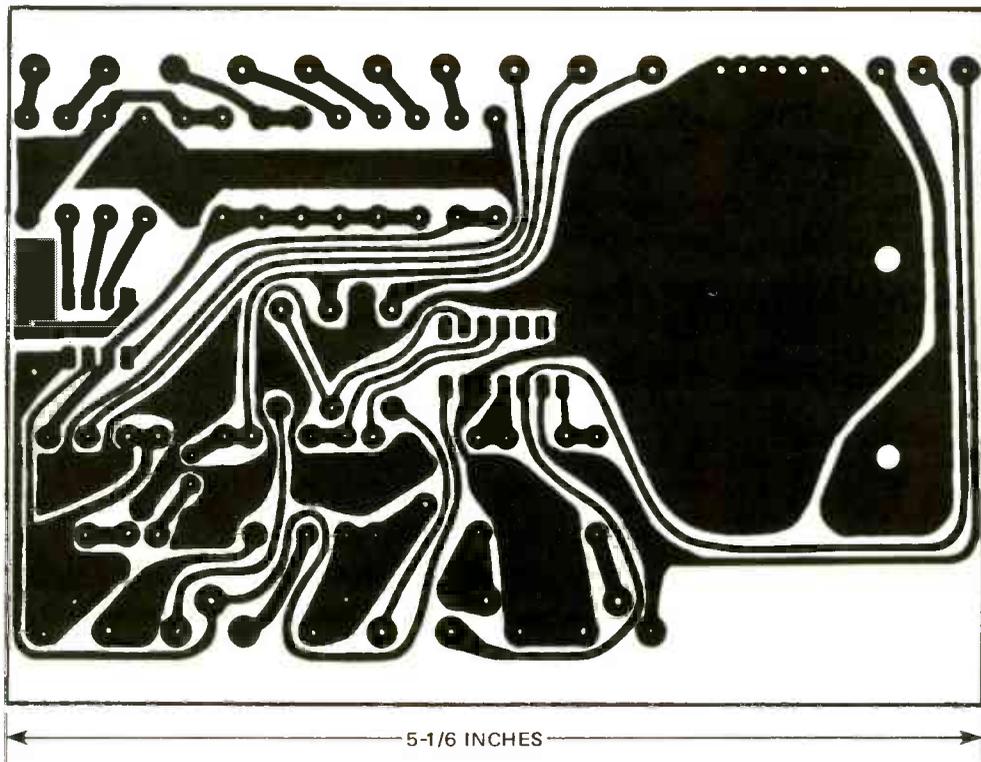


FIG. 4—PC BOARD will fit comfortably in a 6" x 3 3/4"-inch box.

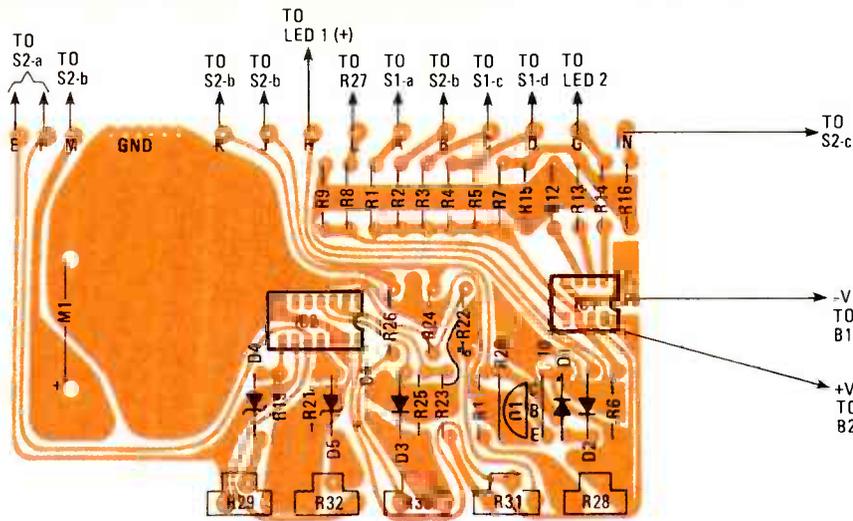


FIG. 5—MOUNT TRIMMER POTS R28-R32 so they can be adjusted from outside of board.

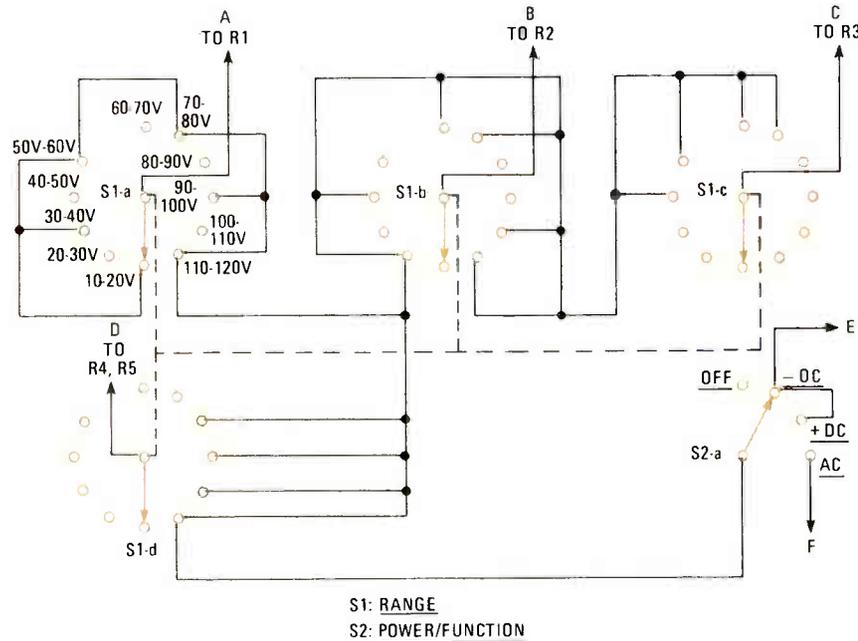


FIG. 6—WIRING FOR SWITCH S1 and one section of S2. Switches are mounted on enclosure and connected to points A through F on PC board.

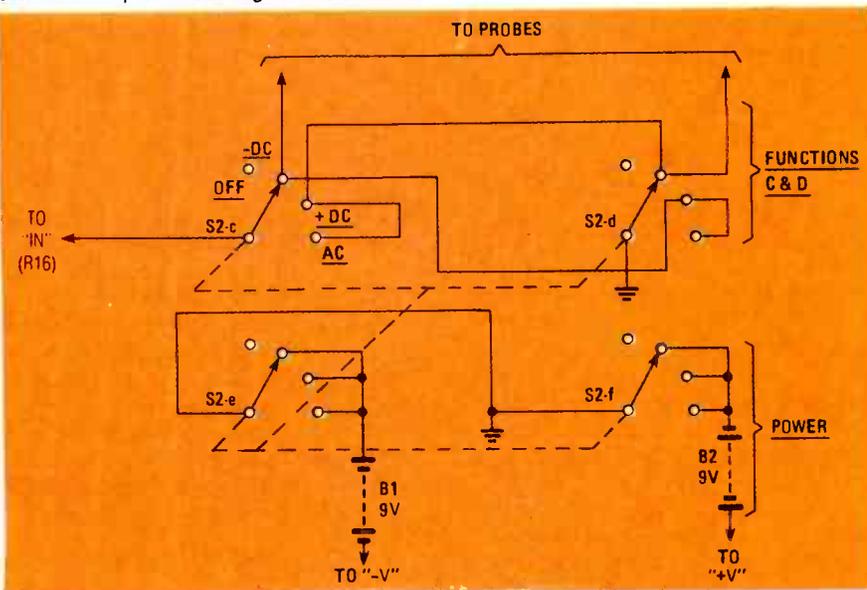


FIG. 7—WIRING FOR FOUR of the six sections of switch S2. This switch is used to select mode of operation and to turn unit on and off.

The movement specified is a standard panel unit, but any equivalent can be substituted. Resolution is limited only by the meter you select and your pocketbook! (Taut-band, mirrored-scale devices don't come cheap.)

Switch wiring is shown in Figs. 6 and 7. When routing the wires to the panel controls, use ribbon cable. It definitely makes for a neater package and there's less chance of committing an error. The LED's are placed in holders and the leads spliced. Slip a piece of spaghetti or shrink tubing over the exposed splices.

Observe diode and capacitor polarity, and follow good work habits in general when soldering. Figure 8 shows the completed board. Keep the input wire to a minimum to avoid noise. Either run a ground wire alongside it, if you're using ribbon cable, or use coaxial cable to reduce stray coupling.

The instrument is powered by two 9-volt batteries; mercury cells should be used since their voltage remains stable throughout their useful life. The ON/OFF switch is incorporated into the function selector, S2.

Calibration

Familiarize yourself with the calibration controls. Potentiometer R27 is the overall zero-set and is mounted on the front panel. DC calibration is done using R28, and R30 is the AC-adjust. Potentiometer R31 is for AC null, or zero. The bias offset, the function which gives our instrument its expanded scale mode, is controlled by R29 and R32—DC and AC respectively.

First you must zero the instrument. Switch the function selector to +DC VOLTS and the range to the lowest scale, 0-10 VOLTS. Adjust R27 for zero. (Of course, you've already mechanically zeroed the meter before applying power.)

Apply 10-volts DC to the input. Since that is the most critical adjustment, the accuracy of the instrument will directly depend on how precise your reference is. Adjust potentiometer R28 for full-scale deflection.

Move the RANGE switch to the next range (10-20 VOLTS). Now, turn pot R29 until the meter again indicates zero, and that's it! Well, the DC part anyway. You may have to strain your eyes a little to insure that your initial calibration is right on the button—as the ranges progress, any small error will be significantly magnified.

Assure yourself the meter is nulled and switch to the AC function. Set the RANGE switch to the lowest range. Using R31, zero the meter; it's imperative you set the overall zero in the DC position prior to trimming the AC pot—they are two different amplifiers with two offsets!

Place a 10-volt RMS sinewave across

A SIMPLE EXPANDED-SCALE VOLTMETER

A SIMPLE EXPANDED-SCALE METER CAN BE MADE USING A ZENER DIODE. (As shown in Fig. 9.)

The diode is normally reverse-biased and little current flows in that mode. However, as the voltage across the Zener is increased, a point is reached where the diode begins conducting—heavily. This voltage is called the breakdown voltage.

When breakdown occurs in normal diodes, they are destroyed. But, Zeners are heavily doped to permit the reverse conduction. A resistor is placed in series with the regulator to limit the current flow. Once the diode conducts, the series resistor drops voltage according to Ohm's law—*minus* the Zener voltage!

Suppose the Zener is rated at 10 volts. Up to the point of 10-volts input, no current flows through the resistor and no voltage is developed. After the 10-volt threshold is reached, and the Zener conducts, the current through the resistor generates a voltage.

A meter across the resistor will measure that voltage.

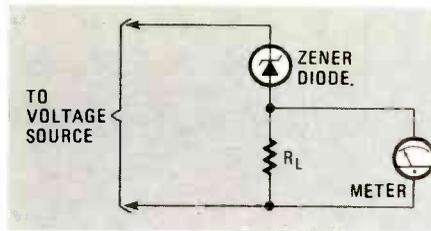


FIG. 9—A SIMPLE expanded-scale voltmeter can be made using just a Zener diode and a resistor. Add a conventional diode and you have an AC line-voltage monitor.

The meter can have any scale desired—if it is a 0 to 10-volt meter, it becomes a 10- to 20-volt meter when used with a 10-volt Zener diode.

The Zener is, unfortunately, a low-impedance device and it takes a tidy sum of current to begin to induce an avalanche condition. This more or less restricts its use to power-supply monitors. By inserting a conventional diode in series with the Zener, you rectify the input-voltage—making the meter particularly attractive as an expanded-scale AC line-voltage monitor.

PARTS LIST

All resistors 1/2-watt, 5%

R1, R22, R23—3 megohms

R2, R6—1.5 megohms

R3-R5—750,000 ohms

R7—560,000 ohms

R8—12,000 ohms

R9—470 ohms

R10—10,000 ohms

R11—2200 ohms

R12—100 ohms

R13, R16, R24, R25—1 megohm

R14, R19, R21—560 ohms

R15—120,000 ohms

R20—15,000 ohms

R26—1800 ohms

R27—50,000 ohms, potentiometer, panel-mount

R28, R30—1000 ohms, trimmer potentiometer, vertical-mount

R29, R32—50,000 ohms, trimmer potentiometer, vertical-mount

R31—500,000 ohms, trimmer potentiometer, vertical-mount

Capacitor

C1—50 μ F, 25 volts, electrolytic

Semiconductors

IC1—LM1458 or LF353N dual op-amp (see text)

IC2—LM3900 quad Norton amp

Q1—2N3906

LED1—jumbo red LED

LED2—tri-color LED (also known as bi-polar LED)

D1-D3—1N4001

D4—3.4-volt Zener diode

D5—6.2-volt Zener diode

M1—0.1 mA panel meter (Radio Shack 270-1752 or equivalent)

S1—4-pole, 12-position rotary switch (Centralab PA-2012 or equivalent)

S2—6-pole, 4-position rotary switch (Centralab PA-2021 or equivalent)

Miscellaneous: IC sockets, binding post, enclosure, two 9-volt mercury batteries, battery clips, ribbon cable, LED holders, solder, etc.

An etched and drilled PC board is available from: Danocinths, Inc., P.O. Box 261, Westland, MI 48185 for \$9.40 plus \$1.25 for postage & handling (order No. HSIF-36). MI residents please add 4% sales tax; allow four weeks for delivery.

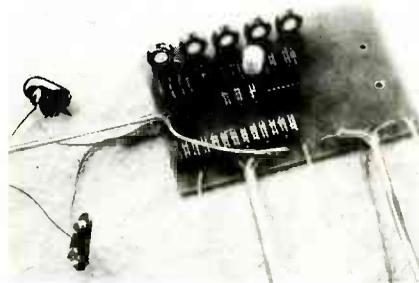


FIG. 8—COMPLETED BOARD ready to be installed in box. Note how ribbon cable keeps things neat.

the input leads and adjust R30 for full-scale deflection. Move the RANGE switch to the next position and adjust R32 for a zero reading. The same requirements apply here as they do in the DC calibration.

The AC amplifier *won't* go below ground—the zero on the meter. Keep that in mind when setting R32. Turn the control to obtain an indication above zero, then back off the pot until it *just* reaches the line. If you retard it any further, you won't know it because you will not get a reverse indication on the meter!

Using the instrument

Button everything up, inserting the batteries first, and apply power. There's nothing tricky about using the expanded-scale voltmeter.

With the RANGE switch in the lowest position, the LED will glow green with no input. Now apply a voltage across the leads. Right away the meter, which is now pretty smart, will tell you quite a bit about your input.

If the polarity is correct, the light will remain green; if not, it changes to red, indicating that the leads are reversed. The situation can be easily remedied by twisting the function knob to the -DC VOLTS setting.

If the voltage is higher than the scale capability—for example, 45 volts on the 0-10-volt range—the OVERLOAD LED, LED1, will glow. Since the meter is fully protected from overloads, it won't be harmed. Simply switch through successively higher ranges until the lamp goes out.

In that example it will go out at the 40-50-volt range, so you know the voltage is between those figures. Merely take the meter reading, in this case 5, and mentally add it to the lower number of the range (40-50) you are using; hence, 40 + 5 for 45 volts.

If the POLARITY LED glows yellow, this indicates that you have an AC voltage present. Turn the function switch to AC VOLTS and proceed just as you would with a DC voltage reading—expanded scale and all!

Below 2 volts, the AC scale is non-linear—but then, most AC meters are, and special scales are required. If that bothers you, or you wish to measure those low-level signals with this instrument, there's an unused amplifier in IC2 that could be used.

However, for voltages that low, a good AC millivoltmeter would probably be the best bet.

The AC scale has another unique characteristic: it's peak reading.

That means you can measure *any* AC voltage, *any* waveform (yes, even pulses, if the repetition rate is high enough), and obtain a peak reading. The value will have to be multiplied by 1.414 since we calibrated for sinewave RMS. But, you can calibrate for peak voltage by using 10-volts peak instead of RMS as a reference. Zener diode D5 will have to be changed to a 3.4-volt device.

If you calibrate your expanded-scale voltmeter for peak volts, an RMS value can be found easily by multiplying the reading by 0.707. **R-E**

Temperature Measurement-

JOSEPH J. CARR

WE'VE BEEN ABLE TO MEASURE TEMPERATURE electronically for many years but only recently have the circuits to do that been readily available. In this article, we will discuss some of the more common temperature-sensitive transducers, the circuits needed to make them work, and will introduce you to several integrated circuit temperature-transducer/amplifier combinations. Several semiconductor manufacturers now make two-terminal temperature devices that are very easy to use.

Temperature transducers

There are several different types of transducers that will convert a temperature to either a voltage or a current. Once the conversion is made, we can use amplifiers and voltmeters to process and display the result.

One of the earliest forms of temperature transducer was the *thermocouple*. If we form a junction of two wires of different metals as shown in Fig. 1, we will note a very interesting phenomenon called *Seebeck effect*. When the junction is heated, a voltage proportional to the temperature of the junction is developed across the two wires. That voltage can be measured and used to determine the temperature of the junction.

The voltage produced in a thermocouple is created by the different *work functions* of the two metals. Over the years, certain standard sets of metals have been defined for use in thermocouples and each standard set has its own temperature characteristics and applications.

Another very popular form of temperature transducer is the *thermistor*, or *THERMAL RESISTOR*. That device has a resistance that is a function of temperature (Fig. 2). There are *positive temperature-coefficient* thermistors, with a resistance that rises with temperature, and *negative temperature-coefficient* thermistors, with a resistance that de-

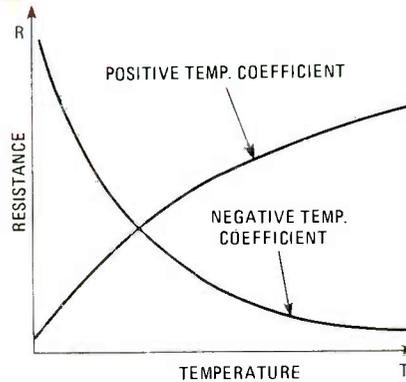
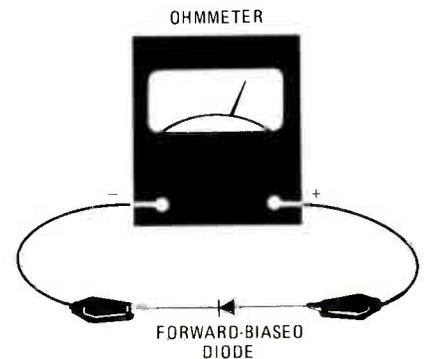


FIG. 2—AS THE TEMPERATURE goes up, the resistance of a positive temperature-coefficient thermistor also rises. The resistance of a negative temperature-coefficient thermistor drops with rising temperature.

Circuits and Components

It's easy to put together a temperature-measuring circuit if you know a little basic electronics. Here are several ideas to get you started.

FIG. 3—THE CURRENT through a pn junction is dependent on temperature. To demonstrate that, connect an ohmmeter across a diode as shown, grasp the diode in your hand, and note the change in resistance.



creases with temperature. The temperature-resistance curves for most thermistors are not linear (i.e., straight-line). That makes it difficult to use thermistors for accurate temperature measurement unless we use them only over the narrow range in which they are linear, or use an external-resistor *linearizing network* to make the curve straighter.

A typical thermistor electronic thermometer uses a Wheatstone bridge, with a thermistor as one of the bridge legs. The output voltage will be zero under a null condition—usually 0° C—and is approximately proportional to the temperature at other points. A differential op-amp can be used to amplify the small output-voltage, and to scale the voltage to some level that is

easy to display on an analog or digital voltmeter, such as 10 mV/°K (Kelvin).

In recent years, semiconductor temperature-transducers have become increasingly important. We know that the voltage across a pn diode-junction, and the current flow through the junction, is strongly affected by temperature. (That property is what causes drift in solid-state amplifiers.) We can demonstrate this with an ordinary silicon diode, say one of the 1N4000 series.

Connect an ohmmeter across the diode (Fig. 3) so that the diode is forward biased. That means connecting the positive terminal of the ohmmeter to the anode of the diode, and the negative terminal of the ohmmeter to the cathode. In case of doubt, the correct connection is the one that shows the lowest resistance on the $\times 1$, $\times 10$, or $\times 100$ scale of the ohmmeter. Note the ohmmeter reading, then apply heat (body heat is sufficient—grab hold of the diode and squeeze it in your palm) and watch the resistance change!

Although diodes are often used as temperature transducers, they are not always the best choice. In many cases, an ordinary bipolar transistor will make a better transducer, especially if it is diode-connected. (The collector and the base are shorted together to form one

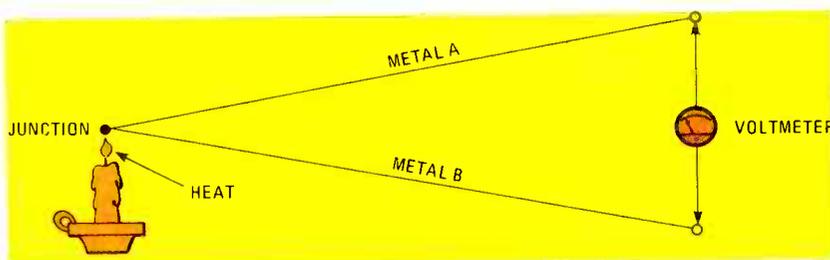


FIG. 1—WHEN A JUNCTION of two dissimilar metals is heated, a voltage that is proportional to the temperature of the junction is created.

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terminal of the "diode;" the emitter is the other.)

The base-emitter voltage of a transistor (V_{BE}) is dependent on both the collector current and the temperature. (If you're interested in the math you can find the formula in any good text on transistors.) Because of that, a transistor can be used to make a very linear temperature transducer that works over a range of approximately -55°C to $+125^{\circ}\text{C}$.

Transistor temperature transducers

Almost any transistor can be used to make rough measurements of temperature because of the relationship between the base-emitter voltage and temperature, when the collector current is held constant. But, some transistors are better temperature transducers than others. It seems that transistors in metal can-type cases (TO-5 and especially the smaller TO-18) have a better response than most epoxy or plastic-cased transistors. In addition, some transistors have a more linear V_{BE} vs. I_C curve than others.

Figure 4 shows a simple temperature transducer that uses NPN bipolar transistors. In this circuit, a dual transistor (two NPN silicon transistors in a single case) such as a MAT-01 (made by Precision Monolithics, Inc.) is used. The emitters are fed from 1- and 2-mA constant-current sources (it is important to keep the emitter currents *different* for Q1 and Q2) and the output voltage is approximately $59\ \mu\text{V}/^{\circ}\text{K}$.

A differential op-amp is needed to amplify and scale the output voltage to a usable level. It is particularly convenient to scale the voltage to $10\ \text{mV}/^{\circ}\text{K}$ so that a simple voltmeter can be used. To do that for this transducer, the differential op-amp must have a gain of 167. When the output voltage is $10\ \text{mV}/^{\circ}\text{K}$, any $3\frac{1}{2}$ -digit DVM can be used to measure temperature.

A solid-state thermometer

The electronic thermometer project shown in Fig. 5 uses a simple op-amp inverting follower circuit and a single—common—transistor such as a metal-case 2N2222. The transistor is used as a temperature probe and needs a suitable enclosure such as an old voltmeter probe grip, a short piece of metal tubing, etc. If the circuit is used to measure the temperature inside some piece of equipment, it can be mounted permanently and does not need a separate enclosure. However used, thermal contact with what is being measured is important. In the case of small-diameter metal tubing, the transistor case should be press-fit inside the tubing to insure that heat is conducted to the transistor's base-collector junction. If the fit is loose, or the enclosure not metal, you should use silicone "heat transfer" grease for the

best results.

Two DC reference voltages are needed: plus and minus 6.2 volts. Diode D1 provides the positive 6.2-volt DC reference, while diode D2 provides the negative 6.2-volt DC reference. The $+6.2$ source is connected to the collector-base terminal of the temperature sensor (Q1). That means that the emitter current of transistor Q1 will be proportional only to the temperature (the collector voltage is *constant*). That current is amplified by an operational amplifier (IC1) and scaled to produce an output potential of $100\ \text{mV}/^{\circ}\text{K}$. Potentiometer R1 is adjusted during calibration to provide the proper scale factor.

Again, an ordinary $3\frac{1}{2}$ -digit DVM can be used to measure temperature, but the reading will be in degrees Kelvin. To convert the reading to degrees Celsius, it is important to note that the Kelvin and Celsius scales are the same, but offset by 273 degrees ($0^{\circ}\text{C} = 273^{\circ}\text{K}$). To read temperature in degrees Celsius, an offset adjustment is needed.

Potentiometer R3 converts the temperature range of the basic circuit from Kelvin to Celsius by summing a counter-current from the -6.2 -volt DC supply with the current from the transistor. The potentiometer is adjusted to produce zero output from amplifier IC1 when the temperature is exactly 0°C .

Calibration

Once the circuit is built it will have to be calibrated. Set R1 and R3 to about the middle of their respective ranges. Turn the circuit on, and wait about 10 minutes for things to stabilize at room temperature. While you're waiting, prepare an "ice-point bath." The ice-point of water is 0°C ; (the temperature where ice and water can exist in the same container). Use a regular thermometer to verify that the temperature is 0°C (or 32°F). When the circuit has stabilized and the bath is ready, put the transistor into the water and wait about 30 seconds. When the output voltage of the operational amplifier has stopped

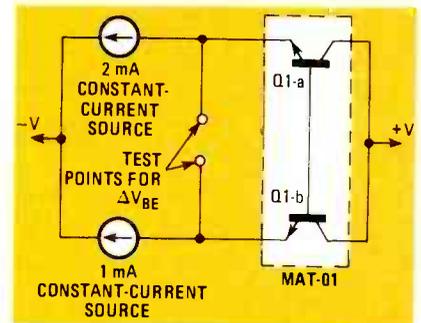


FIG. 4—WHEN THE OUTPUT VOLTAGE of this circuit is scaled by a differential op-amp, an ordinary DVM can be used to read the temperature.

changing, adjust potentiometer R3 for 0.00 volts output. Let the transistor stay in the bath for a few more minutes, while monitoring the bath's temperature with a thermometer (*not* the one you're calibrating) to make sure that it doesn't change. When you are satisfied that the output voltage is reasonably stable (some drift will occur), remove the transistor from the bath and allow it and the thermometer to come to room temperature.

Once both have reached room temperature (indicated by the fact that both the thermometer's reading and the circuit's output voltage no longer change), the last step in calibrating the circuit can be done. Adjust potentiometer R3 so that the reading on the DVM is the same as the reading on the mercury thermometer (ignoring the decimal point and trailing zeros on the DVM). When this is

PARTS LIST—FIG. 5

Resistors $\frac{1}{4}$ watt, 1% unless otherwise noted

- R1—100,000 ohms, potentiometer
- R2—100,000 ohms
- R3—20,000 ohms, potentiometer
- R4—2200 ohms
- R5, R6—10,000 ohms, 5%

Semiconductors

- D1, D2—LM113 (National) 6.2-volt Zener voltage-reference diode or equivalent
- Q1—2N2222 or equivalent, metal case
- IC1—CA3140 MOSFET op-amp or equivalent

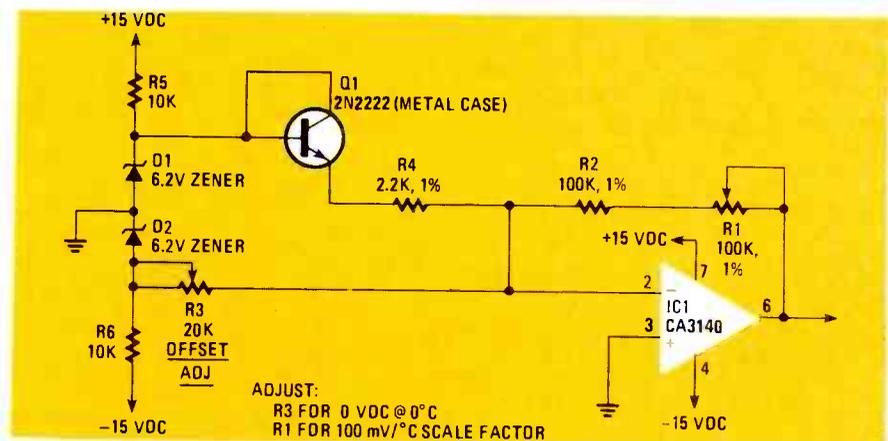


FIG. 5—THIS ELECTRONIC THERMOMETER PROJECT is easy to build and align. A parts list is included in this article for those of you that would like to try it.

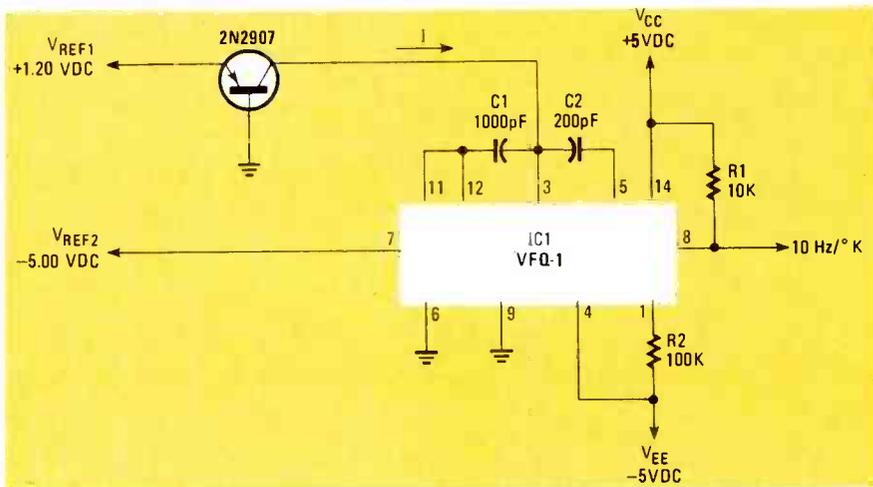


FIG. 6—THE HEART of this temperature-to-frequency converter circuit is a Datel VFQ-1 current-to-frequency converter IC. The 2N2907 is used as the temperature probe.

FAHRENHEIT, KELVIN, CELSIUS AND CENTIGRADE

There are three scales in common use for measuring temperature: Fahrenheit, Celsius (centigrade) and Kelvin.

The Fahrenheit scale, now used only in the United States and a few other English-speaking countries, is based on the freezing and boiling points of water at sea level—32° and 212°, respectively. The zero-point on this scale was probably established by using a mixture of ice and salt—materials commonly used to achieve low temperatures in laboratories at the time the scale was developed.

The Celsius scale, also known as the centigrade scale (it's not capitalized because, while the other three scales bear the names of their inventors—Gabriel Daniel Fahrenheit, Anders Celsius and Lord Kelvin—the term "centigrade" refers to the fact that the scale is divided into a hundred divisions), is used outside the U.S., wherever the metric system is found. On it, the freezing point of water is 0° and the boiling point 100°.

The Kelvin scale is also known as the absolute scale because its zero point is absolute zero, (-273.16° C or -459.69° F), the point at which all molecular motion ceases and there is—literally—no temperature.

One degree in the Kelvin scale is the same size as one degree in the Celsius scale; therefore water freezes at 273.16° K and boils at 373.16° K. The Kelvin scale is used primarily in applications such as solid-state physics and astronomy.

Incidentally, conversion from Fahrenheit to Celsius, and vice versa, is easier than you may think. To convert from degrees F to degrees C, just subtract 32 from the Fahrenheit temperature and divide the result by 1.8. Going from Celsius to Fahrenheit is even easier—double the temperature, subtract 10%, and add 32.

done, a 0-volts DC output will equal 0° C, a 3.00-volts DC output will equal 30° C, and so on. This happens, of course, because of the 100 mV/°C scaling factor. Alternately, a warm-water bath can be used for this part of the calibration procedure. Prepare the warm-water bath by mixing hot and cold water, and follow the steps that were outlined above for calibrating the thermometer circuit at room temperature.

The precision, and amount of drift, of this electronic thermometer depend on the quality of components used. The resistors, except for possibly R5 and R6, should be 1% precision-types with a low temperature-coefficient of resistance. The Zener diodes should be temperature-compensated reference types, such as National Semiconductor LM113's. The op-amp should also be a low-drift type, although acceptable performance can be obtained with an RCA CA3140, especially if it is heat-sinked. An ordinary TO-5 heatsink (the kind made of thin metal) will work nicely.

Other devices

There are a number of IC voltage-to-frequency (or current-to-frequency) converters on the market. An example of an IC that does both is the Datel

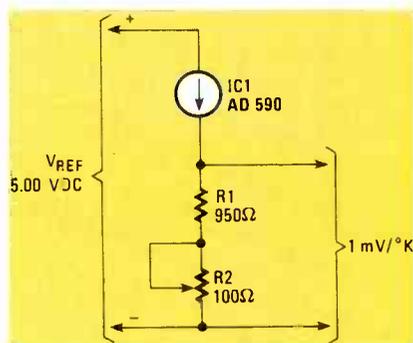


FIG. 7—A TEMPERATURE-SENSITIVE current source, the AD590, is used to measure temperature in this simple circuit.

VFQ-1. That IC is shown in a temperature-to-frequency converter circuit in Fig. 6. In the circuit, we are using the VFQ-1 as a current-to-frequency converter; the current is supplied by the collector of a PNP transistor that is used as a temperature transducer.

This circuit's output frequency will have a scaling factor of 10 Hz/°K. We can, therefore, expect an output frequency of 2730 Hz at the freezing point of water (273° K, or 0° C), and a frequency of 3730 Hz at the boiling point of water (373° K or 100° C). This type of circuit can be used to record the temperature data from an experiment on magnetic tape, or to transmit the temperature via radio telemetry from an amateur rocket or model aircraft. Unfortunately, the Datel IC is still a little expensive (although it is one of the lowest cost converters on the market) and is not generally available through hobbyist outlets.

Another special temperature-measurement semiconductor device is the AD590 (Analog Devices, Inc.) It is a two-terminal IC that is available at low cost in either a TO-18 case or a special two-terminal flat-pack. The device is a temperature-sensitive current source and is scaled to approximately 1 $\mu\text{A}/^\circ\text{K}$. If we pass the current from the AD590 through a 1000-ohm resistor, the result (using Ohm's law) is a voltage change of 1 mV/°K.

There are several ways that we can use the AD590 device. One is simply to connect it as shown in Fig. 7, in series with approximately 100 ohms of resistance. This configuration is called a *one-temperature*, or *one-point*, circuit. We adjust potentiometer R2 so that the output voltage agrees with a mercury thermometer at some specific temperature. Slight nonlinearities in the device, as in all semiconductor devices, will cause some error at points far removed from the calibration point.

Another method is to connect the AD590 directly between a +5.00-volt DC precision reference source and the inverting input of an op-amp. The scale factor of the thermometer can be set by the feedback resistor (R_F) using the formula: $V_O = (1 \mu\text{A}/^\circ\text{K})(R_F)(T)$.

We can also use the AD590 in a *two-trim-point* circuit that uses an op-amp as described above. An offset current is summed with the AD590 current at the inverting input of the op-amp. We can then use *two* potentiometers, one for offset and one for gain, to adjust the circuit at two different temperatures, thereby reducing the error.

Electronic thermometer projects are easy to build and calibrate, and they can be put together by anyone who knows Ohm's law and the basic principles of op-amp circuits. Just remember to use precision components that don't drift with—you guessed it—temperature!

ALL ABOUT

Superscope's PIANOCORDER

IN THESE HIGH-TECHNOLOGY TIMES, IT'S rather surprising that no one has marketed an updated version of the old-fashioned player piano. That is, of course, until recently. Superscope has developed an all-electronic version, the *Pianocorder Reproducing System*, for Marantz pianos. The *Pianocorder* is also available as a kit (model P-100) that can be installed in your own piano. That kit is the subject of this article.

Before we go any farther, let's see just what the *Pianocorder* is, and how it differs from the air-operated units of many years ago. Old-fashioned player pianos used paper rolls about the size of kitchen waxed-paper rolls with music "recorded" on them: the recording took the form of holes and slots in the paper. Among the problems with that system was that those rolls were rather fragile and difficult to store.

Contrast that with the *Pianocorder* system that uses ordinary audio cassette tapes. While you can purchase prerecorded tapes for the *Pianocorder* system, you can also record your own piano music. At this point you may be thinking: "So what, my cassette recorder can do that already." There is a very important difference, though: The *Pianocorder* does not record the music itself, but, rather, the *individual piano-key strokes*. The music you hear does not come from a speaker; it comes from the piano itself. For the dyed-in-the-wool hi-fi purist, you can't get more faithful reproduction from any other music system!

How it works

The system uses eighty solenoids with push rods attached to the upper parts of their moveable cores. (The top and bottom 4 keys of the standard 88-key piano keyboard are not used. Many old-fashioned player pianos had only 80 keys and since those extra 8 keys are seldom used, no provision is made for them.) The solenoids are positioned so that each of the push rods extends through slots in the keybed and comes in contact with the underside of one of the keys. Because each piano key is actually a lever with a fulcrum at its center, when you press a key down, its other end moves up. When the solenoid for any key is energized, its core moves upward, moving the push rod at the same time. The effect of the push rod's striking the bottom of a key is the same as your striking the top of the key at the keyboard.

A rail with 80 very sensitive switches mounted on a PC board is used when recording music: the rail is installed under the front part of the piano keys as shown in Fig. 1. When the rail is



What ever happened to the old-fashioned player piano? It's back, with an electronic facelift—a facelift you can perform yourself.

WARREN BAKER

properly installed and adjusted, one switch is located directly under each key. If a key is struck, the switch under it is closed. The switch closure lets the system know which key has been struck, and that information is recorded on tape. Switches attached to the "sustain" and "soft" foot pedals work in a similar fashion, and the information from them is also recorded by the player piano.

Of course, there's more to a piece of piano music than just striking the keys in a particular sequence. The player's "expression" (how softly he strikes the keys, for example) is also taken into account. A small microphone mounted on the "record" board picks up the relative acoustic pressure in the lower part of the piano and converts it to a signal that, when the recording is played back, helps the *Pianocorder* reproduce the piece of music faithfully. That feature often makes it difficult to tell a recording from the original rendition.

The electronics used in this recording system are quite exotic when compared to those found in most other consumer items. Even though a microprocessor is not used by this player piano, in many ways the system can be compared to a dedicated computer.

Logic and encoding

The system uses sixteen 8-bit words to encode each note (or chord), and to indicate the intensity with which each key is struck and the use of the foot

pedals. Timing is derived from a master clock. Figure 2 shows how the bits are assigned in the encoding scheme.

In examining the system, perhaps the best place to start is word 15, the "sync" word. That is the last in the sequence and can best be compared to the sync pulse of a composite TV signal since it establishes the proper relationships for all of the other words. Word 15 consists of 6 lows, 1 high, and 1 low (00000010); if there is a malfunction and any other bit sequence appears for word 15, the system will not work.

Two bits of word zero (the first word in the sequence) are used for the foot pedals. Five of the remaining six bits of that word are used for bass intensity (more on that later); the leftover bit (bit two) is not assigned. The notes are handled by words 2 through 6, and 9 through 13; each bit represents one of the 80 notes (10 words of 8 bits each give 80 notes).

As pointed out earlier, expression is an important variable in the recording



FIG. 1—HIGHLY SENSITIVE SWITCHES mounted under each key are used to record your own performances.



system. The signal from the microphone on the "record" board is applied to the bass and treble registers' active filters, and then to a digital-to-analog converter (DAC) for inclusion into the respective bass or treble counters and registers. On playback, the process is reversed, and the information used to "modulate" the action of the solenoids. Bass intensity is handled by 5 bits of word 0; treble intensity is handled by 5 bits of word 8. The inclusion of the intensity information helps to combine the *Pianocorder* and the piano into a system that, according to the manual, "...truly reflects the touch of the pianist."

The digital information generated by the logic as just outlined is first fed to a parallel-to-serial converter, and from there goes to a bi-phase converter that generates tones which can be recorded on tape. A 2250-Hz tone is used to represent a logic-0 and a 4500-Hz tone a logic-1. That principle is similar to that used by home computers for storing data on cassette tape and, in fact, both tapes sound similar when you play them back on an ordinary cassette recorder.

During playback, the signal from the

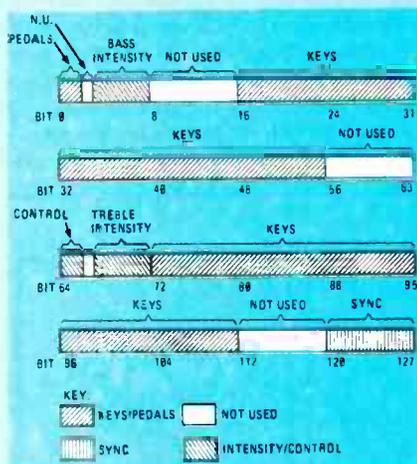


FIG. 2—BIT-ASSIGNMENT used by the *Pianocorder*'s encoding system. Each key or pedal depression results in a 128-bit string.

recorder is fed to the playback logic-board (shown in Fig. 3) through an optoisolator that segregates the cassette recorder's circuitry from the 5-volt circuitry used by the balance of the system. The audio signals are routed to the board's decoders and counters, and the resulting logic-level control voltage goes to the appropriate solenoid-driver board (see Fig. 7). The 170-volts required to drive the solenoids is switched by power transistors that are located on the driver boards.

To reduce heat build-up, a special circuit allows full current-flow to the solenoids only when they are first energized. The current is then reduced to a level just sufficient to hold the solenoids' slugs in position, and held at that point until the solenoid is de-energized.

Power supply

The power supply is quite straightforward and provides the three DC voltages (+5, +12, and +170 volts) that are required by the system. Power for the solenoids is derived from a bridge rectifier. An interlock switch mounted on the playback logic-board prevents the solenoids from being activated if the front of the piano is removed. That feature is included for safety.

The 5- and 12-volt supplies are taken from a step-down transformer. The 5-volt supply uses a 723 regulator. It should be noted that the system uses three separate ground connections. One of those, the system ground, ties together all of the metal parts of the *Pianocorder* and the piano, and connects them to the power-line neutral (the "green" prong of the three-prong power-line plug). That can cause some problems when troubleshooting or testing the *Pianocorder* if you use an oscilloscope (or other piece of test equipment) that is grounded to the power-line neutral. The instructions suggest that you use battery-operated test equipment or an isolation transformer when testing or servicing the system. Otherwise, your common-ground connection should be chosen with great care.

Before you begin

Needless to say, installing the *Pianocorder* in your piano should be done with care. Superscope has made several assumptions about your knowledge and equipment. It is assumed that you have a well-equipped shop with all the usual hand and power tools, and that you know how to use them. Some of the tools used by piano technicians would also be handy to have but it really does not pay to buy them for a one-time project such as this. You can do very well without them, although the job may prove to be a little more difficult. There

are also certain parts of the project where a "helper" will make things a great deal easier; perhaps a family member can be pressed into service in those instances.

Superscope also assumes that you have a "fair" working knowledge of how pianos operate. Don't let that scare you, though, because the installation manual covers all the working parts of the typical piano, in great detail. In general, the instructions are extremely elaborate. There are warnings throughout the instructions (where needed) that urge the installer to be absolutely certain that he understands the step being described before carrying it out. Be sure to heed those warnings!

Before beginning the installation, some measurements have to be made to determine whether or not you will be able to install the *Pianocorder* in your piano; those measurements are completely explained in the instruction manual. Although a number of measurements are required, only a few have any serious bearing on the end result, even though some may seem to indicate that you will not be able to install the unit. In some cases further instructions show you how to overcome the problem, while in other cases, (depending upon your abilities as a technician) you may be able to find your own way out of dilemma.

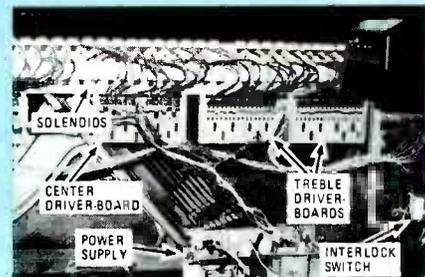


FIG. 3—MOST OF THE ELECTRONICS are installed in the lower part of the piano. Shown here are the solenoids, three of the five solenoid-driver boards, the playback-logic board, and the power supply.

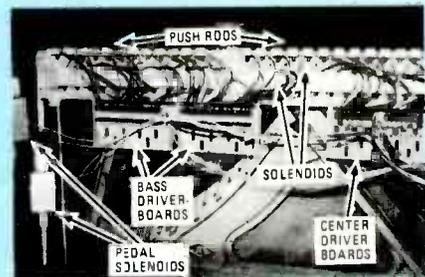


FIG. 4—DURING PLAYBACK, the piano keys are operated by the solenoids which, in turn, are controlled by the appropriate driver boards. The solenoids at the far left operate the "soft" and "sustain" foot pedals.

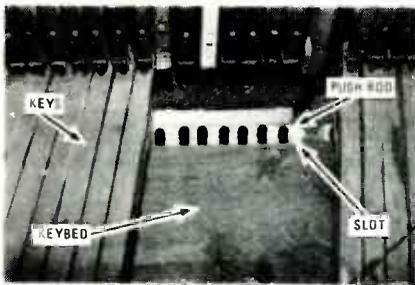


FIG. 5—THREE ½-INCH SLOTS (one shown here) had to be cut into the keybed so that push rods connected to solenoids mounted on the underside keybed could operate the keys. Seven keys were removed here to show detail.

Modifying your piano

The modifications that have to be made to the piano will vary with the type of piano you own. In my case, probably the biggest one was cutting three ½-inch-wide slots through the keybed; those slots let the solenoids that are installed on the underside of the piano operate the keys (see Fig. 5). In addition, I had to modify the mounting bracket that connected the "harp" frame to the keybed. (I cut it down.) The pedal "trap" mechanism also had to be remounted to provide clearance for the pedal solenoids. Although that was easily done for my piano, the same may not be true for other units. The instructions for this part of the project leave the details entirely up to you and plainly state that the examples provided are only representative of some of the methods that can be used.

Installation

It is important that the solenoid push-rods contact the underside of each key

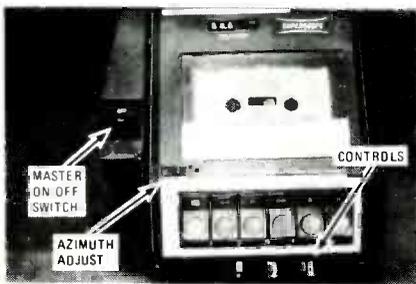


FIG. 6—THE PIANOCORDER'S cassette tape recorder looks much like a regular one. The master ON/OFF switch is at the left.

as cleanly as possible. A locating "stick" has to be prepared, and is used to determine those contact points; it must be marked accurately. The positions determined by the stick are used to place the solenoids in their proper positions on the solenoid rail. If you are sloppy when you position the solenoids, you may have the nasty and time-consuming problem of making individual adjustments after the assembly has been installed in the piano. (In my case, one solenoid was misadjusted; that error caused two of the keys to sound at the same time.)

Since the *Pianocorder* uses cassette tape, it also needs a cassette recorder/player. That unit, shown in Fig. 6, looks like a ruggedized version of a standard portable one. It runs at a speed of 3¾ inches-per-second. In use, the recorder/player swivels out from under the right-hand side of the keyboard. The master ON/OFF switch and other operator controls are also located on the recorder assembly. Some pianos (mine included) may have a slight rim at the front of the cabinet, in the area where the recorder is to be mounted. The modification needed in that case is simple: A half-inch spacer is used to give the recorder enough room to clear the rim.

Since, for some reason, someone had previously modified the piano I used for this project, some of the situations I ran into should not be considered typical. For instance, it appeared that sometime in the past the entire keyboard (and key-

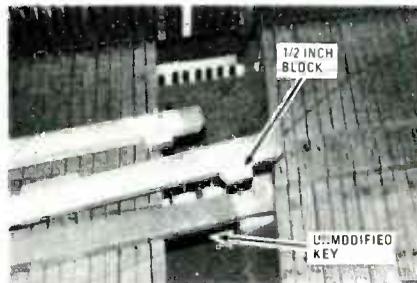


FIG. 7—ADDING A HALF-INCH block of wood to the bottom of each key made it possible to install the *Pianocorder* in my piano. The lower key is shown unmodified.

bed) had been raised a full inch above their normal position. Since the solenoid push-rods could not reach the underside of the keys because of that increased elevation, it at first appeared impossible to install the *Pianocorder*. Fortunately, I was able to solve that problem with a little ingenuity. Gluing half-inch-thick pieces of wood to the underside of each key (see Fig. 7) made up for the increased height and, when the project was completed, the player piano worked perfectly.

It is interesting to note that the above modification also could have saved me considerable work in cutting the mounting bracket. As mentioned earlier, I had shortened the bracket so the solenoid rail could be placed closer to the key-

bed and allow the push rods a longer throw; the added pieces on the keys served the same purpose.

From the point where the solenoid rail is installed in the piano, the work consists mostly of drilling pilot holes for the screws used to mount the various parts of the *Pianocorder*. Surprisingly, however, most of the system's components are connected to each other, and very little is actually attached to the piano. In fact, only the power supply and the playback logic-board (with the piggy-back-mounted "expression" board) are actually secured to it. With the exception of installing the record key-switches (more on those later), all the work is done in the lower section of the instrument.

The instructions are phrased for use by piano technicians who, in all probability, are not too familiar with the electronic parts of the reproducing system. Because of that, it may seem to some readers that the instructions have been too simply written at times. Bear with them, however; they will lead you through the project, and help insure that the piano will produce wonderful music when you're finished.

As you may have guessed by now, installing the *Pianocorder* in your piano is not a one-night project. However, if you decide to undertake the job, the time you spend will be justified by the entertainment this system can provide. The completed player piano will amaze your friends and neighbors, and provide untold hours of family fun. There are tapes available that cover just about every musical taste or period and in addition, you will have the pleasure of being able to record *your own* performances for posterity!

Installing the *Pianocorder* in my piano has been one of the most enjoyable construction experiences that I've had in a long time. Coming from an electronics "builder," that statement means quite a bit. In closing, it should be reiterated that this kit is *not* something for an inexperienced person to undertake without some help from someone with a good knowledge of tools and their proper use. Yet, if you use good common sense and follow the instructions, you should be able to complete this satisfying project. **R-E**



MOST OF THE NOISE-REDUCTION SYSTEMS used in high-fidelity circles during the last few years have been geared primarily to tape recording and playback. For example, Dolby noise reduction, while sometimes used by FM stations to increase their noise-free coverage area or to improve the dynamic range of their musical programs, is confined mostly to tape-recording applications. Specifically, *Dolby B* noise-reduction encoding and decoding has found its widest application in stereo cassette-tape decks.

To date, the only companding type of noise-reduction system that has been applied to phonograph records has been the one developed by dbx, Inc. In that system, program material is first compressed by a ratio of 2:1 for cutting the master disc, and then expanded by a ratio of 1:2 during playback of records manufactured from that master. While the system is startlingly effective, both in terms of noise reduction and in terms of increased dynamic range capability, a dbx decoder is required to play the discs. If they are played back without the decoder, they sound—to say the least—strange.

Now, CBS has come up with a new companding system for discs, designated CX, that is said to offer several advantages over any earlier one. Among them are:

1. Compatibility—encoded recordings can be listened to with or without a decoder.
2. A 20-dB reduction in perceived surface-noise.
3. Excellent transient response.
4. Little or no audible pumping (audible variations in the volume of the background noise due to the action of the filters) or switching of noise in the companded state.
5. Relatively independent signal levels.

To get the most out of the system a decoder costing about \$100 is required, but what sets the CX system apart from the others is that a CX-encoded record can be played on ordinary equip-

ment without the decoder and still sound good. With most musical selections, the undecoded record is comparable in sound quality to a conventional record containing the same program material. Of course, with no expansion during playback, there is no noise reduction. With the decoder, the quality is nearly indistinguishable from

will reduce this to about 81 dB. That is still about 20 dB better than the 60-dB dynamic range available on the best modern vinyl records. Hence, by choosing a 20 dB companding system, and adding the 20 dB of dynamic range at the "bottom," CBS has, in effect, permitted today's vinyl records to equal multi-channel digital tape-recordings as

far as dynamic range and quietness are concerned. Sounds that were previously masked by record surface-noise can now be heard clearly.

Wide-band companding

Record-surface noise has a frequency spectrum similar to that shown by the broken line in Fig. 1; it is relatively strong at bass and treble frequencies. However, sensitivity of the human ear decreases at low and high frequencies, as is shown by the constant loudness-contour curve (the solid-line) in that figure. If the value of the constant loudness-contour curve is subtracted from that of the record surface-noise curve, it can be

CX Noise Reduction for Phono Records



A new noise-reduction system for records from CBS provides 20 dB of noise reduction, yet discs made using it suffer no loss in quality when played without a decoder.

LEN FELDMAN
CONTRIBUTING EDITOR

the original master tape, whether analog or digital.

Why stop at 20 dB?

The CX system works by adding 20 dB to the dynamic range of a recording. This expansion is added at the "quiet" end of the range—the area where record surface-noise begins to present problems.

The reason CBS settled for just 20 dB is interesting. The new system is obviously designed to serve as a stop-gap measure until true digital phonograph-records become available. (The records that are called "digital" today are simply analog discs that have been mastered from digital-audio tapes.) Now that tape hiss is no longer a limiting factor in mass-produced phonograph records (thanks to digital master-tapes) the new limiting factor becomes the surface noise of the disc itself. A professional-type digital tape recorder has a maximum effective dynamic range of about 95 dB per channel. After a 24-track mix-down, it can be shown that the randomly added noise introduced

seen that the perceived noise is nearly flat as a function of frequency. From that, CBS concluded that noise reduction should be uniform at all frequencies. That differs from the approach used by Dolby for tape and FM broadcasting, largely because the noise spectra for those media are not the same as the surface-noise spectrum of a phonograph record.

The wide-band compression/expansion function shown in Fig. 2 was chosen by CBS for its system. The compression curve has a 2:1 gain for signals from above 0 dB reference level (5 cm/second lateral stylus-velocity at 1000 Hz) down to -40 dB. Since compression below -40 dB is not desirable because it would tend to raise the level of the background noise of the master tape above that of the surface noise of the record, the compression slope is rapidly changed to 1:1 below -40 dB.

If digital tape is used as the mastering source for a record, the perceived signal-to-noise ratio is reduced by the 20-dB compression, making it roughly

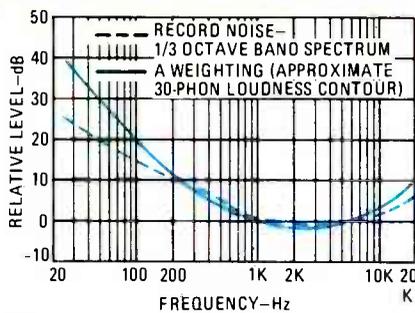


FIG. 1—WHILE RECORD SURFACE-NOISE is greater at bass and treble frequencies, the sensitivity of the human ear is reduced in those ranges. The overall subjective response is essentially flat.

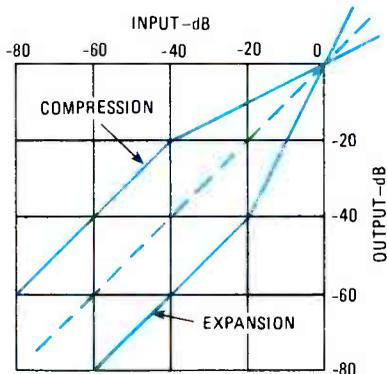


FIG. 2—COMPRESSION AND EXPANSION curves for the CBS noise-reduction system. The curves are complementary so that a processed signal will closely match the original program source.

equal to that of a conventional (unencoded) record. If an encoded record is played back without the benefit of a corresponding expansion circuit, changes in the dynamic gain of the master tape's noise tend to be masked by the continuous record-surface noise, making them all but inaudible to the listener. That effect is aided by carefully choosing the time constants that are used in the control circuitry of the system (more on that later).

Figure 2 also shows the expansion curve of the system. That curve is complementary to the compression curve so that a signal that undergoes the entire process of compression and expansion will match the original program source closely, but with 20-dB less noise. For proper operation, the system requires reasonably accurate tracking by the phono stylus. Not all phono cartridges deliver exactly the same level of output for a given stylus velocity in a record groove and for that reason it is possible for the reproduced signal to differ somewhat from the source material.

According to CBS, however, that effect has been found to be virtually unnoticeable for mismatches of up to 6 dB between the expansion and compression curves. Some of the CX expanders on the market offer a calibration adjustment so they can be used with virtually any stereo cartridge.

Expander

A block diagram of the CX expander is shown in Fig. 3; a representative schematic is shown in Fig. 4. Left- and right-channel signals from a CX-encoded record are fed directly to their respective variable-gain amplifiers. At the same time, those signals are processed by a control circuit whose output is the control voltage for the variable amplifiers. The control circuit consists of three distinct sections: a rectifier circuit with a preset threshold-voltage, a filter circuit, and a time-constant circuit.

Rectifier circuit

In the rectifier circuit, the combined left- and right-channel inputs are full-wave rectified before being passed on to a maximum-signal selection output. For signal values above the present threshold, V_C , the control circuit's output varies in direct proportion to the input-signal level. These changes control the amplification factor of the variable-gain stage. Together with the changing signal-levels at the variable-gain stage, the combined effect is an output that increases or decreases at a 2:1 ratio with respect to the input, when the level of that input is above V_C .

When the signal level falls below V_C , the control circuit's output no longer changes. Under those circumstances no expansion takes place between the input and output.

Filter circuit

The main filter-circuit (IC2-a, D6, R10, R11, and C3 in Fig. 4) is relatively fast, with an attack time-constant of about one millisecond and a release time-constant of about 10 milliseconds. Those time constants allow for rapid

action of the control signal.

If the output of the main filter-circuit were used by itself as a control signal, the results would be unacceptable because noise, distortion, and pumping would occur. To avoid those effects, the multi-filter, multi-time-constant, circuit shown in Fig. 3 is used.

Multi filter/time-constant circuit

This circuit consists of four filters whose outputs are added together to form a single control-signal. Filter 1 is high-pass filter with a "dead band" (the filter ignores signals below a certain level) and a positive-peak rectifier; the filter has a time constant, T_1 , equal to 30 milliseconds. Filter 2 is a low-pass type with a time constant, T_2 , of 2 seconds. Filter 3 is a low-pass type, with a dead-band and a positive-peak rectifier; that filter's time constant, T_3 , is 30 milliseconds. Finally, filter 4 is another low-pass type, with a dead band and a negative-peak rectifier; it has a time constant, T_4 , of 200 milliseconds.

Filter operation

Filter 2 is used to insure minimum audible noise and signal modulation in steady, low-level, signals. If it were used alone, it would suffice for that purpose but would not respond adequately to rapid changes in musical content. That is the function of the remaining filters.

Filters 3 and 4 are used for musical-transient signals of short or medium duration. Filter 3 allows a fast attack to pass, and then begins its 30-millisecond decay. Even with good filtering ahead of this stage, its DC input will contain some ripple. If the ripple component is

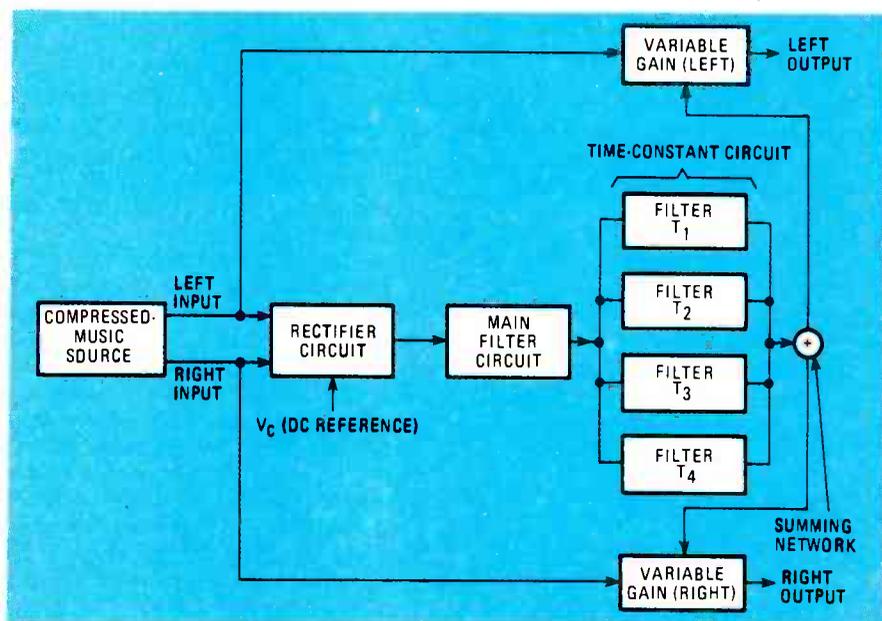


FIG. 3—BLOCK DIAGRAM of a CX expander unit. The input signal is fed to both variable-gain amplifiers and to a control circuit. The output of the control circuit (which consists of rectifier, main-filter, and time-constant circuits) is the control current for the variable amplifiers.

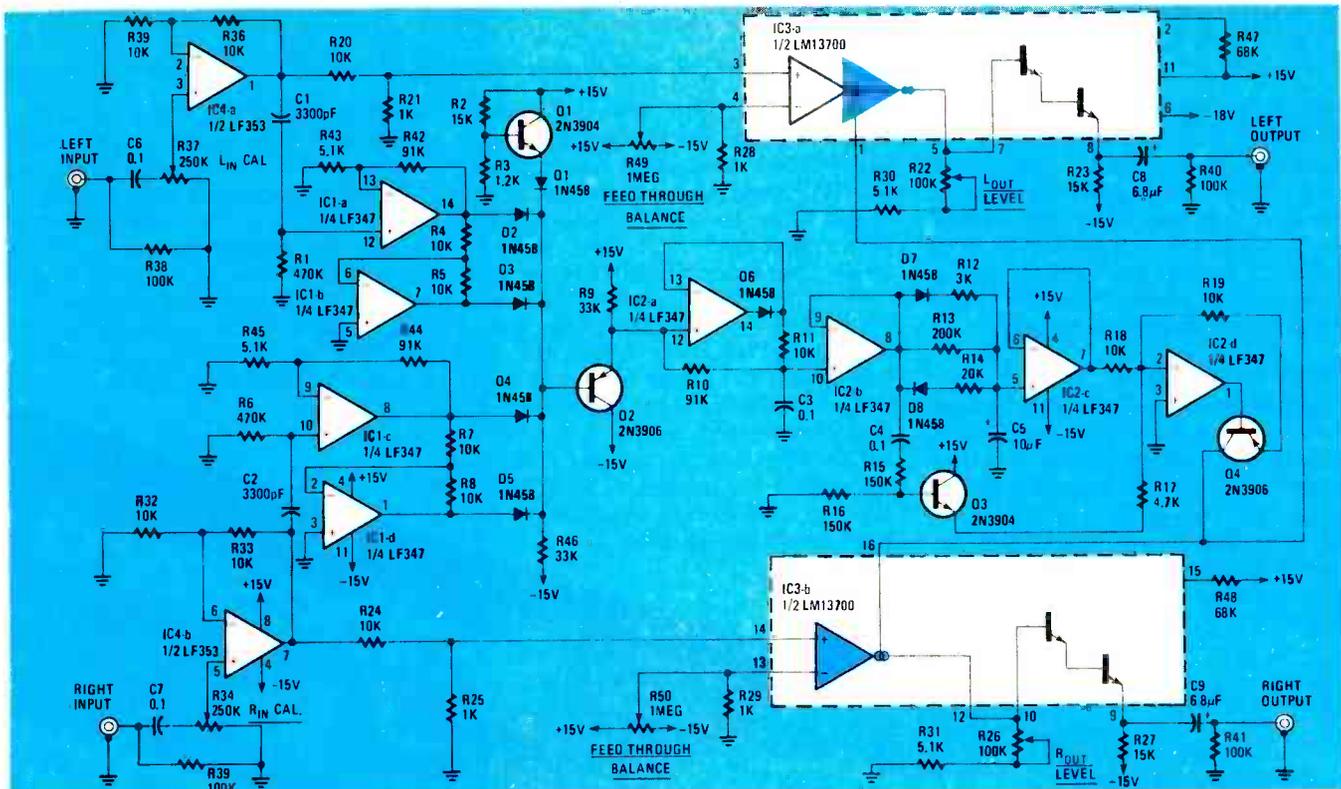


FIG. 4—THE OUTPUT of the time-constant circuit is buffered by IC2-c, and then summed by IC2-d and Q4, a voltage-to-current converter. The control current for the variable-gain amplifiers (IC3-a and IC3-b) is taken from the collector of Q4.

not removed, audible distortion will occur in the transient. Listening tests have confirmed that the human ear is not particularly sensitive to such distortion if its duration is less than 30 milliseconds. So filter 3 passes only the first 30 milliseconds of the attack-transient. If the signal continues for longer than 30 milliseconds, filter 1 takes over. It is a low-pass filter with a 30-millisecond time constant. When a sudden transient signal occurs, that filter will ignore the signal for the first 30 milliseconds, but will allow what comes after that length of time to pass. It will also remove nearly all of the ripple from such signals.

Filter 4 is used to control sudden decreases in signal levels. If such sudden decreases were not controlled, pumping or "breathing" would be heard. It's been demonstrated that the human ear is not sensitive to pumping during a rapid decay of not more than 200 milliseconds. Filter 4 allows the circuit to track the decay for that length of time. After that period, at the time when the listener would begin to notice the decay, control is taken over by filter 2. That filter, thanks to its two-second time constant, keeps the noise-level relatively steady.

According to CBS engineers, the overall combination of the four filters allows their system to operate effectively with music signals that would be

considerably more difficult for other noise reduction or companding systems to handle.

An obvious advantage of the system is the compatibility claimed for it. If the encoded version of a given piece of music is indeed virtually indistinguishable from the conventional pressing of the same material, CBS Records, or anyone else using the CX system, will have to produce only one type of recording in the future. The casual music listener can then listen to that recording on his ordinary phonograph or hi-fi component-system as he normally would. The more serious audiophile, on the other hand, will be able to add a relatively inexpensive expander accessory to his stereo system and enjoy the full benefit of an additional 20 dB of noise reduction.

It is interesting to note that CBS has proposed that its new companding system be incorporated in any multi-channel TV-audio system that might be approved by the FCC in the future. Transition to stereo audio (or multilingual audio), regardless of which of the proposed systems is chosen, is bound to result in some degradation of audio signal-to-noise ratios for many viewers within a TV station's service range. The incorporation of a companding system at the outset would help to offset that degradation. Furthermore, since the CBS system is claimed to be

compatible, those viewers who continue to watch the future "stereo" TV programs over their mono TV receivers would not notice any difference in audio quality. Other noise reduction systems that have been suggested for TV stereo-audio include a modified, compatible form of the linear *dbx* companding system and the newly developed *Dolby C* noise-reduction system (see the May issue of *Radio-Electronics*) from Dolby Laboratories. **R-E**



"Mmmmm—what smells so good?"

BUILD THIS

Part 3 IN THIS PART WE'LL FINISH up the Programma 2, calibrate it, and put it to use. All the hard work is already done, so all that's left are a few easy things like stuffing the switch board, and putting the electronics in a case. Let's get started by discussing the circuitry on the switch board before we put it together.

Switch board theory

Surprisingly enough, the switch board isn't absolutely necessary in this project! A three-position switch could be used in its place to select the proper VCO, serving as a "bandswitch." However that isn't a very elegant approach to selecting ranges, and you'd have an extra switch to fiddle with. Top that off by realizing that the IC's cost

at pin 1 of the IC goes low. Since those conditions also apply to a "9" input, gate IC304-a detects that condition via the "D" input, and prevents decoding of that value. Pin 1 of IC302-b drives inverter IC304-c, which puts a logic "high" on gate IC303-b whenever a "3" or "4" switch input is decoded. That "high" passes through the gate, turning on transistor Q302. On the other hand, if any other number besides "3" or "4" is applied to the decoder, it won't be decoded, and pin 1 of IC302-b will be high. That goes to gate IC303-a, and turns on transistor Q301. That takes care of the decoding scheme for the 1-MHz switch position.

easy to get if you don't have them. That makes this phase of the project a good candidate for a Sunday afternoon when all the stores are closed. Refer to Fig. 15 for details as you stuff the board.

Start by positioning the board as shown. Then begin by installing the 16-pin IC socket at IC301. Position the notch indicating pin 1 pointing up. (Do that with the rest of the sockets, too.) Then install the three 14-pin sockets.

Synthesized RF Generator



GARY McCLELLAN

In the concluding part of this article we'll finish building the Programma 2 synthesized RF generator, calibrate it, and present some hints on using it.

about the same as a decent switch, and you'll want to build the board.

Basically, the switch board, whose schematic is shown in Fig. 13, is nothing but a decoder circuit. It plugs into J101 on the control board, and decodes the BCD signals from the 10-MHz and 1-MHz positions on the switches. The decoded signals then turn on one of three transistors on the VCO board, applying power to the correct VCO circuit.

In operation, BCD data from the 1-MHz switch position is supplied to the switch board, and drives display decoder IC301. Although the IC was designed to drive an LED display, it can decode in other ways, too. When binary-coded-decimal inputs of "3" or "4" are applied to the decoder, the "b" and "g" segment outputs are high, while the "e" segment is low. Gates IC302-a and -b detect those conditions, and the output

Decoding the 10-MHz switch position is easier. Gate IC304-b detects a logic "high" on either the "A" or "B" inputs. When that happens, as it would if the switch were set to "1," "2," or "3," the output of IC304 goes low. That shuts down gates IC303-a and -b making transistors Q301 or Q302 turn off. At the same time, the pin-4 output of IC304-b is inverted by IC304-d, turning on transistor Q303. Thus, the 10-to-30 MHz VCO is selected.

The remaining components on the board are strictly for protection, and can save the IC's if the cable to the control board is plugged in backwards.

Switch board construction

Assembling this board is easy, and the whole thing should take little time. The foil pattern is shown in Fig. 14. Note that all the parts are common, and should be

Check to be sure you've soldered all connections.

Continue with the resistors. Install six 100K units at R301 through R306 as shown, near the left side of the board. Then install a 10K resistor at R307. Bend the leads as shown, and insert into the board. Below it, install another resistor at R308. Finish up by installing a 10K unit at R309. Again, bend the leads as shown, and then insert them into the board. Note that "spaghetti" tubing over the leads is unnecessary.

Note that the two jumpers run between the ICs. Use leftover resistor leads for the jumpers, if you wish. Install the jumper that runs horizontally between IC301 and IC304. Bend the wire into shape first, and then insert it into the board. Pull the wire tight against the board before soldering. After that, install the vertical jumper in the same

manner. Be sure to pull it tightly against the board so that it can't touch the first jumper.

Now for the transistors. Note that they are all 2N3904's, and that they all mount facing in the same direction. Mount Q301 first, with the flat side in the case pointing up. Then mount Q302 below it in the same manner. Finally, mount Q303 near the bottom of the board, with the flat side pointing up.

Install a 1N4148 diode at D301 as shown, with the banded end pointing toward the center of the board. Then install a 0.1 μ F disc at C301 between the transistors. That takes care of the component installation on the board.

Finish up with the cables, starting with the input cable—the one with the plug on it. Cut about a six-inch piece of 8-conductor ribbon cable, and prepare the ends. Then prepare the 8-pin DIP header PL101. Solder the wires to it in order, and snap the cap in place.

Connect the other end of the cable to the board as shown in Fig. 15. (You may want to check out the connections with an ohmmeter.) Once the input cable has been installed, you can proceed to the output cable. Cut about an eight-inch length of 3-conductor ribbon cable, and prepare the end. Install the wires in the holes near the transistors as shown in Fig. 16. You should make a note of where the wires go, for future reference. That completes the board wiring.

At this point you can install the IC's.

Refer to Figs. 15 and 16.

Final assembly

The time has come to install the boards in a case and to connect the cables. But first, a few comments about the cabinet you should use. The prototype used a leftover cabinet from a piece of medical equipment. It's not available commercially but you can probably do just as well with an "off the shelf" product. When you shop for a cabinet, look for one that is at least 3 inches by 8 inches wide by 7 inches deep. That was the size of the prototype's cabinet, and is just right to hold the boards. Also, it should be all metal for shielding. If you use a plastic cabinet, the unshielded electronics may interfere with sensitive measurements. Knowing those two requirements, you are all set to visit your electronics supplier and make a selection. You might even want to use a plain chassis box to keep costs down. If painted and labelled carefully, the box can look better than most cabinets!

Once you have a suitable cabinet you can lay out the boards and controls. Probably the best arrangement is the simplest, so you might want to copy the layout shown in Fig. 17. Otherwise, just be sure to space the control and VCO boards as close together as practical: the rest isn't critical.

Here are some tips to make the board layout easier. The only areas to be concerned about are the front panel and the

bottom. Since the front panel holds only five parts, it's not a problem. That leaves the bottom of the cabinet. Position all three boards on it to determine where to mount them; then use the boards themselves as templates to mark the mounting holes.

Be sure to allow extra room at the front of the cabinet for the switches. About three inches of clearance should be the minimum. Also, if you can, mount the switch board near the front on the bottom of the cabinet. That allows easier access to the control board, which was partly covered by the switch board in the prototype—not such a good arrangement from a service standpoint. With those suggestions, board placement should be easy to determine.

The next step is to machine the cabinet. You can start with the bottom of the cabinet by drilling out the mounting holes for the boards. Then drill a hole in the rear panel for the power cable. It may be necessary to enlarge it so that a grommet can be installed to protect the cable. (We used a plastic strain-relief salvaged from a junked appliance.) You can now drill the front panel. Generally, it will be necessary to clamp the panel in a vise so the holes can be drilled accurately. Be sure to protect the panel's finish by placing a piece of cloth between it and the jaws of the vise. When it comes to making the cutout for the FREQUENCY SET switches, probably the best way is to drill small holes around the

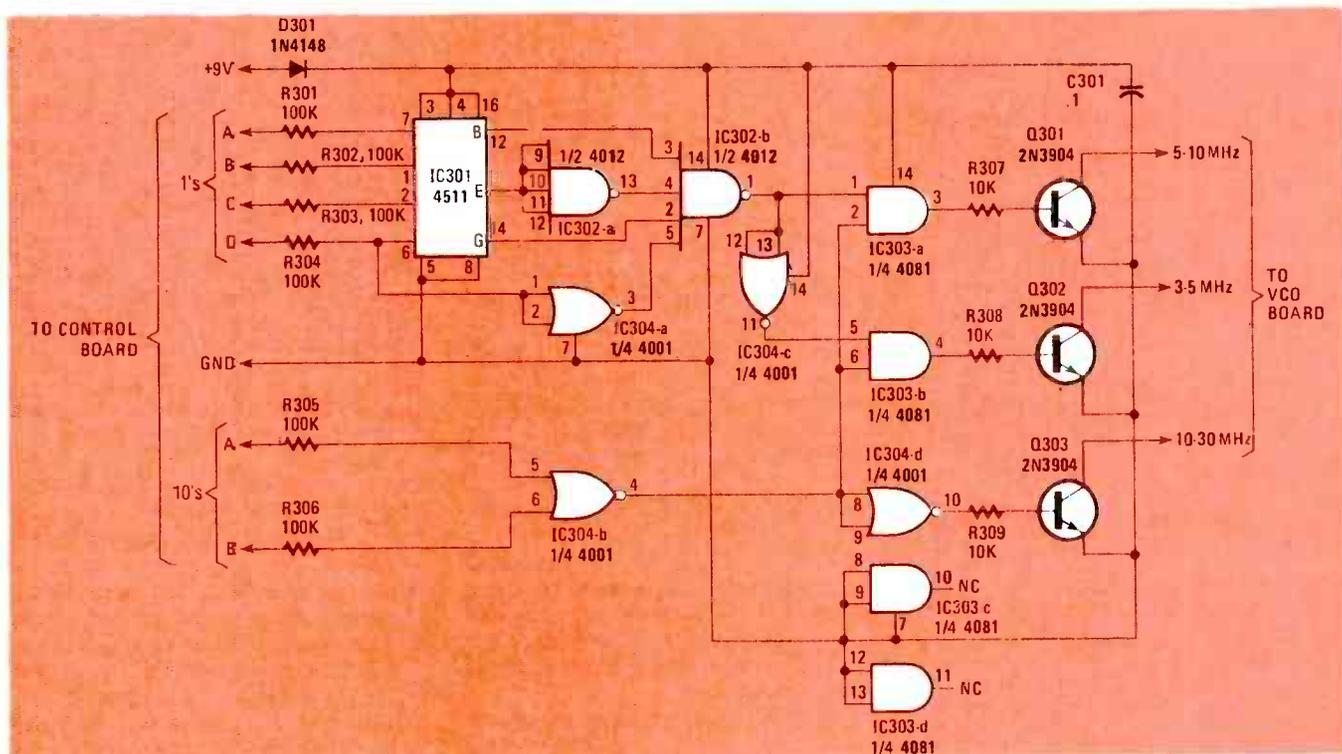


FIG. 13—A SEVEN-SEGMENT LED DECODER, IC301, is put to a rather unorthodox use on the switch board. Its segment-output states determine which of the generator's VCO's will be active.

PARTS LIST—SWITCH BOARD

All resistors 1/4-watt, 5%

R1—5000 ohms, potentiometer, linear taper with switch

R301-R306—100,000 ohms

R307-R309—10,000 ohms

Capacitor

C301—0.1 F, 16 volts, ceramic disc

Semiconductors

IC301—CD4511 CMOS 7-segment latch/decoder/driver

IC302—CD4012 dual 4-input CMOS NAND gate

IC303—CD4081 quad 2-input CMOS AND gate

IC304—CD4001 quad 2-input CMOS NOR gate

Q301-Q303—2N3904 or equivalent

LED1—jumbo red LED

D301—1N4148 or 1N914

S5, S6—SPDT toggle switch

T1—wall-plug transformer, 12 volts, 600 mA

PL1—8-pin DIP header

J1—BNC connector, chassis-mount

Miscellaneous: PC board, IC sockets, 1/2-inch threaded standoffs, metal enclosure (see text), knob, RG-174 coax, ribbon cable, etc.

A complete set of three boards for the Programma-2 is available for \$22.00 ppd. from: Technico Services, PO Box 20HC, Orangehurst, Fullerton, CA 92633. CA residents please add 6% tax; foreign orders please add \$3.00 for shipping. Order No. SSG-1.

A complete set of parts, excluding boards, crystal, transformer and case, is available for \$112.00 ppd. from: Circuit Specialists, Inc., PO Box 3047, Scottsdale, AZ 85281. Order No. KT-5. Phone orders (800) 528-1417; all other inquiries (602) 966-0764. AZ residents please add tax.

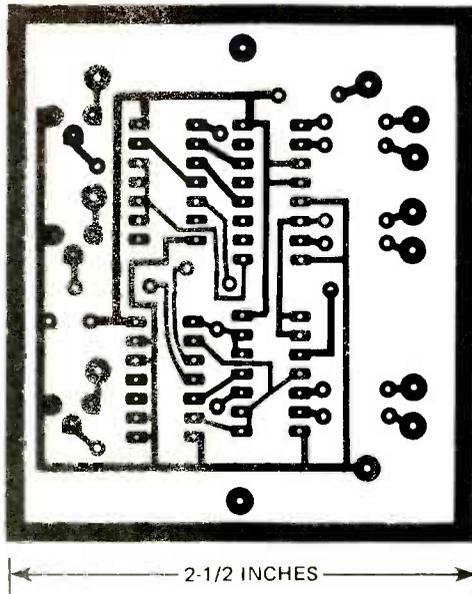


FIG. 14—FULL SIZE FOIL PATTERN for the switch board. Large pads are used to make off-the-board connections.

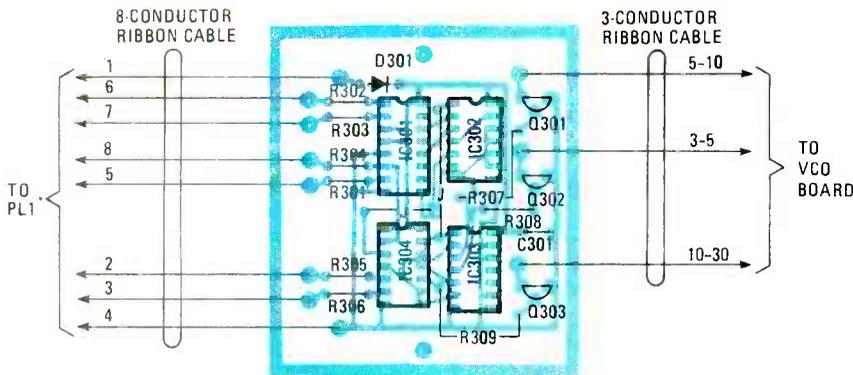


FIG. 15—EIGHT-CONDUCTOR RIBBON CABLE is used between the board and PL1. The plug itself is an 8-pin DIP header. If you can't locate one, cut down a 14- or 16-pin header.

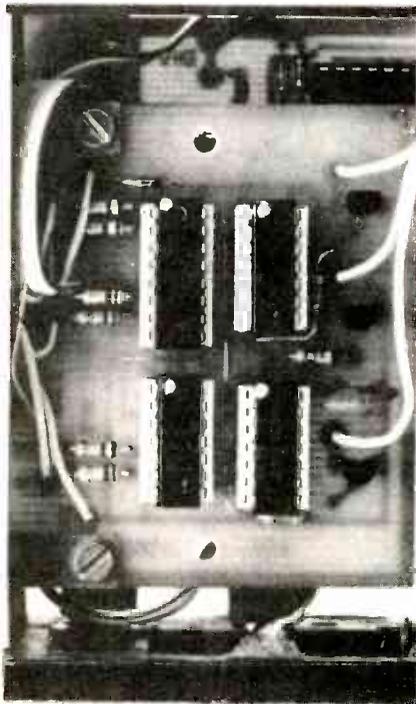


FIG. 16—NOTE THE WAY the leads of resistors R307 and R309 are bent.

inside of the outline, knock out the center, and file the opening to size.

After the holes have been drilled, scrub the cabinet with detergent and water to remove any grease. Then rinse and rub it dry. Next, label the front panel with press-on letters, label tape, or anything else you care to use. We used press-on letters successfully, and you can do the same. One thing, though, and that is when you get to the RANGE switch, use *several* labels. Include 3-30 MHz below HI, and 0.3-3 MHz below LO. The extra labels make the RANGE switch easier to use. Other than that, simply label the controls according to the prototype. Be sure to cover the labels with a coat of acrylic spray so that they don't rub off.

Once the spray is dry you can install the boards in the cabinet and hook them up. You can install the VCO and switch boards immediately, but hold off on the control board because a few wires must be connected to it first.

Cut three six-inch pieces of RG-174 50-ohm coaxial cable, and prepare the ends. Don't substitute ordinary mike cable for this miniature coax—it's too

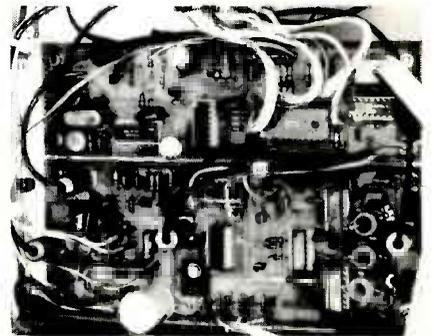


FIG. 17—CONTROL AND VCO BOARDS are mounted side-by-side. Switch board, not seen here, sits above coils at lower right. BCD thumb-wheel-switches are visible at top of photo.

lossy. Solder one end of a cable to the VCO pads (below Q101) on the control board. Note that there is a pad for the shield of the cable, even though it doesn't go anywhere. That is intentional and not a mistake. Solder one end of another cable to the DIV pads (near C101). Connect one end of the remaining cable to the MOD pads (near R128). Finish up by cutting two six-inch pieces of hookup wire, and stripping the ends. Solder one wire to the PWR pad (above C106), and the other to the -2V pad (at

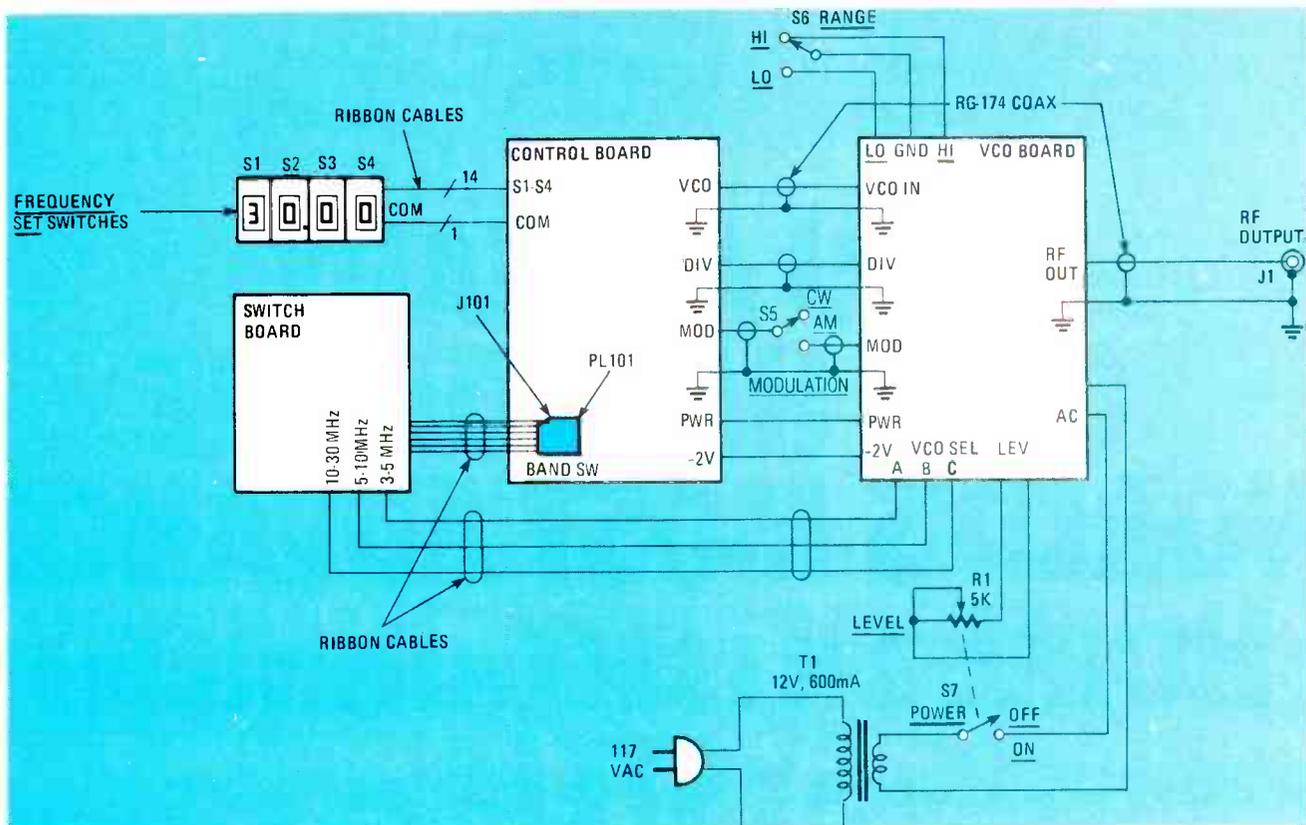


FIG. 18—INTERCONNECTIONS between all boards. Extensive use of color-coded ribbon cable keeps things neat and makes circuit-tracing easy.

R127). That takes care of the control board, and you can now mount it in the cabinet.

The last construction step is to interconnect the boards. Refer to Fig. 18 for details as you make the connections. Start by attaching RCA-type phono plugs to the ends of the coax cables from the control board. Then plug each one of them into the appropriate jack on the VCO board. Next, connect the leads from PWR and -2V pads on the control board to the appropriate terminals on the VCO board. Double-check to be sure they go to the right places; otherwise you may damage the control board. Connect LEVEL pot R1, and power switch S7. Wire up the pot first, using hookup wire to connect it to the board. Then wire up the power switch. If you use an external wall-plug type transformer, all that's necessary is to wire the switch in series with the VCO board and transformer. If you can't find such a transformer, and use an internally-mounted unit, switch the transformer's primary instead.

Next is the RF OUTPUT jack. Cut a piece of RG-174 coax long enough to reach from the jack to the RF OUT jack on the VCO board. Then attach an RCA plug to one end of the cable and plug it into the VCO board. Solder the other end to the jack, and *be sure to make a good ground connection*. That is important because that connector is the *only ground* in this project! Connect the RANGE switch, S6, by running three pieces of hookup wire from it to the

VCO board. (Ribbon cable is great for that!)

Finish up with the switch board connections. Plug PL101 into the 8-pin socket on the control board, and then connect the three wires to the corresponding pads on the VCO board.

That completes the construction. Double-check your work and correct any problems you find before applying power.

Calibration

In all probability, the Programma 2 will work pretty well the first time power is applied, without any calibration. Still, a few adjustments are required to insure that you can get all frequencies set by the switches, and to set the modulation level and get the best accuracy. To make the adjustments you'll need either a receiver with 10-MHz WWV capability, or a frequency counter. For tools you'll need a hex alignment-tool for the coils, and a small screwdriver.

The first step is to set the frequency range of the VCO's. That means that the coils must be adjusted so that the VCO's cover 3-5 MHz, 5-10 MHz, and 10-30 MHz. The front ERROR lamp will show when the coils are adjusted properly.

Make the adjustments in this order: Set the switches to "03.00" and turn on the power. The ERROR lamp may be lit or flickering. If it isn't, adjust L203 on the VCO board until it shows some sign of life. Then adjust the coil until the lamp goes out, and keep turning the core for

about ½-turn more. Switch to "04.99," and check the lamp; it should blink and go out. If not, back off the core slightly. The lamp should now blink and go out for switch settings of "03.00" through "04.99."

Set the switches for "05.00." Again, the ERROR lamp may be lit or flickering. If not, adjust L202. Then adjust the core until the lamp goes out, and turn the core about ½ turn more.

Now switch to "09.99," and check the lamp. It should blink, and then go out. If not, back off the core slightly. The lamp should blink and go out for switch settings of "05.00" through "09.99."

Set the switches for "10.00." The ERROR lamp may be lit or flickering. Adjust L201 for some indication. Then adjust the core so that the lamp goes out, and turn it about ½-turn farther. Switch to "30.00" and check the lamp. It should blink and go out. If it doesn't, back off the core slightly. The lamp should blink and go out for switch settings of "10.00" through "30.00" MHz.

That takes care of the VCO frequency-range adjustments. Now for the modulation-level adjustment. It can be made with an ordinary AM table-radio. Otherwise, you can use a shortwave receiver set to about 3 MHz. Here's how to make the adjustment:

Set your receiver to a clear frequency. Set the FREQUENCY SET switches to the same frequency. Then flip the MODULATION switch to AM. Connect a piece of

continued on page 77

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How to Connect your VCR to More than One TV

A MATV system can be used to distribute program material from a VCR. Here are some suggestions for getting the most out of a combination of the two.

JAMES E. KLUGE

THERE'S LITTLE DOUBT THAT VCR'S (VIDEO CASSETTE RECORDERS) are here to stay. With their tremendous popularity (sales of over one million units are expected this year alone), VCR's are appearing in more and more homes and places of business.

In most cases a VCR is connected to a single television set, but what happens when you want to connect more than one set to a VCR? Since a VCR both accepts and generates signals that are equivalent to those used by TV receivers, it can generally be connected to an MATV (master antenna) system. Here are several recommendations for integrating a VCR into an MATV setup.

Connecting a VCR to a single TV set

Most VCR's offer a choice of output on either channel 3 or channel 4 (some also have channel-5 or channel-6 outputs): the output channel you choose will depend on the channels not in use in your area.

The VCR is most likely to be located next to the most-used TV set in the house. VCR's usually have a built-in VHF/UHF tuner; the VHF input is 75 ohms, and the UHF input is 300 ohms. The VHF hook-up is made by connecting the 75-ohm VHF antenna lead to the VCR's input and the unit's switched-output (tape or off-the-air) to the TV-set's VHF antenna-terminals.

While most VCR's also accept UHF signals, there sometimes isn't any provision included for bypassing the video cassette recorder so that you are able to view those signals directly. In that case, you will need to use a signal splitter as shown in Fig. 1.

MATV hookup

If you wish to connect additional sets to a VCR, the best way to go about it might be to tie the VCR and the sets into an MATV system. That will provide extra benefits, including the option of restricting the VCR signals to only certain outlets or TV sets.

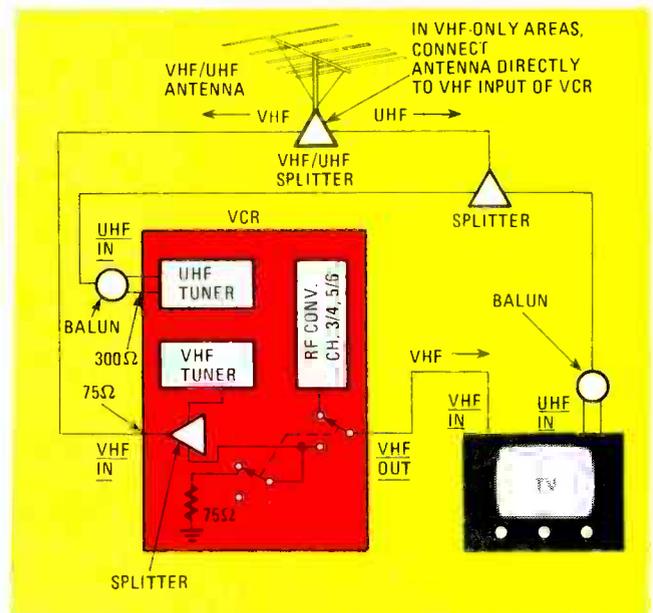


FIG. 1—THIS IS HOW a VCR is connected to a single television set. In the case of some VCR's the UHF signal must be split as shown if you wish to watch it directly.

A small MATV/VCR system is shown in Fig. 2. First of all, the output from the VCR should be injected at the head-end (the point where the signal enters the system—the lead from the antenna in this case) instead of being connected directly to the TV receiver as was the case in Fig. 1. If there is a blank channel in your area that corresponds to the VCR's RF-converter frequency (and does not have an occupied channel adjacent to it), then a simple two-way splitter connected in reverse is adequate to combine the VCR- and off-the-air-signals at the headend.

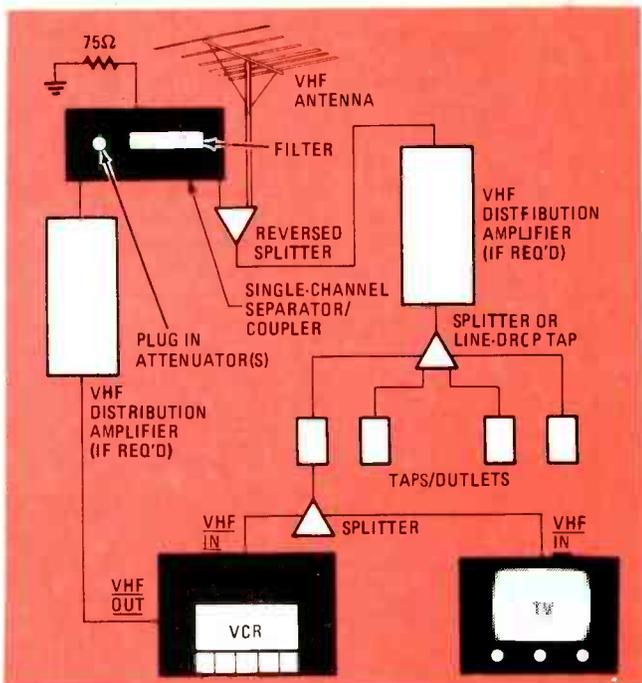


FIG. 2—IN A SMALL MATV/VCR SYSTEM, the output of the VCR's RF converter should be injected at the headend. The setup shown here is recommended if there is an adjacent-channel interference problem.

Adjacent channels

If you have an *adjacent-channel* situation, where an off-the-air signal may interfere with that from the VCR—or vice versa—a single-channel separator/coupler with a plug-in filter tuned to the VCR's RF-converter frequency, and isolated from the adjacent-channel source by a two-way splitter, will be required. That is the set-up shown in Fig. 2. In a typical example, channel 4 might be in use in the area and the VCR's output selected to be on channel 3. The channel-3 bandpass filter will confine the sideband energy of the channel-3 signal so it will not interfere with the channel-2 or channel-4 signals arriving at the TV tuner. The isolation provided by the splitter will reduce adjacent-channel loading of the filter. It will also serve to minimize any possible radiation of the VCR signal by the antenna, something the FCC frowns upon.

In the system shown in Fig. 2, instead of going directly to the TV receiver, the VCR's output goes back to the headend through a distribution amplifier. The receiver gets its signal from a wall outlet or wall tap via a splitter which is used to feed both the VCR and TV-receiver inputs. To minimize losses, the splitter is located between the wall outlet and the TV equipment. If the VCR's output were split and sent to both the receiver and the headend, that would mean an additional splitter in the circuit. The insertion loss of that splitter, coupled with the loss from the VCR's internal splitter, might weaken the signal enough to produce a snowy picture. Furthermore, programs could not be viewed off-the-air while the VCR was in the play mode.

The signal level from the wall tap or outlet must be high enough to overcome the 3 1/2-dB insertion loss of each splitter. For the system shown in Fig. 2, the signal must survive the losses caused by the splitter inside the VCR, and by the splitter between the wall outlet and the VCR—a total of 7 dB—and still be strong enough to provide an adequate signal level at the VHF tuner of the VCR. A distribution or line amplifier may be required after the headend, and/or at the output of the VCR, to overcome the losses introduced by the splitters.

Another important point to keep in mind is that optimum adjacent-channel reception is possible only when the signals

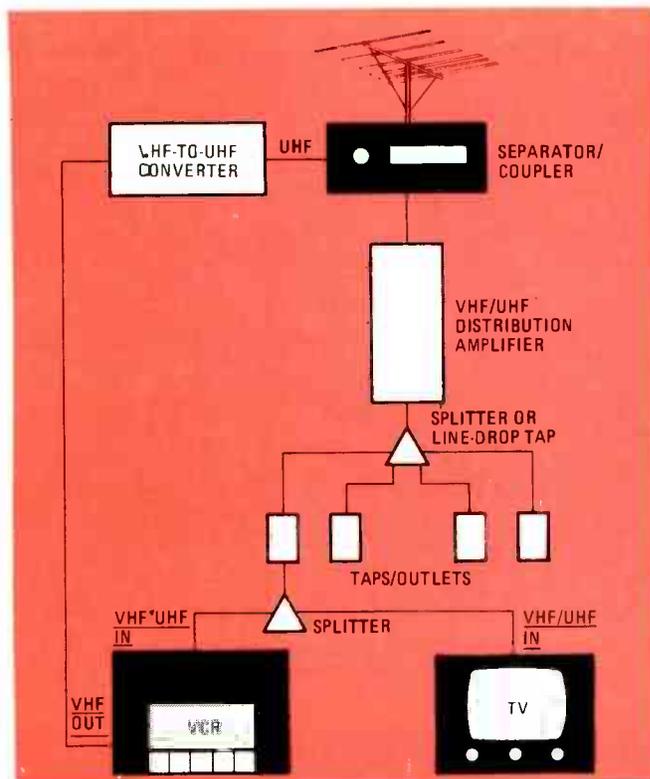


FIG. 3—A VHF-TO-UHF CONVERTER can be used in situations where a co-channel interference problem exists. In areas where UHF channels are in use, make sure that the output of the converter is higher in frequency than any of those channels.

on the adjacent channels are equal in level. In many cases, in-line or plug-in pads (attenuators) will be required to balance things out.

Co-channel problems

Suppose you live in an area where both channel 3 and channel 4 (or 5 and 6) are in use. What do you do when your VCR also uses those channels for output to a TV receiver? That is known as a *co-channel* problem and can be handled only by converting the VCR's channel-3 or channel-4 output to a UHF channel, which requires a VHF-to-UHF converter as shown in Fig. 3. The converter is a common piece of

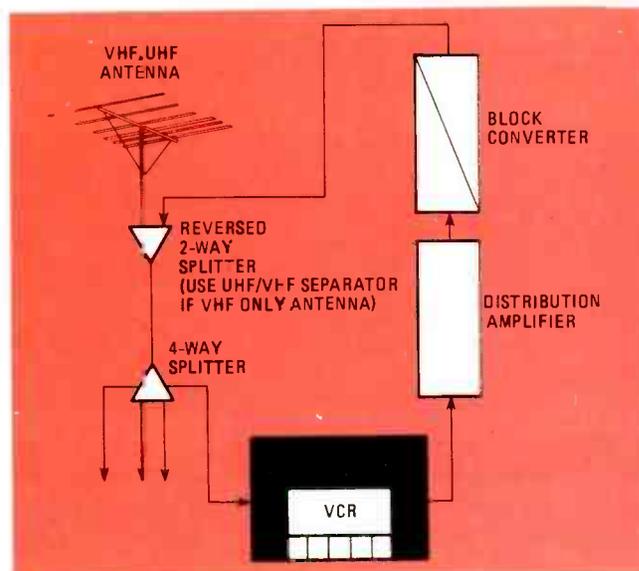


FIG. 4—IN SOME CO-CHANNEL INTERFERENCE situations, a VHF-TO-UHF block converter is more economical to use than several single-channel converters.

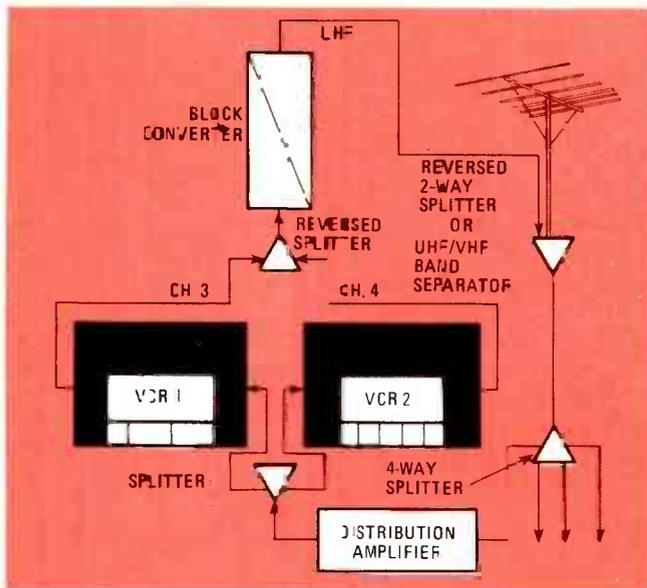


FIG. 5—BLOCK CONVERTERS can also be used to connect two or more VCR's to an MATV system as shown here.

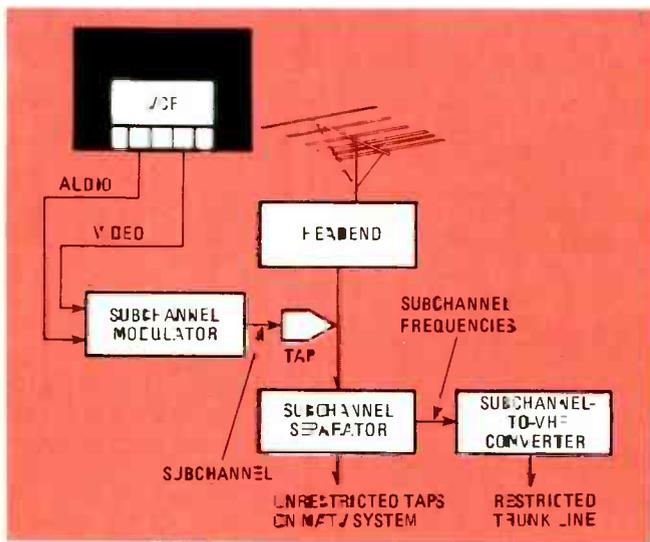


FIG. 6—ONE WAY TO RESTRICT reception of VCR programs is to convert the VCR's output to a subchannel frequency.

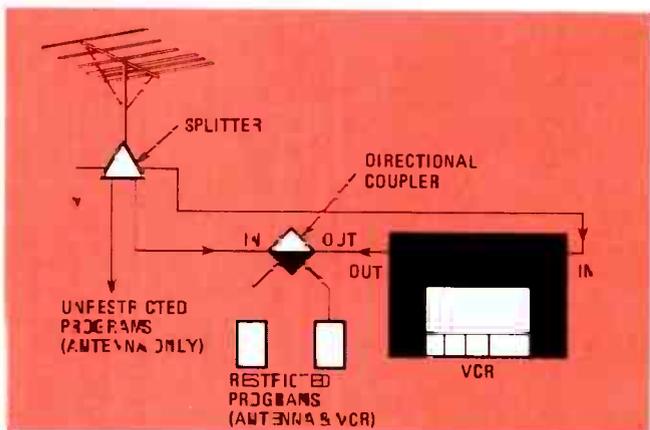


FIG. 7—A DIRECTIONAL COUPLER can also be used to limit who can watch VCR programs. In the arrangement shown here, only the sets connected to the coupler's taps can receive the signal from the VCR.

equipment used by MATV contractors. It can be obtained through many local electronics distributors, although you may have to place a special order to have it tuned to the UHF channel you want. The converter should be located as close to the headend as possible to minimize the higher cable-loss experienced at UHF frequencies. The converter's UHF output may be fed to the UHF-side of a VHF/UHF splitter (separator)-coupler, while the VHF antenna-lead is connected to the VHF-side. The combined signals may need to be amplified before being distributed over the MATV system.

You may run into a situation where it is necessary to convert the VCR's output to a UHF channel in an area where one or more UHF channels are in use. For maximum coupling-efficiency in such a case, you should make sure that the frequency of the output-channel of the VHF-to-UHF converter is higher than that of any of the over-the-air UHF channels that reach the separator-coupler.

A VHF-to-UHF converter that will convert the entire block of VHF channels to UHF is also available. Using that block converter may be a less expensive approach in some cases than using factory-tuned single-channel converters. A setup using the block converter is shown in Fig. 4.

A block converter can also be used when you want to connect two or more VCR's to the MATV system. Such an arrangement is shown in Fig. 5.

Restricted programs

Now that we have discussed some of the interference problems that you may encounter, let's consider the case where you may want only one or more selected TV sets on the MATV system to be capable of receiving programs from your VCR. There could be many reasons for needing that capability. In an industrial or commercial setting, it may be for security; at home, there might be movies or programs unsuitable for younger members of the family. In either case the basic solution is the same, although there can be variations depending on the particular situation.

One approach is to put the VCR program-material on a *subchannel* frequency. To do that, the audio and video outputs of the VCR (*not* the RF-output) are fed to a subchannel modulator to provide a modulated RF signal on one of three HF—*High Frequency*—channels (channel A: 18-24 MHz; channel B: 30-36 MHz, and channel C: 42-48 MHz). Then—as shown in Fig. 6—at some point ahead of the TV sets that are intended to receive the VCR program, a subchannel separator picks off the subchannel program from the MATV trunk-line and applies it to subchannel-to-VHF converters that feed only those TV sets intended to receive the VCR programs.

Another approach is to convert the VHF output from the VCR to a UHF channel. Then, either place traps tuned to eliminate that channel in the line that feeds the sets that you do not wish to receive the VCR signal, or disable the UHF tuners in those sets. If there are only a few sets involved, traps tuned to the VCR's *VHF* output-channel can be placed in the lines feeding the TV sets you do not wish the VCR signal to reach.

A directional coupler can also be used to restrict viewing. An arrangement using such a coupler is shown in Fig. 7. Signals from the VCR are applied to the feedline *output* of the coupler; signals from the antenna are fed into the input. Approximately 30 dB of isolation prevents the VCR's signals from reaching the input jack, but TV sets connected to the coupler's taps will be able to receive those signals, as well as those from the antenna. No other sets in the MATV system will receive signals from the VCR.

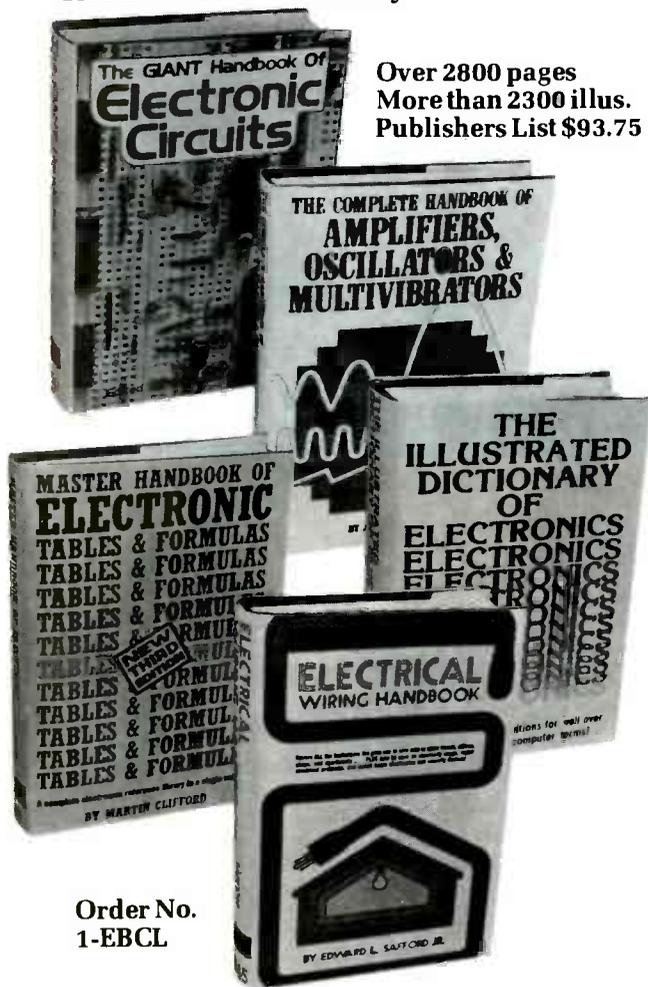
How you eventually set up your MATV/VCR system will, of course, depend on your specific requirements. But whatever form the system takes, you can be sure that following these suggestions will help you get the most out of it. R-E

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RF GENERATOR

continued from page 69

wire to the RF OUTPUT jack, and advance the LEVEL control. Tune in the signal on your receiver carefully. Adjust the pot on the control board for a clean-sounding tone, then turn the pot until the tone sounds rough. Back off the adjustment so that the tone sounds clean again. That completes the modulation adjustment.

The last step is to adjust for the best frequency calibration. You can either use a counter for that, or station WWV at 10 MHz. Here's how to do it:

Put the MODULATION switch in the CW position, and the RANGE switch to HI. Then set the FREQUENCY switches to "10.00." Connect a piece of wire to the RF OUTPUT jack for an antenna if you are using a receiver for calibration; otherwise, connect a frequency counter to the jack.

If you are using a receiver for calibration, tune in WWV at 10 MHz. Advance the LEVEL control on the RF generator until you can just hear its carrier beating against WWV's 10-MHz signal. Then adjust the trimmer on the control board for the lowest-pitched beat note. There may be a slight warble in the project's carrier; that is a normal characteristic of synthesized RF-generators, and some

care will be required to find zero beat.

If you are using a counter, simply adjust the trimmer on the control board until you read 10.000 MHz.

Using the Programma 2

Using this RF generator is a snap because there are so few controls. A few comments on the key controls, though, are in order.

Remember that the range of the FREQUENCY SET switches is "03.00" to "30.00" (MHz). If you exceed those limits, the ERROR lamp will come onto remind you that the frequency is wrong.

The RANGE switch selects direct, or divided-by-10, output frequencies. Use the HI position for outputs of 3 to 30 MHz, and LO for 300 KHz to 3 MHz. Typically, the HI position will be used for RF-stage and mixer-alignment of receivers, while the LO range will be used for IF alignment.

The ERROR lamp serves as a visual reminder that the output frequency is *not the same* as that indicated by the FREQUENCY SET switches. In normal operation, it should blink once when the frequency is changed. If a value is selected outside the range of the FREQUENCY SET switches, it will stay lit, alerting you to your mistake.

To use the Programma 2, simply select the desired frequency and range.

Then adjust the LEVEL control as necessary. If you are working on a receiver, tune in the signal on the receiver first; then adjust the LEVEL control as required.

If you must work with low-level signals, insert a 50-ohm attenuator at the RF OUTPUT jack and then set the attenuator for the desired output level. That may not always be necessary, as the RF output of this project with a 50-ohm load ranges from 10 mV to 300 mV. **R-E**



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JUDGING BY THE MAIL, THERE IS AN INCREASING interest in, and concern about, the weather—what it is, what it was, and what it will be. One reason for that concern may be the high cost of energy for heating and cooling, and how weather effects those costs. In any event, I've received many questions concerning electronic weather-instruments recently.

Your questions seem to indicate that the main problem is devising sensors or detectors. Most of you know how to evaluate a signal and display the result, but you need something that will generate the signal in the first place.

The first thing that I think of when I hear the words "weather instrument" is an anemometer (an instrument that measures wind speed and force) whirling around. There are, of course, several types of devices that can be used to indicate how hard the wind is blowing. Some of them are shown in Fig. 1.

A simple wind paddle attached to the

shafts shown in Figs. 1-c and 1-d. In Fig. 1-c, cup-shaped air scoops are attached to the motor's shaft as shown. Those scoops can be easily made from ping-pong balls that have been sliced in half or from panty-hose containers. A similar device using vertical disc-shaped air-foils in place of the scoops is shown in Fig. 1-d.

In the device shown in Fig. 1-e, air scoops are used to rotate a free-turning shaft mounted in a roller-skate wheel. A counterbalanced crossbar with a permanent magnet on one end is attached to the shaft as shown. Each time the magnet passes a reed switch, that switch closes. The number of switch closures can be counted with a frequency counter or similar circuit and translated into wind speed.

A phototransistor can be used in place of the reed switch in Fig. 1-e. Replace the permanent magnet with a bit of reflective material. The phototransistor will generate a pulse each time the

since you probably won't be able to find a calibrated anemometer, you'll have to find another way. Perhaps the best method is to take the device for a ride in your car.

Pick a calm day, and get a friend to do the driving. Hold the sensor out the window, and drive up and down a road at several different speeds, calibrating your anemometer against the car's speedometer. To cancel the effect of any wind that may be present, drive both ways at each speed and average the readings you take. Using that method, you can calibrate your anemometer sensor at several wind speeds, and interpolate at others.

One more point before we go on. The sensors shown in Figs. 1-a and 1-b must be set on a vane so that they face into the wind. That could present a problem because the wires may wrap around the support and, for that reason, the other designs are more frequently used.

The next type of sensor, shown in Fig. 2, is used to determine wind direction. A standard wind vane, mounted on the shaft of a potentiometer, is shown in Fig. 2-a. The pot's resistance is used to indicate the wind direction. If you use that design, be sure the pot you choose can be taken apart so that the stop can be removed—you'll want the shaft to turn without restriction. Use a skate wheel as a thrust bearing.

The design shown in Fig. 2-b is similar to the one shown in Fig. 1-e for measur-

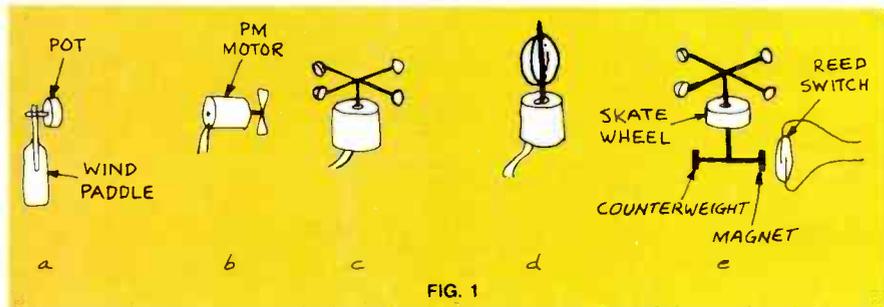


FIG. 1

shaft of a potentiometer is shown in Fig. 1-a. When the wind blows, its force pushes the paddle back, turning the shaft of the pot. That, of course, raises (or lowers) the resistance between the wiper and one end of the pot. The harder the wind blows, the higher (or lower) the resistance. It's a simple matter to measure the resistance from a remote location.

Figure 1-b shows a propeller attached to the shaft of a small permanent-magnet motor. The wind turns the propeller, causing the motor to act as a generator and produce a voltage. The faster the propeller turns, the higher that voltage. Again, it is fairly easy to measure the voltage from a remote location.

The same motor is used in the de-

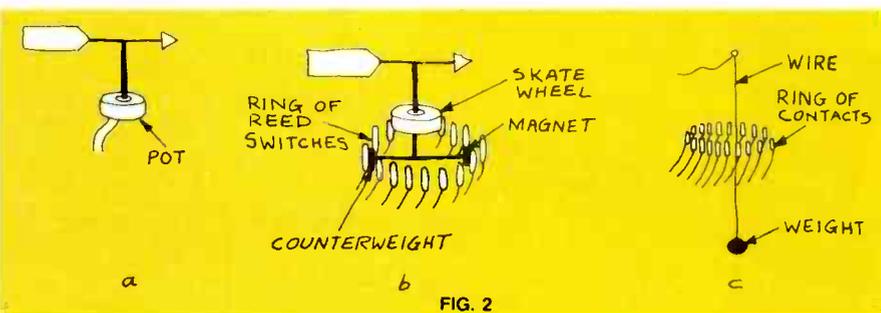


FIG. 2

material passes it. (Of course, the sensor will not work at night unless you provide some illumination.)

Calibrating those devices can be a bit of a problem. The task is easy enough if you have access to a similar unit that is already calibrated—just match your readings to the ones it shows. But,

ing wind speed. The difference is that this time there is a circle of reed switches: as before, one of the switches will close when the crossbar-mounted magnet is in its vicinity, thus indicating the wind direction. It's a simple matter to connect each switch to an LED or lamp to make a remote readout.

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A less reliable—but less costly—way to determine wind direction is shown in Fig. 2-c. The weight is connected to a piece of bare wire that passes through a ring of contacts. When the wind blows, the wire will touch one of the contacts, completing a circuit.

The most expensive way to determine wind direction would be to use a pair of selsyns (DC remote-control devices that use the angular position of a shaft in the transmitter to control the position of an indicator in the receiver). Perhaps you can find surplus units.

Using a barometer to determine air pressure is the easiest of all. Since the pressure is the same inside the house as outside, a remote-reading instrument is not needed. Just keep a store-bought barometer on the shelf with your other weather equipment.

Designing a remote-reading rain gauge is quite another matter: the job can get quite involved. One possible design is shown in Fig. 3. A counterbalanced arm is mounted on the shaft of a potentiometer. A spring is used to hold an empty cup in the "zero" position. When it rains, water runs into the cup through the funnel. The weight of the water in the cup causes the pot's shaft to turn, changing the resistance of the pot, and the resistance measured can be converted into "inches of precipitation."

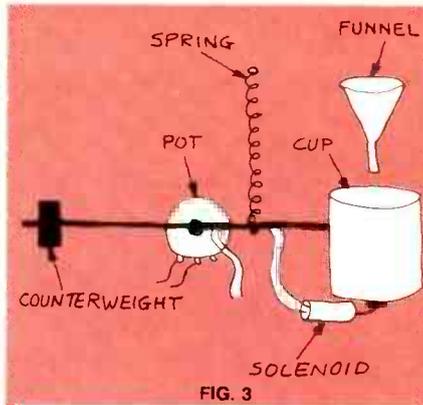


FIG. 3

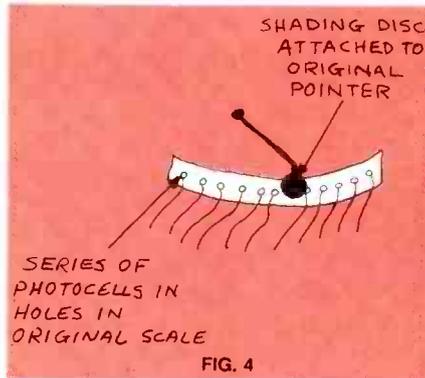


FIG. 4

The solenoid is used to empty the cup; it opens a drain hole in the bottom when a voltage is applied. Another way to empty the cup from a remote loca-

tion is to use a solenoid to tilt the counterbalanced arm. In either case, this is a real "Rube Goldberg" affair. Perhaps you'd be better off just using a standard rain gauge and walking outside to read it.

Measuring air temperature is straightforward and many articles have been written about building remote-reading thermometers. In addition, many manufacturers offer electronic kits for that purpose. There is also the older, non-electronic, type of remote-reading thermometer that has a capillary tube running outside.

A remote-reading hygrometer for measuring humidity is another instrument that will require some jury-rigging. About the best I can suggest is shown in Fig. 4. Take a standard dial-type hygrometer, replace the dial with photocells as shown, and attach a disc to the pointer. The disc will shade a photocell when it passes in front of it, making it possible to determine the pointer's position from a remote location.

An instrument that measures the amount of sunlight over a given period of time is shown in Fig. 5: it consists of a photoresistor connected to a counter through a threshold circuit. Whenever the sunlight reaches a predetermined level, the counter runs, giving you the hours (or any other convenient time

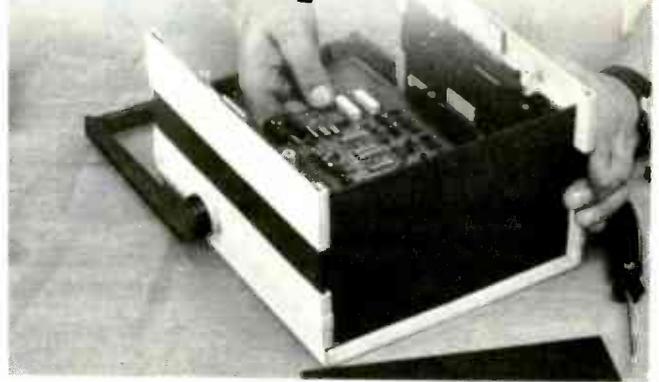
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unit) of sunshine since the last time the counter was reset. For accurate measurements, be sure to keep the photoresistor clean.

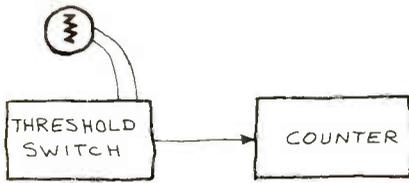


FIG. 5

That should keep you meterologists busy for a while. If you come up with any other ideas, or improvements on the ones presented here, let me know and I'll pass them along.

Electronic hobby kits

The people at OK Machine and Tool Corp. (3455 Conner St., Bronx, NY 10475) have come up with five low-cost electronics kits that I'm sure you will find quite interesting. You'll wind up with a useful device, and have an opportunity to learn something about electronics in the process.

The kits available are named: Quick Reaction (a game), Electronic Organ, Digital Roulette, Electronic Dice, and Morse Code Practice (an audio oscillator); each one sells for less than \$15.00, and comes complete with everything except batteries and tools. The plastic packages the kits come in double as cases for the projects. The instructions are detailed and clear, and even a first-time builder should have little trouble completing any of the kits.

Do you know a young person who you would like to nudge into electronics? You won't find a better way than to present him (or her) with one or more of those kits. An assembled kit may be appropriate for a younger child. The roulette and dice devices can be used with other games, and seeing the internal parts is sure to arouse the child's curiosity. **R-E**



"Sometimes I wish you collected stamps, like other men."

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COMPUTER CORNER

Looking for a computer

KATHY TEKAWA*

BUYING YOUR FIRST MICROCOMPUTER can be an incredibly complex task. Once you begin your search you'll quickly encounter confusing terminology, a seemingly endless variety of systems, smooth-talking salesmen, and—most confusing of all—a constant barrage of new equipment and programs, and enhancements to existing ones. It will be enough to make you want to stick with paper, pencils, and filing cabinets.

But don't despair—you don't have to tackle it *all* at once. Approach the matter in small, logical stages. The first, and most important, step is to task yourself what you intend the computer to do for you. How do you plan to use it to improve your operation? What parts of your day-to-day workload will benefit from increased efficiency due to the computer?

For large and complex business operations, that task is best undertaken by a system analyst—a professional consultant trained in analyzing work procedures determining which should be computerized and exactly how that should be done.

For smaller operations, you can probably save the expense of hiring such a consultant by doing your own detailed study of what, *exactly*, you want your computer to do. Collect as much information as you can. If you intend to prepare a payroll using the computer, determine how many checks will be written each pay period. Make a list of all the categories that will be involved (gross pay, federal tax, state and local taxes, Social Security, other income to withheld or added, etc.). If you're going to be keeping an inventory, how many classes of items will be involved; how many categories (in stock, shipped, in transit, etc.). The more detail you can provide when you visit a computer store, the better the salesmen will be able to help you to determine your hardware and software (program) needs.

Finally, think not only in terms of what you intend to do with the system when it's installed, but also what you would like to do with it in the future.

Once you have a good idea of your re-

quirements, your next concern is to find the best buy. That does not necessarily mean the cheapest price. Careful shopping for price is fine, but that's an area requiring a good deal of judgment: a "bargain" computer could turn out to be a costly mistake. You should also consider such things as the reputations of the dealer and manufacturer, availability of service, and the capability of your system to expand along with your understanding of it. Not only should your computer be able of handling your immediate needs—it should also be able to handle them one or two years from now.

Some representative products

To get you started thinking, and to give you an idea of some of the basic systems available, we've prepared a list describing a few of the wide array of products on the market. Prices range from as low as \$400 up to approximately \$2000. (Depending on the options purchased and the dealer you buy from, prices can vary considerably; therefore they have not been included here.)

Bear in mind that this list is just a sampling of what's available, and is not intended as an endorsement of any of them, or to indicate that they are the cream of the crop. The computer men-

tioned are simply a few of the most prominent and widely-distributed systems, from a handful of manufacturers. The system you ultimately purchase will depend largely on your individual needs.

Apple: The *Apple II* and *Apple III* computers are similar in design, but differ in their capabilities. The *Apple II* (shown in Fig. 1) is intended more for home use; the *Apple III* for business. Both systems store about 140K bytes (1K byte equals 1024 characters) of information on 5¼-inch floppy disks. Both use a TV set or video monitor for color or black-and-white display.

Both systems have full-size keyboards. The *Apple II* supports from 16 to 48K bytes of memory, and the *Apple III* supports up to 128K. The *Apple III* also has a 10-key numeric pad.

As business software-packages flourish, those computers are becoming increasingly recognized as suitable machines for business—as well as for home-use.

Apple Computer, Inc., 10260 Bandlely Dr., Cupertino, CA 95014.

Atari: Atari manufactures two personal computers: the *model 400* and the *model 800*. The first has a memory capacity of 16K, a touch-switch keyboard and RF output for use with a TV



FIG. 1

*Managing Editor, Interface Age Magazine

set. It has excellent color graphics capability but is suited more for home use than for business.

The *model 800* supports up to 48K of memory, has a full-size, typewriter-style keyboard and can be used with a TV set. Up to eight 5¼-inch disk drives, each capable of storing 163K, can be connected to the computer. Although originally designed for home use, the *Atari 800* is beginning to find its way into the business world as well.

Atari, Inc., 1265 Borregas Ave., Sunnyvale, CA 94086.

Commodore: Commodore International offers a wide range of computers. The company began by manufacturing calculators and then progressed into the personal-computer marketplace. Its newest computer is the *VIC* color computer. That system is a single unit with the keyboard/computer using a TV receiver for display.

The *CBM 2001* and *8032* computers offer up to 32K of memory with a 25-line by 40-column display available on the former and a 25-line by 80-column display on the latter. Both have built-in video monitors and full-sized keyboards with ten-key numeric pads.

Commodore International, 950 Rittenhouse Rd., Norristown, PA 19401.

Radio Shack: The first mass-market microcomputer was this company's *TRS-80 Model I*. Since it was introduced, the *TRS-80* family has grown to include four more models.

The *Model I* is no longer in production. The *Model II* is a self-contained system with a full-size keyboard and numeric keypad. It can hold up to 64K of memory and comes with a built-in 8-inch disk drive. The integral video display provides 24 lines of 80 columns.

The *Model III* also is an integrated unit, and is capable of running software written for the *Model I*. It features a full-sized keyboard with a 10-key numeric pad, a video-display screen, up to 48K of memory, and has provision for two built-in 5¼-inch disk drives.

The *TRS-80 Color Computer* is designed for direct connection to a TV receiver and cassette recorder. Its features include color graphics, sound-generation capability and 4K of memory (expandable to 16K). For elaborate game playing, joysticks (control devices) can be added.

The *Pocket Computer* is a calculator-size device with 1.9K of memory and a 24-character liquid-crystal display. A cassette interface for loading or storing programs is optional, and a small printer is available.

Other systems

The list just presented is by no means exhaustive. Some other personal computer manufacturers whose products are well worth looking into are: Heath/

Zenith Data Systems, Ohio Scientific, North Star and—believe it or not—IBM.

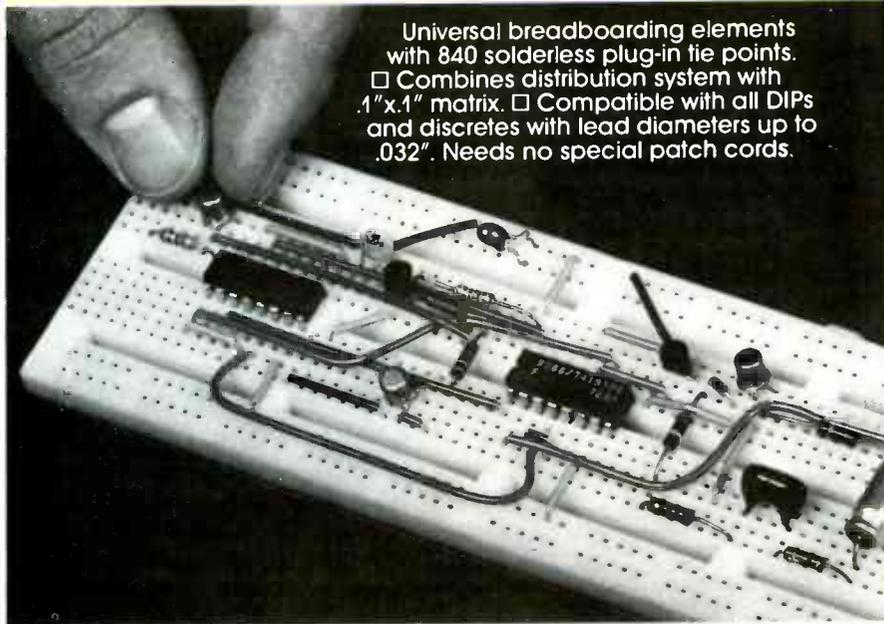
Shopping for a computer for your home or business need not be a grueling, frustrating task. If you do your homework—know exactly what tasks you want your system to do, talk to other users and keep up by reading system reviews and evaluations—you will invest your time wisely and be in a good position to know which system will suit you best.

Next month we'll take a look at computer software, discussing language options, operating systems, and how to select the software best suited to your applications.



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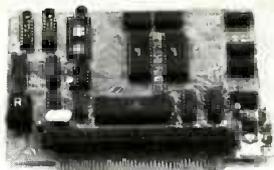
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The System 500 features a wide-range control system with separate high-frequency and midrange controls. Each has a 10-dB range of adjustment. It is priced at \$290.00. — **Jensen Sound Laboratories**, 4136 North United Parkway, Schiller Park, IL 60176.

MOTO-TOOL KIT, model 2501, contains a model 250 constant-speed (30,000 rpm) Moto-Tool with a 0.8-amp, 115-volt, 60-Hz AC series-wound motor, and 24 accessories, all housed in a tough, lightweight, polyethylene storage/carrying

case with a snap-lock cover.

The model 250 with accessories gives the do-it-yourselfer, hobbyist, and model maker a high-speed, multi-use power tool for carving, cutting, drilling, polishing, grinding, sanding, sharpening, and much more. It has a shatterproof molded nylon housing and is shaped to be held comfortably in the hand while being used. The smooth-running 30,000 rpm motor is quiet and has lifetime-lubricated bronze sleeve bearings. A built-in hanger permits the user to hang the Moto-Tool near the work project when not put away in the

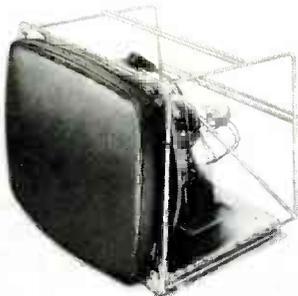


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storage/carrying case. The Moto Tool is 10¼ inches long and 6¾ inches in diameter. The unit comes with a 3-wire grounded cord.

The price of the model 2501 Moto-Tool Kit is \$54.95. — **Dremel, Division of Emerson Electric Co.**, 4915 21st St., P.O. Box 518, Racine, WI 53406.

DISPLAY MONITOR, model NDC-90, is a 9-inch unit that provides high definition and reliable image presentation. The unique features of the display are a wide video bandwidth of 25 MHz; excellent linearity; uniform focus characteristics across the entire screen; a horizontal retrace time that is usually less than 7 microseconds, and electrical and mechanical compatibility with Ball Brothers and Motorola monitors. A specially designed PC board and electronics are incorporated in the monitor to achieve performance levels previously impossible with devices of this kind. Separate horizontal drive, vertical drive, and video-signal inputs, as well as one for composite video, have made it possible to provide



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simple interface circuitry.

The *model NDC-90* has a minimum mean time between failures of 10,000 hours with a 90 percent confidence level. The unit is delivered with P4 phosphor as standard. (Available options are P31 and P39 phosphors, as well as a power-supply module that is compatible with nearly any standard power source used today.)

The *model NDC-90* is priced at \$215.00. — **TSD Display Products, Inc.**, 35 Orville Drive, Bohemia, NY 11716.

CAR STEREO, *model T691*, features road-rated performance and a Powerplay amplifier for greater power and cleaner sound. The system also includes separate bass, treble, balance, and fader controls:



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local/distant, mono/stereo, and FM mute pushbuttons; loudness control; automatic power antenna switching; dial-light dimming; line-level output jacks, and power-off eject. The *model T691* is priced at \$169.95. — **Craig Corporation**, 16 East 52 Street, New York, NY 10022.

COMPUTERIZED WEATHER STATION for households offers twelve functions plus memory, for use by homeowners, farmers, hobbyists, or anyone else interested in receiving specific regional weather information.

The weather station is quite simple to install; cable and wall mountings are attached directly to the full-sized display panel which mounts on your wall. It displays hour and date for high and low readings and its "smart" clock remem-



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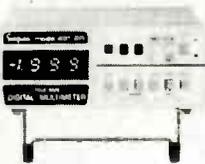
bers how many days are in each month, so that no resetting is necessary.

The digital display shows wind chill, rainfall, humidity, maximum and minimum temperature, time, degree days, heating and cooling, date, barometer, wind direction, and wind-speed readings. Readings are displayed in standard or metric scales, and knots or miles-per-hour for wind speed. The weather station operates on AC, with a battery pack that will hold all memories in case of power failure. It also includes for assembly: rain collector, temperature sensors with cable attached, display unit, mast-arm assembly with cable attached, and remote chassis with line cord.

An automatic select button allows you to have the display hold each function for a four-second interval, and then move on to the next automatically. The *Computerized Weather Station* is priced at \$995.00, plus \$15.00 for packing and guaranteed delivery. — **Edmund Scientific**, 7082 Edscorp Building, Barrington, NJ 08007.

DMM, *model 461-2R*, is a compact, hand-portable digital multimeter that reads true RMS on AC voltage and AC current ranges. The RMS-reading instrument has a high frequency-response—up to 50 kHz. It will respond to the RMS value of any wave shape, thus providing accurate measurements of noisy or complex AC-voltage waveforms.

The *model 461-2R* meets UL-1244 requirements, and is UL-listed. It has a bright 0.3-inch, 3½-digit LED display. 100-µV resolution, and 0.1% basic accuracy.



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Performance is assured by a 100% double burn-in and supported by a one-year factory warranty. It measures 2 × 5.6 × 4.6 inches, weighs 1½ pounds, and operates 8-hours on a single charge of its batteries. It can be operated from AC while the batteries are being charged. There is also a full line of optional accessory probes that will expand the unit's capabilities. It comes with nickel-cadmium rechargeable batteries, an AC charger/adaptor, color-coded UL-approved test leads, and an instruction manual.

The *model 461-2R* carries a suggested retail price of \$216.00. — **Simpson Electric Company**, 853 Dundee Ave., Elgin, IL 60120.

TUNER, *model NAT 301*, is designed to provide the most listenable signal possible. On both FM and AM (including international long wave), several self-adjusting systems select the optimum receiver bandwidth for the particular input signal automatically, taking into account interference from adjacent channels and the noise levels present.

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continued on page 88

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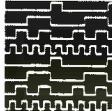
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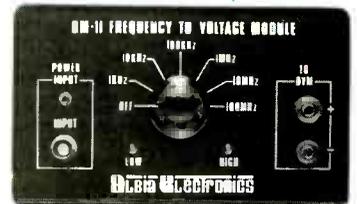
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INPUT IMPEDANCE 300,000 Ohms; **THRESHOLD** Logic 1 thresholds (HI-LED) 70% Vcc Logic 0 thresholds (LO-LED) 30% Vcc. **MIN DETECTABLE PULSE WIDTH** 300 nanoseconds. **MAX. INPUT SIGNAL FREQUENCY** 1.5 MHz; **PULSE DETECTOR (PULSE LED)** High Speed pulse train or single events (+ or - transitions) activate 1/10 second pulse stretcher. **MAX. INPUT VOLTAGE** ±50V continuous 120VAC for less than 15 seconds. **POWER REQUIREMENTS** 5 Volt Vcc 30 Ma 15 Volt Vcc 40 Ma 25 Volts max. with power lead reversal protection. **OPERATING TEMPERATURE** 0 to 50°C **PHYSICAL SIZE** L x W x D 5.8 x 1.0 x 0.7" (147 x 25.4 x 17.8 mm) **WEIGHT** 3 oz.

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NEW PRODUCTS

continued from page 85

one wideband and one narrowband—are provided. The receiver selects the best mode of operation and then sends a signal to the external AM antenna box, tuning it for optimal reception at the desired frequency. The *model NAT 301*, potentially, can deliver AM sound to rival that from the FM section.

On stereo FM, the receiver section maintains the optimum signal-to-noise ratio by reducing stereo separation gradually, and finally limiting the bandwidth of the tuner as required by the quality of the signal being received.



CIRCLE 137 ON FREE INFORMATION CARD

The digital display brightens when the receiver finds the center frequency and locks on to the incoming signal. That visual feedback has the effect of teaching the user those frequencies that he or she uses most often. On FM, a sophisticated muting circuit is activated automatically until this center frequency is located, the receiver has found a listenable station, and the AFC has locked onto the signal.

Similar muting takes place on AM; however, the user may tune off the center frequency, shifting the signal into such a position that any beats or whistles caused by adjacent channels are eliminated.

The *model NAT 301* is priced at \$3,500. — **Naim Audio, Ltd.**, (England); U.S. Distributor: **Audiophile Systems, Ltd.**, 6842 Hawthorn Park Dr., Indianapolis, IN 46220.

STATIC-ELECTRICITY ALARM, *model WA-1*, gives a visual and audible alarm when ambient static electricity reaches predetermined levels.

Static electricity can ruin the microprocessors that are the basis of many new electronic products, and can be a safety problem in many industries, such as ordinance, chemical processing, and papermaking. It is also a peril in surgical operating rooms, and, because static electricity can make a surface dust-attractive, it can cause serious quality-control problems in such industries as graphic arts, photographic processing, and precision assembly.



CIRCLE 138 ON FREE INFORMATION CARD

A wire serves as the *model WA-1*'s antenna. The sensitivity of the alarm is a function of the length of the wire, making it easily adjustable to the user's individual requirements. For example: An 18-inch wire will detect 240 volts at a distance of one foot. A three-position switch has settings for the red-light warning, the high-pitched alarm, or off. The unit measures 1 x 3.25 x 2 inches.

The *model WA-1* is priced at \$69.96. — **Wescorp**, 1155 Terra Bella Ave. Mountain View, CA 94043.

POWER AMP, *model MA5002A*, is designed to provide instantaneous internal electronic compensation for intermittent or continuous 2-ohm operation, without actuating any of its protective circuitry and without current limiting.

The *model MA5002A* is rated at 250 watts stereo at 8 ohms. 20 Hz-20 kHz with less than 0.09% THD; the same specs apply for 375 watts-per-channel at 4 ohms. TIM is less than 0.02%, slew rate greater than 50, IM less than 0.05% (typical 0.02%), and dynamic headroom better than 2 dB. All specifications are continuous operation, FTC sinewave power ratings, with no shutdown during test procedures. The Class "H" fully-complimentary circuitry features low operating wattages for conserving energy, and allows use without a fan under all normal operating conditions.

Protective circuitry is four-way. Short-circuit protection is provided by an ex-

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clusive-design dual-purpose auto-crowbar circuit with automatic reset and front-panel LED indicator. There is also thermal sensing with automatic reset and front-panel indicator, as well as external fusing protection. The chassis has a 16-gauge steel mainframe structure, with modularized construction throughout for easy access to all component parts.

The *model MA5002A* is priced at \$849.00. — **Soundcraftsmen**, 2200 So. Ritchey, Santa Ana, CA 92705.

BUS INTERFACE, *model 4380-488*, is a new IEEE-488 bus interface unit that allows connection of the Bird directional RF Power Analyst wattmeters to a GPIB (General Purpose Instrumentation Bus) for automatic measurement and recording of data. Digital *ThruLine* wattmeters equipped with a bus-compatible output can now become talkers and listeners via GPIB central control.

Typical applications include periodic measurement of one to nine RF-signal



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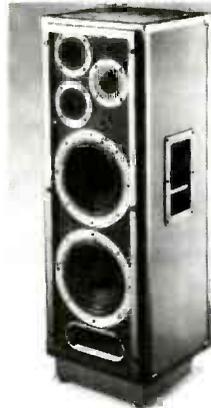
parameters; hard-copy printout of data for logging; scope, graphic terminal, or curve-plotter feed for dependent variables display (such as attenuation or SWR vs. frequency, power vs. time, etc.); alarm or warning functions of performance levels, and automatic testing of equipment or components.

The *model 4380-488* is priced at \$975.00. — **Bird Electronics Corporation**, 30303 Aurora Rd., Cleveland (Solon), OH 44139.

LOUDSPEAKER, *Wharfedale E-90 PRO*, is a high-power speaker system for professional and semi-professional users, designed for use in small club, disco, or concert-hall environments where increased sound-pressure levels without distortion are important.

The *model E-90 PRO* uses two 10-inch moving-coil bass drivers, two 4-inch high-flux moving-coil midrange drivers, and a 1-inch compression-drive horn-loaded tweeter. Its minimum power requirement is 30 watts, and its power-handling capacity is 300 watts of program material. Its sensitivity is 95 dB (1 watt/1 meter). Nominal impedance is 8 ohms. Typical frequency response is 45 Hz to 18 kHz, ± 3 dB.

There are two contour controls. The upper is continuously variable in a range of 2 kHz to 20 kHz; the lower is continuously variable in the 200-Hz to 2-kHz range. The crossover type is a 6- and 12-dB/octave, 14-element network, resistant mounted. Crossover points are 150 Hz,



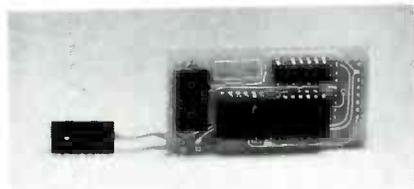
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800 Hz, and 7 kHz. System and treble circuit breakers protect the speakers against misuse or accidents. The reset button for the circuit breaker is located on the front of the speaker cabinet.

The cabinet is a computer-optimized reflex type, made of high-density particle board incorporating crush-resistant steel rails and corner caps. The finish is an abrasion-resistant black vinyl. The grille is semi-opaque, acoustically transparent woven steel mesh. There is a grab handle, as well as recessed transportation handles. External dimensions are 45¼ x 15¾ x 16¾ inches.

The *Wharfedale E-90 PRO* carries a suggested retail price of \$900.25 each. — **Rank Hi Fi, Inc.**, 260 North Route 303, West Nyack, NY 10994.

TYPE-AHEAD BUFFER, *model 150*, features a 40-character type-ahead capability, eliminating the need to wait for computer prompts before entering the next command or data. It is compatible with all *Apple II* computers and software.



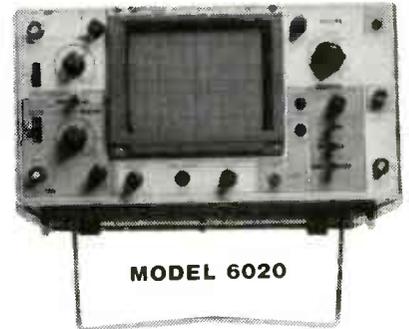
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No software patches, cuts, or jumpers are required, and the simplified design allows for nearly effortless installation. The *model 150* is priced at \$49.95. — **Vista Computer Co.**, 1317 E. Edinger, Santa Ana, CA 92705. **R-E**

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NEW IDEAS

Headlight Alarm

HAVE YOU EVER FOUND YOUR CAR battery dead because you had left your headlights on after shutting off the engine and walking away? Before long your battery is totally drained, and you have to start looking for a passing good samaritan or a service station. It is a frustrating experience, as you know if it has ever happened to you.

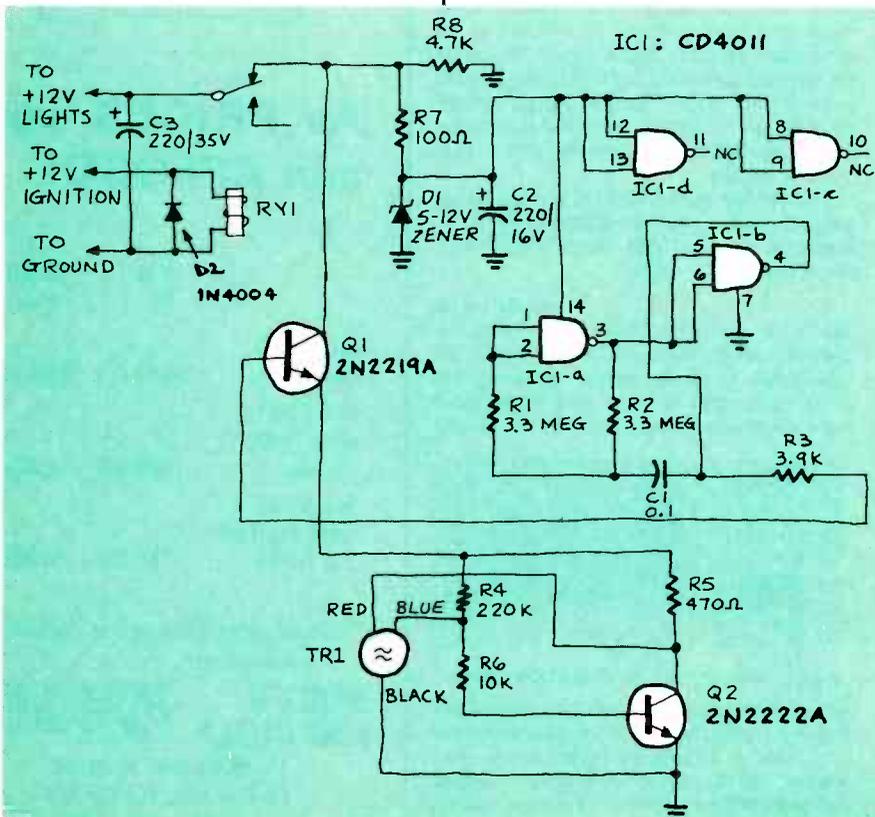
This circuit is designed to give off an alarm anytime that the lights are on but the engine off. The device is easy to build and almost any technique can be used. Installation is also simple and just two connections to your car's electrical system, and one to its chassis, are required for proper operation.

The circuit for the project is shown in Fig. 1. An SPDT relay, RY1 (Radio Shack 275-003 or equivalent), and diode D2 (1N4004 or equivalent) supply power to the rest of the circuit only when the headlights are on and the ignition switch is off. A circuit made up of R7 and D1 regulates the voltage to IC1. The IC is configured as an oscillator, and is used to supply pulses to Q1,

which is used as a transistor switch. Each time a pulse from IC1 reaches it, Q1 supplies power to TR1's driver circuit (TR1 is a piezo-buzzer element, Radio Shack 273-064 or equivalent), sounding the alarm.

The connections to your car are fairly straightforward. The lead marked TO +12V LIGHTS should go to a line that carries +12 volts whenever the headlights are on (the one for the dashboard lights is a good choice). The lead labeled TO +12V IGNITION should go to one of the lines that power the car's accessories (radio, cigarette lighter, etc.). Make those connections to any point that is easily accessible; typically that will be at your car's fuse box. The lead labeled TO GROUND can be made to any convenient point that's connected to the car's chassis.

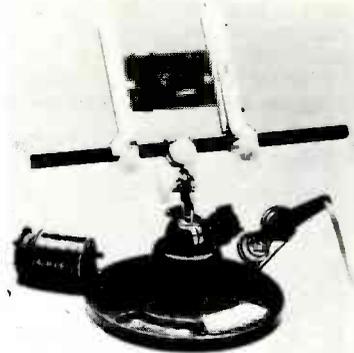
Of course there are times when you wish to use your headlights while the engine is off. All that needs to be done to silence the alarm in those instances is to turn the ignition switch to the ACCESSORY position. —James Griggs



NEW IDEAS

This column is devoted to new ideas, circuits, device applications, construction techniques, helpful hints, etc.

All published entries, upon publication, will earn \$25. In addition, Panavise will donate their model 324 Electronic Work Center, having a value of \$49.95. It combines their circuit-board holder, tray base mount, and solder station (see photo below). Selections will be made at the sole discretion of the editorial staff of **Radio-Electronics**.



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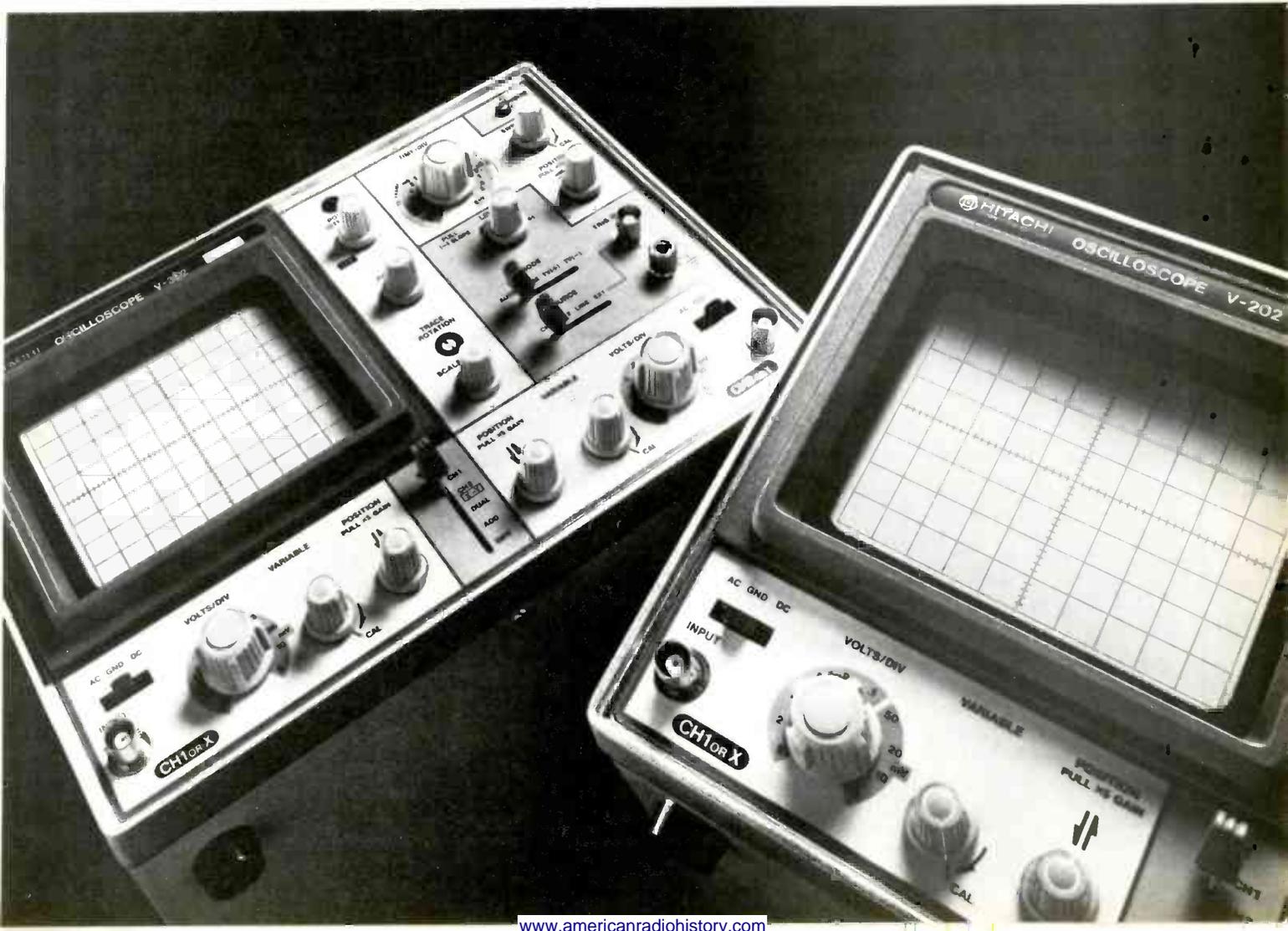
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SERVICE CLINIC

A closer look at high-voltage shutdown circuits

JACK DARR, SERVICE EDITOR

I'VE NOTICED SOME NEW TV CIRCUITS IN the last year or so. Actually, they aren't really new—they just do things a little differently! When activated, they cause the picture to flicker on and off at regular intervals, or cause the sound to go "putt, putt" (like a motorboat). I've gotten quite a few letters from confused technicians who were facing those symptoms for the first time.

The cause of all that activity is quite simple—it's the high-voltage shutdown circuit in operation! I first ran into that type of circuit while going through an Admiral Service Newsletter (looking for something else, of course). The shutdown circuit in the Admiral 4K10/4M10 chassis (and others) causes the raster to flash on and off about once a second, while the sound makes a "tweet" at the same rate.

What happens here is that if an arc, or anything else, trips the shutdown, the circuit tries to reset itself after about a second. If the fault was momentary, the set will come on again and work properly. If the fault is still there, the circuit will shut down the set again (and again, etc.).

Any of the usual problems will cause the shutdown circuit to trigger. Run the regular series of tests to find the specific cause. Start with the DC voltage: Plug the set into a variable-output transformer and turn the line voltage down. Monitor the regulated B+ and bring the line voltage up until the B+ is at the correct value. If the set now works, check the regulator; if it doesn't, look elsewhere.

The same type of shutdown circuit is used in other sets; among them are those in the new Magnavox 13C2 power-supply series. Although the shutdown circuit in the Magnavox sets is different from the one in the Admiral, it works in pretty much the same way, only faster.

The heart of that shutdown circuit is op-amp "Z" in IC322, located on supply module 704191; the op-amp is shown in Fig. 1. The output from the op-amp goes, via diode D1, to the duty-cycle modulator of the switching regulator (Fig. 2). As long as everything in the set is high, the output of the op-amp is high. The slow-start circuit shown in Fig. 1 delays set turn-on and high-volt-

age buildup. When the set is turned on, there's an instant when the +12-volt supply is low. If it is below +8 volts, a control transistor, TS2, is off, and TS3 conducts. That causes capacitor C330 to be charged, pulling the output of op-amp Z low. That, in turn, pulls the output level of the sawtooth oscillator (see Fig. 2) so low that the duty-cycle modulator is cut off, shutting down the set. When the supply voltage rises above +8 volts, the opposite takes place: the transistors turn the op-amp off, causing its output to go high. When that happens, the duty-cycle modulator works again.

That is what happens during shutdown. There are, of course, other situations that can trigger the circuit including low B+, high B+, and excessive current drain. In every case, the output of op-amp Z goes low, cutting everything off.

All of the voltages monitored are found on supply module 704191. The DC voltage developed from the AC line comes from rectifier module 704192. The horizontal oscillator drives both the switching-mode regulator and the

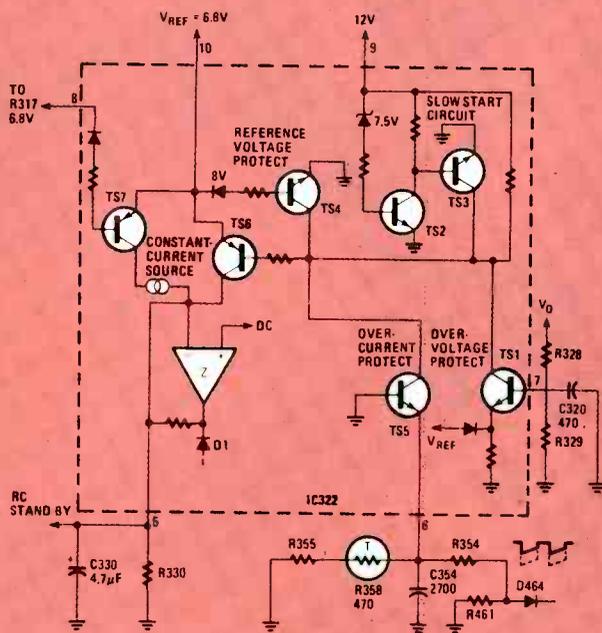


FIG. 1

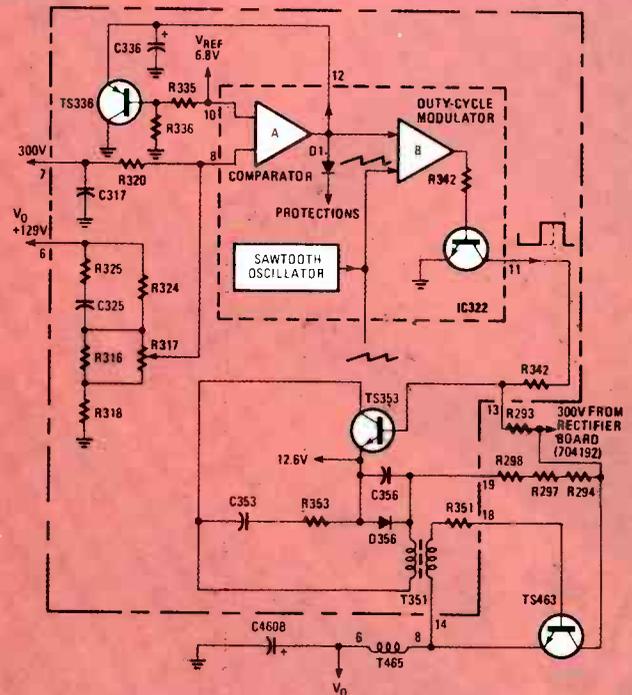


FIG. 2

horizontal-output tube, so they are always in sync. The operating DC voltages come from the flyback. The switching-mode transformer drives the horizontal output transistor, which in turn drives the flyback.

For troubleshooting, the +129-volt DC supply is the key. Pull the horizontal-yoke plug; that disconnects the horizontal-output circuit. Now check the +129-volt DC supply. If it is OK, check the horizontal-output circuitry, the horizontal-output transistor, and all of the low-voltage rectifier diodes coming from the flyback. If the +129-volt DC supply is pulsating, or too high or low, try a new supply module.

If you'd like more information on how the Magnavox shutdown circuit works, refer to the July and October 1980 issues of the Magnavox Service News. R-E

SERVICE QUESTIONS

CAPACITOR SUBSTITUTES

Bill Stiles, CET, of Hillsboro, MO has sent in some information on using Sprague polypropylene capacitors as substitutes for others. A Sprague PP16-S18 is a substitute for a Zenith 22-4001, a .0018 μ F capacitor rated at 1600 volts. A PP16-S11S is a substitute for a Zenith four-legged capacitor. That capacitor comes with a data sheet that says that it is an exact replacement for two Zenith, and one Admiral, part numbers.

Fuji-Svea, Inc. lists an assortment of Sprague capacitors, assortment number KF-34, as Sprague series 715P (note that all of the individual part numbers start with PP). Those capacitors are exact replacements for polycarbonate-film capacitors in critical commutating and S-shaping circuits, with high AC-current carrying-ability. The kit includes 18 different values, including 1.75 μ F at 100 volts (a yoke-return capacitor), and others at ratings of 600, 800, 1200, and 1600 volts. The last two ratings are for .0033- μ F and .0039- μ F capacitors.

Thanks Bill; this is information that I've been trying to get for quite some time.

SMEARY PICTURE

The picture on this Quasar TS-938 was very smeary. The focus control worked normally, but did not help the problem. The picture tube heater-voltage was low; replacing the JA panel (flyback power-supply) helped, but not enough. The sharpness is still below normal. Any ideas?—G.S., Red Bank, NJ

Trying inputting a color-bar signal,

and checking it with an oscilloscope all the way from the video detector on through the video stages. If you have a three-bar function on your bar/dot generator, it will give you three nice square-wave signals.

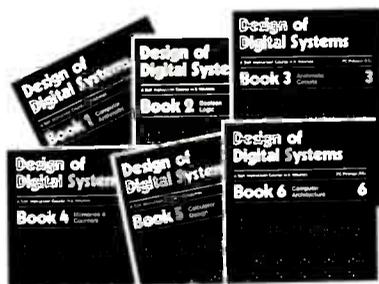
Look for a point where the signal is sharp at the input of the stage, but distorted (rounded corners, slanted, etc) at the output. When you find that stage, check the DC voltages and so on. One common cause of this problem is a leaky transistor; try a new one.

(Feedback: "Thanks! You hit it! The 1st video transistor was leaky. I replaced it and now the picture is 300% better.")

TRIPLER TROUBLES

I've got a problem with an RCA CTC92K. It came in dead—bad tripler, bad output transistor, and an open fusible resistor. I replaced all of those and got sound, but no raster. The high voltage and raster voltages out of the tripler are all OK. I have no screen voltage on the picture tube; that comes from a tap on the tripler. All of the series resistances check out. Any ideas would be appreciated.—L.C., Sacramento, CA

Well, you may have one of two problems. Either the wrong tripler, without the screen tap, or an open circuit between the tap and the screen controls. I was going to tell you to bridge the



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215,000-ohm fusible resistor in the circuit, but you've already done that. There is another resistor in that circuit, 100,000 ohms, and it has a habit of opening up under load. If you are getting high voltage and focus voltages, but no screen voltages at all, even right at the tap of the tripler, that almost has to be the wrong tripler!

NO BOOST VOLTAGE

The problem is no high voltage in this Magnavox T-960. The boost voltage is only about +260 volts instead of +540 volts. Also I get just -23 volts on the grid of the 38HK7. Everything else checks out, but I must be missing something.—B.T., Delta, IA

Well, you do have a *little* boost voltage; the 260-volt B+ means that the stage is trying to work. What you're overlooking is the very low voltage on the grid of the 38HK7. That voltage should be -42 volts, and since it is developed by the drive signal from the horizontal oscillator, that drive is probably very low (it is normally 140 volts peak-to-peak). Try a new 6GH8 in the oscillator stage, and check all of the DC voltages.

THIN VERTICAL LINE

Here's some feedback on the GE 10JA chassis. The symptom was a thin, fuzzy, vertical line on the right side of the screen. But before I got your response, I found the cause. Replacing the horizontal driver transformer cleared up the problem.

Thanks to Danny Davis, Moundville, AL, for that helpful information.

DOUBLE PICTURE

I've got two complete pictures side-by-side on this Zenith 19DC22. All of the tubes and transistors check out OK. Can you help?—T.W., Lafayette, LA

That sounds like an old Zenith problem. The horizontal-hold control is a tunable coil. The coil has a stop, but if the control knob is pulled out a little too much, the stop can be missed. If that happens it is possible to turn the knob too far—far enough, in fact, to make the oscillator run at half speed, 7875 Hz. Turn the knob until the picture returns to normal. From experience, you'll have to turn the knob counterclockwise; turning it clockwise will increase the inductance, making the oscillator run even slower.

6HU8 TUBE

Can you tell me where I can get a 6HU8 tube, or a substitute for it that I can use by rewiring the socket? I've looked everywhere, but had no luck.—E.S. Corydon, IN

You've opened up a real can of worms! I've looked everywhere and come up with what you did—nothing! I finally did run down something in an

old RCA tube manual, a listing that read "6HU8/ELL80." The "ELL80" notation indicates that this is a European type with the "PRO-Electron" numbering. It is a dual power-output pentode with a 2-watt output, a 6.3-volt heater, and a 9-pin base. No substitutes are listed, but the load impedance is 10,000 ohms. You should be able to find two common single-configuration miniature tubes with the same load impedance and run them side-by-side—any impedance from 8,000 to 10,000 ohms should work. You'll have to do some juggling, and mount another socket, so be prepared for a lot of work.

STEREO DISTORTION

I've got a Sanyo DC434 stereo receiver with bad distortion. Everything seems to check out OK, but if I go back from the output and touch coupling capacitor C429, the distortion stops. I need help!—A.C., Howard Beach, NY

I think that you may have already found it. Chances are good that C429 is either leaky or opening up intermittently. That capacitor is a low-voltage electrolytic, and I've grown to suspect them in any circuit with problems. Try a new one and see if that's the case here.

LOW SOUND

I've got a sound problem in this AMC 5CP-301. I've tried a new speaker, changed both transistors, and changed the sound-IF IC with no luck. I get very little signal at the collector of Q301, the driver. Any ideas?—E.S., Zion, IL

I don't think that you are really getting anything out of Q301—just some signal leakage. This is a common-emitter stage; the emitter is bypassed. If the bypass is open, you'll lose practically all of the gain. Use an oscilloscope to check the collector, base, and emitter. If the signals on the base and emitter are nearly the same, the bypass is open. There should be no signal at all on Q301's emitter if the bypass is good.

(Feedback: "You hit the nail on the head. Capacitor C317, the .22 μF bypass capacitor was open. I replaced it and the set now works fine.")

HORIZONTAL-FREQUENCY PROBLEMS

When this Sony KV-1511 was first turned on, the horizontal frequency was completely out of the range of the horizontal-hold control. After 5 to 10 minutes, the frequency drifted back slowly and would lock in at the end of the control's range. Thinking that the component's value had changed and that heat was partially correcting the problem, I tried cooling spray; it had no effect. Voltages seemed to be close enough to what they should be, and didn't drift during warm-up.

In this set, the frequency is controlled by a DC voltage. The horizontal-hold control sets the DC-voltage level that biases the AFC. An oscilloscope showed horizontal pulses across that control. I traced the pulse back to the B+ line, and finally to C533, a 100 µf filter capacitor. Replacing the capacitor fixed the problem.

Thanks for this to Vic Spacek of Bloomfield, CT

VIDEOTAPE COLOR

I wrote you about a problem in a Sony videotape recorder. It would play back previously-recorded material in perfect color, but would not record in color. Although you said that you didn't know anything about that machine, you did suggest a few things to try, including cleaning the record/playback switch's contacts. After finding the thing (the switch on this unit works through a series of levers; the contacts themselves are on one of the circuit boards), I cleaned the contacts with a spray cleaner. The videotape recorder now works perfectly. I just thought that you'd like to know.

—Lloyd Hust, Brigham City, UT

TWO HINTS

Here are a couple of hints for your files. The first deals with the vertical-output fuse in the Zenith 23FC45 that keeps failing. The only way to repair that problem is to replace the vertical-driver transistor (the one with the TO-126 flat-pack case). The transistor seems prone to failure under load. The problem is intermittent, and heating or freezing does not reveal it.

The second hint involves the Zenith 25CC50 and similar chassis. The symptom is poor focus even if the focus voltage is normal. Even though the CRT will test out as good (at least on my testers) the CRT must be replaced anyway. That has shown up recently on 25VACxx and 23VAQ CRT's. R-E

EQUIPMENT REPORTS

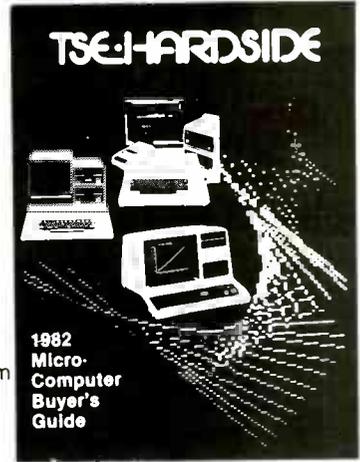
continued on page 36

wide and I could not get quite enough heat from the desoldering gun. Holding the tip of a second soldering iron to the other side of the lug melted the solder, and the Hot Vac did the rest.

The desoldering system is a well-made piece of equipment; I've used Ungar products for many years, and I've liked them. The instructions are very complete, and include a parts list, service information, and clear illustrations. The model 4000 Hot Vac is priced at \$399.00. There is also the model 4000E for 220-volt operation that sells for \$555.55. R-E

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ELECTRONIC HARDWARE CATALOG,

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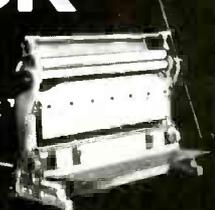
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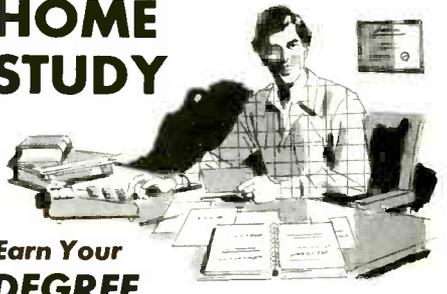
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R-E

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NEW BOOKS

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THE HOME VIDEO HANDBOOK, Second Edition, by Charles Bensinger. Video-Info Publications, PO box 1507, Santa Barbara, CA 93102. 304pp.; 5½ x 8½ inches; softcover. \$8.95.

This is much more than a second printing of the popular first edition; there are 100 additional pages and 80 new photographs and graphics. The aim of this second edition, however, remains the same as that of the first: It is designed to unscramble the confusing data and claims surrounding home-video equipment and to provide clear and visual explanations of technical jargon and popular video systems.

There is a detailed treatment of popular home color cameras, videocassette recorders, videodisc systems, large-screen TV projectors, home-satellite TV receivers, and ½-inch industrial-video systems.

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how one's video equipment can be used to pay for itself, create new opportunities for personal employment, or perform community educational and information services.

Photographs, drawings, and cartoons illustrate the easy-to-read text; there is a list of home-program sources, educational sources, and popular video books, as well as an 11-page glossary of technical terms and a list of manufacturers' addresses.

CIRCLE 121 ON FREE INFORMATION CARD

HOW TO REPAIR CB RADIOS, by Lawrence E. Schultz. Gregg/McGraw-Hill, 1221 Avenue of the Americas, New York, NY 10020. 184pp.; 5¾ x 8 inches; softcover. \$9.95.

This book is written from a service technician's point of view and uses a hands-on approach. Theory is dealt with only when the material is peculiar to CB radios and the reader needs it as a support to trouble-shooting techniques.

None of the techniques and hints in the book are theoretical, however: They have all been tested and proved effective on the service bench.

The introduction describes the many types of CB radios and their accessories. Then we get into basic troubleshooting techniques. Chapters 3 to 8 cover "Developing Signal Frequencies," "The Receiver," "The Transmitter," "Power Supplies," "Antennas and Transmission Lines," and "Single-Sideband Circuitry." The book is fully illustrated with photographs, diagrams, tables, and charts.

CIRCLE 122 ON FREE INFORMATION CARD

MICROCOMPUTERS FOR EXTERNAL CONTROL DEVICES, by James A. Gup-ton, Jr. dilithium Press, P.O. Box 606, Beaverton, OR 97075. 279pp., including appendices and index; 5½ x 8½ inches; softcover. \$13.95

This book deals with the ways in which a microcomputer can be used to control devices in one's home, one's business, or

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CIRCLE 123 ON FREE INFORMATION CARD

30 PROJECTS TO IMPROVE YOUR STEREO SYSTEM, by David B. Weems. Tab Books, Inc., Blue Ridge Summit, PA 17214. 240pp., including appendices and index; 5 x 8 1/2 inches; softcover. \$7.95.

While almost any system can be improved, there are two areas where small changes can pay big dividends in better sound: at the antenna and at the speaker. That is why there are more antenna and speaker-related projects in this book than any other kinds. Some improvements, while real enough, are very expensive. The projects outlined here have all been chosen with one eye upon performance and one eye upon cost.

The 10 chapters deal with FM antennas,

antenna projects, an amplifier project, crossover networks, crossover-network projects, speaker-enclosure projects, speaker-improvement projects, more speaker-improvement projects, high-frequency improvement projects, and stereo-equipment cabinets. Each chapter is fully illustrated with photos, clear line illustrations, or both.

CIRCLE 124 ON FREE INFORMATION CARD

A CONSUMER'S GUIDE TO PERSONAL COMPUTING AND MICROCOMPUTERS, second edition, by Stephen Freiburger and Paul Chew, Jr. Hayden Book Company, 50 Essex St., Rochelle Park, NJ 07662. 198pp.; 7 x 9 1/4 inches; softcover. \$8.95.

The authors of this book assume that the reader has had no previous experience with, or knowledge of, either computers or microcomputers. Thus, the first section, chapters 1 through 5, introduces the reader to fundamental principles and definitions, with photos and charts.

Chapters 6 through 10 constitute a product guide, reviewing over 100 microcomputer products from over 60 manufacturers. They include a selection-and-sources section to assist the reader in reviewing, selecting and purchasing microcomputer products; summary charts of major microcomputer products, offering a quick rundown of specifications for a given product, and comment sections covering the advantages and disadvantages for each microcomputer product, as well as best-buy tips.

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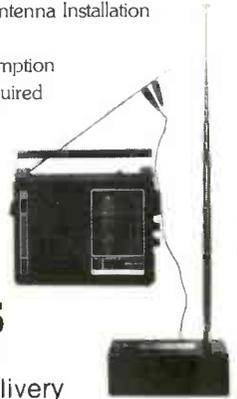
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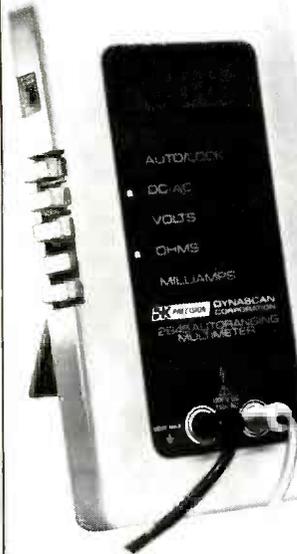
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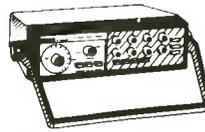
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34 MORE TESTED, READY-TO-RUN GAME PROGRAMS IN BASIC, by Delton T. Horn. Tab Books, Inc., Blue Ridge Summit, PA 17214. 224pp., including appendices and index; 5 1/2 x 8 3/4 inches; \$7.95.

Computers are mainly for serious business, but they can be fun, too—and that is what this book is about. It presents a collection of games, gags, brain-teasers, and non-games, and even sneaks in some programs that educate while they entertain the user.

For a single player there are not only such familiar games as "Craps," "High/Low," "Go Fish," and "Tic Tac Toe", but also new ones with such fascinating titles as "Hangman," "There's Gold in Them There Skyscrapers," and "What Comes Next?"

Two-player games include "To and Fro," "Passing Points," and "Money Mad."

An entire chapter is devoted to the challenging and complex game called "Frustration." After the main game program, there is "Two Man Frustration," "Frustration vs. the Computer," and "The Computer vs. Itself."

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CIRCLE 126 ON FREE INFORMATION CARD

PASCAL PROGRAMS For Scientists and Engineers, by Alan R. Miller. SYBEX, 2344 Sixth Street, Berkeley CA 94710. 374 pp., including appendices, bibliography, and index; 7 x 9 inches; softcover. \$16.95.

This book has the twofold purpose of helping the reader to develop proficiency in using Pascal, and in building a library of programs that can be used to solve problems frequently encountered in science and engineering. The programs presented will prove valuable to practicing scientists and engineers but are also suitable for a junior- or senior-level course in numerical methods.

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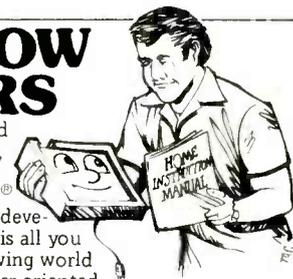
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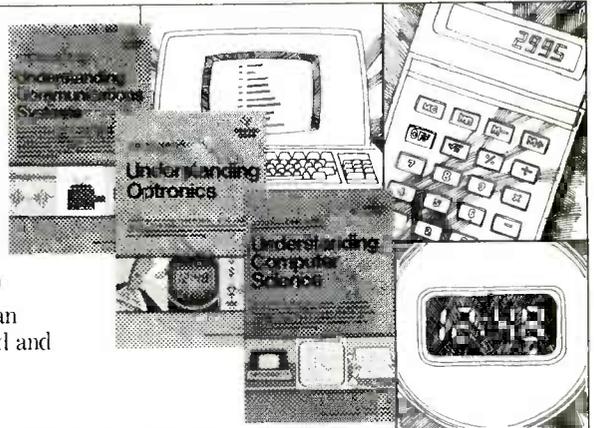


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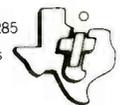


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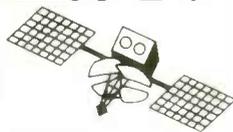
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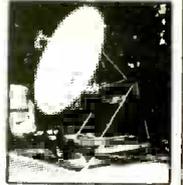
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7400N	.23	74164N	.64	74S194N	1.68	74LS161N	.84
7401N	.25	74165N	.64	74S195N	1.72	74LS162N	1.10
7402N	.24	74166N	.68	74S201N	5.99	74LS163N	.58
7403N	.24	74170N	1.96	74S225N	5.99	74LS164N	.58
7404N	.26	74172N	4.95	74S240N	2.95	74LS165N	.89
7405N	.26	74173N	.79	74S241N	2.95	74LS166N	1.64
7406N	.36	74174N	.66	74S244N	3.49	74LS170N	1.59
7407N	.36	74175N	.58	74S251N	1.49	74LS171N	.59
7408N	.28	74176N	.71	74S253N	2.29	74LS174N	.44
7409N	.28	74178N	1.17	74S257N	1.42	74LS175N	.44
7410N	.25	74179N	1.35	74S258N	1.09	74LS181N	1.99
7412N	.47	74180N	.75	74S260N	1.89	74LS189N	4.45
7413N	.42	74182N	.52	74S274N	17.99	74LS190N	.72
7414N	.42	74184N	2.39	74S275N	16.77	74LS192N	.64
7416N	.36	74185N	2.36	74S280N	2.29	74LS193N	.72
7417N	.36	74190N	.68	74S283N	3.39	74LS194N	.64
7420N	.29	74191N	.68	74S299N	6.54	74LS194N	.64
7422N	.37	74192N	.68	74S373N	2.98	74LS197N	.88
7423N	.37	74193N	.72	74S374N	2.98	74LS197N	.88
7425N	.32	74194N	.72	74S381N	5.95	74LS221N	.89
7426N	.39	74195N	.55	74S412N	2.98	74LS241N	.89
7427N	.32	74196N	.79	74S427N	8.45	74LS242N	1.10
7428N	.48	74197N	.72	74S427N	8.45	74LS242N	1.10
7430N	.22	74198N	1.50	74S474N	8.65	74LS243N	1.10
7432N	.42	74199N	1.55	74S476N	5.95	74LS244N	1.10
7433N	.42	74221N	.68			74LS245N	1.65
7437N	.38	74246N	1.44	74LS00N	.19	74LS247N	.84
7438N	.38	74247N	1.29	74LS01N	.22	74LS248N	1.09
7442N	.25	74251N	1.10	74LS02N	.22	74LS249N	1.10
7445N	.95	74273N	2.39	74LS03N	.22	74LS251N	.54
7446N	.84	74276N	1.19	74LS04N	.22	74LS253N	.54
7447N	.65	74278N	2.38	74LS05N	.22	74LS257N	.89
7450N	.25	74279N	.59	74LS08N	.22	74LS258N	.56
7451N	.29	74283N	1.10	74LS09N	.28	74LS259N	1.29
7453N	.29	74283N	.89	74LS11N	.26	74LS260N	1.25
7454N	.29	74288N	.84	74LS12N	.24	74LS263N	.36
7472N	.36	74351N	.29	74LS13N	.29	74LS275N	4.69
7473N	.38	74365N	6.20	74LS14N	.39	74LS279N	.48
7474N	.42	74366N	.68	74LS20N	.22	74LS280N	1.96
7475N	.42	74367N	.59	74LS21N	.28	74LS281N	.78
7476N	.42	74368N	.58	74LS26N	.22	74LS290N	.72
7483AN	.48	74390N	.96	74LS27N	.29	74LS293N	.44
7484AN	1.36	74393N	1.29	74LS30N	.18	74LS298N	.88
7485N	.66			74LS32N	.29	74LS299N	2.50
7486N	.39	74S00N	.44	74LS37N	.29	74LS320N	2.75
7490AN	.42	74S02N	.44	74LS38N	.29	74LS321N	3.95
7491AN	.44	74S02N	.72	74LS39N	.44	74LS322N	4.95
7492AN	.68	74S04N	.69	74LS47N	.68	74LS323N	5.44
7493AN	.38	74S05N	.69	74LS48N	.99	74LS324N	3.25
7494AN	.68	74S08N	.48	74LS51N	.24	74LS348N	2.65
7495AN	.54	74S09N	.86	74LS55N	.24	74LS352N	1.45
7496N	.59	74S10N	.48	74LS55N	.24	74LS353N	1.45
7497N	1.89	74S11N	.59	74LS56N	.32	74LS362N	9.95
74100N	1.56	74S15N	.69	74LS74N	.32	74LS365N	.52
74104N	.64	74S20N	.48	74LS75N	.36	74LS366N	.52
74107AN	.44	74S32N	.89	74LS76N	.42	74LS367N	.52
74109N	.44	74S32N	.49	74LS78N	.32	74LS368N	.52
74110N	.52	74S37N	.99	74LS83N	.69	74LS373N	1.25
74111N	.72	74S38N	1.17	74LS85N	.84	74LS374N	1.25
74116N	1.38	74S40N	.44	74LS86N	.68	74LS375N	.64
74117N	1.38	74S45N	.69	74LS90N	.39	74LS377N	1.25
74121N	.48	74S47N	.66	74LS91N	.39	74LS378N	.99
74122N	.54	74S85N	2.19	74LS92N	.48	74LS379N	1.09
74123N	.48	74S86N	.78	74LS93N	.39	74LS390N	.98
74125N	.52	74S112N	.78	74LS95N	.48	74LS393N	1.19
74126AN	.48	74S114N	1.96	74LS96N	.58	74LS395N	1.19
74128N	.48	74S124N	2.69	74LS107N	.42	74LS447N	.37
74132N	.45	74S132N	1.24	74LS109N	.36	74LS490N	1.89
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74142N	3.27	74S135N	1.56	74LS123N	.59	74LS670N	1.64
74143N	3.79	74S138N	.96	74LS125N	.44		
74144N	3.79	74S138N	.96	74LS126N	.44		
74145N	.67	74S140N	.89	74LS132N	.54		
74147N	1.32	74S151N	1.10	74LS133N	1.68		
74148N	.89	74S153N	1.10	74LS136N	.42		
74150N	1.44	74S157N	1.10	74LS138N	.48		
74151N	.44	74S158N	1.16	74LS139N	.48		
74153N	.38	74S161N	4.74	74LS141N	.44		
74154N	1.44	74S162N	3.70	74LS147N	1.96		
74155N	.48	74S163N	3.54	74LS148N	1.43		
74157N	.52	74S168N	4.74	74LS151N	.42		
74159N	1.52	74S169N	5.39	74LS153N	.42		
74160N	.48	74S174N	1.06	74LS155N	.87		
74161AN	.64	74S175N	1.06	74LS156N	.99		
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CMOS RAM

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PROM'S

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1.88	256 b1, 16 PIN	
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7406	2/1.19	74109	2/1.19
7407	2/1.19	74121	.69
7408	2/.89	74123	.99
7410	2/.85	74150	1.95
7414	2/.99	74154	1.95
7417	2/1.10	74157	.99
7420	2/.85	74161	1.19
7447	1.19	74164	1.59
7474	.69	74174	1.59
7475	.79	74175	1.49
7476	.69	74192	1.19
7485	1.19	74193	1.19
7486	2/1.19	74367	.99
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4010	.79	4049	.79
4011	.55	4050	.89
4013	.79	4051	1.59
4016	.79	4066	.95
4017	1.39	4069	.69
4018	1.39	4070	.75
4020	1.39	4071	.69
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4024	1.19	4093	1.19
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- 120VAC input
- Size: 3-1/2" w x 5-1/16" L x 2" H



JE215 Adj. Dual Power Supply Kit (as shown) . . . \$24.95
(Picture not shown but similar in construction to above)

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JE210 Var. Pwr. Sply. Kit, 5-15VDC, to 1.5amp. . . \$19.95

DESK TOP ENCLOSURES



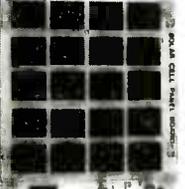
DTE-8 (Pictured).....	\$31.95
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DTE-HK (Case for JE600).....	47.95
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- Panel may be easily connected for Series or Parallel out
- Over 11 square inches of active cell surface
- Voltage line tap @ 0.5V increments
- Provision for charging batteries
- Overall panel size: 4 3/4" L x 4 1/2" H x 1/2" D



The JE305 Solar Cell Panel Kit contains 20 ea. solar cells. On the panel board are power line taps which allow the user to select voltages (1 voltages at a time) from 0.5VDC to 10VDC. The applications of each panel can be further expanded by coupling additional panels in series for more voltage or in parallel for more current. The premium grade solar cells provide the current necessary for the operation of most portable transistor radios, small battery powered cassette tape players & unlimited experimental solar projects.

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LS Schottky

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74LS04	.69	74LS138	1.29
74LS08	.55	74LS139	1.29
74LS10	.55	74LS154	1.95
74LS14	1.09	74LS157	1.19
74LS30	.55	74LS161	1.29
74LS32	.69	74LS174	1.19
74LS38	.69	74LS175	1.19
74LS42	1.29	74LS192	1.49
74LS47	1.29	74LS193	1.49
74LS48	1.79	74LS221	1.49
74LS53	.75	74LS244	1.89
74LS74	.69	74LS245	3.49
74LS75	.75	74LS367	.89
74LS85	1.49	74LS374	1.95
74LS90	.89	81LS97	2.29

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20 pin LP	2/.99	24 pin WW gold	1.69
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28 pin LP	.82	16 p. plug/cover	1.39
36 pin LP	.99	24 p. plug/cover	1.95
40 pin LP	1.19	Also, The Moflex Line	

DIODES & TRANSISTORS

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1N757	2/.59	2N2222A	2/.89
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1N4001	4/.59	2N3772	2.25
1N4004	4/.69	2N3904	2/.69
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1N4733	2/.69	2N4403	2/.79
1N4734	2/.69	2N5129	2/.69
1N4735	2/.69	2N5139	2/.69
1N4742	2/.69	2N5210	2/.79
1N4744	2/.69	2N5951	2/1.29

CAPACITORS

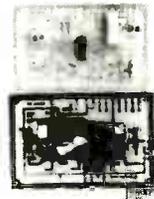
Dipped Tantalum		ELECTROLYTIC	
.1mfd @ 35V	2/.89	1mfd @ 50V	3/.69
.47mfd @ 35V	2/.89	4.7mfd @ 50V	2/.59
1mfd @ 35V	2/.89	10mfd @ 50V	2/.69
2.2mfd @ 25V	2/1.09	22mfd @ 50V	2/.79
3.3mfd @ 25V	2/1.19	47mfd @ 50V	2/.89
4.7mfd @ 25V	2/1.39	100mfd @ 50V	.59
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		2200mfd @ 16V	1.39
100V MYLAR		50V CERAMIC	
.001-.01mfd	4/.79	10pf-.022mfd	4/.59
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7408	74LS08	74C08
7409	74LS09	74C09
7410	74LS10	74C10
7411	74LS11	74C11
7412	74LS12	74C12
7413	74LS13	74C13
7414	74LS14	74C14
7415	74LS15	74C15
7416	74LS16	74C16
7417	74LS17	74C17
7418	74LS18	74C18
7419	74LS19	74C19
7420	74LS20	74C20
7421	74LS21	74C21
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7423	74LS23	74C23
7424	74LS24	74C24
7425	74LS25	74C25
7426	74LS26	74C26
7427	74LS27	74C27
7428	74LS28	74C28
7429	74LS29	74C29
7430	74LS30	74C30
7431	74LS31	74C31
7432	74LS32	74C32
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7434	74LS34	74C34
7435	74LS35	74C35
7436	74LS36	74C36
7437	74LS37	74C37
7438	74LS38	74C38
7439	74LS39	74C39
7440	74LS40	74C40
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7447	74LS47	74C47
7448	74LS48	74C48
7449	74LS49	74C49
7450	74LS50	74C50
7451	74LS51	74C51
7452	74LS52	74C52
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7465	74LS65	74C65
7466	74LS66	74C66
7467	74LS67	74C67
7468	74LS68	74C68
7469	74LS69	74C69
7470	74LS70	74C70
7471	74LS71	74C71
7472	74LS72	74C72
7473	74LS73	74C73
7474	74LS74	74C74
7475	74LS75	74C75
7476	74LS76	74C76
7477	74LS77	74C77
7478	74LS78	74C78
7479	74LS79	74C79
7480	74LS80	74C80
7481	74LS81	74C81
7482	74LS82	74C82
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7490	74LS90	74C90
7491	74LS91	74C91
7492	74LS92	74C92
7493	74LS93	74C93
7494	74LS94	74C94
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New Panasonic Polyester capacitors...
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PARANOSIC ELECTROLYTIC CAPACITORS

Part No.	Value	Price
1000	1000µF	\$1.00
2000	2000µF	\$1.50
3000	3000µF	\$2.00
4000	4000µF	\$2.50
5000	5000µF	\$3.00
6000	6000µF	\$3.50
7000	7000µF	\$4.00
8000	8000µF	\$4.50
9000	9000µF	\$5.00

NEW! KIT
Includes: Capacitors, Resistor, Breadboard, Power Supply, Wires, Solder, Test Leads, Protoboard, ICs, Transistors, Diodes, Zener Diodes, Potentiometer, Switch, LED, Resistor Network, Clock, Calendar, Real-Time Clock, Terminal Products, Batteries, Clocks, Zener Diodes, Breadboards, Resistor & Resistor Networks, Hardware, Power Microprocessor, Support, Luxo Lamps, Clock Bezel, PC Lab Electronics, Transistors, Car Clock, Transistors

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Includes: Capacitors, Resistor, Breadboard, Power Supply, Wires, Solder, Test Leads, Protoboard, ICs, Transistors, Diodes, Zener Diodes, Potentiometer, Switch, LED, Resistor Network, Clock, Calendar, Real-Time Clock, Terminal Products, Batteries, Clocks, Zener Diodes, Breadboards, Resistor & Resistor Networks, Hardware, Power Microprocessor, Support, Luxo Lamps, Clock Bezel, PC Lab Electronics, Transistors, Car Clock, Transistors

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The Digi-Key volume discount and handling charges are simple to apply. Most items sold by Digi-Key may be combined for a volume discount. Items that are not discountable are identified by the suffix "ND" following the part number. After writing your order, total all of the discountable items and apply the appropriate discount. To this subtotal, add the non-discountable items. Then add the handling charge and shipping charges in the U.S. or Canada and Mexico and add the master card or money order. If you are ordering by phone, call 1-800-346-5441 (Mn., Ak., Hi. call 218-681-6674) to get a part number and price. If you are ordering by mail, send your order to: Digi-Key, Highway 13 South, Thief River Falls, MN 56701. You may pay by check, money order, Master Charge, VISA or C.O.D. **DIGI-KEY GUARANTEE:** Any parts or products purchased from Digi-Key that prove to be defective will be replaced or refunded if returned within 90 days from receipt with a copy of your invoice. Prices subject to change without notice.

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VOLUME DISCOUNT Vol. \$0.00-99.99 Add \$2.00 Vol. \$100.00-249.99 Add \$2.75 Vol. \$250.00-499.99 Add \$3.50 Vol. \$500.00-999.99 Add \$4.25 Vol. \$1000.00 & Up Add \$5.00

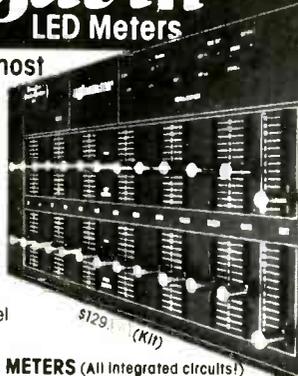
CIRCLE 5 ON FREE INFORMATION CARD

Aaron-Gavin Kits

Equalizers Mixers LED Meters

Featuring this month — our most unique graphic equalizer!

- 11 bands per channel
- 2 channels per band
- Lowest noise, at any price
- LED peak indicator
- MIC input
- High & low level mixer
- Built-in record switching —
- no need to re-patch
- Master gain control on each channel
- Regulated power supply



GRAPHIC EQUALIZERS

Description	Kit	Mfg.
31 Band Stereo EQ	\$279.56	\$444.54
31 Band Mono EQ	\$157.05	\$322.53
21 Band Stereo EQ	\$205.02	\$421.02
21 Band Mono EQ	\$125.05	\$258.64
11 Band Stereo EQ	\$114.94	\$230.00
11 Band Mono EQ	\$ 75.84	\$151.57
11 Band Stereo EQ (As shown above)	\$129.90	\$249.80
5 Band Stereo EQ	\$ 74.50	\$148.99
5 Band Mono EQ	\$ 49.14	\$ 98.27

LED METERS (All integrated circuits!)

Description	Kit	Mfg.
DOT or BAR Pattern, 3 position range switch		
Front panel mount only		
10 LED (Mono)	\$44.40	\$55.80
20 LED (Stereo)	\$52.20	\$68.00
Cabinet or Rack Mount		
20 LED (Mono)	\$50.40	\$68.00
40 LED (Stereo)	\$67.00	\$88.60

Down to — 71dB!

Total frequency response: 10Hz to 100KHz ± 0.5dB. Unweighted! Band frequencies: 16Hz Band frequencies: 16Hz to 16KHz and 20Hz to 20KHz.

Order with this Coupon or send for product specifications. Check box for the item of your choice send check, money order, COD or Visa, Master Charge. Your card number.

Exp. date _____ Add \$7.00 for shipping and handling.
 Check style: Rack Mount Flat Cabinet Upright Cabinet
 Check Freq. Range: 16Hz-16KHz 20Hz-20KHz

NAME _____ PHONE _____
 ADDRESS _____
 CITY _____ STATE _____ ZIP _____
 Aaron-Gavin, 1901 E. Deere St., Dept. 18, Santa Ana, CA 92705. Phone: (714) 957-8710

- 4116-4 MEMORY 16K 8 for \$10.00
 - 8164 MEMORY 64K 10.00
 - 8264 MEMORY 64K 12.00
 - 4Kx16 MEMORY board w/64 2101 chips 50.00
 - MPI 8 inch single side disc drive (OK, used) 175.00
 - MPI 8 inch dual sided disc drive (OK, used) 350.00
 - SHUGART 8 inch drive 850 FDD (ok, used) 425.00
 - MOTOROLA MONITOR 9 inch 115 volt 60.00
 - MOTOROLA MONITOR 12 inch 115 volt 85.00
- Above 2 units accept composite video, no case, used.
 2 units below accept TTL. Hi volt supply only. Used.
 BALL BROS. 12 inch monitor 50.00
 BALL BROS. 5 inch monitor, cased, used. 60.00

DATA STATION CONSOLE w/keyboard & 9 inch monitor, power supply. Logic boards broken send for details on this one. \$80.00

- IR SCOPE see in the dark, new, portable. 260.00
- IR SCOPE KIT pre-assembled, modular 150.00
- 12 VOLT GEL CELL 2½ AH \$14.00 5 AH 17.00
- 12 inch CRT bonded face plate, new, with specs. Made for computer work. \$25 each 5 for \$100.00
- UNDERWATER HYDROPHONE 200 KC 10.00

WALKY TALKIES Govt surplus used condition. 47-55.4 mc range. With schematics. Govt AN/PRC-6 \$25 each 2 for \$45. Ant. \$5 each



ASCII KEYBOARD parallel \$50
 RED LED's 10 for \$1.00

MIN ORDER \$10.00 CATALOG 21 now ready
 Shipping extra on all merchandise

Meshna Inc., PO Box 62, E. Lynn, Mass. 01904

CIRCLE 14 ON FREE INFORMATION CARD

COMMAND PERFORMANCE LED CLOCK MODULE

FIRST TIME EVER OFFERED!



FULLY ASSEMBLED
 REAL TIME

1-10 Units \$34.95
 11+ Units \$31.95

ELAPSED TIME

1-10 Units \$39.95
 11+ Units \$36.95

KIT FORM \$24.95
 (Real/Elapsed Time)

- Battery-Operated: Two Alkaline "D" Batteries
- Sound-Activated Module
- Sensitivity control
- 9" Digital Readout
- 4x4 Printed Circuit Board

RaLar INSTRUMENTS, INC.

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 For further information or to place order call (714) 578-4050

Total Amount of Order: \$ _____
 CALIFORNIA RESIDENTS ADD 6% SALES TAX.

NAME _____
 ADDRESS _____
 CITY _____
 STATE _____ ZIP _____

Enclosed is: Check Money Order
 Charge my: M/C VISA
 ACCT.# _____ EXP. DATE _____
 Free Catalogue With Order • Dealer Inquiries Welcome

CIRCLE 61 ON FREE INFORMATION CARD

TERMINALS, TERMINALS!

Daisy Terminals

Featuring 110, 150 and 300 baud, RS 232 I/O. Full KSR, full or half duplex, Diablo Hytype-I printer, plastic Daisy wheel, off-lease and refurbished. 4-way plotting mode under remote or KBD control. Built in KBD, ptr. typing table, power supply and more, with user manual and schematics. Refurbished.



..... \$999⁰⁰..
 Add \$45.00 for Crate - Pay Shipping on Delivery

Selectric Terminals

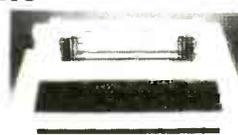
Famous Datel-built "Selectric" I/O terminal. Used, "as-is" cond. (may need minor service). Features 15" carriage Selectric typewriter/printer, KBD/Solenoid assembly, power supply & RS232 I/O circuit board. Speaks IBM "correspondence" protocol. Limited info included.



Used "As-Is" . . . Only \$499⁰⁰..
 Add \$20.00 for Packaging & Handling - Pay Shipping on Delivery

DEC LA-36 Terminals

Off-lease and refurbished, these are the famous DEC dot matrix, 30 character per second RS-232 terminals with such advanced features as 60 cps character catch-up print rate for true 300 baud operation. Built by Digital Equipment Corp. 132 columns, tractor-fed.



Refurbished Only \$799⁰⁰..
 Pay Shipping on Delivery

WRITE OR CALL FOR OUR BARGAIN-PACKED PERIPHERAL FLYER!!

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COMPUTERS, PERIPHERALS, UNLIMITED!
 MasterCharge & VISA Accepted

CIRCLE 35 ON FREE INFORMATION CARD

SURPLUS ELECTRONICS CORP.

7294 N.W. 54th Street
Miami, Florida 33166

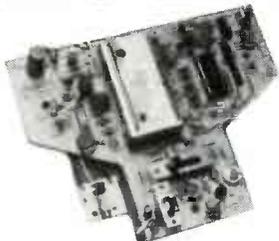
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Phone: (305) 887-8228

TWX: 810-848-6085

We accept MasterCard and Visa.

EQUIPMENT/COMPONENTS/WIRE & CABLE/ACCESSORIES



"TANK BATTLE" TV GAME

In just a short time and with a few minor parts, the most novice hobbyist can complete this exciting Tank Battle game. Create a fun-filled evening for the whole family. Two independent tanks rumble thru land mine fields, shoot shells and fragment when hit. Four distinct engine sounds are produced for the different speeds. Sounds of gunfire, shell bursts and tank explosions are realistic. Automatic on-screen scoring. Supplied with schematic drawing.

SOLD AS IS
\$9.95 ea.



C.B. SPECIAL

CONVERT THESE TO 10 METER FM

New HY-GAIN printed circuit board assembly with PLL02A chip and 3 crystals. (Squelch pot, volume control and channel switch not included.) Boards sold as is, the way we bought them from the manufacturer. Board dimensions 6" x 6 1/2"

1-9 **\$7.50** 50-99 **\$6.00**
10-49 **\$6.50** 100-UP **\$5.50**

COPPER CLAD BOARD

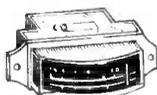
(Double Side)
Size 9.25 x 10.75
Thickness .062
\$2.00 ea.

TRIMMER CAP



1.5-20pF
(ARCO PC-402)
50¢ ea.

E. F. JOHNSON S METER



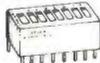
Edge Meter 250 UA, fits in 3/8" x 1 1/8" hole. Black background. Scale 1-20 Top, 0-5 Bottom.

\$1.25 ea 5/\$5.00

COMPUTER GRADE ELECTROLYTICS

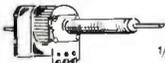
VALUE/MFD	VOLTS	DIAM./LGTH.	PRICE
63,000	@ 15V	3" x 5 1/2"	\$4.00 ea.
10,000	@ 20V	1 1/2" x 5 3/4"	\$3.00 ea.
2,700	@ 25V	1 1/4" x 2 1/4"	\$2.00 ea.
2,900	@ 25V	1 1/4" x 2"	\$2.00 ea.
100,000	@ 30V	3" x 5 1/2"	\$6.00 ea.
39,000	@ 30V	1" x 5 3/4"	\$4.00 ea.
34,800	@ 50V	3" x 5 1/2"	\$3.00 ea.
450	@ 75V	1 1/4" x 2 1/4"	\$2.00 ea.
500	@ 100V	1 1/2" x 3 1/4"	\$2.00 ea.
240	@ 300V	1 1/4" x 3 1/4"	\$2.00 ea.
50	@ 450V	1 1/4" x 2"	\$2.00 ea.

DIP SWITCH



5 POSITION **\$1.00 ea.**
8 POSITION **\$1.50 ea.**
10 POSITION **\$2.00 ea.**
12 POSITION **\$2.50 ea.**

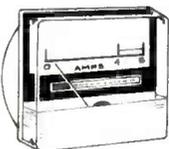
SUB-MINI 10K POT



with C n-Off
1/4" hole mount,
1/8" D shaft,
3/4" thread section.

5/\$1.00

AMP METERS



2 1/4" square, no shunt required. Easy to read dial. Movement: 0-6, 0-10, 0-17
\$2.50 ea.

POWER TRANSFORMER

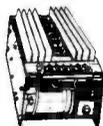
Primary - 115 vac
Secondary - 32 v with 24 v tap at 15 amps
Dim. 4 1/2" h X 3 3/4" w X 4" deep



SCREW DRIVER KIT



Handle stores four blades
2 single slot 5/32" & 3/32"
1 phillips 1 scratch awl
6" long with one blade inserted
\$1.00 ea.



24 Volt POWER SUPPLY

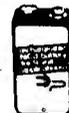
5.4 AMPS
\$45.00 ea.

MFG by ACDC Electronics Inc. Model OEM 24N5.4-1

Input 105-125 vac 50/60 Hz. Has volt adj and O.L. adj. Output terminals contain + out, + sen, - sen, - out, ac neut, ac line and GND

9 VOLT NiCd RECHARGEABLE BATTERY

NEW. Replaces the popular 9V Transistor Battery.



\$4.75 ea.

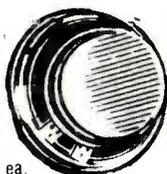
MUFFIN FANS



MFG By Rotron Inc. 3 Blades 4 3/4" Square USED
110 VAC **\$5.95 ea.**
NEW
230 VAC Model MU3A1
\$12.00 ea.

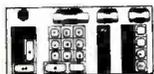
SPEAKER

3" Diam., 8 OHM, 5 Watts



\$2.00 ea.

TEXAS INSTRUMENT KEYBOARD



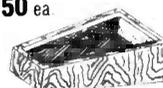
Has 3 slide switches, 26 different keys, key pad removable by 4 screws
\$1.95 ea. 5/\$8.00

AXIAL LEAD ELECTROLYTIC CAPACITORS

2 uF @ 15V 12/**\$1.00**
10 uF @ 15V 12/**\$1.00**
20 uF @ 15V 12/**\$1.00**
50 uF @ 15V 12/**\$1.00**
2.3 uF @ 25V 12/**\$1.00**
3.3 uF @ 25V 12/**\$1.00**
1 uF @ 35V 12/**\$1.00**
2 uF @ 150V 12/**\$1.00**
25 uF @ 25V 15/**\$2.00**
3 uF @ 50V 15/**\$2.00**
5 uF @ 50V 15/**\$2.00**
10 uF @ 25V 10/**\$2.00**
250 uF @ 25V 10/**\$2.00**
50 uF @ 75V 10/**\$2.00**

PROJECT BOX

\$1.50 ea.



4 5/8" w x 7 3/8" l x 3/4" to 1 1/2" h
Has a lip for recessed face plate and a felt bottom

POWER SUPPLY

+ 12 vdc. 1 amps
+ 5 vdc. 4 amps
\$3.95 ea.

IC SOCKETS GOLD-PLATED WIRE WRAP

14 pin **40¢ ea.**
16 pin **45¢ ea.**
40 pin **\$1.75 ea.**

NEW SPRITE FAN

Mfg by Rotron Inc. Model SU2A5. 115v AC. 19 amps. (Impedance protected.) 3 1/4" x 3 1/4" x 1 1/4"
\$12.00 ea.

7' POWER CORD HEWLETT PACKARD TYPE



Molded 3 Prong Plug with molded receptacle. Belden 16 AWG
\$3.00 ea.

COAX CONNECTORS

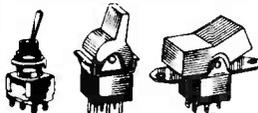
UG-273/U BNC-F/UHF-M **\$2.50**
UG-255/U BNC-M/UHF-F **\$3.00**
UG-146 A/U N-M/UHF-F **\$4.50**
UG-83B/U N-F/UHF-M **\$4.50**
UG-175 RG-58 Adapt **\$.20**
UG-176 RG-59 Adapt **\$.20**
UG-1094 BNC-F/Panel **\$1.00**

SD239 **50¢**
PL259 **60¢**

COAXIAL CABLE

50 OHM-RG 174 **\$4.95/100'** **\$3.00/50'**
75 OHM-RG 62/U **\$12.00/100'**

C & K SWITCHES



Part #	Movement
J-60	SPDT
J-60	SPDT (center off)
L-3	SPDT (momentary)
J-3	DPDT (special large rocker)

\$1.00 ea. 6/\$5.00

MODEM CABLE ASSEMBLIES

\$5.50 ea.

Conn & Hood	# Cond	Length
25 P	14	15'
25 S	10	17'

MAGNETIC CHESS BOARD WITH MEN

Folds in half to carry men
11" w x 11" l x 1" h
\$4.00 ea.



TERMS: All material guaranteed unless otherwise stated. If you are not satisfied with our product, it may be returned within 10 days for a refund (less shipping). Please add \$4.00 for shipping and handling on all orders. COD's accepted for orders totaling \$50 or more. All orders shipped UPS unless otherwise specified. Florida residents please add 4% sales tax. Minimum order, \$15.00. Foreign orders - JS funds only, add 20% for shipping and handling.

7400

SN7400N	.20	SN7472N	.39	SN74156N	.79
SN7401N	.20	SN7473N	.25	SN74157N	.69
SN7402N	.25	SN7474N	.35	SN74160N	.89
SN7403N	.25	SN7475N	.49	SN74161N	.89
SN7404N	.25	SN7476N	.35	SN74162N	.89
SN7405N	.29	SN7477N	5.00	SN74163N	.89
SN7406N	.35	SN7478N	5.00	SN74164N	.89
SN7407N	.35	SN7479N	.99	SN74165N	.89
SN7408N	.29	SN7480N	.69	SN74166N	1.25
SN7409N	.29	SN7481N	.99	SN74167N	2.79
SN7410N	.25	SN7482N	.35	SN74170N	1.95
SN7411N	.29	SN7483N	1.75	SN74172N	4.95
SN7412N	.35	SN7484N	.49	SN74173N	1.35
SN7413N	.40	SN7485N	.59	SN74174N	.99
SN7414N	.69	SN7486N	.45	SN74175N	.89
SN7415N	.29	SN7487N	.69	SN74176N	.79
SN7416N	.29	SN7488N	.69	SN74177N	.79
SN7417N	.29	SN7489N	.69	SN74179N	1.49
SN7418N	.29	SN7490N	.69	SN74180N	.79
SN7419N	.29	SN7491N	.69	SN74181N	2.25
SN7420N	.25	SN7492N	3.00	SN74182N	.29
SN7421N	.29	SN7493N	1.49	SN74184N	2.49
SN7422N	.45	SN7494N	.89	SN74185N	2.49
SN7423N	.29	SN7495N	1.89	SN74186N	1.25
SN7424N	.29	SN7496N	1.49	SN74187N	1.25
SN7425N	.29	SN7497N	1.49	SN74188N	1.25
SN7426N	.29	SN7498N	1.49	SN74189N	1.25
SN7427N	.25	SN7499N	.35	SN74190N	1.25
SN7428N	.49	SN7500N	.39	SN74191N	1.25
SN7429N	.25	SN7501N	.95	SN74192N	.89
SN7430N	.25	SN7502N	.95	SN74193N	.89
SN7431N	.25	SN7503N	.95	SN74194N	.89
SN7432N	.25	SN7504N	.95	SN74195N	.89
SN7433N	.25	SN7505N	.95	SN74196N	.89
SN7434N	.25	SN7506N	.95	SN74197N	.89
SN7435N	.25	SN7507N	.95	SN74198N	1.49
SN7436N	.25	SN7508N	.95	SN74199N	1.49
SN7437N	.25	SN7509N	.95	SN74200N	1.25
SN7438N	.25	SN7510N	.95	SN74201N	1.25
SN7439N	.25	SN7511N	.95	SN74202N	1.25
SN7440N	.25	SN7512N	.95	SN74203N	1.25
SN7441N	.25	SN7513N	.95	SN74204N	1.25
SN7442N	.25	SN7514N	.95	SN74205N	1.25
SN7443N	1.10	SN7515N	.95	SN74206N	1.25
SN7444N	1.10	SN7516N	.95	SN74207N	1.25
SN7445N	.89	SN7517N	.95	SN74208N	1.25
SN7446N	.89	SN7518N	.95	SN74209N	1.25
SN7447N	.89	SN7519N	.95	SN74210N	1.25
SN7448N	.79	SN7520N	.95	SN74211N	1.25
SN7449N	.79	SN7521N	.95	SN74212N	1.25
SN7450N	.20	SN7522N	.95	SN74213N	1.25
SN7451N	.20	SN7523N	.95	SN74214N	1.25
SN7452N	.20	SN7524N	.95	SN74215N	1.25
SN7453N	.20	SN7525N	.95	SN74216N	1.25
SN7454N	.20	SN7526N	.95	SN74217N	1.25
SN7455N	.20	SN7527N	.95	SN74218N	1.25
SN7456N	.20	SN7528N	.95	SN74219N	1.25
SN7457N	.20	SN7529N	.95	SN74220N	1.25
SN7458N	.20	SN7530N	.95	SN74221N	1.25
SN7459N	.20	SN7531N	.95	SN74222N	1.25
SN7460N	.20	SN7532N	.95	SN74223N	1.25
SN7461N	.20	SN7533N	.95	SN74224N	1.25
SN7462N	.20	SN7534N	.95	SN74225N	1.25
SN7463N	.20	SN7535N	.95	SN74226N	1.25
SN7464N	.20	SN7536N	.95	SN74227N	1.25
SN7465N	.20	SN7537N	.95	SN74228N	1.25
SN7466N	.20	SN7538N	.95	SN74229N	1.25
SN7467N	.20	SN7539N	.95	SN74230N	1.25
SN7468N	.20	SN7540N	.95	SN74231N	1.25
SN7469N	.20	SN7541N	.95	SN74232N	1.25
SN7470N	.20	SN7542N	.95	SN74233N	1.25

74LS

74LS00	.29	74LS192	1.15
74LS01	.29	74LS193	1.15
74LS02	.29	74LS194	1.15
74LS03	.29	74LS195	1.15
74LS04	.35	74LS196	1.15
74LS05	.35	74LS197	1.15
74LS06	.35	74LS198	1.15
74LS07	.35	74LS199	1.15
74LS08	.35	74LS200	1.15
74LS09	.35	74LS201	1.15
74LS10	.35	74LS202	1.15
74LS11	.35	74LS203	1.15
74LS12	.35	74LS204	1.15
74LS13	.35	74LS205	1.15
74LS14	.35	74LS206	1.15
74LS15	.35	74LS207	1.15
74LS16	.35	74LS208	1.15
74LS17	.35	74LS209	1.15
74LS18	.35	74LS210	1.15
74LS19	.35	74LS211	1.15
74LS20	.35	74LS212	1.15
74LS21	.35	74LS213	1.15
74LS22	.35	74LS214	1.15
74LS23	.35	74LS215	1.15
74LS24	.35	74LS216	1.15
74LS25	.35	74LS217	1.15
74LS26	.35	74LS218	1.15
74LS27	.35	74LS219	1.15
74LS28	.35	74LS220	1.15
74LS29	.35	74LS221	1.15
74LS30	.35	74LS222	1.15
74LS31	.35	74LS223	1.15
74LS32	.35	74LS224	1.15
74LS33	.35	74LS225	1.15
74LS34	.35	74LS226	1.15
74LS35	.35	74LS227	1.15
74LS36	.35	74LS228	1.15
74LS37	.35	74LS229	1.15
74LS38	.35	74LS230	1.15
74LS39	.35	74LS231	1.15
74LS40	.35	74LS232	1.15
74LS41	.35	74LS233	1.15
74LS42	.35	74LS234	1.15
74LS43	.35	74LS235	1.15
74LS44	.35	74LS236	1.15
74LS45	.35	74LS237	1.15
74LS46	.35	74LS238	1.15
74LS47	.35	74LS239	1.15
74LS48	.35	74LS240	1.15
74LS49	.35	74LS241	1.15
74LS50	.35	74LS242	1.15
74LS51	.35	74LS243	1.15
74LS52	.35	74LS244	1.15
74LS53	.35	74LS245	1.15
74LS54	.35	74LS246	1.15
74LS55	.35	74LS247	1.15
74LS56	.35	74LS248	1.15
74LS57	.35	74LS249	1.15
74LS58	.35	74LS250	1.15
74LS59	.35	74LS251	1.15
74LS60	.35	74LS252	1.15
74LS61	.35	74LS253	1.15
74LS62	.35	74LS254	1.15
74LS63	.35	74LS255	1.15
74LS64	.35	74LS256	1.15
74LS65	.35	74LS257	1.15
74LS66	.35	74LS258	1.15
74LS67	.35	74LS259	1.15
74LS68	.35	74LS260	1.15
74LS69	.35	74LS261	1.15
74LS70	.35	74LS262	1.15
74LS71	.35	74LS263	1.15
74LS72	.35	74LS264	1.15
74LS73	.35	74LS265	1.15
74LS74	.35	74LS266	1.15
74LS75	.35	74LS267	1.15
74LS76	.35	74LS268	1.15
74LS77	.35	74LS269	1.15
74LS78	.35	74LS270	1.15
74LS79	.35	74LS271	1.15
74LS80	.35	74LS272	1.15
74LS81	.35	74LS273	1.15
74LS82	.35	74LS274	1.15
74LS83	.35	74LS275	1.15
74LS84	.35	74LS276	1.15
74LS85	.35	74LS277	1.15
74LS86	.35	74LS278	1.15
74LS87	.35	74LS279	1.15
74LS88	.35	74LS280	1.15
74LS89	.35	74LS281	1.15
74LS90	.35	74LS282	1.15
74LS91	.35	74LS283	1.15
74LS92	.35	74LS284	1.15
74LS93	.35	74LS285	1.15
74LS94	.35	74LS286	1.15
74LS95	.35	74LS287	1.15
74LS96	.35	74LS288	1.15
74LS97	.35	74LS289	1.15
74LS98	.35	74LS290	1.15
74LS99	.35	74LS291	1.15
74LS00	.35	74LS292	1.15

74S

74S00	.45	74S243	3.25
74S01	.45	74S244	3.25
74S02	.45	74S245	3.25
74S03	.45	74S246	3.25
74S04	.45	74S247	3.25
74S05	.45	74S248	3.25
74S06	.45	74S249	3.25
74S07	.45	74S250	3.25
74S08	.45	74S251	3.25
74S09	.45	74S252	3.25
74S10	.45	74S253	3.25
74S11	.45	74S254	3.25
74S12	.45	74S255	3.25
74S13	.45	74S256	3.25
74S14	.45	74S257	3.25
74S15	.45	74S258	3.25
74S16	.45	74S259	3.25
74S17	.45	74S260	3.25
74S18	.45	74S261	3.25
74S19	.45	74S262	3.25
74S20	.45	74S263	3.25
74S21	.45	74S264	3.25
74S22	.45	74S265	3.25
74S23	.45	74S266	3.25
74S24	.45	74S267	3.25
74S25	.45	74S268	3.25
74S26	.45	74S269	3.25
74S27	.45	74S270	3.25
74S28	.45	74S271	3.25
74S29	.45	74S272	3.25
74S30	.45	74S273	3.25
74S31	.45	74S274	3.25
74S32	.45	74S275	3.25
74S33	.45	74S276	3.25
74S34	.45	74S277	3.25
74S35	.45	74S278	3.25
74S36	.45	74S279	3.25
74S37	.45	74S280	3.25
74S38	.45	74S281	3.25
74S39	.45	74S282	3.25
74S40	.45	74S283	3.25
74S41	.45	74S284	3.25
74S42	.45	74S285	3.25
74S43	.45	74S286	3.25
74S44	.45	74S287	3.25
74S45	.45	74S288	3.25
74S46	.45	74S289	3.25
74S47	.45	74S290	3.25
74S48	.45	74S291	3.25
74S49	.45	74S292	3.25
74S50	.45	74S293	3.25
74S51	.45	74S294	3.25
74S52	.45	74S295	3.25
74S53	.45	74S296	3.25
74S54	.45	74S297	3.25
74S55	.45	74S298	3.25
74S56	.45	74S299	3.25
74S57	.45	74S300	3.25
74S58	.45	74S301	3.25
74S59	.45	74S302	3.25
74S60	.45	74S303	3.25
74S61	.45	74S304	3.25
74S62	.45	74S305	3.25
74S63	.45	74S306	3.25
74S64	.45	74S307	3.25
74S65	.45	74S308	3.25
74S66	.45	74S309	3.25
74S67	.45	74S310	3.25
74S68	.45	74S311	3.25
74S69	.45	74S312	3.25
74S70	.45	74S313	3.25
74S71	.45	74S314	3.25
74S72	.45	74S315	3.25
74S73	.45	74S316	3.25
74S74	.45	74S317	3.25
74S75	.45	74S318	3.25
74S76	.45	74S319	3.25
74S77	.45	74S320	3.25
74S78	.45	74S321	3.25
74S79	.45	74S322	3.25
74S80	.45	74S323	3.25
74S81	.45	74S324	3.25
74S82	.45	74S325	3.25
74S83	.45	74S326	3.25
74S84	.45	74S327	3.25
74S85	.45	74S328	3.25

PLANS & KITS

POLICE/fire scanners, scanner crystals, antennas, radar detectors. **HPR**, Box 19224, Denver, CO 80219

TELEPHONE or office bugged? Latest detection equipment finds out fast. Literature \$1.00. **CLIFTON**, Box 220-M, Miami, FL 33168

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SAVE up to 50% on name brand test equipment. Free catalog and price list. **SALEN ELECTRONICS**, Box 82-F, Skokie, IL 60077

more classified on page 116

FUJITECH AUDIO KITS

LATEST AUDIO TECHNOLOGY FROM JAPAN

Model A501 Power Amp

- Pure Class A 25W + 25W
- Switchable to Class AB 100W + 100W
- Switchable to Bridge Class A 100W mono
- Switchable to Bridge Class AB 300W mono
- Frequency Response 5-200KHz (-1dB)
- Signal-to-Noise Ratio 120dB
- Non-magnetic Chassis
- "Out-board" comprehensive protection circuitry
- DC circuitry with limited use of NFB
- High Efficiency Fluid Convection Cooling
- THD under 0.007%



KIT ONLY \$299.00

Model A502 DC Stereo Control Center

- Direct DC coupling from Input to Output
- DC servo circuitry
- Cascade FED Input in all stages
- Separate Moving Coil RIAA amplifier
- Distortion below 0.005% (3V)
- Max Output 15V
- Frequency Response 20Hz-20KHz ±0.2 dB
- Maximum Phono Input MC = 16mv RMS (1KHz) MM = 270mv RMS (1KHz)
- Built-in Headphone amplifier
- Relay Output Muting



KIT ONLY \$349.00

Model A1033 Integrated Tube Amplifier

- Latest Japanese Design
- Distortionless Output Transformer using special winding techniques
- Most circuitry on PCB for easy assembly and humfree performance
- Output 30W x 2 Ultra Linear (Switchable to Triode) 15W x 2 Triode Output (near class A performance)
- THD under 0.4%
- Frequency Response 30~30,000 Hz (-1dB)
- Separate Pre-Out and Main-In



KIT ONLY \$499.00

Send \$5.00 for each assembly manual, refundable with order.

Monarchy Engineering, Inc.
380 Swift Avenue, Unit 21
South San Francisco, CA 94080
Visa or Mastercharge acceptable.

SPECIAL FALL SALE

15% OFF ON ALL ITEMS LISTED IN THIS AD with order of \$25 or more

Sale is in effect from Oct 15 - Nov 30 Limited to merchandise in stock

INTERNATIONAL ELECTRONICS UNLIMITED

CERAMIC DISC CAPACITORS 50V

1pf 47p	220pf	0027pf
5pf 56pf	270pf	010mf
10pf 68pf	330pf	015mf
15pf 82pf	470pf	022mf
18pf 100pf	800pf	030mf
22pf 120pf	001mf	050mf
27pf 150pf	0015mf	050mf
33pf 180pf	003mf	050mf
1pf to 0.050mf		
ea. pk-10 pk-100 1000-		
5.20	95	7.00
1mf/50V disc 1/2" x .050"		
5.25	1.25	9.00

CERAMIC CAPACITOR KIT

5 ea of above \$12.50

10 ea of above \$20.00

MONOLITHIC IC CAPACITORS

ea. pk-10-100-

1uF/50V	15k	2.50	1.30
22uF/50V	20k	3.00	1.60
47uF/50V	20k	3.50	2.00

POLYESTER FILM CAPACITORS

100V ± 10%

ea. pk-10	pk-100
.001uf .515	95
.0015uf .15	95
.0022uf .15	95
.0033uf .15	95
.0047uf .15	95
.0068uf .15	95
.01uf .15	95
.015uf .15	95
.022uf .15	95
.033uf .20	100
.047uf .20	115
.068uf .25	130
.1uf .30	150
.15uf .35	225
.22uf .40	250
.33uf .45	275
.47uf .50	300

POLYESTER CAPACITOR KIT

5 ea of above \$14.95

TANTALUM CAPACITORS

solid asp - radial

1mf/35V	ea	10-	100-
2.2mf/35V	35	31	29
3.3mf/35V	35	31	29
4.7mf/35V	35	31	29
1.5mf/20V	37	32	30
2.2mf/20V	40	35	33
3.3mf/20V	45	40	35
4.7mf/20V	45	40	35
4.7mf/25V	50	45	40
6.8mf/25V	50	45	40
6.8mf/16V	55	50	45
10mf/20V	65	55	50
15mf/20V	65	55	50
22mf/16V	68	57	52
33mf/16V	65	55	50
33mf/10V	70	65	60
47mf/16V	75	70	65
56mf/16V	85	75	70
100mf/10V	1.25	1.10	1.00

ELECTROLYTIC CAPACITORS

axial leads

1mf/50V	15	12	10
2.2mf/25V	15	12	11
2.2mf/50V	15	12	11
3.3mf/50V	16	13	11
4.7mf/35V	16	13	11
10mf/35V	16	13	11
10mf/50V	17	14	11
15mf/35V	17	14	11
22mf/50V	18	14	12
33mf/25V	18	14	12
33mf/50V	18	14	12
47mf/35V	18	14	12
47mf/50V	19	15	13
100mf/10V	19	16	14
100mf/16V	20	16	14
220mf/16V	22	18	17
150mf/25V	23	18	17
220mf/16V	25	21	19
220mf/25V	27	23	21
330mf/25V	29	24	22
470mf/16V	30	25	22
470mf/25V	34	29	26
500mf/16V	29	24	22
1000mf/16V	35	30	27
1000mf/35V	35	30	27
2200mf/16V	1.25	1.15	1.05
2200mf/40V	1.35	1.10	1.00
4700mf/16V	1.35	1.25	1.10
4700mf/50V	1.45	1.30	1.15

LEDS

Red diffused .20" x .34" 1/4 watt (R. 0.9w .25)

pk-10	pk-25	100-	1000-
RED \$1.00	\$2.25	0.90	0.70
GREEN 1.10	2.50	0.90	0.80
WHITE 1.10	2.50	0.90	0.80
YELLOW 1.40	3.25	1.10	1.00
GREEN 1.40	3.25	1.10	1.00

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000				
2N2222A	10-92	NPN	30	1.75	4.00	15.00	1.30
2N2222A	10-18	NPN	.45	5.00	8.00	29.00	26
2N3045	10-5	NPN	.55	3.00	11.75	45.00	42
2N3904	10-92	NPN	25	1.65	3.25	12.00	10
2N3906	10-92	NPN	25	1.65	3.25	12.00	10

FUNCTION GENERATOR KIT

Produces sine, triangle and square wave output at 0-20V variable amplitude (peak to peak) from 2Hz to 200KHz in 5 ranges; a high quality and accurate sine instrument - ideally suited for the hobbyist and experimenter.

BASIC KIT includes PC Board (1.6" x 3") 80386 IC and all board mounted electronics (switches and pots not included) * 1BVDC required \$17.50

POWER SUPPLY includes transformer (12V/250ma wall mt.), PC Board (1.6" x 2") and necessary parts to produce a 1BVDC \$16.50

CASE (Harewood 15910GV) 2" x 3.15" x 6" and necessary switches, pots, etc. to build a complete instrument \$19.75

REGULATED POWER SUPPLY KIT Uses +5V and -12V 10-220V regulators. Includes PC Board (1.15" x 3"), Rectifiers, 7805 & 7812 Regulators, Capacitors & Heat Sinks. Transformer not included. Fits PCB slots of standard case 15910GV. \$4.95 ea.

MINIATURE CERMET TRIMMER

Single turn .80" dia
5w ± 20% 100ppm/°C
1.5" high x .250" dia
5000hm 1k 20K 50K 50K
100K 500K 1M
ea. 10- 100-
\$1.35 \$1.35 1.00 1.00

UNIVERSAL BREADBOARD IC BREADBOARD

10	25-	50-
\$1.25	\$1.05	\$1.95

ELECTROLYTIC CAPACITOR KIT

AXIAL LEADS

1uF/50V	22uF/50V	220uF/50V
2.2uF/50V	33uF/25V	470uF/35V
3.3uF/50V	47uF/35V	1000uF/30V
4.7uF/50V	100uF/25V	2200uF/40V
10uF/50V	150uF/25V	

METAL FILM RESISTORS 1/4W & 1/2W

1/4 watt (R. 0.9w .25)	Total qty ea. pk-25	pk-100	pk-1000		
1/2 watt (R. 0.9w .50)	1-999	5.10	25	45	2.00
500Ω to 1.35k long (body)	1000-	.10	.25	.40	1.90
5000Ω	25	.55	.95	1.00	4.00

METAL FILM RESISTORS 1/4W

1/4-watt Total qty ea. pk-5	pk-10	pk-25	pk-100	pk-1000		
Low temp coef. -50ppm/°C	1-999	5.25	.65	1.10	2.00	7.50
1/8W to 1.35k long (body)	1000-	.25	.60	1.00	1.90	7.00
color banded	5000-	25	.55	.95	1.00	4.00

IEU PROJECT OF THE MONTH

REGULATED POWER SUPPLY KIT Uses +5V and -12V 10-220V regulators. Includes PC Board (1.15" x 3"), Rectifiers, 7805 & 7812 Regulators, Capacitors & Heat Sinks. Transformer not included. Fits PCB slots of standard case 15910GV. \$4.95 ea.

WALL MOUNT TRANSFORMER

117V/12VAC 250ma 60Hz \$3.75
117V/12VAC 1amp 60Hz 4.95

74LS SERIES

74LS00	25	74LS090	50	74LS181	2.00
74LS01	25	74LS195	75	74LS192	6.00
74LS02	35	74LS107	40	74LS199	9.00
74LS03	25	74LS109	40	74LS196	8.00
74LS04	27	74LS112	40	74LS197	8.00
74LS05	27	74LS113	40	74LS199	9.00
74LS10	25	74LS114	50	74LS251	9.00
74LS11	27	74LS125	50	74LS296	9.00
74LS12	35	74LS126	50	74LS298	7.00
74LS13	35	74LS126	50	74LS298	7.00
74LS14	25	74LS156	95	74LS296	9.00
74LS15	35	74LS162	1.00	74LS290	7.00
74LS16	35	74LS163	1.00	74LS298	7.00
74LS17	35	74LS164	90	74LS365	8.00
74LS18	35	74LS165	90	74LS367	7.00
74LS19	35	74LS166	1.25	74LS378	1.10
74LS20	35	74LS170	1.70	74LS490	1.75

BEZELS WITH FILTERS

Snap-In BEZELS of black polycarbonate thermoplastic resin. Red slide-in filter. Provides attractive finish for standard panel cut-out and displays.

No. 140-2 (15 drawer) \$2.50 ea. cut-out 1.156" x 2.375" viewing area 3" x .812"

No. 140-3 (15 drawer) \$2.50 ea. cut-out 1.156" x 3.375" (up to .125" thick panel) viewing area 3" x .812"

No. 140-4 (15 drawer) \$2.50 ea. cut-out 1.156" x 4.375" (up to .125" thick panel) viewing area 4" x .812"

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000				
2N2222A	10-92	NPN	30	1.75	4.00	15.00	1.30
2N2222A	10-18	NPN	.45	5.00	8.00	29.00	26
2N3045	10-5	NPN	.55	3.00	11.75	45.00	42
2N3904	10-92	NPN	25	1.65	3.25	12.00	10
2N3906	10-92	NPN	25	1.65	3.25	12.00	10

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000				
2N2222A	10-92	NPN	30	1.75	4.00	15.00	1.30
2N2222A	10-18	NPN	.45	5.00	8.00	29.00	26
2N3045	10-5	NPN	.55	3.00	11.75	45.00	42
2N3904	10-92	NPN	25	1.65	3.25	12.00	10
2N3906	10-92	NPN	25	1.65	3.25	12.00	10

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000				
2N2222A	10-92	NPN	30	1.75	4.00	15.00	1.30
2N2222A	10-18	NPN	.45	5.00	8.00	29.00	26
2N3045	10-5	NPN	.55	3.00	11.75	45.00	42
2N3904	10-92	NPN	25	1.65	3.25	12.00	10
2N3906	10-92	NPN	25	1.65	3.25	12.00	10

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000				
2N2222A	10-92	NPN	30	1.75	4.00	15.00	1.30
2N2222A	10-18	NPN	.45	5.00	8.00	29.00	26
2N3045	10-5	NPN	.55	3.00	11.75	45.00	42
2N3904	10-92	NPN	25	1.65	3.25	12.00	10
2N3906	10-92	NPN	25	1.65	3.25	12.00	10

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000				
2N2222A	10-92	NPN	30	1.75	4.00	15.00	1.30
2N2222A	10-18	NPN	.45	5.00	8.00	29.00	26
2N3045	10-5	NPN	.55	3.00	11.75	45.00	42
2N3904	10-92	NPN	25	1.65	3.25	12.00	10
2N3906	10-92	NPN	25	1.65	3.25	12.00	10

TRANSISTORS

PK-10	PK-25	PK-100	PK-1000
2N2222A	10-92	NPN	

Builders! Check These Great Values and New Items Available Now at the Radio Shack Store or Dealer Near You!

Video, IF and FM Detector ICs



NEW!
Low As
179

Ideal for Building Receiver Circuits!

- A MC1330 Video Detector.** Fully balanced, high linearity. Video and AFT outputs. With specs. 276-1757 2.49
- B MC1350 IF Amplifier.** Built-in AGC. Usable from DC to 60 MHz! For video and audio. With specs. 276-1758 2.19
- C MC1358 FM Detector.** IF amp (100 kHz to 5.5 MHz), limiter, FM detector, audio driver. 14-pin. 276-1759 1.79

DIP Relay



2.99

Actual Size!

Fits DIP sockets or PC boards, measures only 3/8 x 5/8 x 7/16"! 5VDC, 56-ohm coil. SPDT contacts: 1A @ 125VAC. 275-216 2.99

Top-Quality LS ICs on Sale!

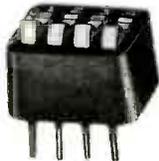
Save Up to 33% Reg. Low As 79¢ **59¢**

• Faster Than TTL • With Pin-Out & Specs

Description	Type	Cat. No.	Reg.	SALE
Quad 2-Input NAND Gate	74LS00	276-1900	.79	.59
Quad 2-Input NOR Gate	74LS02	276-1902	.79	.59
Hex Inverter	74LS04	276-1904	.79	.59
Quad 2-Input AND Gate	74LS08	276-1908	.79	.59
Quad 2-Input OR Gate	74LS32	276-1915	.89	.69
Dual D Flip Flop	74LS74	276-1919	.79	.59
4-Bit Bi-stable Latch	74LS75	276-1920	.99	.79
Decade Counter	74LS90	276-1923	1.09	.89
Retrig. Monostable Multivibrator	74LS123	276-1926	1.49	1.19
1 of 8 Decoder / Demultiplexer	74LS138	276-1939	1.19	.99
4-Binary Counter	74LS161	276-1931	1.39	1.09
8-Bit Shift Register	74LS164	276-1932	1.39	1.09
Quad D Flip Flop	74LS175	276-1934	1.19	.99
Up/Down Binary Counter	74LS193	276-1936	1.49	1.19
Octal Inverting Bus/Line Driver	74LS240	276-1940	1.99	1.49
Octal 3-State Non-Inv. Driver	74LS244	276-1941	1.99	1.49
Octal Non-Inv. Bus Transceiver	74LS245	276-1942	2.99	1.99
Hex Buffer (3-State)	74LS367	276-1835	1.29	.99
Octal D Latch, Fall Through	74LS373	276-1943	2.39	1.59
Octal D Flip Flop (Edge Trig)	74LS374	276-1944	2.39	1.59

DIP Switch

1.49



Fits 8-Pin DIP Socket

Four-position, ideal for digital projects and low-current applications. 275-1304 1.49

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NEW!
Only
99¢
Pkg. of 2

Ideal for models, solar-powered projects, or as low-voltage generators. 1 1/2 to 6VDC. With gear. 273-219 Pkg. of 2/99¢

Microwave Diodes

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Pkg. of 2

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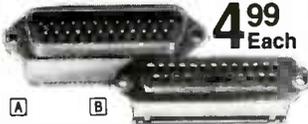
IF Filters

NEW!
Only
1.99
Pkg. of 2

SFE10.7MA5-A. Quality ceramic filters for 10.7 MHz FM IFs. Input/output impedance: 330 ohms. Bandwidth: 280 kHz (3 db). 272-1301 Pkg. of 2/1.99

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4.99
Each



- A D-Submini Male.** Plugs into RS-232 jack. 276-1559 4.99
- B D-Submini Female.** Ideal for extensions. 276-1565 4.99

18V Transformer

6.99

Build a Power Supply!



Steel frame. 120VAC primary. Center-tapped 18VAC secondary, rated 2A. 2 3/4 x 2 1/4 x 2". 273-1515 6.99

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Set of 3



Ideal for Winding Coils

Assortment includes 40 ft. of 22-gauge, 75 ft. of 26-gauge, 200 ft. of 30-gauge. 278-1345 Set 4.49

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NEW!
3.95

New 2.5 x 5 cm polycrystalline-type cell. 0.42V typical. Max. current: 0.2A. 276-124 3.95



D to A Chip

NEW!
4.49

Put Your Micro to Work!



DAC801. Produces up to 20V peak-to-peak output with 8-bit digital input. 16-pin, data included. 276-1791 4.49

DPDT DIP Relays

4.49
Each

Fit 16-Pin Sockets



12VDC, 280-Ohm Coil. Contacts: 1 amp at 120VAC. 275-213 4.49
5VDC, 50-Ohm Coil. With features of above. 275-215 4.49

Now — PC Boards In 2 Steps!



2.49
Set of 4

NEW!

Direct-Etch Dry Transfers. Just rub your circuit (strips, circles, IC pads, etc.) onto board... and you're ready to etch! 276-1577 Set 2.49

Let's Wrap!



5.95 **2.39** Each

- A Wire-Wrapping Tool.** 4 1/2" long, metal. 276-1570 5.95
- B 30-Gauge Kynar Wire**

Color	Cat. No.	Color	Cat. No.
Red	278-501	White	278-502
Blue	278-503	Yellow	278-504

Hi-Style Knobs



- NEW!** Low As **1.69** Pkg. of 2
- A Two-tone "top hat"** for 1/4" shafts. 274-423 Pkg. of 2/1.69
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2.5 to 36VDC Range

TL431. Will sink 1 to 100 mA. Use in voltage monitors, series regulators, over-voltage protectors. 8-pin with data. 276-559 1.89

Stepped Stereo Controls

Only
1.99
Each

• 41 Detents
• 1/4" Shafts



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5k	271-1730	100k	271-1732
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4164
\$19.95



V-1000 Vista "V-DRIVE"

THE LAST WORD IN 8" FLOPPY-DISK ENCLOSURES

THE VISTA V-1000 FLOPPY DISK DRIVE SUBSYSTEM... (text continues)

DISCOUNT PRICES

- CABINET \$ 395
- CABINET with 2 1/2" angle slide drives including power supply & cables \$1495
- CABINET with 2" double slide drives including power supply & cables \$1995

FOR TRS 80[®] MODEL I, PMC 80[®] ZENITH H89, S-100, etc.

ONLY 310⁰⁰ ea. MODEL V-801, 80 TRACKS, SS ONLY 425⁰⁰ ea.

2 DRIVE CABLE .29.95 4 DRIVE CABLE .39.95

MOSTEK MK4015 4K Dynamic RAM

Refresh while supply lasts only .49¢ Pin equivalent to MK4027 except has 1 ms.

S-100 WW \$2.99 each

FIRST QUALITY AT SURPLUS PRICE

2708 EPROMS PRIME-450 Ns.

8 for \$29.95

4K STATIC RAM SELL-OFF

Zilog 6104-4

Same as TMS 4044 but designed specifically for Z-80 based systems. This is full-spec 4K x 1 RAM, 450 Ns.

While supply lasts \$1.49 each.

BECKMAN DIGITAL MULTIMETERS

TECH 300 Digital Multimeter \$110

TECH 310 Digital Multimeter \$140

TECH 310 Digital Multimeter \$185

DC-201 Vinyl Carrying Case \$10

DC-202 Deluxe Carrying Case \$24

HV-211 High Voltage Probe \$35

RP-221 RP Probe \$35

Cr-231 A.C. Current Clamp \$10

DL-241 Deluxe Test Lead Kit \$10

TL-242 Square Test Leads \$6

INTERSYSTEMS

The Preferred S-100 Box

The new Series II CPU Board features a 4 MHz Z-80A CPU and full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

DPS-1, List \$1795

ACP Price \$1499

8300 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9603A	Single Board Microcomputer	\$495.00
9603	Advanced Single Bd. Comp (6809)	\$595.00
9601	16 Slot Mother Board	\$75.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	175.00
9611	Utility Proto Board	39.00
9612	Arith Proc/Memory Module	49.00
9613	Buffered Utility Proto Board	175.00
9614	32K EPROM/RAM Module	250.00
9615	EPROM Programming Head	295.00
9620	16 Channel Parallel I/O Module	325.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9628	32K Static RAM 450ns	695.00
9629	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9641	8 Channel Duplex Serial I/O Mod	395.00
9646	Intelligent Tape Controller	195.00
96103	32/32 I/O Module	275.00
96102	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

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9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	175.00
9611	Utility Proto Board	39.00
9612	Arith Proc/Memory Module	49.00
9613	Buffered Utility Proto Board	175.00
9614	32K EPROM/RAM Module	250.00
9615	EPROM Programming Head	295.00
9620	16 Channel Parallel I/O Module	325.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9628	32K Static RAM 450ns	695.00
9629	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9641	8 Channel Duplex Serial I/O Mod	395.00
9646	Intelligent Tape Controller	195.00
96103	32/32 I/O Module	275.00
96102	Contact Closure Module	350.00

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STORE #2: 542 W. Trimble Road, San Jose, CA 95131 • (408) 946-7010

*Retail prices may vary.

\$24.95 TRS-80/APPLE \$24.95

MEMORY EXPANSION KITS

4116's, 16K (200/250 ns.)

8 pins for \$24.95

Specily Computer

Call For Volume Pricing

16K RAM

CENTRONICS PRINTER Model 737

- Centronics complete printer
- The 737 has everything! Check and compare the features.
- New low price

\$835.00

32K STATIC RAM BOARD

2 or 4 MHz Expandable uses 2114L's

S-100

16K 4 MHz Kit .159.95

16K 4 MHz A&T .217.95

32K 4 MHz Kit .289.95

32K 4 MHz A&T .339.00

Bare Board .39.95

Bare Bd. wall parts less mem. 99.95

NEW! from Zilog

Z-8 CPU comes with Tiny Basic & debug program on the i.C.

\$69.95 w/data

BIPOLAR CPU SALE

Signetics 8 x 300 8 bit CPU

While stock lasts 14.95 ea.

UV "Eprom" Eraser

Model UVe-11E \$69.95

Wipes 4 Eprom's at a time

Backed by 4 1/2 years experience

Model S-52T... \$325.00

Professional Industrial Model

NON-LINEAR SYSTEMS, INC.

TOUCH-TEST 20

DIGITAL MULTIMETER \$319⁹⁵

BECKMAN DIGITAL MULTIMETERS

TECH 300 Digital Multimeter \$110

TECH 310 Digital Multimeter \$140

TECH 310 Digital Multimeter \$185

DC-201 Vinyl Carrying Case \$10

DC-202 Deluxe Carrying Case \$24

HV-211 High Voltage Probe \$35

RP-221 RP Probe \$35

Cr-231 A.C. Current Clamp \$10

DL-241 Deluxe Test Lead Kit \$10

TL-242 Square Test Leads \$6

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DPS-1, List \$1795

ACP Price \$1499

NEC PC-8000 Series Microcomputer System.

NEW INTRO PRICING \$1099.00

- 2.80A CPU 4 MHz
- 5 user programmable function keys
- 82 keys w/ numeric keypad
- 160x100 resolution
- 80 character screen

PC-8000A Microcomputer w/32KRAM \$1295.00 1099.00

PC-8012A I/O Unit w/32K RAM .795.00 699.00

Expansion slot PC-8031A Dual Mini-Disk Drive Unit 1295.00 999.00

PC-8032A Add On Dual Mini-Disk Drive Unit 1095.00 999.00

PC-8023A Impact Matrix Printer. 7995.00 789.00

PC-8004A Cable for PC-8023A Printer. 49.95 44.95

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PC-1202(A) High Resolution Color Monitor w/RGB Input 1195.00 1049.00

PC-1203(A) RGB Cable for PC-1201(A) Color Monitor 19.95 17.95

Basic Language Learning Guide 19.95

PC-8001A Microcomputer Reference Manual 14.95

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2513-001 (SV) Upper 9.50

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MCM66710 ASCII Shifted 12.95

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TR1 602B (SV) 12V 3.95

TR1 602C (SV) 12V 4.95

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AVS1015A/1863 15V 7.95

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IM4603 7.95

2350 ZSRST 8.95

IS218 15V 8.95

SALE TR1472B 11.95

MC1241 11.95

1705 14.95

WD1914 9.95

COM 5018 6.95

INS 9251 15.95

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AVS-2376 13.75

AVS-3600 13.75

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Z8001 16 bit to 8 bit	\$189.00
Z8002 16 bit to 64K	149.00
Z8003 16 bit to 64K	149.00
Z80A	13.95
F-8 (3850)	16.95
2114N (450 Ns.)	3.75
2114L 250ns (404s)	6.50
2114L 250ns (404s)	6.50
4044 250 ns	19.95
4044 250 ns	19.95
EMM4200A	5.95
EMM4201	5.95
AMDS1401A	9.95
AMDS1403A	12.95
1101	1.85
PM2125/93425 (45ns)	11.95
6818 1K 1 CMOS	7.95
2147 Low Power 4K Static	9.95
93415	9.95

STATIC RAMS

21102 450ns	1.24	25-99	100
21102 250ns	1.30	125	99
21102 150ns	1.59	155	115
21102 75ns	3.74	315	235
2112-1	2.95	285	265
2112-2	2.95	285	265
2114L 250ns (404s)	3.75	350	350
2114L 250ns (404s)	6.50	590	590
4044 250 ns	19.95	590	690
EMM4200A	5.95	595	475
EMM4201	5.95	595	475
AMDS1401A	9.95	615	725
AMDS1403A	12.95	1195	1025
6818 1K 1 CMOS	7.95	795	725
2147 Low Power 4K Static	9.95	855	685
93415	9.95	895	500

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1771-01 8" & MiniFloppy	24.95
1781 Dual Floppy	29.95
1791 01 5 1/4" Floppy	36.95
1791-02 Dual Floppy	44.95
1793 DD DS Floppy	44.95
1797 DD DS Floppy	44.95
1691 Data Separator	18.95
2143 Clock Gen.	18.95

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Double Density Includes: 1793

Double Sided Includes: 2147

\$42.95/set

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4164 16 16K (200 Ns.)	2.49
Set of 4 16 16K (200 Ns.)	24.95
4115 8K (16 Pin)	2.49
4050 4K x 1 (16 Pin)	4.95
4060 4K x 1 (16 Pin)	4.95
4096 4K x 1 (16 Pin)	4.95
2194 4K x 1 (16 Pin)	4.75
NOOT 4K x 1 (16 Pin)	4.50
64K 1103 9ns	6.95

SOCKETS

# Pins	Lo-Pin Solderless	Wire Wrap	Level	Cost
8	15	32	59	
14	19	38	59	
16	24	39	62	
18	24	39	62	
22	24	39	62	
24	24	39	62	
24	38	85	120	
24	38	85	120	
36	38	85	120	
40	60	140	185	

ZERO INSERTION FORCE

16 Pin \$5.50 24 Pin \$7.50 40 Pin \$10.25

LED READOUTS

Part #	Size	Color	Description	Price
DL704	300	Red	Common Cathode	99
DL705	300	Green	Common Cathode	99
PN507	357	Red	Common Cathode	99
PN508	357	Green	Common Cathode	99
PN509	357	Red	Common Cathode	99
PN510	357	Green	Common Cathode	99
PN511	357	Red	Common Cathode	99
PN512	357	Green	Common Cathode	99
PN513	357	Red	Common Cathode	99
PN514	357	Green	Common Cathode	99
PN515	357	Red	Common Cathode	99
PN516	357	Green	Common Cathode	99
PN517	357	Red	Common Cathode	99
PN518	357	Green	Common Cathode	99
PN519	357	Red	Common Cathode	99
PN520	357	Green	Common Cathode	99
PN521	357	Red	Common Cathode	99
PN522	357	Green	Common Cathode	99
PN523	357	Red	Common Cathode	99
PN524	357	Green	Common Cathode	99
PN525	357	Red	Common Cathode	99
PN526	357	Green	Common Cathode	99
PN527	357	Red	Common Cathode	99
PN528	357	Green	Common Cathode	99
PN529	357	Red	Common Cathode	99
PN530	357	Green	Common Cathode	99
PN531	357	Red	Common Cathode	99
PN532	357	Green	Common Cathode	99
PN533	357	Red	Common Cathode	99
PN534	357	Green	Common Cathode	99
PN535	357	Red	Common Cathode	99
PN536	357	Green	Common Cathode	99
PN537	357	Red	Common Cathode	99
PN538	357	Green	Common Cathode	99
PN539	357	Red	Common Cathode	99
PN540	357	Green	Common Cathode	99
PN541	357	Red	Common Cathode	99
PN542	357	Green	Common Cathode	99
PN543	357	Red	Common Cathode	99
PN544	357	Green	Common Cathode	99
PN545	357	Red	Common Cathode	99
PN546	357	Green	Common Cathode	99
PN547	357	Red	Common Cathode	99
PN548	357	Green	Common Cathode	99
PN549	357	Red	Common Cathode	99
PN550	357	Green	Common Cathode	99
PN551	357	Red	Common Cathode	99
PN552	357	Green	Common Cathode	99
PN553	357	Red	Common Cathode	99
PN554	357	Green	Common Cathode	99
PN555	357	Red	Common Cathode	99
PN556	357	Green	Common Cathode	99
PN557	357	Red	Common Cathode	99
PN558	357	Green	Common Cathode	99
PN559	357	Red	Common Cathode	99
PN560	357	Green	Common Cathode	99
PN561	357	Red	Common Cathode	99
PN562	357	Green	Common Cathode	99
PN563	357	Red	Common Cathode	99
PN564	357	Green	Common Cathode	99
PN565	357	Red	Common Cathode	99
PN566	357	Green	Common Cathode	99
PN567	357	Red	Common Cathode	99
PN568	357	Green	Common Cathode	99
PN569	357	Red	Common Cathode	99
PN570	357	Green	Common Cathode	99
PN571	357			

7400

SN7400N	19	SN74123N	59
SN7401N	22	SN74125N	39
SN7402N	22	SN74126N	44
SN7403N	22	SN74128N	69
SN7404N	22	SN74132N	69
SN7405N	23	SN74136N	75
SN7406N	23	SN74139N	95
SN7407N	23	SN74141N	70
SN7408N	26	SN74142N	2.95
SN7409N	23	SN74143N	2.95
SN7410N	22	SN74144N	2.95
SN7411N	29	SN74145N	62
SN7412N	29	SN74147N	1.95
SN7413N	39	SN74148N	1.25
SN7414N	59	SN74150N	1.09
SN7416N	29	SN74151N	67
SN7417N	29	SN74152N	67
SN7420N	22	SN74153N	67
SN7421N	35	SN74154N	1.19
SN7422N	29	SN74155N	78
SN7423N	29	SN74156N	78
SN7425N	29	SN74157N	69
SN7426N	29	SN74158N	1.65
SN7427N	25	SN74160N	85
SN7429N	45	SN74161N	86
SN7430N	23	SN74162N	89
SN7432N	29	SN74163N	87
SN7437N	25	SN74164N	87
SN7438N	29	SN74165N	87
SN7439N	29	SN74166N	1.20
SN7441N	19	SN74167N	1.95
SN7442N	79	SN74170N	1.89
SN7443N	95	SN74172N	4.75
SN7444N	95	SN74173N	7.9
SN7445N	79	SN74175N	85
SN7446N	79	SN74176N	75
SN7447N	65	SN74177N	75
SN7448N	79	SN74179N	1.34
SN7450N	19	SN74180N	75
SN7451N	19	SN74181N	1.75
SN7453N	19	SN74182N	75
SN7454N	19	SN74183N	2.25
SN7455N	25	SN74185N	2.25
SN7460N	23	SN74186N	9.95
SN7470N	29	SN74188N	3.90
SN7472N	29	SN74190N	1.15
SN7473N	34	SN74191N	1.45
SN7474N	34	SN74192N	85
SN7475N	38	SN74193N	85
SN7476N	34	SN74194N	85
SN7479N	4.60	SN74195N	85
SN7480N	4.90	SN74196N	85
SN7482N	95	SN74197N	1.95
SN7483N	65	SN74198N	1.39
SN7485N	55	SN74199N	1.39
SN7486N	35	SN74221N	1.19
SN7489N	1.75	SN74225N	.95
SN7490N	39	SN74227N	1.05
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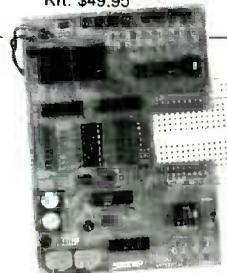
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The CT-90 is the most versatile, feature packed counter available for less than \$300.00! Advanced design features include: three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10MHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally, an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10,000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz \$99⁹⁵ WIRED



SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as: three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	\$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95



7 DIGITS 500 MHz \$79⁹⁵ WIRED

PRICES:

MINI-100 wired, 1 year warranty	\$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz \$159⁹⁵ WIRED



SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	\$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
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DIGITAL MULTIMETER \$99⁹⁵ WIRED

PRICES:

DM-700 wired, 1 year warranty	\$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack + AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include: 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3 1/2 digit, 1/2 inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current:	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
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CND-DA15S	15 pin female	\$ 3.95	\$ 3.60	\$ 3.20	
CND-DA15C	15 pin cover	\$ 1.50	\$ 1.30	\$ 1.10	
CND-DB25P	25 pin male	\$ 3.50	\$ 3.25	\$ 3.00	
CND-DB25S	25 pin female	\$ 4.60	\$ 4.35	\$ 4.20	
CND-DB51212	1 pc. grey hood	\$ 1.60	\$ 1.45	\$ 1.30	
CND-P25H	2 pc. grey hood	\$ 1.50	\$ 1.25	\$ 1.10	
CND-DB51226	2 pc. black hood	\$ 1.90	\$ 1.65	\$ 1.45	
CND-DC37P	37 pin male	\$ 5.80	\$ 5.10	\$ 4.45	
CND-DC37S	37 pin female	\$ 8.70	\$ 7.70	\$ 6.70	
CND-DC37C	37 pin cover	\$ 1.80	\$ 1.55	\$ 1.30	
CND-DD50P	50 pin male	\$ 8.75	\$ 7.75	\$ 6.70	
CND-DD50S	50 pin female	\$11.65	\$10.25	\$ 8.90	
CND-DD50C	50 pin cover	\$ 2.00	\$ 1.80	\$ 1.60	
CND-D2041B	Hardware set 2 pr. RS232, DB25P, EIA	\$ 1.00	\$.80	\$.70	
CND-RS2328F	Class 1 cable 8 con. 8 ft. Cent. 700 Series	\$19.95	\$17.95	\$15.95	
CND-5730360	Printer connector	\$ 9.00	\$ 7.50	\$ 6.00	

MICROCOMPUTER PRODUCTS 6502 SERIES

PART NO.	PRICE	PART NO.	PRICE
2016P3	8/\$100.00	6502	\$12.95
2114N3L	8/\$28.00	6502A	\$18.95
5257N3L	8/\$50.00	6520	\$8.95
2732	8/\$120.00	6522	\$10.95
2716	8/\$50.00	6530-002	\$21.95
2708	8/\$32.00	6530-003	\$21.95

8080 SERIES

PART NO.	PRICE	PART NO.	PRICE
INS 8080A	\$5.50	MC6800P	\$11.95
INS 8085A	\$19.95	MC6802P	\$17.95
DP8212N	\$2.95	MC6808P	\$9.95
DP8214N	\$5.25	MC6809P	\$34.95
DP8216N	\$2.95	MC6821P	\$5.95
DP8224N	\$3.25	MC6828P	\$14.95
DP8224-4N	\$9.95	MC6840P	\$14.95
DP8226N	\$3.50	MC6845P	\$31.00
DP8228N	\$5.55	MC6847P	\$14.95
DP8238N	\$5.55	MC6850P	\$5.41
INS8250N	\$15.00	MC6852P	\$5.79
INS8251N	\$7.50	MC6854P	\$24.95
INS8253N	\$17.95	MC6860P	\$10.89
INS8255N	\$6.80	MC6862P	\$12.00
INS8257N	\$16.45	MC6875L	\$7.40
INS8259N	\$18.00	MC66710P	\$12.50
INS8275N	\$59.95	MC6750P	\$12.50
INS8279N	\$49.95		

Z80 SERIES

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FD1771B-01	\$24.95
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List \$349.00 **\$169.00 Ea**
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• Operates up to 10 MHZ (90 ns RAM Chips)
• Assembled & Tested • Meets or exceeds all IEEE 696/S-100 specifications (including timing).
• Fully static design eliminates the timing problems associated with dynamic memories.
• Switch selectable choice of 24 address lines conforming to the IEEE 696/S-100 extended addressing specifications, or 16 address lines as used in older S-100 systems.
• Ideal for multi-user installations.
• Board is addressable as one 16K x 8 block on any 4K boundary.
• Switch selectable PHANTOM disable and write protect.
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• Low power operation (900 mA typical, 1200 mA maximum).
• 1 year Factory Warranty.



VCT-8804
S-100 "ANY DIP" has full power and ground planes back to back. Boards accommodates .3, .4, .6, .9" Dips.
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5-9 \$22.34
10-24 \$20.02
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Vector 4609 Peripheral Interface Plugboard for construction of custom circuits. Plug compatible with Apple II, Commodore PET and Super Kim microcomputers.
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5-9 \$18.79
10-24 \$16.84



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Universal Microcomputer/processor plugboard use with S-100 bus. Complete with heat sink & hardware. 53" x 10" x 1/16"
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Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Gnd Bus Epoxy Glass 1/16" 44 pin con. spaced .156
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VCT-3690-12 \$26.64
CARD EXTENDER
Card Extender has 100 contacts 50 per side on .125 centers. Attached connector is compatible with S-100 Bus Systems.
VCT-3690 6.5" 22/44 pin
156 ctrs. Extenders ... \$15.66



VCT-3690-12 \$26.64
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156 ctrs. Extenders ... \$15.66



1/16" Vector BOARD
.042 diaholes on 0.1 spacing for IC's
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A MUST FOR EVERY OFFICE WITH DATA PROCESSING EQUIPMENT

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OEMS Stock up at this LOW PRICE

ZERO INSERTION FORCE TEST SOCKETS
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Perfectly balanced fluorescent lighting with precision magnifier lens. Tough thermoplastic shade. Easy lens removal. New wire clip design permits easy installation and removal of fluorescent tube. Comes

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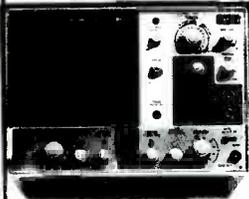
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Single and dual trace, 15 thru 100 MHz. All high sensitivity Hitachi oscilloscopes are built to demanding Hitachi quality standards and are backed by a 2-year warranty. They're able to measure signals as low as 1mV/division (with X5 vertical magnifier). It's a specification you won't find on any other 15 or 30 MHz scopes. Plus: Z-axis modulation, trace rotation, front panel X-Y operation for all scope models, and X10 sweep magnification. And, 30 thru 100 MHz oscilloscopes offer internal signal delay lines. For ease of operation, functionally related controls are grouped into three blocks on the color coded front panel. Now here's the clincher: For what you'd expect to pay more, you actually pay less. Check our scopes before you decide. All scopes complete with probes.

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HIT-V202 20MHz DUAL TRACE
LIST PRICE: \$850
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- Dynamic range 8 div.
- TV sync separator circuit
- Built-in signal delay line (V-352)
- X-Y operation
- Sweep-time magnifier (10 times)
- Trace rotation system
- Fine adjusting, click-positioning function

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DUAL TRACE WITH
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The HITACHI V550B (50MHz) and V1050 (100MHz) offer all the capabilities you might expect from a lab grade oscilloscope. Capabilities such as 3rd trace trigger view, a bright 6" square CRT, and a max. sweep rate of 2ns/div (V1050) 5ns/div (V550B). Also, features you may not expect like, sensitivity of 1mV/div (V550B) .5m/div (V1050) @ 10MHz, automatic focus correction.

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FLU C90 (Case for D800, 802, 804) ... \$10.00
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5¼ DISKETTES

Part No.	Sectoring	Application	heads	Box/10
VRB-MD525-01	Soft Sector	TRS-80 Apple 40 Track Cert	1	\$32.00
VRB-MD525-10	Hard 10 Sector	North Star 40 Track Cert	1	\$32.00
VRB-MD525-16	Hard 16 Sector	Micropolis 40 Track Cert	1	\$32.00
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VRB-MD557-10	Hard 10 Sector	77 Track Cert 100 TPI	2	\$56.00
VRB-MD557-16	Hard 16 Sector	77 Track Cert 100 TPI	2	\$56.00
VRB-MD557-01	Soft Sector	77 Track Cert 100 TPI	1	\$48.00
VRB-MD557-10	Hard 10 Sector	77 Track Cert 100 TPI	1	\$48.00
VRB-MD57-16	Hard 16 Sector	77 Track Cert 100 TPI	1	\$48.00

VRBMD Series comes with reinforced hub ring mounted

8" DISKETTES

VRB-FD32	Hard Sector	Shugart 801R	1	\$37.00
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- 10 inch GOLD Plated Pins
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PRICE

PART NO.	PINS	1-9	10-24	25-99	100-249	250-999
RNS08WWG	8	.60	.55	.49	.45	.41
RNS14WWG	14	.75	.70	.65	.55	.50
RNS16WWG	16	.85	.75	.70	.60	.55
RNS18WWG	18	1.00	.90	.80	.75	.71
RNS20WWG	20	1.20	1.05	.96	.91	.87
RNS22WWG	22	1.35	1.25	1.15	1.05	.99
RNS24WWG	24	1.35	1.25	1.15	1.05	.99
RNS28WWG	28	1.70	1.55	1.40	1.34	1.25
RNS40WWG	40	2.20	2.05	1.85	1.60	1.50

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NEW!
SELECTIVE PLATED
PINS THAT WILL SAVE
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HAVING GOLD ONLY
WHERE IT COUNTS!
Same as above except
pins are selectively
plated.

PART NO.	PINS	1-9	10-24	25-99	100-249	250-999
RNS08TWW	8	.55	.50	.45	.41	.37
RNS14TWW	14	.65	.55	.53	.47	.45
RNS16TWW	16	.75	.65	.58	.51	.48
RNS18TWW	18	.90	.79	.75	.70	.65
RNS20TWW	20	1.10	.95	.91	.87	.82
RNS22TWW	22	1.25	1.15	1.05	.94	.89
RNS24TWW	24	1.25	1.15	1.05	.96	.89
RNS28TWW	28	1.50	1.45	1.35	1.25	1.15
RNS40TWW	40	2.00	1.80	1.60	1.40	1.30

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FLOPPY DISK CONTROLLER
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IEEE S-100 COMPATIBLE SINGLE/DOUBLE DENSITY
5¼"/8" DISK DRIVES
SINGLE/DOUBLE HEADED
ASSEMBLED & TESTED



CCS2810 Z80 CPU
2/4 MHZ CPU W/Serial I/O

CCS2810	A&T	List Price	SALE PRICE
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Shugart
SA801R
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SHU-SA801R \$425.00
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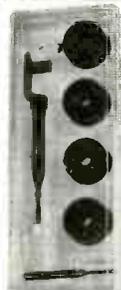
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ok PRODUCTS



JUST WRAP KIT

Just Wrap tool for daisy chain wiring. Tool strips as it wraps and cuts. Includes one 50 foot spool of wire.

Part No.	Description	Price
JW-1*	Just Wrap Tool	\$14.95
JWK-6	Tool w/4 Spools and JUW1	24.95
R-JW*	50 Ft. Replacement Wire	3.49
JUW-1	Unwrapping Tool	3.49

*Specify Color: Red, Blue, White or Yellow.



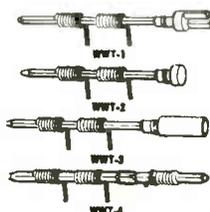
Regular Wrap



Modified Wrap

HAND WRAP TOOL

Part No.	Description	Price
WSU30	Regular	\$6.95
WSU30M	Modified	7.95



TERMINALS

- .025 (0.63mm) Square Post
- 3 Level Wire-Wrapping
- Gold Plated
- 25 PER PKG.

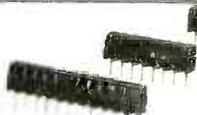
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WWT-1	Slotted Terminal	\$4.98
WWT-2	Single Sided Terminal	2.98
WWT-3	IC Socket Term.	4.98
WWT-4	Double Sided Terminal	1.98
INS 1	Insertion Tool for above	2.49

SOCKET WRAP - ID



Slipped onto socket before wrapping to identify pins.

Part #	Price	Bulk Price	Part #	Price	Bulk Price
14ID	1.49/10	5.50/100	22ID	1.49/5	5.95/50
16ID	1.49/10	5.95/100	24ID	1.49/5	5.95/50
18ID	1.49/10	5.00/50	28ID	1.49/5	6.50/50
20ID	1.49/5	5.00/50	40ID	1.49/5	5.00/25



P.C.B. TERMINAL STRIPS

The TS strips provide positive screw activated clamping action, accommodate wire sizes 14-30 AWG (1,8-0, 25mm). Pins are solder plated copper, .042 inch (1mm) diameter, on .200 inch (5mm) centers.

Part No.	Description	Price
TS- 4	4-Pole	\$1.69
TS- 8	8-Pole	2.59
TS-12	12-Pole	3.49
TS6MD	2-Pole Interlocking	3/1.79



DESOLDERING PUMP

Easy one hand operation. Rugged all metal construction. Replaceable TEFLON® Tip. Self cleaning on each stroke. Suction precisely regulated for reliable desoldering without damage to delicate circuitry.

DSPI	Desoldering Pump	\$9.95
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LOGIC PROBE



Compatible with all logic families using a 4 to 15V power supply. Thresholds automatically programmed. Visual indication of logic levels to show high, low, bad level or open circuit logic pulses.

- 10 N sec. pulse responses
- 120 K input impedance.
- Automatic resetting memory.
- Includes tip with protective cap & coiled cord.

PRB-1 \$36.95

LOGIC PULSER

Superimposes a pulse train (20 pps) or a single pulse onto the circuit node under test without un-soldering IC's.

- Automatic polarity sensing
- 2 us pulse width
- Finger tip push button actuated
- Includes tip with protective cap & coiled cord.

PSL-1 \$48.95

VACUUM VISE

Unique vacuum-based light duty vise for precision handling of small components and assemblies. Rugged ABS construction. 1 1/2" (32mm) travel for maximum versatility. Also features screw lugs for permanent installation.



VV1	Vacuum Vise	\$3.49
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HOBBY WRAP TOOL BW263C

- Auto-Indexing
- Anti-Overwrap
- Modified Wrap

Part No.	Description	Price
BW2630	Tool	\$19.85
BT30	#30 Bit (not incl.)	3.95
BT2628	#28 Bit (not incl.)	7.95
BC1	Batteries & Charger	14.95

INSERTION/EXTRACTION TOOLS

Part No.	Description	Price
INS1416	14-16 pin Insertor	\$3.49
MOS1416	14-16 pin MOS Safe Insertor	7.95
MOS2428	24-28 pin MOS Safe Insertor	7.95
MOS40	40 pin MOS Safe Insertor	7.95
EX1	14-16 pin IC Extractor	1.49
EX2	24-40 pin IC Extractor	7.95



WK-7 IC INSERTION KIT

Complete IC Insertor/ Extractor Kit Individual Components (listed above) \$22.95

IC DISPENSER

Allows IC's to be dispensed from their tube 1 at a time and picked up by insertion tools above.

- Dispenses 8-42 pin IC's
- Compatible with all IC carrying tubes
- Use with WK7 for MOS safe insertion.

Part No.	Description	Price
MDD1	1 Chan. Dispenser	\$21.85
MDD5	5 Chan. Dispenser	83.43
MDD10	10 Chan. Dispenser	160.45

* * *No Discount.

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IDC CONNECTORS

RIGHT ANGLE HEADERS

Size	Part No.	Price	Part No.	Price
10	IDH10SRB	\$1.20	IDH10WRB	\$2.60
20	IDH20SRB	1.90	IDH20WRB	4.15
26	IDH26SRB	2.75	IDH26WRB	5.35
34	IDH34SRB	3.75	IDH34WRB	6.25
40	IDH40SRB	3.75	IDH40WRB	7.35
50	IDH50SRB	4.75	IDH50WRB	9.20

.1" Spacing. Mounts on PC Board & Mates with IDS Socket below. Ejector Bars - 4/1.00.

EDGE CARD CONNECTORS

Size	Part No.	Price
10	IDE10B	\$3.95
20	IDE20B	4.35
26	IDE26B	5.00
34	IDE34B	6.05
40	IDE40B	6.90
50	IDE50B	7.50

.1" Spacing. Crimps onto cable with ordinary vise & mates with standard .062" Card Edge.

RIBBON CABLE

Size	Solid Color		Color Coded	
	10 ft.	100 ft.	10 ft.	100 ft.
10	2.90	17.00	4.00	30.00
14	3.40	23.80	5.00	42.00
16	3.70	27.20	5.60	48.00
20	4.40	34.00	7.00	60.00
24	5.00	40.80	8.00	72.00
26	5.40	44.20	8.60	78.00
34	6.80	57.80	11.00	102.00
40	7.80	68.00	13.00	120.00
50	9.50	85.00	16.00	150.00

25 PIN "D" CONNECTORS

Solder Style	Part No.	Price
Male	DB25P	\$2.95
Female	DB25S	3.95
Cover	DB25C	1.50

IDC Style	Part No.	Price
Male	IDB25P	6.25
Female	IDB25S	6.60
Cover	IDB25C	1.60

Solder Style solders onto cable, IDC Style crimps onto cable with vise. 9, 15, 37 and 50 pin available also.

CABLE PLUGS

Size	Part No.	Price
14	IDP14B	\$1.45
16	IDP16B	1.65
24	IDP24B	2.50
40	IDP40B	4.15

.1" Spacing. Crimps onto cable with ordinary vise & plugs into standard IC Socket.

SOCKETS

Size	Part No.	Price
10	IDS10B	\$1.88
20	IDS20B	2.75
26	IDS26B	3.50
34	IDS34B	4.50
40	IDS40B	5.40
50	IDS50B	6.50

.1" Spacing. Crimps onto cable with ordinary vise & mounts to header sold above.

WIRE WRAP SUPPLIES

WIRE WRAP WIRE

Length	#30 Wire Wrap Wire		
	100/Bag	500/Bag	1K/Bag
2.5"	\$1.38	\$3.94	\$6.81
3.0"	1.43	4.25	7.46
3.5"	1.51	4.57	8.11
4.0"	1.56	4.88	8.73
4.5"	1.63	5.21	9.39
5.0"	1.69	5.54	10.04
5.5"	1.74	5.92	10.69
6.0"	1.82	6.23	11.34
6.5"	2.11	7.08	12.99
7.0"	2.19	7.44	13.68
7.5"	2.29	7.78	14.40
8.0"	2.35	8.12	15.10
8.5"	2.40	8.46	15.80
9.0"	2.46	8.92	16.51
9.5"	2.53	9.15	17.22
10.0"	2.63	9.58	17.91

All lengths are overall, including 1" strip on each end. Choose from colors; Red, Blue, Black, Yellow, White, Green, Orange, and Violet.

Size	Part No.	Each	Tube
08	ICN083WBSG	.44	52x .39 = \$20.28
14	ICN143WBSG	.53	30x .46 = \$13.80
16	ICN163WBSG	.58	26x .50 = \$13.00
18	ICN183WBSG	.78	23x .68 = \$15.64
20	ICN203WBSG	1.00	21x .85 = \$17.85
22	ICN224WBSG	1.07	19x .92 = \$17.48
24	ICN246WBSG	1.09	17x 1.09 = \$15.98
28	ICN286WBSG	1.43	15x 1.23 = \$18.45
40	ICN406WBSG	1.85	10x 1.60 = \$16.00

Selective Plating provides gold in contact where it counts. 3-level wrap. Save by buying sockets by the tube. All gold available at 1/2¢/pin extra charge.

* * * No Discount

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200	3 1/2"	100	5"
100	4"	100	6"

Kit No. 2 - \$24.95

250	2 1/2"	250	5"
500	3"	100	5 1/2"
500	3 1/2"	100	6"
500	4"	100	6 1/2"
250	4 1/2"	100	7"

Kit No. 3 - \$34.95

250	2 1/2"	500	4 1/2"
500	3"	500	5"
500	3 1/2"	500	5 1/2"
500	4"	500	6"

Kit No. 4 - \$59.95

500	2 1/2"	1000	4 1/2"
1000	3"	1000	5"
1000	3 1/2"	1000	5 1/2"
1000	4"	1000	6"

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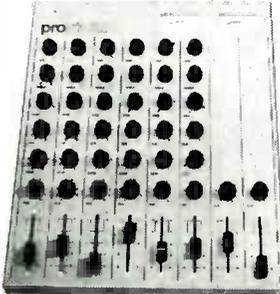
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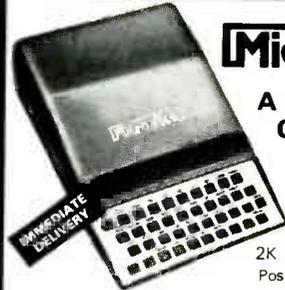
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RS-232 connector, DBC-25-P male, crimp pin, \$2.25
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DYNAMIC RAMS

D2104A 16 pin 4Kx1 300ns
TMS4030 22 pin 4Kx1 300ns
95c

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COM 2502 40 pin 25 KHz +5 - 12
\$4.95



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43/86 pin (double), .156 spacing gold plated solder eyelets

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1/16" FR-4 glass epoxy

4.5" x 6.5"	\$1.00
6.0" x 6.0"	\$1.25
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4-10K linear pots
1 1/2" metal handle
dimensions
2 1/8" square
\$5.95



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Input 110 - 220 VAC
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5 3/4" x 7 1/2" x 4" h



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12"	12 LA20	50W	\$18.00
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Micro Switch V3L-2108-D8 10 Amp, 125 VAC SPDT \$1.00
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Arm length 2 3/8

Arm length 1 3/4

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PCB mount. 10K linear. 1 3/4" travel 75c

POTS

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VALUE	STYLE
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10K Linear	A,B,C
25K Linear	B,C
50K Linear	A,C
50K Audio	C
100K Linear	B,C
500K reverse audio	B
1M Linear	B
All below with Switch 85c	
25K Linear/push-pull	B
50K Linear/push-pull	B
500K Linear/turn	B
50K Audio/turn	C

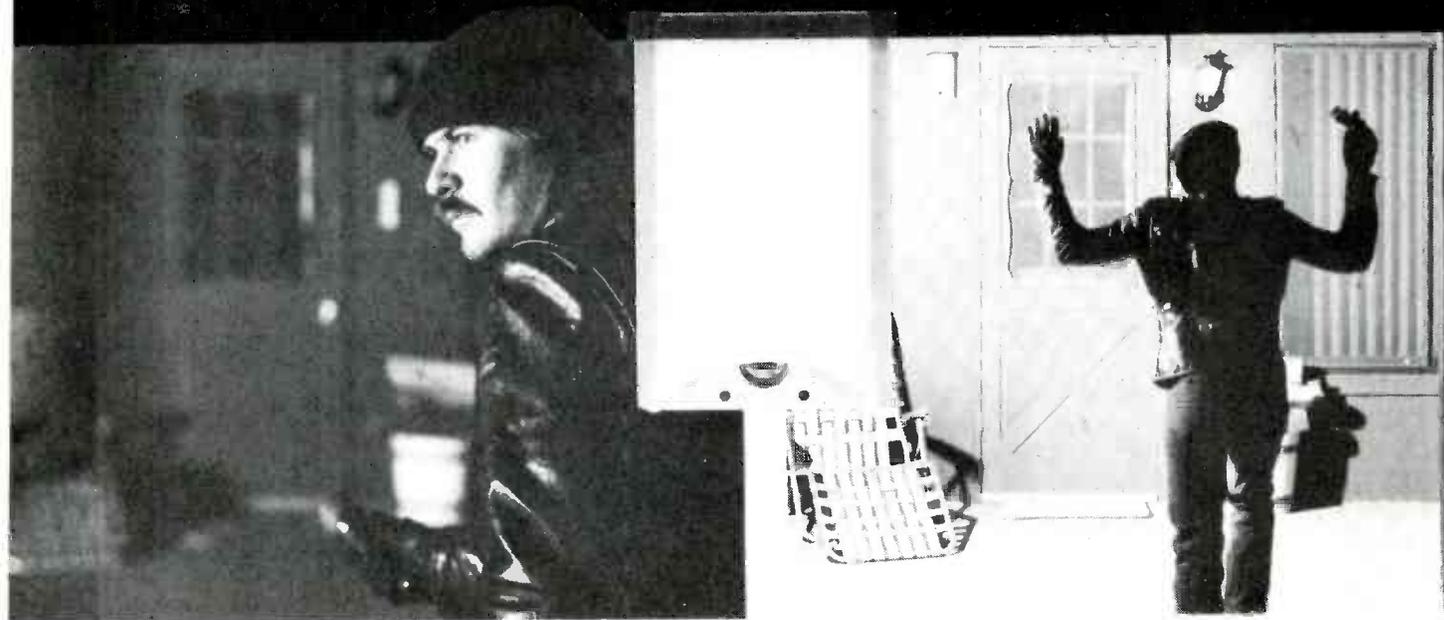


RADIO-ELECTRONICS

CIRCLE 64 ON FREE INFORMATION CARD

OUTDOOR AUTOMATIC LIGHTING WITH PASSIVE INFRARED

SECURITY LIGHT CONTROL



Amazing infrared device detects and foils intruders, welcomes guests, prevents accidents and saves energy!

Your family is sound asleep. An intruder is stealthily approaching your darkened house. But when he enters the detection pattern, the SLC senses his body heat and ZAP! Your outside lights come on instantly, destroying his cover of darkness before he ever gets to your door. A crime is prevented. And when you finally arrive home that same SLC automatically turns on your driveway and porch lights for a safe, warm welcome.

HOW IT WORKS

This exciting new product incorporates the latest advances in heat-sensing infrared technology. Manufactured by Colorado Electro-Optics, the leading producer of infrared security devices in the US, the SLC detects the heat energy of any person or vehicle that enters its invisible detection pattern. It will then automatically turn on up to 500 watts of outside lighting. These lights will remain on until four minutes after the last person leaves the detection area. No timers, no switches, no all-night flood lights.

SLC NEVER FORGETS

Unlike timers that respond only to

preset programs, the SLC reacts to the presence of human beings. It is now possible to have your lights on when and only when you really need them, all automatically. In addition to a reliable security device, the SLC can provide your family with increased safety, convenience and home energy savings. No more stumbling over unseen objects, tripping on dark stairs, or fumbling with your keys. No more wasted energy from forgetting to turn off the lights. And your guests will appreciate the automatic welcome your home always provides.

SAFE, EASY TO INSTALL

The SLC does not emit energy of any kind and is totally harmless to living things. Rugged, weather resistant, UL listed and good looking, a low-cost SLC should be put near every entryway. The sensor is adjustable to cover an area 35 feet by 25 feet. Installing the SLC is as simple as wiring a switch, an easy job for the do-it-yourselfer.

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SLC ORDER FORM

If not completely satisfied I may return the SLC within 60 days of purchase for a full refund. The unit carries a limited one year warranty.

Please Print

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

Please send me _____ Security Light Control(s) at \$199 each, totalling \$ _____

For my convenience, Colorado Electro-Optics will pay surface shipping charges.

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ACCOUNT NO _____

EXPIRATION DATE _____

Personal Check
 Ship COD to above address
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Please send more information.

SIGNATURE _____

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2200 Central Ave., Dept. R
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74LS10	25	74LS175	95
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74LS27	35	74LS197	85
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74LS32	35	74LS241	1.85
74LS33	55	74LS242	1.85
74LS37	55	74LS243	1.85
74LS38	35	74LS244	1.75
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74LS42	55	74LS247	7.6
74LS47	75	74LS248	1.25
74LS48	75	74LS249	99
74LS49	75	74LS251	1.30
74LS51	25	74LS253	85
74LS54	35	74LS257	85
74LS55	35	74LS258	85
74LS56	1.25	74LS259	2.85
74LS73	40	74LS260	65
74LS74	45	74LS266	55
74LS75	50	74LS273	1.65
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74LS85	1.15	74LS283	1.00
74LS86	40	74LS290	1.25
74LS90	65	74LS293	1.85
74LS91	89	74LS295	1.05
74LS92	70	74LS298	1.20
74LS93	65	74LS324	1.75
74LS95	85	74LS352	1.55
74LS96	95	74LS353	1.55
74LS107	40	74LS363	1.35
74LS109	40	74LS364	1.95
74LS112	45	74LS365	95
74LS113	45	74LS366	95
74LS114	50	74LS367	70
74LS122	45	74LS368	70
74LS123	95	74LS373	1.85
74LS124	2.99	74LS374	1.80
74LS125	95	74LS377	1.45
74LS126	85	74LS378	1.18
74LS132	75	74LS379	1.35
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1488	99	1793	49.95
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6821	4.95
6828	9.95
6834	16.95
6840	14.95
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6844	44.95
6845	29.95
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LM566V	1.49	LM3916	3.95
LM567V	1.29	75451V	.39
LM723	.49	75452V	.39
LM733	.98	75453V	.39

T=TO-220 V=8 PIN K=TO-3

EPROMS

1702	256 x 8	(1us)	4.95	8pcs	4.50
2708	1024 x 8	(450ns)	3.95	3.50	
2758	1024 x 8	(450ns)(5v)	9.95	8.95	
TMS2516	2048 x 8	(450ns)(5v)	7.95	6.95	
2716	2048 x 8	(450ns)(5v)	5.95	5.50	
2716-1	2048 x 8	(350ns)(5v)	12.95	11.95	
TMS2716	2048 x 8	(450ns)	9.95	8.95	
TMS2532	4096 x 8	(450ns)(5v)	19.95	17.95	
2732	4096 x 8	(450ns)(5v)	16.50	15.95	

STATIC RAMS

2101	256 x 4	(450ns)	1.95	100pcs	1.85
2102-1	1024 x 1	(450ns)	.89	.85	
21L02-1	1024 x 1	(450ns)(LP)	1.29	1.15	
2111	256 x 4	(450ns)	2.99	2.49	
2112	256 x 4	(450ns)	2.99	2.79	
2114	1024 x 4	(450ns)	8/17.95	2.10	
2114L-2	1024 x 4	(200ns)(LP)	8/22.95	2.45	
2114L-3	1024 x 4	(300ns)(LP)	8/21.95	2.45	
2114L-4	1024 x 4	(450ns)(LP)	8/18.95	2.25	
TMS4044-4	4096 x 1	(450ns)	3.49	3.25	
TMS4044-3	4096 x 1	(300ns)	3.99	3.75	
TMM2016	2048 x 8	(200ns)	CALL		
HM6116	2048 x 8	(200ns)	CALL		

DYNAMIC RAMS

4027	4096 x 1	(250ns)	2.50	100pcs	2.00
4116-150	16.384 x 1	(150ns)	8/19.95	2.35	
4116-200	16.384 x 1	(200ns)	8/17.50	1.95	
4116-300	16.384 x 1	(300ns)	8/16.95	1.85	
4164	65.536 x 1	(200ns)	CALL		

LP=LOW POWER

DIP SWITCHES

4 position	85
5 position	90
6 position	90
7 position	95
8 position	95

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

LEDS

Jumbo Red	10/1.00
Jumbo Green	6/1.00
Jumbo Yellow	6/1.00
5082-7760 43°C	.79
MAN74 3°C	.99
MAN72 3°C	.99

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7805T	.89	7905T	.99
7808T	.99	7912T	.99
7812T	.89	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		

7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	79105	.79

78L05	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69	LM317K	3.95
LM309K	1.49	LM323K	3.95
LM317T	1.95	LM337K	4.95

T=TO-220 K=TO-3 L=TO-92

IC SOCKETS

8 pin ST	13	.11
14 pin ST	15	.12
16 pin ST	17	.13
18 pin ST	20	.18
20 pin ST	29	.27
22 pin ST	30	.27
24 pin ST	30	.27
28 pin ST	40	.32
40 pin ST	49	.39

ST = SOLDER TAIL		
8 pin WW	.59	.49
14 pin WW	.69	.52

2716 EPROMS 450NS (5V)

8/5.50 ea.

ALL MERCHANDISE 100% GUARANTEED!

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CMOS

74C00	.35	74C374	2.75	4019	.45	4098	2.49
74C02	.35	74C901	.80	4020	.95	4099	1.95
74C04	.35	74C902	1.85	4021	.95	14409	8.95
74C08	.35	74C903	.85	4022	1.15	14410	8.95
74C10	.35	74C905	10.95	4023	.35	14411	9.95
74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	2.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
74C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
74C195	2.25	4015	.95	4082	.30	80C95	.85
74C200	5.75	4016	.45	4085	.95	80C96	.95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
74C373	2.75	4018	.95	4093	.95	80C98	1.20

7400 SERIES

7400	.19	74128	.55
7401	.19	74132	.45
7402	.19	74136	.50
7403	.19	74141	.65
7404	.19	74142	2.95
7405	.22	74143	2.95
7406	.22	74144	2.95
7407	.22	74145	.60
7408	.24	74147	1.75
7409	.19	74148	1.20
7410	.19	74150	1.35
7411	.25	74151	.65
7412	.30	74152	.65
7413	.35	74153	.55
7414	.55	74154	1.40
7416	.25	74155	.75
7417	.25	74156	.65
7420	.19	74157	.55
7421	.35	74159	1.65
7422	.29	74160	.85
7423	.29	74161	.70
7425	.29	74162	.85
7426	.29	74163	.85
7427	.29	74164	.85
7428	.45	74165	.85
7430	.19	74166	1.00
7432	.29	74167	1.95
7433	.45	74170	1.65
7437	.29	74172	5.95
7438	.29	74173	.75
7440	.19	74174	.89
7442	.49	74175	.89
7443	.65	74176	.89
7444	.69	74177	.75
7445	.69	74178	1.15
7446	.59	74179	1.75
7447	.69	74180	.75
7448	.69	74181	2.25
7450	.19	74182	.75
7451	.23	74184	2.00
7453	.23	74185	2.00
7454	.23	74186	18.50
7460	.23	74190	1.15
7464	.39	74191	1.15
7465	.39	74192	.79
7470	.35	74193	.79
7472	.29	74194	.85
7473	.34	74195	.85
7474	.35	74196	.79
7475	.49	74197	.75
7476	.35	74198	1.35
7480	.59	74199	1.35
7481	1.10	74221	1.35
7482	.95	74246	1.35
7483	.50	74247	1.25
7484	.50	74248	1.85
7485	.65	74249	1.95
7486	.35	74251	.75
7489	4.95	74259	2.25
7490	.35	74265	1.35
7491	.40	74273	1.95
7492	.50	74276	1.25
7493	.49	74279	.75
7494	.65	74283	2.00
7495	.55	74284	3.75
7496	.70	74285	3.75
7497	2.75	74290	.95
74100	1.00	74293	.75
74107	.30	74298	.85
74109	.45	74351	2.25
74110	.45	74365	.65
74111	.55	74366	.65
74116	1.55	74367	.65
74120	1.20	74368	.65
74121	.29	74376	2.20
74122	.45	74390	1.75
74123	.55	74393	1.35
74125	.45	74425	3.15
74126	.45	74426	.85
		74490	2.55

74S00 SERIES

74S00	.44	74S74	.69	74S163	3.75	74S258	1.49
74S02	.48	74S85	2.39	74S168	4.65	74S260	1.83
74S03	.48	74S86	1.44	74S169	5.44	74S274	19.95
74S04	.79	74S112	1.59	74S174	1.09	74S275	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S280	2.90
74S08	.48	74S114	1.50	74S181	4.47	74S287	4.75
74S09	.98	74S124	2.77	74S182	2.95	74S288	4.45
74S10	.69	74S132	1.24	74S188	3.95	74S289	6.98
74S11	.88	74S133	.98	74S189	14.95	74S301	6.95
74S15	.70	74S134	.69	74S194	2.95	74S373	3.45
74S20	.68	74S135	1.48	74S195	1.89	74S374	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S381	7.95
74S30	.48	74S139	1.25	74S197	4.25	74S387	5.75
74S32	.98	74S140	1.45	74S201	14.95	74S412	2.98
74S37	1.87	74S151	1.19	74S225	8.95	74S471	9.95
74S38	1.68	74S153	1.19	74S240	3.98	74S472	16.85
74S40	.44	74S157	1.19	74S241	3.75	74S474	17.85
74S51	.78	74S158	1.45	74S251	1.90	74S482	15.60
74S64	.79	74S161	2.85	74S253	7.45	74S570	7.80
74S65	1.25	74S162	3.70	74S257	1.39	74S571	7.80

PROMS

74S188	(82S23)	OC	32 x 8	3.95
74S287	(82S129)	TS	256 x 4	4.75
74S288	(82S123)	TS	32 x 8	4.45
74S387	(82S126)	OC	256 x 4	5.75
74S471		TS	256 x 8	9.95
74S472	(82S147)	TS	512 x 8	16.85
74S474	(82S141)	TS	512 x 8	17.85
74S570	(82S130)	OC	512 x 4	7.80
74S571	(82S131)	TS	512 x 4	7.80

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DYNAMIC RAMS

4116	150NS	16K x 1	8/19.95
4116	120NS	16K x 1	8/29.95

STATIC RAMS

2147	55NS	4K x 1	9.95
6116	150NS	2K x 8	CALL
6116	120NS	2K x 8	CALL

EPROMS

2716-1	350NS	2K x 8	12.95
2732A	250NS	4K x 8	25.95
2732A-2	200NS	4K x 8	32.95

MPU's

Z-80B	CPU	6mHz	19.95
Z-80B	CTC	6mHz	17.95
Z-80B	PIO	6mHz	17.95
68B00	CPU	2mHz	10.95
68B21	PIA	2mHz	12.95
68B50	ACIA	2mHz	12.95
8085A-2	CPU	5mHz	16.95

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- PLUG IN SLOT #
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- INCLUDES 5 RAM-ROM OPTIONS
- ENJOY THE BEST OF BOTH WORLDS
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 - THOSE EXTRA PLUG-IN CARDS CAN CAUSE EXTRA HEAT
- HOW TO HOOK IT UP
1. Clip it on your APPLE
 2. Unplug your 120V cable (you won't need it)
 3. Plug short 120V cable from Super Fan II to the back of your computer
 4. Plug the supply cable from Super Fan II to your 120V power source
 5. Turn on the rocker switch and a built-in red ready light comes on
 6. You are all set "COOL IT"

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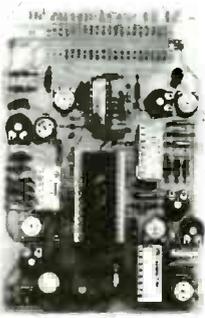
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TERMS For shipping include \$2.00 for UPS Ground, \$3.00 for UPS Blue Label Air, \$10.00 minimum order. Bay Area Residents add 6 1/2% sales tax. California Residents add 6% sales tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice. Send SASE for complete list.

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Sound Effects Kit \$18.50



The SE-01 is a complete kit that contains all the parts to build a programmable sound effects generator. Designed around the new Texas Instruments SN76477 Sound Chip, the board provides banks of MINI DIP switches and pots to program the various combinations of the SLF Oscillator, VCO, Noise, One Shot, and Envelope Controls. A Quad Op Amp IC is used to implement an Adjustable Pulse Generator. Level Comparator and Multiplier Oscillator for even more versatility. The 3 1/2" x 5" PC Board features a prototype area to allow for user added circuitry. Easily programmed to duplicate Explosions, Phasor Guns, Steam Trains, or almost an infinite number of other sounds. The unit has a multiple of applications. The low price includes all parts.

assembly manual, programming charts, and detailed 76477 chip specifications. It runs on a 9V battery (not included). On board 100mW amp will drive a small speaker directly, or the unit can be connected to your stereo with incredible results! (Speaker not included). 76477 is included. Available separately for \$3.15 each.

AY3-8910 PROGRAMMABLE SOUND GENERATOR

The AY3-8910 is a 40 pin LSI chip with three oscillators, three amplitude controls, programmable noise generator, three mixers, an envelope generator, and three D/A converters that are controlled by 8 BIT WORDS. No external pots or caps required. This chip hooked to an 8 bit microprocessor chip or Bus (8080, Z80, 6800 etc.) can be software controlled to produce almost any sound. It will play three note chords, make bangs, whistles, sirens, gunshots, explosions, bleats, whines, or grunts. In addition, it has provisions to control its own memory chips with two IO ports. The chip requires +5V @ 75ma and a standard TTL clock oscillator. A truly incredible circuit.

\$12.95 W/Basic Spec Sheet (4 pages)

60 page manual with S-100 interface instructions and several programming examples, \$3.00 extra

MANY OTHER COMPONENTS AND KITS AVAILABLE IN OUR COMPLETE CATALOG. CALL OR WRITE FOR FREE CATALOG.

Doomsday Alarm Kit \$9.95

If you have trouble sleeping and you would like the rest of the neighborhood to share your misery then this little kit will be for you! There is no way to accurately describe the unearthly howls, screams and tones that come out of this kit. Four separate tone oscillators are mixed, cancelled and stepped at a varying rate. 10 Watts of crazy sounds. A great fun kit or a practical burglar alarm. Complete with PC board and all necessary components less speaker. For 6-12 VDC. ORDER DA-02.

Overvoltage Protection Kit \$6.95

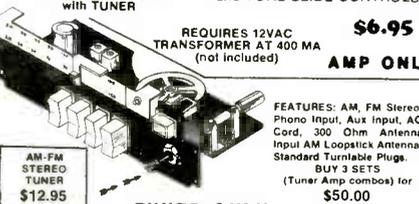
Protect your expensive equipment from overvoltage conditions. Every computer should have one! Works with any fused DC power source from 10 to 20 volts up to 25 amps.

7 Watt Audio Amp Kit \$5.95

SMALL, SINGLE HYBRID IC AND COMPONENTS FIT ON A 2" x 3" PC BOARD (INCLUDED). RUNS ON 12VDC. GREAT FOR ANY PROJECT THAT NEEDS AN INEXPENSIVE AMP LESS THAN 3% THD @ 5 WATTS. COMPATIBLE WITH SE-01 SOUND KIT.

Stereo AMP/Power Supply Board

Takes low level audio and drives 8 ohm speakers ON-BOARD Rectifiers and Filter supply power for AMP AND TUNER, VOLUME, BALANCE, AND TONE SLIDE CONTROLS



REQUIRES 12VAC TRANSFORMER AT 400 MA (not included) **AMP ONLY \$6.95**

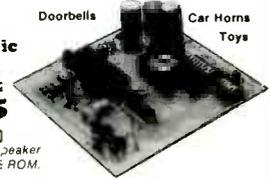
AM-FM STEREO TUNER \$12.95 (Requires 12VDC) **TUNER ONLY**

- * COD MINIMUM \$20.00 + ADD \$2.50 FOR COD'S
- * UPS DELIVERY ADDRESS MUST ACCOMPANY ALL COD ORDERS
- * \$10.00 HANDLING ON ORDERS UNDER \$10.00
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- * ADD 6% FOR SHIPPING
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- * ALL FOREIGN ORDERS ADD 25% FOR SHIPPING (CANADA 15%)
- * NO FOREIGN COD'S
- * CALL (214) 278-3553 TO PLACE CREDIT CARD OR COD ORDER

SEE SPECIAL FALL PRICES BELOW (PRICES GOOD THRU DECEMBER 31, 1981) SHOP EARLY FOR CHRISTMAS

The Super Music Maker REVISION 2 \$24.95 (Basic Kit)

Does not include speaker switches or 2706 ROM.



Now you can play hundreds of songs using the Bullet Super Music Maker. The unit features a single factory programmed microprocessor IC that comes with 20 pre-programmed short tunes. By adding the additional PROMS (2708's) the system can be expanded to play up to 1000 notes per PROM. Just think... a compact electronic instrument that will play dozens, hundreds or even thousands of selections of music. The kit comes with all electronic components (less the PROM), and a drilled, plated and screened PC Board which measures 4" x 4 1/2". The 7 watt amplifier section is on the same PC board and drives an 8 ohm speaker (not included), from a whisper to ear splitting volume. Since the unit works on 12 VDC or 12 VAC, vehicle or portable operation is possible. What do you get for \$24.95? Everything but a speaker, transformer, case, switches, and PROM. Additional 2708 albums containing popular tunes are available for \$9.95 each or you can program your own PROMS using information provided with the kit instructions. Lists of available PROM albums are available on request. (Note: Unit plays electronic music one note at a time, it is not possible to play chords or a melody with harmony simultaneously.)

- * Envelope control gives decay to notes.
- * On board inverter allows single voltage (+12) operation.
- OPTIONAL ACCESSORIES**
- DIP Switches (One 8 pos., One 5 pos.) 2.00/set
- (Can be directly soldered to PC Bd. to access tunes)
- Rotary Switches Two 5 position 2.50/set
- (For remote wiring to PC Bd. to access tunes)
- Attractive Tan Plastic Case 6.50
- Wallplug Transformer (For operation on 117VAC house voltage) 3.00

- FALL SPECIALS:** (Good Thru Dec '81)
- 1. Super Music Maker w/ case and two 5-position rotary switches \$32.00
 - 2. Super Music with one 2716 2K X 8 PROM filled with over 50 selections of additional music (1500 notes) \$32.00
 - 3. The Whole Ball of Wax! #2 + case and switches. \$39.95

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16k → \$750.00
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48k → \$1199.00
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74 S00

74S00	39	74S138	75
74S02	45	74S140	100
74S03	38	74S158	75
74S04	39	74S174	135
74S06	39	74S175	135
74S10	39	74S189	75
74S15	45	74S189	4.25
74S20	55	74S201	6.75
74S22	55	74S240	2.75
74S30	75	74S244	2.95
74S37	55	74S251	2.75
74S50	65	74S287	2.95
74S51	65	74S288	2.95
74S64	55	74S299	5.75
74S74	65	74S470	9.25
74S86	95	74S471	9.50
74S112	1.95	74S473	9.50
74S132	1.45	74S474	9.50

COMPONENTS

SN7400N	18	SN7482N	40
SN7402N	22	SN7492N	30
SN7404N	21	SN7493N	45
SN7408N	22	SN7495N	60
SN7410N	18	SN7496N	80
SN7412N	20	SN74122N	39
SN7413N	22	SN74138N	95
SN7414N	28	SN74141N	99
SN7415N	27	SN74151N	65
SN7417N	29	SN74153N	55
SN7420N	17	SN74154N	25
SN7422N	20	SN74155N	55
SN7423N	20	SN74157N	55
SN7430N	26	SN74160N	89
SN7432N	24	SN74161N	85
SN7434N	18	SN74163N	85
SN7442N	45	SN74164AN	87
SN7443N	42	SN74165N	55
SN7445N	64	SN74174N	88
SN7451N	19	SN74175N	79
SN7454N	19	SN74180N	75
SN7474N	27	SN74181N	115
SN7475N	35	SN74293AN	1.95

CONT'D

2716	6.25ea	8 for	5.75ea
5V 450NS			
TMS2716	5.25ea	8 for	4.50ea
2708			
450NS 4 10 ea		8 for	3.95ea
2732	19.95 ea	4 for	16.95 ea
4116	300NS 2.00ea	8 for	12.00
200NS 2.35 ea		4 for	15.00
2114L	300NS 2.95 ea	4 for	2.75ea
200NS 3.50 ea		4 for	3.00ea
2111	450NS 2.50ea	10 for	2.00ea

SPECIALS

3inch MUFFIN FAN w/line cord \$9.95

UPD 765C: Floppy Disk Controller \$17.95 w/spec's

2732A: 250NS EPROM \$24.50

AY5-1013A: 30K Band UART \$3.95

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Discrete Mono Metal Gate CMOS IC

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Bus Oriented
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1 Bit Address
Raw solder Select

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video 100 \$1550.00

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74LS00

74LS00	28	74LS158	80
74LS02	28	74LS161	83
74LS03	28	74LS162	89
74LS04	28	74LS163	98
74LS06	22	74LS164	86
74LS08	29	74LS165	86
74LS09	28	74LS169	1.56
74LS10	28	74LS170	1.75
74LS14	80	74LS174	80
74LS15	80	74LS175	85
74LS20	22	74LS175	85
74LS21	26	74LS190	85
74LS26	40	74LS191	1.25
74LS27	27	74LS195	96
74LS28	37	74LS197	78
74LS30	29	74LS221	1.25
74LS32	31	74LS240	1.65
74LS36	31	74LS241	1.65
74LS42	63	74LS243	1.55
74LS48	77	74LS244	1.55
74LS74	38	74LS245	2.45
74LS75	45	74LS241	1.25
74LS80	45	74LS253	85
74LS90	56	74LS257	85
74LS93	85	74LS259	1.95
74LS98	80	74LS260	1.80
74LS107	43	74LS273	1.55
74LS113	45	74LS279	4.5
74LS122	45	74LS280	1.25
74LS123	89	74LS293	1.80
74LS125	80	74LS365	85
74LS126	79	74LS367	75
74LS138	64	74LS372	1.45
74LS139	69	74LS373	1.45
74LS151	49	74LS377	1.25
74LS153	49	74LS669	1.55
74LS157	89	74LS670	1.80

TERMINALS

2102			
450NS			
NE 555	2.95	103A	.75
AY5 1013A	4.25	UPD765C	17.85
1488	1.10	controller	1.95
1489	1.10	JLN2001	1.40
8726	1.30	TMS4400	1.40
8728	1.30	MC4008P	1.75
8212	2.75	MHO026	1.55
8216	2.75	03624	1.95
IS410SCR	95	03001	1.95
17410TRIAC	95	03002	1.95
7905	85		
7908	85		
7915	85		
7918	85		
7805	85		
7808	85		
7812	85		
MC1330AP	1.60	16	10/1 20
MC1350P	1.15	18	10/1 60
MC1380P	1.50	20	10/2 80
LM380	1.20	22	10/2 80
LM565N	1.90	24	10/2 80
LM741	25	28	10/3 80
MC1458P	55	40	10/4 75
LM720	55	40	10/4 75
LM366	1.75		

OR

AS SHOWN

THE MPD 117 turns an ordinary outlet into a controlled power source

\$79.50

SHELF / DESK MOUNTED #5722 \$155.00

DESC: 80 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800 1900 2000 2100 2200 2300 2400 2500 2600 2700 2800 2900 3000 3100 3200 3300 3400 3500 3600 3700 3800 3900 4000 4100 4200 4300 4400 4500 4600 4700 4800 4900 5000 5100 5200 5300 5400 5500 5600 5700 5800 5900 6000 6100 6200 6300 6400 6500 6600 6700 6800 6900 7000 7100 7200 7300 7400 7500 7600 7700 7800 7900 8000 8100 8200 8300 8400 8500 8600 8700 8800 8900 9000 9100 9200 9300 9400 9500 9600 9700 9800 9900 10000

POWER SUPPLY MODEL #CP198
input - 110/125V output - 5Vdc
At 29.95 City price avail

Apple Expansion Kit 16K Memory Add-On includes instructions \$25.95

TR580 16K Add-On instructions & Dip Switches \$25.95

GLOBAL Logic Probes

LP-1: \$40.00
Pulse width to 50ns. Rep. rate to 10MHz

LP-3: \$60.00
Pulse width to 50ns. Rep. to over 60MHz

LP-1: Logic Probe w/comp. nothing extra to buy. Min. pulse width 30ns. \$18.95

CARDS

MICROSOFT Z80 \$295.00

16K RAM \$160.00

VIDEO VIDEOTERM 80 column \$295.00

KEYBOARD ENHANCER \$120.00

CALIF COMP SYS APPLE CLOCK \$1240.00

PROTO BOARD \$25.00

PRINTERS EPSON MX-80 \$560.00

CENTRONICS 737-1 \$950.00

753-1 \$2,995.00

BASE II inc 8008 \$649.00

850 \$749.00

1981 I.C. MASTER \$59.95

Synertek "KTM-3" LOW COST TERMINAL WITH KEYBOARD AND VIDEO I/O \$499.00

689.00

Low Profile — TIN

1-24	25up	50up	100up
AB27-Ti	\$ 17	\$ 16	\$ 15
A1427-Ti	20	19	18
A1627-Ti	22	21	20
A1827-Ti	28	28	27
A2027-Ti	33	32	31
A2227-Ti	36	35	34
A2427-Ti	37	36	35
A2627-Ti	43	42	41
A4027-Ti	46	45	44

Standard Soldertail — TIN

1-24	25up	50up	100up
AB7	\$ 30	\$ 29	\$ 28
A14T	36	35	34
A16T	38	37	36
A18T	44	43	42
A22T	72	71	70
A24T	52	51	50
A26T	78	77	76
A36T	83	82	81
A40T	108	107	106

Standard Soldertail — Gold

1-24	25up	50up	100up
ABG	\$ 38	\$ 37	\$ 36
A14G	55	54	53
A16G	63	62	61
A18G	69	67	66
A22G	81	80	79
A24G	91	90	89
A26G	101	100	99
A36G	141	140	139
A40G	155	154	153

SOCKETS

WIRE WRAP Level 3

1-24	25up	50up	100up
ARWG	\$ 55	\$ 54	\$ 53
A14WG	69	67	66
A16WG	71	70	69
A18WG	73	72	71
A20WG	101	100	99
A22WG	123	122	121
A24WG	135	134	133
A26WG	143	142	141
A36WG	183	182	181
A40WG	195	194	193

Wire Wrap — TIN

1-24	25up	50up	100up
ARWT-Ti	\$ 41	\$ 40	\$ 39
A14WT-Ti	59	58	57
A16WT-Ti	63	62	61
A18WT-Ti	67	66	65
A20WT-Ti	91	90	89
A22WT-Ti	99	98	97
A24WT-Ti	109	108	107
A26WT-Ti	139	138	137
A36WT-Ti	163	162	161
A40WT-Ti	189	188	187

PORTABLE THANDAR OSCILLOSCOPE



Model SC110
Only \$369

- DC—10MHz
- 2" DIAGONAL CRT
- SMALL SIZE (10"x5.8"x2")
- ULTRA LOW POWER CONSUMPTION
- LIGHT WEIGHT (2 lbs)
- AUTOMATIC CIRCUIT POWER DOWN FOR UNUSED SECTIONS

6500 SERIES MICROPROCESSOR IC's

A = (2 MHz) B = (3 MHz) C = (4 MHz)

P6502	\$ 8.82	P6506A	\$ 8.82	P6520A	\$ 3.74	P6530-005	\$ 15.84
P6502A	9.66	P6507	8.09	P6820	3.40	P6532	10.82
P6502B	15.02	P6507A	8.82	P68B20	3.74	P6532A	11.87
P6502C	21.00	P6512	8.82	P6521	4.90	P6545-1	17.51
P6503	8.09	P6512A	8.66	P6521A	5.34	P6545A-1	22.44
P6503A	8.82	P6513	8.09	P6821	4.90	P6551	10.71
P6504	8.09	P6513A	8.82	P68B21	5.34	P6551A	11.76
P6504A	8.82	P6514	8.09	P6522	4.40	P6591	40.00
P6505	8.09	P6514A	8.82	P6522A	11.24	P1791-02	40.00
P6505A	8.82	P6515	8.09	P6530-004	15.84	P1793-02	40.00
P6506	8.09	P6520	3.40				

MICROPROCESSOR CRYSTALS

FREQ (MHz)	CASE P/N	PRICE	(MHz)	CASE P/N	PRICE	(MHz)	CASE P/N	PRICE
1.00	HC33 CY1A	\$9.50	4.9562	HC18 CY8A	\$8.00	15.00	HC18 CY15A	\$4.75
1.8432	HC33 CY1A	\$9.50	5.00	HC18 CY7A	\$8.00	18.00	HC18 CY19A	4.75
2.06	HC33 CY2A	8.25	5.088	HC18 CY9A	8.00	18.432	HC18 CY20A	4.75
2.4516	HC33 CY2B	8.25	5.1443	HC18 CY8C	8.00	19.68	HC18 CY24A	4.75
3.2784	HC33 CY3B	6.00	6.00	HC18 CY6C	6.00	20.00	HC18 CY22A	5.25
3.579	HC33 CY3B	6.00	6.144	HC18 CY6C	6.00	23.664	HC18 CY23B	5.25
4.00	HC18 CY3A	6.00	6.00	HC18 CY6A	6.00	27.00	HC18 CY27A	8.15
4.434	HC18 CY4C	6.00	10.00	HC18 CY12A	4.75	32.00	HC18 CY32A	8.15
4.55	HC18 CY4B	6.00	14.31818	HC18 CY18A	4.75	100.00	HC18 CY100A	8.15

XR2206K FUNCTION GENERATOR KIT

OPERATES ON EITHER SINGLE 12V ±5V SPLIT SUPPLY INCLUDES ALL PARTS TO BE MOUNTED ON PC BOARD

Only \$19.95
POWER SUPPLY NOT INCLUDED

POWER SUPPLY

5 Volt 3 Amp APS 5-3

1-9	\$3.25
10 up	35.55
25 up	34.04

LIQUID CRYSTAL DISPLAY

● High Contrast Ratio
● Wide Viewing Angle
● 0.5 in. Digit Height

● ULTRA Low Power Consumption
LCD106 — \$13.50

MEMORIES

STATIC RAM's

	1-9	10 up	100 up
2102-1 (500ns)	\$ 2.00	\$ 1.80	\$ 1.10
2114L-2 (200ns)	3.50	2.95	2.60
2114-3 (300ns)	3.40	2.80	2.50
2114-2 (200ns)	3.50	2.95	2.60

EPROM's

2708	3.50	3.30	3.10
2716 (5V)	6.50	4.80	4.50
2732 (350ns)	13.00	11.00	9.90

DYNAMIC RAM

4116 (200ns)	3.00	2.20	2.00
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ANCRONA HAS MOTOROLA SEMICONDUCTORS

8FR90	\$1.91	MC858P	\$1.50	MC1488P	\$1.47	MC4024P	\$5.75	MC7906CT	\$2.10	MC6674P	\$11.17	MPSH34	\$1.00
8FR91	2.42	MC862L	2.27	MC1489AL	1.89	MC4026P	3.05	MC7908CT	2.10	MC66810C	7.47	MPSU03	1.19
CA3054	1.54	MC958L	4.43	MC1489L	1.69	MC4044P	5.75	MC7912CT	2.10	MC1R03	.79	MPSU05	1.00
CA3059	3.34	MC1302P	3.72	MC1489P	1.47	MC4558NCP1	3.18	MC7915CT	2.10	MC1R06-2	1.01	MPSU06	1.09
CA3079	2.23	MC1309P	2.86	MC1494L	8.53	MC6800P	13.90	MC7918CT	2.10	MC1R318-B	7.74	MPSU10	1.23
DAC08CP	3.49	MC1310P	6.29	MC1495L	7.47	MC6808P	13.90	VC7924CT	2.10	MDA100A	2.05	MPSU51A	1.13
MB0101	.73	MC1330A1P	2.20	MC1496G	2.07	MC6809P	45.39	MC10101P	.92	MDA101A	2.21	MPSU56	1.09
MBD102	.88	MC1349P	1.72	MC1568R	13.42	MC6821P	7.33	MC10102P	.92	MDA102A	2.38	MPU131	.91
MBD201	1.03	MC1350P	1.44	MC1594L	12.74	MC6840P	12.22	MC10104P	.92	MDA104A	2.54	MR250-2	2.27
MBD501	1.57	MC1351P	2.10	MC1595L	10.63	MC6844P	45.39	MC10107P	1.00	MDA106A	2.83	MR750	.84
MC78L05CP	.66	MC1352P	2.01	MC1710CP	8.99	MC6845P	41.20	MC10109P	.92	MDA108A	3.31	MR751	1.06
MC78L08CP	.66	MC1355P	2.10	MC1733CP	1.30	MC6846P1	39.90	MC10115P	.92	MDA110A	3.80	MR752	1.12
MC78L12CP	.66	MC1357P	2.19	MC1736CP1	2.07	MC6847P	18.06	MC10116L	1.10	MDA200A	2.21	MR754	1.26
MC78L15CP	.66	MC1358P	.91	MC1807P	1.36	MC6850L	1.36	MC10116P	.92	MDA201A	2.38	MR756	2.10
MC78L18CP	.66	MC1364P	2.01	MC1808P	1.36	MC6855P	6.84	MC10123L	2.39	MDA202	2.54	MR758	2.65
MC78L24CP	.66	MC1372P	6.48	MC1809P	1.36	MC6852P	7.33	MC10124L	3.01	MJ13055T	1.29	MR760	3.21
MC78M05CT	1.47	MC1373P	5.19	MC3062L	4.00	MC6854P	32.26	MC10124P	2.52	MPF102	.66	MR812	.51
MC78M06CT	1.47	MC1391P	1.44	MC3302P	1.12	MC6860P	12.92	MC10125L	3.01	MPN3402	.76	MRF476	2.93
MC78M08CT	1.47	MC1403U0	4.08	MC3303P	5.80	MC6875L	13.49	MC10125P	2.52	MPS918	1.28	MR901	3.15
MC78M12CT	1.47	MC1405L	15.28	MC3325P	2.10	MC6881P	8.91	MC10137L	32.36	MPS3638A	.48	MR911	3.04
MC78M15CT	1.47	MC1408L6	3.84	MC3340P	2.10	MC6882AL	6.13	MC10176P	6.26	MPS3704	.50	MV209	1.13
MC78M18CT	1.47	MC1408L7	4.75	MC3360P	3.50	MC6885P	2.72	MC10189L	3.27	MPS6514	.68	MW839	2.42
MC78M20CT	1.47	MC1408L8	6.55	MC3370P	3.72	MC6886P	2.72	MC10195L	2.52	MPS6520	.72	MV215	2.27
MC78M24CT	1.47	MC1408PB	4.45	MC3303P	1.77	MC6887P	2.72	MC10216L	1.83	MPS6521	.83	MW2205	.78
MC79L05CP	1.12	MC1413P	1.68	MC3405P	3.60	MC6888P	2.72	MC14411P	17.26	MPS6522	.76	MW2209	.78
MC79L12CP	1.12	MC1436CU	4.96	MC3408L	3.55	MC6889P	3.14	MC14412VP	15.53	MPS6523	.85	ME597N	1.98
MC79L15CP	1.12	MC1437L	3.99	MC3415L	31.42	MC7905CT	1.65	MC14435VP	6.64	MPS6566	.73	SC1368	.98
MC79L24CP	1.12	MC1439L	4.62	MC3417L	14.83	MC7908CT	1.65	MC14457P	6.60	MPS6909	.57	SC136D	1.17
MC684P	3.20	MC1439P1	3.97	MC3420L	10.08	MC7812CT	3.14	MC14458P	13.73	MPS6959	.60	SC1418	1.76
MC680P	2.05	MC1445G	4.20	MC3423P1	1.66	MC7812CT	1.65	MC14490FP	5.60	MPSA06	.73	SC1410	1.98
MC684P	5.10	MC1455P1	9.90	MC3438L	4.53	MC7815CT	3.14	MC14490VP	4.24	MPSA12	.85	T2800B	1.91
MC830L	2.27	MC1455U0S	1.98	MC3448AP	5.80	MC7815CT	1.65	MC14495P	3.96	MPSA13	.65	11L116	1.32
MC835L	2.46	MC1458CL	1.44	MC3470P	12.64	MC7818CT	1.65	MC3400A	3.52	MPSA20	.38	TI02	1.91
MC839L	5.88	MC1458CP1	1.08	MC3476P1	3.18	MC7824CT	3.14	MC68488P	32.26	MPSA42	.82	TI110	1.36
MC848L	3.17	MC1458P1	1.08	MC3480P	12.85	MC7902CT	2.10	MCA255	1.76	MPSA56	.88		
MC847L	2.46	MC1458P1S	1.33	MC3503L	18.62	MC7905CT	2.10	MCM68A10P	5.59	MPSA64	.75		
MC857P	1.50	MC1488L	1.68	MC4016P	10.10	MC7906CT	4.20	MCM66612S	46.50	MPSA70	.44		

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STORES DO NOT ACCEPT MAIL ORDERS

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PHONE ORDERS (213) 641-4064

MOTOROLA'S OPTO TRIAC DRIVER COUPLER

Type	Triac	Peak mA	Block Volts	Price
MOC3009	15	250	\$2.20	
MOC3010	8	250	2.71	
MOC3011	5	250	2.86	
MOC3020	15	400	3.15	
MOC3021	8	400	3.52	
MOC3030*	15	250	3.96	
MOC3031*	8	250	5.22	

*Zero Crossing

Z-80 SERIES

	2.5 MHz	4.0 MHz
Z-80-CPU	\$ 7.10	Z-80A-CPU \$ 8.05
Z-80-CTC	5.90	Z-80A-CTC 6.35
Z-80-P10	5.90	Z-80A-P10 6.35
Z-80-DART	14.30	Z-80A-DART 15.50
Z-80-S10/0	20.10	Z-80A-S10/0 21.25
Z-80-S10/9	14.50	Z-80A-S10/9 15.70
Z-80-DMA	21.50	Z-80A-DMA 22.70

★ 20% DISCOUNT COUPON

Bring this COUPON into one of our stores or mail to our Mail Order address shown below and receive a 20% DISCOUNT on purchases from this page of \$50.00 or more. Offer EXPIRES on December 15, 1981

NAME _____
ADDRESS _____
CITY _____ STATE _____
ZIP _____ PHONE NO. _____

Coupons accepted only with full name and address filled in.

CBM8032 32K RAM

80 Column Screen \$1499.00

EPROM 2716-5 \$6.50

(5 VOLT)

EPROM Erasing Lamps

- ERASES 4 CHIPS IN LESS THAN 20 MINUTES
- SIMPLE TO USE
- SAFETY INTERLOCK
- ERASES 2708, 2716, 1702A, etc.

UVS-11E \$85.00

30 MHz HITACHI DUAL TRACE PORTABLE OSCILLOSCOPE

MODEL V-302B \$995.00

Universal Oscilloscope Probe \$3600

More sensitive to your input

KEY ADDITIONAL FEATURES:

- 100MHz bandwidth
- Heavy duty tip
- Break resistant center conductor
- Slender, flexible cable
- 6ft. cable length
- Wide compensation range
- Fits all scopes

LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new D.C. design that gives a frequency response from 0Hz-100KHz \pm 0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation! Specifications: • T.H.D. less than .005% • T.I.M. less than .005% • Frequency response: DC to 100KHz \pm 0.5dB • RIAA deviation: \pm 0.2dB • S/N ratio: better than 70dB • Sensitivity: Phono 2MV 47K/Aux. 100MV 100K • Output level: 1.3V • Max output: 15V • Tone control: bass \pm 10dB @ 50Hz/treble \pm 10dB @ 15Hz • Power supply: \pm 24 D.C. @ 0.5A

ONLY \$44.50

X'former

\$4.50 ea.

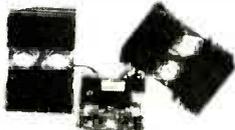


100W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:

- Output power: 100W RMS into 8-ohm 125W RMS into 4-ohm
- Frequency response: 10Hz-100KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: \pm 40V @ 5 amp
- One channel, needs two for stereo



TA-1000KIT

\$51.95

Power transformer

\$24.00 each

50 WATTS AUTO STEREO BOOSTER BY VERTRONIX

Specifications: • 50 watts RMS total (25W + 25W)

- Frequency Response: \pm 0.5dB. 20Hz~20KHz
- T.H.D.: 0.2% at full rated output
- Input Impedance: 20K ohms
- Crosstalk: Better than 90dB
- Sensitivity: 1.5V for full rated output
- S/N Ratio: Greater than 95dB
- Speaker Load: 2~8 ohms
- Voltage Supply: 9~18VDC.



Model V-Amp 500

REG. PRICE \$119.00 EACH
OUR SPECIAL PRICE \$55.00 EACH

"FISHER" 30 WATT STEREO AMP

MAIN AMP (15W x 2)

Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply \pm 16V DC (not included). Power band with (KF 1% \pm 3dB). Voltage gain 33dB. 20Hz-20KHz.



Super Buy Only \$18.50

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Supply 6 18V DC

ONLY \$6.00 EACH



2 WATT AUDIO AMP

Pre assembled units. All you need is to hook up the speaker and the volume control. Supply voltage from 9~15V D.C. measures only 2" x 3 1/2", making it good for portable or discrete applications. Comes with hook up data.



BUY 2 FOR \$4.99

1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6~9V D.C.
SPECIAL PRICE \$1.95 ea.



NEW MARK III 9 Steps 4 Colors LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large from -30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V-9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM \$18.50

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from -36dB +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6 12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.



MARK IV KIT \$31.50

MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

All functions same as Mark IV but this is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.



\$41.50 EACH KIT

SOLID STATE STEREO GRAPHIC EQUALIZER PRE AMP KIT TA-2500

Specifications:

- Total Harmonic Distortion: Less than 0.05%
- Intermodulation Distortion: (70Hz:7KHz = 4:1 SMPTE Method) Less than 0.03%
- Frequency Response: Overall 10Hz ~ 100KHz +0.5dB, -1dB.
- RIAA Curve Deviation: (Phono) +0.2dB, -0.2dB (30Hz ~ 15KHz)
- Channel separation (at rated output 1KHz)
- Phono, Tuner, Aux and Tape Monitor better than 70dB.
- Input sensitivity and impedance (1KHz for rated output) Phono: 2MV 47K ohms Aux: 130MV 50K ohms Tuner: 130MV 50K ohms Tape: 130MV 50K ohms
- Graphic Equalizer control: 10 Band Slide Control
- Frequency Bands: 31.5Hz, G3Hz, 125Hz, 250Hz, 500Hz, 1KHz, 2KHz, 4KHz, 8KHz, 16KHz also with on panel selector for Phono, Tuner, Aux 1 and Aux 2.
- Power Supply: 117 VAC

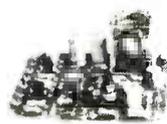
Kit comes with all electronic components, transformer, instructions and a 19" rack mount type metal cabinet.



MODEL TA-2500 \$119.00 PER KIT

ELECTRONIC DUAL SPEAKER PROTECTOR

Cut off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

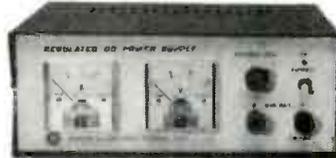


KIT FORM \$8.75 EA.

PROFESSIONAL REGULATED VARIABLE D.C. POWER SUPPLY KIT

All solid state circuitry with high efficiency power transistor 2SD388 and I.C. voltage regulator MC1733. Output voltage can be adjusted from 0-30V at 1 amp current limited or 0-15V at 2 amp current limited. Internal resistance is less than 0.005 ohm; ripple and noise less than 1 MV, dual on panel meter for voltage and amp reading, also with on board LED and audible over load indicator. Kit comes with predrilled P.C. board, instructions, all necessary electronic components, transformer and a professional look metal cabinet. The best project for school and the most useful instrument for repairman. Build one today!

MODEL TR 88A 0 ~ 15V D.C. 2 amp
MODEL TR 88B 0 ~ 30V D.C. 1 amp



\$59.50 PER KIT

REGULATED DUAL VOLTAGE SUPPLY KIT

\pm 4 ~ 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.



\$12.50 PER KIT

POWER SUPPLY KIT

0-30V D.C. REGULATED

Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V. 2 AMP Complete with PC board and all electronic parts. Transformer for Power Supply. 2 AMP 24V x 2 **\$9.50**



0-30 Power Supply
\$10.50 each

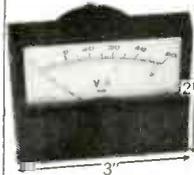
AUDIO OUTPUT dB METER



Meter made of clear plastic with a silver white face plate. Scale reads from -20 +3dB. Meter also comes with an internal dial light.

MODEL: 6F-3 \$6.50 EACH

TWO IN ONE PANEL METER D.C. VOLTAGE AND AMP IN ONE



D.C. Volts reads 0-50
D.C. Amp reads 0-3
Meter case made of black plastic with a white scale plate and glass window.

#ST-680 \$12.50 EA.

POCKET STEREO CASSETTE PLAYER WITH STEREO HEAD PHONE

This unit is a high fidelity stereo player which will give you years of listening pleasure and follow you wherever you go. Made by the same company in Japan who use the "Big Name."

Complete set comes with 1 Stereo headphone, 3 AA size alkaline batteries, 1 leather like carrying case for player and 1 carrying case for storage of 4 cassette tapes and 1 demo tape.



MODEL SWM-33
OUR DIRECT IMPORT PRICE

\$67.50



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Trim Caps Set	\$13.50	18V 800MA	\$3.00
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We sell you all the above components in a package for **\$125.00** and you will receive a free predrilled P.C. board and instructions at no charge!

SANYO UHF VARACTOR TUNER
For UHF CH 14 83

Tuning voltage +1V~+28V D.C. Input impedance 75 OHM. I.F. band width 7~16 MHz. Noise figure 11.5dB MAX. Size 2 3/4" x 1 1/4" x 3/4". Supply voltage 15V D.C. Sound I.F. = 58.0 MHz. Video I.F. = 62.5 MHz.



All units are brand new from Sanyo.
MODEL 115-B-405A
\$35.00 EACH

Tuner is the most important part for the circuit. Don't let those \$19.00 tuners fool you!

TV GAME BOARD

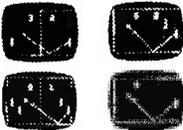
PLAYS 4 GAMES: TENNIS, HOCKEY, HANDBALL AND JAI-A-LAI.

All boards complete with all parts ready to play. Requires 6C size batteries and a small speaker for sound effects. The boards were surplus from a famous game manufacturer. They will play on all US standard black and white or color TV sets (Regular price for these games were \$39.50 each)
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PART #57456

TENNIS JAI-A-LAI



HOCKEY HANDBALL

ELECTRONIC PIN BALL MACHINE



That sounds and plays like the real thing. All units are brand new but without the case. Functions of the game include double flipper control, kicker control, 1-4 players, 3 speed ball control, tilt switch, automatic score, extra bonus cave and many more. All solid state with LED panel, no moving parts. Requires 9V battery to operate. speaker not included.

A perfect gift for yourself or friends.
SPECIAL \$8.99 EACH SPEAKER \$1.25 EACH

ELECTRONIC MUSICAL TELEPHONE REST KIT

This telephone rest can be used as a door charm, an audible indicator and for many other sound projects. The special custom made I.C. is pre programmed with 4 musical tunes. Kit comes with a nice looking plastic case, pre-drilled P.C. board, volume control, special sound I.C. speakers and all electronic components and instructions. Ideal for home or school projects.



MODEL FIH-3000

BUY NOW!
SPECIAL PRICE! ONLY \$15.50 PER KIT

LCD CLOCK MODULE!

• 0.5" LCD 4 digits display • X'tal controlled circuits • D.C. powered (1.5V battery) • 12 hr or 24 hr. display • 24 hr. alarm set • 60 min. countdown timer • On board dual back-up lights • Dual time zone display • Stop watch function.

NIC1200 (12 hr)
NIC2400 (24 hr)
ON SALE
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0.5" LED ALARM CLOCK MODULE
Assembled! Not a Kit!

Features: • 4 digits 0.5" LED Displays • 12 hours real time format • 24 hours alarm audio output • 59 min. countdown timer • 10 min. snooze control.



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SPECIAL TRANSFORMER FOR CLOCK
\$2.50

DIGITAL TIMER/CLOCK

• 24 Hour preset time to turn on or off
• 12 Hour green 0.5" display for time
• operated on 12~16V A.C.

The whole timer is self contained in a compact plastic case (as seen in photo). Designed for VTR with push button switch for easy setting. Limited quantity available.



MODEL VEQ 0143

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MJ2955 PNP	150 Watts	BV=60 V	\$3.50
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All above parts guaranteed to be prime and come with data sheets.

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These fans are pulled out from used computers. But carefully cleaned by ultrasonic cleaner. All in "like-new" condition. Size 4 11/16" x 1-1/2" x 4 11/16"
MODEL MF505
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12V DC POWERED
Lights up 8~15 Watt Fluorescent Light Tubes Ideal for camper, outdoor, auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board. light tube not included!
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Never worry about battery. EXCLUSIVE! **\$3.95 ea.**
Because it has none! Easy to carry in pocket and handy to use. Ideal for emergency light. It generates its own electricity by squeezing grip lever. Put one in your car, boat, camper or home. You may need it some time!



Model F-179

No FCC license required.

OUR PRICE \$49.50
ADDITIONAL MICROPHONE (TRANSMITTER) AVAILABLE AT **\$28.00 EACH**



MURA WMS-49

Transmitter: FET mic for flat 30 ~18 KHz response extra controlled 49MHz AM Band for drift-free performance. 100 MW output (range approx. 1/4 mile) for reliable long range transmission. Powered by a 9V radio battery (included).
Receiver: Extra controlled locks on 49MHz transmitter signal. With on panel VU meter monitors the signal strength from the microphone. Standard phone jack outlet connection to a P.A. or other phone input. 9V battery included. This professional set is ideal for on stage, in field, church, in house or outdoor use.

SUPER FM WIRELESS MIC KIT—MARK III

This new designed circuit uses high FEQ. FET transistors with 2 stages pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive condenser microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

FMC-105

\$11.50 PER KIT

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TEET MODEL WEM-36 is a factory assembled FM wireless microphone powered by two AA size batteries. Transmits in the range of 88-108 MHz with 3 transistor circuits to meet with F.C.C. part 15 regulations. Element is built in a plastic tube type case with an omni-directional electret condenser microphone unit. By using a standard FM radio, signal can be heard anywhere on a one-acre lot. Sound quality was judged "very good."



MODEL WEM-36

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WHISTLE ACTIVATED SWITCH BOARD

All boards are pre-assembled and tested. Your whistle to its FET condenser microphone from a distance, as far as 30 feet away (sensitivity can be easily adjusted) will turn the switch on, then match your whistle to it again, then it turns off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, TV, Hi-Fi, radio or other projects. Unit works on 9V D.C.



MODEL 968

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ULTRASONIC SWITCH KIT

Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC.
\$15.50



ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off
uses 7473 I.C. and 12V relay

\$5.50 each



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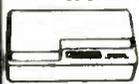
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4002	20	4028	50	4082	20	74C76	70
4008	65	4029	75	4093	60	74C83	1.30
4007	27	4030	35	4098	75	74C85	1.40
4008	65	4034	25	4101	65	74C86	50
4009	45	4035	75	4102	65	74C90	90
4011	20	4040	65	4103	65	74C91	50
4012	20	4043	65	4104	40	74C151	1.75
4013	30	4044	65	4105	40	74C153	1.75
4014	55	4046	90	4106	40	74C161	1.20
4015	50	4047	90	4107	40	74C163	1.15
4016	30	4049	40	4108	27	74C165	1.25
4017	50	4051	60	4109	27	74C173	1.30
4018	50	4052	60	4110	40	74C174	1.30
4019	45	4052	75	4111	40	74C175	1.20
4020	65	4053	75	4112	40	74C181	1.15
4021	55	4056	75	4113	20	74C182	1.15
4022	40	4059	20	4114	20	74C183	1.15
4023	20	4071	25	4115	27	74C185	5.50
4024	45	4072	20	74C73	45		
4025	25	4076	35				
		4077	35				

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4" x 6" DOUBLE SIDED EPOXY BOARD 1/16" THICK
\$60. ea. \$52.60

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1/16" thick with 1/10" spacing
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4002	20	4028	50	4082	20	74C76	70
4008	65	4029	75	4093	60	74C83	1.30
4007	27	4030	35	4098	75	74C85	1.40
4008	65	4034	25	4101	65	74C86	50
4009	45	4035	75	4102	65	74C90	90
4011	20	4040	65	4103	65	74C91	50
4012	20	4043	65	4104	40	74C151	1.75
4013	30	4044	65	4105	40	74C153	1.75
4014	55	4046	90	4106	40	74C161	1.20
4015	50	4047	90	4107	40	74C163	1.15
4016	30	4049	40	4108	27	74C165	1.25
4017	50	4051	60	4109	27	74C173	1.30
4018	50	4052	60	4110	40	74C174	1.30
4019	45	4052	75	4111	40	74C175	1.20
4020	65	4053	75	4112	40	74C181	1.15
4021	55	4056	75	4113	20	74C182	1.15
4022	40	4059	20	4114	20	74C183	1.15
4023	20	4071	25	74C32	45		
4024	45	4072	20	74C73	75		
4025	25	4076	35				
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10 Conductor, # 22 color coded wire, gray PVC outer cover, 3/4" diameter
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74LS04 25	74LS74 35	74LS153 55	74LS244 1.10
74LS08 25	74LS76 35	74LS158 55	74LS249 90
74LS10 25	74LS83 60	74LS158 50	74LS257 55
74LS11 30	74LS86 35	74LS161 70	74LS266 65
74LS12 30	74LS92 50	74LS163 70	74LS283 65
74LS20 25	74LS96 70	74LS166 210	74LS295 85
74LS21 30	74LS112 35	74LS169 85	74LS352 1.00
74LS26 30	74LS122 40	74LS174 60	74LS366 45
74LS28 45	74LS123 70	74LS181 1.85	74LS368 45
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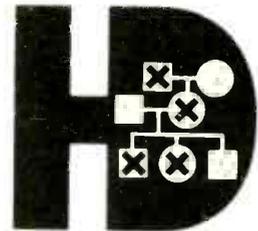
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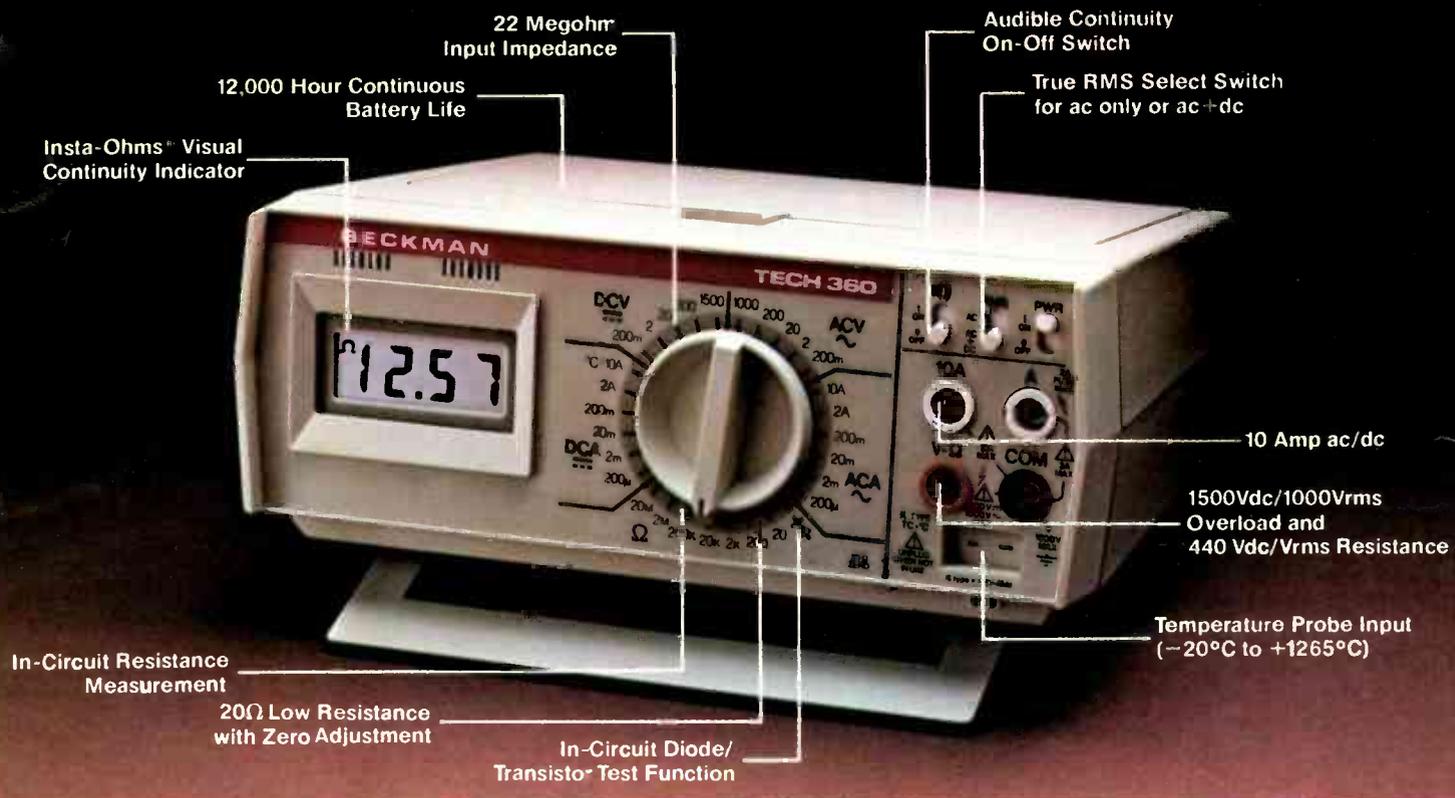
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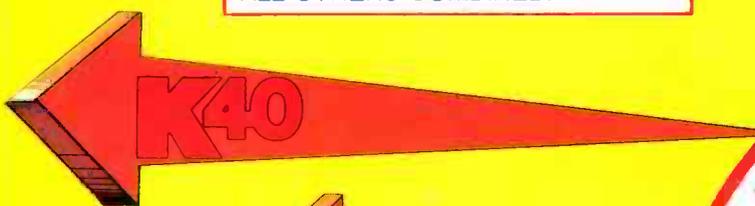
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