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TV module repair the PTS way

Caution: CMOS ICs

Kansas City's 'Audio Mart'

Facts about soldering

PC-77 show report

***Servicers now have 'universal'
warranty claim form/service ticket***

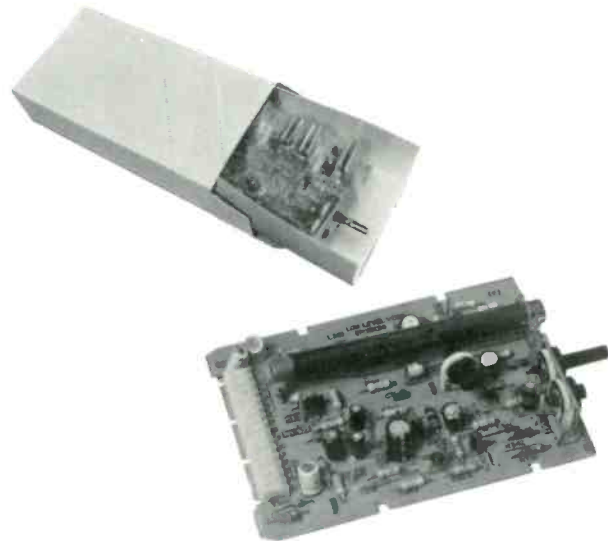
...See editor's memo

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*Increase Your Profits By Utilizing
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Consider these features!

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We use original parts on all modules, no matter who the manufacturer is. Brands we rebuild include Admiral, GE, Magnavox, Montgomery Ward, Philco, Quasar, RCA, Sears/Warwick, Zenith and others.
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PTS ELECTRONICS, INC.
PRECISION TUNER SERVICE

P.O. Box 272 Bloomington, IN 47401 812-824-9331

THE COMPLETE LIST OF ALL PTS SERVICENTERS APPEARS ON THE NEXT PAGE.

...for more details circle 102 on Reader Service Card

EDITOR'S MEMO



Universal Warranty Claim Form/Service Ticket

The consumer electronics service industry has been asking for it for years and now, at last, it's a reality.

Through the combined efforts of the National Association of Retail Dealers of America (NARDA) and the Electronic Industries Association (EIA), and with the cooperation of most major entertainment electronic manufacturers, the servicers of entertainment electronic products now have a manufacturer-approved, universal warranty claim form/service ticket, a reproduction of which is shown here, and on page 34.

The new form, designated Form 317, not only is designed for use as a universally-accepted warranty

claim form but also can be used by servicers as a standard service ticket, for both in-warranty and out-of-warranty repairs.

Entertainment electronic manufacturers who to date have approved the new form and are now accepting it in place of their own warranty claim forms include: Admiral, GTE Sylvania, Magnavox, MGA, Panasonic, Quasar, RCA, Sony, U.S. Pioneer, and Zenith.

The new five-copy form is 7 1/4 inches wide by 10 inches high and includes a block of space near the bottom in which the dealer's logo, address and phone number may be imprinted.

NARDA, which played a promi-
continued on page 47

| | | | |
|---|---------------|---|------------------------------------|
| BRAND _____ | | CLAIM NO _____ | |
| CUSTOMER'S NAME (LAST NAME FIRST) _____ (PLEASE PRINT!) | | SERVICE CENTER NO _____ | |
| ADDRESS _____ | | MODEL NO _____ | |
| CITY _____ | STATE _____ | ZIP CODE _____ | AREA CODE _____ PHONE NUMBER _____ |
| CUSTOMER'S COMPLAINT _____ | | SERIAL NO _____ | |
| DEALER'S NAME _____ CITY _____ | | DATE PURCHASED _____ MD OAT YR | |
| SERVICE PERFORMED (CHECK ONLY ONE): <input type="checkbox"/> ADJUSTMENTS OR ALIGNMENTS <input type="checkbox"/> LOOSE CONNECTIONS ONLY <input type="checkbox"/> OTHER OR COMBINATION OR PARTS USED | | DATE OF FAILURE _____ MD OAT YR | |
| EXPLANATION OF SERVICE PERFORMED _____ | | DATE OF SERVICE _____ MD OAT YR | |
| TIME STARTED _____ | | CHECK ONE BOX TO INDICATE PRODUCT WORKED ON: <input type="checkbox"/> Comp <input type="checkbox"/> Stereo <input type="checkbox"/> B/W <input type="checkbox"/> Color | |
| TIME COMPLETED _____ | | CHECK ONE BOX ONLY: <input type="checkbox"/> CARRY IN SERV. MINOR <input type="checkbox"/> CARRY IN SERV. MAJOR <input type="checkbox"/> HOME SERVICE <input type="checkbox"/> SHOP SERVICE <input type="checkbox"/> CAT REPLACEMENT <input type="checkbox"/> STOCK REPAIR MINOR <input type="checkbox"/> STOCK REPAIR MAJOR | |
| TIME ON JOB _____ | | TOTAL LABOR CHARGE _____ | |
| QTY _____ | PART NO _____ | PART DESCRIPTION _____ | |
| SERVICE WAS SATISFACTORILY COMPLETED _____ | | TOTAL PARTS CHARGE _____ | |
| CUSTOMER'S SIGNATURE _____ | | OTHER _____ | |
| TECHNICIAN'S SIGNATURE _____ | | SALES TAX _____ | |
| MURPHY APPLIANCE CO. 8300 S. Transit Road Lodiport, N. Y. 14094 825-8081 | | GRAND TOTAL _____ | |
| CUSTOMER'S CLAIM CHECK SERVICE CENTER _____ | | PICK UP DATE _____ | |
| | | A M _____ P M _____ | |

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THE WORLD'S LARGEST TUNER SERVICE IS CLOSE TO YOU!

- | | | |
|--|--|--|
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THE COVER: A small portion of the TV module repair line at PTS Electronics, Inc., a Bloomington, Indiana-based TV tuner/module repair company whose module repair activity is the subject of an article which begins on page 22 of this issue.

10 Caution: CMOS ICs!

A servicer-oriented examination of the composition and typical functions of complementary metal oxide semiconductor ICs—which are being used in increasing numbers of entertainment and communications electronics products—plus tips for 'nondestructive' testing and handling of these relatively sensitive devices. By Joseph J. Carr, CET.

22 Color TV Module Repair the PTS Way

How an Indiana-based TV tuner/module repair firm is helping servicers cope with—and even benefit from—modular design.

26 PC-77 Show Report

An overview of the current status of the CB market—where it's at now and where it's most likely to go during the next few months—based on the activities and opinions of exhibitors and attendees at the 2nd Annual Personal Two-Way Communications Show, held again this year in Las Vegas, Feb. 15-17. By Don W. Mason, ET/D Managing Editor.

30 Kansas City's Audio Mart

How one high-end audio sales/service specialty dealer is gearing up to hold off the emerging threat of mass merchandisers, whom he believes are now moving into his segment of the audio market. By Grier Lowry.

34 Universal Warranty Claim/Service Ticket

A full-page reproduction of Form 317, the combination warranty claim form and service ticket which has been developed jointly by NARDA and the EIA and the use of which for warranty claim purposes has been approved by most major TV manufacturers. (See Editor's Memo in this issue.)

36 Facts About Soldering

Sure it's easy. But today's heat-sensitive microelectronic technology makes the use of the right type of solder and the right soldering equipment more important than ever. By Al Friedman.

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We've got the longest running feature on TV.

Our Color Bright 85® picture tube warranty is the longest in the industry. We can offer it because we're confident that a Color Bright 85 picture tube will probably last longer than five years.

The warranty is a great selling tool that builds customer confidence in your quality work. Plus, it lets you form a long-term customer relationship with each picture tube you replace.

*Limited warranty, naturally. It does not cover labor for replacing a tube.

The Color Bright 85 picture tube offers economy with the high quality standards you expect from Sylvania. Couple that with the new 5-year warranty* and you'll find the Color Bright 85 is an easy sale.

And it can be better for you in the long run.

GTE SYLVANIA

NEWS OF THE INDUSTRY

Sony's Trinitron Color TV Production Passes Million Mark In U.S.

The one millionth Trinitron color television set has been produced by the Sony Corporation of America at its plant in San Diego. This boosts the world-wide total of Trinitron receivers to ten million.

The Trinitron system features a single electron gun, a narrow picture tube neck, a single large-diameter electron lens and an aperture grille that provides full-length vertical color stripes.

Sony introduced the Trinitron models in the United States in 1969. The San Diego plant was opened in 1972.

New Color TV Electron Gun Development From Zenith Gets Patent

A new in-line electron gun, called the "EFL", now being used in Zenith's 19-inch diagonal color TV models, has been patented. The new gun is housed in the narrow neck of the firm's 19-inch 100-degree picture tubes. Compared to conventional bi-potential guns, the gun is a tri-potential electron gun that uses two additional lens elements to improve sharpness and detail.

Karl Horn, Zenith senior vice president, said, "The new gun concentrates the electron beam to produce a spot size up to 60 per cent smaller than is possible with conventional gun systems."

American Consumers Surveyed Have Low Opinion Of Appliance Servicers

A survey of American consumers conducted in 1976 resulted in a performance rating of 20 major industries, including the category titled "Appliance Repair Services." The survey was sponsored by *U.S. News & World Report* and its results were reprinted in *ServiceShop* magazine. Airlines and Banks were at the top in the results and were rated excellent, while Appliance Repair Services, which included TV/Radio Repair Service, was rated 19th, one step above the lowest and poorest, which was Railroads.

The survey was completed by 5,448 households selected as a cross section of the general population. Results disclosed that "there was a widespread feeling that manufacturers and retailers are not sufficiently interested in their customers and don't always give them full value for their money."

Survey of Manufacturers Indicates Stable CB Market In 1977

The results of a year-end survey of CB manufacturers, conducted by *TV Digest*, indicate that, after a 2-year period of spiraling annual increases, "CB sales in 1977 will run even with—or slightly behind—1976 totals. The median forecast by those surveyed indicate unit sales of 12.2 million in 1977, with the average retail price of 23- and 40-channel units settling at the \$150 level."

In addition to its survey of CB manufacturers, *TV Digest* produced its own annual 12-month forecast for 1977, and predicted for the CB industry, "A year of transition and shakeout, with the industry slowly recovering from the 23-channel to 40-channel debacle, and at least one prominent name (plus a host of lesser brands) leaving the market. Sales will barely top 11 million," the report goes on to say, "but pricing will improve significantly during the 2nd half as 23-channel dumps slowly disappear from the pipelines."

Sales To Dealers Of Consumer Electronics Almost Break Records For January & February

Sales of consumer electronic products were off to a good start for 1977, according to the latest EIA figures, with increases recorded in every category but auto radios. Color TV sales were up 22.2% over 1976, topping all records for the first 8 weeks of the year, except that recorded in 1973. The EIA figures are as follows:

| Sales To Dealers For Week Ending Feb. 18 According To Figures From The EIA | | | |
|---|-----------------|-----------------|--------------------|
| Products | 1977 To Date | 1976 To Date | Per Cent Change |
| Color TV | 1,046,719 | 856,782 | +22.2% |
| B & W TV | 638,544 | 579,751 | +10.1% |
| Total TV | 1,685,263 | 1,436,543 | +17.3% |
| AM Radios | 712,617 | 418,495 | +70.4% |
| AM/FM & FM | 1,650,422 | 1,556,323 | + 6.0% |
| Auto Radios | 1,680,940 | 1,688,173 | - 0.4% |
| Total Radio | 4,043,979 | 3,662,991 | +10.4% |

Police And CB'ers Helping Each Other

A recently retired official in the state highway patrol of Missouri has called the use of CB radios "one of the most revolutionary ideas in law enforcement to occur in the

Six important questions to ask of any DMM that claims to be designed for field service.



We give you a choice of 3½ or 4½ digits, manual or autorange.

At Fluke, we've been building DMMs for a long time. We're the leader.

And if there's one thing we've learned over the years, it's that what works for the bench doesn't always work for the field.

But a lot of companies don't understand that. They'd like you to believe their DMM is perfect for field service. Just because they've put it in a different case.

Here's how to tell the difference:

1) Is the size and shape designed for the field?

How do you carry your tools? We designed the 8030A/8040A DMMs into an ideal shape after we researched the requirements of field service work. It's sized to fit in a case. And it's rugged, to take the beating field instruments must survive.



If it doesn't fit here, it's not for field service.

2) Does it have true rms ac?

Make sure you get usable accuracy. You'll need true rms ac to eliminate errors when measuring distorted waveforms. (And if you don't understand the importance of true rms, write for our bulletin on True RMS Measurement.)

3) Does it give full performance?

Just because it's a field instrument, you shouldn't sacrifice

performance. Demand five measurement functions in 26 ranges. Top specs, like our 8040A basic dc accuracy of $\pm 0.05\%$ or our 8030A basic dc accuracy of $\pm 0.1\%$. And the specifications are guaranteed for one year. Important extras, like diode test for measurement of semiconductor junctions in-circuit, high voltage protection, and self test feature. And a complete line of accessories: various battery options, and probes for measurement of rf voltages, high current ac, high voltage dc and temperature.

4) Do you have a choice of manual or autorange?

We offer two versions: the 8030A 3½ digit and the 8040A 4½ digit with autoranging. Because we know not all field service applications are alike.

5) What is the price?

A field service DMM is a tool, and should carry a practical price. Our 3½ digit 8030A is \$250.* Our 4½ digit 8040A is \$440.* Check around and you'll see how practical that is.

6) Do you trust the company that builds it?

We became the leader in DMMs for one reason only. We build digital multimeters that people trust and continue to use, year after year. We've sold hundreds of thousands of DMMs.

And every bit of that experience has gone into the 8030A and 8040A DMMs.

For data out today, dial our toll-free hotline, 800-426-0361. John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043. Fluke (Nederland) B.V., P.O. Box 5053, Tilburg, The Netherlands. Phone: (013) 673-973 Telex: 52237.

*U.S. price only.

The field service DMMs for field service people.



...for more details circle 116 on Reader Service Card

APRIL 1977, ELECTRONIC TECHNICIAN/DEALER / 5

century." Colonel S.S. Smith, retired Missouri Highway Patrol superintendent, told CB manufacturers, distributors and dealers at the recent PC-77 in Las Vegas that "I am firmly convinced that cooperation between citizens and law enforcement through CB radios results in a far better service in protection to the public as well as providing a positive means whereby citizens can become directly involved in matters of highway safety, crime prevention and crime control."

Colonel Smith headed the Missouri patrol when it undertook an unusual experiment using CB radios in patrol vehicles, as well as base stations at troop headquarters and weigh stations. "Besides saving many lives, CB reports resulted in arrests for murder, kidnapping, armed robbery, assault, rape, escape from state and federal institutions, auto theft, house burglaries, and a host of traffic violations."

"An interesting spin-off of the data we collected has proven to be most worthwhile," noted the Colonel. "We found that the lapse time between the occurrence and notification of accidents investigated by conventional means was about 14 minutes, as compared to about 8 minutes when notified by CB radio."

Bureau Of Standards Stations Discontinues Two Frequencies

The National Bureau of Standards (NBS) has cancelled broadcasts on three less-used frequencies of radio stations WWV and WWVH. Frequencies affected are 20 and 25 MHz at WWV (Fort Collins, Colorado) and 20 MHz at WWVH (Kauai, Hawaii).

The decision to terminate these broadcasts was based on the results of a 1975 survey of over 12,000 users. Both stations will continue to broadcast on their other frequencies of 2.5, 5, 10, and 15 MHz, with no change in radiated power. NBS radio station WWVB will also continue broadcasting on 60 kHz with no change.

Zenith To Produce & Market Video Tape Recorder Of Sony Design

An agreement has been reached between the Zenith Radio Corporation and the Sony Corporation that gives Zenith the rights to produce and market video player/recorders based on the tape scan technology incorporated in the Sony Betamax video Tape recorder. Zenith expects to offer the player/recorder in volume during the fall selling season this year.

The separate video player/recorder unit, to be produced for Zenith by Sony, will be capable of attachment to any TV receiver. In addition, Zenith plans to introduce several

RCA's FREE & EASY '77 Dealer Awards



FE-4-18



FE-4104



FE-4117



FE-4106



FE-4108



FE-4116



FE-4111



FE-4105



FE-4112

models in which the video player/recorder tape deck will be combined with a large screen Zenith color receiver. Using a special timer, the new Zenith unit will permit video recording during pre-set time periods while the consumer is away from home.

Also planned is the availability of a black-and-white camera and microphone for in-home motion picture photography with sound recording.

Firm pricing plans for the new equipment have not been developed as yet, but company spokesmen say the player/recorder will be priced to be competitive with other high quality video player/recorders.

Future Electronic Consumers Predicted For An Active Role

In the near future, consumers of electronic products will be much more active in their participation with the products, according to an RCA executive.

In appearing at a Rotary Club in San Francisco, Roy H. Pollack, vice president and general manager of the RCA consumer electronics division, said that the electronic products produced in the past that were designed just for entertainment are gradually evolving into products which will involve the consumer in a more active role.

Examples of such products forecast by Pollack included:

- An s.o.s. system for fire, smoke and intrusion
- The widespread use of the picture telephone
- A home TV system with built-in video game capability and video recording/playback at the viewer's convenience
- Wristwatches that electronically read out the time, date, temperature and blood pressure
- A wrist radio which could be used for electronic voting, census taking, civil defense, medical monitoring and instant communications with police and other security agencies.

New Color TV With AM/FM Radio For Hotels & Motels Introduced by GTE Sylvania

A combination 19-inch (diagonal) color TV with AM/FM radio designed for use in hotels and motels has been introduced by GTE Sylvania. It is the first combination receiver marketed by the company.

Designated the GM6971RW, the television set features a solid-state chassis with GT-Matic self-adjusting tuning, a Chroma-line picture tube and plug-in integrated circuits and transistors. The radio has pushbutton tuning. ■



When you think of receiving tubes, think RCA! When you think of dealer awards, think RCA "Free and Easy '77." Then get both from your local participating RCA tube distributor. Quality tubes and quality awards go hand in hand from RCA.

Free with your purchase of RCA Entertainment Receiving Tubes

Check out these 17 values; select the award you want; then visit your participating RCA distributor and find out how easily you can take home that award when you place your tube order.

- SPALDING "DRIBBLER" BASKETBALL — FE-4102 — Value: \$12.00 (Not Illustrated)
- SPALDING TENNIS CARRY-ALL — FE-4103 — Value: \$15.40 (Not Illustrated)
- WILSON PRO STAFF GOLF BALLS — FE-4118 — Value: \$15.75
- SPALDING REBEL FOOTBALL — FE-4104 — Value: \$17.00
- WATER PIK SHOWER MASSAGE — FE-4105 — Value: \$24.95
- SPALDING PANCHO GONZALES SIGNATURE RACKET — FE-4106 — Value: \$22.60
- PRESTO BURGER/2 — FE-4107 — Value: \$35.90
- GARCIA MITCHELL SPINNING COMBO — FE-4108 — Value: \$39.95
- SCHICK PRO JET-1200 STYLING DRYER — FE-4109 — Value: \$39.00
- SKIL DOUBLE INSULATED 2-SPEED JIG SAW — FE-4110 — Value: \$40.95 (Not Illustrated)
- TAYLOR AMERICAN EAGLE BINOCULARS — FE-4111 — Value: \$56.95
- SHEPHERD BALL-B-Q FAMILY SIZE GRILL — FE-4112 — Value: \$54.95
- HAZEL SAXONY 21" DUFFEL BAG — FE-4113 — Value: \$50.00
- ROCKWELL 16" HEDGE AND SHRUB TRIMMER — FE-4114 — Value: \$34.95
- SKIL MULTI-PURPOSE X-TRA TOOL — FE-4115 — Value: \$67.95
- OLIVETTI UNDERWOOD PORTABLE TYPEWRITER — FE-4116 — Value: \$79.50
- OLIVETTI "DIVISUMMA 32" ELECTRONIC PRINTING CALCULATOR — FE-4117 — Value: \$109.00

RCA Distributor & Special Products Division, Deptford, N.J. 08096

RCA Receiving Tubes

TECHNICAL LITERATURE

The New 1977 Battery Index, just released by the National Distributors Association (NEDA), simplifies customer re-order of replacement batteries for many electronic devices. The new index includes 182 battery types which account for approximately 80% of total battery sales. Handy number suffixes are used to accommodate listings for both Ni Cad rechargeable batteries and 9 groups of various non-rechargeable types. Available for 50 cents for quantities less than 100, or \$16.50 per hundred, from *National Electronic Distributors Association*, 3525 W. Peterson Avenue, Suite 601, Chicago, Ill. 60659.

Hard-To-Find Tools for electronic assembly work and precision mechanics are covered in the latest catalog from Jensen Tools. The new 136-page catalog includes over 3,000 tools of interest to field engineers, technicians, instrument mechanics, locksmiths, watchmakers, and electronic hobbyists. Categories covered include: micro-tools, test equipment, soldering equipment, tweezers, screwdrivers, power tools, and 32-page section cover-

ing tool kits and tool cases. Available free from *Jensen Tools and Alloys*, 4117 North 44th Street, Phoenix, AZ 85018.

Two-Way Radio Cable Products are covered in a new brochure from Cerro Communication Products. The new 4-page brochure covers the firm's new line of 50 and 75 ohm cable for CB, land mobile and marine radio applications. It includes physical and electrical properties in a comprehensive chart. The literature, called Catalogue No. 9876, includes 8,58,59 and 174/U type cable which is available in various bulk lengths, plus a 59/U co-phasing harness. Available free from *Cerro Communications Products*, Halls Mill Road, Freehold, N.J. 07728.

A TV Symptom Repair Manual, the 1977 edition, is now available from General Electric. The newest manual contains information on GE products included in the last manual, and adds information on the newest GE chassis. The booklet lists a variety of symptoms and tells you what to check and in what order. The information represents the combined experiences of hundreds of technicians. Available from \$1 at GE distributors or from *General Electric Company*, Product Service, College Blvd., Portsmouth, Va 23705.

Antennas For TV, MATV And CB are fully described and illustrated in the newest 56 page catalog from Jerrold Electronics. The new literature includes home TV antennas, system antennas, CB antennas, towers, MATV headend equipment, MATV distribution equipment, preamplifiers, reception accessories and remote controls. Available free from Jerrold distributors, or from *Jerrold Electronics Corporation*, Distributor Sales Division, 200 Witmer Road, Horsham, Pa. 19044.

Professional Test Instruments, available in kit or wired form, are described and illustrated in the latest brochure from Eico Instruments. Included in the new literature is the firm's complete line of electronic test and measuring instruments, including oscilloscopes, VTVM's, VOM's, generators, tube/transistor testers, power supplies and probes. Available free from *Eico Electronic Instrument Co., Inc.* 283 Malta Street, Brooklyn, N.Y. 11207.

AM and SSB CB Radios are fully described and illustrated in full color in a new folder available from Cobra Communications. The full line of the firm's CB units and accessories are included in the folder. Available free from distributors and *Cobra Communications*, 1801 W. Belle Plaine Avenue, Chicago, Illinois 60613.

CB Service And Test Instruments for the professional servicers are pictured and described in the new full-color folder from Hickok Instruments. The literature covers the firm's new Model 388 CB In-line tester which provides digital read-out of frequency, power output, standing-wave ratio, and percent of modulation. Also included in the folder are descriptions of the Model 256 CB/RF generator, the model 244 Mobil/comm power supply, frequency counters, and the model 270 function generator. The folder is free from *Hickok Electrical Instrument Co.*, 10514 Dupont Avenue, Cleveland, Ohio 44108.

Test Instruments for Electronics are fully pictured and described in the latest test instrument catalog, No. 811-22, from Heath/Schlumberger. This is the catalog of fully assembled test instruments, including single and dual trace oscilloscopes, frequency counters, chart recorders, power supplies, digital multimeters, function generators, audio test instruments, CRT rejuvenator/testers, VOMs & VTVMs, electronics learning courses, probes and accessories. Prices are included. Available free from, *Heath/Schlumberger Instruments*, Benton Harbor, Michigan 49022. ■




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Caution: CMOS IC's

By Joseph J. Carr, C.E.T.

An explanation of Complementary Metal Oxide Semiconductor (CMOS) integrated circuits—and a review of the special servicing techniques they require.

■ Complementary Metal Oxide Semiconductor (CMOS) integrated circuits have found their way into industrial, commercial, and consumer products. Although there are some analog CMOS-based chips around, the vast majority are digital logic elements. And if you think that "digital electronics" aren't presently of much importance to the consumer-oriented electronic servicer, let me remind you that CMOS digital chips are now used in TV receivers with pushbutton tuning, synthesized front-ends and the on-screen channel number display, as well as in many PLL-synthesized CB radios, TV games, and digital clocks.

The use of CMOS IC's in the consumer electronic products we service is just in the beginning. Certainly, in the not too distant future, their use will become widespread. Now is the time to learn what CMOS chips are, how they function, and how to handle them during servicing.

WHAT ARE CMOS CHIPS?

The CMOS integrated circuit, or chip, is part of a family of digital logic integrated circuits that are based on the MOSFET transistor principle rather than on the bipolar construction used in TTL, DTL, ECL, and RTL logic chips. In Fig. 1, you see both a typical digital logic (CMOS) inverter stage, and for comparison, a bipolar type TTL inverter stage. An inverter stage—whether CMOS or bipolar—is a circuit that will deliver a

high output (+5VDC) when the input is low, and a low output when the input is high.

The CMOS Inverter

The CMOS inverter (Fig. 1A) uses two MOS-

FET transistors of opposite polarity type in a complementary symmetry circuit. Transistor Q1 is an N-channel device, while Q2 is a P-channel. Recall that an N-channel MOSFET will

turn on when its gate is made positive with respect to the source, and turns off when the gate potential is zero. The P-channel device does just the opposite. This means that one transistor of the complementary pair in Fig. 1A will always be on, while the other is off.

If we view the output stage of the CMOS inverter as a series circuit consisting of the channel resistances of Q1 and Q2, the situation as seen by the output terminal will be as is shown in Fig. 2. In Fig. 2A, we see the situation existing when the input is low, and in this case, Q1 is off and Q2 is on—so R_{Q1} is high and R_{Q2} is low. By normal voltage divider action, this places the output on high. The situation reverses, however, as shown in Fig. 2B, when the input is high. In this case, Q1 is on and Q2 is off, so R_{Q1} has a low resistance, and R_{Q2} has a high resistance. And, again, by voltage divider action, we find that the output is low.

The CMOS output will present a low resistance path (200-1000 ohms) to ground in the low stage, and a path of similar resistance to $V_{CC}(+)$ when high. The off transistor in each output state will, however, present an extremely high resistance; so, to the power supply, there is always a high resistance to ground. The only time when this resistance drops appreciably is when the output stage is in transition from high to low, or from low to high. At those times, the on/off roles of the two transistors is reversing. When the out-

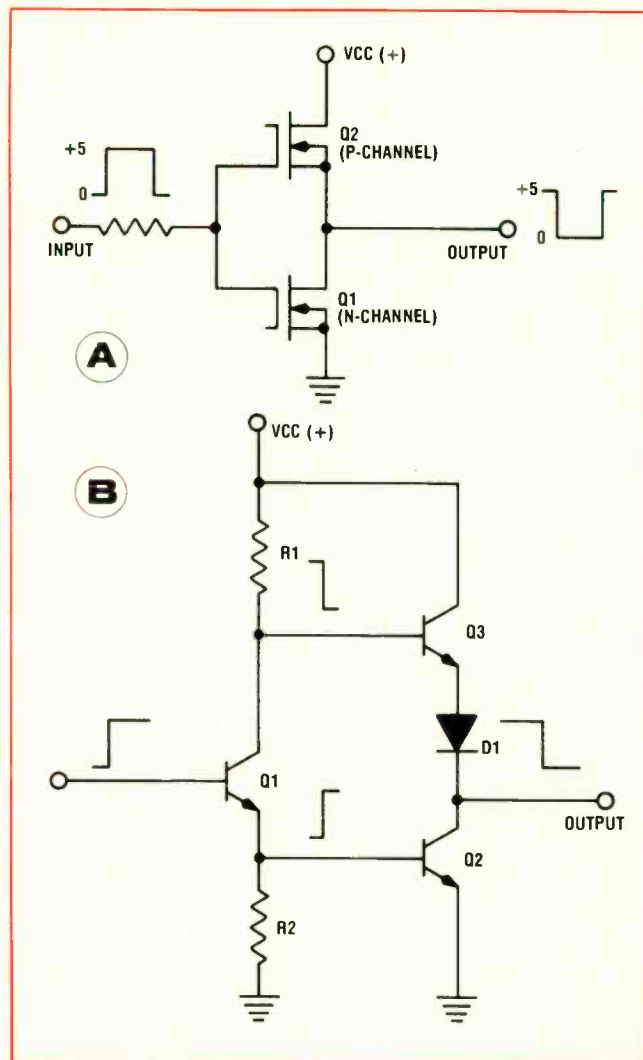


Fig. 1—Schematic drawings of: (a) a typical CMOS inverter circuit, and (b) a typical TTL inverter circuit.

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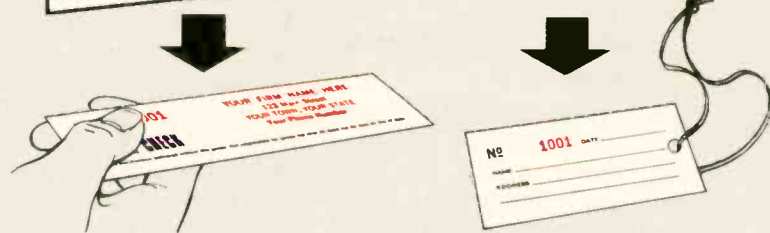
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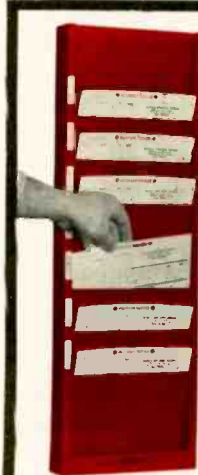
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put is stable on either high or low states, though, the power supply sees such a high resistance that only a few *microamperes* is drawn.

The CMOS Inverter Vs. TTL Inverter

Now let's contrast the behavior of the CMOS inverter with that of the TTL inverter, as shown in Fig. 1B. A TTL stage will always draw current, and often in considerable amounts. A certain well-used TTL NAND gate draws 8 ma when the output is high, and 22 ma when the output is low. On the other hand, a CMOS chip with the same number of independent NAND gates asks for only 15 μ A on high, and 170 μ A on low; a fact that accounts for the popularity of CMOS chips in the large, powerful systems.

Another useful property of CMOS chips is their ability to operate from a wide range of Vcc(+) and logic voltage levels. Most will operate nicely over a +4 to +18 volt range. The TTL chip, on the other hand, will not operate well without a supply of very nearly +5VDC. Because of this sensitivity to voltage, the heavy current requirements of the TTL chip will often cause sufficient I-R drop in the printed circuit tracks to create problems. When a TTL output drops low, there is a sudden and very sharp rise in current demands that will drop the terminal voltage at the ICC Vcc(+) input.

Besides the possibility of starving the chip, this voltage drop also creates "glitches", or spurious pulses, that raise hob with things like gates, counters, and flip-flops.

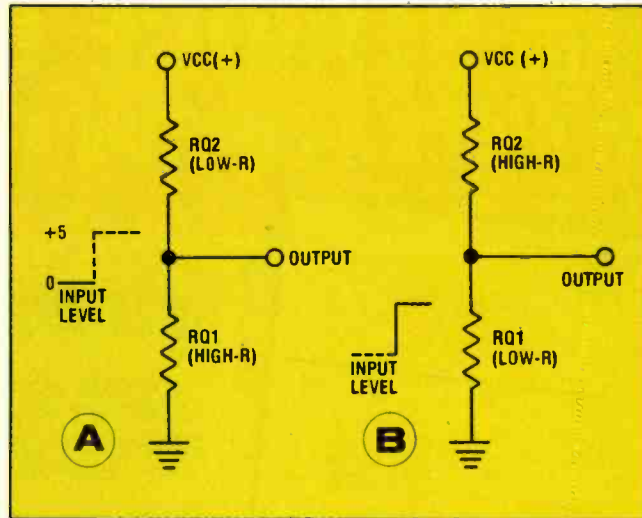


Fig. 2—Drawings of a resistor network representing: (A) CMOS in a high output state, and (B) CMOS in a low output state.

The TTL printed circuit board has to have a generous sprinkling of 0.1-1.0 μ F bypass capacitors to alleviate such problems. The usual ratio is not less than one capacitor for every two chips unless a single chip is relatively far away from its neighbors. Whenever a nearby TTL chip undergoes a transition, these capacitors will smooth things out by dumping their charge onto the Vcc(+) line.

CAUTION! CMOS CHIPS ARE EASILY DESTROYED

The main problem for servicers is that static electricity from your body and tools, or by transient charges generated as you connect test equipment can easily destroy CMOS chips. Although the CMOS chip is relatively safe when in a circuit, they can be extremely vulnerable to static damage when handled out of the circuit.

The sensitivity to static electricity is comparable to the MOSFET problem of several years ago—but, with CMOS chips, it can result in a lot higher dollar loss. The common CMOS chips are

fairly low in cost. A typical quad NAND gate of 4000-series costs around one dollar, for example, but the special purpose CMOS types can get to be very expensive. One digital clock chip, for example, costs \$18—a frequency counter chip used in a car radio costs \$30—and a popular microcomputer chip costs over \$79.

Why Are CMOS Chips So Sensitive?

A typical CMOS chip of the MOSFET type is shown in Fig. 3A. The gate electrode is insulated from the n-channel by a metal oxide layer that may be as little as 1/10,000th inch thick. The breakdown voltage of so thin a layer is typically in the 80 volt range. With the possibility of a buildup of several hundred volts of static electricity on your body, tools and work surfaces, it's easy to see how, without proper precautions, you could "zap" a CMOS IC into never-never land, along with your service profit from that job, and maybe even the next two jobs.

The failure mechanism of a CMOS-

MOSFET is illustrated by the structure diagram in Fig. 3B. When the insulated layer of metal oxide is breached, metal ions are pulled into the void. If a sufficient number of ions are drawn in through the gate, the channel will be shorted, and the device will be destroyed. A more insidious fact, though, is that the action may be delayed because a sufficient number of ions may not enter the void immediately. Eventually, the accumulation of ions will build up enough to short the gate and destroy the chip—and you'll be faced with a callback.

The Cure For Unwanted Static

Even though some CMOS chips feature built-in Zener diode protection against unwanted static electricity, some safeguards are recommended. An example of a "protected" CMOS-MOSFET inverter is shown in Fig. 4. The 4000-series CMOS chips with a "B" suffix will usually have this type of protection, but protection is not absolute. Because of this, and the fact that older CMOS devices and many currently sold for special functions do not have protection, we suggest the following special handling techniques.

A grounded environment will eliminate most unwanted static electricity. For example, a large aluminum sheet should be fastened to your workbench. If your work with CMOS devices will be done only occasionally, a more temporary arrangement can be used consisting of a regular cookie sheet, or a homemade "static blot-

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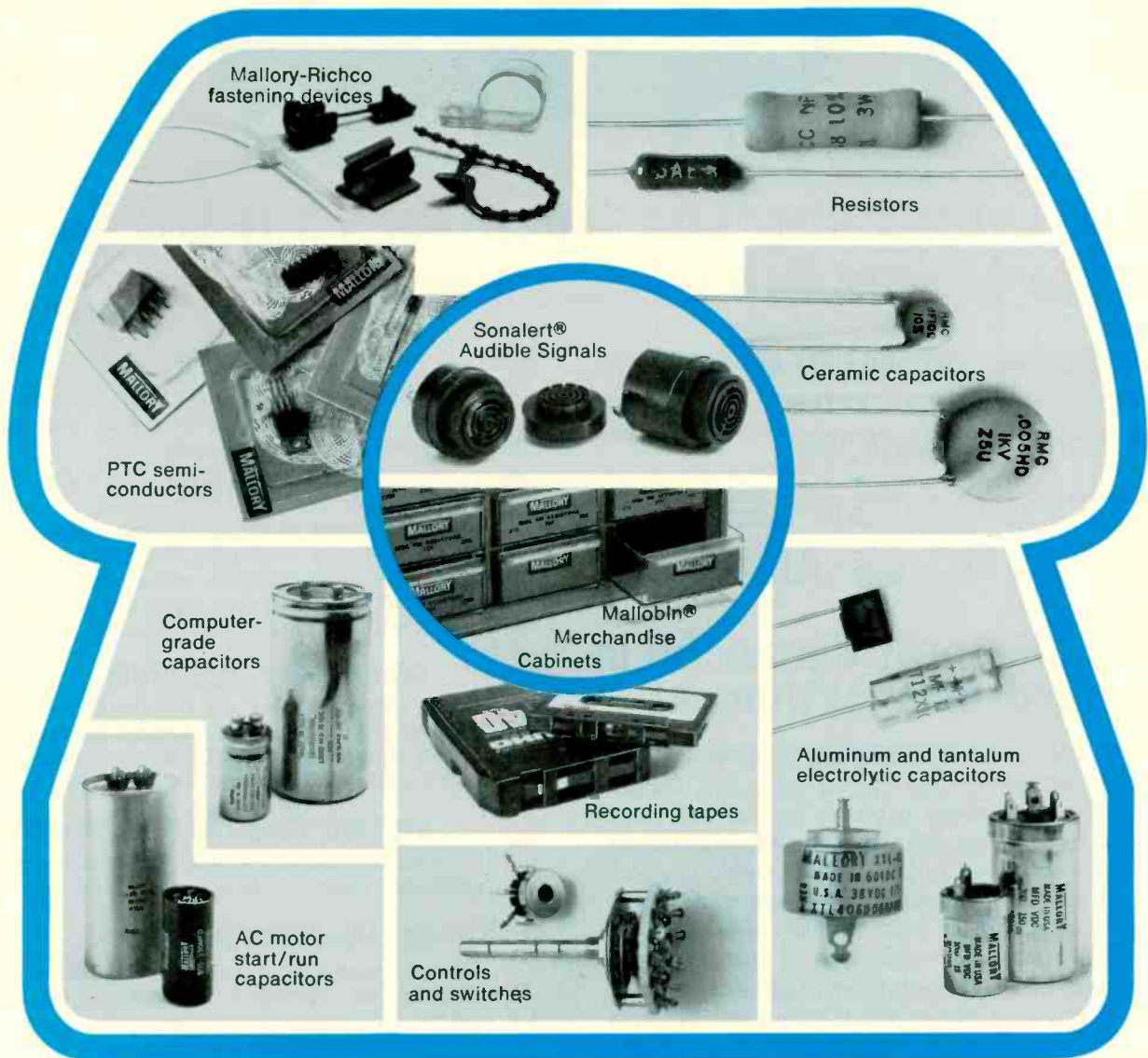
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ter" made with a piece of aluminum sheeting backed by plywood or masonite.

You must ground all of your tools—and yourself—to the aluminum sheet. Flexible ground wires, made of red and black test lead wire, seem to work best. For tools, I prefer one screwdriver and a pair of metal tweezers because they can be made to take solder so easily.

The ground to your body can consist of a connection to your metal watch band with an alligator-clip-equipped lead wire, or better yet, a wire permanently soldered to a low-cost metal-banded ID bracelet. Remember to scrape off the chrome-plating before soldering, however.

The metal work surface on the bench should

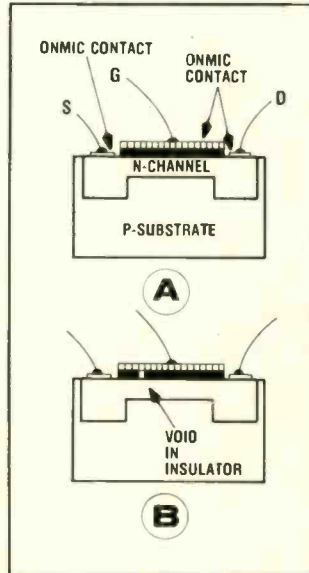


Fig. 3—Construction drawings of (A) a normal CMOS-MOSFET structure, and (B) the same CMOS-MOSFET structure with a breach in the insulated gate layer.

be "earth-grounded"—but *not directly*. Accidental contact with the 120-volt AC mains while grounded directly could be fatal. Instead, use a

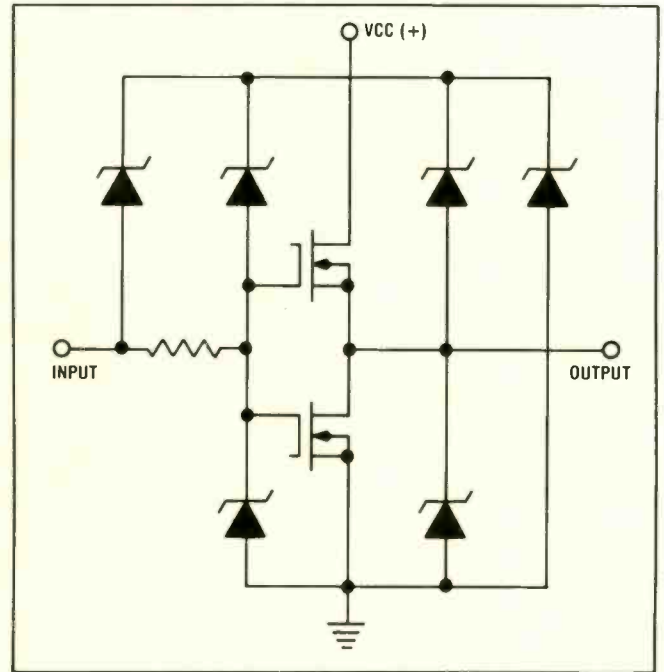


Fig. 4—Schematic drawing of a diode-protected (B suffix) CMOS inverter.

1-megohm, two-watt resistor between earth ground and the metal plate. The "earth-end" of the resistor should be connected to a *cold* water

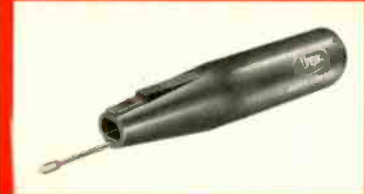
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the power line ground is the *third* wire, and is the round post on the wall outlet—not one of the slots. The metal box containing the outlet is also grounded, as is the metal screw holding the plate on the box.

In one service shop I visited recently, the technician had "created" an earth-ground connection by drilling a hole in the metal outlet box cover to accept a 1/2-inch phone jack. (see Fig. 5). A 1-megohm resistor was wired inside the box from the ground to the main terminal of the jack. The ground wire to the metal plate on the bench was then connected to a phone plug's "tip" terminal.

This is a good idea, only if you first remove any AC wires that might

have been in the outlet box. Any AC wires held back by tape or wire nuts might accidentally come

loose and apply 120 volts to your metal grounding plate—and to you.

In Summary—Rules Of Thumb For CMOS Work

- Always handle CMOS devices, or equipment and pc boards containing CMOS devices, in a grounded environment as we have described.
- CMOS chips are stored at the factory in a black conductive foam, and pc-boards containing CMOS chips are stored in a black conductive bag. Leave them as they were shipped from the factory, until you are ready to work on them in a grounded environment.
- When removing CMOS devices from the black foam or bags, always following the grounding rules, and touch the bag or foam first, then touch the IC. This will cause any static charge to equalize, preventing the destructive potential difference.
- Avoid touching the IC's pins.
- Use only soldering irons which have a grounded tip (i.e., those with a three-wire power plug.)
- Do not remove, or insert, CMOS chips with the power on.
- Avoid wearing nylon, or any synthetic, clothing.
- Use grounded test equipment only.
- When handling CMOS-equipped pc boards, handle only the edges, being careful not to touch any components.
- And good luck!

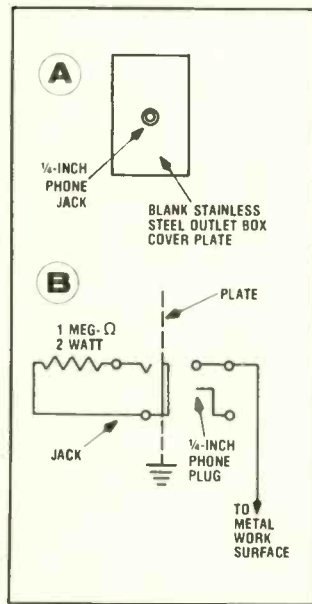


Fig. 5—A drawing and diagram of an earth ground system using the outlet cover plate and a phone plug and jack.

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Color TV Module Repair The PTS Way

How a Bloomington, Indiana, firm is solving TV module inventory and availability problems for servicers around the country

■ A "repeat performance" is underway these days in Bloomington, Indiana, with one firm that recognized the need for the TV service industry fifteen years ago for rebuilt TV tuners. Today, that firm, PTS Electronics, Inc., one of the world's largest independent tuner rebuilding companies, has recognized another need of servicers, and is on its way to becoming one of the world's largest independent TV module rebuilding companies.

When the TV manufacturers introduced the modular TV chassis a few years ago, PTS executives observed the same set of circumstances surrounding the availability or replacement modules as they had found with TV tuners. As Dick King, PTS national sales manager, puts it, "The answer is as simple as the law of supply and demand. As a particular modular TV chassis is phased out of production to make way for new designs, the TV manufacturers are forced to produce smaller quantities of the older modules, which in turn forces the prices up. At this point, rebuilding modules becomes economically feasible."

"When we entered the world of TV module rebuilding more than a year ago," King continues, "we anticipated this new business would be sizeable—but never in our wildest dreams did we believe we would be flooded."



Fig. 1—Defective modules are "signed in" when received at the PTS plant, and are immediately put into the rebuilding process.



Fig. 2—In the initial step of the module rebuilding process, incoming modules are thoroughly cleaned.



Fig. 3—PTS technicians man the IF module repair and alignment stations.

It's easy to see why the TV module rebuilding business at PTS is growing by leaps and bounds, however, when you examine some of the problems that the module has introduced into the TV service business. One good example is the cost of maintaining a replacement module inventory. Without a module rebuilding service that offers fast service, any servicer who works with more than one brand of TV finds it necessary to keep a costly inventory of replacement modules in order to provide his customers fast service. With the one-day (or 24-hour) service that PTS offers, the need for a large inventory is eliminated.

A savings in time and bother is another reason for the popularity of the service. Although most major TV manufacturers have now established satisfactory rebuilding programs for their own modules, the task of contacting a different source for every different brand of rebuilt module needed is a problem for any shop repairing more than one brand. PTS offers

rebuilding/exchange service on all major brands of modules including: Admiral, GE, Magnavox, Montgomery Ward, Philco, Quasar, RCA, Sears/Warwick, Zenith and others. Prices are reasonable, refunds are offered on dud modules, and there is a one-year warranty on rebuilt modules.

There have been problems in developing the module rebuilding business, but they are essentially the same problems PTS encountered and solved when they started the tuner rebuilding business 15 years ago. Some manufacturers have been reluctant to divulge up-dating information or to make available specialized parts peculiar to their modules. However, as with the tuner business, PTS strives to position itself as an ally to the manufacturers as much as possible. In fact, as with tuners, a number of manufacturers count on PTS as their major source for their rebuilt modules. When a manufacturer has been totally uncooperative, PTS has had to resort to manufacturing otherwise unob-



Fig. 4—A view of additional module repair stations and the air testing section.



Fig. 5—Polyethylene "skin" packaging protects the rebuilt modules against dirt, dust and damage.



Fig. 6—A skin-packaged rebuilt module is inserted into the shipping container, stamped with the original manufacturer's type and number.

tainable parts with technical data coming from its own research and manufacturing facilities.

Although the firm has established a total of 43 company-owned service centers throughout the United States and Canada, all of the module rebuilding work is currently performed at their headquarters plant in Bloomington, Indiana. Their eventual goal is to stock all of the branch service centers with complete inventories of rebuilt modules. Until that time, however, service dealers and distributors are asked to send their defective modules to Bloomington, preferably by United Parcel Service (UPS), for faster service. Although not necessary, it's suggested that the rebuild order include a brief description of the trouble symptom caused by the defective module.

One of the reasons that PTS can offer one-day service is the "assembly-line" approach to defective modules as they are received at the Bloomington plant. Here's how it works.

Receiving

As the modules for rebuilding are received, they are immediately started into the rebuilding process no matter what time of the day they come in. Each module is given a rebuilding date code so that it may be identified and located at any stage of the process, and so that there will be a reference date for warranty purposes.

Cleaning

Once the modules are "signed in" they are cleaned in preparation for the repair portion of the rebuilding process. This is the initial step in the rebuilding process.

Test and Repair

The modules are next separated by brand and type and assigned to the test/repair/alignment stations specializing in the repair of the particular modules. Phil Collier, manager of module rebuilding, pointed out that only professional technicians under strict supervision perform the module repairs, and a continuous training program for the technicians is conducted by the firm.

Once at the various stations, the module is visually inspected for missing or broken parts, burned or damaged contacts and the solidity of connections and joints. A primary electrical check is made here to prevent any electrical damage to the testing equipment, and further troubleshooting is performed until the defective components are located.

Defective parts are replaced, all other repairs are made, and the module is aligned to the manufacturer's specifications. Each and every module, whether it be IF,

chroma, audio, deflection, video or horizontal, is temperature cycled, then retested, and air tested in an actual TV chassis on all channels. A final visual inspection is made prior to sending the module to the packaging and shipping dept.

Packaging and Quality Control

Prior to packaging, an invoice is prepared, utilizing the code numbers, and it is priced according to the type of module.

Each module is then skin-packaged to keep it dust-free and clean during storage, and to protect against damage during shipping. The skin-packed module is next inserted into an individual container which is stamped with the original manufacturer's type and part number.

At this point, random modules are selected, the packaging is inspected and then opened. These random samples are tested as a check to insure that the strict demands necessary for the rebuilding process are maintained.

The modules are then shipped back to the customers via the most efficient means, usually UPS, and in almost all cases, within 24 hours after having been received.

To keep ahead of the rapidly increasing volume of replacement modules received and repaired, PTS is now in the process of constructing an additional 20,000 square feet of manufacturing facility at the company's national headquarters in Bloomington.

PTS Electronics is a good example of the age-old formula for success—"Find a need, and fill it." In their case, however, you can add the words—"correctly" and "repeatedly." ■



PC-77 Show Report

A review of the 2nd annual Personal 2-Way Communications Show held in Las Vegas By Don W. Mason

■ The CB industry—in the one year between PC-76 and PC-77—has come down from out of the clouds.

At the time of PC-76, the first national trade show devoted totally to two-way radio communications products, the CB industry was riding at the top of a gigantic sales boom, and the future looked bright. Wildly trying to catch up with demand, the producers over-produced. And then, in July, came the FCC announcement of the expansion from 23 to 40 channels—and everybody tried to unload what they had just over-produced.

By this past February 15th—when the doors opened in Las Vegas on PC-77, the second annual two-way communica-

tions show—CB manufacturers, marketers and retailers had experienced a year-long "shake-down-cruise", so to speak. The 40-channel models were a reality—and for sale—the overstocked warehouses of 23-channel models had started to empty out—the big manufacturers, such as RCA, GE, Motorola and others had entered the CB marketplace in full force—and there was some hope for a more stable year ahead for the CB industry.

No FCC Surprises Ahead

One of the most encouraging notes for the CB industry was struck at a PC-77 Seminar appearance by FCC officials. FCC chief engineer, Raymond Spence,

told the show-goers that "the best news we have for you—is no news at all." In other words, Spence said, "Because the CB industry and the government need some time to straighten out the service, there'll be no new services nor expansions of present services in the near future. You can look forward to a period of stability, with no new surprises."

Spence was referring to earlier FCC plans to possibly open new space in the 27-MHz band and in the 230- and 900-MHz ranges for CB service. The chief of FCC's safety bureau, Charles Higginbotham, also assured the seminar group that the FCC is postponing plans for the new service, but, he said, "We must still look ahead and do the planning now." Higginbotham indicated that a report on the subject from the Personal Radio Planning Group of the FCC may be published in mid-1977.

Attendance & Exhibits Double In Size

This year's show—as

far as attendance and the number of exhibitors—lived up to all expectations. It was roughly twice as big as PC-76, in exhibit space, number of exhibitors and attendance. This year, more than 400 exhibitors utilized 80,000 square feet of exhibit space (almost the entire Las Vegas Convention Center) to present their wares to 15,974 distributors, dealers and CB enthusiasts.

Although attendance was up to expectation, the prevailing mood at this year's show was almost entirely different than the one a year ago. Last year's show occurred at the peak of the boom, and there were visions of huge fortunes to be made dancing in everyone's heads. You could almost hear the rustle of paper money changing hands—and the squeak of pencils writing up the orders. This year, with the transition from 23 to 40 channels and the uncertainty over prices and supply, the mood was subdued, by comparison. There was a lot more looking and wondering than buying.

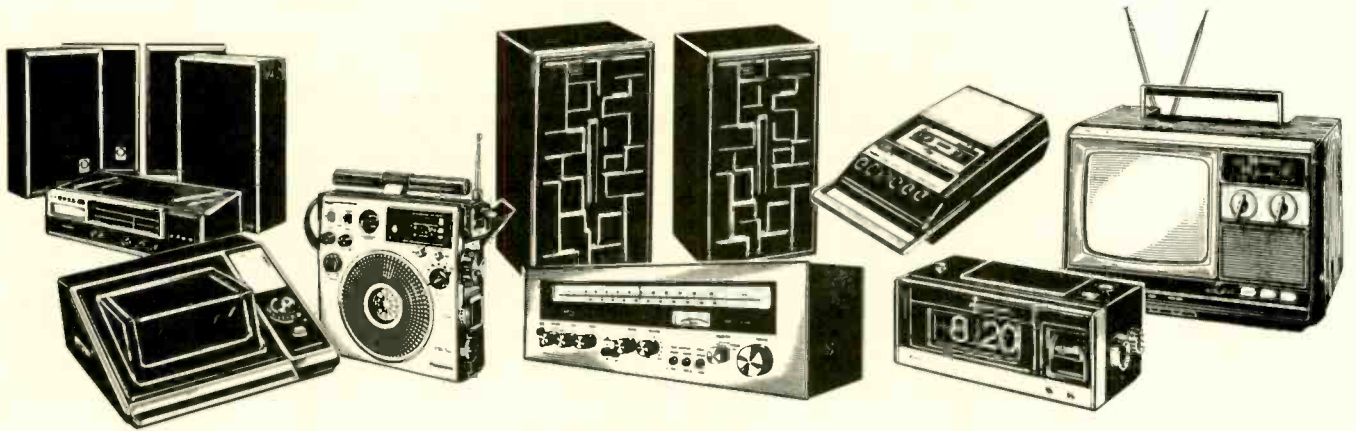
The 23's Are Still With Us

It was obvious from walking up and down the exhibit aisles at PC-77 that there were still plenty of 23-channel radios around. Many manufacturers were showing the 23's out front with their new 40-channel models. For example, Pace had six 23's on display, E.F. Johnson had seven 23-channel models, Kraco had 10, Kris had three and Hy-Gain one. RCA was showing two PLL 23-channel models which

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had been introduced just last fall, and which RCA plans to keep in their line.

Pace marketing manager, Bob Morrison, interviewed by *PC-77 Show Daily*, explained that "There is still a demand for the 23's—and the market can absorb both radios (23- and 40-channel). Most manufacturers still have inventories of the older radios, and we won't see a complete 40-channel market shift until the year's end."

According to Carl H. Insel, vice president and general manager of E.F. Johnson's personal communications division, his firm still has 150,000 23-channel models at dealers and in inventory—but he feels that they'll be gone by the middle of this year—with consumer acceptance of the 40-channel radios in full swing by this spring.

Hy-Gain, by contrast, with only one 23-channel model on display, was reported to have only 400 23's left in inventory. Mike La Rocco, Hy-Gain marketing coordinator, as interviewed by *PC-77 Show Daily*, said that "Because 80 percent of our inventory at the beginning of last year had PLL circuitry, we had an edge when we started to sell off our 23's—because the consumer knew his radio could be converted to 40-channel capability if he wanted." (Only PLL-equipped 23-channel sets can be economically converted to 40-channel operation.)

Even though individual company estimates of the number of 23-channel radios left to sell were available from company spokesmen at PC-77, it was harder to

come up with a total industry estimate of 23's still, so to speak, in the "pipeline." Although close to a million (980,253) CB license applications were received by the FCC in January of this year, meaning that much of the 23-channel inventory was depleted during the Christmas season, the best estimates we could find still place the 23-channel inventory at the time of PC-77 (Feb. 15) at around 2 million units.

Dealers/Distributors Show Concern

A number of dealers and distributors at the show told us that they were worried that their 40-channel sales will suffer until most of the 23's are cleared out—probably for most of 1977. Furthermore, several distributors said they were concerned that, because of the low "clearance" prices (\$29.95-\$49.95) on the 23's, some mass merchandisers might be tempted to go cut-rate to stimulate the sales of 40-channel models. Commenting on this subject, Carl Insel, E.F. Johnson vice president, said, "There's a lot of pressure on 40-channel prices because of the cheap 23's—a lot of pressure. I think the major manufacturers will hold prices, though. They have to, because once you start cutting them you can't get them back."

Another possible reason for sluggish 40-channel sales to date—and a major topic of conversation at PC-77—was the rumor going around that, because of FCC specifications, on power output and modulation limits, the 40-channel radios are under-

powered and under-modulated.

At one of the PC-77 Seminar sessions, FCC chief engineer Raymond Spence emphasized that "the talking power of the 40-channel models is every bit as good as the 23's," and he warned that "dealers who are using this rumor to unload 23's had better be careful, because the rumor could come back to haunt them."

One company spokesman, interviewed by *TV Digest*, admitted that "We did it to ourselves. When channel expansion was announced, there was an expectation that performance wouldn't be as good because of the tighter specs, and consumers and dealers heard of that. Then we found out it wasn't necessarily true, but we never got the word to the dealer level. Some still think the lower-performance thing is true, and now we've got to correct it."

Linear Amps Are On The Way Out

PC-77 also probably marked the beginning of the end for the manufacture, sale and use of linear amplifiers that increase the 4 watts legal limit for CB transmission to as much as several hundred watts.

When the FCC's Spence announced that the FCC is moving to outlaw linear amps designed for CB use, the PC-77 seminar audience applauded. "You can destroy the industry by selling these things," he said. "You're not doing anybody, or your future, a favor by selling them."

John Sodolski, who is vice president of the Communications Division of the Electronic Industries Association

(EIA), the sponsoring organization for PC-77, added to Spence's remarks by announcing that linear amp designs which permit use with CB would be banned from next year's two-way show, PC-78. Actually, the EIA had voted before the show to ban the exhibit of such linear amps for PC-77, but the action came too late to be applicable this year.

Reviewing the Exhibits

Although PC-77 was considered at one time to be the first chance for CB manufacturers to exhibit their new line of 40-channel radios, a number of manufacturers whose equipment had been FCC type-accepted, did unveil their new 40's in Chicago in January at the Winter CES Show. For that reason, and probably because the industry is still in the transitional stage between 23's and 40's, there were not many truly "new" products introduced in Las Vegas.

The only technologically new item introduced at the show was a mobile CB transceiver from SBE that uses a microprocessor (MPU)-equipped programmable memory tuning system which is actuated by a card entry system. Called the Key-Com, the new unit provides: 'priority channel scanning,' 'automatic live-channel capturing' and the monitoring of pre-set channels. The new unit, priced at \$279, will be available in June.

Of course, all manufacturers presented their new lines of 40-channel models, available since the first of the year, including the major electronic manufacturers such as General Electric, RCA, Motorola, Pana-

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GENERAL  ELECTRIC

sonic, and Sharp, who are now in the the CB market in full force.

One of the largest CB lines exhibited at PC-77 was that of GE, which featured seven 40-channel transceivers, all with PLL circuitry. Prices of the GE models ranged from \$134.95 for a unit with a lighted S/RF meter, to \$329.95 for a single-sideband radio. Also introduced by GE were other mobile units, a base station with mobile capability, a line of CB antennas, 2- and 3-channel hand-held CB transceivers, and walkie-talkies.

RCA exhibited their Co-Pilot line of 40's, including mobile and base station transceivers, an in-dash combination with AM/FM/MPX radio, a line of CB antennas, accessories, and scanning monitors. Their new 40-channel line features 6 mobiles, 1 base station, and the autosound combination. The mobiles range in price from \$140 to \$300.

Four new underdash 40-channel CB radios make up the new line exhibited by Motorola at the show. The new units all feature a dual-gate F.E.T. front-end (for improved off-channel interference protection), plus automatic noise limiters and automatic gain controls. Prices range from \$179.95 to \$259.95. Also featured in the Motorola exhibit was their new line of CB antennas, a base station converter, and a 'desk-top' microphone.

CB Service Equipment More Visible This Year

One trend we noticed at this year's show was the more visible appearance of the CB test equipment manufactur-

ers, including B&K-Precision, Hickok, Sen-core, Simpson and Leader. Each of these companies exhibited CB test equipment designed to make it relatively easy for any competent electronic servicer to move into CB servicing, which is estimated to become a \$50 to \$75-million market in the next year or two. The test equipment offered by these firms would allow a service shop to become completely equipped for both CB installation and service for an investment of from \$895 to \$1300.

Industry Changes Are Predicted

The mistakes made by the government and the industry in 1976—the bad timing of the FCC's announcement of expansion to 40 channels—the over-production of 23's by too many companies—and then the 'dump' prices (as low as \$29.95) used to unload the 23's before the 40's take over—all contributed to the mood prevalent at PC-77.

Many exhibitors at this year's show were predicting changes in the lineup of CB producers by next year because of the over-supply situation and the 23-to-40 channel transition. As Carl Korn, president of Dynascan, producers of Cobra CB, told *TV Digest*, "There are too many people in the business. You can't get 150% of the market, only 100%. There are just too many companies trying to get that 100%."

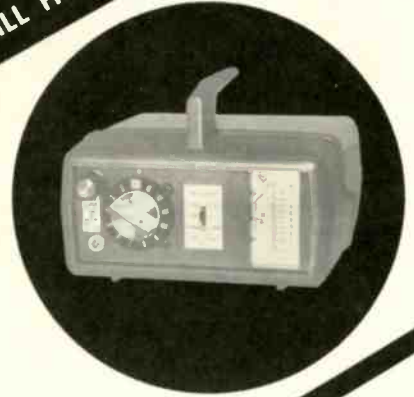
Next year's show—PC-78—will be held February 14, 15, 16—again in Las Vegas. It'll be interesting to see who'll be there, and what the prevailing mood of the industry will be, then. ■

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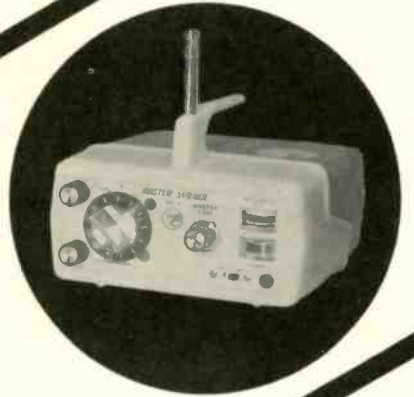
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Fig. 1—This sound demonstration room is the most recent addition to the upgrading strategy at Audio Mart, in Kansas City. The room encircles a console with 16 switches that control 16 amplifiers, 16 pairs of speakers and 16 different lighting effects, to create a wide variety of moods.

Kansas City's Audio Mart:

By Grier Lowry

Battling 'Price' With Expertise And Service

■ Fred Hulen, owner of Audio Mart, one of the three largest independently owned audio specialty sales-and-service businesses in Kansas City, Mo., believes that mass merchandisers—who in the past have concentrated most of their audio sales efforts on 'moderately priced' equipment—are now beginning to focus in on the high-end of the market.

Hulen, who seems to be attuned to audio sales activities in other parts of the country as well as in the Kansas City market, says he senses that this recent trend also is surfacing in other major market areas.

Independents Can Retain Hold On High-End Audio With 'Expertise' And 'Service'

Asked whether or not independent audio specialty retailers can successfully defend their present dominance in the high-end audio market, Hulen replied:

"It's a fact of life that we independents cannot successfully compete with mass merchandisers and discounters if we play their traditional game—big ad programs tied to 'price promotions'. But, we can retain our dominance if we increase our efforts in the

areas which won us the high-end audio market in the first place—technological expertise and guidance during the sale, and fast, proficient service when required after the sale.

"Expert, responsive customer-service has been our principal reason for success, and upgrading our customer-service, in my opinion, is the key to solidifying our position with established customers and attracting new ones."

In becoming one of the top audio specialty outlets in its market, Hulen's 11-year-old Audio Mart has carved an enviable niche with 18-to-35-year-old males, who as a group spend substantial sums on sound gear. Hulen says he has no intention of forfeiting this buying group to the discounters and chains.

Hulen's prime sales target is the audio buyer who might start with a system costing about \$600 and then gradually upgrades to more sophisticated gear, including, for example, speakers that cost \$300 or more apiece, and who is willing and able to spend comparable sums for other system components.

"Of course, the specialist has another reason to keep attuned to the needs of his customer and to

keep upgrading services," notes Hulen. "Our average customer is becoming increasingly more sophisticated and demanding. Before he spends \$300 for a speaker he wants to be *enlightened*, and he wants service. Falter in either of these areas and you get lost in the shuffle."

Facility Layout Emphasizes 'Quality Levels' Yet Still Caters To Range Of Customer Needs And Budgets

Although Hulen's 4,800-square-foot facility is somewhat out of the mainstream in a 'strip' shopping center in the Eastern suburbs of Kansas City, store traffic is nevertheless high, and most customers are, as Hulen puts it, "deadly serious buying types."

Hulen's own customer-service upgrading program started with the physical layout and appearance of his facility, which has undergone a series of expansion and rejuvenation measures, all designed to keep it "stimulating and efficient." The most recent change, involved a division of the demonstration area into three main display rooms, each of which is designed and equipped to accommodate a specific level of customer taste, need and budget.

First-time customers are taken on a "nickel tour" through all three display rooms. During this tour, the escorting salesman qualifies them by subtly determining the type and price range of equipment they are interested in, need and can afford.

Selling 'High Technology' With High Technology

The 'showpiece' room of the facility is technologically and acoustically equipped to satisfy even the most sound-wise audiophile. The heart of this display area is a control console equipped with 16 switches which operate a band of relays that, in turn, control 16 different amplifiers, 16 pairs of speakers, and 16 different lighting systems, all designed to establish 'listening moods'.

Press another switch on the control console and you trigger the opening or closing of the display room door, which is a Plexiglas type that slides up and down and has low damping and high absorptive factors, thus eliminating outside noise which might distract



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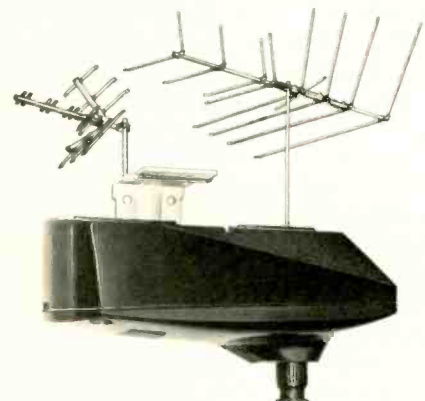
When price or performance problems give you "headaches", take Winegard Gold Star for fast, effective relief.

Gold Star is the new, complete line of "V" antennas and pre-amps from Winegard. They are the best performing, best built "V" line yet to come along.

High quality materials and workmanship combine with Winegard engineering and know-how to produce the best possible "V" antennas at the lowest possible cost.

Only the folks who created the outstanding "CHROMSTAR" line could offer you so much value with the Gold Star line of 16 models.

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the customer during the demonstration. A large segment of the interior walls of the room are curved so that the sound radiates from the speaker systems positioned around the curved area and is focused on a central 'listening point' in the room. Carpeting, textured walls, and the use of other non-reflective, sound-absorbing materials make this room as acoustically correct as need and economics permit.

Hulen's own line of custom speaker systems are displayed and demonstrated in the 'showpiece' room, along with name-brands of other speakers, including Tempest Lab, BES and Avid. Hulen's 'private-label' speaker systems are fashioned from what he considers to be the best elements of the name-brand systems—for example, Altec woofers. Hulen's private-brand systems are housed in 4-foot upright cabinets and, at a typical price of \$329, are competitively priced with top national brands.

A second sound room is devoted exclusively to one brand of sound products, Yamaha. The focal point of this room is a 14-foot display table, covered with black suede and trimmed in metal aluminum, on which this line of sound products are displayed. The black-suede-and-silver trim complement Yamaha's 'cosmetic' theme.

"We decided to devote one sound room to this brand because our own sales experience proved that it has high acceptance in our market, and it fits in neatly with our overall emphasis on quality product-lines," explains Hulen. "Now we can chaperon our many Yamaha-oriented customers to one room devoted entirely to various Yamaha components and demonstrate and display them in a setting tailored to emphasize their best qualities."

Merchandise in a third sound room is designed for the interests of the budget-minded or 'beginning' audiophile who can spend from \$350 to \$1,000 for his first system. The selection includes speakers, receivers, tuners, amplifiers, etc., all with relatively 'moderate' price tags."

Like many retailers, Hulen started out with a modest inven-



Fig. 2—Fred Hulen, owner of the Audio Mart, considers amplifier and speaker clinics an important factor in the growth of his operation. He started the business in 1965 with a small inventory but through attention to customer-service and constant upgrading techniques, he is now one of the leaders in the audio specialty business in his area.

tory. So small, in fact, Hulen says, "A blindfolded customer could have rolled a bowling ball through our store without hitting anything."

"Now, however, we have the size, variety and type of inventory it takes to serve customers who are turned on by quality sound. For example, we do almost no business in the so-called 'bookshelf' speakers. Instead, our speaker sales—and therefore our inventory—is concentrated in the \$300 to \$1,000 systems.

"And we provide the ultimate in demonstration equipment, surrounding the buyer with products which suit his needs, and then dispense liberal quantities of information and guidance."

Clinics Enhance 'Expertise' Image And Stimulate 'Upgrade' Sales

Periodical clinics are a forceful element in the Hulen selling formula. A minimum of six of these clinics are held each year, with emphasis on amplifier and speaker clinics. The 'bring-in-your-old-speaker-for-testing' clinics generate increased traffic, create heightened interest in and awareness of the store's products, and, as Hulen puts it, "serve as a stepping-stone to move consumers from low-quality to medium-and high-quality sound equipment.

"What we aim for in our speaker clinics is to demonstrate to customers how they can improve the



Fig. 3—The service department at the Audio Mart is independently operated by an electronic technician who pays a percentage of labor charges for the space. The department is located just inside the front entrance, where it has top visibility to incoming traffic.

performance of speakers by adding devices such as frequency energizers and equalizers. We make 'before' and 'after' tests of speakers on an analyzer. Each customer who brings in a speaker for testing is given an instant 'before' color picture of the frequency response of his or her speaker, and then an 'after' picture which clearly reveals the improvement in response which results from the addition of an energizer and equalizer to the speaker. We have girls who clip descriptions of the speakers to the photographs and then hand them to the owners.

"During these clinics we also demonstrate our own line of speakers, and some 'factory' models, and compare their sound with that of the customer's present speaker. The idea, of course, is to sell the customer a better speaker by proving that ours produce significantly better sound."

The clinics, which invariably are well-attended, are publicized with spot announcements on two FM radio stations and with newspaper announcement-type ads under 'Audio' in the classified section of the Kansas City Star. Personal letters are also sent out by Hulen to names of previous buyers. (The names are obtained from sales tickets.)

"We usually hold the clinics on weekends. The format usually involves a loudspeaker clinic the first day, followed by an amplifier

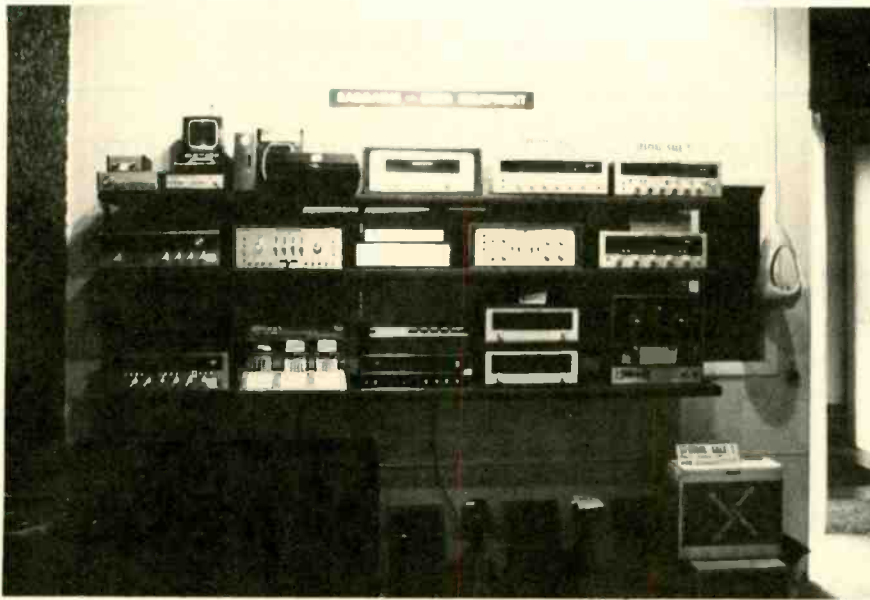


Fig. 4—One of three sound rooms at the Audio Mart, this room features good, clean used equipment for those customers on a limited budget, or for someone just getting started in sound equipment.

clinic the next day.

"We ask factory reps to come in and add their knowledge. And if we can get any 'provocative' visual aids from the factories or distributors, we gratefully accept them. At our most recent clinic, we ran the Yamaha 'Learn to Listen' demonstration simultaneously with our other demonstrations, and it proved to be a big plus."

"I don't want to give the impression that these clinics create a lot of 'instant' business for us, because they don't," Hulen explains. "But they do give us an abundance of exposure we wouldn't otherwise get. People talk about them. Only a small percentage of people have ever been to an amplifier clinic. This is a type of education I feel the specialty retailer should foster. Our place is sometimes packed during the clinics. The 'before' and 'after' photographs give the attendee something to take home and study, and think about. He can see the frequency responses of his speaker on the analyzer, with and without the energizers and equalizers. Of course, some buyers get so excited the day of the clinic they decide to invest in the accessories. So many people are locked into a power, or 'how-many-watts', syndrome. We show how even the smallest receiver reacts when a frequency generator is added."

In-House 'Subcontracted Servicing'

Like most growth-minded audio

dealers, Hulen has a deep conviction that in-house service is a necessary element of successful audio retailing. He feels that audio retailers who farm out service or depend on local distributors or factory service centers are derelict in their responsibility to provide the buyer with a full-service for his or her sound needs.

Yet, Hulen also recognized that for many electronic dealers in-store service is either a losing or, at best, a break-even proposition. Also, Hulen recognized that overseeing the many additional details and problems which service involves—pricing, technician turnover, record-keeping, etc.—can consume valuable chunks of a retailer's time—time which should be spent attending to managerial and sales responsibilities.

Consequently, Hulen decided to take another approach to servicing: He rented to a skilled electronic technician, Dale Martin, space in his store. Martin Electronics now occupies space at the front of the Audio Mart facility. In return for a share of the store space, Martin gives Hulen a percentage of the net service labor income and the net profit on parts sales. (The parts inventory is financed and maintained by Hulen.) This approach has proved to be an equitable, mutually satisfactory arrangement, with advantages for both parties.

Martin, who hires extra help

when necessary, operates the service business on an 'independent contractor' basis, and therefore, is his 'own man'. He turns out most audio service jobs in two to five days. His hourly labor charge is \$15, with a \$7.50 minimum charge.

The service adjunct, incidentally, is located at the side of the front entrance, where it has top visibility to incoming traffic. An example of purposeful layout planning, the front location for service is beneficial from three standpoints: 1) It erases any question in the customers' minds that the firm doesn't provide in-store service, 2) it eliminates the possibility of a customer carrying a broken piece of equipment through the selling area and creating an undesirable impression on the customer considering the purchase of a new product, and 3) it is more convenient for the customer.

'State-Of-Art Technology' Is Ad Theme, Not 'Price'

FM radio is the principal advertising medium for Audio Mart, and in this medium, the basic message Hulen tries to get across repeatedly is: "Audio Mart, The Technology Leader," and "Slightly Ahead Of Our Time."

"The 'technology leader' aspect is demonstrated in a number of ways, including our new sound room with the custom-built control unit," Hulen says. "But we can do things in the service area that add credence to this claim. Our testing of amplifiers covers distortion and power output, and we can test the largest amplifiers. Our equipment includes a large non-inductive load bank that permits testing even 500-watt channels. Not too many shops can boast this type of gear."

"Despite the growing incursion of the multi-store operators into our high-end market," Hulen concludes, "we've managed year-to-year increases in volume. And we've done it by providing what any progressive audio specialist must provide for his customers: good service, good information, and good products. That's the level at which we compete in our market, and we intend to stay at that level in the future." ■

UNIVERSAL WARRANTY CLAIM/SERVICE TICKET FOR ENTERTAINMENT ELECTRONIC SERVICERS

LABOR WARRANTY PARTS WARRANTY NO WARRANTY

BRAND _____

CLAIM NO. _____

(PLEASE PRINT)

| | | |
|-----------------------------------|------------|--------------------|
| CUSTOMER'S NAME (LAST NAME FIRST) | FIRST NAME | SERVICE CENTER NO. |
| ADDRESS | | MODEL NO. |
| CITY | STATE | ZIP CODE |
| | AREA CODE | PHONE NUMBER |
| CUSTOMER'S COMPLAINT | | SERIAL NO. |

DEALER'S NAME _____ CITY _____

DATE PURCHASED
MO. DAY YR.

SERVICE PERFORMED (CHECK AND DESCRIBE BELOW)

ADJUSTMENTS OR ALIGNMENTS LOOSE CONNECTIONS PART(S) REPLACED OTHER

DATE SERVICE REQUESTED
MO. DAY YR.

EXPLANATION OF SERVICE PERFORMED

DATE SERVICE COMPLETED
MO. DAY YR.

CHECK PRODUCT WORKED ON

TIME STARTED TIME COMPLETED TIME ON JOB

TV STEREO OTHER

COLOR

B/W

QTY. PART NO. PART DESCRIPTION

CHECK REPAIR CATEGORY

MINOR MAJOR

CARRY IN SERV.

HOME SERVICE

SHOP SERVICE

CRT REPLACE.

STOCK MERCH.

SERVICE WAS SATISFACTORILY COMPLETED

TOTAL LABOR CHARGE

CUSTOMER'S SIGNATURE

TECHNICIAN'S SIGNATURE

TOTAL PARTS CHARGE

SERVICE CENTER

DISTRIBUTOR INFORMATION

OTHER

NAME

SALES TAX

CODE

GRAND TOTAL

CLAIM NO.

CUSTOMER'S CLAIM CHECK

CLAIM NO. _____

SERVICE CENTER _____

PICK UP DATE _____

A.M.

P.M.

Shown here, in slightly reduced dimensions, is the new form 317 developed jointly by NARDA and the EIA for use as a combination warranty claim form and service ticket by entertainment electronic servicers. (See Editor's Memo in this issue for a list of those manufacturers who to date have approved use of this form for warranty claims.)



Dodge makes vans with a sense of value.

Here are some great reasons why Dodge is the number one maker of compact van-type vehicles.

1. Value for the money.

Every Dodge Tradesman is designed to give you what you want for your money. That's why Tradesman offers you two wheelbases, three overall lengths, and a variety of power plants. Not to mention standard equipment like front disc brakes and Electronic Ignition. Plus options like overdrive transmission,* power steering, and automatic transmission with a new low-slip torque converter. And we didn't leave out comfort, either. Tradesman gives you a good-looking interior. You can even equip it with optional high-back Command seats for on-the-job comfort.

2. Large cargo capacity.

Tradesman's a trim compact size with an engine that is far forward. So you can carry king-sized loads. Even our 109-inch-wheelbase model, the shortest in the business, has more than nine feet of loadspace behind the engine.

3. Better maneuverability.

Curb to curb, Tradesman's turning circle is tighter than either Chevy's or Ford's. And since Tradesman is shorter overall than

Chevy and Ford, you can load and unload in even the tightest spots.



4. Maxivan: Biggest van there is.

For extra-big jobs, there's Maxivan, the biggest van in the business... with 18 extra inches of load length over the standard Tradesman.

5. Good gas mileage.

In EPA estimates, Dodge B100 Tradesman with a standard 225 Six and manual transmission* got 24 MPG, highway; 18 MPG, city. Your actual mileage may differ depending on your driving habits, condition of your van, and optional equipment. But Tradesman offers a Fuel Pacer option that can help you get maximum mileage.

Dodge Tradesman: A whole lot more.

The reasons for buying a Dodge Tradesman van don't stop there.

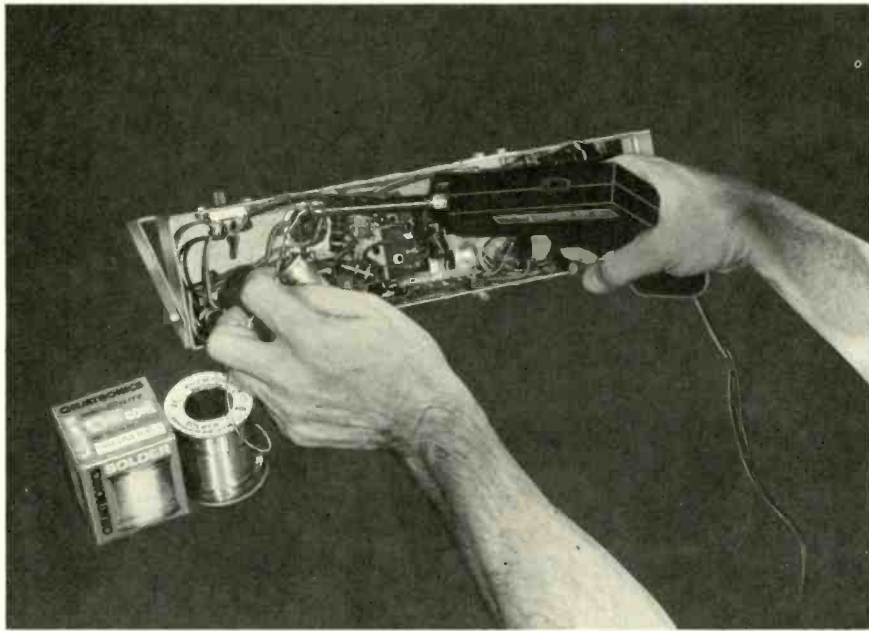
They're as numerous as Tradesman's other great features: small Six and V8 engines. Big 22-gallon gas tank. Or an optional 36-gallon tank. Options like a sliding side door (127-inch-wheelbase models only) for easy loading. Automatic speed control. Air conditioning that's available as an option on every eight-cylinder model Tradesman. A KaryVan model that gives you the maneuverability and convenience of a Tradesman van... plus the loadspace of a big truck.

See for yourself at your Dodge Dealer's. There are a lot of great reasons to buy or lease from America's number one maker of compact van-type vehicles.

*Not available in California or with high altitude certification. Available on B100 only.



96 out of every 100 Dodge trucks registered in the last ten years are still in use.
(Source: R. L. Polk & Company, *Trucks in Operation*, 1975.)



Facts About Soldering

By Al Friedman

What technicians should know about the composition and use of solder, to avoid those cold, high-resistance connections which reduce equipment performance and lead to profit-robbing make-goods

■ From the beginning of the electronic industry, soldering has been—and still is—the primary method for making permanent, low-resistance connections. On the surface, soldering is an easy task. Almost anyone can learn to solder, once someone shows them how, but quality soldering, as is required by the professional electronic technician, is quite a different matter. Avoiding the “cold-joint”, the short-lived connection, destroyed circuit boards, and a generally messy job requires knowledge and technique.

WHAT SOLDER IS—AND HOW IT WORKS

As most technicians know, solder is an alloy mixture of tin and lead. Solder is usually specified in terms of the relative proportions of

tin and lead in the alloy. For example, 40/60 solder is 40% tin and 60% lead.

The question is: Why tin and lead? And the answer is that an alloy of tin and lead has a lower melting point than either of the metals by themselves. Pure tin melts at 450°F and lead melts at 621°F. However, when we add lead to tin, as in an alloy, we actually *lower* the melting point to a minimum of 361°F with a mixture of 63% tin and 37% lead. In other words, adding 37% (by weight) lead to pure tin lowers the melting point by about 90°F. That means we will need less heat to do the job properly.

Another reason for using tin in solder is its ability to actually dissolve copper when the tin is in its liquid state.

If this seems hard to believe, consider ordinary table salt, which has a melting point of almost 1500°F, and water with its melting point of 32°F. When we sprinkle salt crystals on ice (which is “solid” water), and then heat the water to its melting point, the salt dissolves.

Similarly, when we bring liquid tin into contact with solid copper, as an electrical wire, the outer layer of copper dissolves. It is this fact that makes tin a necessary ingredient in a good solder.

Many people think of soldering as a mechanical process, where the solder melts, flows into all the cracks and crevices, and then solidifies. Actually, soldering is a *chemical* process. The solder melts, dissolves a minute quantity of copper, and then solidifies to form one continuous metal.

If we were to cut a cross-section of good solder joint, we would see pure copper, then a layer of copper/tin/lead alloy, and then a layer of tin/alloy. A joint like this is strong physically and an excellent, very low resistance conductor. What’s more, there is no possibility of galvanic action between dissimilar metals, or corrosion between the metals.

The proportion of tin to lead is very important, with 63/37 the best proportion for electronic applications. However, 60/40 is close enough and is available at any electronic distributor. Solder mixtures leaner than 60/40 can lead to the technician’s nightmare, the “cold solder joint.”

This problem of the “cold solder joint” can be caused by a solder with too wide a “plastic” range. The plastic range is the degree spread between the solid and liquid states of solder when its consistency is that of a mushy, semi-solid plastic. In this stage, solder *does not dissolve copper*.

In the case of 60/40 solder, that range is only 10 degrees, between 360°F and 370°F, and it rarely is the cause of the cold solder joint. With a 40/60 solder, which is sometimes offered for sale to electronic technicians and hobbyists, the plastic range is from 360°F to 460°F, or 100 degrees. With this wide a range, there is much more likelihood of producing a cold solder joint. Then, to make matters worse, it’s likely that the solder

(The author is the president of Chemtronics, Inc., manufacturer/marketer of chemicals and solder for use in servicing and repairing electronic equipment.)

closest to the iron is liquid while the rest of the solder is plastic.

SOLDERING FLUX

So far, we have been talking about pure copper. But copper exposed to air is not pure copper. A tiny amount of surface copper inevitably mixes with oxygen to form a thin layer of copper oxide.

We mentioned earlier that solder, in order to produce a good bond, must actually dissolve some copper and form a new alloy. Unfortunately, the copper oxide, acting as a shield layer between the copper and the molten solder, makes this difficult.

In fact, the heat of the soldering iron increases the rate of oxidation dramatically. Therefore, when we apply a soldering iron to the copper wire, we significantly increase the thickness of the copper oxide layer.

This brings us to the use of a soldering flux to cut through the shielding layer of copper oxide. The flux loosens the copper oxide and pulls it away from the copper, allowing the melted solder to make direct contact with the bare, unoxidized copper.

Several kinds of soldering fluxes are available, but only one type is recommended for electronic technicians: resin flux, also known as rosin flux.

"Acid" flux, which is actually a salt rather than an acid, and organic type flux (mostly hydrophalides) are very efficient at removing copper oxides, but they can cause long range problems such as causing corrosion of the solder joint over a period of time.

Resin flux is the only type that is completely non-corrosive and non-conductive. Just choose a pure organic resin and you can't go wrong. And don't let the two different spellings of the word confuse you. Some manufacturers say resin, and some say rosin, but they are all talking about the same thing.

Modern solder, as you know, is available with a resin core. That is, the solder is made hollow and filled with resin. Consequently, the resin gets to the right place, at the right time, in the right amount.

USING SOLDER

If you're a reader of Electronic

Technician/Dealer, you have probably been soldering for many years. But let's review the fundamentals, anyhow.

This is a good checklist of things to remember when soldering:

1) **START WITH A GOOD SOLDERING IRON**—A soldering iron that heats fast and then maintains its temperature rather than continuing to get hotter is best for repair work on electronic equipment. You probably already have your favorites from among the wide range of irons, guns, torches, etc. available today. No matter which type you choose, be sure it can generate enough heat to bring 60/40 solder to 370°F. Remember, too much heat will make the flux run and will increase oxidation faster than the flux can handle it.

Don't try to use your old soldering gun for PC boards. It's too hot. Instead, invest in a thermostatically-controlled iron. And you'll also find that a good vacuum-type desoldering tool will save you a lot of time and trouble.

Needless to say, you must keep the tip of the soldering iron clean and well tinned. "Tinning" is the thin layer of solder that facilitates the transfer of the heat from the soldering iron to the solder joint.

2) **MAKE SURE THE SOLDER JOINT ITSELF** is hot enough to melt the solder—Solder should be applied to the joint and the soldering iron simultaneously rather than to the soldering iron alone. The joint itself should be hot enough to melt the solder completely, not just hot enough to make it plastic. When the hot joint melts the solder, flux pulls away the copper oxide, allowing the solder to wet the copper, forming a strong chemical bond. Proper heating of the joint and the solder results in a solder joint that is smooth and shiny. Cold solder joints are usually dull and lumpy because the solder was actually plastic rather than liquid.

If you are soldering two objects of unequal size, make sure the larger object is hot enough to melt the solder.

3) **MAKE SURE THE JOINT DOESN'T MOVE** while it is cooling.—If the wires being soldered move, even slightly, during the cooling process, a cold solder

joint is likely to occur. This kind of cold solder joint may look shiny and smooth on the outside, but, in time, it will deteriorate and decrease in conductivity.

The best way to avoid movement is to start with a joint that is mechanically solid before it is soldered. If this is not possible, use a chilling spray while you hold the work in place to insure fast, motionless cooling.

4) **MAKE SURE THE SOLDER JOINT IS CLEAN**—Resin flux is excellent for removing copper oxide, but it doesn't do a thing for dirt, dust, grease, gunk, or other foreign matter. Use a file, steel wool or emery cloth to clean off paint or varnish. And remember, a copper wire will often look clean, but will be coated by oil or other foreign matter that impedes good soldering. If there is any doubt at all about the cleanliness of the wires, give them a shot of a good degreasing spray. You'll be amazed at how much easier a really clean wire is to solder.

5) **DON'T HOLD THE SOLDERING IRON** to the joint too long—As soon as the solder flows freely and is melted by the joint as well as by the soldering iron, remove the soldering iron. Too much heating time uses up the resin flux and makes for a poor solder joint.

6) **DON'T DAMAGE SEMI-CONDUCTORS**—Transistors and diodes can't take too much heat. Make sure to use a heat sink on transistor leads, or spray the transistor with a component cooler before you apply heat to the lead.

7) **DON'T USE TOO MUCH SOLDER**—You can have too much of anything, no matter how good it is. Make sure that all solder is present and accounted for. If solder splatters onto the chassis, or rolls around in little balls, or floods some tiny hole, that excess solder will almost inevitably come back to haunt you sometime in the future.

In summary, use the right kind of solder for the job, and the right type of flux, select the proper soldering iron, and apply in the right place at the right time, and a professional-type soldering job will be the result. ■

DEALER SHOWCASE

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

MAGNETIC CB RADIO MOUNT DISPLAY 133

A new display rack that demonstrates how to use the new magnetic CB radio mount from *Cornell-Dubilier* is now available. Called the "Show N' Sell" Display, EMD-1, the rack is of sturdy construction of white wrought iron. It holds a complete Easy Mount with a CB radio attached so customers can see how the instant connect/disconnect feature of the mount works. The EMD-1 display will mount on the counter, on wall, or in the dealer's CB



transceiver display shelf unit. A special introductory offer includes: 24 Easy Mounts, 1 display unit, 1 CDE Mark 1 transceiver, plus descriptive literature.

PORTABLE CB POWER PACK 134

A new 2.6 ampere hour power pack that furnishes 14 volts for powering portable CB equipment is now available from *Globe-Union*. The 14 volts from the power pack is the same as the



"12 volt" system in the vehicle, and as such, insures full rated output from the transceiver. The new pack consists of a GC-1426 rechargeable battery and a FX-14 charger housed in a simulated

leather carrying case with an adjustable carrying strap. The entire pack weighs 4.5 lbs. and measures 6½ in. x 8¼ in. x 2¾ in. Designated the PP-1426, the new pack has enough capacity to power an AM CB transceiver for an 8 to 12 hour day with normal intermittent transmit usage. With proper charging, the unit can be used for 300 to 500 "days" over a 3 to 5 year period.

PROFESSIONAL CB BASE STATION 135

A new CB base station with PLL synthesizer has been introduced by *Sonar Radio*. Designated FS-2340, the new transceiver is said to offer adjacent-channel rejection of 80 dB and high overload resistance to handle strong local stations. It features a Nuvistor front end and Class-B push/



RCA Color Picture Tube Types and their RCA Replacements

RCA Matrix
Hi-Lite
Colorama A
Colorama
1977 Edition

43C1
43C2
43C3
43C4
43C5
43C6
43C7
43C8
43C9
43C10
43C11
43C12
43C13
43C14
43C15
43C16
43C17
43C18
43C19
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43C99
43C100

pull modulator. Also included in the FS-2340 model are: gated noise limiter, LED digital readout, delta tune, built-in low-pass filter, conversion with voice oriented audio, and an all-aluminum chassis and cabinet.

SELF-SERVICE TUBE TESTER 136

A new tube tester for self-service by your customers is now available from



Eico. The new model 660 will test every tube type including novistors, novars and compactrons. It features 65 tube sockets and five custom pin straighteners. A flip-chart lists over 1700 tube types, plus step-by-step instructions for the customer. Only three controls need to be operated to test for emission, shorts or gassiness. The meter is color-coded and easy-to-read. A colorful header sign, illuminated by fluorescent lamps, is included. The model 660 tester is available either as a counter-top unit, or with an optional floor display stand and tube storage cabinet. With counter-top display, the unit is priced at \$325.

REPLACEMENT SEMICONDUCTOR PACKAGING 137

A new packaging concept for replacement semiconductors which is said to make it easier for the service technician to store and use the replacement items has been announced by the *Raytheon Company*. The new method makes available the company's RE line of transistors, diodes, and ICs in convenient individual boxes. Only two box sizes are used, and they are designed so that multiples occupy exactly the same size and shape as standard receiving tube cartons. Since



the RE type number is marked on the top and side of each box, selection from shelf, peg board, or tube caddy is simplified. The smaller RE box is available in sleeves of 5 and 10; the larger box in sleeves of 5.

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Replace 458 color picture tubes with only 71 RCA types. It's quick and easy with RCA's new 1977 Color Picture Tube Replacement Wall Chart available now from your local RCA Distributor.

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RCA Distributor and
Special Products Division

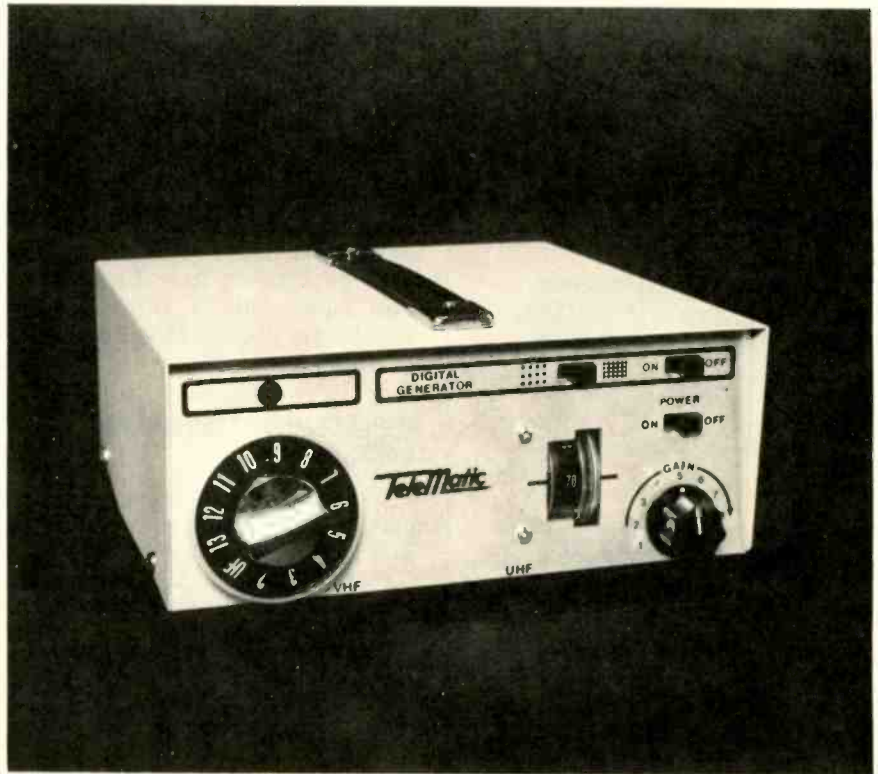
TEST INSTRUMENT REPORT

Features & specifications of recently introduced test instruments designed for servicing applications

Telematic's 'Ferret' TV Mini-Analyzer



Back panel of Telematic's 'Ferret'.



For more information about this test instrument circle 139 on the Reader Service Card in this issue.

■ The Telematic 'Ferret' is an AC-powered combination VHF/UHF TV tuner substitutor and crosshatch/dot generator which is housed in a 7 $\frac{3}{4}$ " x 3 $\frac{1}{2}$ " x 7 $\frac{3}{4}$ " metal case.

Inputs to the Ferret's all-solid-state VHF and UHF tuners are applied through two separate sets of screw-type 300-ohm antenna-input terminals on the back panel of the unit.

Tuning of the VHF tuner of the Ferret is accomplished with a conventional detent-type channel selector and concentric fine-tuning control, while tuning of the UHF tuner is accomplished with a calibrated thumbwheel.

One particularly unique feature of the Ferret's TV tuner substitutor function is that the output of the Ferret's built-in UHF tuner not only can be internally applied to the VHF tuner of the Ferret, for conventional operation, but also can be applied directly to the UHF input of the receiver's VHF tuner, thereby permitting *direct* substitution testing of the receiver's UHF tuner.

Selection of either of these two modes of UHF tuner substitution is accomplished by a two-position

switch labeled 'UHF' on the back panel of the Ferret. In the 'INT' position of the switch, the output of the Ferret's UHF tuner is applied internally to the unit's VHF tuner, for conventional through-the-VHF tuner operation. In the 'EXT' position, the output of the Ferret's UHF tuner is applied to a back-panel jack labeled 'UHF', from which it can be connected directly to the UHF input of the receiver's VHF tuner (via a shielded cable supplied with the Ferret), for direct 'substitution testing' of the receiver's UHF tuner.

The standard 42-MHz IF output of the Ferret's VHF tuner is available at the back-panel jack labeled 'IF', from which it can be applied directly to the receiver's IF input via one of two shielded cables provided with the Ferret. (The ends of one cable are respectively terminated in male and female phono-type connectors which match those typically employed in the tuner-to-IF connectors which match those typically employed in the tuner-to-IF connections of TV receivers, and the other cable is terminated on one end with a male phono-type connector and on the

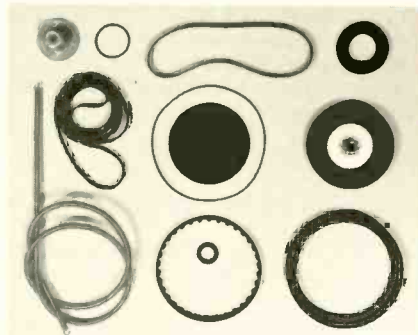
other end with alligator-type clips.)

A calibrated control labeled 'GAIN' in the lower right-hand corner of the Ferret's front panel varies the gain of the unit's tuners and, therefore, the amplitude of the 42-MHz signal available at the 'IF' jack. Maximum output exceeds 1000 μ V.

The Ferret's built-in crosshatch/dot generator is equipped with its own on/off switch and, depending upon the setting of the two-position pattern-selector switch on the Ferret's front panel, produces either a crosshatch pattern consisting of 20 vertical and 16 horizontal lines or a 320-dot pattern.

The 42-MHz output of the generator, which is available at the back-panel jack labeled 'GEN OUT', either can be injected directly into the video IF stages of the receiver (for either 'signal-injection' troubleshooting of the video IF section or 'signal-trace' troubleshooting of the detector, luminance channel and chroma sections). Or, for static and dynamic convergence adjustment procedures, it can be applied either to the VHF antenna termi-

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nals of the receiver or to those of the Ferret, where, with the Ferret's and the receiver's VHF tuners on Channel 3, a harmonic of the generator output is coupled through the tuners and produces a stable pattern on the TV screen. (Although it might seem that the use of a harmonic would produce an exceptionally weak receiver input signal and, therefore, a weak, unstable pattern, application of the Ferret in the ET/D lab has verified that this is not the case. Surprisingly, the gain provided by the Ferret's VHF tuner, plus that of our receiver, proved sufficient to produce a stable, snow-free display on the screen of the receiver.)

The advantage of having a stable, standard-pattern signal-source built into a TV tuner substitutor—as does the Ferret—became readily apparent during our applications testing of the Ferret in our lab. While we were attempting to use the Ferret and an

over-the-air signal to substitute test the VHF tuner of a black-and-white receiver which was producing an acceptable picture only on Channel 10 (our strongest TV station), we discovered that we had completely lost the output of our MATV system. However, by using the Ferret's pattern generator output as the signal source, we were able to continue our tuner substitution test, which revealed that the VHF tuner was, in fact, the source of the 'Channel 10 only' reception problem (Subsequent troubleshooting uncovered a shorted base-emitter junction in the RF amp.)

The following day, when high winter winds subsided, we discovered the cause of our MATV problem: the high winds had shifted the antenna and mast mounted on top of our five-story building here in Duluth, which, in turn wound the coax around the mast, breaking its center conductor.

Price of the Ferret is \$99.95. ■

A "bestseller" you'll never put down.



It's RCA's all new 1977 "Top of the Line" SK Series Replacement Guide. The most comprehensive list to date of transistors, rectifiers, thyristors and integrated circuits — 381 RCA types, including 68 brand new, that will replace 123,000 domestic or foreign semiconductors in entertainment and industrial equipment. The 68 new types have enabled us to increase our replacement capability by over 11,000 additional industry devices. **You can't afford to be without it.** The 1977 Replacement Guide is a complete, accurate information source for your Solid State replacement needs. The book represents thousands of hours of engineering know-how. Keep in mind, too, that RCA SK replacement semiconductors measure up to strict AQL standards.

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RCA SK Replacement Semiconductors

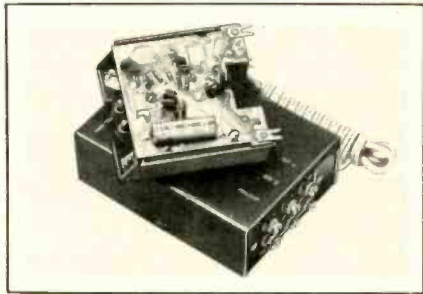
...for more details circle 125 on Reader Service Card

NEW PRODUCTS

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

ANTENNA PREAMPLIFIERS 140

Two new solid-state antenna preamplifiers that feature power supplies with built-in two way splitters have been introduced by the *Winegard Company*. The built-in splitter allows two TV sets to be operated off of one preamplifier at a cost savings compared with placing a separate splitter in the line. The two amplifiers are: a VHF-FM preamp, model AC-2260, and a VHF-UHF-FM model, AC-8260. The AC-2260 features UHF by-pass,



switch selectable FM trap and lightning protection diode. It is 300 ohms in and out. Gain is +14dB and the noise figure is -3dB. Model AC-8260 is an 82-channel preamp, featuring separate VHF and UHF amplifying stages with lightning protection diode and switch selectable FM trap. AC-2260 is priced at \$49.25 and AC-8260, at \$61.50.

SOLDERING IRON TIP CLEANER 141

A new soldering iron tip cleaner for small and miniature irons is now available from *American Beauty*. Designated Model 481, the new device is a simple wick that stays wet for several



days and delivers moisture as needed. A 3/4 in. center opening in the sponge wick provides an ample wiping edge. Dross falls to the bottom of the unit, leaving the sponge clean and free of

contaminants. Model 481 is said to be nearly spill-proof and easy to clean and refill. It is made of high-impact, non-burn plastic and stainless steel.

FLAME RETARDANT LOUSPEAKER 142

A new 8-inch flame retardant loudspeaker with dual voice coils and mounting facilities for two transformers is now available from *Quam-Nichols Company*. The dual 8-ohm voice coils make this loudspeaker, Model 8C10DVFR, suitable for simultaneous music and paging applications. Alternately, one voice coil can be used for program and one for line monitoring. If transformers are ordered with the speaker, the company will mount them at no charge. The



new product utilizes a 10-ounce barium ferrite ceramic magnet. The speaker has a frequency response range of 60 to 10,000 Hz. The unit weighs three pounds.

PORTABLE 30 MHZ FREQUENCY COUNTER 143

A new frequency counter, not much larger than a pocket calculator, but with a full six-digit LED display and guaranteed operation to 30 MHz with 1 Hz resolution, has been announced by *B&K Precision*. The new Model 1827 counter features 1ppm resolution on the six-digit scale with ± 0.25 ppm



NEW CB transceiver – test set with single knob test control

Model CB981 tests any CB in a few minutes accurately, completely, without fuss or extra equipment. One box does it all! The CB981 is designed for continuous high-volume production testing and servicing of 40-channel CB transceivers. The 981 provides the precision of more sophisticated LogiMetrics Signal Generators in a solid-state instrument that's easy to use and virtually error-proof. Other features include:



- Fully synthesized channels
- Self calibrating
- Continuous rotary attenuator
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RF Signal Generators, Frequency Synthesizers, Traveling Wave Tube Amplifiers

...for more details circle 138 on Reader Service Card

stability. The input circuitry is said to be sensitive enough to display a 100mV sinewave signal, but is protected against an input signal of up to 200 volts (Peak AC & DC). Optional accessories include a signal tap to continually monitor the output frequency of a 23- or 40-channel transceiver without affecting normal set operation. Other optional accessories are rechargeable batteries and an AC adapter/charger, an under-shelf or under-dash mounting bracket, 27JHz pickup antenna, general purpose input clip-lead and vinyl carrying case. The Model 1827 is priced at \$120.

INSTANT CHILL SPRAY 144

A new double-size can of a chilling spray for finding intermittent components and cracks in printed circuit boards, and for other trouble-shooting is now available from *Tech Spray*. Designated minus 62 Instant Chiller, No.



1669-30S, the new sized container contains 30 ounces, and costs the technician only 50 cents more than the 15-ounce product. A 24 inch extension spray-pipe is included.

CB MIKE CORD SELECTOR 145

A new guide for selecting the right CB microphone cord is available from the *Belden Corporation*. The pocket-size guide, made from heavyweight plastic, has a calibrated slot for measuring the size of the three, four or five conductor cord to be replaced. To gage the outside diameter, the old cord is slipped through a large hole and slid down the tapered slot until it becomes snug. Calibrations printed at the side of the slot indicate outside diameter in inches, and appropriate Belden re-



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They're recommended regularly in Sams Photofact folders and books. So see your Triad distributor for full information. Or write us direct.

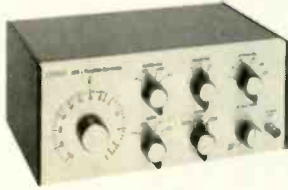
| Catalog No. | Secondary #1* | Secondary #2 |
|-------------|--------------------|---------------|
| F-170SX | 20 VCT @ .200 ADC | 6.3V @ .200A |
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| F-172SX | 24 VCT @ .400 ADC | 6.3V @ .300A |
| F-173SX | 30 VCT @ .400 ADC | 6.3V @ .300A |
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| F-175SX | 44 VCT @ .400 ADC | 6.3V @ .500A |
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TWO NEW GENERATORS FROM EICO®



EICO 390 SWEEP/FUNCTION GENERATOR

- .2 Hz to 200 KHz
- Sine, Square, Triangle
- Linear & Log Sweep

Now you can afford a Function Generator that will meet all your signal requirements! The 390 generates discrete sine, square, and triangle waveforms over a very broad frequency range. You have a choice of either linear or logarithmic sweep with slow, medium, or fast rates. The 390 also allows for external frequency control through a rear panel input. With its 50-ohm output impedance and calibrated attenuator, the 390 can handle everything from checking the response of an audio amplifier to driving digital circuits.

Model 390 assembled **\$169.95**



EICO 388 PORTABLE COLOR BAR PATTERN GENERATOR

- Battery Operated with LED Indicator
- IC Digital Circuit Design
- RF Adjustable, Channels 2, 3, 4

The 388 is truly the most advanced pocket-size portable color generator in the field today. A single MOS LSI IC provides 9 digitally controlled, stable patterns. The 388 operates by simply connecting its output cable to the TV's VHF terminals. Two matrix slide switches select any one of the 9 patterns. Crystal controlled chroma and timing oscillators assure precision, accuracy and stability. The 388 is powered by two 9-volt transistor batteries.

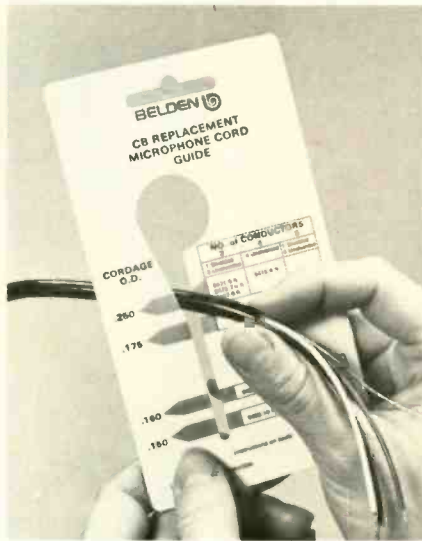
Model 388 assembled **\$89.95**

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placement part numbers. Instructions for using the guide are on the back. A slot at the top of the card facilitates hanging it alongside a CB mike replacement cord display. Available free from Belden.

PREAMPLIFIED BASE STATION MICROPHONE 146

A new pre-amplified base station microphone with balanced performance and a new modernistic design is being introduced by the *Astatic Corporation*. Designated Model 1104C, the new mike features base-mounted slide

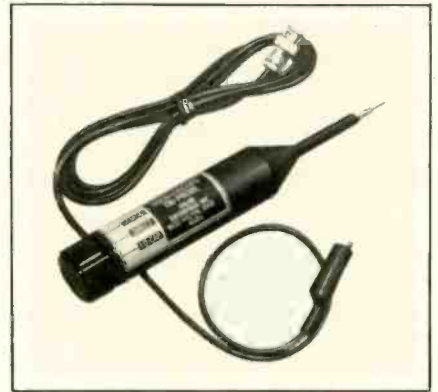


controls that allow adjustment of the high gain amplifier to the proper modulation level and tone quality for individual voices. An adjustable master gain control prevents overmodulation and distortion. Output impedance is compatible with inputs of all commercial transmitter transceivers. Model 1104C is powered by a 9 volt replaceable battery, and has a six-wire coil cord for relay, electronic or virtually any type of hookup. During receive, the audio circuit is open. List price is \$83.

THREE-WAY OSCILLOSCOPE PROBE

147

A new oscilloscope probe that is said to do the work of three probes is now available from *Valor Enterprises*. Called Model VTP-1 Tri-Probe, the new device allows the technician to dial the function he needs; the Demodulation Section for tracing



waveforms in RF and IF stages of circuits, the Direct section when maximum scope sensitivity is needed in low frequency test and low impedance circuits, or the Low Capacity section to trace waveforms in high impedance circuits, reduce distortion and frequency discrimination. Low capacity section provides 10 to 1 attenuation when used with a scope with an input impedance of 1 megohm. The Tri-probe can be adjusted for scopes having different input impedances.

HAND-SIZE PORTABLE DVOM 148

A new hand-size, battery-operated, digital VOM with a single selector switch that provides five functions and 22 ranges has been introduced by *Triplet Corporation*. Designated Model 3000, the new instrument is only 3 inches wide by 5-³/₈ inches long by 1-³/₈ inches deep. A 3¹/₂ digit display on Model 3000 features high intensity LED's with blinking overrange indication, auto-zeroing and auto-polarity



indication. Also, if a low battery condition exists, all decimal points are simultaneously displayed preventing erroneous readings. The meter is provided with an easily removable, snap-in battery pack with four rechargeable Ni Cad batteries. It also can be operated from 117 VAC line power via the AC Adapter/Charger which is included. Priced at \$140.

COPPER DESOLDERING BRAID 149

A new desoldering braid made of pure copper wire is now available from *Soder-Wick*. The new product will desolder components and terminals, remove bridges and icicles or any unwanted solder. Its copper color lets you see just how much you've used and fea-



tures a dispenser. Non-Activated pure water-white rosin flux protects Solder-Wick and assures clean and contaminant-free desoldering. The braided wick is simply laid against the connection to be desoldered and a hot soldering iron is applied to the top of the wick, which then soaks up the solder by capillary action.

MOBILE CB ANTENNA 150

A new mobile CB antenna with an adjustable trunk lip mount for installation on a sloping surface such as is found with hatchback or fastback autos is now available from *S & A Electronics*. It is a base-loaded quarter-wave antenna with a V.S.W.R. of under 2:1 at the band edges and under

1.5:1 at resonance. The mount design allows the antenna to be straight up for maximum radiation even when mounted on the sloping surface.



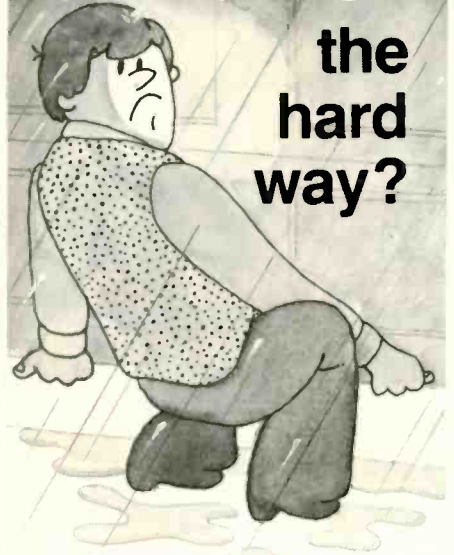
Mounting hardware is of rugged chrome plated steel for longer service life. It comes complete with 17 feet of coaxial cable and a PL-259 connector. Height is 43 inches.

CB DEALER SALES TRAINING PROGRAM 151

A Dealer Sales Training Program for CB radios, antennas and accessories is now available from *Motorola, Inc.* The program is contained in a detailed 32-page illustrated brochure that contains several self-tests, produced for Motorola's national dealer distribution organization. The new

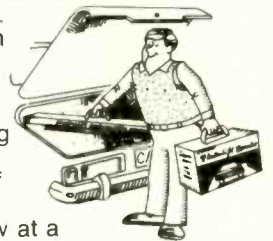
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your garage

the
hard
way?



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program is for dealers who want to train their own sales personnel in the communications basics of CB radio and related equipment. It is written in easy-to-understand terminology, and covers demonstration techniques and tips on how to close a sale.

EMERGENCY SOLDER 152

A new tape-like, solder strip for quick on-the-spot soldering repairs has been announced by *Multicore Solders*. Called Emergency Solder, the new product can be carried in a shirt pocket or stored flat and requires only an ordinary match or candle flame to melt the solder. Multiple cores of rosin



flux are incorporated into the flat strips, and the flux is non-corrosive and non-conductive, and need not be removed after soldering. The emergency solder is suitable for any solderable metal, but is not suitable for aluminum. The new product is available in a 2-color display package.

CB MIKE & ACCESSORIES MERCHANDISER 153

A new space-saving countertop display for merchandising CB microphones and related accessories is now available from *GC Electronics*. Designated Merchandising Program

As a businessman, you'd make a terrific human being.

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If you can spare even a few hours a week, call the Voluntary Action Center in your town. Or write: "Volunteer," Washington, D.C. 20013.

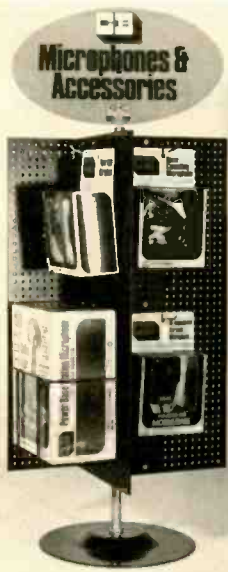
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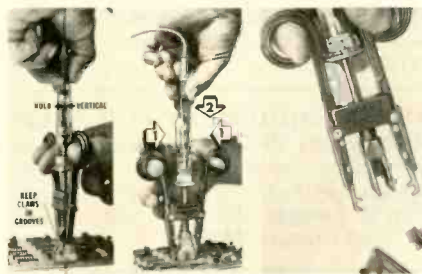
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49-872, the display contains a power base mike as well as four types of hand mikes, all of them suitable for 23 or 40 channel use. Also included are high demand accessories such as plugs, connectors, mike holders and batteries.

D-I-P EXTRACTOR & DESOLDERER 154

A new extractor tool that can automatically remove a DIP IC from the side or ends and eject it has been introduced by Edsyn, Inc. The new device features a heavy duty heating head and cool-grip handle for easy gripping and removal. The heating head is placed over the DIP, and as the solder melts, built-in spring action automatically lifts the DIP from the circuit board. The IC is retained by the tool's claws until a simple squeeze of the handles allows the component to fall away.



EDITOR'S MEMO

continued from page 1

ment role in the design of the form, has been designated by the EIA as the industry's control agency for assignment of serial numbers to be used on the form. (The Modulus 11DR numerical coding system has been adopted as the standard numbering system for Form 317.)

Pre-numbered copies of the new form, with or without dealer logo

imprinting, are available from NARDA, or a servicer may have the form reproduced by his local printer, in which case the servicer must obtain from NARDA an assigned block of serial numbers.

NARDA is presently offering non-imprinted copies of Form 317 in postage-paid quantities of 100 (\$8.50), 500 (\$27.50), and 1000 (\$41.50). Copies of the form imprinted with your logo, address and phone number (four lines, 27 characters per line) are available from NARDA in postage-paid quantities of 500 (\$35), 1000

(\$47.50) and 5000 (\$42.50 per thousand).

For more information about Form 317 and its usage, contact either NARDA (2 North Riverside Plaza, Chicago, IL 60606) or the manufacturer's 'agent' to whom you submit warranty claims. ■

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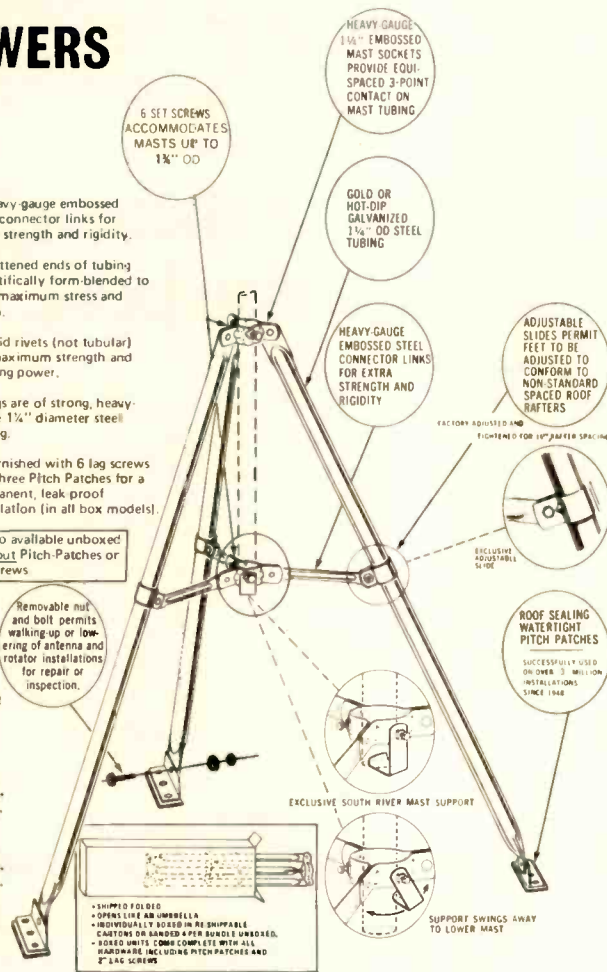
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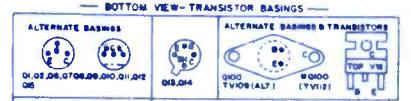
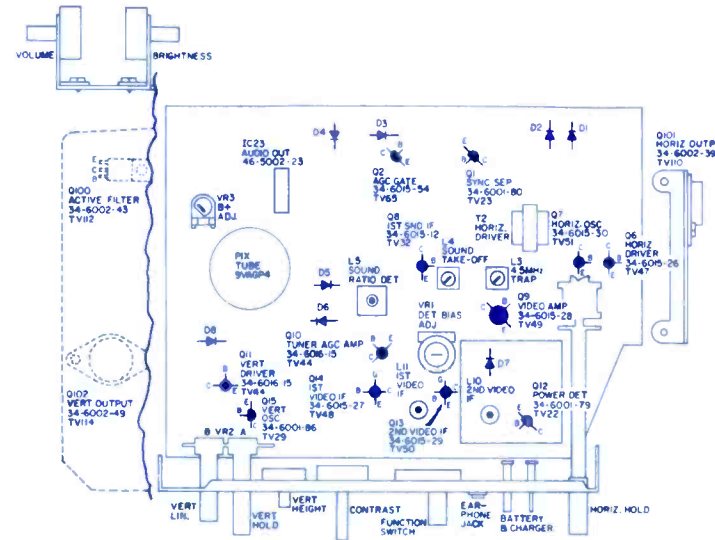
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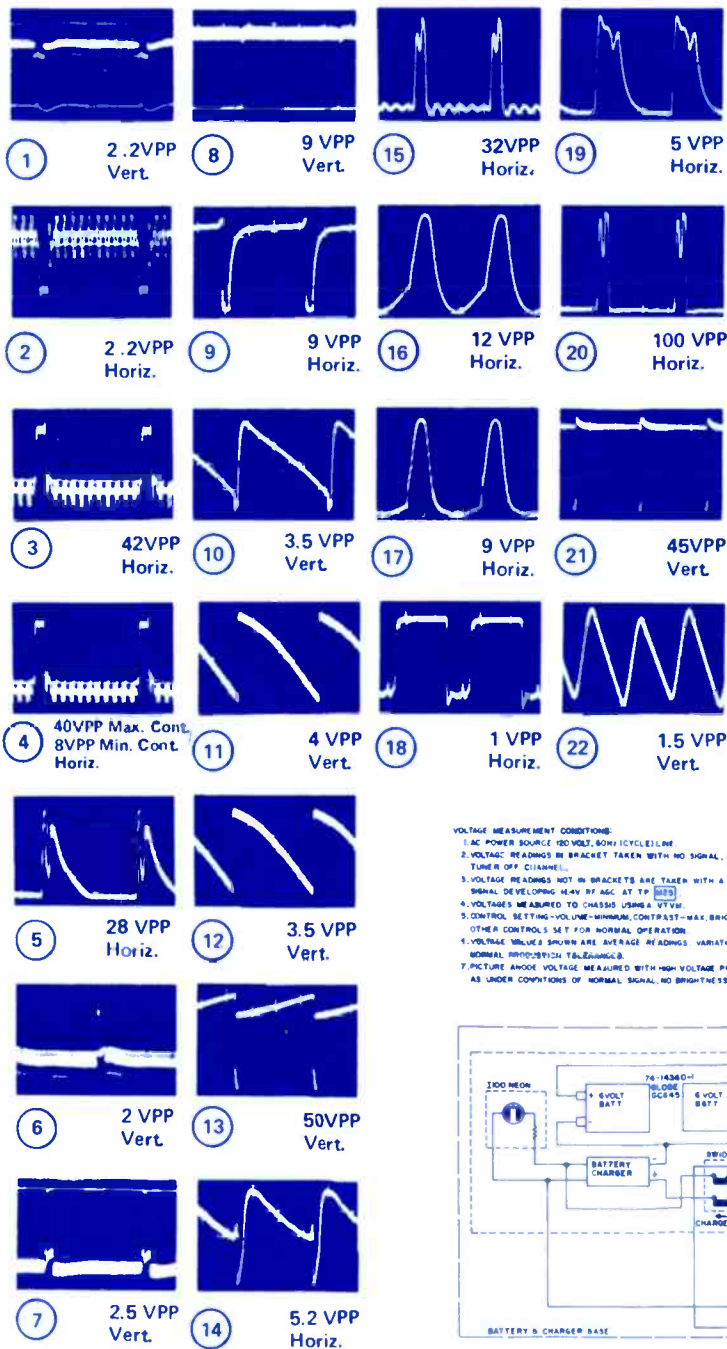
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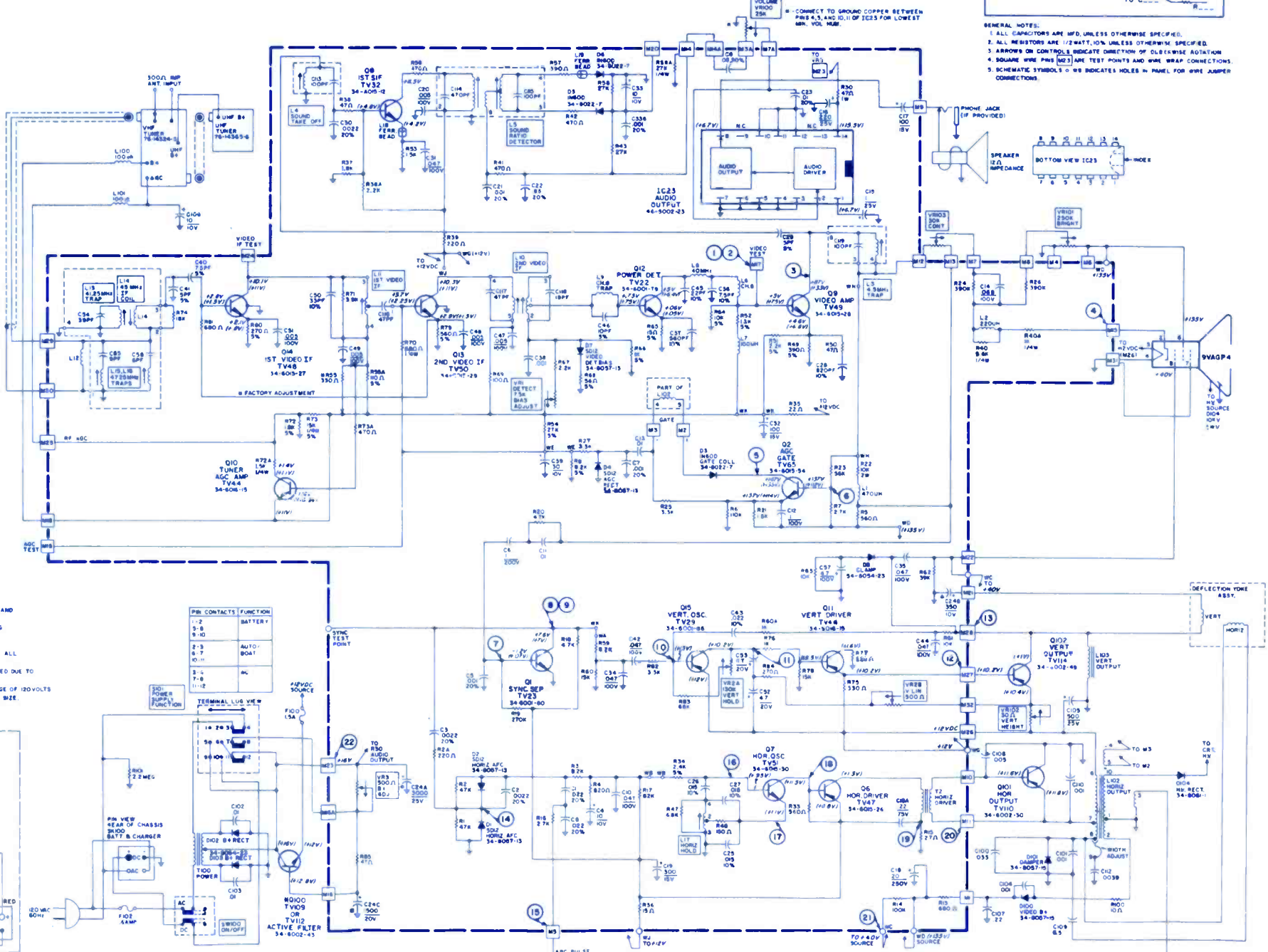
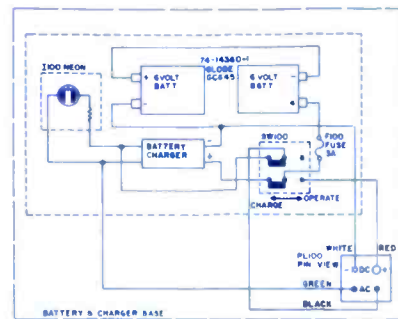


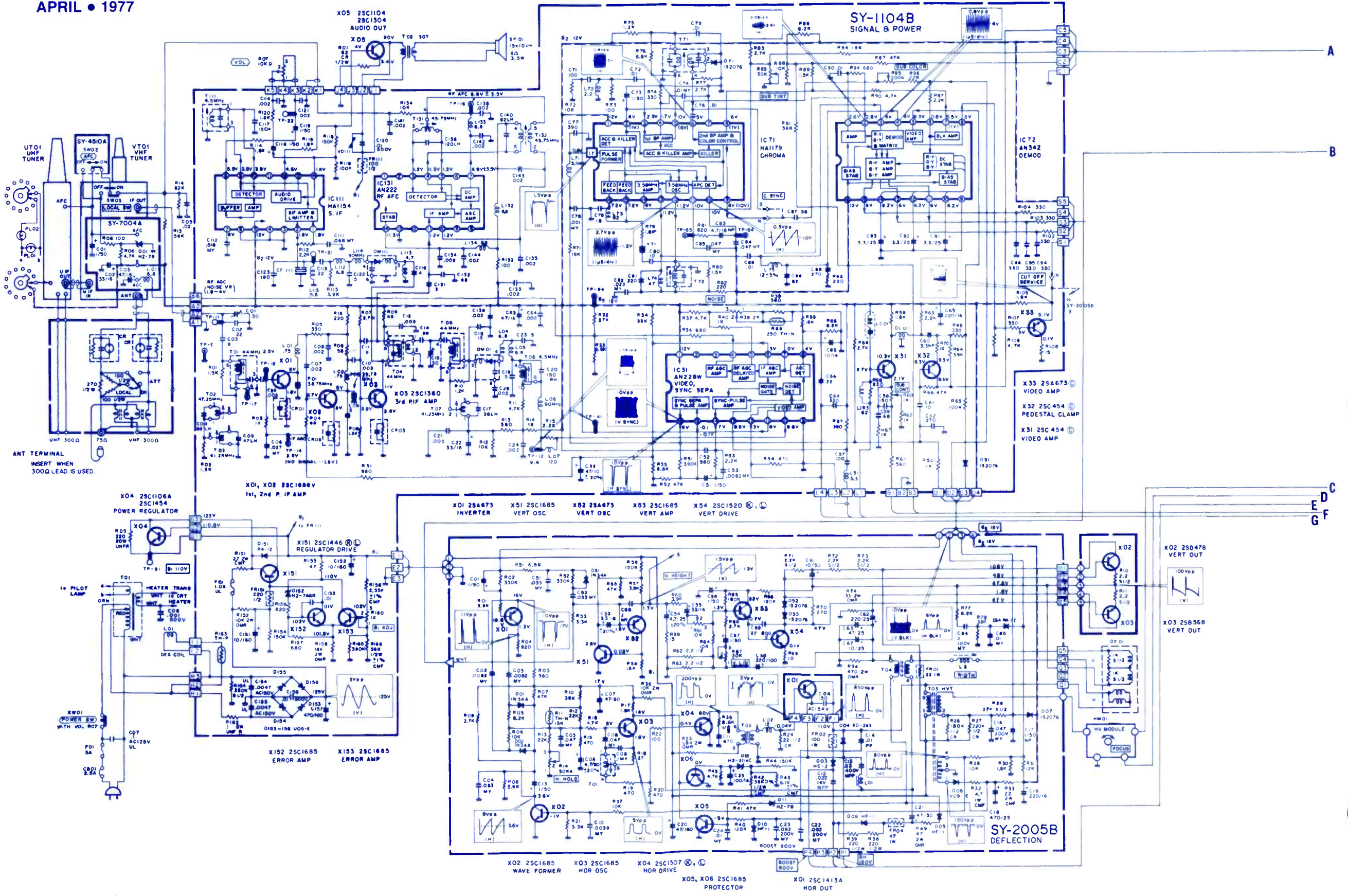
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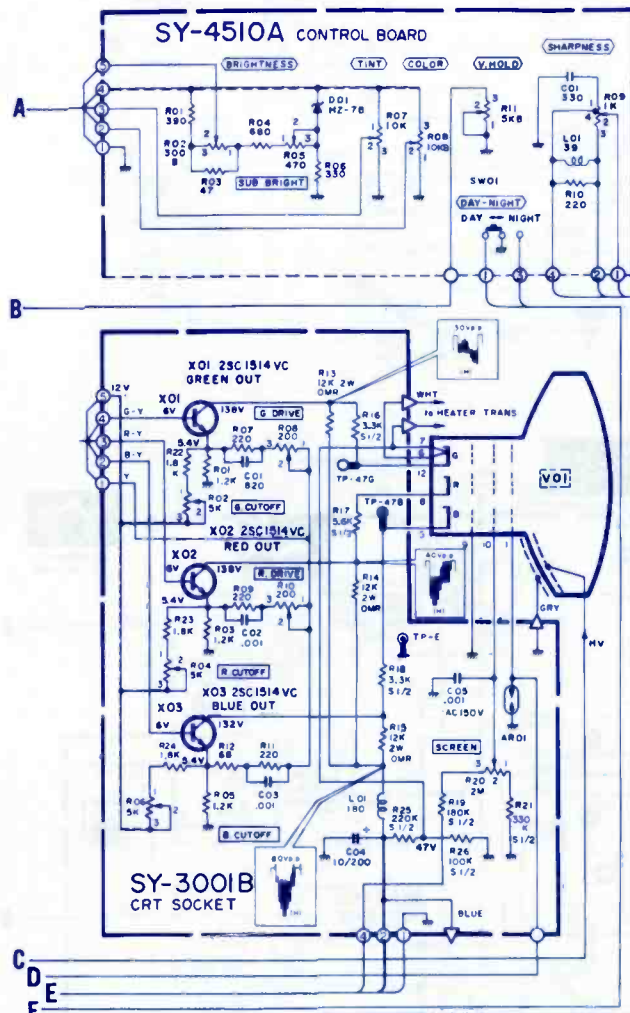
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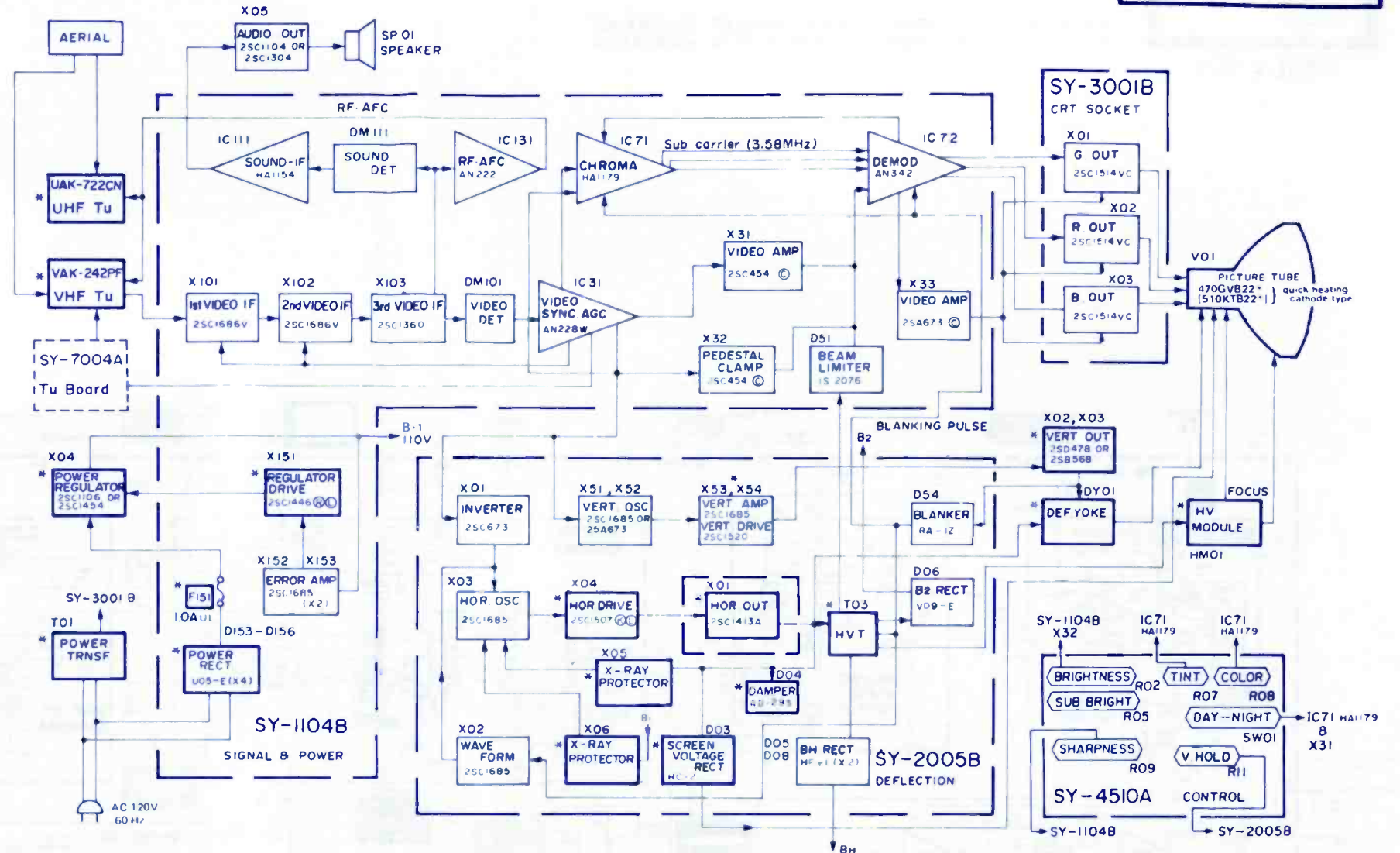


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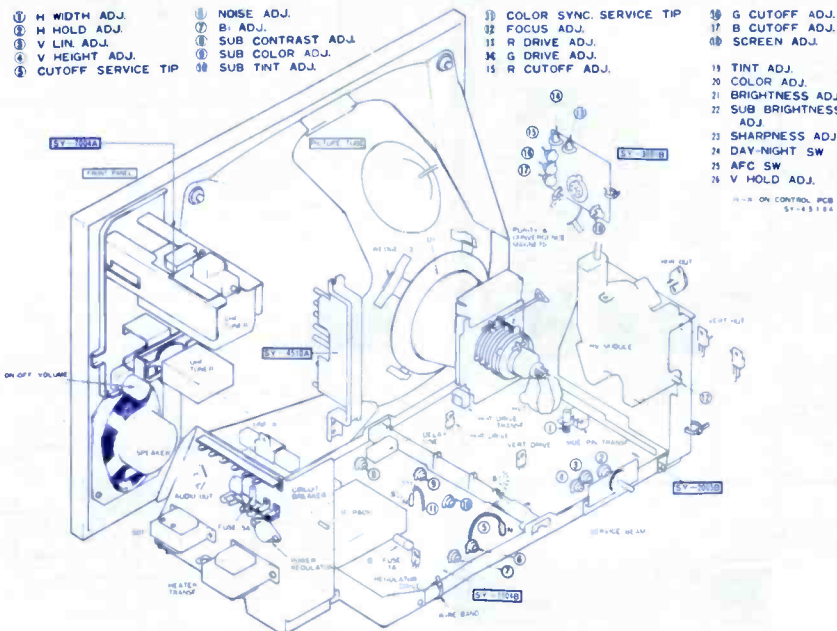
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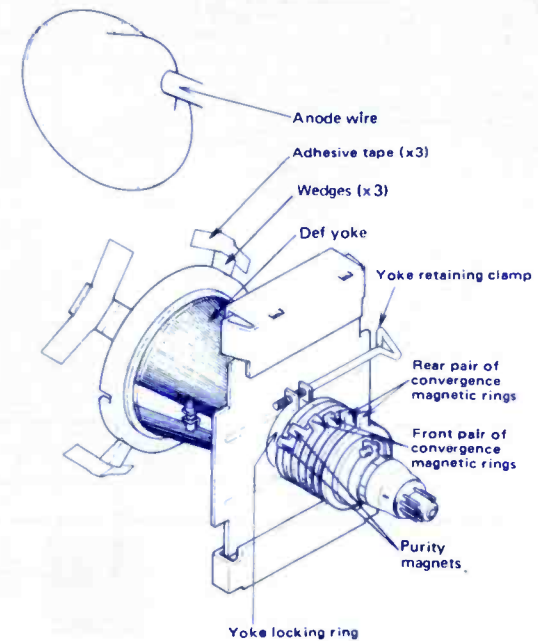
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|---------|----------|
| 19C7988 | 510KT822 |
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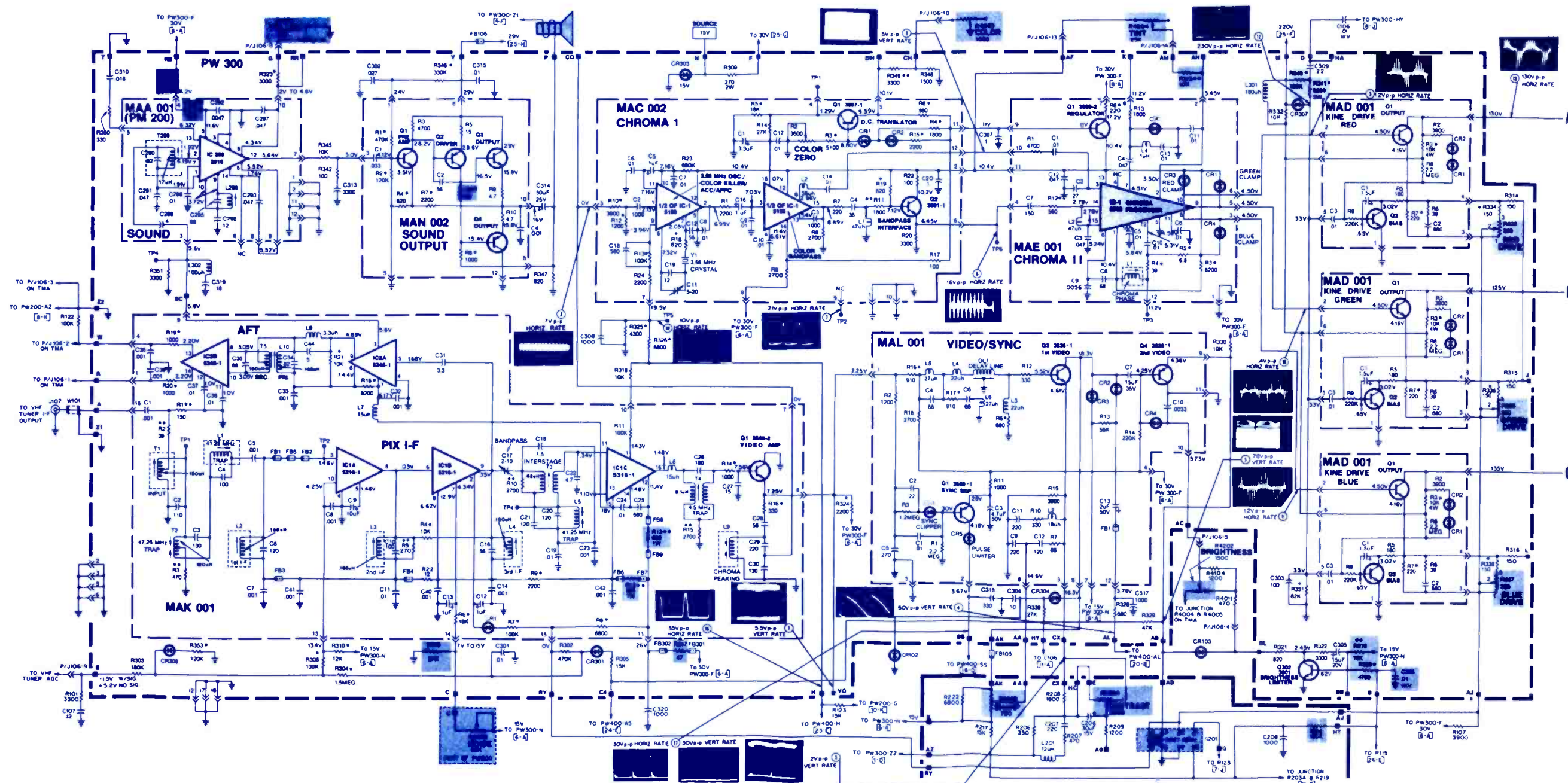
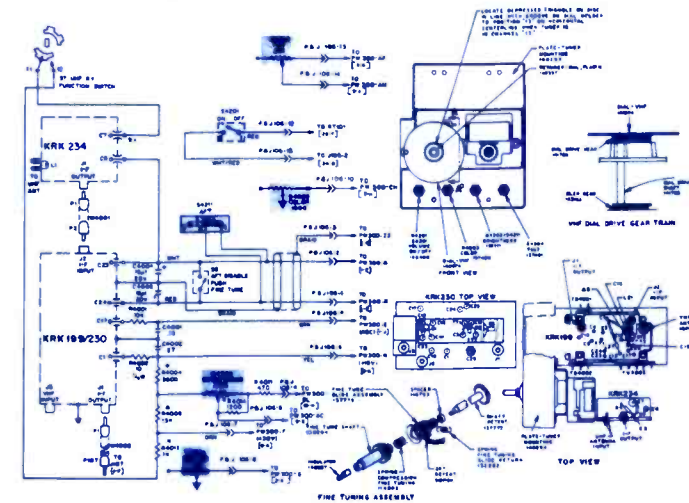


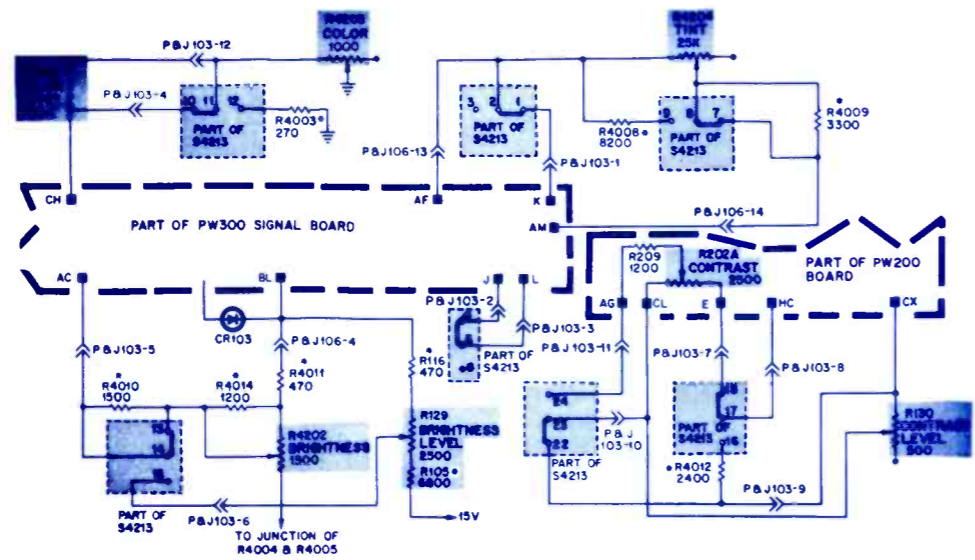
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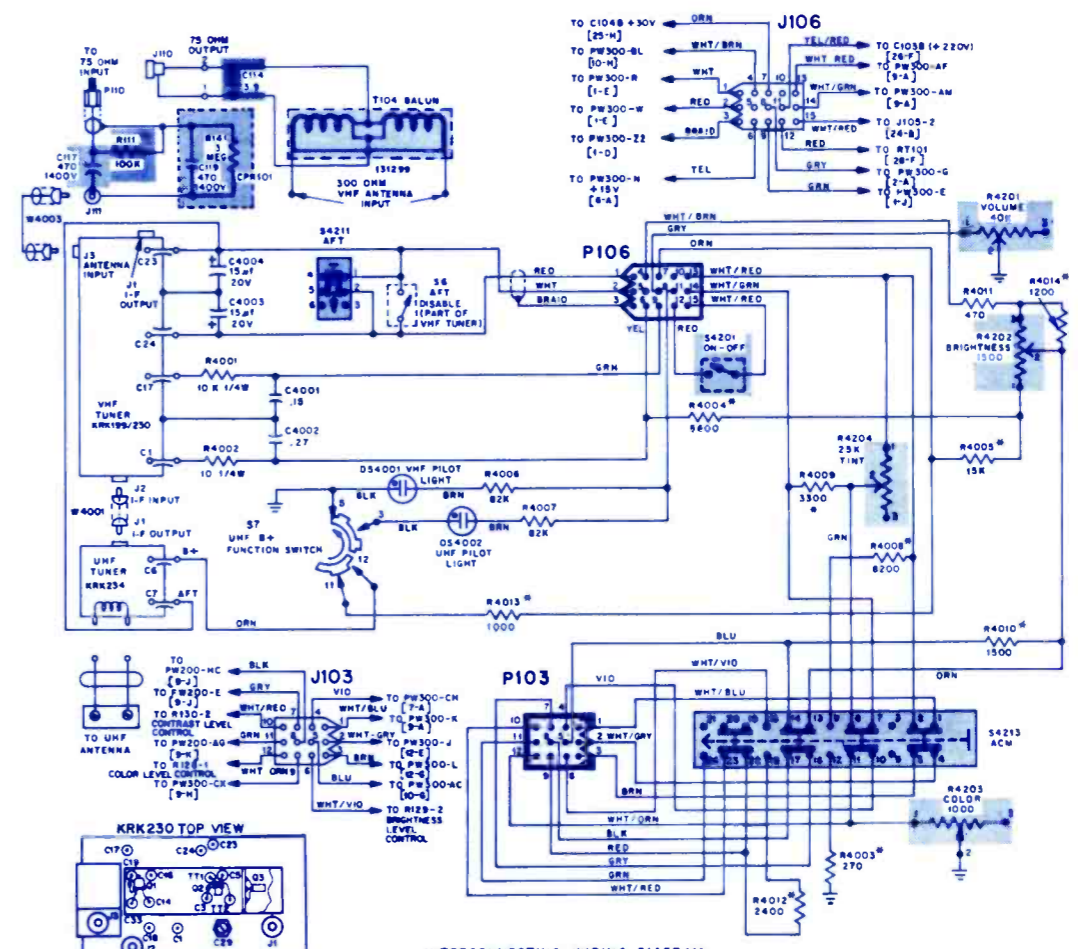
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- 16 G CUTOFF ADJ.
- 17 B CUTOFF ADJ.
- 18 SCREEN ADJ.
- 19 TINT ADJ.
- 20 COLOR ADJ.
- 21 BRIGHTNESS ADJ.
- 22 SUB BRIGHTNESS ADJ.
- 23 SHARPNESS ADJ.
- 24 DAY-NIGHT SW
- 25 AFC SW
- 26 V HOLD ADJ.







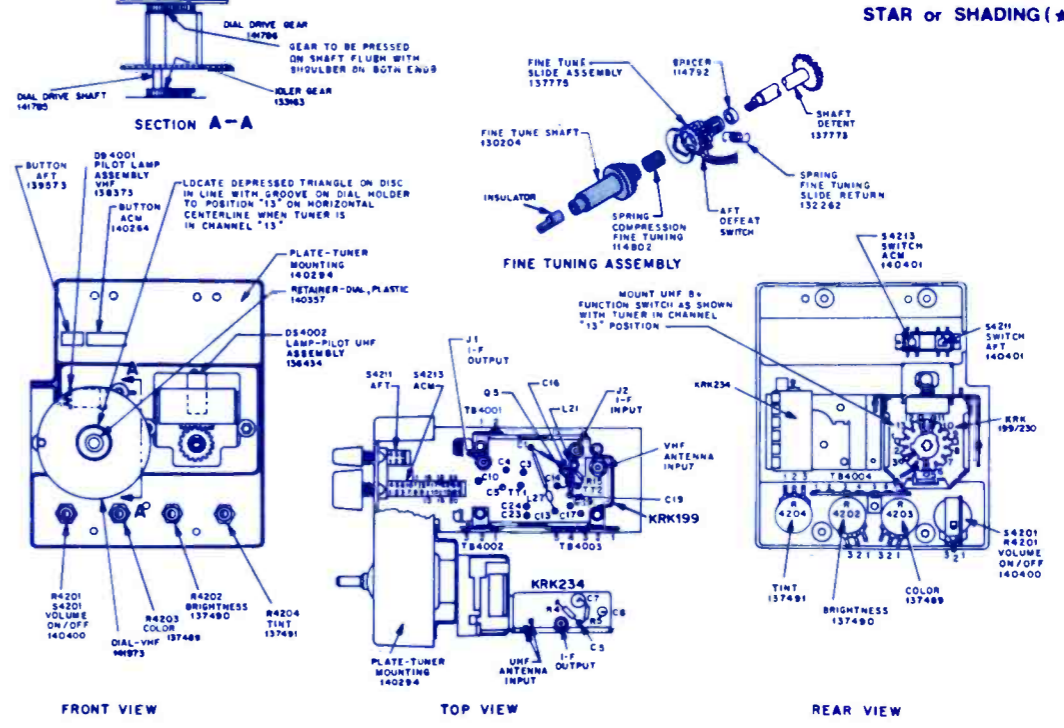
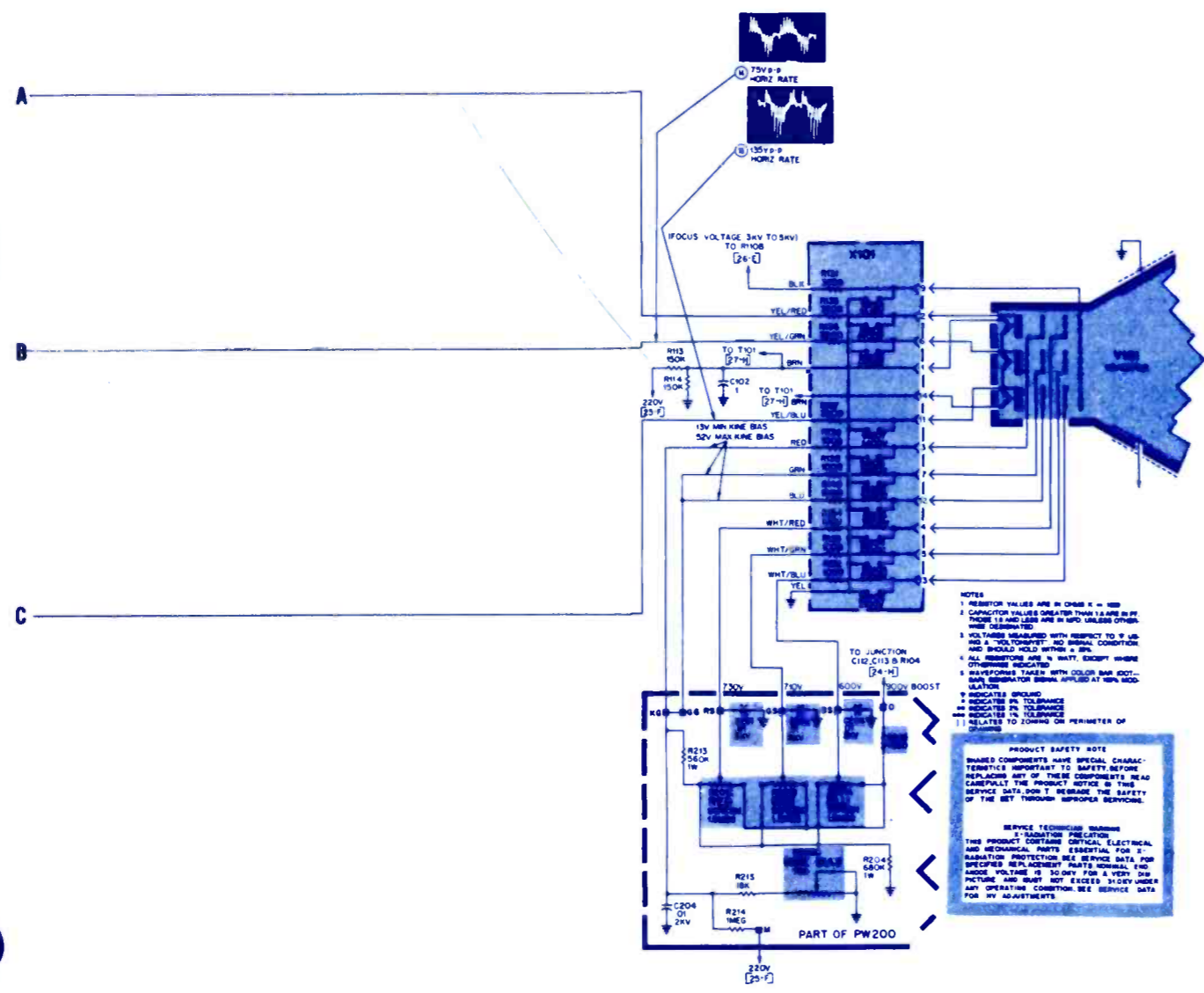
TUNER MOUNTING ASSEMBLY



INTERCONNECTING WIRING DIAGRAM

STAR or SHADING (★) RESISTOR

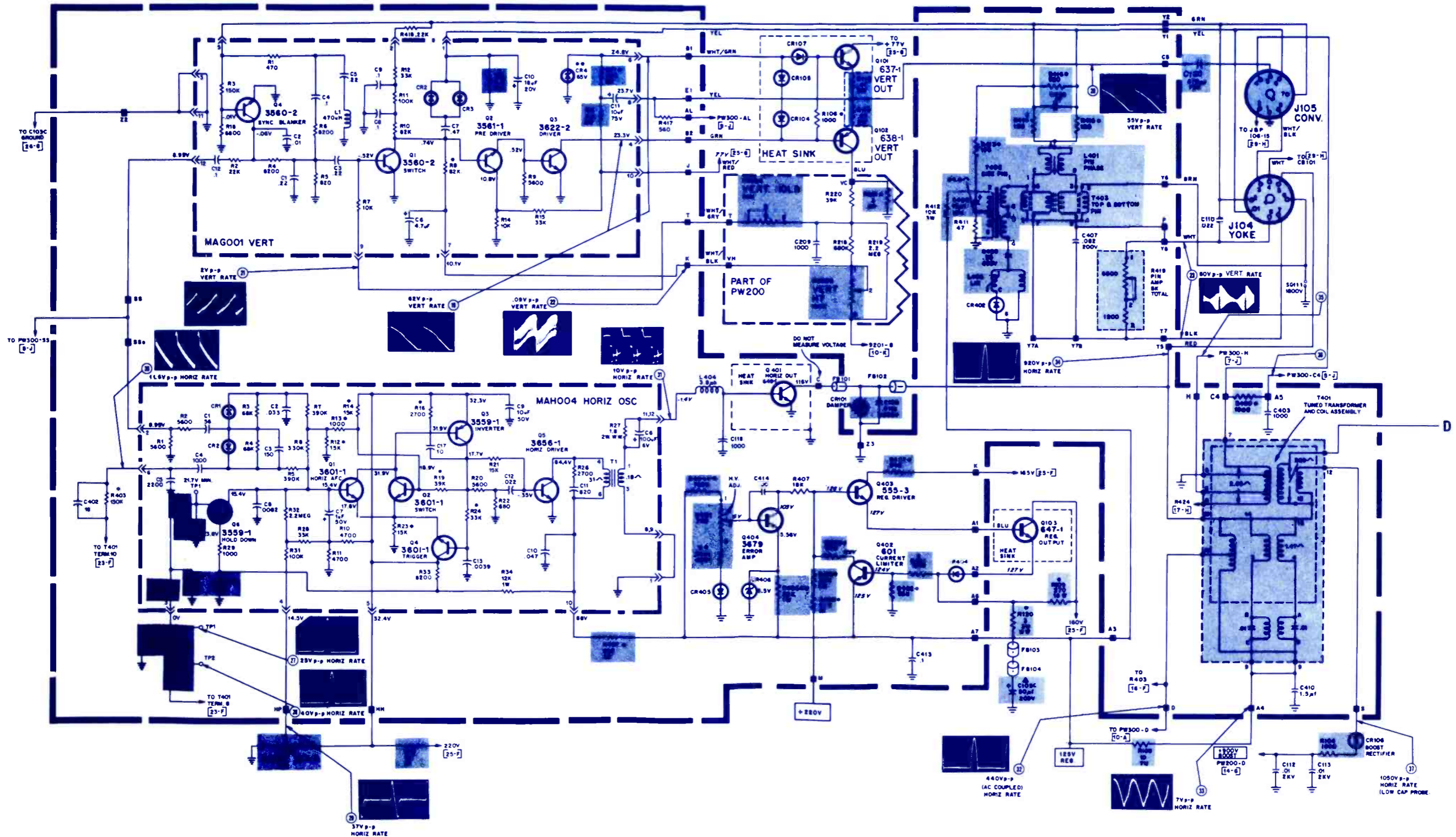
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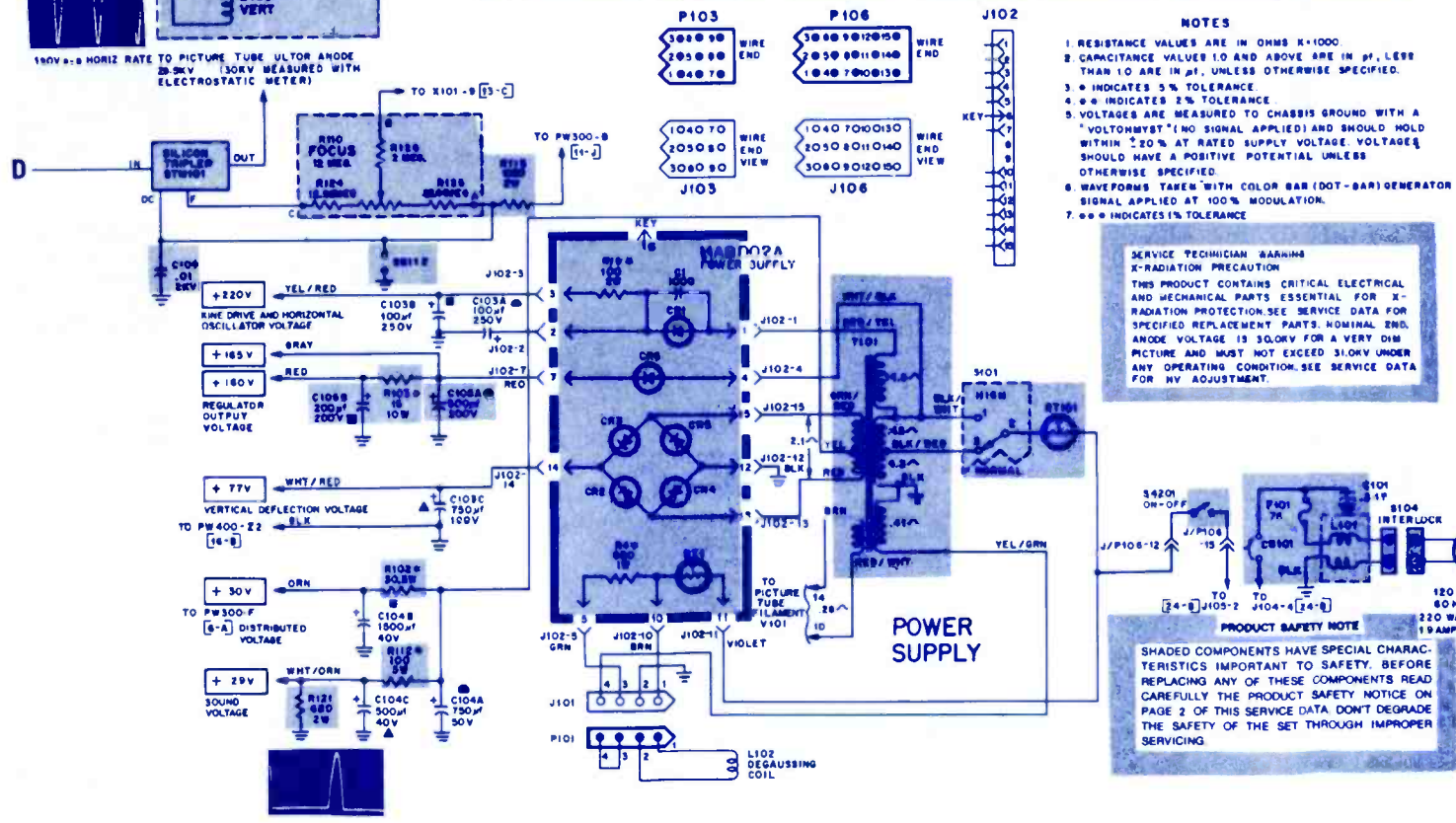
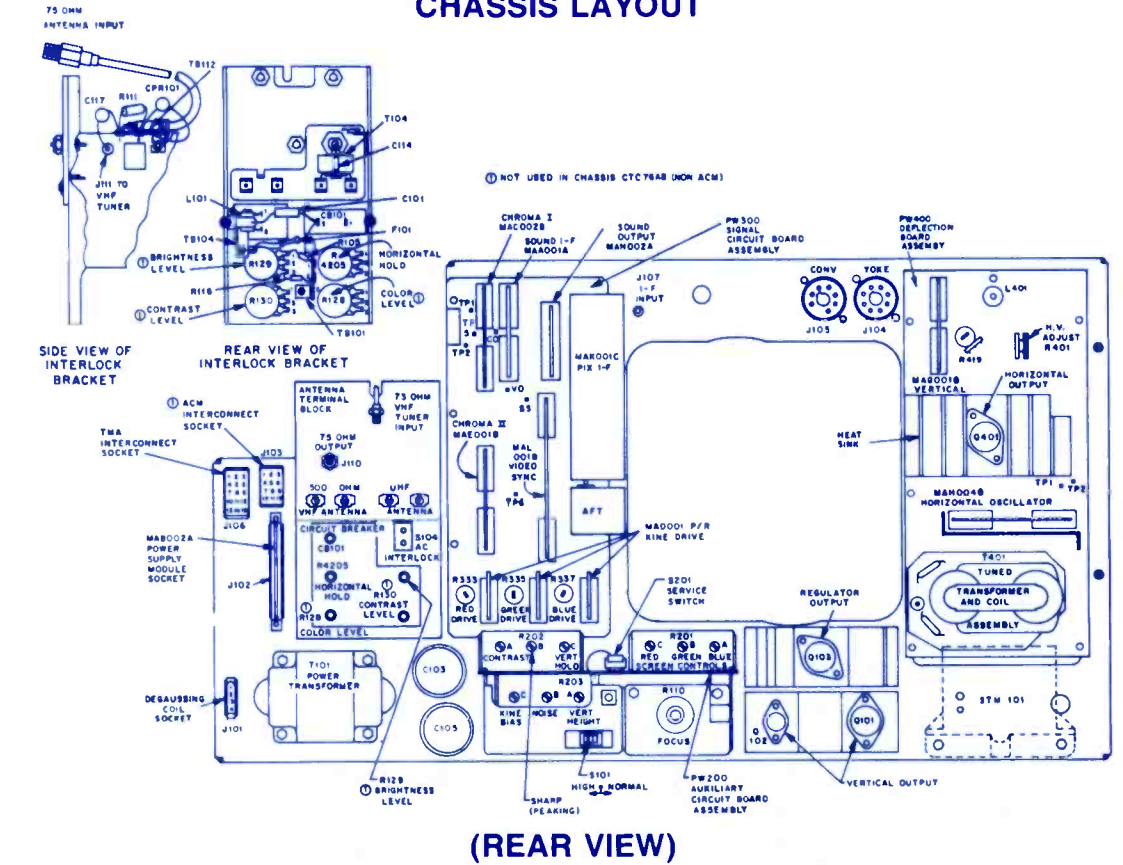
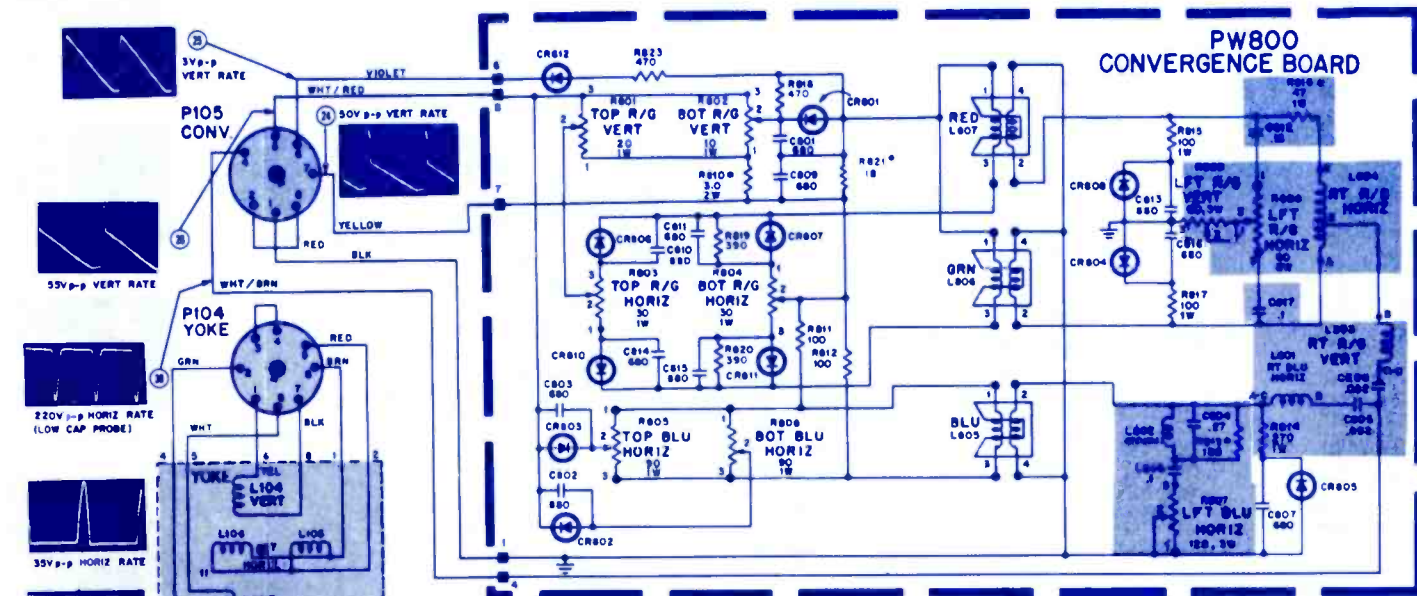
NOTES
1. RESISTOR VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. CAPACITOR VALUES GREATER THAN 1 μ ARE IN PFD; 1 μ AND LESS ARE IN NFD UNLESS OTHERWISE INDICATED.
3. VOLTAGES MEASURED WITH RESPECT TO 0 UNLESS OTHERWISE INDICATED.
4. ALL RESISTORS ARE 1% TOLERANCE UNLESS OTHERWISE INDICATED.
5. WAVEFORMS TAKEN WITH COLOR BAR SIGNAL; MAIN OPERATOR SIGNAL APPLIED AT 100% MODULATION.
6. INDICATES 5% TOLERANCE.
7. INDICATES 1% TOLERANCE.
8. INDICATES 1% TOLERANCE.
9. INDICATES 1% TOLERANCE.
10. INDICATES 1% TOLERANCE.
11. RELATES TO TUNING OR PERIMETER OF CHANNELS.

PRODUCT SAFETY NOTE
SHARED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS, READ CAREFULLY THE PRODUCT NOTICE IN THIS SERVICE DATA BOOK TO REASSURE THE SAFETY OF THE SET THROUGH PROPER SERVICE.

SERVICE TECHNICIAN WARNING
THIS PRODUCT CONTAINS OPTICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR RADIATION PROTECTION. SEE SERVICE DATA FOR SPECIFIC REPLACEMENT PARTS NUMBERS. NO PICTURE AND SOUND SHOULD EXCEED 300V UNDER ANY OPERATING CONDITION. SEE SERVICE DATA FOR HV ADJUSTMENTS.



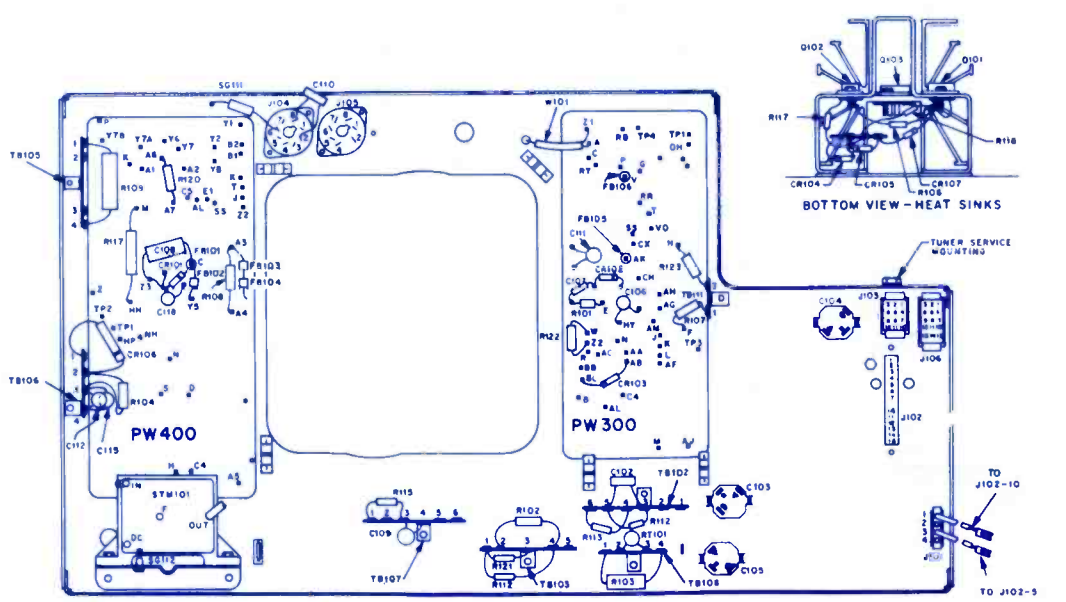
CHASSIS LAYOUT



- NOTES**
- RESISTANCE VALUES ARE IN OHMS X-1000.
 - CAPACITANCE VALUES 1.0 AND ABOVE ARE IN μ F, LESS THAN 1.0 ARE IN nF, UNLESS OTHERWISE SPECIFIED.
 - W INDICATES 5% TOLERANCE.
 - W INDICATES 5% TOLERANCE.
 - W INDICATES 2% TOLERANCE.
 - VOLTAGES ARE MEASURED TO CHASSIS GROUND WITH A "VOLTMYST" (NO SIGNAL APPLIED) AND SHOULD HOLD WITHIN $\pm 20\%$ AT RATED SUPPLY VOLTAGE. VOLTAGE SHOULD HAVE A POSITIVE POTENTIAL UNLESS OTHERWISE SPECIFIED.
 - WAVEFORMS TAKEN WITH COLOR BAR (DOT-BAR) GENERATOR SIGNAL APPLIED AT 100% MODULATION.
 - W INDICATES 1% TOLERANCE.

SERVICE TECHNICIAN WARNING
X-RADIATION PRECAUTION
THIS PRODUCT CONTAINS CRITICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR X-RADIATION PROTECTION. SEE SERVICE DATA FOR SPECIFIED REPLACEMENT PARTS. NOMINAL END ANODE VOLTAGE IS 3000V FOR A VERY DIM PICTURE AND MUST NOT EXCEED 3100V UNDER ANY OPERATING CONDITION. SEE SERVICE DATA FOR HV ADJUSTMENT.

PRODUCT SAFETY NOTE
SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE ON PAGE 2 OF THIS SERVICE DATA. DON'T DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING.



1690

MAGNAVOX
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T922-01

ELECTRONIC TECHNICIAN/DEALER **TEKFAKX**

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 4 NEW SETS

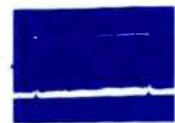
APRIL • 1977



1 2Vp-p(V)



2 60Vp-p(V)



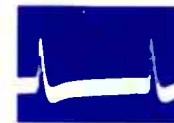
3 10Vp-p(V)



4 10-Vp-p(H)



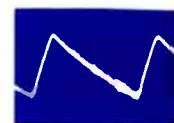
5 1Vp-p(V)



6 0.2Vp-p(V)



7 10Vp-p(V)



8 10Vp-p(H)



9 1Vp-p(H)



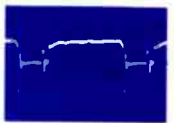
10 6Vp-p(H)



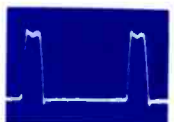
11 15Vp-p(H)



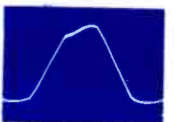
12 4Vp-p(H)



13 8Vp-p(H)



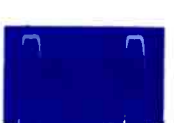
14 100Vp-p(H)



15 20Vp-p(V)



16 0.08Vp-p(V)

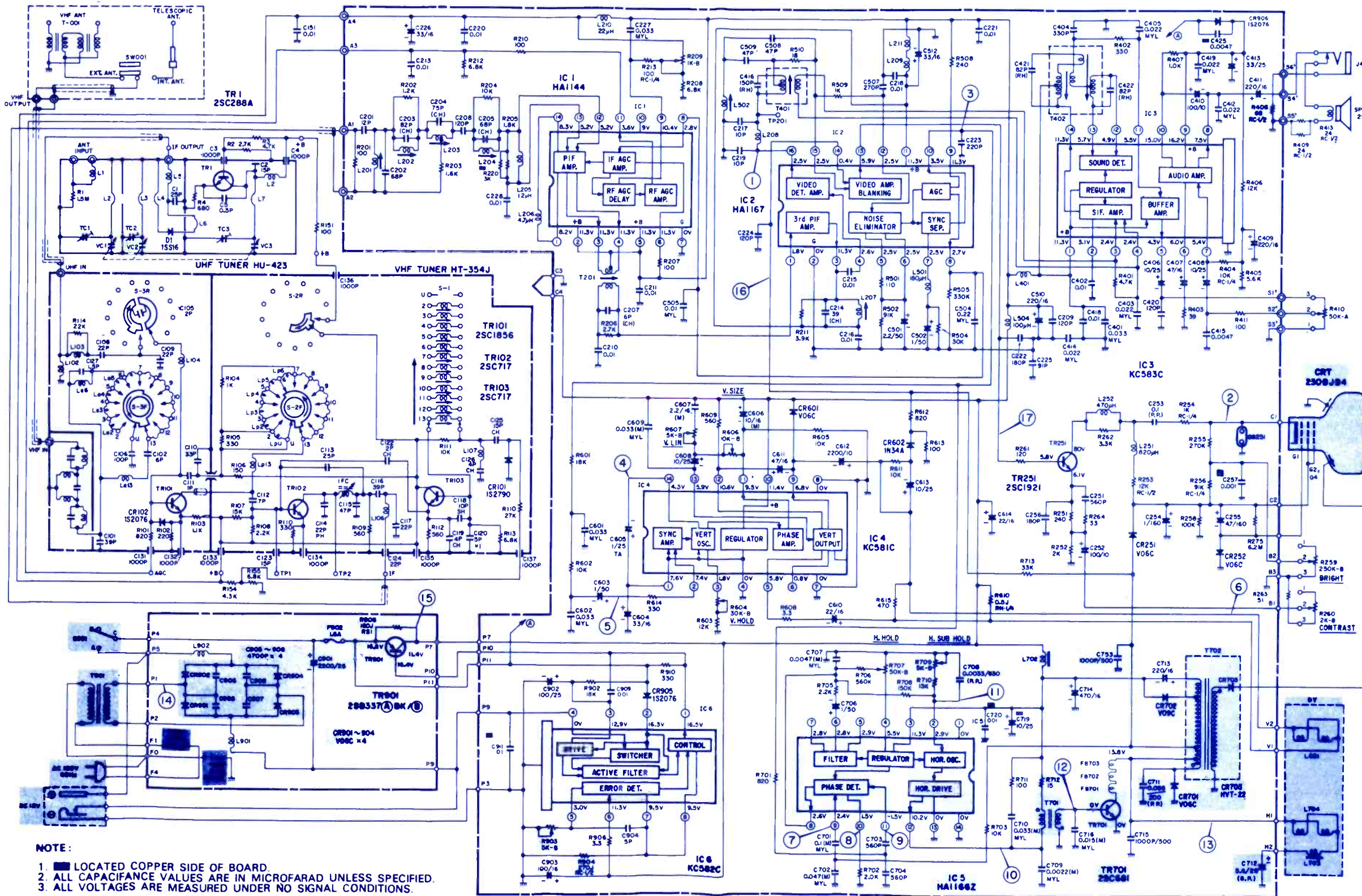


17 2Vp-p(H)



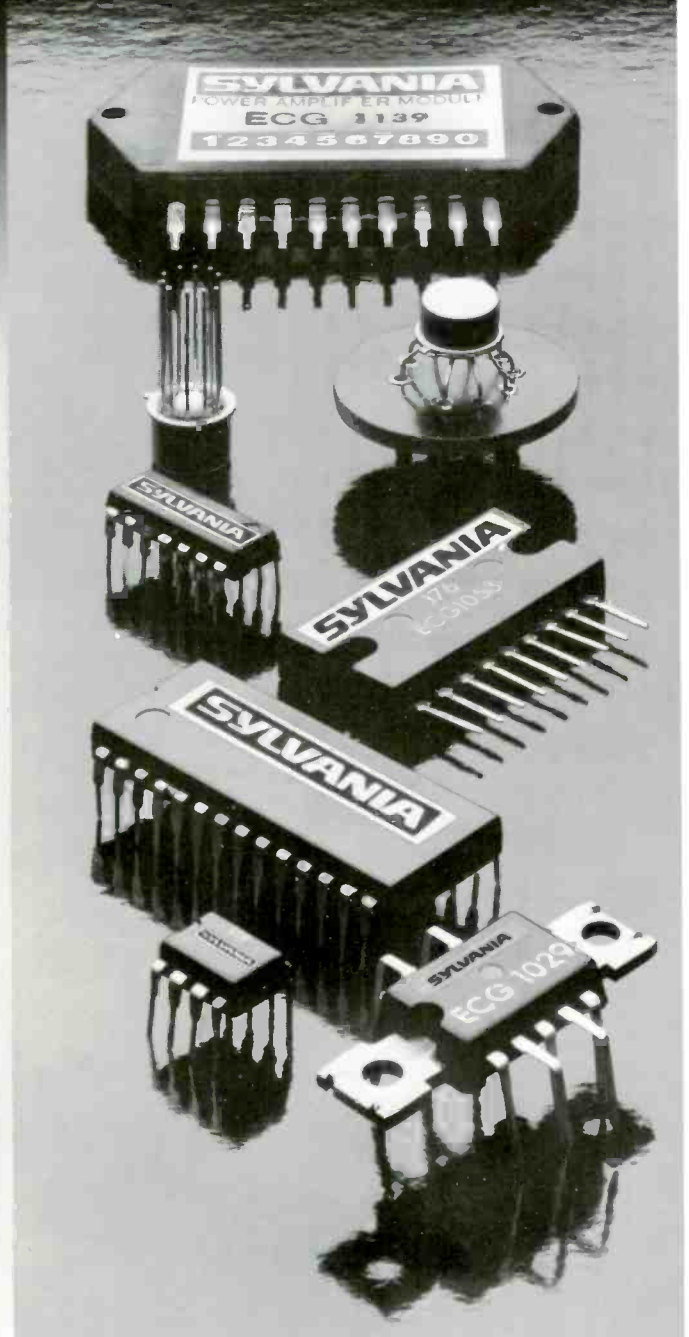
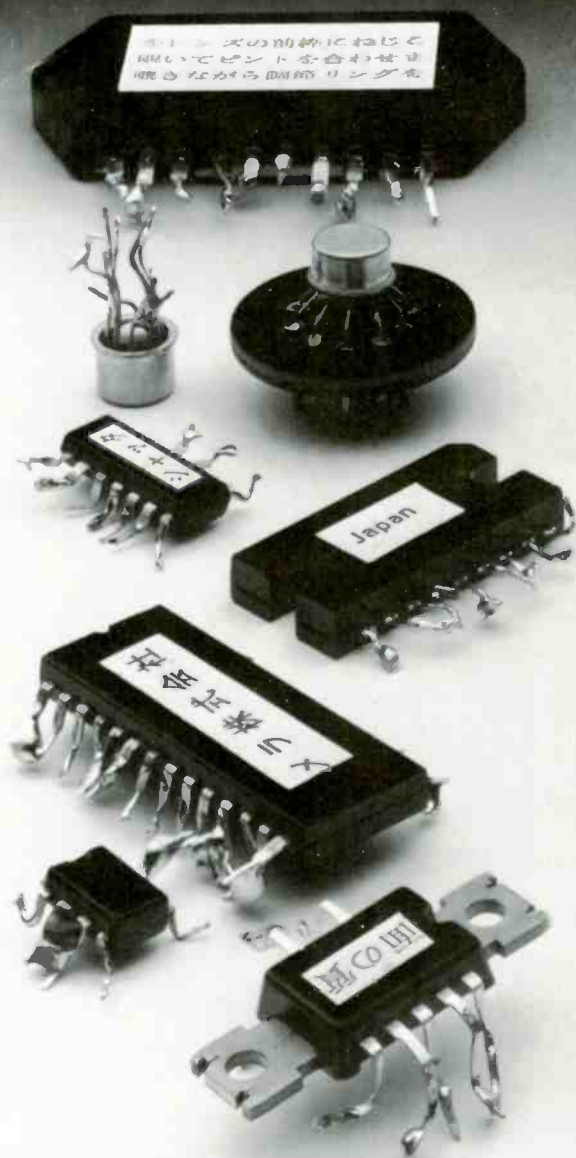
18 6Vp-p(H)

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NOTE:
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5 OHMS
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AND 8 dB RANGES

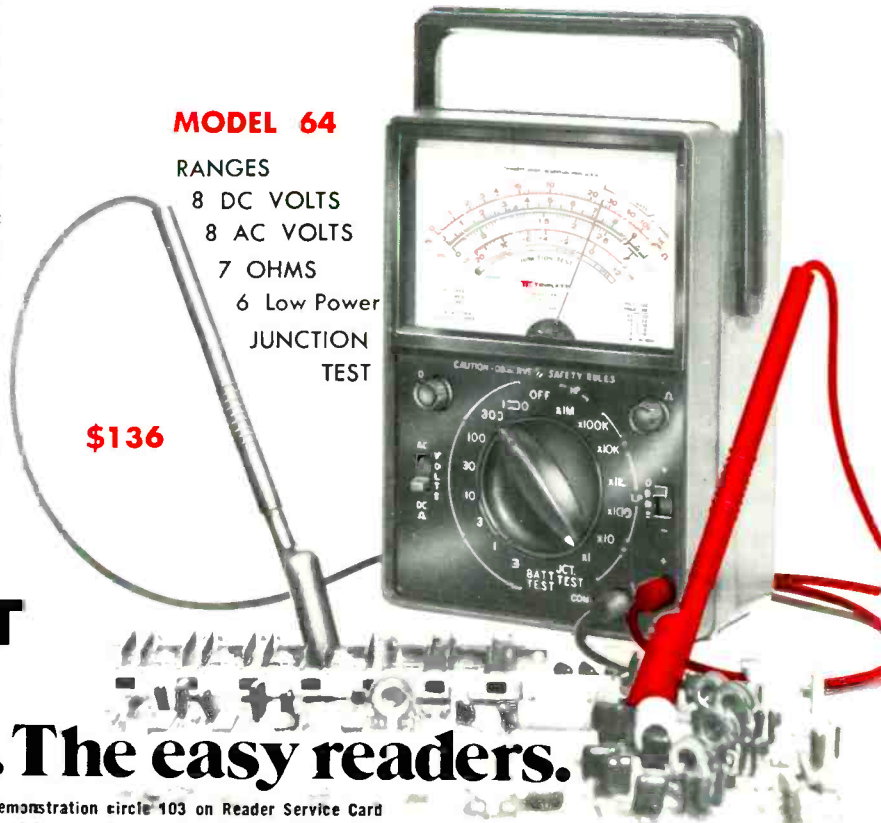
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