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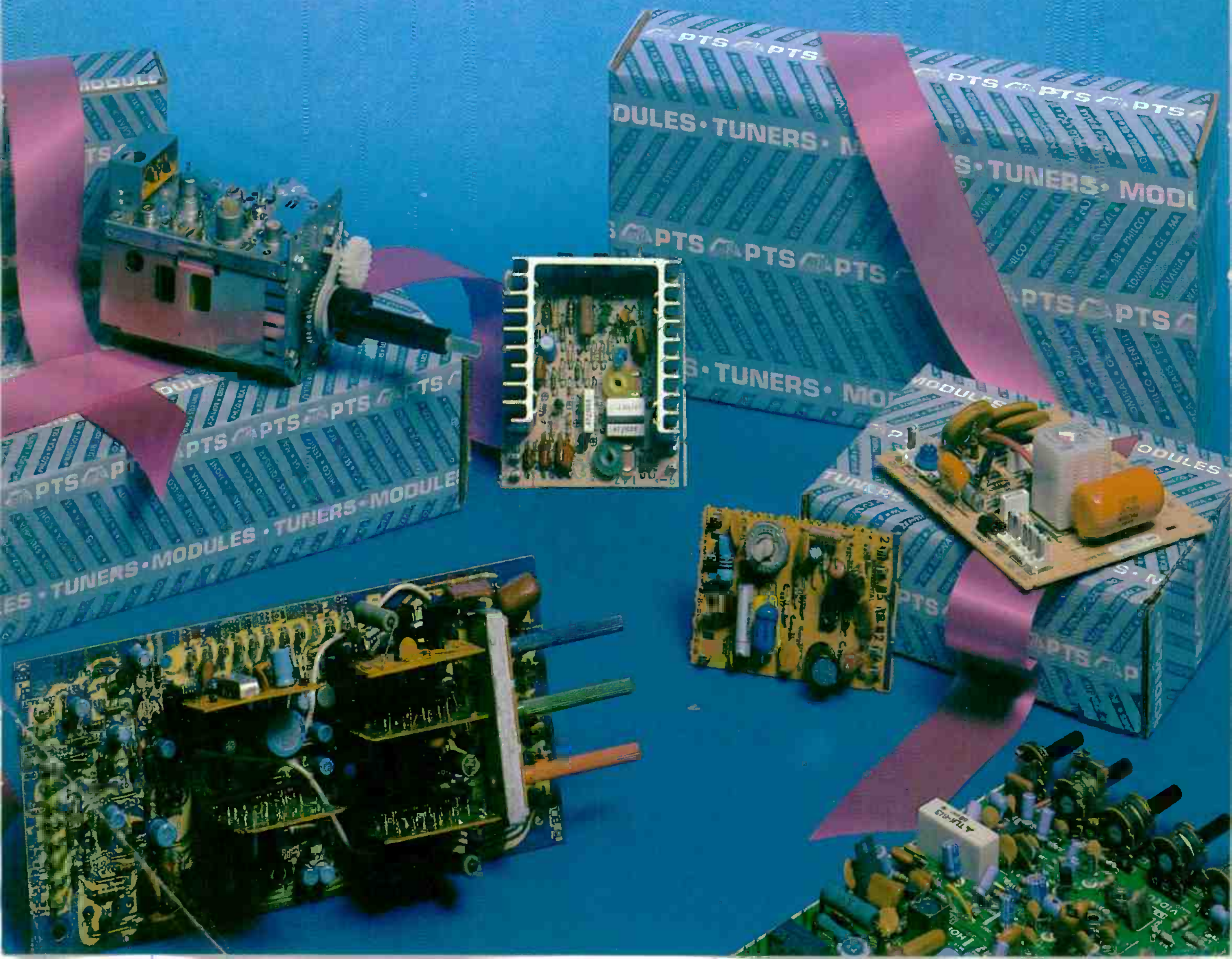

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INDUSTRY REPORT

Chicago Radio Station "Goes National"

WMFT, a Chicago area stereo radio station has become the nation's first radio "superstation" with its signal, including local news and weather, being broadcast all across the United States.

United Video Systems of Tulsa, Okla., says it is distributing the station's signal via satellite and is making it available to any other cable system in the U.S. which cares to purchase it. United Video "piggybacks" WFMT's signal on the signal for WGN-TV, Chicago, one of the three "super" television stations in the nation.

Japanese Firms Target of Payoff Probe

Some U.S. officials of four Japanese consumer electronics firms, together with Teamsters Union officials, are believed to be the target of a U.S. Attorney's Grand Jury Probe looking into illegal payoffs to keep labor peace.

The Japanese firms involved are the U.S. sales arms of their Japanese parents. They are Sony Corp. of America; Matsushita Electric Corp. of America; Hitachi Sales Corp.; and Toshiba America, Inc.

According to recent newspaper reports of the investigation, some current and former U.S. officials of these firms are being investigated concerning their dealings with representatives of Local 805 of the International Brotherhood of Teamsters, a New York City local.

The investigation is under the auspices of the U.S. Attorney's Organized Crime and Racketeering Unit in New York City and concerns itself primarily with the payment of some $300,000 in cash, plus expensive consumer electronics equipment, allegedly to two high ranking officials of Local 805. The payments, according to press reports, were to assure "labor peace."

Under provisions of the Taft-Hartley Act and the Organized Crime Control Act of 1970, it is illegal for union officials to accept bribes and it is also illegal for corporations to offer them.

According to reports in the *Chicago Tribune,* Local 805 President Abraham Gordon and Secretary-Treasurer Murray Baratz reportedly demanded and received "substantial amounts of merchandise, such as color TV sets, hi-fi speakers, clock radios, videotape machines and cameras."

Examples of the types of charges being investigated, the news report said, were instances where Panasonic allegedly contributed 650 radios valued wholesale at $19,397.34 and another 674 clock radios, valued at some $12,300 to the union "but in a goodly number of cases they were given to Gordon and Baratz personally."

"Earth Stations" Increase

A recently completed study by market researchers Frost and Sullivan contends the greatest expansion of satellite communications over the next 10 years will be by entertainment television and this in turn will give rise to a $1.1 billion earth station equipment market. The researchers said the size of the market this year is $58 million and by 1988 will total $194 million.

"The satellite opens up a whole new era in communications," according to Frost and Sullivan. In the future, the researchers said, two-way television to rural arctic aras is being planned and will include medical and educational television transmission. "Even Cuba makes use of satellite communications through the Soviet Intersputnik system."

ETA Urges Court Test

Spokesmen for the newly formed Electronic Technicians' Association International (ETA-I) say they would welcome a threatened lawsuit by the ISCET division of NESDA over the legality of ETA's certification program for electronic technicians.

According to ETA President Dick Glass, who formerly headed NESDA, allegations that ETA cannot use the initials "CET" for certified electronics technician and that the newly formed organization is perpetrating a fraud on "unsuspecting" technicians are without foundation.

"They (NESDA) have threatened to take ETA people to court," Glass said, "the sooner they do this, the better off the industry will be."

According to Glass he personally registered all of NESDA's present copyrights and he states the initials CET are not protected nor are parts of the design on the ISCET emblem.

In another statement Glass said that dates for ETA-I's first convention have been finalized for August 3, 4 and 5. The meeting is set for Bingeman Park in Kitchener, Ontario, Canada.

Among topics on the agenda will be work sessions for wives of technicians who run their own businesses, digital electronics courses, a discussion of ETA's new certification program, and a business management session conducted by Glass.

Registration information is available from Glass and ETA-I by writing 7046 Doris Dr., Indianapolis, Ind. or by calling 317-241-7783.

Jerrold Announces "Two-way" Games for Cable TV

Jerrold Electronics, a subsidiary of eral Instruments Corporation, has nounced it will supply major cable

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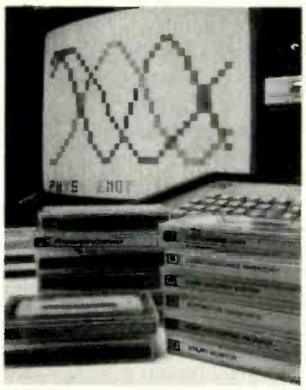

On the cover: The modern "home information" center. General Instrument Corp. 8900 microcomputer system is tied to a television output to permit access to a wide range of educational, entertainment, and informational packages—plus computing power for those who need it. (Photo courtesy of General Instrument Corp.)

FEATURES

DEPARTMENTS

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sion systems with subscriber callable video games. The system is called PlayCable.

The games, "NFL Football," "Major League Baseball," and "NBA Basketball," will function in both one-way and two-way cable television systems, according to Jerrold. Individual cable system operators will store the programs available to subscribers on minicomputers and transmit them to PlayCable subscribers as requested.

Jerrold said a special terminal connected to the subscriber's TV will allow viewers to choose from as many as twenty games and informational services. The special terminal, available from the cable television operator or from a retail outlet for about $250, is a Mattel Electronics "Intellivision" terminal. Jerrold said it expects the monthly subscription fee for the PlayCable capability to be about $10.

PlayCable will be tested initially by four cable television systems. They are Teleprompter Corp., American Television Communications Corp., Cox Cable Communications, and United Cable Television Corp. According to General Instruments Board Chairman Frank Hickey, "The widespread utilization of low-cost computers in the home to provide both entertainment and information services is brought much closer by the ability to deliver a library of high quality packaged programs over cable." ET/D

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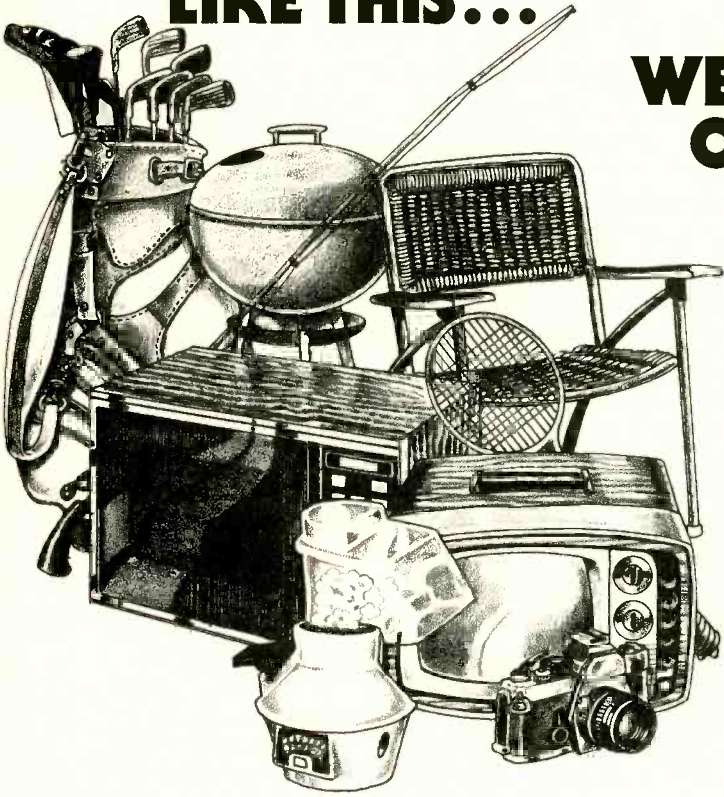

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FROM THE EDITOR'S DESK

I guess the most amazing thing about the digital electronics revolution is that it is already here and no one is overly conscious of it. Or if they are, they aren't saying very much about it.

By here, I mean the technologies are already in place, the products already being produced, the "software" programs already being built, that will carry consumer electronics into the 1980s with "all the gusto in life"—as one TV beer commercial puts it.

I was looking over the program agenda the other day for one of the electronics industry's high technology shows, and one of the main speakers at this event (Wescon) this coming September will talk on the subject of "One World—All Digital." I believe he's right.

Everything from television signal transmission off earth satellites, data communications, home and business computers and TV games, stereo tuners and receivers, television tuners, microwave ovens, kitchen mixers—you name it—and you'll find it is either entirely designed around digital technology or at least controlled to a large degree via digital methodologies.

That's one reason for ET/D's special emphasis on digital electronics in this issue, plus the allied series on microprocessors, the fifth article of which is contained herein—on programming no less. We hope to present a "taste" of the world of electronic service that is just around the corner. There's no doubt about it, the service shop of—not tomorrow—but right now, must be professionally managed and, in addition to all of the traditional technologies, it must have its experts in digital/microprocessor technologies.

This means knowing how to troubleshoot such equipment, understanding the basics of data transmission and the essentials of computer programming.

ET/D plans a steadily increasing diet of such material in the future—beginning with this issue. As always, our articles will be designed to give you the basic understanding of the subject matter, and to prepare and point you in the right direction for obtaining more detailed information on each one of the topics discussed.

Also, in this issue you will find our annual rundown of the Electronic Distribution Show (formerly NEWCOM). The show is primarily designed for the manufacturers of test gear and components and their distributors and as such is always a good focal point for getting a handle on what kind of, and how many, new products in the way of test gear, will be turning up on your work benches in the not too distant future. While the number of new products introduced at this show may not have been great, some of the design concepts and the technologies involved truly reflect the state-of-the-electronics industry's art as of 1980.

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NEWSLINE

IHF OPPOSES FM RULE CHANGES. Contending the changes would have a deleterious effect on high-fidelity FM reception, the Institute of High Fidelity is opposing moves to narrow the FM bandwidth from its present 200Khz. IHF President, Robert Gur-Arie, called the move, proposed by the National Telecommunications Information Administration in order to permit more FM stations, "shortsighted."

TIME-LIFE FORMS VIDEO CLUB. The formation of a new club to distribute motion pictures on Video Cassettes has been announced by Time-Life Films. Similar to the Time-Life book or record club in operation, the new division--to be known as Time-Life Video Club -- will distribute direct to consumers feature films recorded on half-inch videocassettes. Later a spokesman said, distribution may include videodiscs.

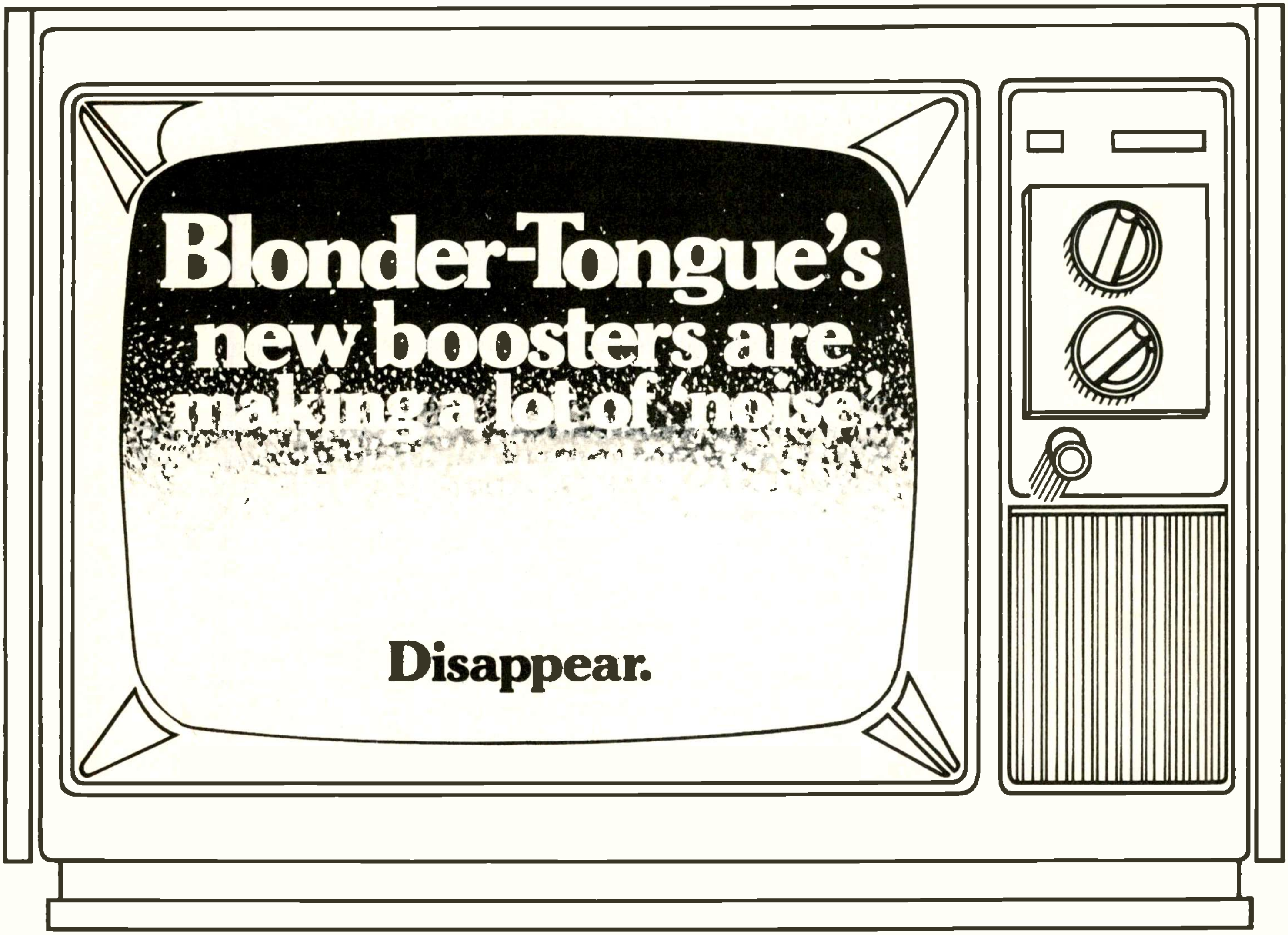
SURVEY SHOWS RCA AS COLOR LEADER. A survey of television manufacturers by Television Digest, a consumer electronics industry publication, shows RCA the apparent winner (by a whisker) in the race for top color TV peddler. According to the publication, manufacturers who were asked to estimate their competitors' market shares, guessed RCA had 21 per cent of the color market for 1979 models while Zenith showed 20.5 per cent. Rounding out the top five were Sears (7.9%), Magnavox (7.2%), and GE (6.9%).

ZENITH LEADER IN BLACK AND WHITE. The same survey indicated that Zenith retained its lead as the biggest seller of black and white television with a 16.1 per cent share of market, compared to RCA's 14.5 per cent. The next three black and white leaders were GE (10%), Sears (9%), and Panasonic (7.4%).

ELECTRONICS SHOWS 15% GROWTH. The wholesale sales of all types of electronic equipment, systems and components totaled $64.9 billion in 1978, according to the Electronic Industries Association. Every category, industrial, communications, components, and consumer, showed substantial growth in factory sale dollar volumes, the EIA said. The overall growth rate was 15 per cent.

INDUSTRIAL IS LARGEST CATEGORY. Over one third of the sales volume was in the industrial category which showed total sales of some $25.5 billion, up 18 percent over 1977 figures. Communications' dollar volume was $20.7 billion, up almost 12 per cent; component sales were $11.4 billion, a 14 per cent increase; and consumer electronics sales totaled $9.3 billion, up 14.6 per cent.

CUSTOM AUTOMOTIVE SOUND ASSOCIATION, GM, SETTLE OUT OF COURT. General Motors has agreed, as a result of CASA's lawsuit, to change its policy requiring radios as standard equipment in its new X-body cars and nine other models. Philip Christopher, president of CASA, speaking at the Consumer Electronic Show, also welcomed Honda's announcement that it would cease making radios standard with its 1980 models and announced CASA's plans to file suits against Toyota and Volkswagen.



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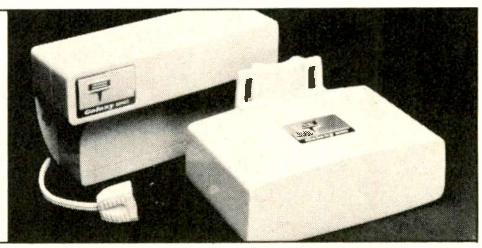

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STRICTLY BUSINESS

What should a service manager be doing with his time? When we get right down to it, what actually is the job?

Well, we know what the service manager should not be doing. He should not be sweeping the floor, or unloading the truck. He should not be answering the telephone. He should not be making repairs. Other people can do those jobs . . . but only you, as the manager, can manage your operation. And that is what you should be doing.

Here's what some other people have had to say about this. John Sperry (author of the Sperry Tech Guide) has said, "I didn't really get to be a manager until I got away from where the production was going on. and built a 'think room.' "

And J. W. Williams, Jr., Executive Director of the Texas Electronics Association, has said, "The manager should be steering the boat, not rowing it."

James Smith said one year at the NARDA School of Service Management, "The day I hung up my tools is the day I started making money."

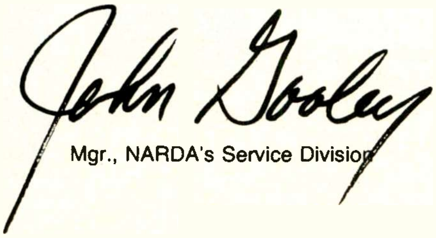
There was another manager who said, "If I am spending my time on any project that will be completed within five years, I am not doing my job." In this case, the man is a highly paid manufacturing executive, but his point is well taken. The manager's job is to look to the future.

The manager should gather the facts. He should come to a decision. He should put that decision into operation. And finally he should evaluate the results. Failure to touch any one of these bases is to operate under the SWAG system. Scientific Wild Ass Guess.

And what should the manager be gathering, analyzing, deciding, implementing, and evaluating about? Ultimately, every facet of his business. But you have to start somewhere, and usually the highest priorities can be found from among these questions:

Is the business making enough money? Is the net profit high enough? Are we getting enough return on investment? Will there be enough cash to pay the bills next month . . . or next December? Am I getting enough business information from my financial statements? Are the technicians making enough calls? Are technicians wasting too much time on lack of parts, call backs, not homes? Are they using enough of their time productively? Are they spending too much of their time completing a call? Are they bringing in enough money each day? Have the charges to the customers been set right? Is there enough money being charged for calls performed long distances away? Are there enough parts in inventory? Is inventory costing too much?

The wise manager will hang up his tools, go into his 'think room,' and apply a considerable amount of his time and attention to one of these questions every month. Let's start steering the boat . . . instead of rowing it.



Mgr., NARDA's Service Division

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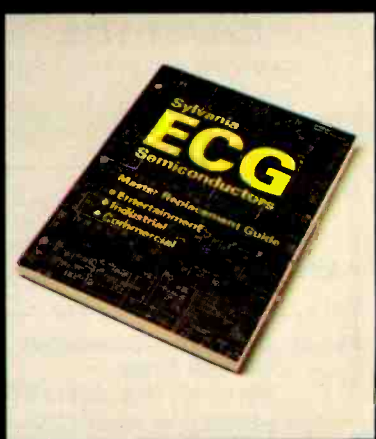

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LETTERS

CORRECTION:

In the April issue ("Triggered-Sweep Scopes," by Robert L. Goodman), page 38, scope photographs marked Figs. 12 and 13 have apparently been transposed. Fig. 12 shows the keying pulse occurring during the horizontal sync. Fig. 13 captioned "A mis-timed gating pulse, is keying correctly on the back-porch burst signal."

Robert B. Swanson CET
215 Monroe
Bolingbrook, IL 60439

EDITOR: You're right. We've checked and found everything originally labeled correctly. Somethow they got transposed in the production process and the transposition was not noticed. Thank you for bringing it to our attention.

KOREAN MANUFACTURERS:

I need help in obtaining the schematic of a Westport black and white TV receiver, 115vac and 12vdc type, Model #RP-205BN, manufactured by the Taihan Electric Wire Co. Ltd., Seoul, Korea.

Joseph La Guardia
Integrated Electronic Service
30101 SW 169 Ave.
Homestead, FL 33030

EDITOR: Korean imports are starting to become common both under their own names and as offered by chain stores and catalog houses. Taihan Electric Wire Co.'s U.S. address is Taihan (American) Corp., 6960 Lurline Ave., Chatworth, CA 91311 (213-998-0718). Gold Star's address is 330 Madison Ave., New York, NY 10017.

HELP NEEDED:

I need information (schematics on the following equipment): Intercom System, Webster Electric Model A2712A-3 (main station), Model A2724 (substation). Oscilloscope, Tektronix Model 512.

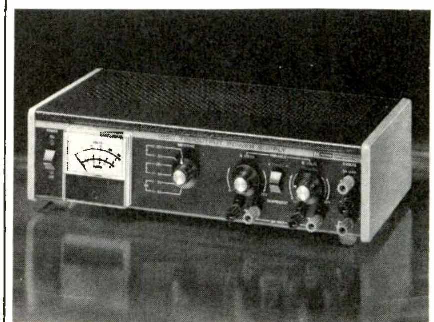
Harrison M. Robertson
ROBH3637254-N2-Z813ADIR -A79
PSC #2, Box 15414
APO S.F. 96347

I have an old pulse generator Model 79-B by Western Electric. I'd like to fix it. Does anyone have a schematic?

Bernard Kustich
1521 N. Salina St.
Syracuse, NY 13208

Three supplies in one

the auto-tracking B&K-PRECISION 1650



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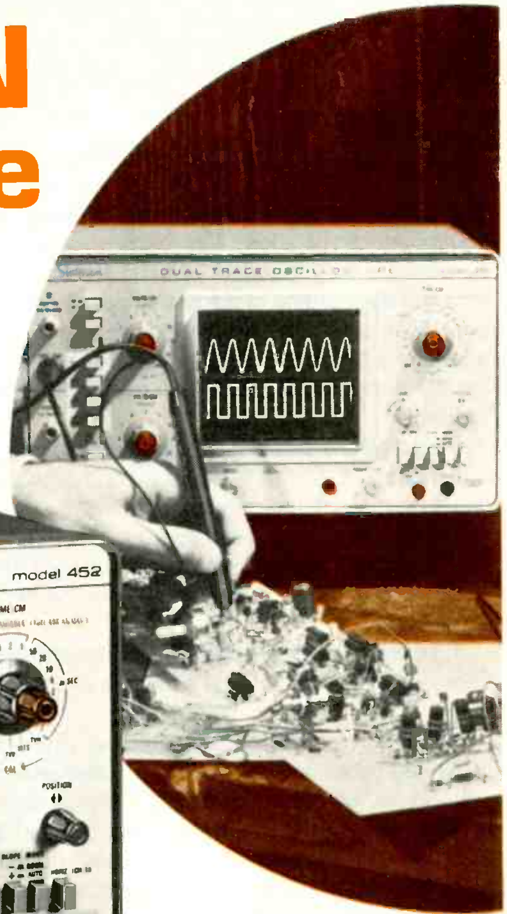
with triggered sweep. Reliable, versatile and easy to use. It's your best scope buy.



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- Displays CH A, B, A&B, A + B, A-B
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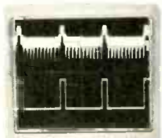
- X5 magnification
- Human-engineered front panel controls

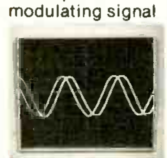
Check logic including countdowns and PLL



Display composite video and AGC pulse

Display op-amp input/output, A/D converter

27 MHz "CB" envelope and modulating signal



Check phase shift and distortion in amplifiers

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SERVICE SEMINAR

MOS IC Handling Procedures

Thoughtful handling procedures and some inexpensive equipment can go a long way towards reducing static electricity damage to integrated circuits. Basic principles are the frequent discharging of static electricity from the human body and other objects and avoiding the use of static producing accessories. The following procedures are effective in reducing the possibility of integrated circuit damage due to static electricity.

1. Just before touching any component or module, touch the metal chassis (observe line isolation precautions) to ensure your body is not statically charged.

2. When removing circuit boards or modules from the chassis, place them on a conductive surface such as aluminum foil. Do not place them directly on the floor, carpet, workbench or TV cabinet.

3. Touch the metal chassis (observe line isolation precautions) just before picking up a module or component for insertion.

4. When removing or replacing integrated circuits, grounded tip solder irons are absolutely essential.

5. Some "solder suckers" generate up to 20,000 volts of charge when triggered and should not be used. Even when the IC being removed is known to be bad, a solder sucker can generate enough static to damage other components on the board. Anti static solder suckers are available and are essential for IC work.

6. Replacement integrated circuits are packaged in conductive foam or with aluminum foil. Do not remove the IC from its protective package until it is ready to be used. Just before removing the IC touch the conductive foam to the chassis or circuit board into which it will be inserted. This can be done by touching the board with one hand and the conductive package with the other.

7. Try to minimize motion when handling unpackaged integrated circuits. When seated, the simple action of lifting your feet from the floor can generate static electricity. Clothes readily generate static electricity when brushed against other objects.

8. Do not use freon propelled sprays on the circuit boards or chassis. Freon sprays can generate more than 5,000 volts of static electricity. Even when an IC is in a protective package or soldered into a circuit board, a freon propelled spray can generate static electricity which could damage internal components not directly connected to the IC pins. A short bristle brush (½ inch or 1.25 centimeters) with a metal handle is a safer method of clearing debris.

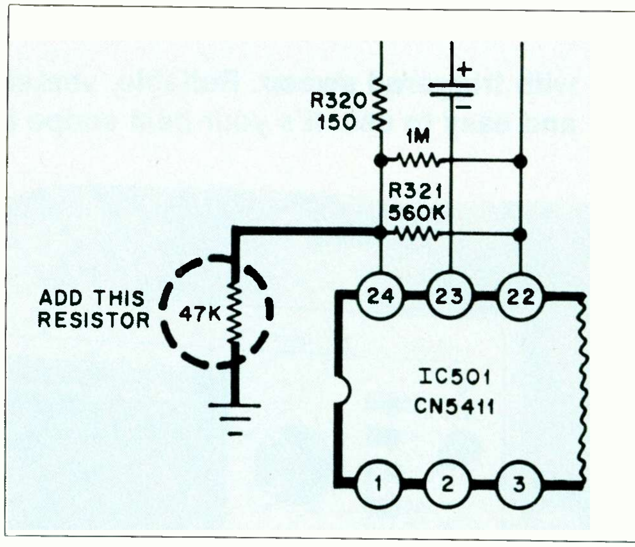
9. Defective components should be returned in a conducting package, not in plastic boxes or plastic envelopes. Aluminum foil is an effective packing material.

In situations where the above guidelines are in conflict with safe operating procedures, the safety rules come first. Components and TVs can be replaced, people cannot.
(Courtesy of RCA)

Panasonic

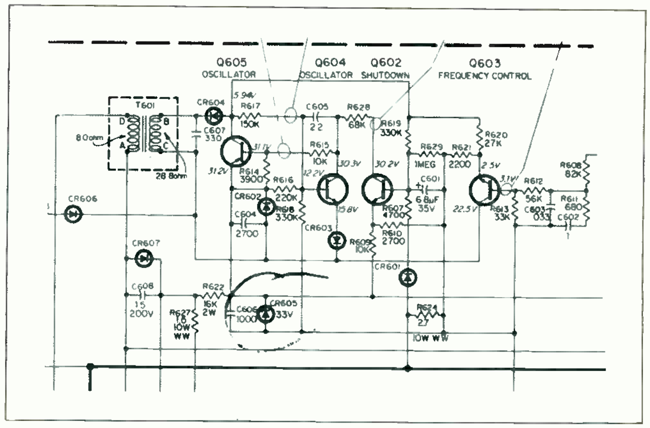
Color TV Models CT-2558, CT2598, CT5902—Heavy retrace-like lines at top of screen. Possible intermittent and may be accompanied by sound buzz. Cause: Poor ground connection between Main PC board and chassis frame. Repair: Insert washer and tighten screw in center of main board near TPA16. Also retighten all corner and edge screws.

Set shuts off by itself when changing channels. Indicator lite stays on. May or may not operate after being shut off for several minutes. Cause: Horizontal shut down operates on certain signal of no or non-standard modulation. Repair: Connect a 47K-ohm ¼w resistor from Pin 24 of IC501 to ground.



RCA

Color TV Chassis CTC 87 Series—Lack of width, 114v line measures about 90v. Possible cause: leaky or shorted CR 605, 37v zener. Use RCA stock number 145113 regulator trim kit *only* for replacement.



Dead, will not start. Possible cause: Q 3038 x-ray protection transistor, check by substitution.

Two black vertical lines at right side of screen; Check for shorted CR 3125 (in blanker base circuit). ET/D

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The Model TECH 300 with 0.5% Vdc accuracy, but without the continuity function or the 10-amp current ranges, is just $100.

Whichever model you choose, you get a multimeter that won't let you down. There's exceptional overload and 6kV transient protection, plus ruggedness to take a 6-foot fall and to come up working.

So get the Beckman digital multimeter that performs and keeps on performing. No matter how tough the going gets. For information on the complete line and accessories, write or call your local distributor or the Advanced-Electro Products Division, Beckman Instruments, Inc., 2500 Harbor Boulevard, Fullerton, CA 92634, (714) 871-4848, ext. 3651.

BECKMAN

Circle No. 106 on Reader Inquiry Card

What's new in test gear

A look at the Electronic Distribution Show

If you're interested in taking a look at some of the new test products that will be showing up soon on your distributors shelves, this report will provide you with a personal tour.

By Richard W. Lay

New product introductions at this year's Electronic Distribution Show (formerly NEWCOM) were at a minimum as manufacturers seemed to be holding off waiting to see more clearly just what types of products will be used for servicing in the 1980s.

The show, produced with the express purpose of allowing manufacturers to obtain new distributors or just to keep old ones happy, seemed to spawn less activity this year than last.

Among the most active participants, insofar as new test gear for the home entertainment and industrial service markets, were VIZ Manufacturing, showing a new power supply, four new bench-top DMMs, and its innovative new color/signal generator; PTS Electronics with two new power supplies and a new DMM; and Sencore with its futuristic microprocessor controlled DMM — the Microranger — as well as its new "Z" meter for measuring capacitance and inductance.

Also there was B&K-Precision paying tribute to the growing service area of VCR machines with the introduction of its relatively low priced NTSC signal generator (for $685).

Fluke, the originator of the "hand-held" concept in DMMs showed an updated version (for $129) of its incredibly successful Model 8020 DMM, the new one being the Model 8022A, complete with low power LCD, four digit display.

Non-Linear Systems reported the success of its portable MS 215, dual trace, 15MHz oscilloscope prompted the firm to show an updated 30MHz (Model 230) version of the unit which should be available sometime this fall for $559.

Leader Instruments showed its still to be introduced portable battery operated oscilloscope — a dual trace, 20MHz unit — and a 520MHz digital counter, the Model LDC 824S, a unit with selectable gate times and frequency/period modes.

Rounding out the test gear introductions were Continental Specialties and Hickok. Continental Specialties has a new "combo unit," its previously introduced MAX-100, 100 MHz counter and the PS-500 Prescaler, which of course extends the capability of the MAX-100 up to the 500 MHz region "and beyond," according to the firm.

Hickok meanwhile displayed a new, universal temperature probe (TP-20) for use with most DMMs to convert readings into degrees, Celsius or Farenheit, and which carries a suggested retail of $39.95.

In the service aids area, RCA and GTE Sylvania were out with some new units. RCA is offering its color television test jig in a new cabinet enclosure which has a front mounted speaker and provides revised impedance matching switch positions.

Sylvania, meanwhile, has hit the market with its new "Solder Sucker," a fully automated desoldering device designed to meet the challenge of such service nightmares as 40-pin ICs. According to Sylvania this new unit, in the $200 range, is equipped with an enclosed bellows air pump independent of the desoldering tool.

The television antenna, CATV, MATV system manufacturers also displayed their wares. The most innovative item

Fig. 1 - The apartment model of the Winegard 20/20 does double duty with plant hangers. (Hangers available soon.) Circle no. 161.

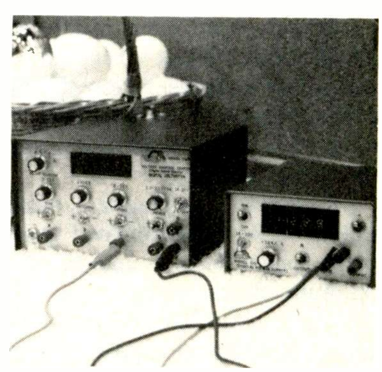

Fig. 2 - PTS Electronics regulated power supplies DMMs, the DG-5 (left) and the DG-2. The DG-5, retailing at $269.95, produces four variable DC voltages while the DMM can be selected to monitor any of the supplies or an external voltage. The DG-2 is a regulated output over the 0 to 30Vdc range at 5 amps. Circle no. 152.

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from these was Winegard's new 20/20 antenna. With a turning radius of 30 inches it is intended for easy installation in an attic or garage. Several model variations are available. The basic antenna includes hardware for garage, attic, under eve or roof mounting. Other models are available with a preamplifier, with a rotator or with both. Perhaps the most unique version is the apartment model which installs like a pole lamp. Winegard, of course, also offers a complete line of home and MATV equipment and antennas.

RMS Electronics exhibited its expanded line of MATV system hardware, splitters, tap-offs, multi-outlet directional taps, baluns and other items and antennas and installation hardware. RMS also emphasized cables, splitters and other equipment for VCR to multiple TV set hookup and a line of exact replacement antennas for TV sets and radios.

Blonder-Tongue offered an extensive line of television signal distribution equipment including amplifiers, filters, converters, line amplifiers, directional taps, equipment for complete distribution systems, as well as antennas, amplified splitters and other home system items.

A recent entry into the field, Trans USA Corporation presented a line of MATV equipment including preamplifiers, distribution amplifiers, directional taps and other items for home system or multiple dwelling installations.

The Finney Company displayed selected units from their complete line of MATV and home system equipment and components. They also offered the Finco Teletuner, a high fidelity TV audio tuner, amateur 10, 6, 2 and 1¼ meter antennas, CB antennas, and monitor antennas. ET/D

Fig. 3 - The DMM of the "future," Sencore's DVM56 "Microranger." This unit is microprocessor automated with non-blinking, LED readout; dcV to 10KV capacity; non-blinking peak and null with range hold; full AcV capability including PP, average, true RMS, or dB readings. Scheduled for Fall introduction. Circle no. 153.

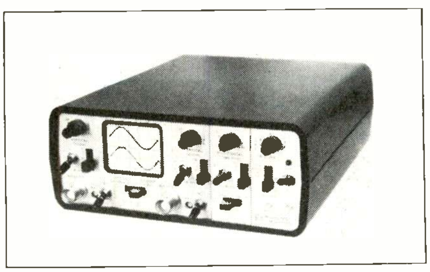


Fig. 4 - This new 30MHz, dual trace, "Miniscope" from Non-Linear Systems provides two-channel operation with separate, chopped or alternate sweep modes, provides up to 3.5 hours operation on one charge. Priced at $559, it weighs 3.5 pounds. Circle no. 156.

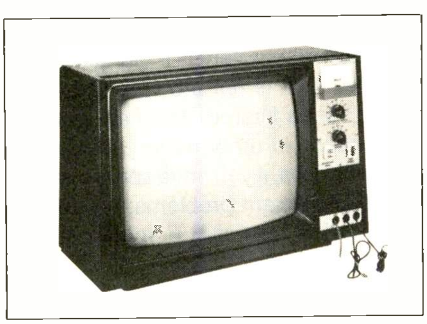


Fig. 5 - RCA's Distributor and Special Products Division is offering this test jig Model 10J106B, a revised and updated version of its previous test jig. Circle no. 159.

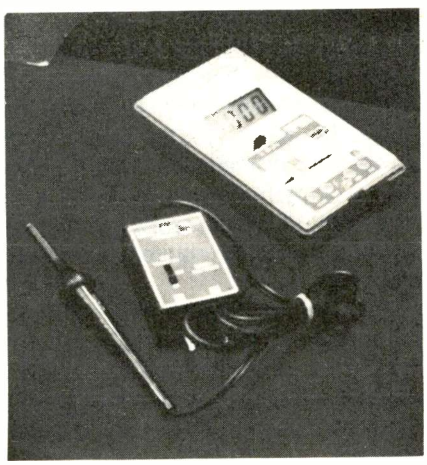


Fig. 6 - Hickok's TP-20, at $39.95, provides almost any voltmeter with the capability of reading temperatures from -67-to-302 degrees Farenheit, or -55-to-150 degrees celsius. Circle no. 157.

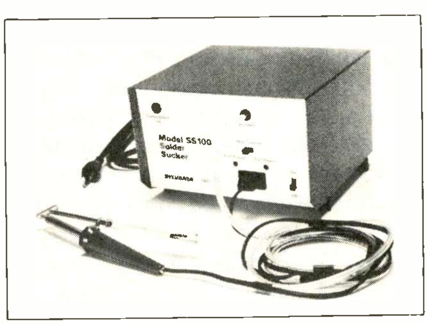


Fig. 7 - The Sylvania Model SS100 vacuum desoldering system, a completely self contained–except for 120v ac power source–unit. Circle no. 160.

Fig. 8 - This VIZ WR 515B "Signalyst" at $249 retail is aimed at the TV, video recorder, CATV, MATV, CCTV service markets. Just a few of the pluses on this unit include scope triggers for H and V; progressive or interlaced scan for all 11 basic patterns, and adjustable RF/IF carriers. Circle no. 155.

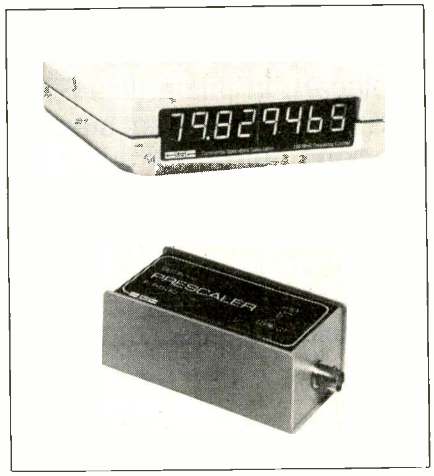


Fig. 9 - The MAX-100, 8-digit frequency counter has been combined with the PS-500 prescaler, both from Continental Specialties, for a package that allows the user to measure frequencies in the 500 MHz range. Suggested retail is $195 retail. Circle no. 158.

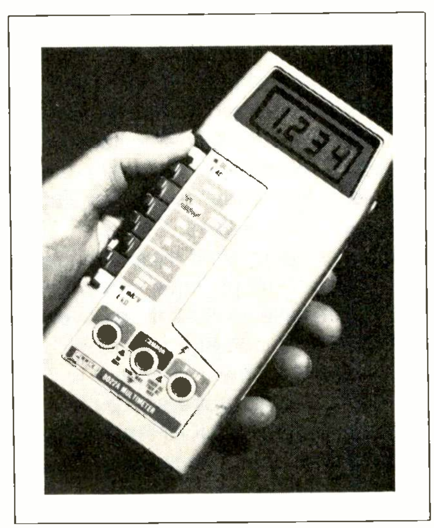


Fig. 10 - Fluke's newest "hand-held" unit, the 8022A, is a revised version of its previously introduced 8020A. Retailing at $129, the 8022A is available with 40 Kv probe and 1Ghz RF probe. Circle no. 151.

Troubleshooting logic circuits

A basic approach for the technician

In any digital system pulse trains represent information. Losing one upsets the applecart. In this article ET/D outlines the important steps in checking out power supply and "clocking" circuits in microprocessor-type systems.

By Robert Goodman, CET

The CLOCK frequency generator is the heart of most all digital/logic systems so we will start off with ways to properly view these pulses on an oscilloscope. Throughout this article we will touch on some "nuts and bolts" logic troubleshooting service information. Next we will touch on a microprocessor application as found in one television receiver's electronic tuner control system.

Operation and troubleshooting of power supplies used in microprocessor systems will be the following item on the agenda. The scope will be used to detect "spikes and glitches" on the regulated DC power supply lines. Some comments about what trouble glitches on DC power supply lines can cause, and digital noise spikes will be covered. And then we'll look at a typical microcomputer power supply.

Using the logic probe and pulse generator probe to "JOG" test pulses that are then used check gate action through a digital/logic system will bring this article to its summation.

Pulse information

Microprocessor systems and most all digital/logic devices require some type of clock pulse in order to perform and time the various functions. The clock generates accurately timed pulses and is often crystal controlled. The logic systems are gated (enabled) by these clock pulses. The faster the clock frequency the most functions that can be performed, but this speed is limited by response (rise) time of the IC's that are used in the system. Clocks vary from simple local devices to very diverse and complex systems.

The simple clock puts out equally spaced pulses. They should be as narrow as possible and still enable the gates. The reason for the narrow clock pulses is to discriminate against noise pulses or glitches. Some systems, such as the 8080A microprocessor IC that we will look at shortly, require a two-phase clock.

Thus, the clock is the very heart of most digital/logic systems. For this reason then, the clock pulses should be one of the first items to be checked with the scope when troubleshooting these systems.

One note of caution when using a scope probe for observing these clock signal pulses. If the scope's shielded probe case is not properly grounded you will obtain erroneous clock pulse waveforms on the scope that may trick you into seeing a distorted pulse when it is not. Not only should the ground lead from the scope case be connected to chassis ground of the equipment to be tested, but the probe's ground shield must be connected to the ground pin of the clock IC you are testing. This caution is readily illustrated for a clock pulse shown in the trace of (fig. 1) where the probe shield was not grounded. Note the ringing distortion on the pulse waveforms. A clean clock pulse is shown in the (fig. 2) trace with

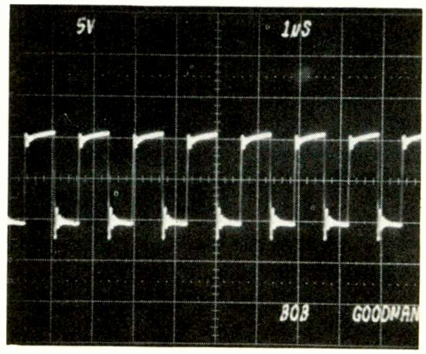


Fig. 1 - Distorted clock pulse due to improperly grounded scope probe shield.

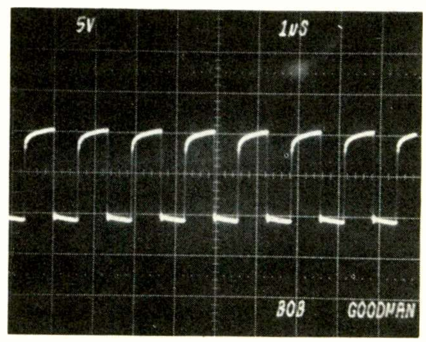


Fig. 2 - Clean clock pulse with properly grounded probe.

the probe shield properly grounded. *Always* use an X10 attenuation scope probe for checking clock and logic pulses. These clock pulses can radiate (transmit) very potent R F signals (if the complete unit is not properly shielded and I/O lines filtered) and can cause interference in other nearby electronic devices. Thus, if you have some strange acting equipment problems, be on the alert for this type of R F spectrum pollution.

GE's tuner chips

One application of the microprocessor is found in GE's tuner control module. This unit accepts TV channel selection logic

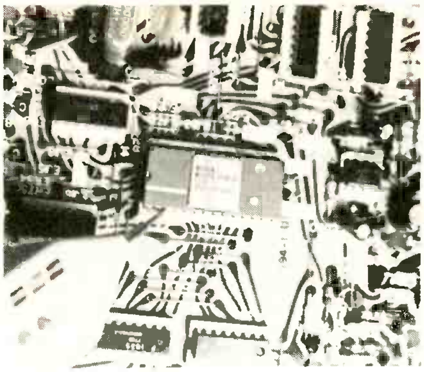


Fig. 3 -A GE EIC20 tuning control chip being checked with a log probe.

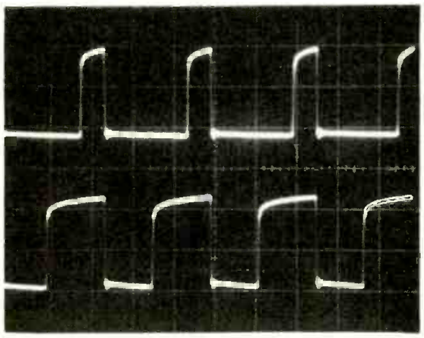


Fig. 4 - Timing pulses of a two phase clock system.

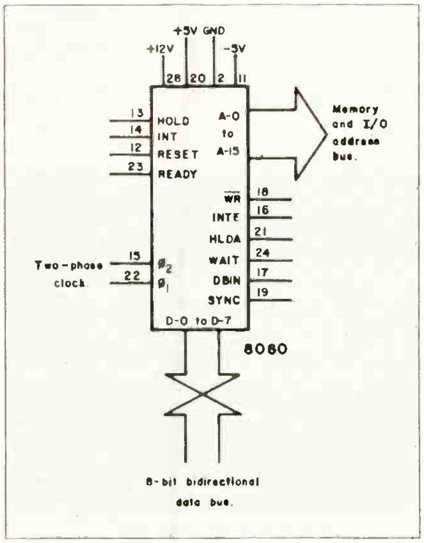
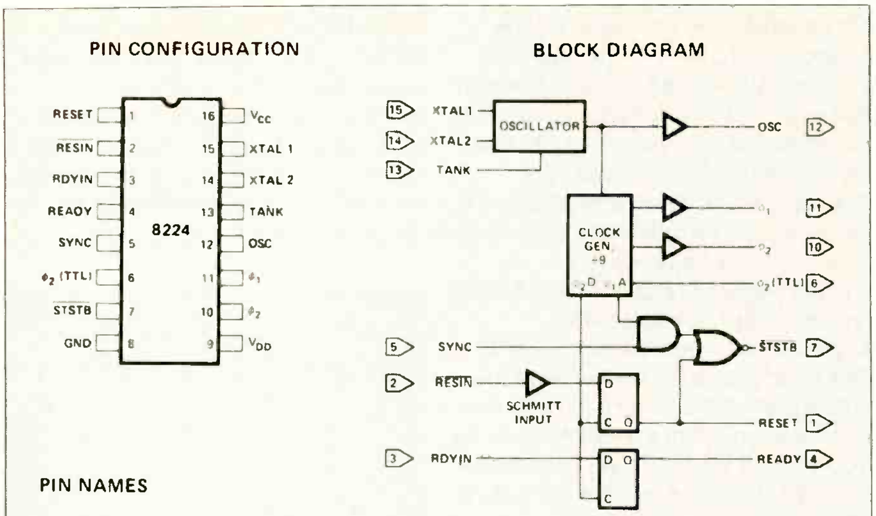


Fig. 5 - Block diagram of INTEL'S 8080A IC with data and address bus.

inputs from the set's channel selector keyboard and the remote decoder module.

The heart of the tuner control module is a frequency-synthesizer. The frequency-synthesizer is a large scale, N-channel MOS, integrated circuit, industry type NC 6410. It's complexity and technology are in the microprocessor class. However, it differs from the microprocessor in that it is not a programmable device but rather is "dedicated" to perform specific functions in response to selected input commands. This tuner control system uses a phase-locked-loop, divider circuits, and a voltage-controlled



PIN NAMES

RESIN	RESET INPUT		XTAL 1	CONNECTIONS
RESET	RESET OUTPUT		XTAL 2	FOR CRYSTAL
RDYIN	READY INPUT		TANK	USED WITH OVERTONE XTAL
READY	READY OUTPUT		OSC	OSCILLATOR OUTPUT
SYNC	SYNC INPUT		ø2 (TTL)	ø2 CLK (TTL LEVEL)
STSTB	STATUS STB (ACTIVE LOW)		Vcc	+5V
ø1	8080		VDD	+12V
ø2	CLOCKS		GND	0V

Fig. 6 - Block diagram of the 8224 IC.

oscillator to perform its various functions.

The 8080A

An 8080A microprocessor "chip" requires a two-phase clock pulse input. A clock—in digital/logic jargon—is a device that generates at least one clock pulse, or a timing device that provides a continuous series of timing pulses. A two-phase clock is a two-input timing device that provides two continuous series of timing pulses that are synchronized together. A single clock pulse from the second series always follows a single clock pulse from the first series. The dual-trace scope photo in (fig. 4) shows the timing of these two clock pulses. The top trace is the phase 1 and the bottom trace is the phase 2 clock pulse.

In the 8080A specifications, it is stated that the minimum pulse width for clock phase 1 is 60 n sec, and the phase 2 clock pulse width is 220 n sec. Refer to (fig. 5) for the pinouts of the 8080A INTEL chip. This is a two-phase clock system. These clock pulses can be generated with an INTEL 8224 clock generator chip.

Frequency check

A frequency counter is now a "must-have" instrument for checking out digital/logic, microprocessor, PLL and other frequency divider systems now found in almost all electronic devices encountered by the electronic service technician.

Your first step for isolating problems in a non-operational logic system is to check for clock operation and correct clock frequency. The frequency counter would be used to check the output from the clock generator chip. If you were troubleshooting a system that uses the popular 8080A microprocessor IC these two check points would be pins 10 and 11 of the 8224 clock generator and divider "chip" shown in the (fig. 6) block diagram drawing. The 8080A requires two-phase clock signals at pins 15 and 22. This clock generator IC also requires a crystal for accurate frequency generation and control.

There may be cases where you cannot make direct connections to the clock output signal or do not want to due to circuit loading. The frequency counter's probe capacitance could cause the frequency of the oscillator to change, or stop the clock oscillator from running in a worst-case condition. A pick-up loop will allow signals to be picked up without a direct probe connection. For this application the inductive loop is used to "pick-off" the frequency pulses quickly, without any direct connections, thus eliminating interference with the measured circuit. The pick-up loop can also be connected to the input of the scope to take a quick look at various oscillator signals.

Check the crystal

Most clocks in digital/logic systems use a crystal to keep the frequency pulses stable and accurate. Should the clock not operate or be off frequency the crystal would be the prime suspect.

Remember that most crystals used in two-way radio transmitters are designed to operate on an overtone rather than their fundamental frequency. For example, an oscillator operating at 33 MHz will use a third overtone crystal with a fundamental frequenty of approximately 11 MHz. In practice there are few, if any, crystals with a fundamental frequency over 20 MHz. The exact operating frequency of the crystal depends on the circuit it is used in. Measurement of the exact operating frequency of the crystal is only possible by measuring the output of the circuit it is operating in.

Logic power supplies

A proper DC voltage power source is required for operation of the microprocessor and logic systems that have been discussed in this article. In fact, all digital/logic systems must have very precisely regulated DC power supplies that are well filtered. Use your scope to check for a smooth DC output voltage from the power supply and check for correctly regulated DC voltage levels to all logic circuits with a DVM. Most all of these voltage supplies are electronically regulated and filtered.

The scope can be used to monitor the DC supply lines in order to "catch" spikes in TTL (transistor-transistor-logic) systems. A very fast "wide-band" triggered-sweep scope is required to detect these transient pulses.

When a TTL circuit is switched from a low to a high state, transients occur on the supply voltage line because of the TTL totem pole output action. Note the typical TTL gate circuit shown in (fig. 7). When the logic level goes high it is actually short circuiting the supply voltage during a brief period.

If several gates switch on simultaneously, the current spike on the supply line is increased linearly with the number of gates. These "spikes" (due to insufficient DC supply line filtering) can "trigger on" fast TTL gates. This is quite fatal to logic. By fatal we mean it can destroy information stored in memory systems (PROM's, ROM's, RAM's and etc.). So use your scope to check those DC voltage power supply lines for open filter or by-pass capacitors.

To track down these spikes in a microprocessor system you not only need to check at the DC power supply voltage output terminal, but at various filter or by-pass points throughout the system. You will notice that there are many filter and by-pass capacitors located in any logical system that contains many gates. The logic pulse scope trace shown in (fig. 8) is of a properly operating gate. Now should a filter capacitor open in this stage the scope pulse that is seen in (fig. 9) may be observed. Note the small spikes as the pulse goes from a high to a low-transition. The amplitude of these spikes will vary as to which filter capacitor opens, C1 or C2, in the case of the TTL gate circuit shown in figure 7.

If you use the scope to check the DC regulated voltage coming out of the logic system power supply you should see a smooth, clean trace even with a very high vertical scope amplifier gain setting. Should trouble occur in the electronic regulated DC circuit or filter capacitors some ripple or pulses will be observed.

Micro-computer power

A well regulated power supply for a micro-computer system is shown in the (fig. 10) schematic drawing. Note that it produces a regulated +5 volts at 3 amps and +12 volts and −12 volts at 0.50 amp which supplies all computer operations. This power supply is found in the Processor Technology Model SOL-20 mini-computer home or hobby system. In order to accurately measure these critical DC voltages that must be supplied to logic devices, a digital volt meter (DVM) should be used.

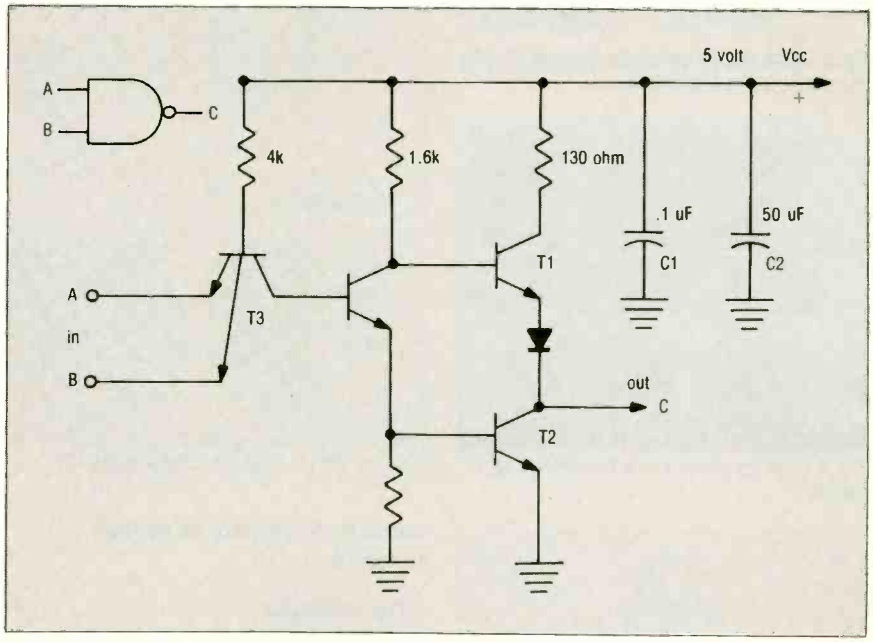


Fig. 7 - Typical TTL gate circuit and filter capacitors.

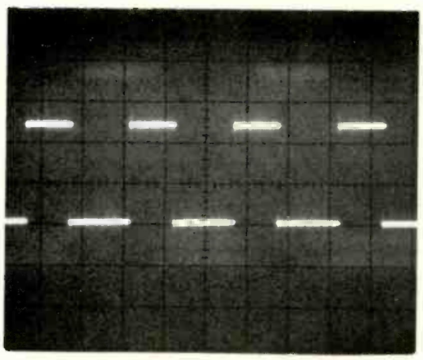


Fig. 8 - Normal TTL gate pulses.

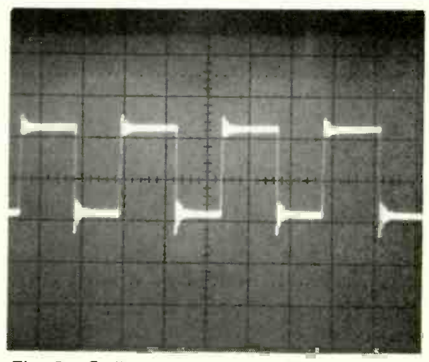


Fig. 9 - Spikes due to open filter capacitors.

Feed through spikes

Digital signals are subject to noise which may cause a small amount of input signal to be fed through to the output gate. Or signals from one stage can feed to another via the DC power supply lines. Small noise spikes can ride on the main DC voltage. Sometimes this is not enough to cause false operation, however should these spikes become higher in amplitude, due to improper filtering or leakage, they could cause false gate turn on or off in subsequent stages. Use a fast triggered-sweep scope to look for such spikes. These feed through spikes can cause erratic operation in logic devices.

Logic probe testers

Low cost logic probes are ideal testers to check out the "state of the gates" in digital/logic systems. One such probe, shown in fig. 11 being used to check out

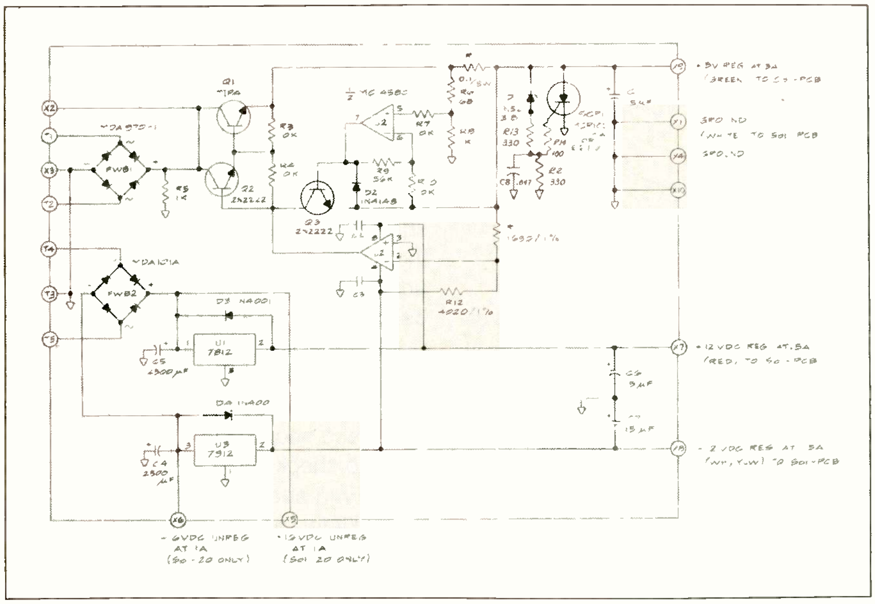


Fig. 10 - Micro-computer power supply schematic.

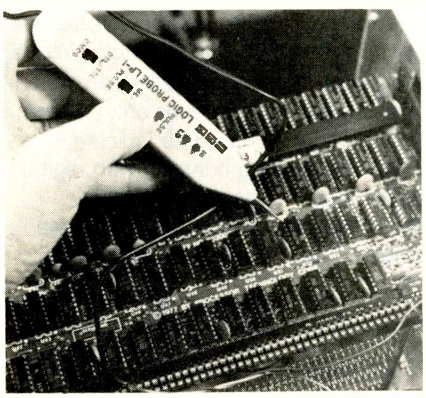


Fig. 11 - Logic probe being used to check ROM ICs.

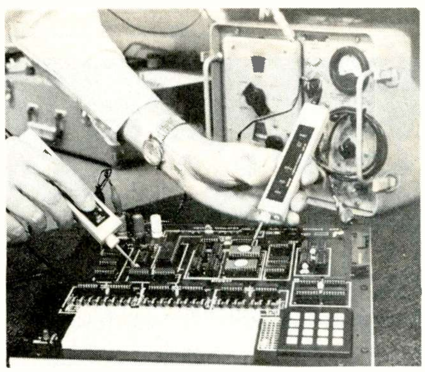


Fig. 12 - E&L Instruments MMD-1 trainer and Continental Specialties PL-2 logic test probe in operation.

a bank of ROM memory chips, is used to detect, memorize and display logic levels, pulses and voltage transients in mixed and single logic family systems.

The probe detects out-of-tolerance logic signals, open circuit nodes, as well as transient events down to 50 nano-seconds.

Connect the logic probe's clip leads to the power supply of the circuit that you are testing. Set the logic mode switch to TTL, CMOS, etc, and the memory/pulse switch to the pulse position. Touch the probe tip to the circuit node to be analyzed. The three display LED's on the probe's body will light up and provide a read-out of the gate's state. The memory mode is used to detect, store and display low repetition rate or single shot pulses or transient events.

Connect the black lead to common (-) and the red lead to plus (+) Vcc. In order to minimize the possibility of power supply spikes, or other spurious signals from affecting the operation of the logic probe, connect the power leads as close to the node to be tested as possible.

Memory mode

The Continental Specialties LP-1 probe contains a pulse memory flip-flop that catches and holds (memorizes) level transitions or pulses as narrow as 50 nanoseconds. The memory is activated by either positive or negative level transitions.

To set the probe for catching and memorizing an event, just touch the probe tip to the gate under test with the switch in memory position. The next event that occurs will activate the PULSE LED and latch it on. To reset and rearm the memory move the memory/pulse switch to the pulse position and then return it to the MEMORY position. Note: When arming the memory, the probe tip must be in contact with the terminal to be tested. If the memory is armed with the tip floating (not connected) the memory will be activated when the tip makes contact, thus giving you a false read-out indication.

Pulse generator probe

This completely automatic pulse generator may be used for troubleshooting the more sophisticated microprocessor chips and any other family of digital/logic circuits. The photo in (fig. 12) shows the E&L Instruments model MMD-1 microprocessor program trainer in the process of being debugged by using Continental Specialties LP-2 logic test probe and the DP-1 pulse generator IC probe tester.

By obtaining its power from the circuit under test, the pulser self-adjusts the amplitude of its output to the input requirements of the circuit to be tested. When the pulser tip is connected to the circuit node to be tested, the probe's autopolarity sensing system selects the sync or source pulse required to activate the test point.

Simply depress the push button "once" to provide a clean bounce free pulse. When the push button is held down for more than one second, the unit produces a pulse train at 100 pulses per second.

The pulser has a "fail-safe" feature, which permits an overvoltage condition up to 25 volts. Other built-in protection will withstand a reverse voltage to 50 volts, and allows the unit to pulse continuously into a short circuit.

The pulser contains a circuit that automatically selects the sink or source pulse required by the circuit under test. By comparing the test point voltage (between pulses) to the center of the dead zone voltage for IC being tested, the DP-1 senses whether a "0" level is present and outputs a "1" pulse, if a "1" level is present it outputs a "0" pulse.

This feature conveniently allows you to jump from point to point on a circuit board without regard to the logic state of the test point.

By depressing and releasing the push button, a single, debounced pulse is produced at the output. The push button may be depressed as rapidly as needed to produce a controlled stream of single pulses.

The push button must be released within one second in order to remain in the single shot mode. The LED flashes once for each single shot pulse that is

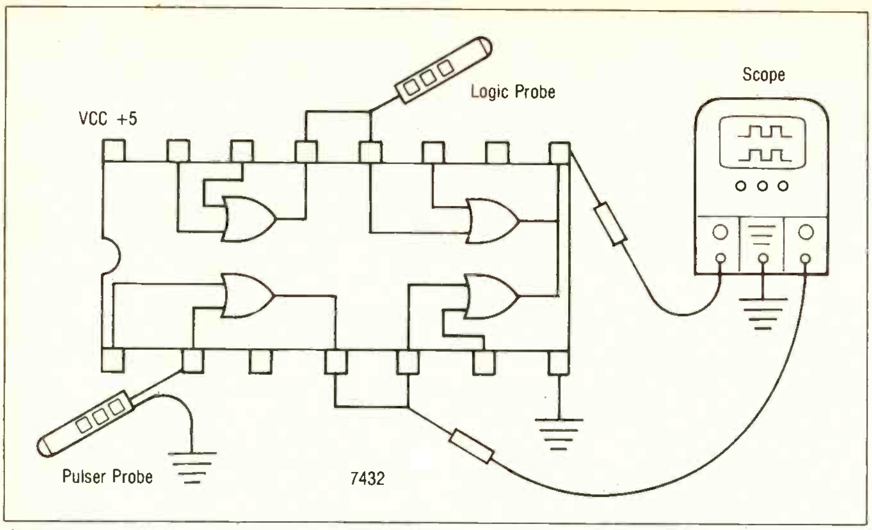


Fig. 13 - Set up for using pulser and logic probes plus a scope for monitoring several gate actions simultaneously.

produced by the probe.

Continuous mode

When the push button is depressed, a single pulse is instantly produced. If the button is held down more than one second, the output switches from single shot to continuous mode, producing a train of pulses at a 100 pulse per second rate. The LED stays lit for continuous mode operation.

The power cable of the DP-1 not only feeds power to the unit, but also acts as the return path for the output pulse. In order to decrease common moding and ground loops, clip the power cable lead as close to the pulsing point as possible.

When power is first applied to the pulser the LED will light and stay on for about one second. After the LED has gone off, the pulser is ready to use.

"Jogging" technique

With the pulser's high fanout it has the ability to overriding the output level set by a gate, by applying the needed input pulse to the circuitry under test.

This sets the stage for system troubleshooting by using the "jogging" method. A digital system can be deactivated by disconnecting the system's clock and replacing it with test pulses from the DP-1. The complete system can now be jogged through, one cycle at a time, while different points of interest in the system may be displayed with logic monitors, logic probes - or even an oscilloscope.

One or more logic probes may be used simultaneously to indicate the movement of a pulse from IC to IC, or show the response of several gates to the same stimuli. The distinct advantage of this test technique becomes quite evident once you have put this it into operation.

The pulser test probe troubleshooting approach may also be used with a dual-trace scope and a logic probe in order to check more gate actions at the same time and to quickly isolate logic faults. Refer to the drawing in (fig. 13) of the test set-up with a scope for troubleshooting a 2-input Quad OR gate IC.

I think you will find that the pulser and logic probes are an extremely effective way to troubleshoot digital/logic circuits and gates. In many cases they are much more useful and faster than only a scope. The features in this issue indicate ET/D's continuing concern with digital electronics and its application in consumer electronics. Get out those probes. There's more to come. ET/D

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Logic troubleshooting hints

- Know your logic theory and correct gate operation.
- Make sure you understand how the logic device should operate.
- IC logic gates will very often become overheated when they are defective. A high "chip" temperature (hot) may well indicate a faulty logic IC.
- Try not to replace any components until you have zeroed in on the trouble spot.
- Use the logic test probe for signal tracing and logic pulser probe for signal injection.
- Have well established in your mind the circuit signal flow and the logic levels that should be expected.
- When troubleshooting with the logic probe, always touch the probe tip to the IC terminal leads. Avoid the probe tip test at the IC socket.
- Use a DVM to measure the very critical voltages found in all logic circuits.
- Remove and install MOS microprocessor chips and all other logic devices very carefully. Be on the alert for any static build-up.

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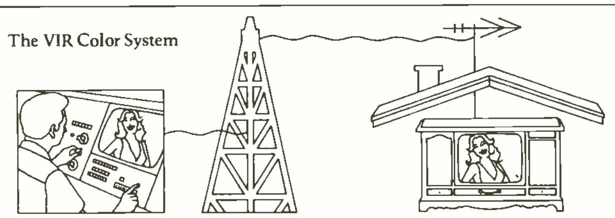

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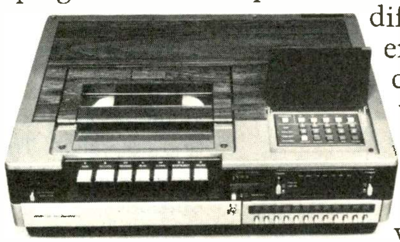

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Introduction to data transmission

Some elementary techniques

In our information oriented world data storage and transmission devices have become man's newest servants. In this article we'll introduce you to intelligent terminals, the relationship between transmission speed and bandwidth, and other facts you'll need to understand this fast growing field.

By Bernard B. Daien

Our technological civilization relies upon speedy movement of information. The earliest electrical communication was telegraph, but it was very slow, and soon replaced by voice communication, which is still the most frequently used means of information transfer. Lately *data* transfer has been growing at a fantastic rate ... you know of data transfer as teletype "computer printout." But teletype has been largely supplemented with "source data collection." Source data collection is to teletype what telephone was to the telegraph. It permits faster, cheaper, more efficient, information transmission.

Source data collection permits the *storing of data as it is generated,* and then transmitting it, at some appropriate time, at high speed. For example, a teletype machine generates characters at the very slow rate of a few per second. By storing a message, or several messages, for a few minutes, and then sending them at very high speed as coded pulses, *the time on the line* can be reduced, easily, over a hundred times! This reduces cost several ways ... it reduces the time the line is used ... it also permits several users to share the same line without interference, as each user is on the line a very short time, when no one else is on the line. This "time sharing" of facilities enables communications companies to handle more customers per line, and per equipment at the receiving end ... and thus lower the rates per customer.

This is but one example of what modern data communications is doing, and is so self evident, that nothing further need be said.

The computer era

We are now well into the computer era. Computers prevail in industry, business, and education. These computers must communicate with each other, and the outside world. Since computers generate, and can accept, information at extremely high speed (millions of bits per second), it is obvious that data transmission must also be at high speed. But this is a problem, since most telephone and telegraph systems were not designed to handle such high speed data. Although there is a great deal of literature available concerning computers, by comparison there is little regarding data communications.

This article is an introductory level discussion covering such areas as digital transmission, transmission codes, bandwidth requirements, "buzz words," etc. After reading it, you should be able to make sense out of the more advanced, specialized texts, which are available. Unfortunately, introductory texts are seldom encountered.

Good paying jobs are increasingly available in the data transmission field. Yet a shortage of qualified technicians exists. It is time for all technicians to upgrade their skills in communications, in order to keep up with the state of the art.

When the word "communications" is used, the typical technician thinks of 2 way FM, CB, amateur radio, etc. A little

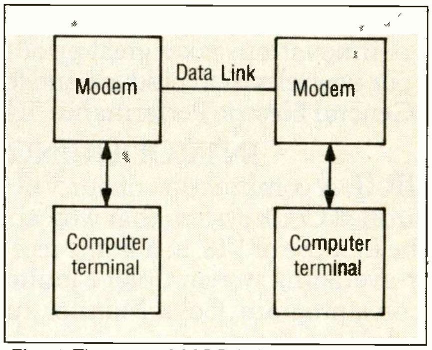

Fig. 1-The use of MODEMs in data communications cycle

thought quickly makes it apparent that stock market reports, bank financial transactions, process control signals, and a host of other similar data is transmitted with ever increasing volume. Someone has to set up, maintain, modify, and repair the equipment used ... so the modern tech has to add a new dimension to "communications" simply because it is here to stay, *and is growing faster than other types of communications*. Airlines use data transmission to handle flight reservations everywhere, motels use it the same way. These are just typical examples.

Some new terms

In order to get started, we have to define a few terms used in data transmission. Just like a telegrapher's key, some form of switch is closed and opened causing current to flow, or stop. When current flows, it is called "marking," no current periods are "spacing." Since there are only two states in this case, we also treat it as binary, with current being a "one" and no current a "zero." As in binary, we refer to the smallest piece of data (a one or a zero condition) as a "bit." If we run data on a line at the rate of one bit per second, it is also called a "baud," thus ten bits per second would *generally* be ten baud. (The reason the word

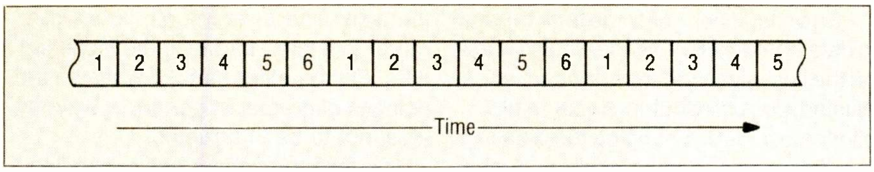

Fig. 2-Time Division Multiplexing. The numbers indicate the channel in use and six 300bps channels on an 1,800bps data link.

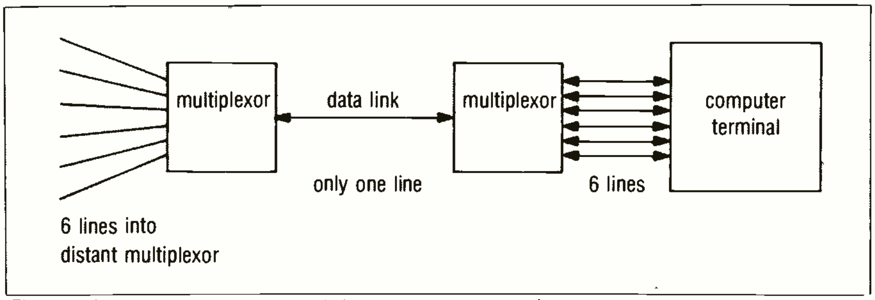

Fig. 3-A block diagram of a multiplexor data transmission system.

Glossary of Common Terms

The following terms are frequently encountered in data communications, and are therefore included, along with brief explanatory notes.

Alphameric ... Alphabetic-numeric, containing at least the ten decimal numbers and 26 letters of the English alphabet.
ASR ... Automatic send/receive.
Bit ... Short for "binary digit." The smallest piece of binary information.
Block ... A group of characters connected together as a unit.
Byte ... A set of binary digits, usually 8 to 16 in length.
Data Set ... Another term for a modem.
EOM ... End of message.
PBX ... A private exchange connected to the public telepone system.
Simplex ... Communication in one direction only.
SOM ... Start of message.
WPM ... Words per minute.

generally is included is that there are certain signals which technically have a difference between "bits per second" (bps), and bauds. It is easier to stick with bits per second (bps) in this article.

Typically, a character (letter, number, punctuation symbol, etc.) takes several bits to form. Sometimes transmission speeds are given in words per minute, a "word" being five characters plus a space to separate the words ... this is a sort of "average" word.

Data is transmitted and received by "terminals," and the connecting lines are called "links." Terminals are called up by "addressing," since each terminal has a set of bits which it recognizes, and which is called its "address." The signals sent over the link can be ac, dc (audio tones), or any of several other methods of communication, such as frequency shift keying (FSK).

We'll hold off on the definitions for a bit, and look at some of the implications of what we have said already. As you know, the bandwidth of the system must increase as the speed of transmission goes up. Or, the faster we transmit, the higher the frequency, and the greater the bandwidth. In simple AM radio transmission, if we limit our highest modulating frequency to 5KHz, then the bandwidth of the radiated double sideband signal is 10 KHz. On the other hand, if we look at a TV transmitter signal, with a 4.5 MHz video frequency, even with the aid of vestigal sideband mode of transmission, the bandwidth is over 5 MHz!

Bandwidth vs. speed

In order to handle high speed data transmission, we must have a link with the bandwidth capability required. When telephone lines are used, in many systems "voice quality" can be achieved with a 3 KHz line. When TV is sent over lines, a special coaxial cable is used to obtain the extra bandwidth. Thus, there is a relationship between the line bandwidth, and the bps speed capability in data transmission.

Bell Telephone voice quality lines often use "equalization" to flatten the response (like peaking coils in a video amplifier), and it is possible to extend the speed to over 4000 bps this way. Each line has to be individually equalized, for the specific conditions on that line, however. Let's think about that for a moment. Equalization will work ok if we know the line we are using.

But what happens on a long distance call, where we are routed, automatically, over whatever available lines are open, between the terminals? These lines therefore vary from call to call ... i.e., they are not predicable. Under these circumstances we can equalize for the "average line," and take a transmission rate of about 2000 bps, or we can use a very ingenious system of "automatic" equalization ... in which case a sample transmission is sent and returned. The frequency losses are then analyzed, and the line corrected to achieve the desired bandwidth, which, then, can be over 4000 bps.

One way to get around this problem altogether is to lease a phone line, equalize it, and use it as, and when desired. When there is a great deal of data to be transmitted regularly, this is practical.

While we are on the subject of telephone lines as data links, there are a few more facts that need to be mentioned. If a terminal sends data, then stops sending to receive data, or vice versa, the process is called "half duplex operation." If two links are used between terminals so that transmission and reception can be handled simultaneously, it is termed "full duplex operation." In both modes of operation a problem is encountered on phone lines due to "echo suppressors" used on voice lines.

Use of suppressors

Echo suppressors are used on long distance lines to avoid hearing the speaker's voice returned from the round trip, but delayed, so as to appear as an echo. Echo suppressors interfere with the proper operation of data terminal transmission, and the suppressors must be turned off. This is accomplished by a signal tone slightly higher in frequency than 2Khz, with a duration of a half second. This tone is sent when there is no data on the line, and accomplishes echo suppressor turn off as long as data continues to remain on the line. When there is a lull in data transmission over a tenth second duration, the echo suppressors come back into operation and must be suppressed again by the tone. The action is a continuous repeat of "enable/disable."

Modems

Up to this point we have been talking as if the phone line link plugs directly into the terminal (which is usually some sort of computer). A little thought will quickly indicate that computers need some sort of interface circuitry to feed, or operate from, a phone line. This "interface" is called a modem (for MODulater/ DEModulator) or a "data set" by telephone technicians. See figure 1.

Full duplex modems often operate with frequency shift keying (FSK), using one frequency for the "mark," and another frequency for the "space" signal. The modem also sends and receives *control* signals to and from the terminal it interfaces with, and is thus under control of the computer. (These are not data, but a separate set of binary signals.)

These control signals enable the computer to indicate to the modem when it is ready to receive data, and also enables the modem to indicate to the computer when a data transmission is incoming. The computer also indicates to the modem when it wants to transmit data, and the modem acts either as a transmitter, or as a receiver, in accordance with the signals from the computer. Data links are not exclusively copper wire lines, since microwave links are used along with various forms of light transmission.

Sometimes an "acoustic coupler" is used, to link (interface) data.

The acoustic coupler (transducer) converts the digital data into sound waves which are fed into the mouthpiece of a standard telephone set, and in receiving the sound output of the telephone is picked up by an acoustic microphone. (Sometimes an induction coil type of pickup is used in receiving.) Due to sound interference, and other limitations, acoustic couplers usually are limited to the relatively slow operation of 500 bps or less.

"Error detection" of some form is used in data transmission. Since a noise burst on the line might add a mark where none existed, or a dropout in signal might eliminate a mark, changing the data in a significant way, it is important to detect such errors. There are several schemes used, some of them very complex, and beyond the scope of this article. Some of these advanced methods even have the ability to correct errors.

Multiplexing

Time division multiplexing (TDM) is used to operate several slow speed transmissions on a single line. For example, six 300 bps transmissions can be handled on an 1800 bps line, by "interleaving" them on a time sharing basis. This is shown in Figure 2, where each of the six channels has a share of the total time in sequence, the sequence being repeated over and over.

Thus six customers can be handled on a single line, apparently simultaneously. The "multiplexors" sort out the transmissions, as shown in Figure 3. The abbreviated buzz word for a multiplexor is "MUX." Another close relative of the multiplexor is the "concentrator," which is a somewhat more complex device since it performs additional functions.

The data concentrator is able to take the low speed inputs, and translate them into other code forms which take less time to transmit, i.e., they "concentrate" the data timewise. This results in more data handled, lower cost, and the ability of the computer to do more work.

Enter microprocessors

A fast growing application today is the use of "smart" machines, which are based on microprocessors. These can be programmed to perform a wide variety of functions, involving different transmission speeds, different codes, and interfacing with magnetic memory devices. This enables the storage of data until a batch of economic size is accumulated, then transmitting it by the most expeditious method. Since the microprocessor is a rudimentary part of a computer, it can be programmed to make decisions, and follow complex instructions, hence the title "smart."

The microprocessor also has the inherent ability to handle "interrupts." An interrupt is basically a request to be heard. If the microprocessor (hereafter referred to as an "MPU") receives a signal indicating incoming data, the decision must be made, "What to do?" If the incoming data will be lost forever, obviously we cannot disregard it. We must stop whatever we were doing, note the point where we left off, so we can return to it later, and take the incoming data. On the other hand, if what we are doing is of greater importance, we may elect not to be interrupted.

The microprocessor easily handles this situation because there is provision for "IRQ," which means, "interrupt request," and this request may be denied. There is also provision for "NMI" which means "non maskable interrupt," or an interrupt with sufficient priority that it cannot be denied. As you can see, the "smart" microprocessor is of great advantage, and is rapidly being incorporated into data terminals. In effect, the MPU takes much of the work off the back of the large computer, and is often referred to as a "preprocessor."

Since the MPU is capable of following instructions (programming), and these instructions can be changed as required, it is a small computing machine. We can use its ability to have it understand commands written in English-like language. A part of the machine converts *our* language into a language it can use. This means that we can use less skilled personnel, and the operators can handle more work per hour (a form of automation). Thus the MPU not only assists the large computer, it also assists humans who work in data transmission. This is another example why technicians must update into microprocessors if they wish to remain in electronics.

Codes

Regardless of the method used to transmit data signals, they all are in binary form, i.e., "1"s and "0"s. But these ones and zeros can be used in any coding ... for example, radio telegraphers use dots and dashes, but in International Morse Code, while railroad telegraphers use the old Morse Code. They are different, but both work.

Data transmission is generally in one of the following codes: USASCII for United States of America Standard Code for Information Interchange; Baudot; BCD Transcode for Binary Coded Decimal; EBCDIC for Extended Binary Coded Decimal Interchange Code; and Hollerith (or Punched Card) Code.

These codes have been mentioned only for reference, and perspective, to help you understand that several codes are in common use, and that each has advantages for certain types of use. If you think about it, you will begin to realize just how "smart" MPU terminals are. They can handle *all* codes with ease, even interpret one into another! ET/D

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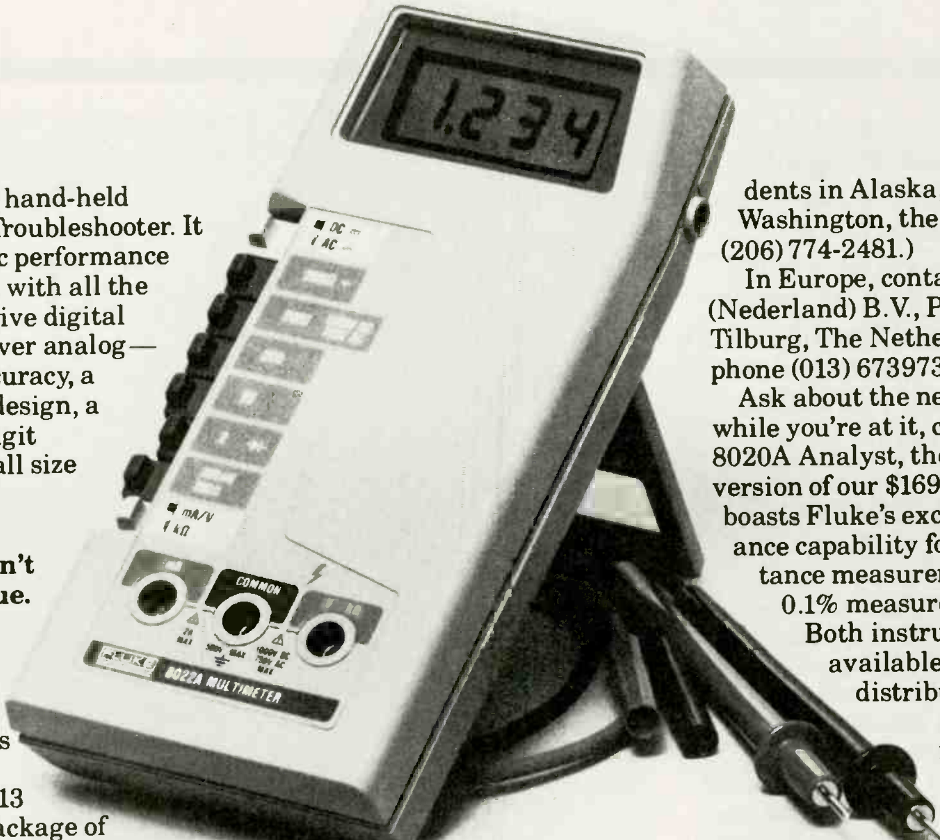

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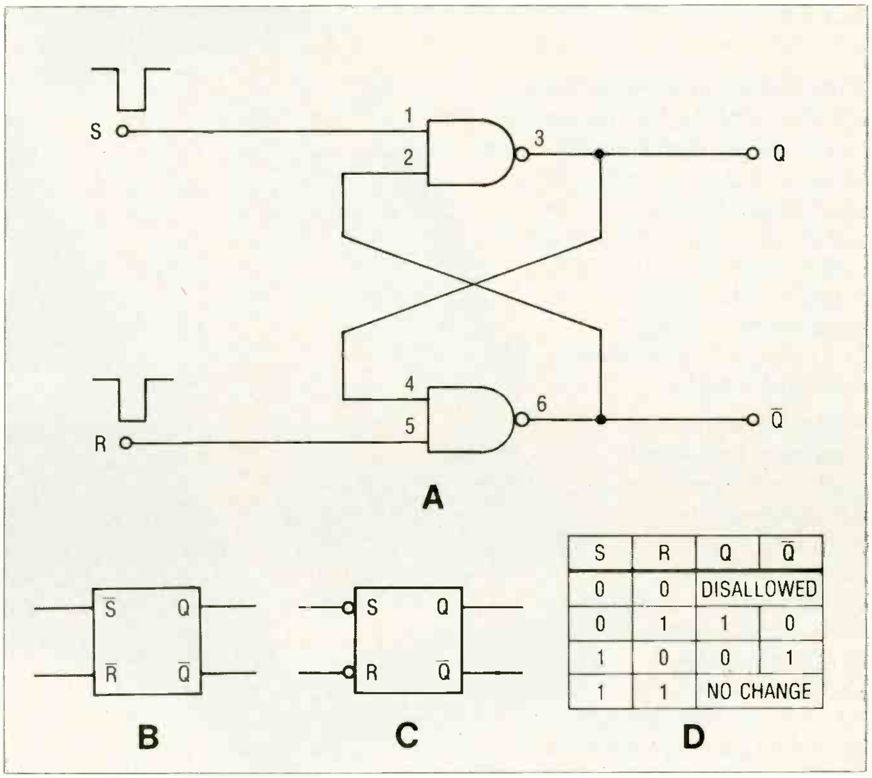
Introduction to digital electronics

Part III: Flip-flops

Flip-flops are the basic storage circuit of digital systems. Each is capable of storing a single bit of information. Various types of flip-flops, their assembly from gates and their operation, with appropriate experiments are discussed in the third part of this series.

By Joseph J. Carr C.E.T.



S	R	Q	$\overline{Q}$
0	0	DISALLOWED	
0	1	1	0
1	0	0	1
1	1	NO CHANGE	

Fig. 1 - NAND-logic RS flip-flop, A) Circuit using TTL 7400 gates, B) Schematic symbol sometimes used, C) Alternate schematic symbol, D) Truth table.

All of the devices studied in previous installments of this digital electronics series have been "transient" in nature. Once a pulse, or any other input conditions, has passed, the output state reverts back to its previous condition. Gates and inverters do not have any memory, so once the input condition has passed, then the output that resulted from those conditions also passes.

A *flip-flop* is a circuit capable of storing a single bit of digital data; it will remember an input condition and hold the same output after the data has passed. There are various different types of flip-flop circuits, and they all operate on slightly different sets of rules. But the one thing that they all have in common is the ability to store a single data bit.

All common types of flip-flops can be made from various combinations of the basic gates (i.e., AND, OR, NAND, NOR, NOT, and XOR). The NAND, NOR, and NOT gates are particularly often used. Except for the two most simple flip-flops presented in this installment, most electronic circuits use IC flip-flops. It is simply too costly to make flip-flops from gate ICs when the same IC manufacturers also offer the various flip-flops already made in IC form.

Reset-set flip-flops

One of the simplest flip-flop circuits is the *reset-set* flip-flop, also called the RS flip-flop (note that some textbooks called these *set-reset* and *SR*, but they are the same under slightly different labels).

The RS flip-flop is made from either two NAND gates or two NOR gates, although the operation of the respective circuits is slightly different.

Fig. 1A shows an RS flip-flop made from a pair of NAND gates (i.e., the TTL type 7400 device contains four two-input NAND gates).

There are two inputs to the RS flip-flop in Fig. 1A, *set* (S) and *reset* (R). There are also two complementary outputs, Q and not-Q. The inputs of this circuit are active-LOW, so are sometimes labeled $\overline{S}$ (not-S) and $\overline{R}$ (not-R). Anytime that you see an input that is designated as a "not" input, or has a bar over the designating letter, or has a circle on the schematic diagram for the input (i.e., Fig. 1C), then that input is active when it is brought LOW, and it is inactive when kept HIGH. Most of the time (there are always exceptions to our little rules), the lack of a bar over the letter, or a circle on the schematic symbols, means that the input is active when brought HIGH.

A momentary LOW (or a permanent LOW, for that matter) on the *set* input of Fig. 1A causes the outputs to go to a state where the Q output is HIGH and the not-Q is LOW. The outputs have memory, so will stay in this condition after the input pulse passes, unless the *reset* function is activated.

The reset function is obtained by applying a momentary LOW to the *reset* input. This forces the outputs to go to a state where the Q is LOW and the not-Q is HIGH.

The rules of operation for the NAND-logic RS flip-flop of Fig. 1A are summarized in the truth table of Fig. 1D. Note that there are two other conditions also listed in the table, in addition to those listed above.

One of these is the case where both *set* and *reset* inputs are brought LOW simultaneously. This is a disallowed state, and the circuit will not know what to do, so the output condition following this will not be predictable.

The other condition is the case where both inputs are made HIGH simultaneously. In this condition, no change will occur in the output state. The RS flip-flop will remain in whatever had been its state prior to making both inputs HIGH.

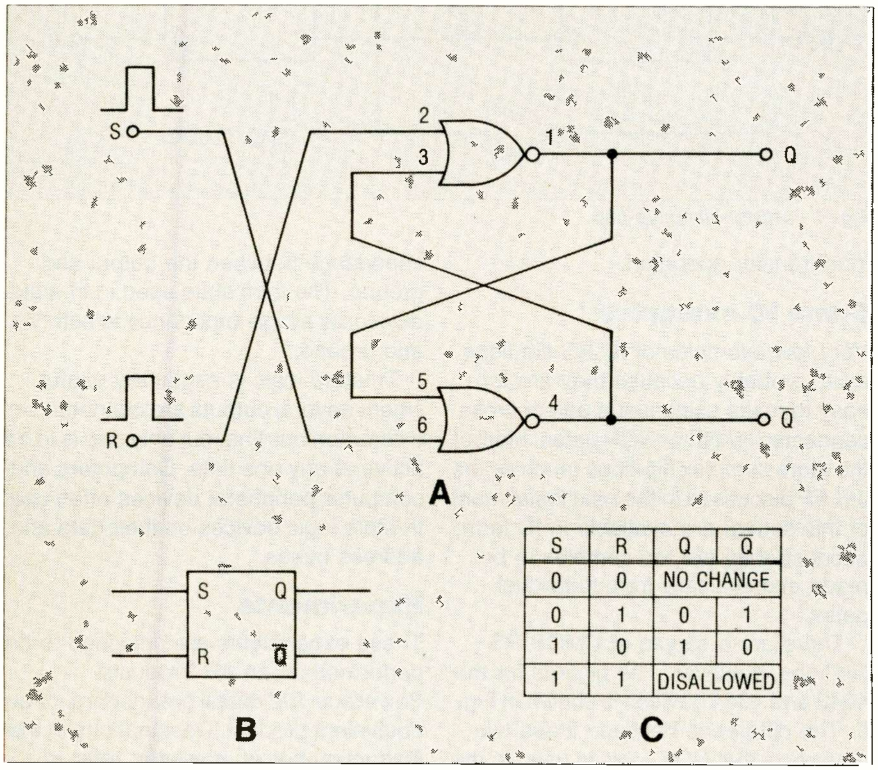
The NOR-logic version of the RS flip-flop is shown in Fig. 2A. This circuit may be constructed from TTL 7402 NOR gates. It performs differently from the NAND-logic version, although you will note certain similarities (a slightly different set of operating rules applies).

The rules governing the NOR-logic RS flip-flop are summarized in the truth table of Fig. 2, but briefly let us review:

1. If both inputs are LOW, then the NOR-logic RS flip-flop outputs will remain in their present state. No change will occur.

2. Both inputs HIGH is a disallowed state.

3. If the set input is brought momentarily HIGH (and the *reset* input is left LOW), then the outputs go to a state where Q is HIGH and not-Q is LOW.



S	R	Q	Q̄
0	0	NO CHANGE	
0	1	0	1
1	0	1	0
1	1	DISALLOWED	

Fig. 2 - NOR-logic RS flip-flop, A) Circuit using TTL 7402 gates, B) Schematic symbol sometimes used, C) Truth table.

4. If the *reset* input is momentarily brought HIGH (and the *set* input remains LOW), then the outputs go to a state in which Q is LOW and not-Q is HIGH. (Note: In general, on any digital circuit, the *set* condition will be Q HIGH and *not-Q* LOW, while the *reset* condition means that Q is LOW and *not-Q* is HIGH.)

Clocked RS flip-flops

We sometimes get into problems with flip-flops that are too simple. We see, for example, electronic versions of the old "relay race" problem. But many of the problems can be tamed using clocked operation, and master-slave flip-flops (type of clocked RS flip-flop). The purpose of the clock is to synchronize the changes in the output condition by only allowing them to occur at certain times during, or immediately after the presence of a clock pulse. Note that most large scale digital circuits will have at least some clocked logic elements in order to keep things straight.

There are two basic forms of clocking used in flip-flops: *level triggered* and *edge triggered*.

A level triggered flip-flop is one in which the output state changes in response to conditions on the inputs only when the clock input is either HIGH or LOW. Some level triggered circuit (positive types) require the clock line to be HIGH before operation occurs, while others (negative types) require that the clock line be LOW.

An edge-triggered flip-flop will allow state changes only during the *transition* period of the clock pulse. The clock must be making a transition between either HIGH or LOW, or LOW and HIGH. A "positive edge triggered flip-flop" will allow output changes to occur only when the clock line is in the process of snapping from LOW-to-HIGH. But a negative edge triggered flip-flop requires exactly the opposite: a HIGH-to-LOW transition.

It is important to remember the difference between these two types of triggering. This information can often help you understand a digital circuit's operation. Let us reiterate:

Level triggered means that changes can take place only during the time when the clock input is either HIGH (positive level triggered) or LOW (negative level triggered).

Edge triggered means that changes can take place only during the instant when the clock pulse is in transition. A positive edge triggered device reacts during the LOW-to-HIGH transition, while a negative edge triggered device reacts only when the clock transition is HIGH-to-LOW.

An example of a simple level triggered clocked RS flip-flop is shown in Fig. 3. The main flip-flop is the same as the circuit in Fig. 1A, so it is shown here in block form. The S and R inputs are controlled by a pair of NAND gates. When the clock input is LOW, then both inputs to the RS flip-flop section (i.e., points A and B) see a HIGH, so no changes can take place.

But when the clock input goes HIGH, the levels at points A and B (i.e., the S and R inputs of the FF section) are then controlled by the other inputs of the NAND gates. These inputs are used as

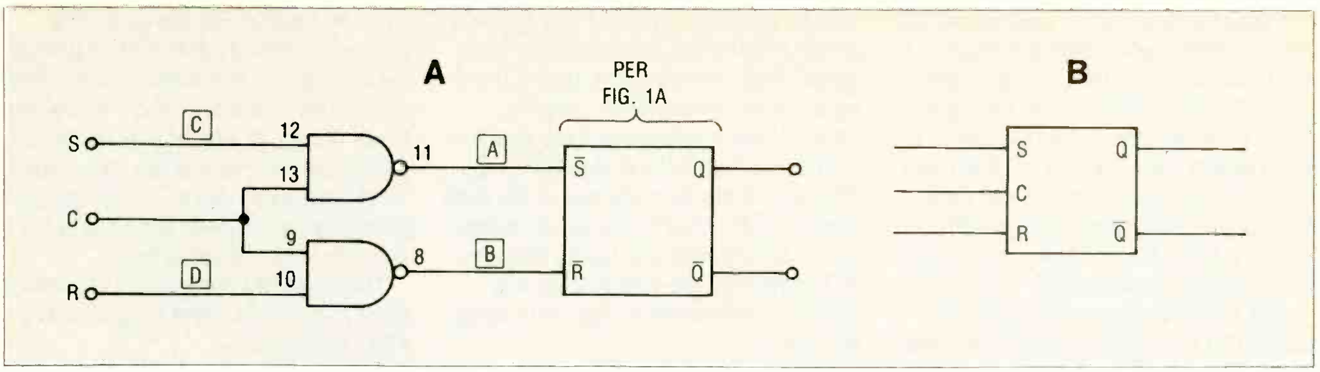


Fig. 3 - Clocked RS flip-flop, A) NAND gate circuit implementation, B) Typical schematic symbol.

the S and R inputs for the clocked FF. If you doubt this, then review the operation of the NAND gates in Part II of this series, or perform the experiments given at the end of the article.

Master-slave flip-flops

The use of clocking helps a great deal in taming the RS flip-flop. But several problems, again electronic versions of the old fashioned relay race, can still come up. Most of these are solved by using a slightly different approach, the master-slave flip-flop of Fig. 4. This circuit allows only one output change of state for each clock pulse.

The M-S flip-flop of Fig. 4 uses two clocked RS flip-flops, of the same type as Fig. 1A, connected in cascade. The inverter shown in Fig. 4 allows us to drive the clock inputs of the two RS FF sections out of phase with each other.

Recall that the clocked RS flip-flop of Fig. 3A can only change output state in response to S and R input conditions when the clock input is HIGH. In Fig. 4, the main clock line of the M-S flip-flop is kept HIGH, so FF2 is active and FF1 is inactive.

When a clock pulse is applied, in this case a negative-going transition, FF2 will become inactive and FF1 will become active (the inverter causes the clock input of FF1 to go HIGH at this time). Any commands placed in the S and R inputs will cause changes in the outputs of FF1 (i.e., points A and B in Fig. 4).

But because FF2 is inactive at this time, changes at A and B cannot be reflected as changes in the Q and not-Q outputs. But once the clock pulse has disappeared, however, the clock input of FF2 goes HIGH again, so the changes commanded by the levels at A and B can take place, and will affect the Q and not-Q outputs.

The synchronization occurs by keeping FF2 inactive when the input stage (FFI) is being set up, and then rendering FFI inactive while the data is transferred to FF2. This is called a

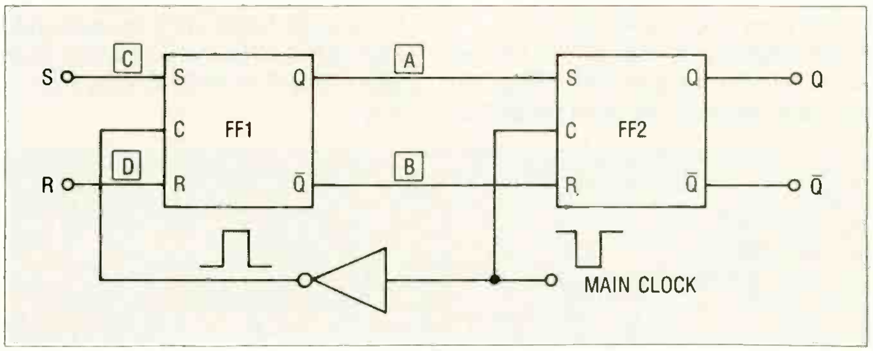


Fig. 4 - Master-slave flip-flop.

load-transfer operation.

Some IC examples

Very few examples of IC RS flip-flops exist, probably because they are too easy to make using just a pair of cross connected NAND or NOR gates. Most of the more complex flip-flops (such as the J-K FF discussed in the next installment of this series) are available in IC form, because they are too complex to be made economically from individual gates.

There are a couple of CMOS RS flip-flops, however. The pinouts for the 4043 and 4044 devices is shown in Fig. 5. The difference between these two devices is that NOR logic is used in the 4043, and NAND logic is used in the 4044. The rules governing these respective types were discussed in Figs. 2 and 1.

Note that both the '43 and '44 devices are quad RS flip-flops, meaning that there are four, independent RS flip-flops inside of each IC package.

Both of these CMOS devices have what is called *tri-state* outputs. Earlier in this series we told you that digital circuits operated in only two states, HIGH and LOW. Now we have to tell you that was a dirty lie. There are tri-state devices on the market, in which the third state is an inert condition that is neither HIGH nor LOW, but is defined as high impedance.

Recall that a HIGH state means the output sees a low impedance to V+, while a LOW condition sees a low impedance between the output and ground. The third state used in tri-state devices is a high impedance to both V+ and ground.

Tri-state logic is especially useful where several outputs are connected to a common bus line, but only one is to be active at any one time. Computers and computer peripheral devices often use tri-state logic devices on their data and address buses.

Experiments

These experiments are designed to be performed on an AP Products *Powerace 102* digital breadboard, or an equivalent product. Designations in the instruction below, however, refer to points and features of the *Powerace 102*. Designations such as "S2" refer to switches on the Powerace, while L4 is typical of the LED level indicators.

Experiment No. 1

Make an RS flip-flop using NAND logic. We will cross connect two sections of a TTL 7400 quad, two-input NAND gate IC for this experiment.

1. Connect the circuit of Fig. 1A, using the pin numbers shown. The V+ for the 7400 is pin no. 14, and must be connected to 5+ volts dc, while ground is pin no. 7.
2. Connect the Q output of the RS flip-flop (IC pins 3 and 4) to indicator L3, and connect the not-Q of the RS flip-flop (IC pins 2 and 6) to indicator L4.

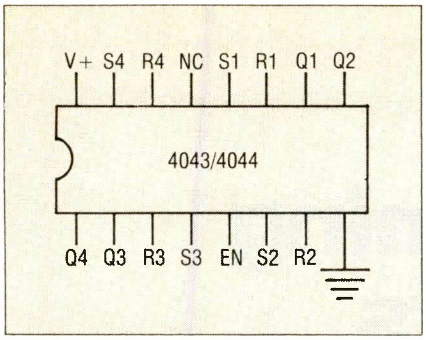


Fig. 5 - Pinouts for CMOS 4043 and 4044 quad RS flip-flop ICs.

3. Connect the *set* input of the RS flip-flop to the not-Q terminal of switch S5, and the *reset* input of the RS flip-flop to the not-Q terminal of switch S6.
4. Turn the Powerace 102 *on*. If L4 is not lighted, then momentarily depress S6.
5. Momentarily depress S5. This applies a negative-going pulse to the *set* input.
6. Note L3 and L4. What has happened? Is Q (L3) HIGH or LOW. Is not-Q (L4) HIGH or LOW.
7. Momentarily depress S6 and note any changes in L3 and L4.
8. Compare these results with the truth table in Fig. 1.

Experiment No. 2

Repeat experiment No. 1 using two sections of a 7402 NOR gate instead of the NAND gate. The correct pins are shown in Fig. 2A. Again, use pin No. 14 for +5V dc and pin No. 7 for ground.

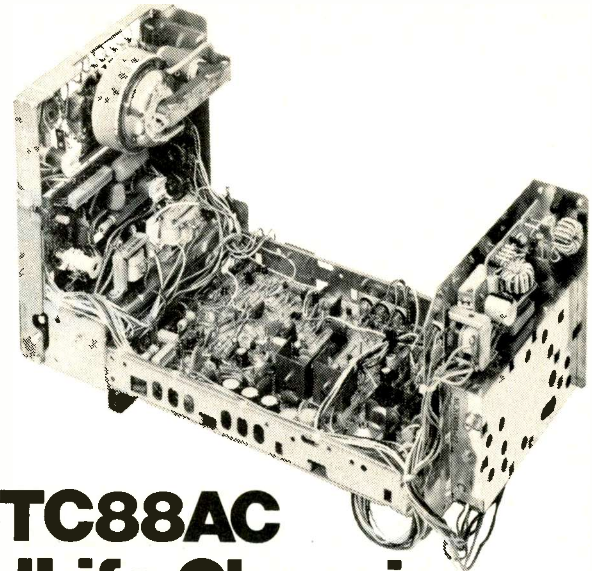
Recall that a NOR-logic RS flip-flop has active-HIGH inputs. This requires that we used the Q terminals of S5 and S6 instead of the not-Q as were used in Experiment No. 1.

Experiment No. 3

Build a clocked RS flip-flop using one section as shown in Fig. 1A (a NAND-logic RS flip-flop) and two additional NAND gates. Note that the 7400 device used to make the RS section also contains two more NAND gates to make the control section. The pinouts for these two gates are shown in Fig. 3.

1. Connect the circuit of Fig. 3, using the same pins as in Fig. 1A for the RS section, and the pins shown in Fig. 3 for the control gates.
2. Pin No. 14 is connected to +5v dc and pin No. 7 is grounded.
3. Connect the Q output of the RS flip-flop to L3 and the not-Q output of the RS flip-flop to L4.
4. Connect the *clock* input of the RS

continued on page 47



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Programming computers

The method for the madness

If you ever needed evidence that machines don't speak English, here it is. How we get machines to respond to human "wishes" is the subject of this fifth in ET/D's series on microprocessors. This article touches on assemblers, compilers and "machine language."

By Steven K. Roberts*

A few years ago, I designed and built a micro-processor system around the Intel 8008, the original CPU-on-a-chip. It was a wirewrapped agglomeration of about 350 IC's, which took seven months to pass from a vague idea to its debut as a computer. It was about midnight on Halloween of 1974 when at last, after weeks of hair-pulling, cursing debugging, the damn thing suddenly worked.

I was actually able to read the front panel switches and write the data to the front panel lights! Wow! This simple test passed at last, I fell into my first peaceful slumber in many a night.

The next day, a friend dropped by, responding to my excited babble on the phone. I demonstrated the great thinking monster, already named BEHEMOTH, performing not only the switch-to-light program but also some real exciting stuff like having the panel display count all by itself.

"Neat," she said. "What does it do?"

In frustration, I repeated the demonstration. Obviously, the capability needed to execute the simple routines could also be used to compute the world.

Mr. Roberts is president of Cybertronics, Inc., a microprocessor engineering firm in Louisville, Ky.

"Uh-huh," she murmured, looking for a tactful way of asking why I had spent seven months and a few thousand dollars to do what she could do with a few parts from Radio Shack.

The problem, of course, is that BEHEMOTH had no software yet.

Without software, the system was just a whole lot of chips waiting to be told what to do. I was looking at potential; my friend was looking at reality. As it turned out, the task of building useful software was considerable longer and more difficult than the design and assembly of the computer itself.

The most elegant microprocessor system, adorned with 64 thousand bytes of memory and festooned with all the I/O devices its bus can handle, is a cute but useless piece of hardware if it is without software. The whole business of computing is the execution of instructions: computers are merely tools which accomplish that end.

In the last couple of articles in our series, we have irreverently ripped the lid off a CPU chip and poked clumsily about inside, attempting to glean something about its structure. We also examined the relationship between the super-chip and the rest of the world in order to get some idea of what a system looks like. Well, we're done with that for the time being. A few 6-32's in the right places. . . there—the cabinet is closed.

Language

In various places throughout this series, we have tossed about some ideas concerning the underlying concepts of software—most notably in the December issue, where we created the ET/D compusette 80 whose resemblance to the new Sharp RT-3388 was purely coincidental and almost calls for a:

DECIMAL	HEXADECIMAL	BINARY
0	0	0000
1	1	0001
2	2	0010
3	3	0011
4	4	0100
5	5	0101
6	6	0110
7	7	0111
8	8	1000
9	9	1001
10	A	1010
11	B	1011
12	C	1100
13	D	1101
14	E	1110
15	F	1111

Fig 1-The relationship between decimal, hex, and binary. The use of hexadecimal code allows a single 'digit' to represent any value which four bits of data can assume. The eight bit value 11111111 is thus FF in hex and 255 in decimal.

"See? I told you so!". As you may recall, in that article we presented a program which would handle the tape counter and search functions of the computerized deck. Also, in our May discussion of the innards of the 8080, we described some of the instruction types and how they are seen by the CPU.

So we'll begin unconventionally.

Given the basic premise that our involvement with a computer requires us to tell it what to do, we find that there are numerous ways in which we can do so. The most brute-force, hard-core method is machine code: straight binary instructions that are directly executed by the processor. In our May issue, we mentioned some of these, such as 00111100, which causes the Accumulator to be incremented.

Well, it's a good thing we don't have to

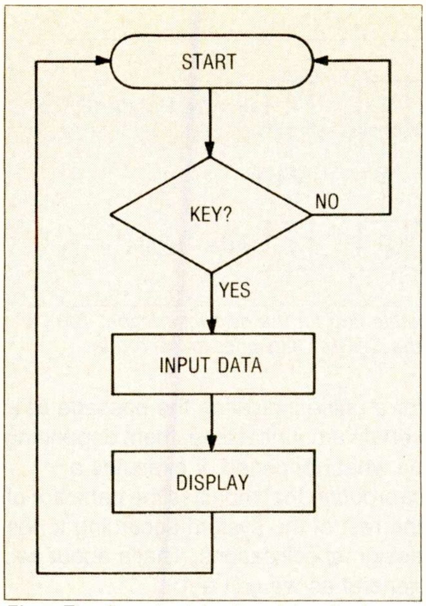


Fig 2-The flowchart for the data display "program" of Figure 3.

```
START:
IN    A,STROBE
RRA
JP    NC,START
      (NO CARRY, GO TO START)
IN    A,DATA
OUT   DISPLAY,A
JP    START
```

Fig 3-This simple keyboard routine demonstrates the basic principal of the 'wait loop.' The value of the bit indicating a keystroke is continuously tested until it is high, then the data is read and displayed.

A Few Special Terms

Assembler: A program that translates assembly language into the computer's native language.
Assembly Language: A low-level language that is similar in structure to the computer's native language but is more convenient to use.
Branch: Normally, a computer executes the statements of a program in order. Statements that tell the computer to break out of this normal mode are said to cause a branch. In BASIC it can be GOTO, in Z80 instruction set it is JP.
BUS: The means used to transfer information from one part of a computer to another (connection).
Compiler: A program that translates one computer language into another. Most commonly the term refers to a program that translates a higher level language into the computer's native language.
Disassembler: A program that translates a computer's native language into assembly language.
Subroutine: A portion of a program that can be executed by a special statement. It gives a single statement the strength of a whole program.
Terminal: The condition of a computer just before it dies. (That's all folks).

do it this way. Personally, I'd seek another profession if I had to bring myself down to the machine's level everytime I wanted something done. During the first few months of BEHEMOTH's existence, however, machine code was the only choice I had.

These cumbersome binary numbers can be made a little less awkward by the use of Hexadecimal to represent them. Figure 1 depicts the relationship between good old fashioned Decimal, Hexadecimal (call it "Hex"), and straight binary. No magic here—the method we use to express a number is entirely a function of convenience. Hex lets us break up a binary number into little chunks of four bits each, and give each of the sixteen possible combinations of four bits a name. It looks nicer on paper if the numbers all require the same number of written characters, so instead of sticking with decimal and counting 8, 9, 10, 11 . . . we use the first six letters of the alphabet. A is the same thing as 10. F is the same as 15. So much for the need to remember combinations of 1's and 0's: that increment instruction (00111100) can be broken down into two groups of four bits each (0011, 1100) and the groups named according to the table in Figure 1. The result is 3C. Same number.

If you really must have it in decimal, you simply multiply the digits by their binary weight. All you need to remember is that the number or letter in the leftmost column represents the number of "16s" and the rightmost number is the number of ones. For instance, the decimal equivalent of 3C is 60 ($3 \times 16 + 12$). The decimal equivalent of C3 is 195. Now, what is the decimal equivalent of Hex 20? or Hex A7? of Hex FF?

What's an assembler?

So there is machine code—the way we least want to speak with computers. Hex helps, but looking at pages of that stuff will make your head swim. The next step, then, is the expression of our instructions in codes which make some human sense—such as 'INC A' for the increment instead of '3C' or '00111100'. There is still a one-to-one correspondence between the written instruction and the one the machine sees, but this way it is considerably easier for people to deal with.

But it is much harder for the machine. In order to convert a program written in "human" code to something it can understand, it first has to run another program—one which takes the "human instruction" (program) and "assembles" it into machine language. This involves not only the conversion of statements into their binary codes, but also the manipulation of labels—allowing us to say something like 'IN A, SWITCH' or 'CALL BEEPER' instead of numerically designating the input port or giving the address of the BEEPER routine.

(If you think about it for a moment, it becomes clear that some poor fellow had to write the first Assembler in machine language—ughhh!)

Assembly language is the method we will use to talk to our systems in this series. Not only is it more efficient than all higher-level languages in terms of actual instruction execution, but it allows us to know at all times exactly what *the machine* is doing. But for perspective's sake, let's take a quick look at some of the more sophisticated languages.

High level

You've probably heard of some of them—probably even run into a couple in school: BASIC, FORTRAN, COBOL, ALGOL, PASCAL, LISP, SNOBOL, RPG, and C. Each offers certain advantages in certain kinds of environments, and each has its staunch, sometimes almost militant, supporters in the computer world.

High-level languages really simplify things. In BASIC, the most widely used 'interpreter' in the microprocessor business, you simply say "Let A=SQR (X)" if you want to create a value named 'A' that is equal to the square root of 'X'. To do this simple thing in Assembler, you would probably write or copy an extensive program that calculates square roots using the Newton-Rhapson method or some such madness . . .

Interpreter languages, which are assimilated by the computer one statement at a time (and are thus sinfully slow) and Compilers, which are extensively processed into machine code before execution, require considerable machine overhead. They have the general advantage of allowing program expression in something closer to English (and getting closer still by the day) but are, probably without exception, somewhat less efficient than straight Assembler in the execution of code. In all business environments—in fact, in most large-system environments—the tradeoff heavily favors the higher level languages (who cares if PAYROLL takes 8 minutes instead of 6.783?) but in machine control tasks, including appliances and the like, the opposite is true.

So we always have between ourselves and the computer a program that serves as a translator, converting our structured, formatted statements into blocks of binary code that, in turn, "make sense" to the system. With that in mind, let's delve into the concepts of programming.

Machine control

In almost every "control" task that comes to mind, the same overall type of program structure can be used. Generally, such a control problem, which may occur in an appliance as well as a piece of industrial equipment, involves the continuous monitoring of certain conditions and the modification of certain variables as a function of those conditions. You may recall our December installment dealing with the cassette deck—the program spent most of its time in a "loop," waiting for a reel pulse. When it found one, it went to the subroutine called COUNT, which updated the tape counter, then returned to the loop.

Let's look at a typical wait loop, one which appears in thousands of systems. The objective is to allow somebody to type on a keyboard and have the data appear on a CRT display. Figure 2 shows the program logic in "flow chart" form.

Beginning at START, the computer arrives at the "decision block," labeled KEY?. This is a test to determine whether or not a key has been pressed. (We are assuming the use of a typical ASCII keyboard, which produces a strobe signal when any key has been hit, indicating to the system that the data (in the 7-bit ASCII code) may be read on the input port to which the keyboard is connected.)

Wave the flag

If no key has been pressed, we do not want any data—it would only be garbage So, we simply go 'round and again. This is called loop. In the program (Figure 3), this function is accomplished by the first three instructions: First, input the port, shown in more detail in Figure 4. Bit 0 carries the strobe line, and has been connected such that when it is a 1, it indicates the presence of a key. Second, rotate the Accumulator to the right, causing all bits to move over one position-bit zero into the CARRY flag. Since CARRY is one of the testable flags for which the machine continually searches, we are in a position to issue a conditional JUMP instruction that depends on it. Third, then, is the actual test—if the carry bit is zero, jump to START. The machine will perform this three instruction loop until someone hits

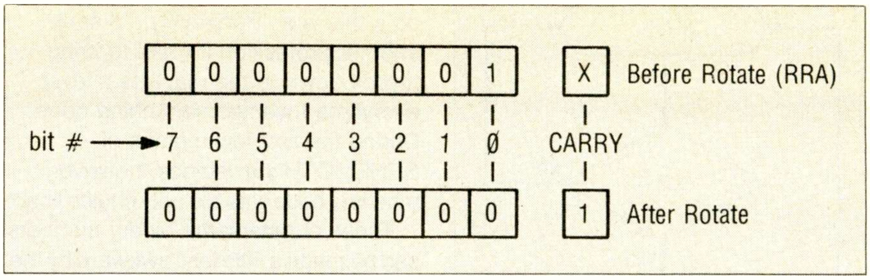


Fig 4-The STROBE data before and after the rotate flag for the next instruction. The "X" is used to indicate a "don't care" condition of the CARRY flag prior to the rotate.

a key or until hell freezes over, whichever comes first.

Somebody hits a key! On the next pass through the loop, the value called STROBE is 01 instead of 00, the carry bit is set on the rotate, and the JUMP IF NOT CARRY is invalid. The system then proceeds to the next instruction, directing it to input the actual key code (DATA). This it does, then outputs it to something called DISPLAY, which we can assume is a CRT. After it has done this, it is ready to wait for another key again.

Get me out

If this program were entered into a system, assembled, and run, it would allow you to sit at a keyboard and type to your heart's content, with the information copied verbatim onto the CRT display in front of you. But do you notice a flaw in the logic?

How do you ever stop it?

Suppose you are tired of typing onto a display screen, and want to do something else with the computer? You could always hit the RESET button—the brute-force method of interrupting a system no matter what it's doing. Or ... we could change the program to make it a little more flexible.

One of the characters in the ASCII set, which appears on all computer keyboards, is ESC, or 'ESCAPE'. It is as undistinguished as all the others-merely a 7 bit code (Hex 1B), but has such a nice name that it is often used to 'escape'. So lets add a test to our keyboard routine of Figure 2 whicn will jump to another program if the key that was struck happens to be ESCAPE. The result is shown in the flow chart in Fig. 3.

This time we add a test after reading the key value, in which we compare the data we read to the value of the ESC key. If it is not equal, the loop is allowed to continue, but if it is, we jump ELSEWHERE.

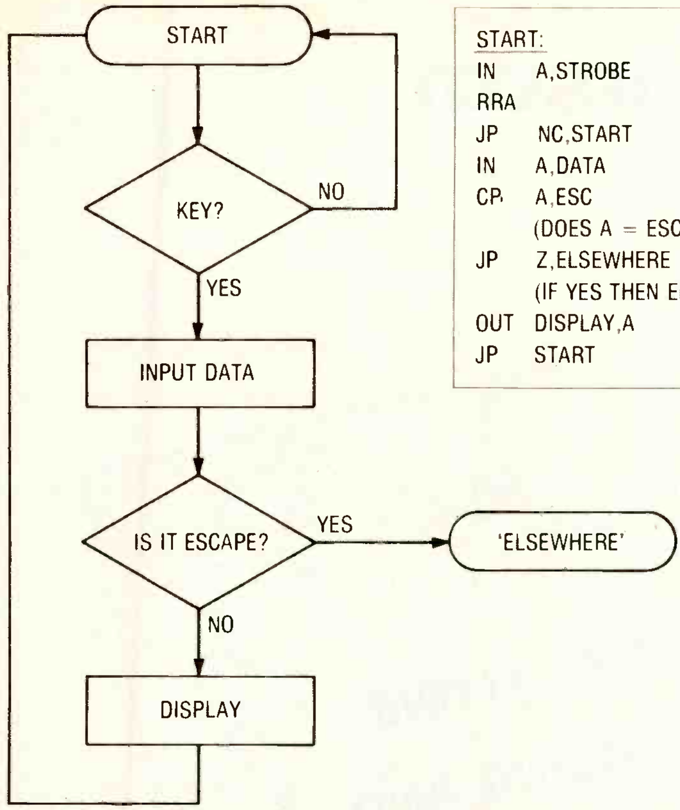
In a real control application, such as the one we will describe in the upcoming article on an actual system, the concepts are about the same. The program spins in a loop, waiting for an external event or for a pulse indicating the passage of a certain amount of time, then, depending on what happened, it executes a *subroutine* that modifies the behavior of the rest of the system according to the design specifications. That's about as general as we can get.

The instruction set

I promised you a presentation of the complete instruction set of the 8080, and here we are, already awash in a sea of paper. Tell ya' what—so's we can do it justice, we'll generalize a bit. For the moment, rather than a detailed listing of the instruction set, we'll look at the major types along with some representative samples. As mentioned in May, we use the Z-80 operational codes for clairty, and now and again will toss in some of the Z-80 instructions where their absence from the 8080 is particularly depressing. The complete Z-80 instruction set is much longer and more confusing, so we'll bleed those in as necessary in future articles, presenting only the basics now.

Instruction groups

First, there is the DATA TRANSFER GROUP. These instructions allow us to move data between registers or to and from memory. Recall that there are seven registers—A,B,C,D,E,H, & L—and that of those, A is the Accumulator and the other six can be taken as pairs if desired. In particular, registers H & L are used extensively to address memory. The data transfer instructions are all identified by the mnemonic "LD" for LOAD, and the operands which follow determine the source and destination locations in the system. "LD A,E" (load A with E) for example, causes the data in E to appear in A. Likewise, "LD A,(HL)" causes the data in the memory location currently addressed by the contents of H and L to appear in A. It is possible to name an arbitrary location: "LD 3E72H,A", though a bit clumsy, would cause the data in A to be written into location 3E72 (Hex) in memory. (Normally, such absolute memory references are accomplished with a




```
START:
IN    A,STROBE
RRA
JP    NC,START
IN    A,DATA
CP    A,ESC
      (DOES A = ESCAPE?)
JP    Z,ELSEWHERE
      (IF YES THEN ELSEWHERE)
OUT   DISPLAY,A
JP    START
```

Fig 5-The improved keyboard routine (with its associated flowchart) allows exit upon depression of the ESCAPE KEY. Note that after the "compare" instruction, which checks the Accumulator against the value 1B, the ZERO Flag is set to indicate an "equals" condition. The next statement directs the processor to go ELSEWHERE in this case.

named location to enhance program readability—such as "LD VALUE,A". VALUE would be a defined location named elsewhere in the program as the actual address.) We can also load immediate values into registers or pairs of registers, store data in memory indirectly (where we have the machine place the data in a location that is addressed by another location), perform exchanges, and much more. None of the condition flags are affected by any of the data transfer instructions.

Second, there is the ARITHMETIC GROUP. These perform arithmetic operations on data in registers and memory, and heavily affect the condition flags (Zero, Carry, Sign, Parity, and Auxiliary Carry). Most of them focus on the accumulator, such as the ADD instruction which allows any register, any byte in memory, or any piece of immediate data to be added to the current contents of the accumulator. The instructions in this group include all the variations of: ADD, SUBTRACT, INCREMENT, and DECREMENT. Also, there is the DECIMAL ADJUST ACCUMULATOR (DAA) which we used with the tape counter logic, an instruction which converts binary to two four-bit binary coded decimal numbers for display to humans.

Boolean operations

The third major group is the LOGICAL GROUP which, although all instructions use logic, is limited to "Boolean" operations on data such as AND, OR, EXCLUSIVE OR, COMPARE, COMPLEMENT, and ROTATE. These are incredibly useful to the programmer, as they allow efficient bit manipulation with a minimum of software overhead—something which cannot be said for most of the high level languages. Briefly, the first three produce a result that is a function of two bytes of data, performing the designated logic bit-by-bit. The AND operation will produce a '1' in any position if both of the original bits in that position were also '1', OR will produce a '1' if either or both were '1', and EXCLUSIVE OR will produce a '1' if one or the other but not both of the original bits was a '1'. The COMPARE affects the flags in numerous ways to depict the relationship between the accumulator and some other piece of data, COMPLEMENT merely inverts all the bits in the accumulator, and the ROTATE instructions provide four ways to shift the positions of the bits (as in the keyboard wait loop example).

Fourth, we have the BRANCH GROUP. The function of these is to alter normal program flow, and they do not affect the condition flags in any way. The branch instructions may be separated into two classes, conditional and unconditional. The conditional branches are only executed if a certain specified condition of one of the flags exists; the unconditional branches alter program flow regardless.

Branches are of three types: JUMP, CALL, and RETURN. If you merely want the program flow to break off, conditionally or unconditionally, and take up somewhere else, you would use a JUMP. If you want it to perform a subroutine, however, where it would be expected to come back to the original program after doing its thing elsewhere, you would use a CALL. The question that immediately arises here, of course, is: how does the computer know where to come back TO?

The stack pointer

There is a thing called the STACK. It is always referenced by a STACK POINTER. The fundamental use of this is the storage of subroutine return addresses: when a CALL is executed, the address of the instruction after the call is "shoved onto the stack," and the pointer decremented to point at the next word down. This can happen as often as the programmer wishes, as a table is gradually created that allows for an orderly return to the original level of the program. Subroutines call subroutines which call subroutines which call still more subroutines, and as long as the proper number of RETURNs is executed (yup—a RETURN is the opposite of a CALL), the system will eventually wind up back where it started.

Screwing this up while writing a program results in what is usually known as a STACK CRASH, a generally frustrating phenomenon.

And last, there is the STACK, I/0, AND MACHINE CONTROL GROUP. Stack, you say? Yes, in addition to pushing subroutine return addresses onto the stack, it is possible to "save" the contents of registers by doing a "PUSH"—and to restore them by doing a "POP."

This comes in especially handy when the program uses interrupts—a means by which an external event can asynchronously force the processor to cease its normal

continued on page 46

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A new catalog describing and illustrating its line of television signal distribution products for MATV, CATV, audio/video, and home use is available from *Blonder-Tongue*. The catalog has a separate section for each of the company's major product groups. Individual product specifications, application drawings and product features are highlighted to facilitate easy reference by specifying engineers, industrial and commercial buyers, and individual home TV owners. Copies of the catalog are available by writing to Blonder-Tongue Laboratories, Inc., One Jake Brown Rd., Old Bridge, NJ 08857.

The Toll Free Digest Company has just published exactly what its name implies—a directory of toll-free "800" telephone numbers. This 4th edition is a classified directory of reportedly over 17,000 numbers in 490 categories. The electronics listing is too short but it would be invaluable to anyone planning a trip or in need of a call to the IRS. Hotels and motels occupy over half of the book and the IRS toll-free number for each state is listed. $5.00 including postage and handling from *Toll-Free Digest,* Box 800, Claverack, NY 12513.

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...change
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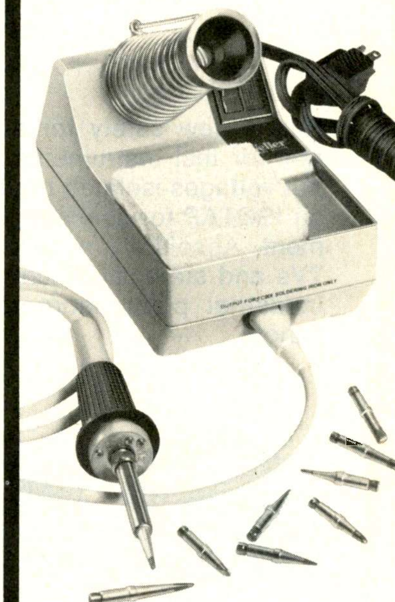

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The "Radio Handbook" 21st edition by William I. Orr, W6SAI, has just been published by *Editors and Engineers*, a division of *Howard W. Sams & Co., Inc.* This handbook has been an industry standard since its development in the '30's, for engineers, technicians and radio amateurs. It contains detailed information on the design and construction of modern radio communications equipment, including extensive sections on the construction of linear amplifiers and VHF and UHF transmitters and converters. 1136 pages, hardbound, $21.50. As always, an invaluable book for anyone involved with radio communications.

Digital Troubleshooting. Here's something that is not very familiar to most of us but must become so soon. ETD found "Getting Started in Digital Troubleshooting" by James Coffron to be the best introduction to digital troubleshooting we have seen so far. Presented mostly as troubleshooting problems—with extensive background material—it is the closest thing to a hands on approach possible in printed form. Typical digital systems are broken down into sections, and clock pulses, for instance, are followed through each stage where operation might be affected. Written by a Hewlett-Packard engineer—a recommendation in itself—all of the techniques presented are stated to be field tested and all of the information relates to actual equipment. "Getting Started in Digital Troubleshooting," James Coffron, Reston Publishing Co. Inc., A Prentice-Hall Company, Reston, VA, Hardbound $16.95 ET/D

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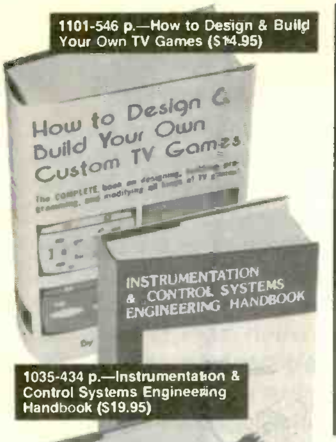

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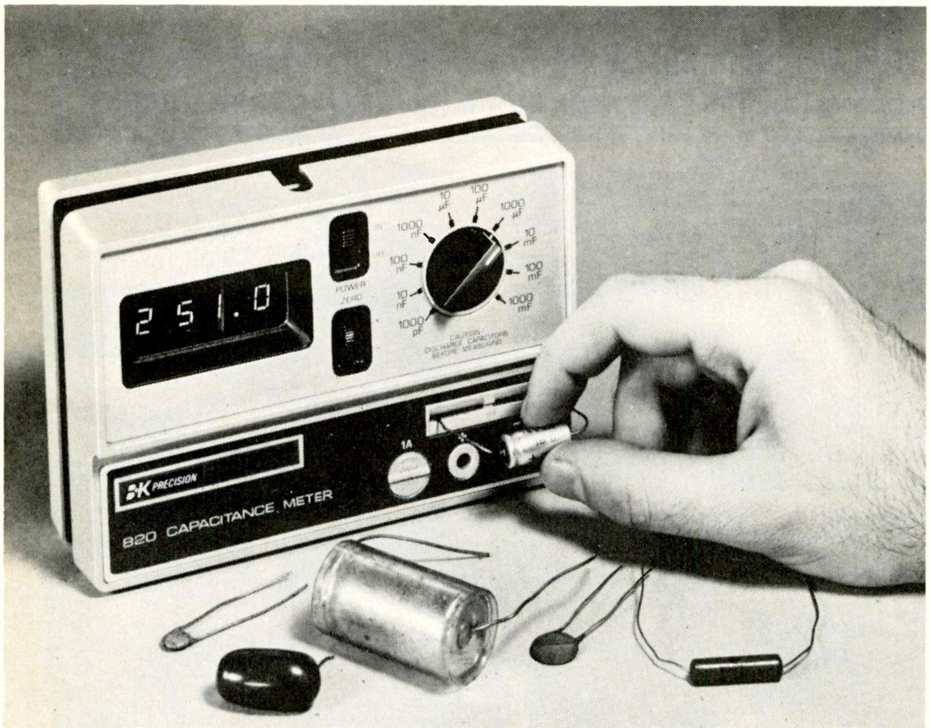
TEST INSTRUMENT REPORT



B & K-Precision's Model 820 Capacitance Meter. For more information circle Number 150 this issue.

B & K-Precision's Portable Capacitance Meter

It's here at last

By Richard W. Lay

As components go, capacitors constitute a major element of any electronic circuit. That's why it's so hard to believe that just within the last year or so we have begun to see precision capacitor checkers and analyzers making their way into the home electronics service market. This fact remains despite the evidence that—aside from electronic tubes themselves—the component generally most likely to fail or lose tolerance was ... you guessed it ... the good old capacitor.

So it is, I suspect, that many of you out there will welcome with open arms a really low priced, fully portable unit for measuring a wide range of capacitance values.

The unit is here now from B & K-Precision. It's their Model 820 Capacitance Meter, an out-of-circuit tester capable of measuring capacitance values from .1 pF to 999.9mF in 10 ranges. This hand-held, battery powered (4 standard "C" cells) unit, weighing only 1½ pounds, is a natural for many bench or field service applications.

ET/D has been using one of these units on and off now for the past couple of months and we can say unequivocably the 820 is certainly a welcome addition, especially when working in critical timing circuits where actual capacitance values or matched pairs become very important.

Because this type of test gear is not really as familiar to many of us as our voltmeters, or scopes for that matter, I thought it would be appropriate to give you a closer look at some of the operating principals and circuitry behind B & K's meter.

Before we go any further though, let's take a look at what the Model 820 will do for us and then we can get into some of the operating principles.

Basically, this unit is a hand-held piece of test gear ideally suited for lab, shop, or educational use. It's main utility is realized when sorting unknown capacitors, selecting pairs, or just checking general tolerances and parameters. The 820 is battery operated with battery life in the 6-hour range (continuous operation). Either rechargeable or regular batteries are permissible since a rechargeable battery pack is one option.

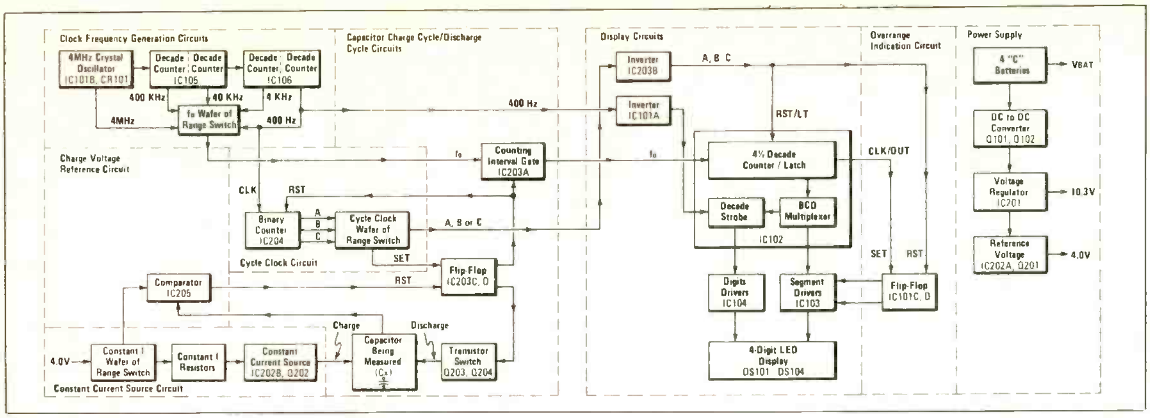
Also, the 820, operable from about 4VDC to 6VDC, has a built-in battery test terminal so that the batteries may be tested without removing the back cover.

Although the 820 is an out of circuit tester and all capacitors should be fully discharged before testing, it is fuse protected. The readout is via 4 seven segment LEDs with an overrange indicated by the bottom segment of each LED, i.e., (——). The accuracy is reported by B & K-Precision at .5% of the full scale reading (plus or minus LSD) on the 1,000pF to 100μF ranges and 1% of full scale readings (plus or minus LSD) on the 1,000μF to 1,000mF ranges. During the weeks which I used this piece of test gear I found nothing to dispute this statement.

The only annoyance I encountered with the 820 was the charging time on the 1,000mF range, up to 35 seconds with a minimum of 25 seconds if you "hit it right." However, this is said to be typical of all capacitor testers using this test principle on the market today since the larger the capacitor in farads, the longer the time it will take to charge to a given reference voltage, other things being equal.

The ten full-scale readings on the 820 are 1,000pF, 10nF, 100nF, 1,000nF, 10μF, 100μF, 1,000μF, 10mF, 100mF, and 1,000mF. Since many schools are now using the nanofarad terminology, B & K has adopted this practice. Just remember pF = 10^{-12}; nF = 10^{-9}; μF = 10^{-6}; and mF = 10^{-3}. However, you'll be happy to know a handy conversion chart is supplied on the back of the 820 itself.

Using the 820 is a simple matter of plugging in the two banana jack test leads and "zeroing" the LED reading in the 1,000pF range so that it fluctuates between "0" and "1." This zeroing procedure compensates for the capaci-



A block diagram of the 820.

tance which may be in the test leads and B & K says up to 20pF of capacitance may be zeroed out in this manner.

However, it is not necessary to use the test leads with capacitors which have their own wire leads of appropriate length because there is a front panel, spring tensioned slot socket which is capable of accepting a wide variety of capacitor lengths, dimensions and various lead dress.

The 820 is a state-of-the-art piece of test gear with 11 ICs, eight transistors, and associated circuitry mounted on two circuit boards. It is designed around the familiar RC time constant principal using a constant current source. According to B & K the meter has a precision current source and precision voltage reference to which each capacitor is charged.

Capacitors on the seven lowest ranges are charged to a maximum of 2.5 volts, on the three highest mF ranges, a maximum charge of .5 volts is used.

The basic clock frequency is 4MHz and is developed through a crystal controlled oscillator (IC101B—see block diagram). Three basic clock frequencies, 4MHz, 400KHz, and 40KHz, are used in combination with constant current sources of 1µA, 1mA, or 20mA, to produce five different "Charging times" of 2.5mSEC, 25mSEC, 250mSEC, 2.5 seconds or 25 seconds (for full scale readings).

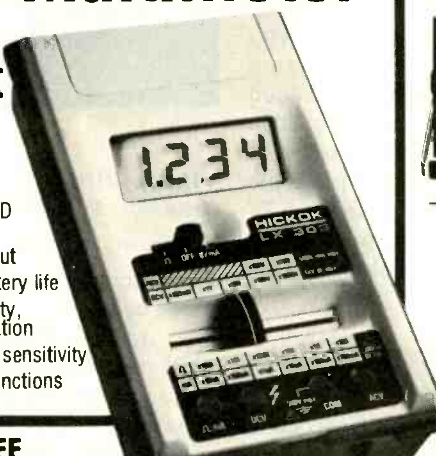
This charging time is what is converted eventually into capacitance in direct readout in picofarads, nanofarads, microfarads, or millifarads, depending on the clock, voltage reference and current source used.

After looking over the schematic or block diagram for this diminuitive 820 meter, one can understand why such units years ago were found only in laboratory settings. It would have been too bulky and expensive for a serviceshop.

However, now that it is here in integrated circuit form via B & K-Precision, I'd have to say it certainly is a "buy" at $130. ET/D

HICKOK TEST INSTRUMENTS

HICKOK New Digital Mini-Multimeter



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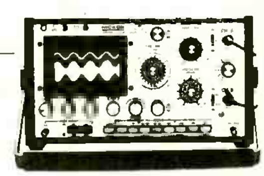

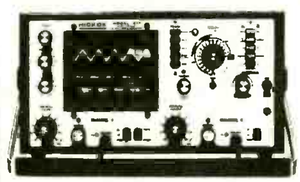

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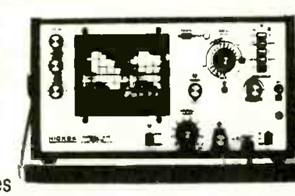

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Circle No. 117 on Reader Inquiry Card

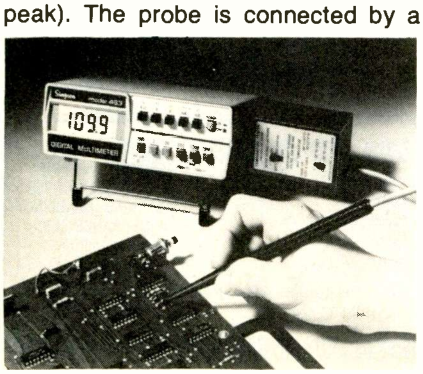
NEW PRODUCTS

Digital Multimeter
Circle No. 132 on Reader Inquiry Card

A new digital multimeter of reportedly high basic accuracy is the latest introduction of *Sinclair Radionics, Inc.* Model DM-450 provides six functions with 34 ranges and a basic accuracy of 0.05%. while ten megohms is the standard input impedance. It can be operated on the basic dc ranges with an input impedance greater than 1000 megohms which is very useful in MOS circuits. Basic ranges are to 1200V dc, 750V ac, current to 10A ac or dc and resistance to 10 megohms. The price is $199.00.

Temperature Probe
Circle No. 133 on Reader Inquiry Card

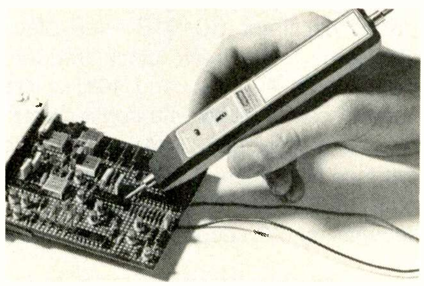
Simpson Electric Company has announced a new temperature probe for testing, troubleshooting, and service of electronic, electrical, or heating and air conditioning equipment. The probe can be connected to almost any analog or digital volt-ohm-milliammeter. Temperature is read directly on the millivolt display. For example, a reading of −25.1mV equals −25.16°. The pencillike probe has low thermal mass for fast response and high sensitivity, even when checking tiny electronic components. It's insulated, so you can measure temperature in "live" circuits (to 350V peak). The probe is connected by a



4-foot cable to a circuit module which converts degrees to millivolts. A switch selects −50° to +150° C or −58° to +302°F ranges. A 9-volt transistor battery reportedly provides up to 750 hours operation. Accuracy at the probe tip is stated to be ± 1°C from 0°C to 100°C. From −50°C to 0°C and from 100°C to 150°C, the accuracy decreases linearly to ± 3°C. Response time is 1.5 seconds to within 2°C of final reading for a 50°C change. Output circuit loading is 5000 ohms minimum. The price is $97.

Digital Pulser Probe
Circle No. 134 on Reader Inquiry Card

The Model DP-100 digital pulser probe designed as an aid to rapid troubleshooting of digital logic systems is now available from *B&K-Precision*. The DP-100 generates a single pulse or a 5Hz pulse train which will automatically pull an



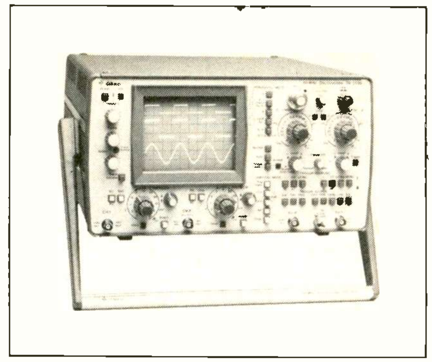
existing low state to high or high state to low. It is compatible with DTL, TTL, RTL and CMOS logic circuits. Operating power is supplied by the circuit under test. The net price is $80.

Test Jig Adapter
Circle No. 135 on Reader Inquiry Card

The heart of the *RCA* color TV test jig, the horizontal and vertical matching transformer and selection switches, are available as a separately packaged adapter, along with a low impedance yoke. This allows the modernization of most earlier 18 in. or 19 in. test jigs or the construction of a jig from a salvaged TV receiver. All RCA test jig accessories can be used with the adapter.

60MHz Oscilloscope
Circle No. 136 on Reader Inquiry Card

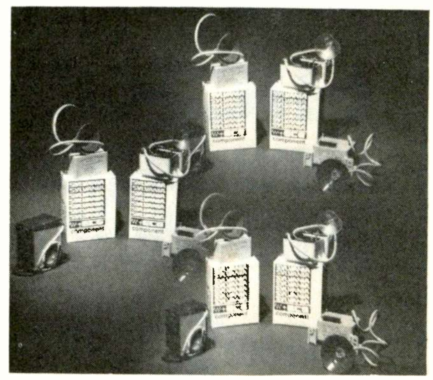
The new *Gould* OS3500 oscilloscope is a portable dual trace instrument with a 60MHz (−3 dB) bandwidth and the unusual option of an accessory add-on multimeter. It offers all of the capabilities of a good dual-trace scope and adds some unique features. In addition to standard dual-trace displays, it offers a third display to view the triggering signal.



The DM3010 add-on DMM when used with the scope—it can be used independently—offers increased accuracy in measuring amplitude, time and frequency. The cost of of the OS3500 complete with probes is $1995; the price of the DM3010 is $360.

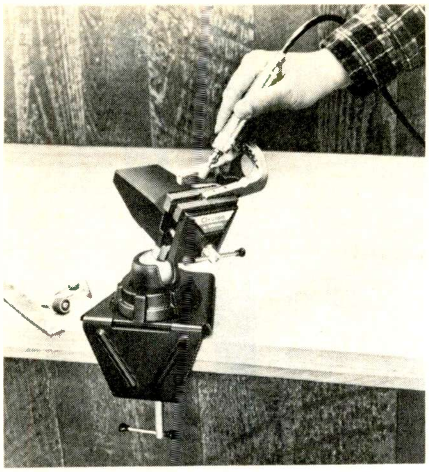
HV Multipliers
Circle No. 137 on Reader Inquiry Card

GTE has recently announced the addition of 13 high voltage solidstate multipliers to the *Sylvania* ECG line. These multipliers include eight five-step triplers, three six-step triplers, an eight-step quadrupler and a five-step tripotential tripler, all intended for use in the high voltage section of color TV receivers. All are cross references to the part numbers they replace in the 1979 ECG Guide.



Vise/Clamp
Circle No. 138 on Reader Inquiry Card

A new Vise Base Clamp and D-Vise/Clamp combination has just been introduced by *Dremel*. Both are designed for the do-it-yourselfer, hobbyist, craftsman, model maker and technician who needs that "extra hand" a vise provides to do the job easier. The new vise clamp can be placed over the Dremel D-Vise and allows it to be clamped to any flat surface for greater stability without permanently mounting the D-Vise. No screws are needed to mount the D-Vise with the use of the new vise clamp. The D-Vise reportedly offers 180° tilt and 360° swivel for positioning of

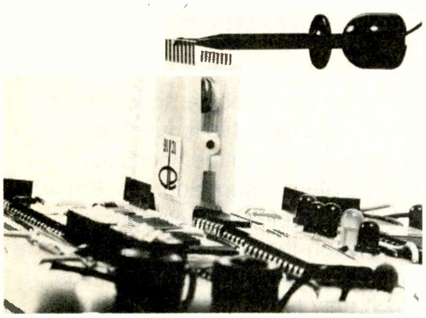


a work piece. Machined slide rods assure parallel jaw alignment and equalized work pressure.

The D-Vise/Clamp combination No. 2221 features one D-Vise and one No. 2218 Base Clamp, and sells for $28.00. The No. 2218 Vise Base Clamp has a list price of $4.95.

IC Test Clip/Puller

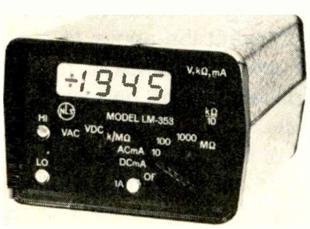
Circle No. 139 on Reader Inquiry Card



A P Products has refined its basic test clip design in the new Super Grip II to provide a narrower nose clearance for easier attachment to high density boards. New pin design with offset rows and button heads make it easier to attach test probes and prevents probes from slipping off once attached. Super Grip II test clips are available in 8, 14, 16, 16LSI, 18, 20, 22, 24, 28, 36, and 40 pin configurations.

Digital Volksmeter

Circle No. 140 on Reader Inquiry Card



Non-Linear Systems new Model LM-353 3½ digit Digital Volksmeter includes voltage ranges to 1000V ac and dc, resistance ranges to 10,000 K ohms and current ranges to 1000 MA, all in a 9.2 ounce package measuring 1.9 inches high by 2.7 inches wide by 4 inches deep. Additionally the ohms ranges can be operated at a low applied voltage to avoid turning on semiconductor junctions. The LM-353 uses a LCD display and operates up to 100 hours on standard AAA cells and sells for $149.50.

One-Hand Soldering System

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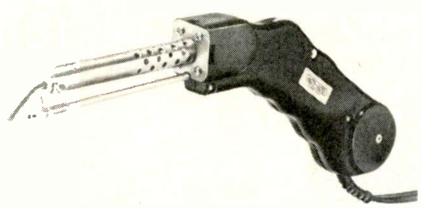
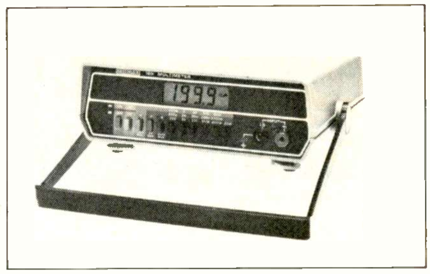


The Hot Rod soldering system, available from *Michael Anthony ' Co.*, combines soldering iron and solder into a self-contained "one-hand" tool. Unlike conventional soldering irons, the Hot Rod features a solder-feeding mechanism which gives the operator a free hand while soldering, reportedly providing greater precision and control for intricate work. A refillable solder magazine is located in the handle of the gun. Solder is fed from the magazine directly onto the gun tip by means of a thumb dial located on top of the handle. The solder magazine comes equipped with a full supply of 60/40 rosin core solder, but can be refilled with any type of solder up to 18 gauge. The Hot Rod System provides even heating up to 840°F tip temperature, with 60 watts of power (120V/60Hz). The product is listed by Underwriters Laboratories, Inc. The Hot Rod soldering system is a useful tool for any industrial applications, home and auto repairs, hobbies, cfts, and do-it-yourself projects. Cost of the standard kit is $19.95.

Digital Multimeter

Circle No. 142 on Reader Inquiry Card

One year battery life is reportedly a feature of *Keithley Instruments* new five function, 3½ digit LCD DMM. Ranges are selected by 11 color coded pushbutton switches and the front panel is color coded also. The LCD used features 0.6 inch digits, polarity indication is automatic and the decimal point is positioned by



the range selection. Voltage ranges are protected up to 1400V peak and resistance ranges are protected to 300V RMS. A two amp fuse protects the current ranges. Accessories include a 40KV probe, a 50 ampere shunt, an RF probe, test leads and a carrying case. The price including batteries and leads is $149.

PC Board/Breadboard System

Circle No. 143 on Reader Inquiry Card

Continental Specialties Corporation now offers The Experimenter System™ a scratch pad, breadboard, PC board system, with each development step, the layout sheet, the breadboard, and the printed circuit board, the indexed equivalent of each other. The circuit can be sketched in its final layout form, breadboarded and wired on the PC board, maintaining the exact layout throughout the process.

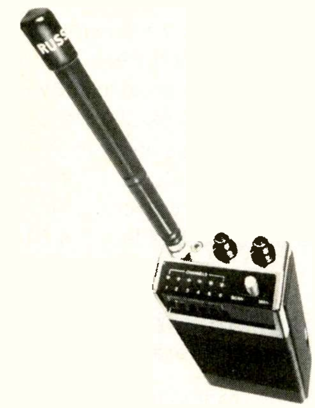
Printed Circuit Supplies

Circle No. 144 on Reader Inquiry Card

A new and comprehensive assortment of printed circuit materials has been released by *GC Electronics*, Rockford, Il.

The materials will serve the needs for laying out and preparing printed circuit boards for engineering prototypes and experimental as well as hobbyist applications. Included in this greatly enhanced line of PC aids are chemicals, tool kits, graphic symbols and accessories. The GC pressure sensitive drafting configurations are available in convenient quantities. Special repeat adhesive allows one to reposition a symbol several times if design changes dictate. ET/D

DEALER'S SHOWCASE



Scanner Antenna

Circle No. 145 on Reader Inquiry Card

Russell Indusries has recently announced a new antenna which is stated to be the first five band, "Rubber Duckie" antenna. It covers VHF low band, high band, ham, VHF and UHF T-band and while it is designed specifically for use with the Bearcat Four-Six and Fannon/Courier Scanfare scanners, it can be used with most single and multi-band scanners.

Automatic Dialing Telephone

Circle No. 146 on Reader Inquiry Card

A telephone that remembers numbers and dials them automatically is being introduced by *General Telephone &*

Electronics Corporation. The new telephone is a repertory dial telephone known as Access I. It can be programmed in seconds to remember nine frequently called or emergency numbers and automatically will remember the last number dialed manually. By depressing just two buttons, any of the stored numbers will be dialed automatically.

Home Speaker Systems

Circle No. 147 on Reader Inquiry Card

Audiotex division of GC Electronics has introduced four new high fidelity Home Speaker Systems featuring a total motor system which reportedly results in higher than normal efficiency for acoustic suspension speakers. Now available is the 8-inch, Two-Way System (Cat. No. 94-1200, suggested retail price $59.95 each), with a power handling capacity of 35 watts RMS with a frequency response of 45 Hz to 20 kHz. A 10'' woofer and wide-dispersion phenolic-ring tweeter highlight the Audiotex 10-inch, Two-Way System (Cat. No. 94-1300, suggested retail price $69.95 each), with a power rating of 35 watts RMS and a frequency response of 40 Hz to 20 kHz. The new 10-inch Three-Way System

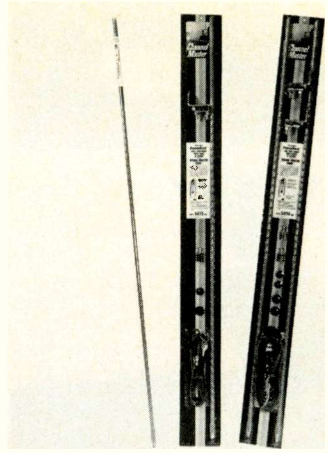
(Cat. No. 94-1350, suggested retail price $89.95 each). A deep-throw 10'' woofer, 4½'' hardback midrange, and phenolic-ring tweeter of 40 watts RMS with a frequency response of 40 Hz to 20 kHz. The 12-inch, Three-Way System (Cat. No. 94-1400, suggested retail price $99.95 each), utilizes an acoustic suspension system with a 12'' woofer, 4½'' hardback midrange, and wide-dispersion phenolic-ring tweeter. The system handles 45 watts RMS with a frequency response of 35 Hz to 20 kHz.

Inductively Tuned CB Whip

Circle No. 148 on Reader Inquiry Card

Channel Master has introduced, reportedly, the only CB antenna with integral inductive tuning. Constructed of 3/8 inch unbreakable fiberglass with a weatherproof polyvinyl sheathing, PoweRod tunes with the twist of a screwdriver. No cutting, no wrapping and unwrapping, no guesswork, no chance of ruining the antenna. Channel Master's unique integral inductive tuning feature readily tunes the antenna to any mount and any mounting position, no more permanent tuning for one mount only, Channel Master states.

PoweRod's solid fiberglass construction allows flexibility, but will not detune



(bend) at highway speeds. And PoweRod, it is stated, provides greater range, higher performance, clearer reception and better interference reduction than other antennas of its type. SWR is 1.5:1 or better. It comes in red or white and fits any standard 3/8 inch by 24 threaded mount. Model numbers 5045 and 5046, manufacturer's suggested retail price is $15.95. Single or dual mirror mounting kits are also available. ET/D

PROGRAMMING

continued from page 37

operation and execute an interrupt service routine. This is functionally the same as a subroutine, including the storage of the return address. But what of all the carefully-developed information that currently occupies the seven registers? What of the flags, which may have just been set up pending a conditional test at the precise moment the interrupt occurred?

The very first thing that happens in any intelligently-written interrupt service routine is a save of all registers and flags on the stack. The following sequence of instructions does it: PUSH AF...PUSH BC...PUSH DE...PUSH HL. The first of those, "PUSH AF," pushes Accumulator and Flags; the rest take care of the other six registers. Upon exit from the interrupt routine, a reverse series of POPs takes place, and all is exactly as it was. Neat huh?

This last group also includes some convenience instructions for manipulating the stack pointer, enabling and disabling interrupts (sometimes you really do want the above to occur—no matter how nice a stack is. Time may be too critical...), and performing inputs and outputs as we saw in the keyboard routine of Figures 2 and 3. There is an instruction called, appropriately, HALT, which stops the processor, and another called NOP, which does absolutely nothing. It is the easiest one of all, but it takes an awful lot of them to get anything accomplished.

And there you have it: an informal description of the 8080 instruction set. If it appears particularly grim, it may be because it is somewhat self-defeating to go into detail about a processor's behavior without demonstrating things on a "real" system—hands on. The only reason for an instruction set is to give the person programming the machine as flexible a language as possible with which to talk to the machine. It is possible to get by with a lot less; desirable to have a lot more.

But . . .it's a good start. While the architecture differs from system to system, the principles are identical, and tying this into the service business just for fun, the more sense it makes to you, the less mysterious tomorrow's fixit problems are likely to be.

DIGITAL

continued from page 33

flip-flop to the Q terminal of pulse generator P1.

5. Connect the *set* input of the RS flip-flop to S3, and the *reset* input of the RS FF to S4.
6. Turn the Powerace 102 on.
7. Note L3 and L4.
8. Set both S3 and S4 to "0."
9. Press P1 and release. This clocks the RS FF.
10. Note what output changes occurred.
11. Is this a "disallowed" state, or a "no change" state? Why does this result differ from the truth table for the "0-0" condition in Fig. 1?
12. Set both S3 and S4 to "1."
13. Press P1 and release. This again clocks the FF.
14. What happened? Answer the same questions as in step No. 11 above.
15. Set S3 to "1" and S4 to "0."
16. Press P1 to clock the FF.
17. Does this set (L3 on) or reset (L4 on) the FF?
18. Set S3 to "0" and S4 to "1."
19. Press P1 to clock the FF.
20. Answer again the questions of step No. 17.
21. Compare the results of this experiment with the truth tables of Figs. 1 and 2. Which does it resemble and why?

Experiment No. 4

Connect two sections of a 4043 CMOS IC as a master-slave FF, and then re-do experiment No. 3. A single section of the CMOS device 4049 will serve as the inverter.

Experiment No. 5

Perform Experiment No. 4 again, using a 4044 instead of the 4043. Explain any differences in operation.

Experiment No. 6

Direct set (also called preset) and direct clear (also called direct reset or preclear) inputs are used on some flip-flops. A direct set input on a master-slave FF forces the Q output to go HIGH, and the not-Q to go LOW, independently of clocking. Similarly, the preclear input causes the Q output to go LOW and the not-Q to go HIGH, also independent of clocking.

In this experiment you are to think of a way to add preset and preclear functions to a master-slave FF. Use individual gates instead of the 4043/4044 devices. (Hint: You will need two quad, two-input NAND gates (TTL 7400's) one section of a 7404 hex inverter, and two sections of a 7410 triple, three-input NAND gate.)

If you give up (please don't until you have tried to figure out the problem), then look at Fig. 5-1E, on page 191 of the TTL Cookbook (Sams 21035) by Don Lancaster. Note well, that this book and the companion CMOS Cookbook belong in the library of any person learning digital electronics, and will be very useful in practical ways. ET/D

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Part Number	Your Cost	Part Number	Your Cost	Part Number	Your Cost	Part Number	Your Cost
AN 214	1.70	UPC 1025H	2.05	2SB 649	1.80	2SC 1308K	3.50
AN 239Q	4.50	UPC 1156H	2.20	2SC 460	.30	2SC 1358	3.25
AN 247P	2.70	2SA 495	.35	2SC 710	.25	2SC 1383	.25
AN 315	2.00	2SA 564	.35	2SC 756	1.80	2SC 1664A	2.50
BA 521	2.25	2SA 643	.35	2SC 799	1.90	2SD 313	.60
HA 1342A	2.50	2SA 684	.40	2SC 867A	4.30	2SD 350	4.50
LA 4031P	1.75	2SA 733P	.25	2SC 945	.25	2SD 669	1.50
LA 4400	1.85	2SA 747A	4.90	2SC 1014	.60	2SD 733	2.60
SID 30-15	1.50	2SB 407	.85	2SC 1096	.50	2SK 23A	.70
STK 439	7.25	2SB 474	.70	2SC 1124	.90	121-831	4.50
TA 7205P	1.80	2SB 507	.80	2SC 1172B	3.75	ECG 165	3.25
UPC 554C	1.25	2SB 618	2.95	2SC 1226A	.55	ECG 500A	9.95

Send for our complete list of Japanese parts and prices

Our **Professional Replacement** parts are top quality and replace over 130,000 industry types at a substantial saving to you over most other replacement lines.

To order, just send us the ECG, SK, GE, or other part number and we will promptly ship you the premium **PR** direct replacement, plus a free **PR** replacement guide. Remember—these are first quality parts—no culls, no seconds! 2 year warranty on all parts.

Orders over $25.00 shipped free, under $25 add $1 UPS.C.O.D. orders are welcome. To approximate the cost of a replacement part order, deduct 40% from the dealer cost of ECG or other types. All orders shipped within 24 hours.

Special OEM Pricing Available

Write or Call—Toll Free
1-800-526-4463

DEVCO
P.O. Box 270, Garwood NJ 07027
(201) 688-0300

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RATES: 45 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 60 cents per word. Boxed or display ads charged at $55 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad. Send ad copy with payment to Dawn Anderson, ELECTRONIC TECHNICIAN/DEALER, 1 East First Street, Duluth, MN 55802.

BOX NUMBER REPLIES: Mail box number replies to: ELECTRONIC TECHNICIAN/DEALER, Classified Ad Department, One East First Street, Duluth, MN 55802. Please include box number in address.

FOR SALE

TECH BENCH kit or plans. Designed for the TV/Radio Tech. Test instrument shelf on two power columns with 10 fused outlets. Bench has four fused outlets with C-MOS grounding, four large tool drawers and neon bench lighting. E-Z build construction. Plans and kit information $1.98 plus 50¢ handling. Technical Workshop, Box 368, Placentia, CA 92670. 8/79

TV TECHNICIAN AND DEALERS, "INCREASE YOUR INCOME THOUSANDS OF DOLLARS YEARLY," "Rent-Lease-Sell TV's with a guaranteed system," Send stamp or call (1-805) 937-4905 for free details, basic plan $15.00, deluxe version $25.00, master plan $40.00...Perry's Rental System, Box 1407, Santa Maria, CA 93456. TF

THERE'S NO NEED TO BUY ORIGINAL JAPANESE TRANSISTORS WHEN OUR REPLACEMENTS WILL DO THE JOB of many original types. Phyltron's LX123A replaced over 50 Japanese types in our catalog. Don't tie yourself up with excessive inventory, buy Phyltron Electronics replacement transistors and save.

Write for free catalog. One year unconditional guarantee. Phyltron Electronics, 487 Springfield Ave., Summit, NJ 07901. TF

PICTURE TUBE MACHINE
We buy and sell NEW AND USED CRT rebuilding machinery. COMPLETE TRAINING. Buy with CONFIDENCE from the ORIGINAL MFGR. For complete details, send name, address and zip code to:

LAKESIDE INDUSTRIES

4069-71 N. Elstone Ave., Chicago, IL 60618
Phone: 312-583-6565

GENUINE SONY SEMICONDUCTORS—CHECK THESE PRICES!!
EG. 1-9/ 10-24—SG613-8.50/7.30-SID 30-15 2.60/2.30, -2SC867A 5.10/4.90-2SC1114 5.50/4.80-2SC1358 6.50/5.70, -2SC1124 1.50/1.30-2SC634A 0.45/0.41. Contact us for complete list of Japanese semiconductors and pricing information. Bescor, 547 S. Broadway, Hickville, NY 11801 (516) 822-3988

TUBES—Receiving, Industrial and Semiconductors, factory boxed. Free price list. Low, low prices. **TRANSLETERONIC INC.** 1365-39th Street, Brooklyn, N.Y. 11218E 800-221-5802, 212-633-2800. TF

REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S89633 etc. $19.95. Magnavox 361380-1 $29.95 etc. Sylvania, G.E. etc. $17.95 to $22.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 665 Jerricho Turnpike, Huntington Station, N.Y. 11746, 516-549-3925 TF

B & K test equipment. Free catalog. Free shipping. 15% discount. Spacetron-GW, 948 Prospect, Elmhurst, IL 60126. 7/79

TV BOOKKEEPING: Simplified system, specially designed for TV Sales and Service Business. Keep your own and save money, we show you how. Send $2.00 To: BOOKKEEPING; 100 W. Miracle Strip Pkwy; Mary Esther, FL. 32569 for more information.

LINEAR AMPLIFIER, 2-30 MHz, 100 or 200 watt solid state. 300 MHz COUNTER. Modulation BOOSTER. Omnidirectional BASE ANTENNA. Plans $3.00 each. $10.00/all. Catalog of others. **Panaxis,** Box 130-ET7 Paradise, CA 95969

ELECTRONIC BARGAINS, CLOSEOUTS, SURPLUS! Parts, equipment, stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-013, Box 762, Plattsburgh, NY 12901. TF

TV AND RADIO TUBES 36¢ EA!! Send for free color parts catalog. Your order free if not shipped in 24 hours. Cornell Electronics 4215-17 University San Diego California 92105 TF

send a message... ...write here.

1. Number of insertions: (circle) 1 2 3 6 12
2. Start with (month) ______________ issue (Copy must be in by 1st of month preceding)
3. Amount enclosed: $______________.

PAYMENT MUST ACCOMPANY ORDER. WE'LL BILL RATED FIRMS

NAME______________________ COMPANY______________________

STREET____

CITY______________________ STATE______________ ZIP__________

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Automobile radio and tape replacement parts: Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. **Laran Electronics Inc.** 3768 Boston Road, Bronx, NY 10469 (212) 881-9600 out of New York state (800) 223-8314. TF

For Sale: All new picture tube Rebuilding Equipment. First class professional Grade. 2 ovens, Litton sealing machine, etc. $5800 or offer. Call or write: T&C Services, Inc., 37 W. Quincy, Westmont, IL. 60559. 312-963-4020. 12/79

For sale or trade Marconi 1066 B generator lab calibrated used four times only. Range 10-40 470 MHZ AM 100% mod FM 100 KHZ deviation. Phil Trainer, 11130 Leavenworth, Omaha, NE 402-333-6677 late evenings.

VIDEO MOVIES G/PG/R/X: Beta or Vhs, bought, sold, rented. Blank tapes, Video recorders, supplies: Cat $1.00, refundable. Astro Electronics, 160 Woodbridge Ave., Highland Park, NJ 08904. 11/79

COLOR PICTURE TUBE REBUILDING EQUIPMENT. SEMIAUTOMATIC ELECTRONICALLY CONTROLLED PROCESS. COMPLETE TRAINING. Call or write Atoll Television, 6425 W. Irving Park, Chicago, IL 60634. Phone 312-545-6667. 8/79

TUNER SERVICE serving over 300 dealers in the Chicago area wants additional lines. Write or call: Economy Tuner Service. 4901 N. Elston, Chicago, IL 60630. Phone 312-282-3939.

For Sale: Sencore SM152 Sweep & Xtal Markers. Cost $450.00. Like new condition with manual and cables. $200.00. R. McLaughlin, 51 Lyon St., Valley Stream, NY 11580.

SATELLITE TELEVISION-FOR INFORMATION ON BUILDING OR BUYING YOUR OWN EARTH STATION SEND $3.00 TO SATELLITE TELEVISION, BOX 140 OXFORD, NEW YORK 13830.

Selling Rider's Radio manuals 1-15, eleven volumes, $165. Also 27 Television volumes, $275. Sams' Photofacts to 1367, make offer. Supreme Publications, Box 46, Highland Park, Illinois 60035.

AM RADIO reception systems for interiors of buildings, ships, tunnels, etc. Receiver connection not required. Catalog A, Extronix, Inc. 64 Gough Ave., Ivyland, PA. 18974. 12/79

One man moonlight shop gone out of business. Must sell equipment. Write or call for list of equipment. Top quality. Call Bill, 713-849-8293, P. O. Box 843, Angleton, TX 77515.

We have many duplicate Sams for sale set 40 and for $4.00 a set. Write: A & D Electronics, 3042 37th Avenue, Rock Island, Illinois 61201. We will ship C.O.D.

HELP WANTED

TUNER TECH NEEDED. MUST BE TOP NOTCH AND CAPABLE OF MANAGEMENT. Call TOLL FREE 1-800-433-7124 (In Texas call 1-800-772-7411) BETWEEN 5 and 6 PM Central Time. 8/79

WANTED

MANUFACTURERS: New Electronics distributor needs tube, transistor, antenna and other lines. ELECTRONIC MERCHANDISE WANTED. Elect. Dept. P. O. Box 4013, Delaware City, DE 19706. 8/79

BUSINESS OPPORTUNITIES

MOVING TO FLORIDA? TV SERVICE AND RENTAL BUSINESS FOR SALE ON FLORIDA'S WEST COAST. DOING $40,000 - $50,000 PER YEAR. ALL REASONABLE OFFERS CONSIDERED, ALSO BUILDING AVAILABLE. CONTACT: MR. SOTHERN, 1-813-535-2026 AFTER 7 PM OR WRITE: 1834 SUNRISE BLVD., CLEARWATER, FLORIDA 33520 TF

Business Opportunity. TV sales and service business doing $50,000/yr, Zenith and RCA sales and warranty. Everything goes, owner retiring from 15 years service. No. California Mountain community of 5000 at 2400 ft. elevation. Only shop within 35 miles. Write to "Dick"; P. O. Box 816; Hayfork, CA 96041. 9/79

T.V. Sales service 28 years in same location. Carry in service Zenith-Sale service dealer. Choice location on US #1 South Broward-North Dade County Line. $12,500.00. All fixture parts equipment. Paul's TV Sales Service, 222 N. Federal Hwy, Hammandale, FL 33009. 8/79

MECHANICALLY INCLINED INDIVIDUALS: Assemble electronic devices in your home. Investment, knowledge, or experience not necessary. Get started in spare time. Above average profits. $300-$600/wk. possible. Sales handled by others. Write for free details. Electronic Development Lab, Drawer 1560B, Pinellas Park, FL 33656.

TV Sales and service. Oldest established TV business in town. Authorized Zenith and RCA dealer. 40 miles west of Chicago. Grossed $131,000 last year. Asking $20,000. Write 710 South Northwest Highway, Barrington, Illinois. 60010 312-381-7444. 7/79

Vermont-Radio-TV S&S. Long established, owner retiring. Price $275,000 w/terms. Details to qualified buyer. Marble City Realty, Box 265, Rutland VT., 05701.

TV Sales and Service. 17-year-old business. Owner retiring. Zenith. Gross $51,000 net approx 28,000. Complete inventory including Van. Price $32,000. Contact Nicholas B. Johns, REALTOR, R & G Realty, Inc., REALTORS, Post Office Box 332, Winter Park, Florida 32790. 305-628-2669. 7/79

BROADCAST STATION. Start your own, any type! Unique Cable FM station operation-investments/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:", Box 130 ET7, Paradise, CA 95969

SOUTH LAKE TAHOE. Retail television and appliance store well established. '79 gross over $300,000 by owner. 702-588-6662. 7/79

Need experienced professionals in large aerospace conglomerate. Degree required, many benefits, excellent future. Send name, address, employer, phone, best time to contact, to Roy Randall, Randall's Radio & TV, 8433 S.E. Banyan Tree St., Hobe Sound, FL 33455.

ELECTRONICS/AVIONICS EMPLOYMENT OPPORTUNITIES. Report on jobs now open. Details FREE. Aviation Employment Information Service, Box 240Y, Northport, New York 11768. 8/79

ALTHOUGH THE UNITED WAY IS IN THE BUSINESS OF GIVING AWAY MONEY, WE DON'T JUST GIVE IT AWAY.

Sometimes people think that because United Way is in the business of giving away money, that's all we do.

But they're wrong. Because before United Way gives away money, a lot of things must happen. Volunteers carefully assess each organization requesting assistance.

Does the organization represent the best interest of the community?

Will it provide an important human service not provided elsewhere?

Does it really deliver the services to the people who *need* them?

When, and only when, these and other questions have been answered does United Way *give* money.

Thanks to you, it works. For all of us. United Way

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Mobile Training Institute
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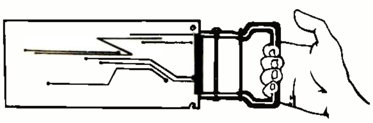
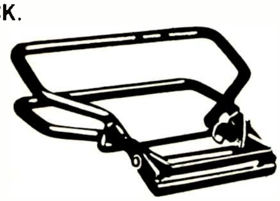
Circle No. 120 on Reader Inquiry Card

BRANEM'S "BULLDOG GRIP" CIRCUIT BOARD EXTRACTOR



THE SAFE, SIMPLE, SOLUTION FOR REMOVING THE TIGHTEST FITTING CIRCUIT BOARDS.

THE EXTRACTOR'S VINYL COATING PROTECTS THE BOARD FROM DAMAGE AND THE OPERATOR FROM ELECTRIC SHOCK.



HANDLES ANY WIDTH BOARD UP TO 3/32" THICK WHILE GRIPPING ONLY 1/8" OF THE BOARD EDGE.

MANY MANUFACTURERS OF ELECTRONIC EQUIPMENT INCLUDE ONE WITH EVERY MACHINE THEY SELL.

WIRE FORMED PRODUCTS
METAL FABRICATION
PLATING-COATING

BRANEM
Imagineering with wire.

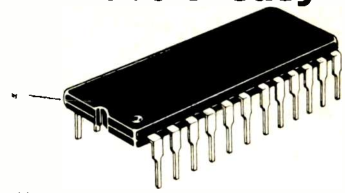
BOX 156, GREENE, NEW YORK 13778 607-656-4166

Circle No. 107 on Reader Inquiry Card

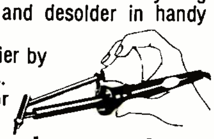
AD INDEX

This index is furnished for the readers' convenience. However, the publisher can not guarantee its accuracy due to circumstances beyond our control.

Tools to change PC components fast & easy



You can do a better job quicker with light weight Endeco soldering and desoldering irons. The irons designed by a professional for professionals.
Endeco switch model desoldering irons deliver 40w (750°F nominal) for safe removal of components and idle at 20w (500°F nominal) for long tip life! The unique head design and good tip wetting action makes removal fast. 8 tip sizes!
Part replacement is quick with an Endeco soldering iron. Dual heat switch for 900°F (40w) or 750°F (20w). 6 tip sizes!
All Endeco irons feature . . . exclusive "on" light in unbreakable handle . . . stainless steel construction for long life and cool handle . . . burn resistant cord set . . . attachments that convert one iron to the other. And Endeco has everything needed to solder and desolder in handy metal case kits!
Make your job easier by using Endeco irons.
See your distributor today or write . . .



Enterprise Development Corp.
5127 E. 65th St. Indianapolis, IN 46220
Phone: (317) 251-1231

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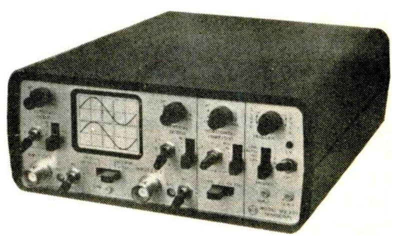
New!! 30 MHz!! *MINISCOPE* From NLS



MS-230 $559

- 30-megahertz bandwidth.
- External & internal trigger.
- Line synchronization mode.
- Power usage: less than 50W.
- Rechargeable batteries and charger unit included.
- 2.9" H x 6.4" W x 8.5" D.

NLS products are available from Nationwide Electronic Distributors. Send for our brochure today!

Non-Linear Systems, Inc.
Originator of the digital voltmeter.
Box N, Del Mar, California 92014
Telephone (714) 755-1134 TWX 910-322-1132

Circle No. 119 on Reader Inquiry Card

ETD TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

1798

SONY
B&W TV Model
TV-121

JULY • 1979

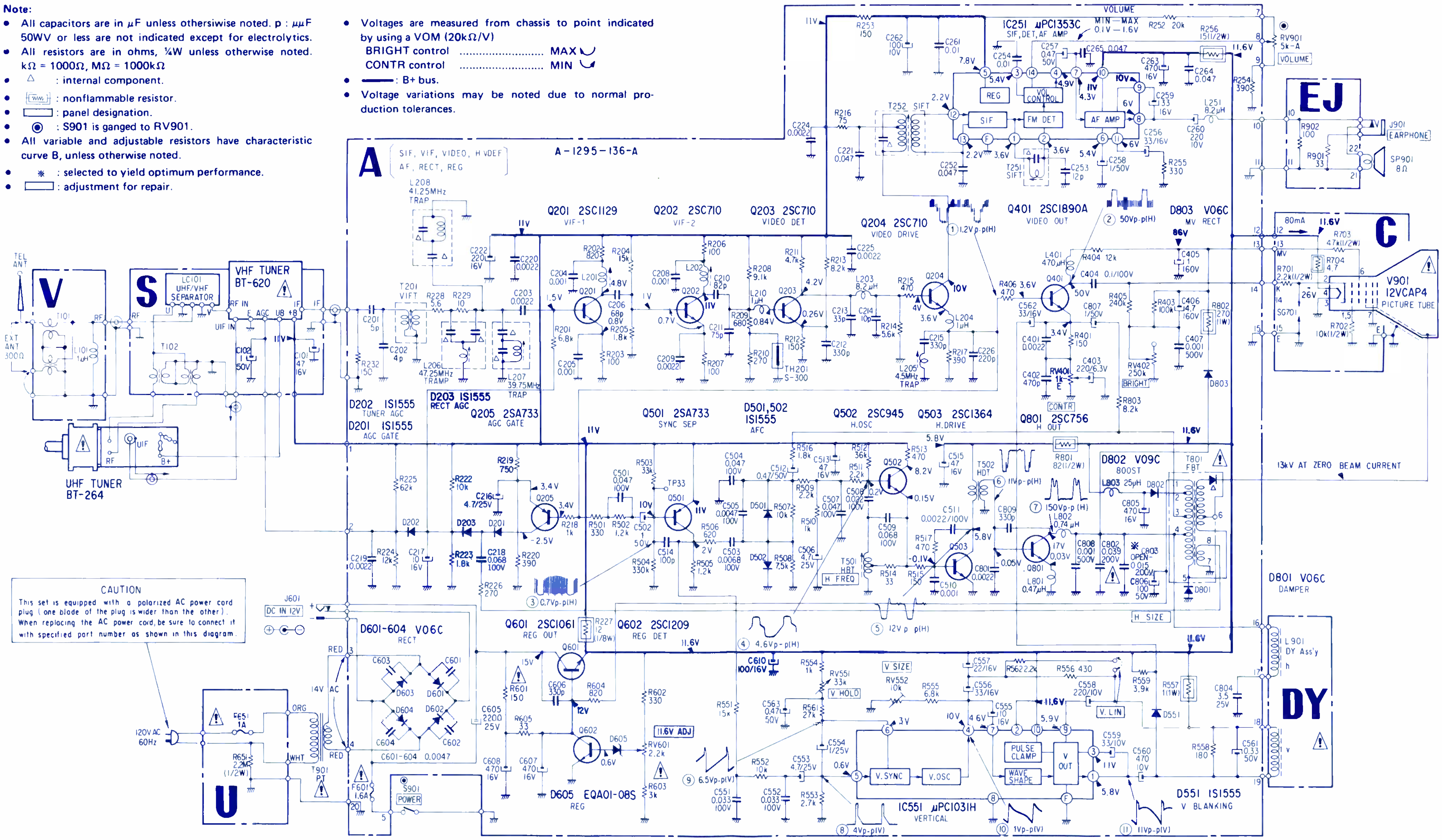
	SCHEMATIC NO.		SCHEMATIC NO.
SONY B&W TV Model TV-121	1798	ADMIRAL Color TV Chassis 28M55	1800
RCA Color TV Chassis CTC 97	1799	MIDLAND B&W TV Model 15-037	1801

The components identified by shading and mark ⚠ are critical for safety. Replace only with part number specified.

: Changed portions

Note:

- All capacitors are in µF unless othersiwise noted. p : µµF 50WV or less are not indicated except for electrolytics.
- All resistors are in ohms, ¼W unless otherwise noted. kΩ = 1000Ω, MΩ = 1000kΩ
- △ : internal component.
- [WW] : nonflammable resistor.
- ▭ : panel designation.
- ◉ : S901 is ganged to RV901.
- All variable and adjustable resistors have characteristic curve B, unless otherwise noted.
- ※ : selected to yield optimum performance.
- ▭ : adjustment for repair.
- Voltages are measured from chassis to point indicated by using a VOM (20kΩ/V)
  BRIGHT control .... MAX
  CONTR control .... MIN
- ▬▬ : B+ bus.
- Voltage variations may be noted due to normal production tolerances.



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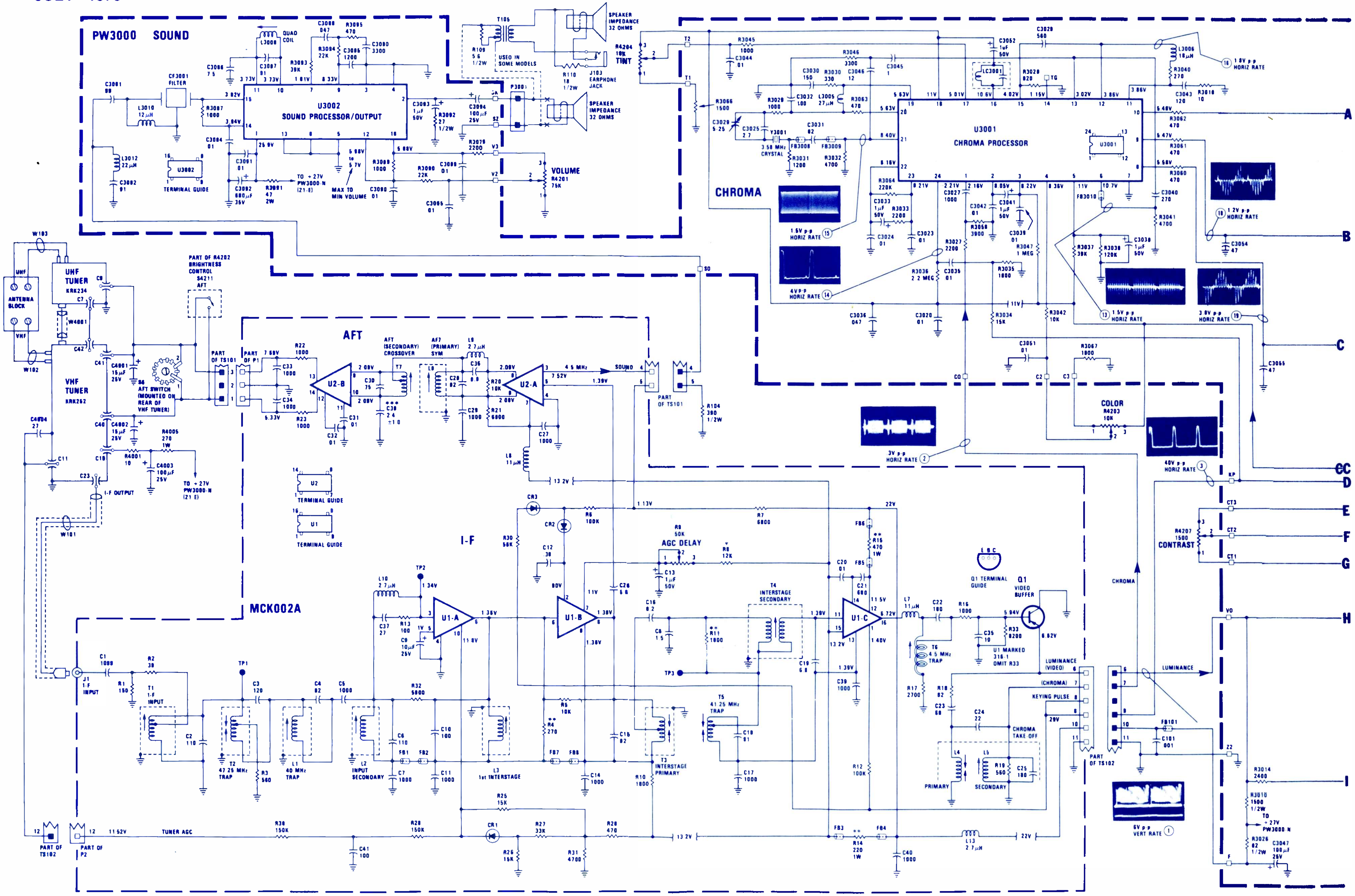
1799

RCA
Color TV Chassis
CTC 97

JULY • 1979

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



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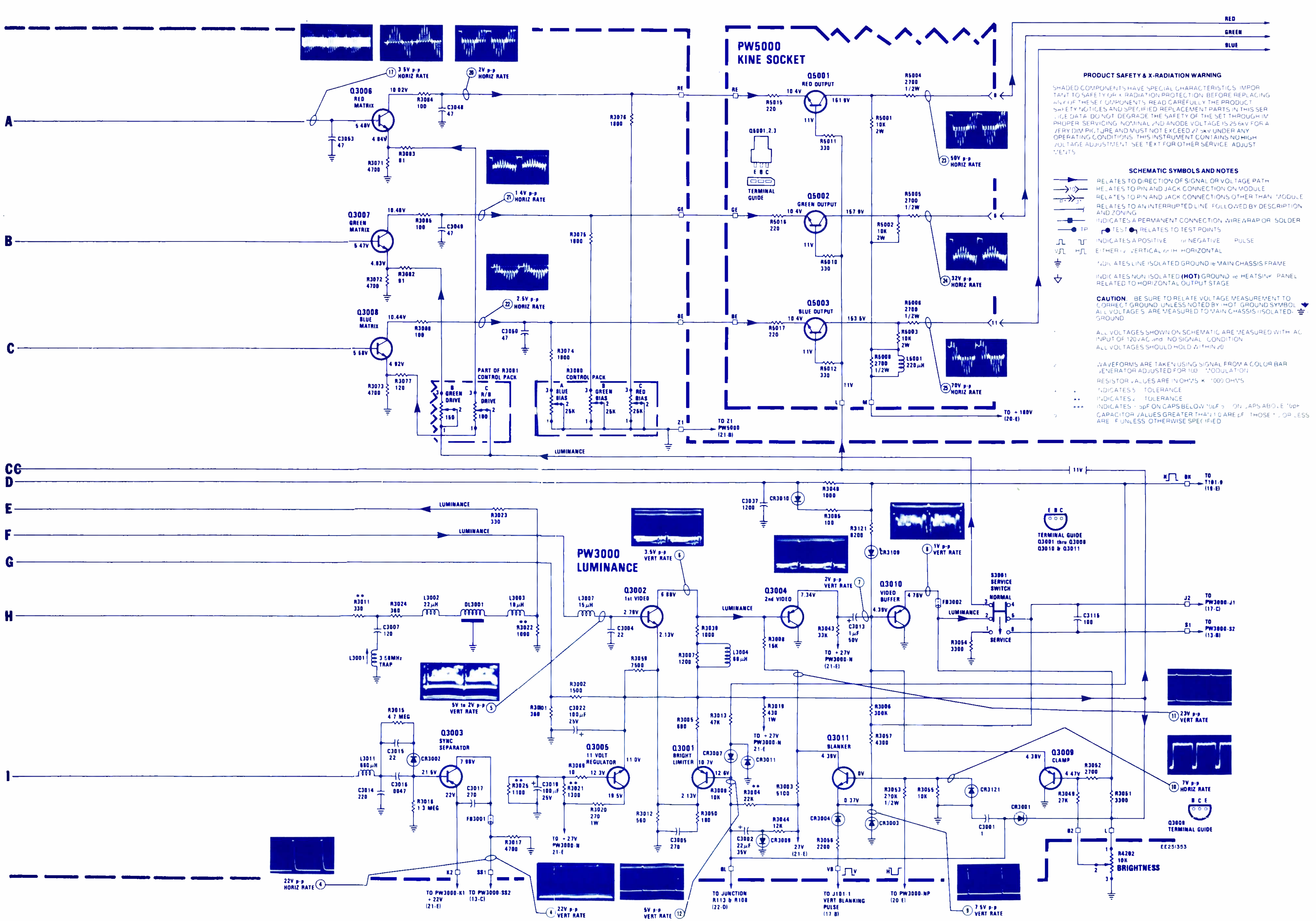
RCA
Color TV Chassis
CTC 97

ADDITIONAL INFORMATION NEXT PAGE



PRODUCT SAFETY & X-RADIATION WARNING

SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY OR X RADIATION PROTECTION. BEFORE REPLACING ANY OF THESE COMPONENTS, READ CAREFULLY THE PRODUCT SAFETY NOTICES AND SPECIFIED REPLACEMENT PARTS IN THIS SERVICE DATA. DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING. NOMINAL 2ND ANODE VOLTAGE IS 25.6kV FOR A VERY DIM PICTURE AND MUST NOT EXCEED 27.5kV UNDER ANY OPERATING CONDITIONS. THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT. SEE TEXT FOR OTHER SERVICE ADJUSTMENTS.

SCHEMATIC SYMBOLS AND NOTES

- RELATES TO DIRECTION OF SIGNAL OR VOLTAGE PATH
- RELATES TO PIN AND JACK CONNECTION ON MODULE
- RELATES TO PIN AND JACK CONNECTIONS OTHER THAN MODULE
- RELATES TO AN INTERRUPTED LINE FOLLOWED BY DESCRIPTION AND ZONING
- INDICATES A PERMANENT CONNECTION, WIREWRAP OR SOLDER
- TP / TEST: RELATES TO TEST POINTS
- INDICATES A POSITIVE or NEGATIVE PULSE
- EITHER (V) VERTICAL or (H) HORIZONTAL
- INDICATES LINE ISOLATED GROUND ie MAIN CHASSIS FRAME
- INDICATES NON ISOLATED **(HOT)** GROUND ie HEATSINK PANEL RELATED TO HORIZONTAL OUTPUT STAGE

CAUTION. BE SURE TO RELATE VOLTAGE MEASUREMENT TO CORRECT GROUND UNLESS NOTED BY HOT GROUND SYMBOL. ALL VOLTAGES ARE MEASURED TO MAIN CHASSIS ISOLATED GROUND

ALL VOLTAGES SHOWN ON SCHEMATIC ARE MEASURED WITH AC INPUT OF 120VAC and NO SIGNAL CONDITION. ALL VOLTAGES SHOULD HOLD WITHIN 20

WAVEFORMS ARE TAKEN USING SIGNAL FROM A COLOR BAR GENERATOR ADJUSTED FOR 100 MODULATION

RESISTOR VALUES ARE IN OHMS K 1000 OHMS

- * INDICATES 5 TOLERANCE
- ** INDICATES 2 TOLERANCE
- *** INDICATES .5pF ON CAPS BELOW 10pF 5 ON CAPS ABOVE 10pF

CAPACITOR VALUES GREATER THAN 1.0 ARE pF. THOSE 1.0 OR LESS ARE F UNLESS OTHERWISE SPECIFIED

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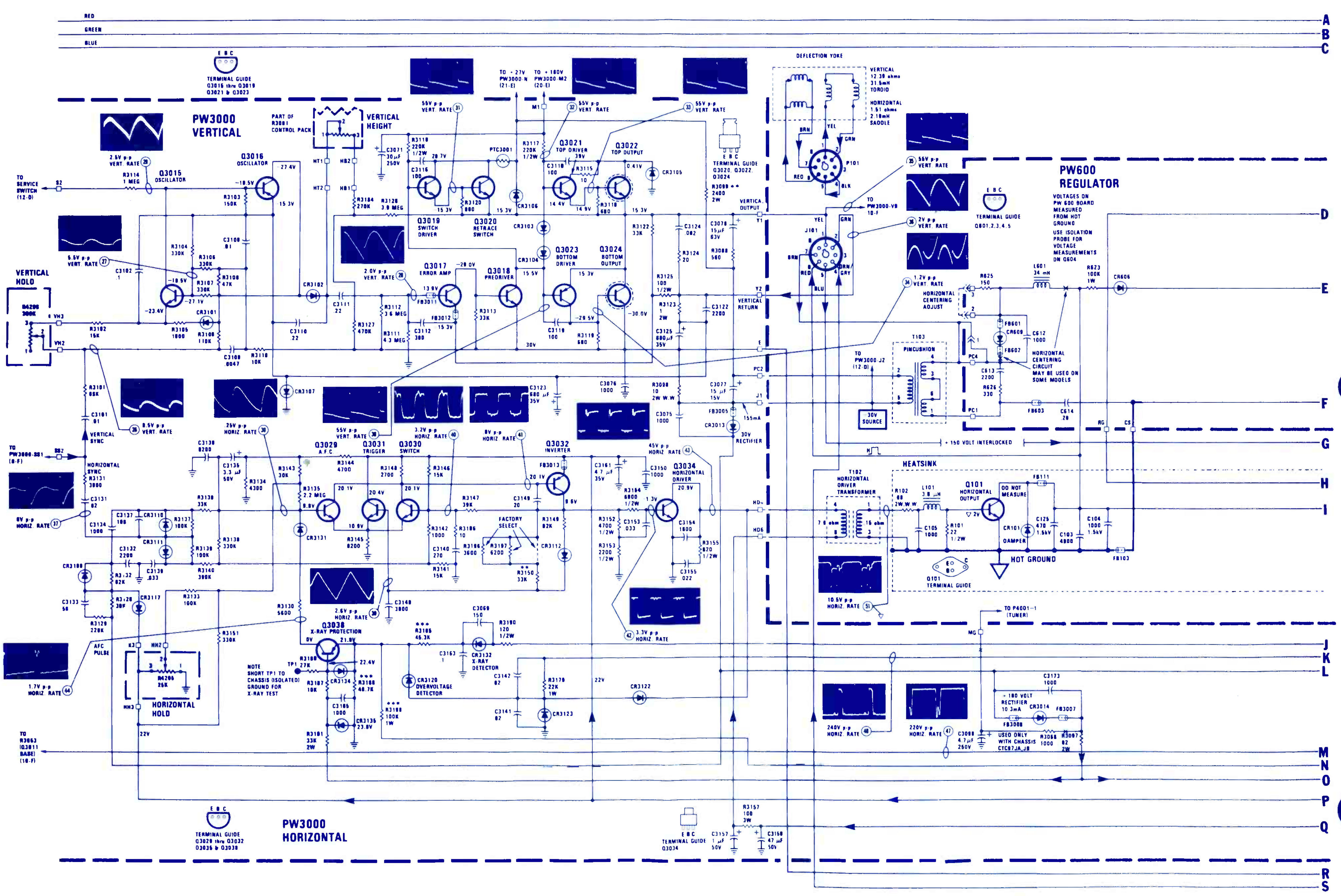
Color TV Chassis
CTC 97



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RCA
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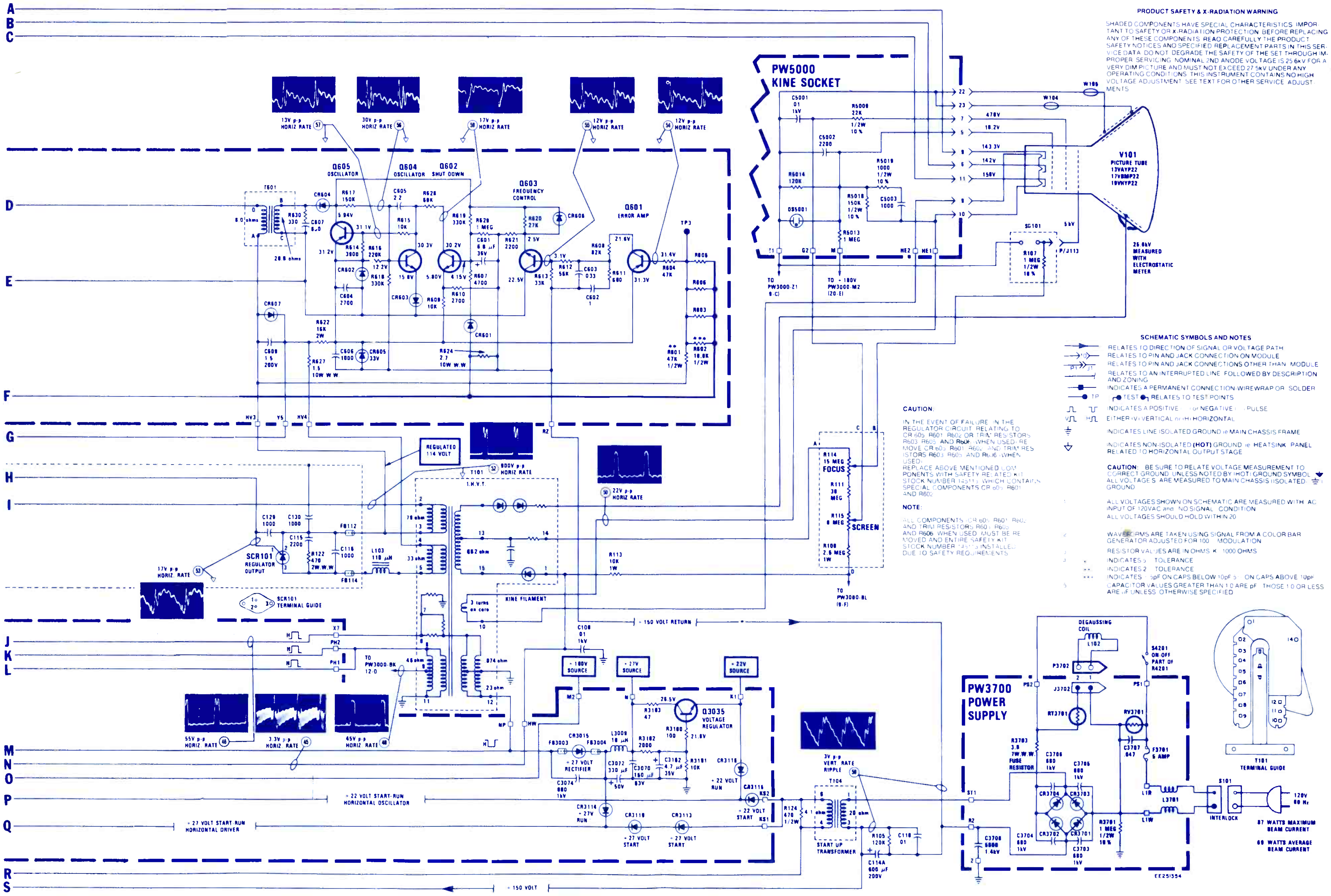
CTC 97



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SCHEMATIC SYMBOLS AND NOTES

- RELATES TO DIRECTION OF SIGNAL OR VOLTAGE PATH
- RELATES TO PIN AND JACK CONNECTION ON MODULE
- RELATES TO PIN AND JACK CONNECTIONS OTHER THAN MODULE
- RELATES TO AN INTERRUPTED LINE FOLLOWED BY DESCRIPTION AND ZONING
- INDICATES A PERMANENT CONNECTION-WIREWRAP OR SOLDER
- TP / TEST RELATES TO TEST POINTS
- INDICATES A POSITIVE or NEGATIVE PULSE
- EITHER (V) VERTICAL or (H) HORIZONTAL
- INDICATES LINE ISOLATED GROUND ie MAIN CHASSIS FRAME
- INDICATES NON-ISOLATED **(HOT)** GROUND ie HEATSINK PANEL RELATED TO HORIZONTAL OUTPUT STAGE

CAUTION: BE SURE TO RELATE VOLTAGE MEASUREMENT TO CORRECT GROUND UNLESS NOTED BY (HOT) GROUND SYMBOL. ALL VOLTAGES ARE MEASURED TO MAIN CHASSIS (ISOLATED) GROUND.

1. ALL VOLTAGES SHOWN ON SCHEMATIC ARE MEASURED WITH AC INPUT OF 120VAC and NO SIGNAL CONDITION. ALL VOLTAGES SHOULD HOLD WITHIN 20%.
2. WAVEFORMS ARE TAKEN USING SIGNAL FROM A COLOR BAR GENERATOR ADJUSTED FOR 100% MODULATION.
3. RESISTOR VALUES ARE IN OHMS K = 1000 OHMS.
4. * INDICATES 5% TOLERANCE. ** INDICATES 2% TOLERANCE. *** INDICATES ±.5pF ON CAPS BELOW 10pF 5% ON CAPS ABOVE 10pF.
5. CAPACITOR VALUES GREATER THAN 1.0 ARE pF. THOSE 1.0 OR LESS ARE μF UNLESS OTHERWISE SPECIFIED.

CAUTION.

IN THE EVENT OF FAILURE IN THE REGULATOR CIRCUIT RELATING TO CR 605, R601, R602 OR TRIM RESISTORS R603, R605, AND R606 (WHEN USED) REMOVE CR 605, R601, R602, AND TRIM RESISTORS R603, R605, AND R606 (WHEN USED). REPLACE ABOVE MENTIONED COMPONENTS WITH SAFETY RELATED KIT STOCK NUMBER 145115 WHICH CONTAINS SPECIAL COMPONENTS CR 605, R601 AND R602.

NOTE:

ALL COMPONENTS (CR 605, R601, R602 AND TRIM RESISTORS R603, R605 AND R606 WHEN USED) MUST BE REMOVED AND ENTIRE SAFETY KIT STOCK NUMBER 145115 INSTALLED DUE TO SAFETY REQUIREMENTS.

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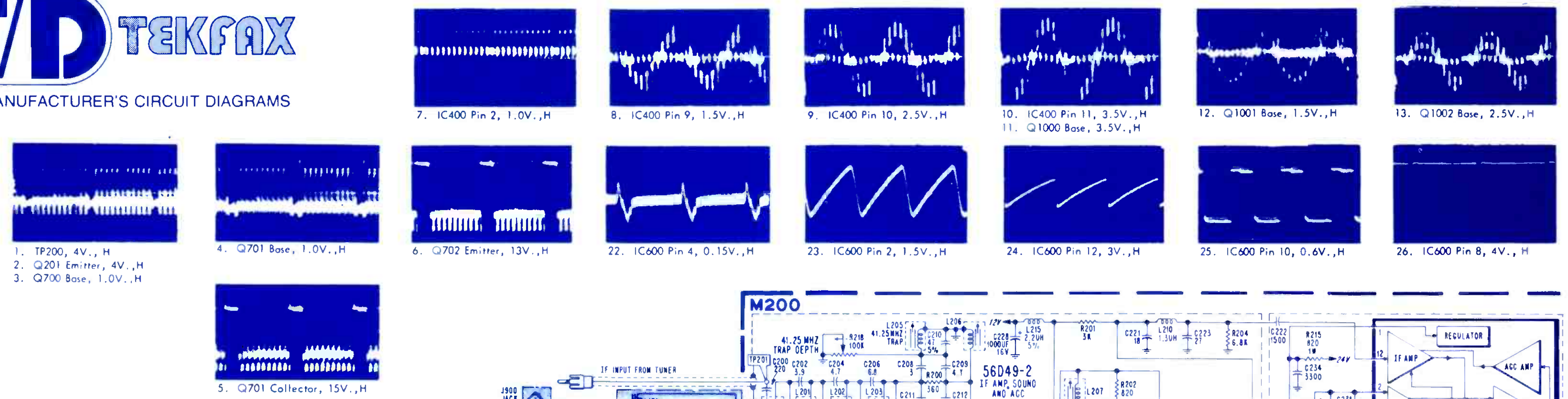
1800

ADMIRAL
Color TV Chassis
28M55

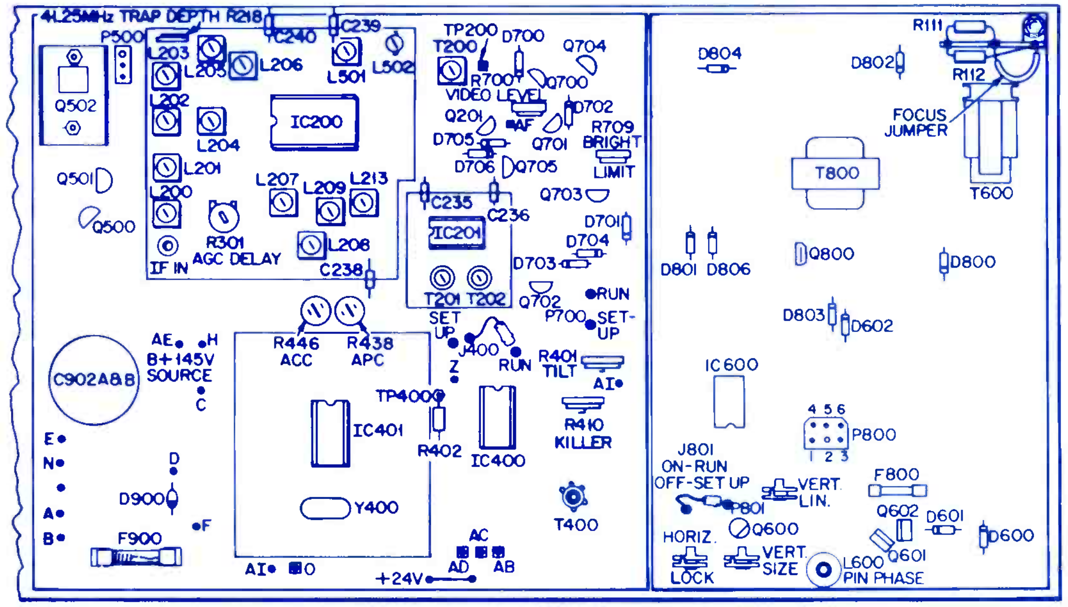
JULY • 1979

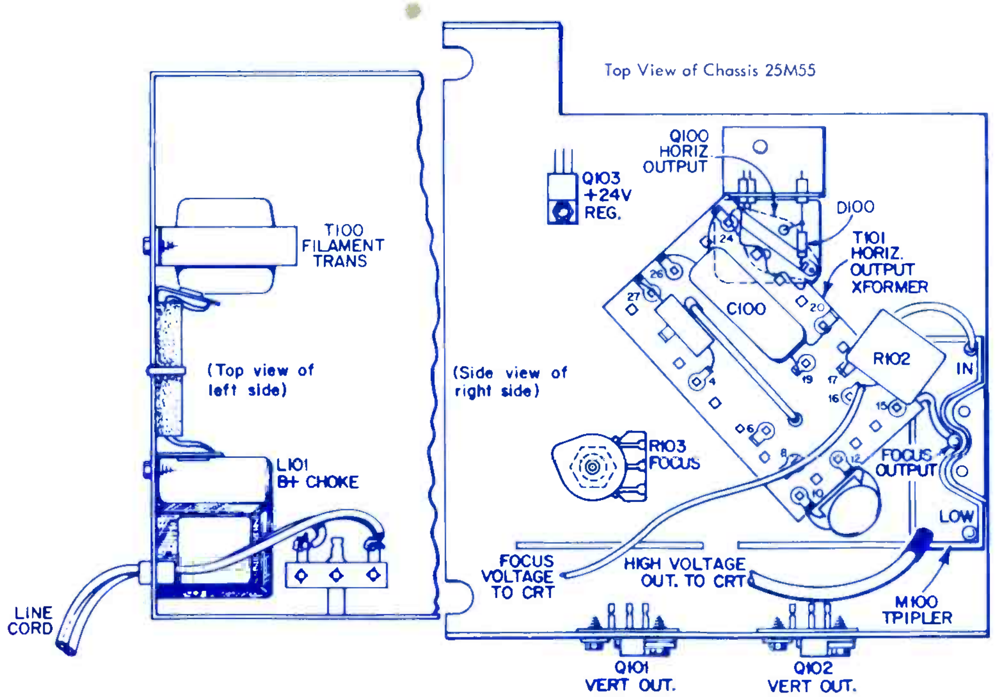
ET/D TEKFAX

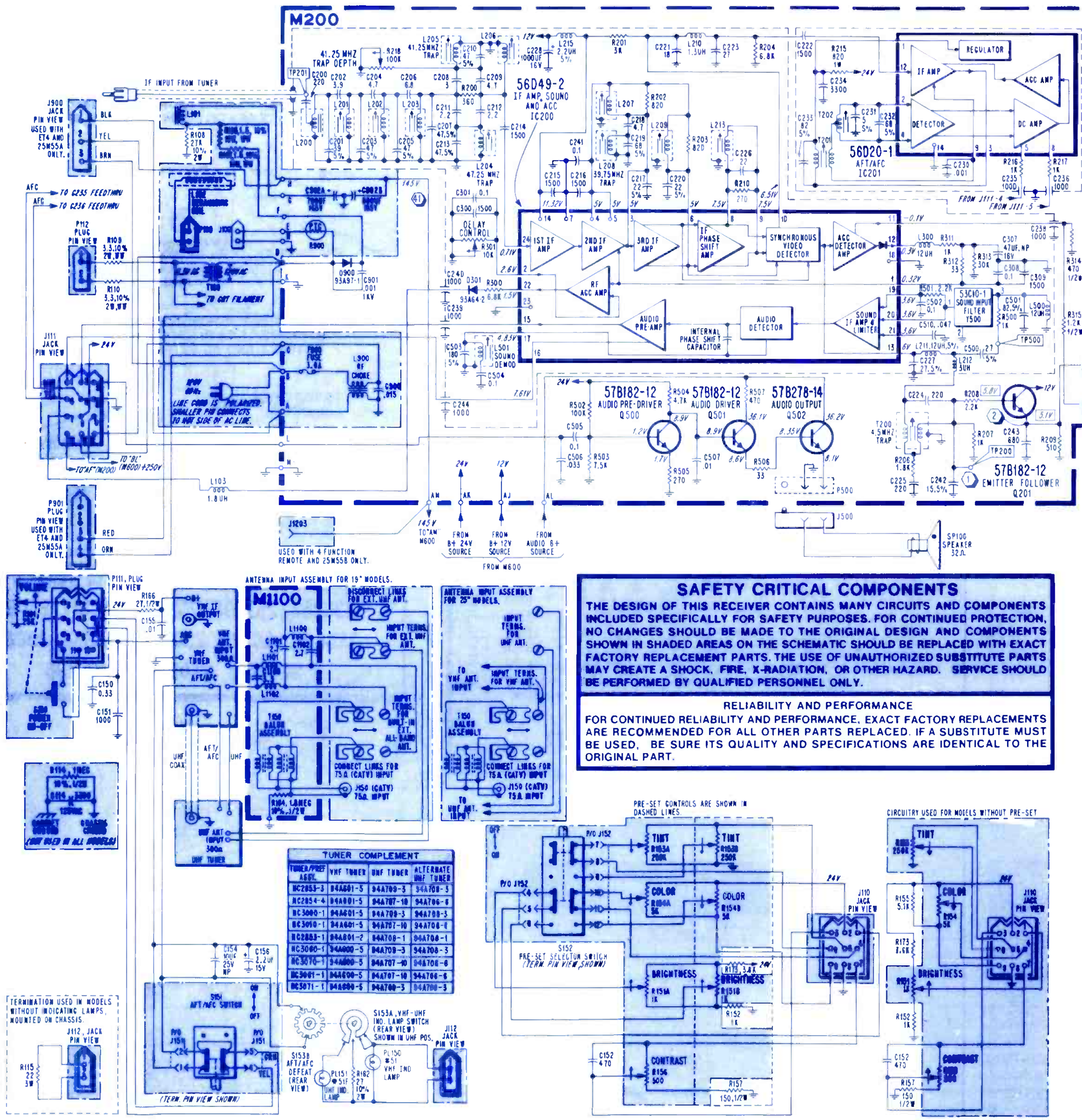
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



CHASSIS LAYOUT







SAFETY CRITICAL COMPONENTS

THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN AND COMPONENTS SHOWN IN SHADED AREAS ON THE SCHEMATIC SHOULD BE REPLACED WITH EXACT FACTORY REPLACEMENT PARTS. THE USE OF UNAUTHORIZED SUBSTITUTE PARTS MAY CREATE A SHOCK, FIRE, X-RADIATION, OR OTHER HAZARD. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.

RELIABILITY AND PERFORMANCE

FOR CONTINUED RELIABILITY AND PERFORMANCE, EXACT FACTORY REPLACEMENTS ARE RECOMMENDED FOR ALL OTHER PARTS REPLACED. IF A SUBSTITUTE MUST BE USED, BE SURE ITS QUALITY AND SPECIFICATIONS ARE IDENTICAL TO THE ORIGINAL PART.

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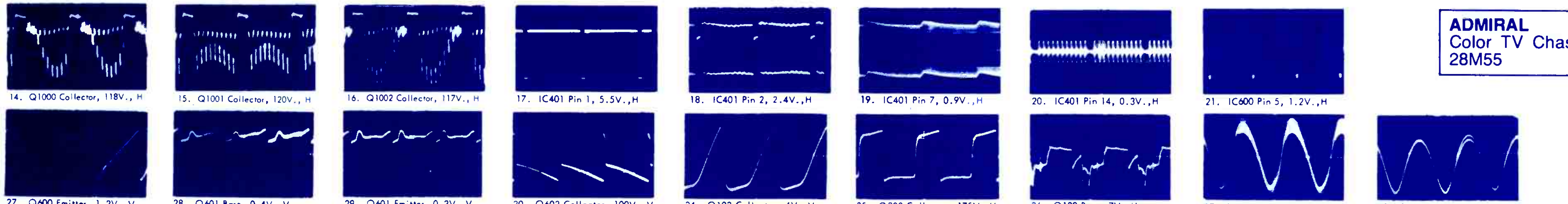
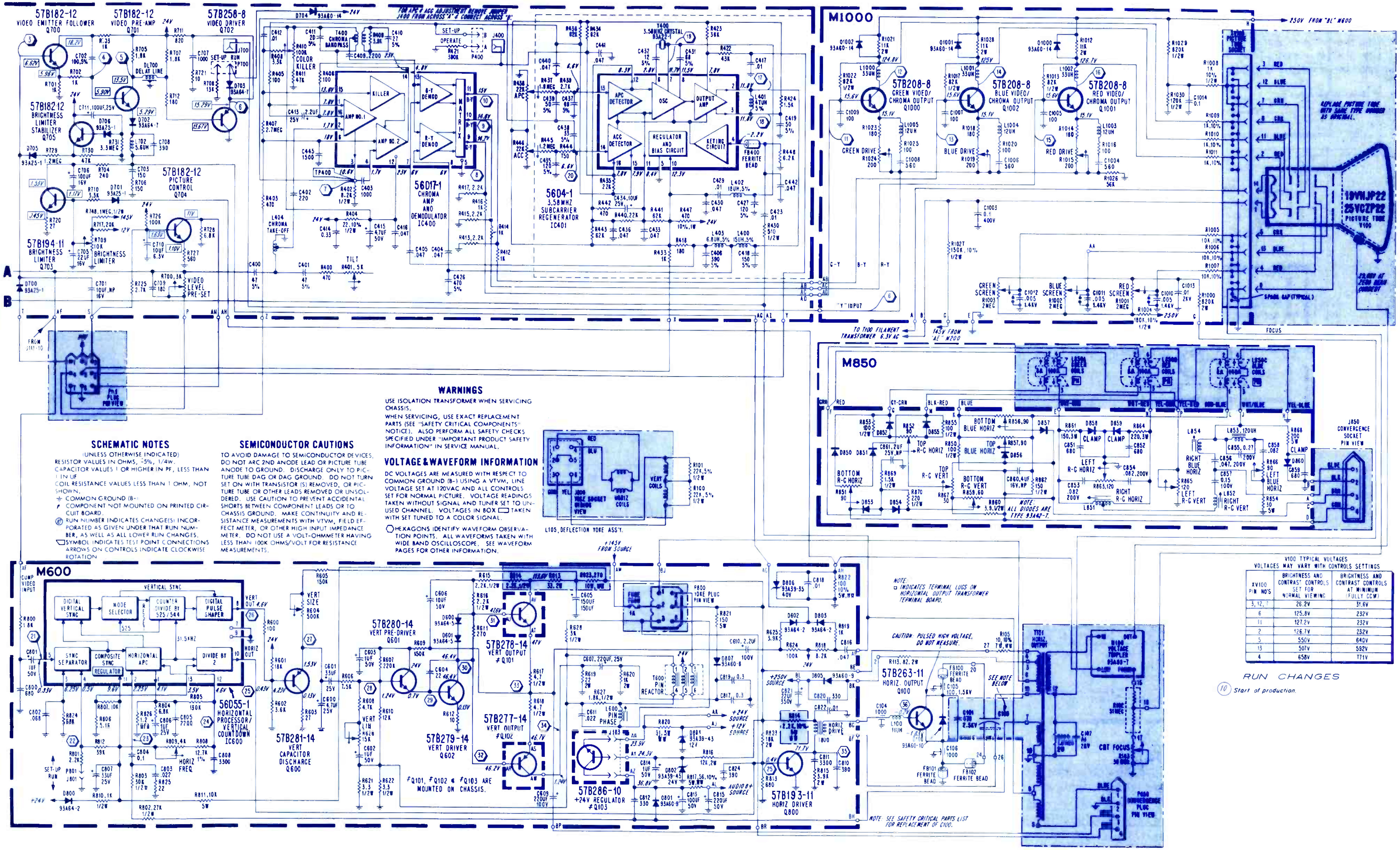
ADMIRAL
Color TV Chassis
28M55



14. Q1000 Collector, 118V., H
15. Q1001 Collector, 120V., H
16. Q1002 Collector, 117V., H
17. IC401 Pin 1, 5.5V.,H
18. IC401 Pin 2, 2.4V.,H
19. IC401 Pin 7, 0.9V.,H
20. IC401 Pin 14, 0.3V.,H
21. IC600 Pin 5, 1.2V.,H
27. Q600 Emitter, 1.2V.,V
28. Q601 Base, 0.4V.,V
29. Q601 Emitter, 0.3V.,V
30. Q602 Collector, 100V.,V
31. Q101 Base, 100V.,V
32. Q102 Base, 100V.,V
33. Q101,102 Emitter, 100V.,V
34. Q102 Collector, 4V.,V
35. Q800 Collector, 175V.,H
36. Q100 Base, 7V.,H
37. B+ 148V Ripple, 0.4V.,V
38. B+145V Regulated Ripple, 0.15V.,V



SCHEMATIC NOTES

(UNLESS OTHERWISE INDICATED)

RESISTOR VALUES IN OHMS, ±5%, 1/4W.

CAPACITOR VALUES 1 OR HIGHER IN PF, LESS THAN 1 IN UF

COIL RESISTANCE VALUES LESS THAN 1 OHM, NOT SHOWN.

⏚ COMMON GROUND (B-)

/ COMPONENT NOT MOUNTED ON PRINTED CIRCUIT BOARD.

Ⓝ RUN NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.

▭ SYMBOL INDICATES TEST POINT CONNECTIONS

ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION

SEMICONDUCTOR CAUTIONS

TO AVOID DAMAGE TO SEMICONDUCTOR DEVICES, DO NOT ARC 2ND ANODE LEAD OR PICTURE TUBE ANODE TO GROUND. DISCHARGE ONLY TO PICTURE TUBE DAG OR DAG GROUND. DO NOT TURN SET ON WITH TRANSISTOR (S) REMOVED, OR PICTURE TUBE OR OTHER LEADS REMOVED OR UNSOLDERED. USE CAUTION TO PREVENT ACCIDENTAL SHORTS BETWEEN COMPONENT LEADS OR TO CHASSIS GROUND. MAKE CONTINUITY AND RESISTANCE MEASUREMENTS WITH VTVM, FIELD EFFECT METER, OR OTHER HIGH INPUT IMPEDANCE METER. DO NOT USE A VOLT-OHMMETER HAVING LESS THAN 100K OHMS/VOLT FOR RESISTANCE MEASUREMENTS.

WARNINGS

USE ISOLATION TRANSFORMER WHEN SERVICING CHASSIS.

WHEN SERVICING, USE EXACT REPLACEMENT PARTS (SEE "SAFETY CRITICAL COMPONENTS" NOTICE). ALSO PERFORM ALL SAFETY CHECKS SPECIFIED UNDER "IMPORTANT PRODUCT SAFETY INFORMATION" IN SERVICE MANUAL.

VOLTAGE & WAVEFORM INFORMATION

DC VOLTAGES ARE MEASURED WITH RESPECT TO COMMON GROUND (B-) USING A VTVM, LINE VOLTAGE SET AT 120VAC AND ALL CONTROLS SET FOR NORMAL PICTURE. VOLTAGE READINGS TAKEN WITHOUT SIGNAL AND TUNER SET TO UNUSED CHANNEL. VOLTAGES IN BOX ▭ TAKEN WITH SET TUNED TO A COLOR SIGNAL.

⬡ HEXAGONS IDENTIFY WAVEFORM OBSERVATION POINTS. ALL WAVEFORMS TAKEN WITH WIDE BAND OSCILLOSCOPE. SEE WAVEFORM PAGES FOR OTHER INFORMATION.

V100 TYPICAL VOLTAGES
VOLTAGES MAY VARY WITH CONTROLS SETTINGS

XV100 PIN NO'S	BRIGHTNESS AND CONTRAST CONTROLS SET FOR NORMAL VIEWING	BRIGHTNESS AND CONTRAST CONTROLS AT MINIMUM (FULLY CCW)
3, 12, 1	26.2V	31.6V
6	125.8V	232V
11	127.2V	232V
2	126.7V	232V
5	550V	640V
13	507V	592V
4	658V	771V

RUN CHANGES

⑩ *Start of production.*

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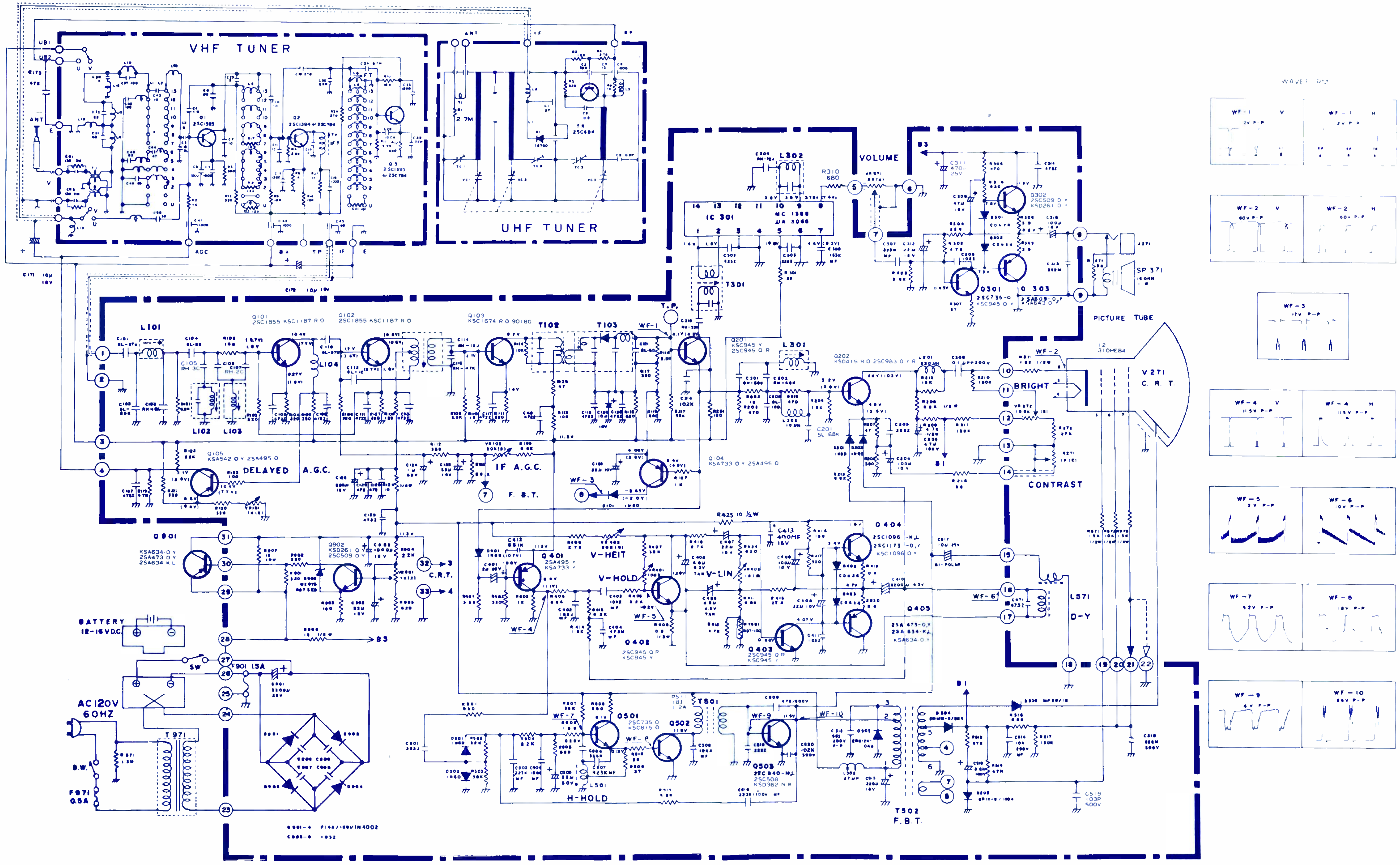
1801

MIDLAND
B&W TV Model
15-037

JULY • 1979

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

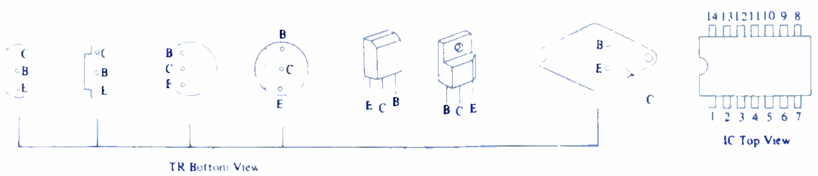


✱IMPORTANT SAFTY NOTICE

THE SHADE AREA ON THIS SCHEMATIC DIAGRAM X-INCORPORATES SPECIAL FEATURES IMPORTANT FOR PROTECTION FROM X-RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS IN THE SHADED AREAS OF THE SCHEMATIC

NOTES

1. All resistance values in ohms K=1,000 M=1,000,000
2. All capacitors not noted in schematic diagram are in pF. The 3rd numeral of capacitance value indicates 10's multiplier (Ex 683=68,000pF)
3. Voltage reading taken with "VTVM" from point indicated to chassis ground, tuner on unused channel, contrast at maximum, AGC fully clockwise, other controls at normal.
4. DC voltages in ( ) are values for normal signal input
5. Voltage reading may vary ±20%
6. Slight variations between set and schematic diagram may be noted due to production improvement



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JAPANESE TRANSISTOR SUBSTITUTION MANUAL

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* Introduction includes a guide to understanding Japanese transistors
* A 90 page 8½" by 11" soft cover book

PARTS PROCUREMENT PROBLEMS

FUJI-SVEA Has the Largest Inventory of Original Japanese Parts Anywhere

Seeking Original Japanese Replacement Parts for CB, TV and Stereo Repair Use?

TYPE	25-UP	10-24	1-9
2SA 473	.45	.55	.60
2SA 483	2.00	2.20	2.50
2SA 484	1.50	1.75	1.95
2SA 485	1.40	1.60	1.80
2SA 489	1.10	1.25	1.40
2SA 490	.70	.80	.90
2SA 493	.45	.53	.59
2SA 495	.30	.35	.40
2SA 496	.50	.64	.70
2SA 497	1.00	1.20	1.30
2SA 505	.50	.64	.70
2SA 509	.30	.35	.40
2SA 525	.50	.64	.70
2SA 530	1.50	1.70	1.90
2SA 537A	1.50	1.70	1.90
2SA 539	.40	.45	.50
2SA 545	.45	.53	.59
2SA 561	.30	.35	.40
2SA 562	.30	.35	.40
2SA 564A	.20	.27	.30
2SA 565	.70	.80	.90
2SA 566	2.50	2.70	3.00
2SA 606	1.00	1.20	1.30
2SA 607	1.10	1.25	1.40
2SA 624	.70	.80	.90
2SA 627	3.10	3.30	3.60
2SA 628	.30	.35	.40
2SA 634	.40	.45	.50
2SA 640	.30	.35	.40
2SA 642	.30	.35	.40
2SA 643	.30	.40	.45
2SA 653	1.90	2.10	2.40
2SA 659	.35	.40	.45
2SA 661	.50	.64	.70
2SA 663	3.65	3.80	4.20
2SA 666	.35	.40	.45
2SA 671	.80	.90	1.00
2SA 672	.30	.35	.40
2SA 673	.35	.40	.45
2SA 678	.35	.40	.45
2SA 679	4.20	4.40	4.90
2SA 680	4.20	4.40	4.90
2SA 682	.80	.90	1.00
2SA 683	.30	.35	.40
2SA 684	.35	.40	.45
2SA 695	.40	.53	.59
2SA 697	.40	.53	.59
2SA 699A	.50	.64	.70
2SA 705	.40	.53	.59
2SA 706	.85	1.00	1.10
2SA 715	.60	.70	.80
2SA 719	.30	.35	.40
2SA 720	.30	.35	.40
2SA 721	.30	.35	.40
2SA 725	.30	.35	.40
2SA 726	.30	.35	.40
2SA 733	.20	.27	.30
2SA 738	.40	.53	.59
2SA 740	1.50	1.70	1.90
2SA 743A	.85	1.00	1.10
2SA 744	4.20	4.40	4.90
2SA 745R	3.80	4.00	4.40
2SA 747	4.20	4.40	4.90
2SA 748	.70	.80	.90
2SA 750	.35	.40	.45
2SA 755	.80	.90	1.00
2SA 756	2.30	2.40	2.65
2SA 758	3.40	3.55	3.90
2SA 764	3.80	4.00	4.40
2SA 765	3.10	3.30	3.60
2SA 774	.40	.45	.50
2SA 777	.50	.64	.70
2SA 794A	.60	.70	.80
2SA 798	.50	.55	.60
2SA 814	.70	.80	.90
2SA 815	.60	.70	.80
2SA 816	.50	.64	.70
2SA 818	.70	.80	.90
2SA 837R	2.50	2.70	2.90
2SA 839T	1.30	1.45	1.60
2SA 908	8.60	8.80	9.80
2SA 913	.70	.80	.90
2SB 22	.30	.35	.40
2SB 54	.20	.27	.30
2SB 55	.40	.53	.59
2SB 75	.35	.40	.45
2SB 77	.35	.40	.45
2SB 173	.30	.35	.40
2SB 175	.20	.27	.30
2SB 176	.30	.35	.40
2SB 178	.35	.40	.45
2SB 186	.20	.27	.30
2SB 187	.20	.27	.30
2SB 202	1.10	1.20	1.30
2SB 220	.90	1.10	1.20
2SB 303	.30	.35	.40
2SB 324	.30	.35	.40
2SB 337	.70	.80	.90

TYPE	25-UP	10-24	1-9
2SB 346	.30	.35	.40
2SB 367	1.10	1.25	1.40
2SB 368B	1.80	2.00	2.25
2SB 379	.70	.80	.90
2SB 381	.30	.35	.40
2SB 400	.30	.35	.40
2SB 405	.30	.35	.40
2SB 407	.80	.90	1.00
2SB 415	.30	.35	.40
2SB 434	.80	.90	1.00
2SB 435	.90	1.10	1.20
2SB 440	.40	.53	.59
2SB 449	1.30	1.45	1.60
2SB 461	.90	1.10	1.20
2SB 463	.90	1.10	1.20
2SB 471	1.10	1.25	1.40
2SB 472	2.10	2.50	2.80
2SB 473	.80	.90	1.00
2SB 474	.70	.80	.90
2SB 481	.90	1.10	1.20
2SB 492	.60	.70	.80
2SB 507	.80	.90	1.00
2SB 509	1.10	1.20	1.30
2SB 511	.70	.80	.90
2SB 514	.70	.80	.90
2SB 523	.70	.80	.90
2SB 526C	.70	.80	.90
2SB 527	.90	1.10	1.20
2SB 528D	.70	.80	.90
2SB 529	.70	.80	.90
2SB 530	3.20	3.40	3.70
2SB 531	1.80	2.00	2.25
2SB 536	1.00	1.20	1.30
2SB 537	1.00	1.20	1.30
2SB 539	3.20	3.40	3.70
2SB 541	3.20	3.40	3.70
2SB 554	5.00	6.00	6.60
2SB 556	3.20	3.40	3.70
2SB 557	2.10	2.50	2.80
2SB 564B	.35	.40	.45
2SB 56[illegible]	.40	.53	.59
2SB 595	1.10	1.40	1.50
2SB 596	1.10	1.40	1.50
2SB 600	5.00	6.00	6.60
2SC 183	.40	.53	.59
2SC 184	.40	.53	.59
2SC 281	.30	.35	.40
2SC 283	.40	.53	.59
2SC 284	.80	.90	1.00
2SC 317	.40	.53	.59
2SC 352A	2.00	2.20	2.50
2SC 353A	1.40	1.60	1.80
2SC 367	.60	.70	.80
2SC 369	.30	.35	.40
2SC 370	.20	.27	.30
2SC 371	.30	.35	.40
2SC 372	.20	.27	.30
2SC 373	.20	.27	.30
2SC 374	.30	.35	.40
2SC 375	.30	.35	.40
2SC 377	.30	.35	.40
2SC 380	.20	.27	.30
2SC 381	.35	.40	.45
2SC 382	.35	.40	.45
2SC 383	.35	.40	.45
2SC 387A	.35	.40	.45
2SC 388A	.40	.53	.59
2SC 39[illegible]	.20	.27	.30
2SC 40[illegible]	.30	.35	.40
2SC 430	.50	.64	.70
2SC 454	.30	.35	.40
2SC 458	.20	.27	.30
2SC 460	.35	.40	.45
2SC 461	.35	.40	.45
2SC 478	.60	.70	.80
2SC 481	1.30	1.40	1.50
2SC 482	1.10	1.25	1.40
2SC 484	1.30	1.40	1.50
2SC 485	1.30	1.40	1.50
2SC 486	1.30	1.40	1.50
2SC 493	3.00	3.20	3.40
2SC 495	.45	.55	.60
2SC 496	.45	.55	.60
2SC 497	1.10	1.25	1.40
2SC 509	.35	.40	.45
2SC 510	1.30	1.40	1.50
2SC 515A	.80	.90	1.00
2SC 517	2.50	2.70	3.00
2SC 535	.30	.35	.40
2SC 536	.30	.35	.40
2SC 537	.30	.35	.40
2SC 627	1.30	1.45	1.60
2SC 631	.35	.40	.45
2SC 632A	.35	.40	.45
2SC 634A	.35	.40	.45
2SC 680	1.90	2.10	2.40
2SC 681A	3.00	3.25	3.50
2SC 684	.80	.90	1.00

TYPE	25-UP	10-24	1-9
2SC 693F	.20	.27	.30
2SC 696	1.00	1.20	1.30
2SC 708	1.30	1.45	1.60
2SC 710	.20	.27	.30
2SC 711	.20	.27	.30
2SC 712	.20	.27	.30
2SC 715	.30	.35	.40
2SC 717	.35	.40	.45
2SC 727	1.00	1.20	1.30
2SC 730	3.00	3.20	3.40
2SC 731	2.50	2.70	2.90
2SC 732	.20	.27	.30
2SC 733	.20	.27	.30
2SC 734	.20	.27	.30
2SC 735	.20	.27	.30
2SC 738	.20	.27	.30
2SC 756	1.50	1.80	2.00
2SC 756A	1.50	1.80	2.00
2SC 763	.35	.40	.45
2SC 772	.30	.35	.40
2SC 773	.35	.40	.45
2SC 774	1.00	1.20	1.30
2SC 775	1.40	1.60	1.80
2SC 776	2.00	2.20	2.50
2SC 777	3.00	3.25	3.50
2SC 778	2.90	3.20	3.40
2SC 781	1.90	2.10	2.40
2SC 783	2.10	2.50	2.80
2SC 784	.30	.35	.40
2SC 785	.35	.40	.45
2SC 789	.80	.90	1.00
2SC 790	.80	.90	1.00
2SC 793	2.00	2.20	2.50
2SC 799	2.00	2.20	2.50
2SC 828	.20	.27	.30
2SC 829	.20	.27	.30
2SC 830H	2.50	2.70	3.00
2SC 838	.35	.40	.45
2SC 839	.30	.35	.40
2SC 853	.70	.80	.90
2SC 867	3.20	3.40	3.70
2SC 867A	3.20	3.40	3.70
2SC 870	.35	.40	.45
2SC 871	.35	.40	.45
2SC 895	4.20	4.40	4.90
2SC 897	2.00	2.20	2.50
2SC 898	2.50	2.70	3.00
2SC 900	.20	.27	.30
2SC 923	.20	.27	.30
2SC 929	.20	.27	.30
2SC 930	.20	.27	.30
2SC 941	.20	.27	.30
2SC 943	.35	.40	.45
2SC 945	.20	.27	.30
2SC 959	1.00	1.20	1.30
2SC 971	.70	.80	.90
2SC 982	.70	.80	.90
2SC 983	.50	.64	.70
2SC 1000	.35	.40	.45
2SC 1012	1.20	.40	1.50
2SC 1013	.50	.64	.70
2SC 1014	.50	.64	.70
2SC 1017	.80	.90	1.00
2SC 1018	.60	.70	.80
2SC 1030	1.80	2.10	2.40
2SC 1047	.35	.40	.45
2SC 1051	3.40	3.55	3.90
2SC 1060	.70	.80	.90
2SC 1061	.70	.80	.90
2SC 1076	30.00	35.00	39.00
2SC 1079	3.40	3.55	3.90
2SC 1080	3.40	3.55	3.90
2SC 1096	.45	.55	.60
2SC 1098	.50	.64	.70
2SC 1111	2.10	2.50	2.80
2SC 1114	4.20	4.40	4.90
2SC 1115	2.50	2.70	3.00
2SC 1116	3.20	3.40	3.70
2SC 1116A	3.40	3.55	3.90
2SC 1124	.80	.90	1.00
2SC 1127	.80	.90	1.00
2SC 1161	1.30	1.45	1.60
2SC 1162	.70	.80	.90
2SC 1166	.20	.27	.30
2SC 1167	3.80	4.00	4.40
2SC 1170B	3.80	4.00	4.40
2SC 1172B	3.20	3.60	3.95
2SC 1173	.50	.55	.60
2SC 1175	.35	.40	.45
2SC 1177	11.00	12.60	14.00
2SC 1189	1.00	1.10	1.20
2SC 1209	.30	.35	.40
2SC 1211D	.30	.35	.40
2SC 1212A	.80	.90	1.00
2SC 1213	.30	.35	.40
2SC 1215	.35	.40	.45
2SC 1222	.20	.27	.30
2SC 1226	.50	.55	.60

TYPE	25-UP	10-24	1-9
2SC 1226A	.50	.55	.60
2SC 1237	1.80	2.00	2.25
2SC 1239	2.20	2.70	2.90
2SC 1279	.50	.55	.60
2SC 1306	1.30	1.45	1.60
2SC 1307	1.90	2.10	2.40
2SC 1310	.20	.27	.30
2SC 1312	.20	.27	.30
2SC 1313G	.20	.27	.30
2SC 1316	4.20	4.40	4.90
2SC 1317	.20	.27	.30
2SC 1318	.35	.40	.45
2SC 1325A	6.50	6.90	7.60
2SC 1327	.20	.27	.30
2SC 1330	.50	.55	.60
2SC 1335	.50	.55	.60
2SC 1342	.45	.53	.59
2SC 1344	.45	.53	.59
2SC 1358	4.20	4.40	4.90
2SC 1359	.30	.35	.40
2SC 1360	.50	.55	.60
2SC 1362	.35	.40	.45
2SC 1364	.35	.40	.45
2SC 1377	3.20	3.40	3.70
2SC 1383	.30	.35	.40
2SC 1384	.35	.40	.45
2SC 1396	.45	.53	.59
2SC 1398	.70	.80	.90
2SC 1400	.35	.40	.45
2SC 1402	3.00	3.20	3.40
2SC 1403	3.20	3.40	3.70
2SC 1407	.50	.55	.60
2SC 1419	.60	.70	.80
2SC 1444	1.60	1.80	2.00
2SC 1445	2.50	2.70	2.90
2SC 1447	.60	.70	.80
2SC 1448	.70	.80	.90
2SC 1449	.60	.70	.80
2SC 1451	1.00	1.10	1.20
2SC 1454	3.20	3.40	3.70
2SC 1475	.80	.90	1.00
2SC 1478	.50	.55	.60
2SC 1509	.50	.55	.60
2SC 1567	.60	.70	.80
2SC 1567A	.60	.70	.80
2SC 1584	6.00	6.30	7.00
2SC 1586	6.50	6.90	7.60
2SC 1624	.60	.70	.80
2SC 1626	.60	.70	.80
2SC 1628	.60	.70	.80
2SC 1647	.70	.80	.90
2SC 1667	3.00	3.20	3.40
2SC 1669	.90	1.00	1.10
2SC 1674	.30	.35	.40
2SC 1675	.20	.27	.30
2SC 1678	1.10	1.25	1.40
2SC 1679	3.00	3.20	3.40
2SC 1681	.30	.35	.40
2SC 1682	.30	.35	.40
2SC 1684	.30	.35	.40
2SC 1687	.40	.45	.50
2SC 1688	.35	.40	.45
2SC 1708	.30	.35	.40
2SC 1728	.70	.80	.90
2SC 1730	.45	.53	.59
2SC 1756	.50	.55	.60
2SC 1760	.70	.80	.90
2SC 1816	1.50	1.75	1.95
2SC 1856	.45	.53	.59
2SC 1885	.45	.53	.59
2SC 1908	.30	.35	.40
2SC 1909	1.80	2.00	2.25
2SC 1945	4.50	5.00	5.60
2SC 1957	.60	.70	.80
2SC 1969	3.60	4.00	4.40
2SC 1973	.70	.80	.90
2SC 1975	1.30	1.70	1.90
2SC 1978	5.40	6.00	6.60
2SC 2028	.50	.64	.70
2SC 2029	1.50	1.80	2.00
2SC 2074	.80	.90	1.00
2SC 2076	.50	.64	.70
2SC 2091	.90	1.10	1.20
2SC 2092	1.80	2.00	2.25
2SC 2098	[illegible]	3.40	3.70
2SC 2166	[illegible]	1.60	1.80
2SD 72	.50	.64	.70
2SD 77	.35	.40	.45
2SD 90	1.30	1.45	1.60
2SD 91	1.30	1.45	1.60
2SD 92	1.30	1.45	1.60
2SD 93	1.60	1.80	2.00
2SD 118	2.90	3.20	3.40
2SD 130	1.10	1.25	1.40
2SD 187	.35	.40	.45
2SD 201	2.30	2.40	2.65
2SD 202	3.40	3.55	3.90
2SD 218	2.50	2.70	3.00

TYPE	25-UP	10-24	1-9
2SD 234	.60	.70	.80
2SD 235	.60	.70	.80
2SD 261	.35	.40	.45
2SD 287	2.50	2.70	2.90
2SD 300	4.50	5.00	5.60
2SD 313	.60	.70	.80
2SD 315	.60	.70	.80
2SD 325	.60	.70	.80
2SD 330	.60	.70	.80
2SD 350	3.80	4.00	4.40
2SD 380	5.20	5.40	5.95
2SD 381	.85	1.00	1.10
2SD 424	3.80	4.00	4.40
2SD 425	2.90	3.20	3.40
2SD 426	3.10	3.30	3.60
2SD 427	1.80	2.00	2.25
2SD 525	.90	1.10	1.20
2SD 526	.60	.70	.80
2SK 19BL	.50	.55	.60
3SK 22Y	1.40	1.60	1.80
3SK 39	.90	1.10	1.20
3SK 40	.90	1.10	1.20
3SK 41	1.30	1.45	1.60
3SK 45	1.30	1.45	1.60
AN 203	1.40	1.60	1.80
AN 214O	1.50	1.70	1.90
AN 239	4.20	4.40	4.90
AN 247	2.50	2.70	3.00
AN 274	1.50	1.75	1.95
AN 313	3.00	3.20	3.40
AN 315	1.80	2.00	2.25
BA 511A	1.80	2.00	2.25
BA 521	1.90	2.10	2.40
HA 1151	1.50	1.75	1.95
HA 1156W	1.60	1.80	2.00
HA 1306W	2.00	2.20	2.50
HA 1339	2.50	2.70	3.00
HA 1339A	2.50	2.70	3.00
HA 1342A	2.50	2.70	3.00
HA 1366W	2.50	2.70	3.00
HA 1366WR	2.50	2.70	3.00
LA 4031P	1.80	2.00	2.25
LA 4032P	1.80	2.00	2.25
LA 4051P	1.80	2.00	2.25
LA 4400	1.90	2.10	2.40
LA 4400Y	2.00	2.20	2.50
LA 4420	2.00	2.20	2.50
LD 3001	2.00	2.20	2.50
M5 1513L	2.00	2.20	2.50
STK 011	3.80	4.00	4.40
STK 013	7.60	8.00	8.80
STK 015	4.20	4.40	4.90
STK 435	4.50	5.00	5.60
STK 439	7.90	8.00	8.80
TA 7045M	2.00	2.20	2.50
TA 7055P	2.00	2.20	2.50
TA 7061AP	.90	1.10	1.20
TA 7062P	1.10	1.25	1.40
TA 7203P	2.50	2.70	2.90
TA 7204P	2.00	2.20	2.50
TA 7205P	1.60	1.80	2.00
TA 7222P	3.40	3.55	3.90
TA 7310P	1.30	1.45	1.60
TBA 810SH	1.90	2.10	2.40
TC 5080P	5.00	5.20	5.80
TC 5081P	3.00	3.20	3.40
TC 5082P	3.40	3.55	3.90
UHIC 001	4.20	4.40	4.90
UHIC 002	4.20	4.40	4.90
UHIC 003	4.20	4.40	4.90
UHIC 004	4.20	4.40	4.90
UHIC 005	4.20	4.40	4.90
uPC 20C	2.10	2.50	2.80
uPC 563	1.90	2.10	2.40
uPC 575C2	1.30	1.45	1.60
uPC 576	1.90	2.10	2.40
uPC 592H	.70	.80	.90
uPC 1001H	1.90	2.10	2.40
uPC 1008C	4.20	4.40	4.90
uPC 1020H	1.90	2.10	2.40
uPC 1025	1.90	2.10	2.40
uPC 1154	2.00	2.20	2.50
uPC 1155	2.00	2.20	2.50
uPC 1156	1.90	2.10	2.40
uPD 861	8.00	8.40	9.50
uPD 857	8.00	8.40	9.50
uPD 858	6.00	6.30	7.00
PLL 0IA	3.00	4.20	4.60
PLL 02A	5.00	5.20	5.90
PLL 03A	7.60	8.00	8.80
C-3001	1.30	1.45	1.60
2SC F8	2.20	2.70	2.90
4004	1.90	2.10	2.40
4005	2.00	2.20	2.50
SG 613	5.20	5.40	5.95
78L05	.90	1.00	1.10
MPS U31	1.50	1.70	1.90
SN 7400	.15	.17	.19

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