ET/D

OCTOBER 1979 • $1.00

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

The growing service field

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

Better than brand new.*

Send us your worn out tuners and bad modules. Your Zeniths. Your RCAs. Your Sonys. Your Quasars. Any make, any model. They'll be returned, rebuilt, better than brand new.

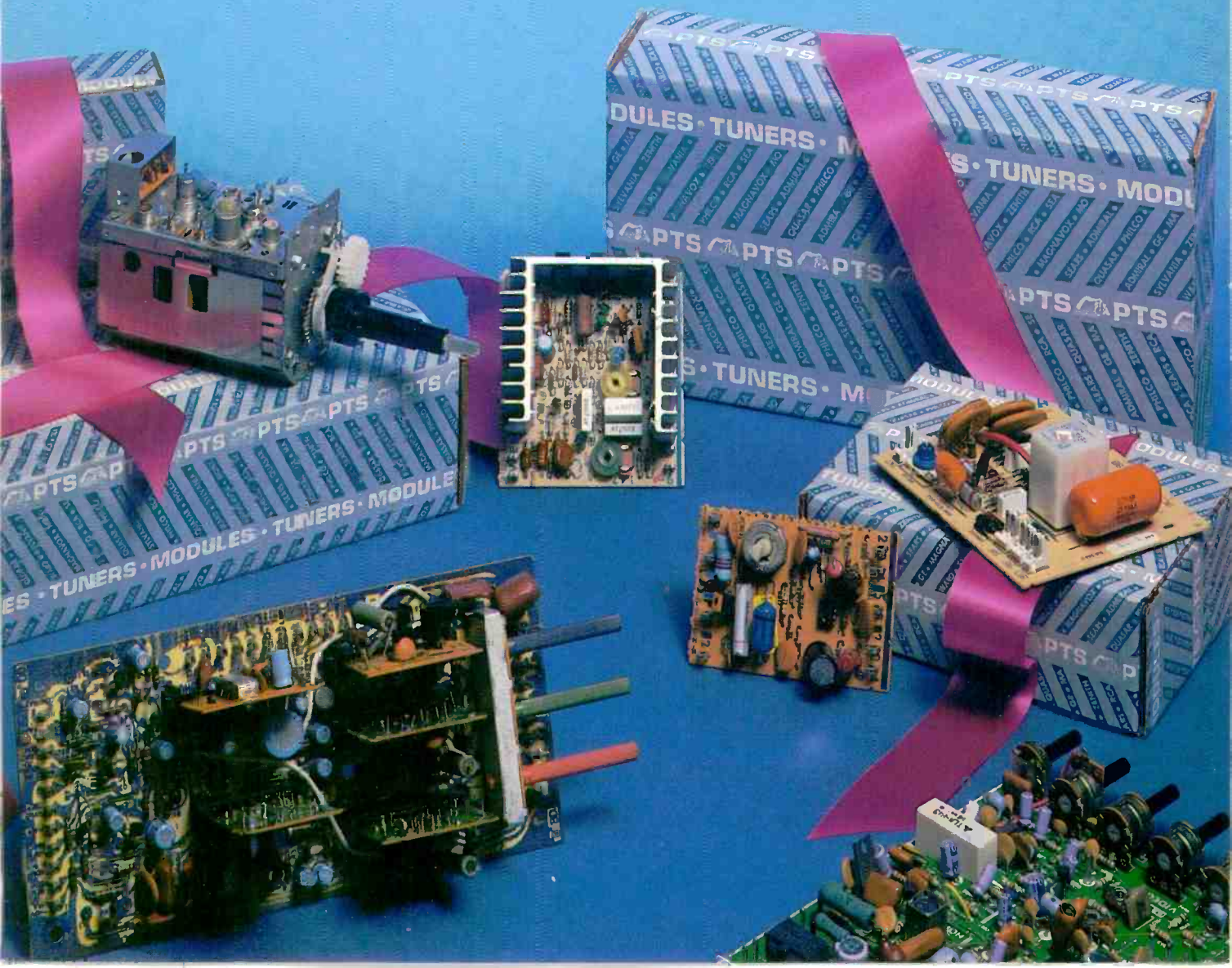
*PTS tuner and module rebuilding includes original or superior parts, expert workmanship, same day service, protective packaging and a one-year limited warranty.

PTS®

PTS ELECTRONICS, INC.

The Only Name You Need To Know

For the location nearest you, see Servicenter Guide on next page.



INDUSTRY REPORT

ETA-1 Annual Meeting Held in Canada.

The first annual meeting of the Electronics Technicians' Association-International was held in Kitchener, Ontario, August 3, 4 and 5.

Bill Patullo, CET, ETA-C (Canada) chairman, welcomed the group to Canada. The treasurer's report indicates the organization to presently be on a sound financial footing. Dick Glass's president's report reiterated the goals of ETA: to establish a truly independent professional technicians association, to preserve the CET program, to initiate association projects directly beneficial to technicians, and to establish an association unit specifically devoted to those who teach electronics technology.

Means of accomplishing these ends were discussed. Mentioned were refresher training programs, presently in operation, an employment upgrading service, possibly resulting in a special bulletin, regularly published, local chapter meetings on a monthly basis, and the further development of EEA (Electronics Educators Division).

Officers elected were Jesse B. Leach, CET, re-elected as Chairman and D. C. Larson, CET, re-elected as Vice-Chairman; George Savage, CET, of Doniphan, NB, was elected national secretary, and John McPherson, CET, Yorktown, VA, treasurer. Division officers include: ETA-C, Bill Patullo, CET, Chairman; Ronald Speed, CET, Vice-Chairman; James Sims, CET, Secretary; Paul Maillous, CET, Treasurer and Ray Pierce, CET, EEA-C Chairman.

Leon F. Howland, CET and Walter Cooke, CET, are Chairman and Vice-Chairman respectively of the ETA Certified Technician Division, while Alan Hartley, CET, and Edward Carrol, CET, are, respectively, Chairman and Vice-Chairman of EEA.

Ron Crow, CET, retained his appointed position as Director of Certification; Dick Glass remains President and Chief Executive Officer.

The next annual meeting will be held in July 1980 at a location yet to be determined.

GTE and Mattel Sign Marketing Agreement

GTE and Mattel Inc. have reached an agreement under which GTE will make and sell "Intellivision," Mattel's TV game and home-computer oriented system.

According to a GTE statement, the circuit products division of GTE will make the master component for Intellivision for both the Mattel and Sylvania brands. Mattel will continue to market the product under its own name.

GTE's General Manager of Entertainment Products, Thomas Shepherd, said the agreement "meets a rapidly growing need in the market as color television evolves from a purely off-the-air receiver to a device which provides for multiple uses..."

Intellivision was described by GTE as "a transition between the video game and the home computer...with the addition of a keyboard component, which is expected to be introduced by early 1980, the user will be able to convert the entire system into an interactive computer."

Chicago to Host Midcon Meet

Chicago's O'Hare Exposition Center will house this year's Midcon electronics exhibition Nov. 6-8. Some 300 companies have signed up to display at the annual meeting which alternates between Chicago and Dallas, Tex.

According to a show spokesman, the meeting will feature some 120 professional presentations in addition to the exhibitors' show. The presentations, to be located at the adjacent Hyatt Regency O'Hare Hotel, will include presentations on 16-bit microprocessor based systems and single-chip microcomputers.

One of the highlights will be a demonstration Nov. 7 of a programmable videodisc television system which can display still and moving pictures as well as alpha numeric data with random access capabilities.

Villont Re-elected NESDA Chief

Bob Villont, CET, president of the National Electronic Service Dealers Association, was elected to a second consecutive term during the association's annual meeting in August in Tucson, Az.

According to spokesmen for the association, Villont's re-election to a second term will provide the continuity necessary for continued existence as NESDA comes through one of the most difficult periods in its history. In addition to the continuing rift over control of the ISCET program which ultimately led to the split, and formulation of a third independent association (ETA-I), NESDA in the past 12 months has suffered the resignation of Executive Vice President Charles Porter and the move of its headquarters from Indianapolis, Ind., to Ft. Worth, Tex.

"Many people came down here (Tucson) to attend a funeral and were surprised to learn that we are emerging from this period stronger than ever," NESDA's newly appointed administrator, J.W. Williams, told ET/D. According to Villont, the Tucson meeting marks a new milestone for NESDA, signifying a bottoming out of its period of troubles. "We are very pleased with the way things went here in Tucson," Villont told ET/D. "We feel we have faced the issues

ET/D

ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
INDUSTRIAL SERVICE MARKETS

OCTOBER 1979, VOL. 101, NO. 10

On The Cover: The use of microprocessors for television and appliance control is increasing rapidly. The dedicated microprocessor (inset) provides a flexibility of control previously unthinkable. This television receiver and microwave oven, today's top of their respective lines, are forerunners of tomorrow's commonplace.

FEATURES

DEPARTMENTS

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

ELECTRONIC TECHNICIAN/DEALER (ISSN 0192-7175) is published monthly by Harcourt Brace Jovanovich Publications. Corporate offices: 757 Third Avenue, New York, New York 10017. Advertising offices: 757 Third Avenue, New York, New York 10017 and 111 East Wacker Drive, Chicago, Illinois 60601. Editorial offices: 111 East Wacker Drive, Chicago, Illinois 60601. Accounting, Advertising Production and Circulation offices: 1 East First Street, Duluth, Minnesota 55802. Subscription rates: one year, $10; two years, $16; three years, $20 in the United States and Canada; all other countries: $45. Single copies: $1 in the United States and Canada; all other countries: $3. Controlled Circulation postage paid at Dansville, New York 14437.

POSTMASTER: Send Form 3579 to ELECTRONIC TECHNICIAN/DEALER, P.O. Box 6016, Duluth, MN 55806.

150,000 REASONS WHY YOU SHOULD SWITCH NOW TO THE BIGGEST, BROADEST-EVER LINE OF ZENITH UNIVERSAL SEMICONDUCTORS covering Zenith exact replacements plus the most popular types in the industry–all in a new catalog!

It's all under one numbering system that saves you time and adds value to any Zenith semiconductor you may already have in stock!

Switch now to Zenith Universal Semiconductor replacements and see how well your shop shapes up...your bottom line, too.

Shown here are just a few of the more than 150,000 cross-references in the July, 1979 edition of the Zenith Universal Semiconductor cross-reference guide.

Check with your Zenith distributor for your copy of Zenith's Universal Semiconductor cross-reference guide...and ask how you can enjoy the convenience of our special Tube Caddy/Benchtop Organizer.

ECG is a registered trademark of GTE SYLVANIA

ZENITH®

The quality goes in before the name goes on®

Zenith Radio Corporation / Service, Parts & Accessories Division / 11000 Seymour Avenue / Franklin Park, Illinois 60131

Circle No. 117 on Reader Inquiry Card

squarely, they are behind us and we are prepared to proceed from here," he said.

In addition to Villont, other officers elected during the week-long convention were Vice President Bill Lawler of Los Angeles; Secretary Warren Baker, CET, Albany, N.Y.; and Bill Abernathy, Treasurer, Ft. Worth, Tex.

Color TV Imports Dip

The Electronic Industries Association reports that color TV and radio imports for the first half of 1979 were significantly down while monochrome and phonograph imports rose slightly.

Color TV imports were down 37.8 per cent while home radio imports dipped 25 per cent during the period. However, monochrome TV imports rose 2.1 per cent and phonographs jumped 39 per cent to 196,204 units, according to EIA figures.

Computer Retailing Patterns Mature

Computer manufacturers apparently have come to realize that people don't buy little black boxes for the sake of little black boxes.

Faced with the prospect of a market the size of which perhaps rivals that of televison worldwide—yet not really knowing how to tap it—some computer firms have committed to selling their product through uniform retail channels—the retail showroom.

Two at least, Digital Equipment Corporation and Radio Shack, have developed the "computer center" concept, in effect computer department stores which offer their products, plus instructional and software support, in addition to the function of "selling" those little black boxes.

Even IBM is into the so-called computer retail center concept with its "Business Computer Centers" first opened up some 18 months ago to sell its $15,000 small systems unit.

The trouble with the small computer business up to now has been the hobbyist. Most computer hobbyists come from engineering or programming backgrounds—or both—and need little software or instructional support once their purchase is made.

This just isn't so with the general public, which in addition to being convinced a computer is a necessary part of their lives, will also have to be taught—in most cases at least—how to use what is quite frankly a very complex and sensitive piece of machinery.

What's developing now, at least according to computer makers, is a market the size of which makes their eyes pop. Every conceivable type of small business—from small family owned operations to professional offices with revenues under $10 million annually—is a target.

One industry expert, Jerry Droll, di-

ET/D

Richard W. Lay, *Editor (Chicago)*

Walter H. Schwartz, *Managing Editor (Duluth)*

David Hagelin, *Publisher (Chicago)*

Tom Greney, *Group Vice President (Chicago)*

John Paszak, *Graphic Design*

Kathy Tarnowski, *Production Manager*

Debi Harmer, *Production Supervisor*

Lillie Pearson, *Circulation Supervisor*

Gene Bailey, *Reader Service*

Julie Laitin, *Promotion Director*

Dawn Anderson, *Classified Ad Mgr.*

Please submit editorial manuscripts to:
Editor, ET/D, 111 East Wacker Drive
Chicago, Ill., 60601

ADVERTISING SALES

Please send all advertising material to:
ET/D,
Production Mgr.
1 East First Street
Duluth, Minn. 55802
(218) 727-8511

East Region
Thomas Palmisano
757 Third Avenue
New York, N.Y. 10017
(212) 888-4382

Midwest Region
David J. Hagelin or Larry Eaton
111 East Wacker Drive
Chicago, Ill. 60601
(312) 938-2344

Southern & Western Region
Chuck Cummings
613 N. O'Connor
Irving, TX 75061
(214) 253-8678

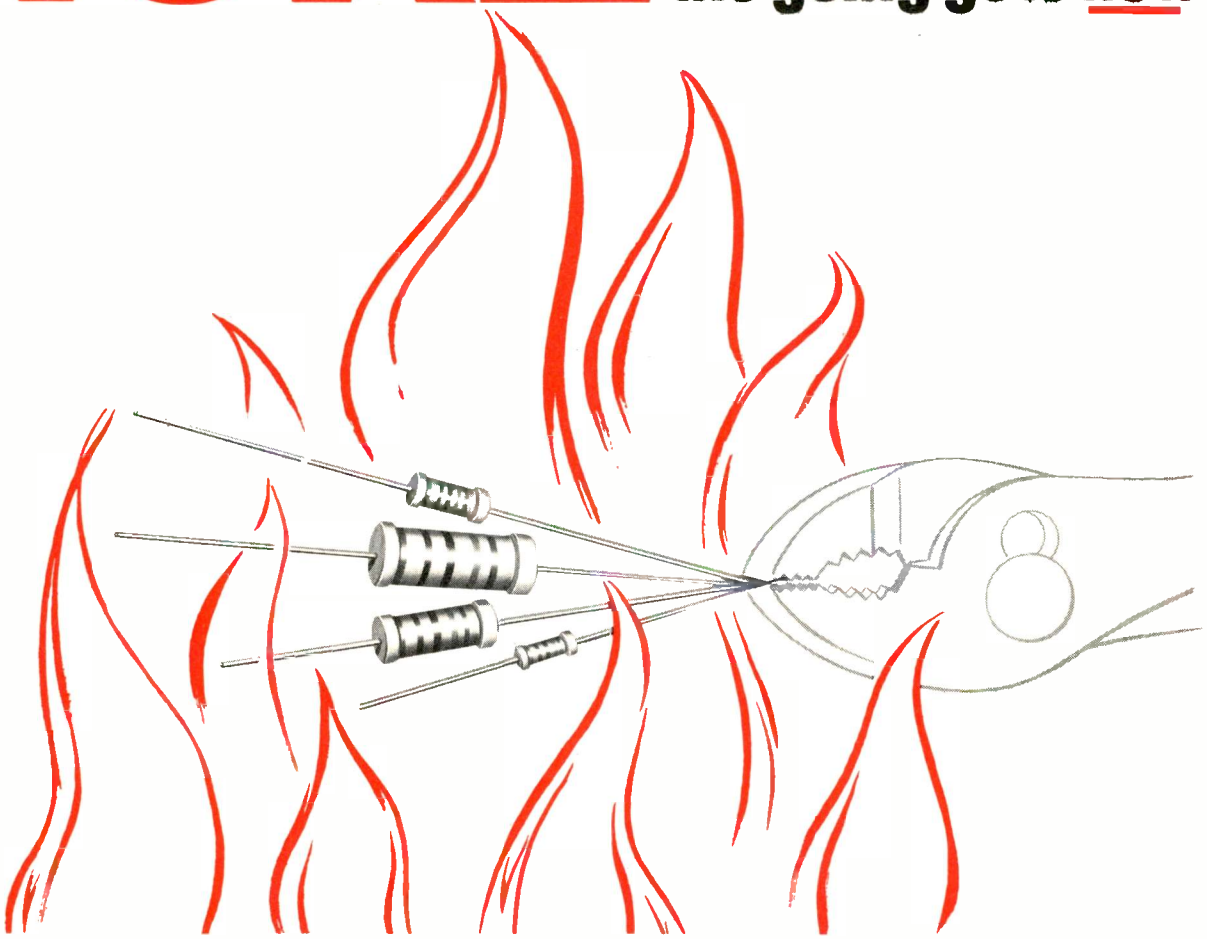
HBJ

HARCOURT BRACE JOVANOVICH PUBLICATIONS

Robert L. Edgell, *Chairman*
Richard Moeller, *President*
Lars Fladmark, *Senior Vice President*
Arland Hirman, *Treasurer*
Thomas Greney, *Group Vice President*
Ezra Pincus, *Group Vice President*
Harry D. Ramaley, *Vice President*
Lois Sanders, *Group Vice President*
Joe Bilderbach, *Vice President*
James T. Gherna, *Vice President*
George A. Glenn, *Vice President*

SPRAGUE FLAMEPROOF RESISTORS

MORE to go with when the going gets hot!



MORE to beat the heat: These resistors are expressly made to meet the needs of today's safety-conscious world. They feature specialized noncombustible ceramic construction . . . will not flame or short under the most severe overloads. Rather, they will open as any good fuse does.

Sprague Flameproof Resistors are ideal replacements for composition, carbon-film, metal-film, and wirewound resistors in entertainment, commercial, and industrial equipment. Resistance tolerance is ±2% as opposed to the ±5% or ±10% tolerances of most conventional carbon-film and carbon-composition resistors.

In addition, excellent resistance stability and extremely long shelf/service life are assured.

MORE to fit your needs: You won't have to compromise with a "nearly-right" when you make selections from this line. It includes:

127 resistance values (3.3Ω to 1.0 MΩ) rated at ¼ Watt
149 resistance values (1.0Ω to 5.1 MΩ) rated at ½ Watt
145 resistance values (2.2Ω to 5.1 MΩ) rated at 1 Watt
150 resistance values (3.3Ω to 10.0 MΩ) rated at 2 Watts

MORE in buying convenience: Sprague flameproof resistors are sold through Sprague distributors (and only through Sprague distributors). This broad network of sales outlets makes them available in your area to save procurement time.

Flameproof resistors are also available in three popular cabinet assortments to give you a balanced inventory of frequently-used ratings and values. Cabinets are included at *no extra cost!*

For a copy of Descriptive Circular M-648 and the name of the Sprague stocking distributor nearest you, write or phone David Spooner, Sprague Products Company, 65 Marshall St., North Adams, Mass. 01247. Tel. 413/664-4481.

SPRAGUE PRODUCTS COMPANY Distributors' Division of Sprague Electric Co.

THE FOREMOST SUPPLIER OF ELECTRONIC COMPONENTS

6S-9118

SPRAGUE®
THE MARK OF RELIABILITY

a subsidiary of **GK Technologies**

Circle No. 116 on Reader Inquiry Card

rector of operations for Image Resource, has estimated by 1982 about one-third of the small systems computers sold will be sold through retail outlets and by salesmen who will provide personal service. Another third of the units sold will be by original equipment manufacturers who will have to offer personal service support to move their product.

Leader Announces Selected Price Increases

Leader Instruments Corp. has announced that it raised prices an average of 6 per cent on 15 of its test instrumentation products but its 40 other products will not be affected.

According to Marketing Manager George Zachman the new price list "reflects ongoing efforts by the company to combat inflationary pressures and accelerate competitive advantages."

Leader manufacturers oscilloscopes, frequency counters, multimeters, generators, transistor checkers, attenuators and bridges

NATESA Re-elects Officer Slate

All of the current national officers of NATESA were re-elected as the organization met in national convention during the latter part of August at Chicago.

Re-elected were: President Paul F. Kelley, Warwick, RI.; Vice President Leo Cloutier, Los Angeles; Treasurer Richard Ebare, Essex Junction, Vt.; and Lelia Aunspaw, Dayton, Ohio.

Highlights of the three day meeting included eight hours of business management and technical sessions. In addition to reports from several manufacturers on technical aspects of their new products, Paul Dontje, a retired serviceshop owner and now a business consultant, presented a two-hour seminar on the John Sperry system for parts and labor pricing.

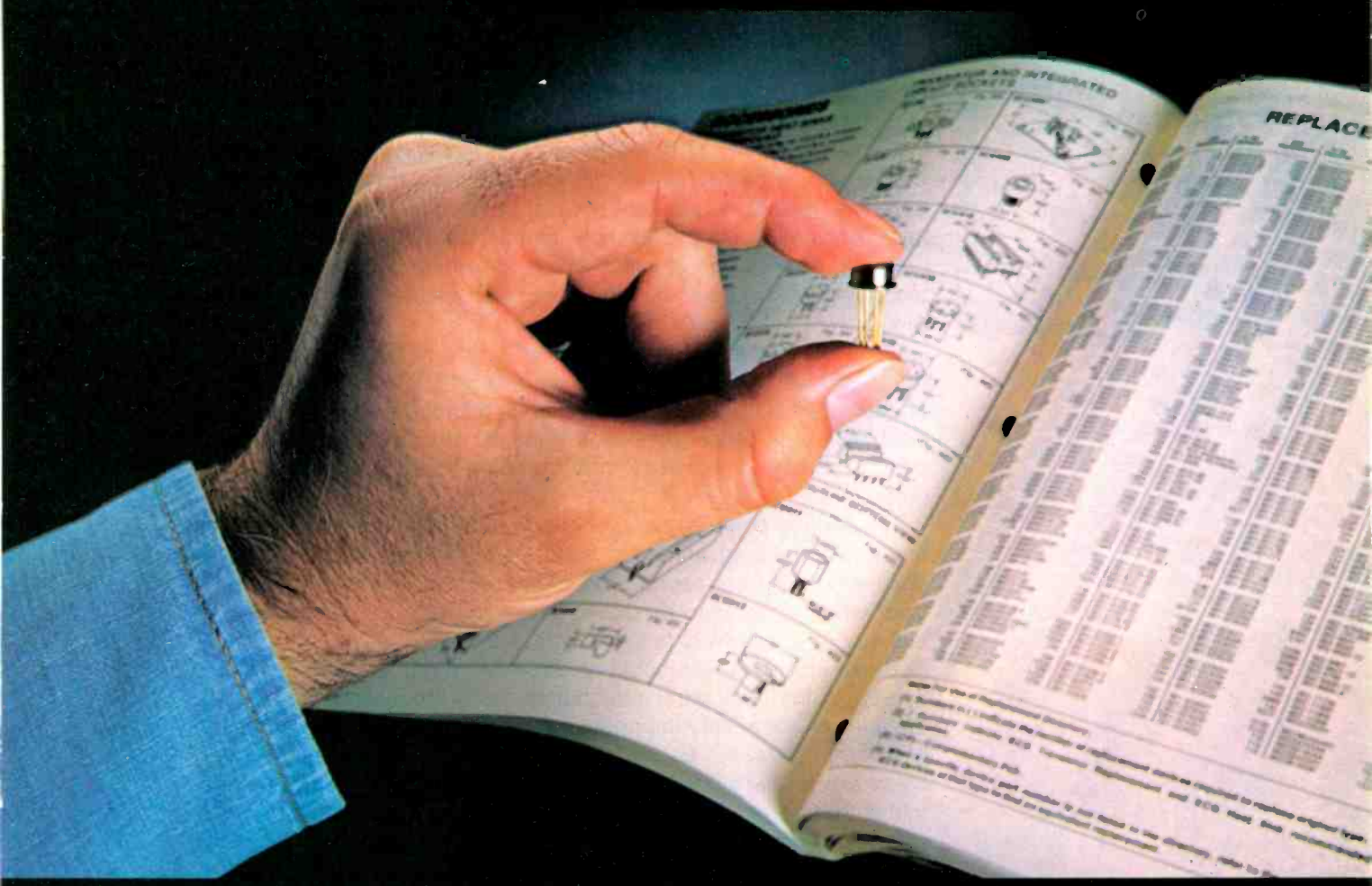
Executive Director Frank Moch reported to the meeting that at long last, after years of fruitless investigation, the federal government has finally given up its crusade to label television sets as substantial fire and safety hazards to the public.

Moch also stressed the necessity of continuing education, especially in the area of microprocessors, and business diversification for "anyone planning on being around a year from now."

IBM To Enter Video Disc Market

MCA, the only current producer of video discs and IBM have formed a joint venture, DiscoVision Associates. According to *The Wall Street Journal* the equally owned operation has taken over MCA's disc production business and assets and IBM has contributed patents and cash. Initially discs will be produced for the consumer and industrial markets but DiscoVision Associates will not market consumer discs directly. ETD

SYLVANIA ECG® SEMICONDUCTOR GUIDE HELPS SOLVE GE AND RCA'S PROBLEMS.



No one knows better than Sylvania that the show must go on. So when a faulty semiconductor in any brand of home entertainment product turns into a showstopper, it's Sylvania to the rescue. Our ECG® semiconductor guide is the most used, and useful, guide in the industry. It makes it easy to replace any ailing performer with an ECG semiconductor that will get the show back on the road.

When it comes to replacement parts the right place to come is Sylvania. Your Sylvania distributor carries a complete line of ECG® semiconductors, picture tubes, receiving tubes, and test equipment designed to make any brand work like it's brand new.

Sylvania. The easy way to get even the hardest part.

SYLVANIA GTE

ECG is a registered trademark of GTE Sylvania.

FROM THE EDITOR'S DESK

The staff of ET/D has just returned from visits with three organizations comprised of technicians, managers and educators serving primarily in consumer and light industrial electronic service markets.

These organizations, of course, were the newly formed Electronic Technicians' Association, International (ETA), which met in Kitchner, Ontario; the National Electronic Service Dealers Association (NESDA), which gathered in Tucson, AZ.; and the National Association of Television and Electronic Servicers of America, which just completed its annual meeting in Chicago.

Since all three organizations are part of the technologically complex electronics industry, it is not surprising that what we discovered was that all seem to face essentially the same problems *and challenges.*

It seems to be that what it boils down to is this: If you are a technician employed in the industry your main problem is continuing education—specifically the relatively new and still evolving microprocessor technologies.

If you are the owner or manager of an electronics serviceshop your problems may be twofold—locating and hiring the technician who has done his homework and kept abreast of the new developments in microelectronics, plus continually searching the horizon for new and profitable service opportunities which, spawned by the new technologies, are beginning to appear with greater and greater regularity.

Continuing education, where to find it, how to get it, what to look for, is and will continue to be the purpose of ET/D in the months ahead. In addition to specific articles on microprocessor technologies, troubleshooting processor based systems, etc., ET/D will attempt to point you in the direction of proper reading material for educational purposes.

The second point—looking ahead to future business opportunities and how to take advantage of them—is the subject this month of two special reports from people who ET/D feels should have an inside track when it comes to predicting where the electronics service industry of tomorrow is going.

These articles, which begin on page 14, to me are personally exciting in that they bring into sharper focus the feelings and attitudes of some very important people *from the manufacturing side of electronics repair.* Essentially, without getting into detail about these articles, which you can read for yourself, what we are being told is that tremendous opportunity abounds in the consumer, small business, and light industrial service markets for technicians astute enough to master microprocessor technologies and for managers astute enough to "go after" new business.

As far as I'm concerned that kind of attitude is the most important element in continued success in the electronic service industry.

Discover one of today's highest resolution LCD 3½-digit DMM's.

Resolution is an often forgotten, but very important specification. B&K-PRECISION remembered its importance and designed the new Model 2815 to offer performance that's a cut above other 3½-digit LCD meters.

With 0.01 ohm, 100nA, 100μV resolution, the 2815 delivers greater resistance resolution than other comparably priced, currently popular DMM's. That difference is particularly important when you're trying to measure the very small contact resistance of a connector, switch or relay; or observing a slight change in the current demands of a low-power circuit.

The 2815 also delivers accuracy that's a match for most any task, with 0.1% DC accuracy and 0.3% AC accuracy. Unlike many other portable DMM's, the 2815 is also built to stay accurate in rf fields up to 450MHz.

Protection circuitry is another area where the 2815 excels. In the ohms mode, where protection is needed most, the 2815 is protected to +1000VDC or −450VDC or 350VAC RMS. That's greater protection than you'll find on most other highly regarded DMM's.

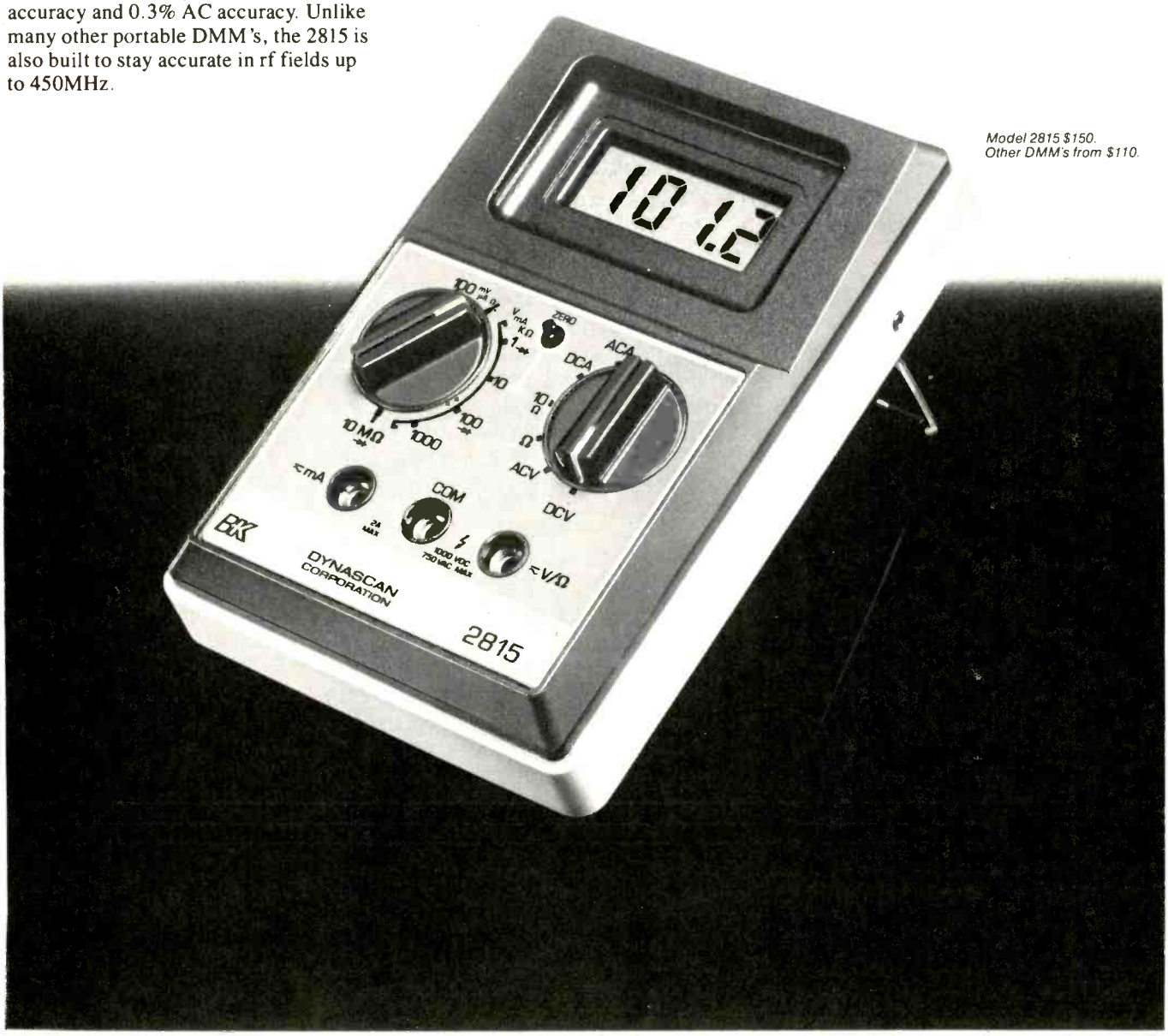
Other features that round out the 2815's high performance are: alternating high-/low-power ohms ranges for solid-state circuitry analysis, auto-zero and auto-polarity; and a control to zero-out test lead resistance on the 10 ohms range. It also has a built-in tilt stand.

It's easy to discover the B&K-PRECISION 2815... It's in stock for immediate delivery at your local B&K-PRECISION distributor.

B&K PRECISION DYNASCAN CORPORATION
6460 W. Cortland Street • Chicago, IL 60635 • 312/889-9087

In Canada: Atlas Electronics Ontario International Sales: Empire Exporters, Inc. 270 Newtown Road, Plainview, L.I., N.Y. 11803

Model 2815 $150.
Other DMM's from $110.



Circle No. 106 on Reader Inquiry Card

NEWSLINE

NARDA-CES CONVENTION AND SHOW COUPLED. The 1980 Winter Consumer Electronics Show (CES) and the annual convention of the National Association of Retail Dealers of America have been tied together for the first time. Both events are in Las Vegas. The CES, scheduled January 5-8, will end as NARDA begins its meeting at the Aladdin Hotel, January 8-10. The CES, incidentally, reports it had sold out all available exhibit space for the Winter show as of August.

QUASAR PLANS HEAVY PROMOTIONS. Quasar, the recently reorganized marketing-sales arm of Matsushita Electric, has announced plans for a heavy barrage of advertising for all of its consumer electronic product lines during the rest of this year. According to company execs, some $10-million will be spent annually on promotions. As one spokesman put it: "The consumer electronics business will explode in the 1980s and diversified firms will lead the market."

FCC MAY DECONTROL COMMERCIAL RADIO STATIONS. Program content and limits on the number of commercials a radio station may broadcast would be decontrolled under a proposal now before the Federal Communications Commission. Currently the FCC places guidelines and restrictions on the number of news and public affairs program and the number of commercials the nations 7,700 AM and FM commercial stations air.

TV SALES TO FINISH YEAR STRONG. According to RCA sales forecasts, color television sales -- industry wide -- will remain strong for the balance of 1979. Favorable factors, according to RCA execs, are the "extremely" large number of older receivers and "a sizeable pool of buying prospects who are more established in their jobs and therefore less likely to be affected by the economy."

PHILIPS GAINS STAKE IN GRUNDIG. N.V. Philips, the Dutch electronics complex, and West German consumer electronics manufacturer Grundig have announced formation of a limited partnership. Under the agreement, Philips will gain about 25 per cent of the West German firm's capital. Officials of the companies say a holding company -- Philips Beteiligungs -- will be established in Fuerth, West Germany. According to sources Philips will pay some $203 million for its minority stake in Grundig.

SYLVANIA ANNOUNCES NEW TUBES. Sylvania has announced the addition of nine new receiving tubes to their replacement tubeline. Sylvania says four of them are for use as horizontal deflection amplifiers in color TVs, two are for use as boost diodes, and another contains a medium amplification triode for use as a vertical oscillator and a pentode for vertical amplifier and deflection applications.

HITACHI OSCILLOSCOPES

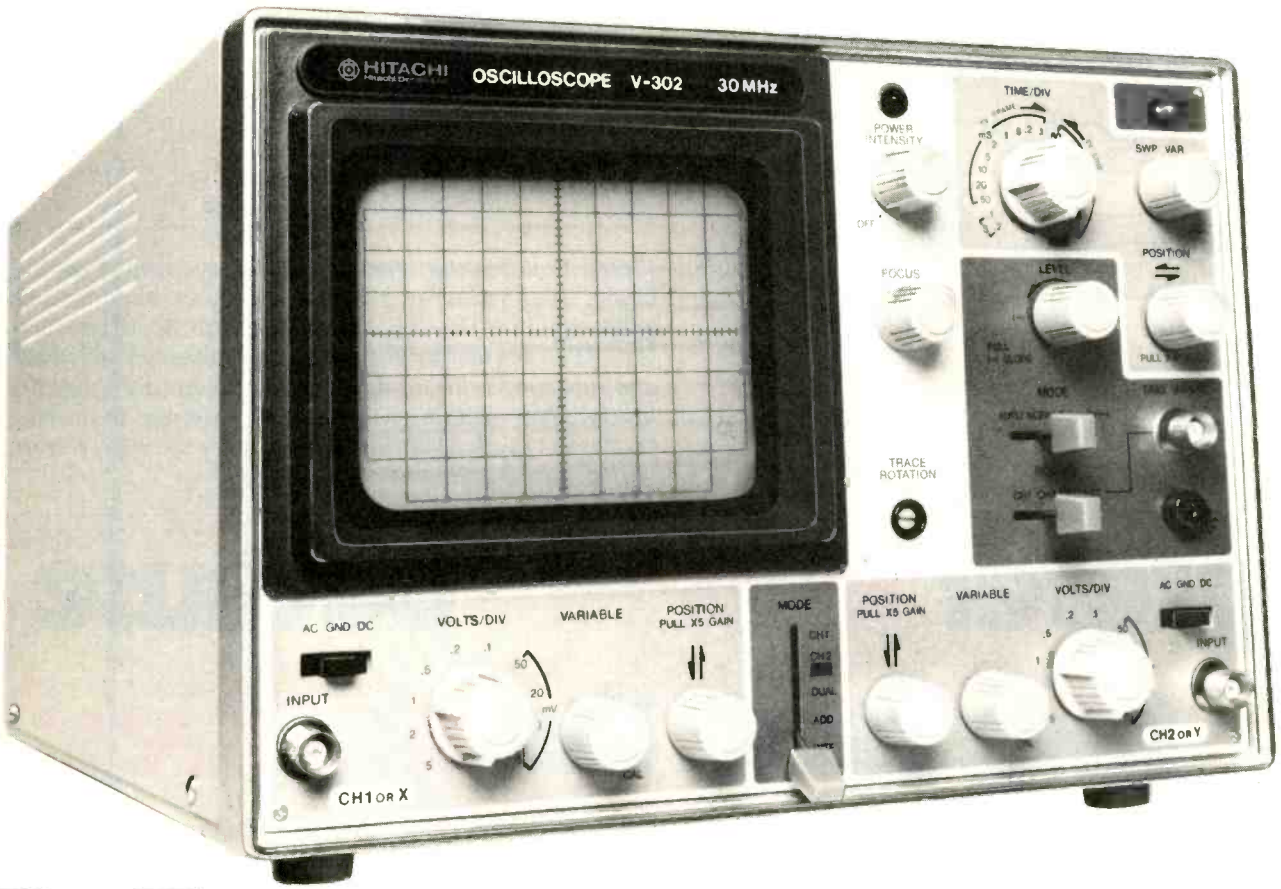
Single and dual trace, 15 and 30 MHz. All four high sensitivity Hitachi oscilloscopes are built to demanding Hitachi quality standards and are backed by a 2-year warranty. They're able to measure signals as low as 1mV/division (with X5 vertical magnifier). It's a specification you won't find on any other 15 or 30 MHz scopes. Plus: Z-axis modulation, trace rotation, front panel X-Y operation for the dual trace models, and X10 sweep magnification. And, both 30 MHz oscilloscopes offer internal signal delay lines. For ease of operation, functionally-related controls are grouped into three blocks on the color coded front panel. Now here's the clincher: For what you'd expect to pay more, you actually pay less. Suggested list price of our top line V-302 dual trace 30 MHz is only $945.00. The other models comparably less. Check our scopes before you decide.

Hitachi...The measure of quality.

- V-302 30 MHz Dual Trace $945.00
- V-301 30 MHz Single Trace $745.00
- V-152 15 MHz Dual Trace $695.00
- V-151 15 MHz Single Trace $545.00

HITACHI
Hitachi Denshi America, Ltd.

For more information, contact
Hitachi Denshi America, Ltd.,
175 Crossways Park West, Woodbury, N.Y. 11797
(516) 921-7200.

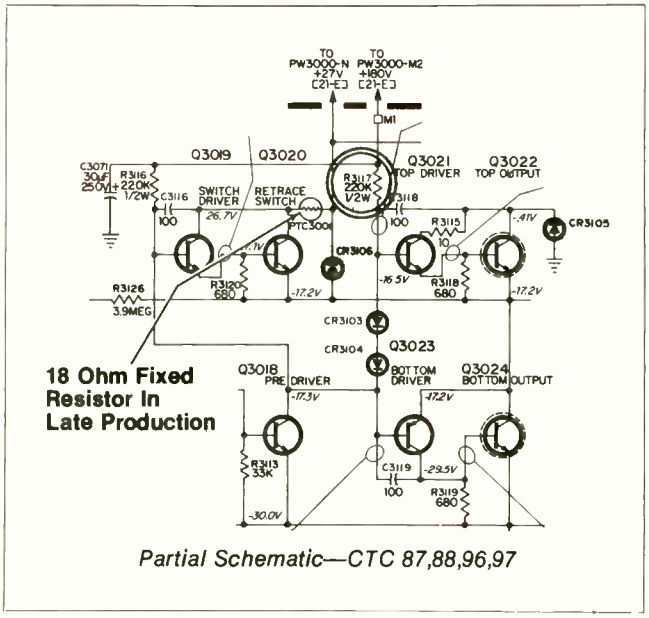


More sensitive to your input.

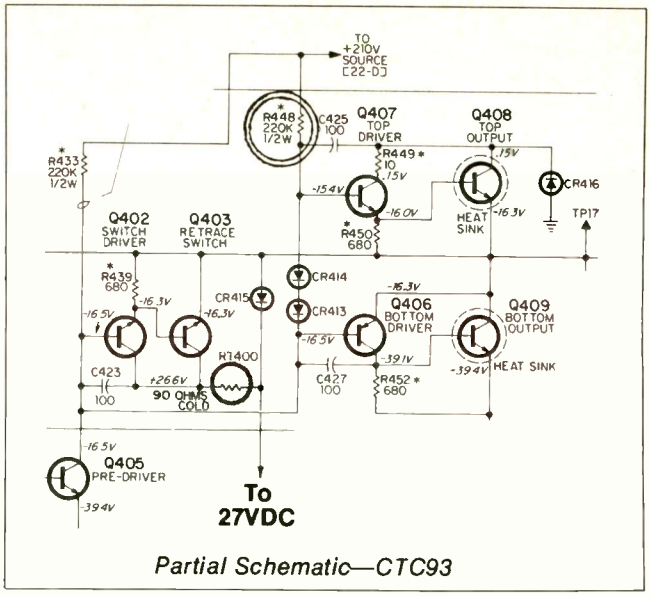
SERVICE SEMINAR

RCA

CTC 87, 88, 96, 97/CTC 93. Insufficient vertical deflection, especially top half of raster. May be almost normal at turn on, then top half shrinks. Retrace switch overheats. Note: In late production CTC 81, 88, 86, 97 chasis the thermistor in series with the retrace switch collector PTC 3001 is replaced by an



Partial Schematic—CTC 87,88,96,97

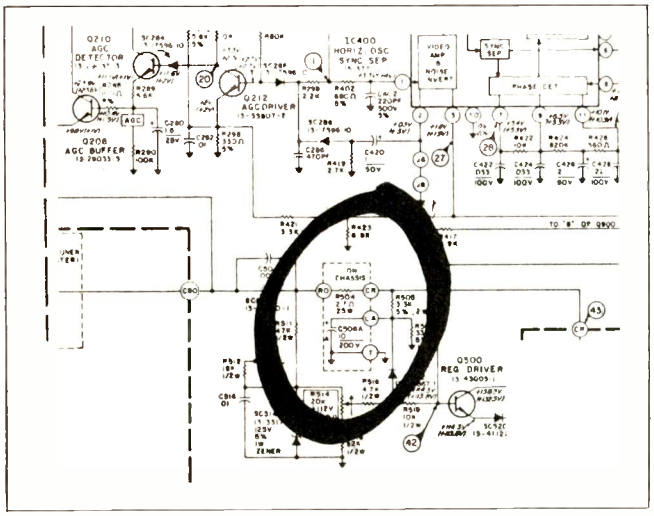


Partial Schematic—CTC93

18ohm fixed resistor which may also overheat. Possible cause: Open top driver transistor base bias return resistor (220k-ohm ½ W 5%—R3117 in CTC 87, 88, 96, 97; R448 in CTC 93). If this resistor is okay, check for open printed circuit or components in the top driver, top output circuitry. When the top driver/top output is not operational, the retrace switch may be biased in such a manner that it attempts to supply current for top vertical deflection.

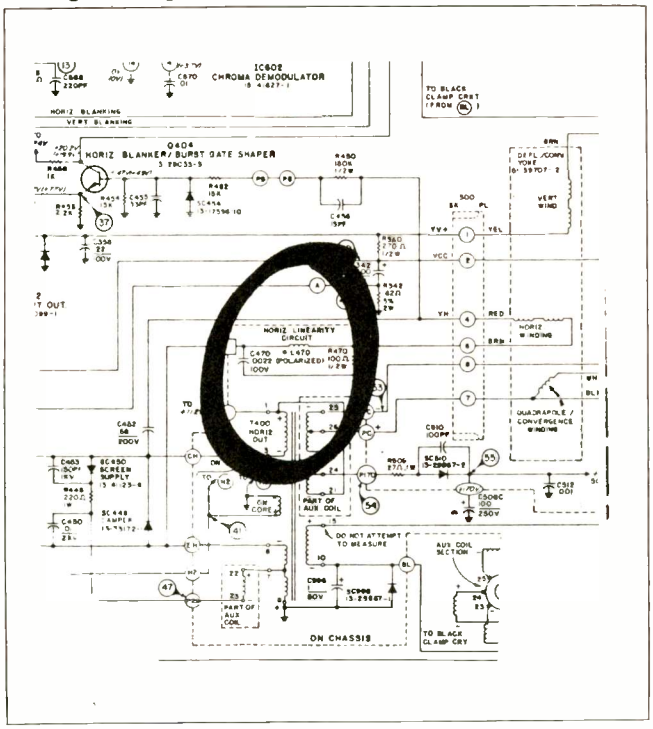
Color TV Chassis CTC 87—Intermittent shutdown. Possible cause: Intermittent solder connections on C103, C104, or C125 leads (horizontal output collector circuit). **Vertical retrace lines at top of raster.** Possible cause: Leaky retrace switch Q3020 and/or open R3116 in base of Q3019 switch driver. **Intermittent color, no color, momentary color lock out** when changing channels. Possible cause: Shorted C3029 trimmer and/or incorrect AFPC adjustment.

SYLVANIA



E21, Excessive high voltage—B+ rises to shut down level. Possible cause: Open C506A

No High Voltage. Possible cause: Open L470. ET/D



The changing face of electronics

Servicing in the age of microprocessors

(Editor's Note: The impact of the new technologies on the electronics industry has been revolutionary. They have significantly affected the field of electronic service. There are new and more complex consumer products. There is new test equipment of almost laboratory quality available for field use. To help assess the impact of these new developments on the technician in the field, ET/D recently interviewed two executives of a well established manufacturer of electronic test equipment: Myron Bond, the Vice President of Marketing of B&K Precision, and Gus Rose, the company's Director of Engineering. Here are their responses to ET/D's questions.)

"I see a tremendous expansion in the need for field servicing for all types of products...appliances, home security systems, even computers and television games." – Bond

ET/D: *How do you see the new developments in electronic technology affecting the electronic servicing profession?*

Bond: There will be significant change. The service technician will be much more involved with a much wider variety of products, such areas as security systems, appliances, microwave ovens. We're seeing more and more digital logic circuitry used in television sets today. For instance, we have been in contact with the manufacturers and we can definitely see an immediate need for logic probes in servicing television sets right now.

Rose: I think one of the real crunches to emerge from the new technologies will be the increasing shortage of qualified technicians for servicing products. Just about everything is going to some form of microprocessor control—appliances, TV receivers now have the digital tuning which is more and more lending itself to processor based designs. What you need now is a basically sharper technician—probably getting pretty close to some basic engineering requirements in sophistication in some of these areas.

The other thing this technician is going to need is some type of digital troubleshooting equipment. Logic probes are one approach. I can see a requirement for even more sophisticated devices—such as like logic analyzers and signature analyzers—eventually being required to do some of the troubleshooting on what are now called consumer items. I'm talking about processor, or combo micro/digital controllers for FM tuning systems, channel selection for television, even today's appliances are becoming more electronic than electrical. I think the Radarange was the first to go that way. Soon you'll see washer, dryers, you name it, with processors because they are very low cost and they are very easy to implement.

Essentially what we're talking about here is the fact that the basic circuits are not going to change that much. It is the interface between the processor and the controls to make the set, or whatever it is, do what you want it to, that is new. The modern technician will have to learn this new technology.

Where you normally had to do three or four things to get your TV or appliance to do something, now you push a button and the processor gets it all together. It makes it easier to use, but it's more complicated inside.

ET/D: *With all of these changes in consumer products, and everything seems to be going from mechanical to electronic in the way of consumer goods, how will this myriad of product be serviced?*

Bond: The factory service facilities are fine in the larger cities. But get away from the metropolitan areas and there will have to be people out there to

service this equipment. The consumer is not going to want to wait until the unit goes all the way back to the factory to have his new purchase serviced.

We've already seen a change in some equipment where they're getting away from the modules and going toward larger boards. We know that the practice in the past was to change boards and send them back to the factory. But, you're not going to be able to do that anymore because there are too many boards in circulation now. We're going to have to find a way to service these units in the field.

ET/D: *With all of the changes you've been describing to me, do you see the independent electronic servicing industry surviving much longer?*
Rose: Regardless of what large companies try to do, in the end they will have to depend on the independents. And, as long as there is some business opportunity, there are going to be independents getting into the business. Just in talking to a few companies—we know that their factory facilities get overloaded, especially when they introduce new types of products, for example, processor based products. Their so-called hotshot service centers don't even have experience with these new introductions which the purchaser ends up sending back to them. These guys just dread getting this stuff back because it comes from all over the country.

Eventually, what I see is the manufacturers preferring to train qualified people to do the work, and not necessarily to do their service exclusively.
Bond: Absolutely it (independent service) will survive. I see a tremendous expansion in the need for field servicing for all types of products. In almost every area, appliances, home security systems, even computers and television games.

ET/D: *How is LSI technology impacting the electronic test gear market?*
Bond: LSI has impacted test instrumentation the most through compact size, longer life, greater reliability and greater accuracy. You've got a tenth of a per cent accuracy on the DMM—this is common today, whereas just a few years ago you were looking at an analog meter with two or three per cent accuracy.
Rose: Another area of importance for the technician is that he is going to have to get familar with the use of a good triggered sweep oscilloscope for doing the type of work we are talking about. Also, what the computer industry has been living with for years, the logic analyzers, for instance, to some extent will show up in consumer service. This is true because you are going to a similar type of "hardware" in consumer products and this is going to show up in the need for similar types of test instrumentation.

ET/D: *What advice would you have for the person considering the purchase of new test equipment in view of this fast paced movement of technology?*
Rose: I think the best thing is to buy over your present requirements—especially in oscilloscopes and frequency counters. Buy a little more than you think you need today.
Bond: Most microprocessors today

"What you need now is a basically sharper technician–probably getting pretty close to some basic engineering requirements." – Rose

have an upper limit of about 5MHz (clock speeds) but we're looking for the 10mHz microprocessor shortly and I'm sure it'll go beyond that.
Rose: Another thing to consider is the fact that the manufacturers are getting back to a minimum number of boards. It gets the technician more into the area of fixing a set, rather than just changing a board. I think this is happening with the mini-computers too. So much more is going into the basic chips that you don't need this proliferation of plug-in modules. You'll do your troubleshooting by localizing to a chip and replacing it.

ET/D: *But how can you ask someone to replace a soldered-in, 40 pin chip in the field?*
Bond: We are aware, and some manufacturers have informed us, that they are going toward a plug-in type chip as opposed to soldered in. I agree, soldered in chips are almost impossible to replace in the field, but the manufacturers are now ready to spend a little more to buy sockets for these chips so they can be changed in the field. Manufacturers are very concerned about the cost of servicing equipment in the field and particularly the cost of the investment in boards. They are looking for faster, more reliable means of servicing in the field to reduce this tremendous investment in boards.

ET/D: *How, as an executive of a test instrument manufacturing company, do you view the market for test gear ... optimistically, cautiously, or pessimistically?*
Bond: The dollar volume market for test instrumentation is growing. As we continue to witness the increased growth of microprocessors, we will also witness a great deal more of field service work and the need for instrumentation to meet this requirement. We at B&K-Precision feel the greatest growth area for test instrumentation is in the area of field service work. The present day service technician is getting more and more involved in servicing a greater variety of equipment, rather than limiting himself to home entertainment products. As this trend continues you'll see the service technician getting involved in a tremendous variety of electronic product, even small business computers. I think the use of logic analyzers is going to make this very practical. People do depend very much on computers and they don't want to be without them for weeks or months while they're being repaired back at the factory.
Rose: I think the only obstacle right now to the proliferation of the home computer is the method of communicating with the computers. A lot of people can't handle them. But, I think the manufacturers are going to eliminate many of the obstacles. Once this happens, there is no reason why everyone would not take advantage of the benefits of a home computer.

ET/D: *Is there any particular piece of advice either of you could give the service technician on how he might weather the technological storm that seems to always be threatening his existence?*
Bond: The key point is that they've got to go to school—continuously. They must continuously update themselves. It is the only way they can survive. ET/D

In search of new servicing fields

Don't overlook telephones or computers

New opportunities in electronic servicing are rapidly multiplying, due largely to the impact of large scale integration and the LSI chip. In this article, the president of a company well-known throughout the television industry, presents his views and feelings on "emerging" opportunities for growth and profit for the so-called "TV shop."

By David L. Turney*

Mr. Turney

A few accessories

Service technicians are searching for an offset or growth opportunity to fill the "void" of "declining TV service and repair." At Thordarson, we are *not* party to the declining TV service syndrome, but our marketing people report that a new demand in the service areas may be developing in telephone and computer service! Let me elaborate.

Let's take the less technical one first; telephones. Court decisions and various federal rulings over the years have cleared the air for connection of privately owned telephone instruments to the telephone company installed lines. The lengthy scenario of all those legal developments is a subject which could fill many pages and will not be dealt with here. But, let's take a look at the practical ramifications of the present consumer movement towards ownership of telephones.

Industry sales projections are sketchy, but under the most pessimistic of views, predictions exceed a $1-billion market within the next five years for privately owned telephone instruments and related products. Sale of the instrument logically leads to sale of telephone accessories. Sales of the instrument and accessories logically leads to repair potential. "Accessories" refers to the parts to install telephones around the house, accessories to interface the telephone with various different types of telephone company provided connectors, accessories such as additional bells, whistles and features; accessories such as various color options, not to mention the answering devices and amplifiers. But, the big questions looming are, "who is going to service these telephones? Will there be a replacement market? Who is going to install these telephones?" Well, we believe that although many consumers will install the phones themselves, there will definitely be a percentage of the market that would welcome the opportunity to have a telephone installed by a professional technician and, although the telephone is predicted to eventually become a low enough price piece of equipment to essentially be in the "throw-away" consumer product realm, there will be a repair market. Namely, some of the more sophisticated instruments and some of the instruments sold in the next few years before prices drop dramatically will definitely be candidates for service and telephones having sentimental value will be repaired.

A basically simple device

Having worked in the telephone industry building and rebuilding telephone instruments for a number of years, I can tell you personally that the telephone instrument is basically a simple piece of equipment to deal with. Almost all telephones are designed and produced around the concept of major subassemblies or modules, any one of

*President Thordarson Meissner, Inc.

which has far less complexity than even the most simple TV set. The various subassemblies within the telephone generally, if available from the original equipment manufacturers, are available only through limited distribution and then only at a very high price. However, a very high percentage of the malfunctions of the telephone instrument can be corrected by simple adjustment, calibration, or refurbishment of the components that are already in the set.

To the extent that repair parts are necessary, another large percentage of the repairs can be accomplished by utilizing parts from other "out of service" telephone instruments! Again, speaking from experience gained from working in the telephone industry, telephone components are designed with long service anticipated. For this reason component failure is greatly reduced. Companies who "factory recondition" telephones generally report that given ten telephones of a particular type that are out of service, they can turn out seven factory reconditioned phones of A-1 condition. Even so called decorator phones, which frequently sell for prices upwards of $100, utilize very standard telephone industry components, so they too can utilize components which have been removed from other instruments.

Obtaining parts

Where do you obtain the telephones to extract parts for repair of other instruments? Electronic parts surplus dealers are frequently the source. Industry publications within the telephony marketplace nearly always carry advertisements of parts for sale and telephone instruments for sale.

As the industry grows, more and more sources for the replacement parts will become available to distribution. This repair parts market, like any other market, will have to grow as the demand is created at the consumer level. Thordarson, for instance, is presently entering this market by offering telephone accessories. To compliment this, we are offering a line of both decorator and standard phones.

It is almost a certainty that the federal bureaucracy will enter the picture if and when repair activity does become significant. Type certification now exists and technician and/or shop certification may be in the works. You should obviously stay abreast of such developments and take the necessary precautions to remain legal and not mislead the ultimate consumer. However, the important point is that connection of private equipment to the telephone lines, provided that the equipment is in compliance with certified specifications, *is* legal!

Personal computers

Now, let's take a look at the more technically complex market, the repair market on computers. The personal computing field is growing rapidly. This, to a limited extent, may offer repair opportunities, but a very high number of present day owners of personal computers are people with sufficient technical background to permit them to do their own repairs. As the market further expands, this will be less true and gradually people will enter the market who have virtually no concept of the technical ramifications of what's under the cover. Many of these computers, if not the majority of them as presently being actually sold in the market, utilize a display not any different in technical operation from that of a simple portable TV set and its CRT with standard type of deflection components "painting" a picture on the screen. Behind that is various driving circuitry interfaced with the computer circuitry proper. All of these circuits, as exotic as they may sound in name, utilize digital technology which a TV service technician who is capable of analyzing a modern day color TV set circuit is fully capable of understanding. So, the question again is where do we get the parts? Well, a large percentage of electronic circuitry involves discrete components or "chips" which are readily available from existing distribution suppliers of passive and active components, including Thordarson. Deflection components at the moment could be a large problem; however, Thordarson is presently preparing to introduce a line of fully cross-referenced deflection components for computer applications. Microprocessor chips themselves, like the sophisticated clock and calculator chips of several years ago, are now becoming available through suppliers of such higher technology devices.

We have addressed the personal computing side of this marketplace which, in terms of gross numbers, will ultimately be the largest market and the largest quantity of the opportunity for repair in the computer field. However, for the immediate future, the low end of small "business" systems is a major candidate for repair possibilities. Many software and service organizations are already springing up in the marketplace, but very few of these have any more

continued on page 46

Small TV antenna systems

A few tips

Many TV antennas and systems are badly installed. Even large commercial systems often work poorly, as you probably noticed last time you stayed at a hotel or motel.

By Walter H. Schwartz

A certain degree of confusion regarding TV antennas and antenna systems—large and small—seems to be common. ET/D recently attended a Winegard MATV Seminar. Some of the points stressed there and a few kinks picked up from other sources may clear up some of it. Also included is a bibliography of articles which have appeared over the last few years in ET/D on various aspects of antennas and systems. Hopefully, we can tie them together here.

Noise and snow

To produce a picture free of perceptible noise, a signal to noise ratio of 45dB is considered necessary. (A definition here: while some call all noise, snow, I feel more comfortable calling outside noise, manmade noise, noise, noise generated by the antenna system, preamplifiers and amplifiers, etc., system noise, and that generated by the TV receiver, snow.)

We need sufficient signal to override the noise generated by the set and that which may be generated by any amplifiers or preamplifiers in the antenna system. (A good 75 ohm system generates a minimum of about 1μV of noise. Any amplifiers, splitters, etc., add to this since any conductors above absolute zero are noise generators.) Manufacturers seemingly do not like to talk about noise figures of TV tuners, but apparently a good modern TV receiver will produce a picture with just a trace of snow at about 100μV and be free of snow at 200μV at the antenna terminals (Reference 3,8).

The antenna

Most of the foregoing may seem rather obvious, but apparently, viewing a cross-section of antenna installations, it is not. The way to begin then is with an antenna that will produce, with a recommended safety factor, about 1000μV (also referred to as 0dB) of signal on the weakest channel desired, plus perhaps enough to overcome down lead loss, at its terminals. We often work, as a practical matter, with much less; this is an ideal. Remember, anything we do from this point on, adds noise, degrades the signal to noise ratio. That is why a preamp is not a substitute for an adequate antenna and adequate antenna height. *Get that signal.* Then, do what you will with it, but get it in the first place. This will also minimize the effects of manmade noise. Use a coax down lead to avoid picking up any more noise on it, and you have done your best (Reference 4,7).

As a bad example of what not to do, an installer in an area where I once lived was afraid to climb roofs. Even though the area stations were about 60 miles away, his usual antenna installation was 20 feet of mast standing next to the house, a good antenna and a high gain preamp. The result was usually a strong, but snowy picture, excessively affected by power line noise, auto ignition, etc. We found most of these problems could be remedied by installing the antenna on the house, gaining the extra 20, 25 or more feet of height. Usually the preamp could then be removed. Another problem presented itself later when the area stations all moved to new, higher, nearer transmitting antennas; the high gain preamps overloaded, in some instances completely wiping out all channel reception.

db	uv	db	uv	db	uv
−40	10.00	0dbmv	1 000	41	112 200
−39	11.22	1	1 122	42	125 900
−38	12.59	2	1 259	43	141 300
−37	14.13	3	1 413	44	158 500
−36	15.85	4	1 585	45	177 800
−35	17.78	5	1 778	46	199 500
−34	19.95	6	1 995	47	223 900
−33	22.39	7	2 239	48	251 200
−32	25.12	8	2 512	49	281 800
−31	28.18	9	2 818	50	316 200
−30	31.62	10	3 162	51	354 800
−29	35.48	11	3 548	52	398 100
−28	39.81	12	3 981	53	446 700
−27	44.67	13	4 467	54	501 200
−26	50.12	14	5 012	55	562 300
−25	56.23	15	5 623	56	631 000
−24	63.10	16	6 310	57	707 900
−23	70.79	17	7 079	58	794 300
−22	79.43	18	7 943	59	891 300
−21	89.13	19	8 913	60	1 000 000
−20	100.0	20	10 000	61	1 122 000
−19	112.2	21	11 220	62	1 259 000
−18	125.9	22	12 590	63	1 413 000
−17	141.3	23	14 130	64	1 585 000
−16	158.5	24	15 850	65	1 778 000
−15	177.8	25	17 780	66	1 995 000
−14	199.5	26	19 950	67	2 239 000
−13	223.9	27	22 390	68	2 512 000
−12	251.2	28	25 120	69	2 818 000
−11	281.8	29	28 180	70	3 162 000
−10	316.2	30	31 620	71	3 548 000
− 9	354.8	31	35 480	72	3 981 000
− 8	398.1	32	39 810	73	4 467 000
− 7	446.7	33	44 670	74	5 012 000
− 6	501.2	34	50 120	75	5 623 000
− 5	562.3	35	56 230	76	6 310 000
− 4	631.0	36	63 100	77	7 079 000
− 3	707.9	37	70 790	78	7 943 000
− 2	794.3	38	79 430	79	8 913 000
− 1	891.3	39	89 130	80	10 000 000
− 0dbmv	1000.0	40	100 000		

Fig. 1 DBMv to microvolt conversion chart. The zero dB reference point is 1000μV.

Field strength meters

Ideally, measure the signal with a good field strength meter. Unfortunately, the better instruments cost $500 or $600. For an occasional job the cost is hard to justify, but unless you know your area's signal characteristics very well indeed, you need some sort of reasonably accurate idea of what sort of performance to expect. A known good television receiver, don't use a tiny black and white portable on which you can hardly see bad snow, and attenuators can give you a good indication. Simply connect the TV to the antenna through the multiple step attenuator. These typically have attenuation factors in a three stage unit, of 3 to 21dB in 3dB steps (Fig. 2).

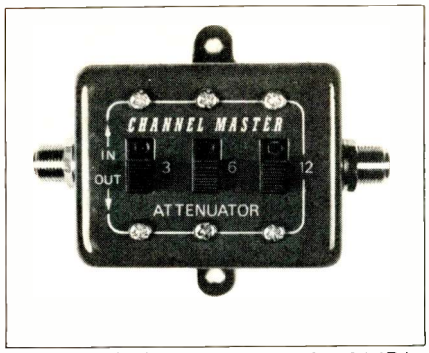


Fig. 2 A typical step attenuator–0 to 21dB in 3dB steps.

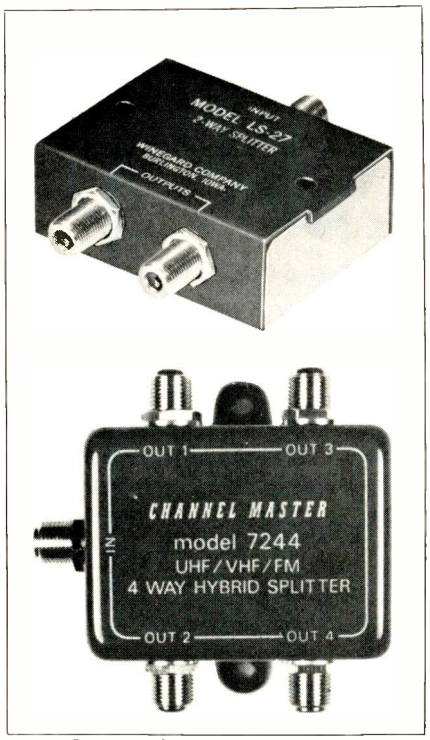


Fig. 3 Two-and four-way splitters. (Courtesy Winegard and Channel Master.)

Assuming a good picture—snow free—to begin with, insert attenuation until snow becomes perceptible. The amount of attenuation you have inserted tells you the signal margin you have to work with. The TV set will do one thing a field strength meter will not do, it will show you any ghosting present (2, 5).

Preamplifiers

Use a preamp if you have a marginal signal and cannot tolerate down lead losses or if you have a weak signal and have to tolerate a certain amount of snow in any case, or possibly as a system amplifier for small systems, though I prefer a more accessible amplifier, if possible, rather than a mast mounted preamplifier if the signal level is adequate.

Preamplifiers are specified for a certain maximum number of channels, a maximum *total* signal input. So if you have one or more very strong channels and others comparatively weak—*check your preamp specifications* (1, 6).

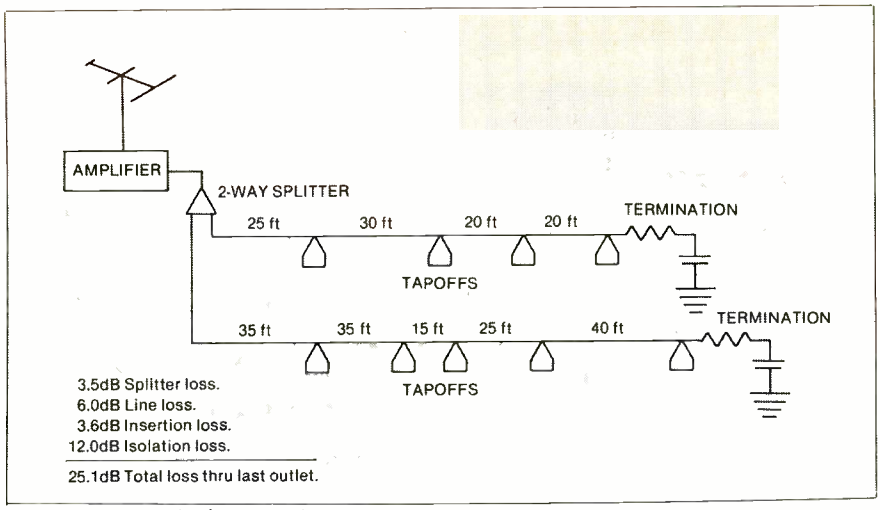


Fig. 4 A nine outlet home system

Signal distribution

Now that we've got our signal (a minimum of, hopefully, about 200μV) at the end of the downlead, what do we do with it?

In a small home system with typically four outlets, we can perhaps use simply a four-way splitter. If we have 0dB in, we can have -7.5dB out (1000μV in, about 425μV out, 7.5dB splitter loss), and live with the situation happily. If we are down to about 200μV, obviously we cannot split so easily. Here perhaps that preamp could be used; some have splitters in their outputs. Or, we can use an amplified splitter (Fig. 5). These have four outlets, with typically a minimum of 6dB gain. Now with 200μV in (-14dB), we can get -8dB out (again, about 400μV). In each case, we have assumed no excessive line loss. A central location and 20 to 30 feet (about 1dB loss on Channel 13, UHF losses are, of course, greater; Channel 2, less) of good quality cable to each outlet. Where more gain is needed to drive a slightly larger system or longer line lengths, small systems amplifiers can be used. These can have gain of perhaps 15dB (Fig. 6).

With the 7.5dB loss of a four-way splitter, we then have 7.5dB of gain to allow a long cable run or permit us to install another two-way splitter or a splitter outlet, such as the Winegard LS-2850 at the end of a cable. These amplifiers can do a remarkable job. Once in an emergency, I drove the system for a small mobile home park with two 400-foot trunk runs from one. The pictures at the ends of the two lines were snowy, but quite watchable and much better than nothing.

Larger home systems can require trunk lines, miniatures of large distribution systems. Here we start to work backwards (Fig. 4). We need 0dBmV (1000μV) at the end of the line where we have 12dB isolation loss requiring a +12dBmV signal in front of it. This determines the overall signal level of the system; the required level at the end of the longest line. The other tapoffs can be set to suitable levels. Feedthrough or insertion loss is the series loss presented by each tapoff. Our longest leg in Fig. 2 has four tapoffs in the line (and one at the end). Nominal insertion loss depends upon the tapoff isolation. Use the maximum figure as specified by the manufacturer, which is usually about 0.9dB—0.9×4 is 3.6dB. We also have 150 feet of coaxial cable—about 4dB/100 ft for 6dB of loss, according to the cable manufacturer's data. Now we need at the splitter 3.6+6+12dB or 21.6dBmV signal level. This is about 12,000μV. Add 3.5dB loss for the splitter and we have a needed input to it of 25dBmV or about 18,000μV.

Some of the small system amplifiers will easily handle this sort of output (up to 250,000μV total) and if your input is sufficient, i.e., +10dB from the antenna or a preamp, a 15dB amplifier will handle it. Or you use a higher gain amplifier.

If you need more gain, a preamp may be in order if the signal level is much below 0dBmV, or amplifiers with gain in the 20-30dB region are available (Fig. 7a and 7b). Amplifiers are available generally with gains from about 15dB, and an output capability of 50dBmV for small home systems, to units for large systems with gains of over 60dB and output capabilities of over 600dBmV. Watch those output (and input) capabilities, different manufacturers define them differently in terms of number of channels handled.

In the Fig. 4 system, the signal level

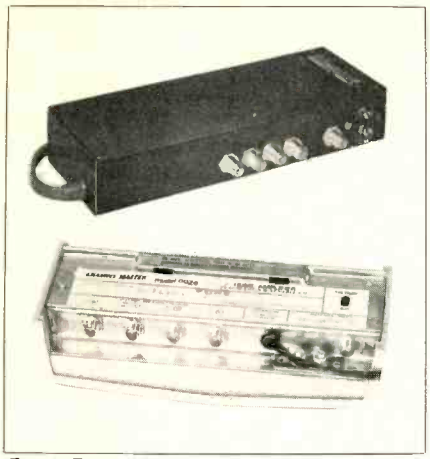


Fig. 5 Four outlet amplified splitters. Top, Winegard's BC-274 and, bottom, Channel Master's 0024.

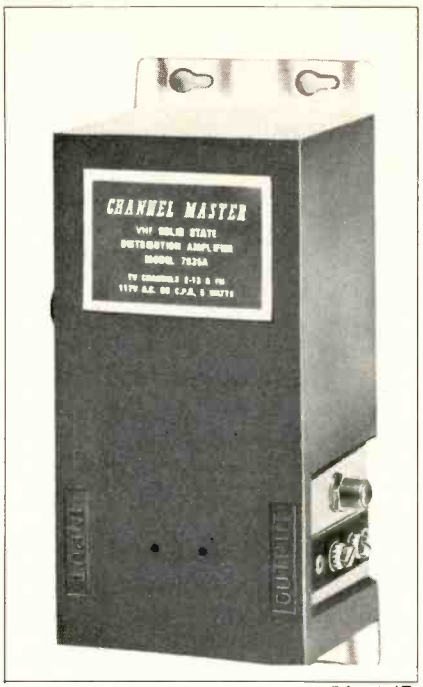


Fig. 6 Channel Master Model 7035A 15dB gain.

Fig. 7a Winegard's Model DA2300 amplifier 26dB gain.

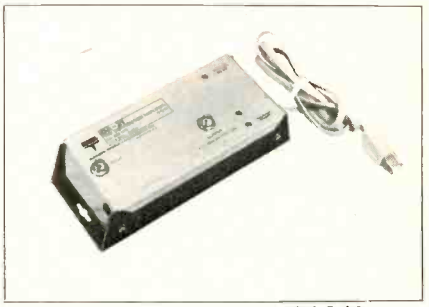


Fig. 7b Blonder Tongue's Model DA21 amplifier 23dB gain typical.

into the system was determined by the level necessary at the farthest outlet, plus all losses or, in this case, about 25dBmV. Outlets nearer to the antenna have less attenuation ahead of them and so the tap-off isolation can be set higher. (In this example, depending on building layout, this may not be the best way to do things. If all outlets are close to a central small motel or apartment building. The idea is to minimize both signal loss and expenditure of time and money; where the idea is to minimize both signal loss and expenditure of time and money; Check alternatives.)

The next tapoff back does not have its own insertion loss (.90dB), and the last 40 feet of cable (about 1.6dB) to contend with. Therefore, it probably can be set for 15.0dB isolation. The next tapoff has another .9dB less insertion loss and 1dB less cable loss. We'd probably set it at 15.0dB isolation also. The next outlet (second in the line) has only the losses at the splitter, 70 feet of cable and the insertion loss of one previous tapoff ahead of it, for a total of about 7.5dB below the system input of 25dBmV or 17.5dBmV. Depending upon which manufacturer's variable tapoffs we use, we could set it to 15dB or 17dB isolation—20dB isolation would drop the signal to -2.5dBmV (about 750μV), which probably would be okay too. The first outlet in the line has only splitter loss and the loss of 35 feet of cable, something less than 4.5dB in total. Here we could use 20dB of isolation and come out nicely at about OdBmV.

Check out

When the system is finished, check it out. Apparently, many installers don't considering the performance of the average motel system. The TV picture should be snow free and reflection free (reflections can be caused by open cable grounds—the picture may be snow free) at each tapoff.

This short presentation covers some basics. It does not pretend to cover everything, but I wish I had understood this much the first time I tried to set up an elaborate home system. I ended up with the most gosh-awful lot of splitters and cables you ever saw. It worked, but it was much more complicated (and expensive) than necessary.

Your MATV equipment manufacturer offers training seminars and planning services. Use them, attend the seminars and when a new problem arises, consult their planning service. The cost is nominal, sometimes free, and the advice is expert. *You will save money.* One other point: A field strength meter can save you from a good deal of uncertainty; it is necessary if you do any amount of antenna work.

Bibliography

1. Kluge, James E., "TV Antenna Preamps," May 1976.
2. Wolf, Bert, "How to Use a Field Strength Meter," Dec. 1975.
3. Kluge, James E., "Noise and Noise Figure," Dec. 1976.
4. Kluge, James E., "Sizing Up TV Antenna Gain," April 1976.
5. Kluge, James E., "Twenty TV-Related Uses for a Field Strength Meter," March 1977.
6. Pawlowski, Allen, "MATV Amplifiers," March 1978.
7. Kluge, James E., "Coaxial Cable," March 1979.
8. Daien, Bernard B., "Electronic Noise and Noise Sources," June 1979.
9. Kluge, James E., "Interpreting MATV Amplifier Specs.," Sept. 1974. ETD

Tomorrow's tools. For today's problems.

You might say we make time machines.

CSC's smarter tools for testing and design help you make the most of your time in every corner of electronics, by working *smarter* instead of harder, for far less than you'd expect.

We give your head a head start with a variety of solderless breadboarding systems that let you translate ideas directly into working circuits as fast as you can think.

We offer the most logical way to test logic—The Logical Force™—portable, circuit-powered digital instruments that dramatically cut the time (and cost) of diagnosing state-oriented logic. Available singly or in Logical Analysis Test Kits. The Logical Force simplifies design, maintenance, field service, education . . . wherever you need logical answers at a logical price.

Also instrumental in making life easier are CSC's value-packed test instruments. Including palm-size frequency counters that go from audio to past 550 MHz. Our Ultravariable Pulse Generator™ that lives up to its name with a range of 0.5Hz to 5 MHz and a duty cycle variable over ten-million-to-one. A function generator whose VCO is externally sweepable over 10:1.

There's a lot more, too. All in our new 38-page catalog, crammed full of smarter ideas in testing and design. Send for your free copy today.

Smarter tools for testing and design.

CONTINENTAL SPECIALTIES CORPORATION

70 Fulton Terr. New Haven, CT 06509 (203) 624-3103. TWX 710-465-1227
OTHER OFFICES San Francisco (415) 421-8882. TWX 910-372-7992
Europe CSC UK LTD Phone Saffron-Walden 0799-21668. TLX 817477
Canada Len Finkler Ltd. Ontario

Call toll-free for details
1-800-243-6077
8:30AM-5PM Eastern Time

Available at selected local distributors

Circle No. 107 on Reader Inquiry Card

Digital electronics part VI

Shift registers

In this article the author takes a look at some of the more common types of registers to see what they are, how they work, and what they are used for.

By Joseph J. Carr, CET

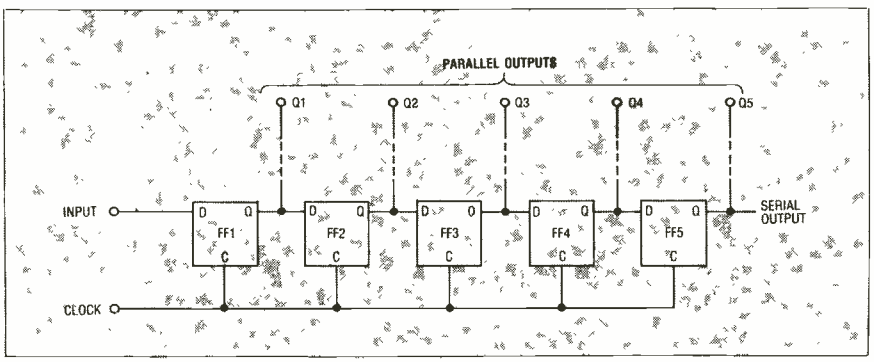


Fig. 1 Block diagram of a shift register showing both serial and parallel outputs.

A flip-flop is able to store a single *bit* of digital data. When two or more flip-flops are organized to store multiple bits of data, they constitute a *register*. Most registers are merely specially connected arrays of flip-flops.

There are several different circuit configurations that one would call a "register," and we classify them according to the manner in which data is input and output to and from the register. We have, for example, *serial-in-serial-out* (SISO), *serial-in-parallel-out* (SIPO), *parallel-in-parallel-out* (PIPO), and *parallel-in-serial-out* (PISO).

Figure 1 represents both SISO and SIPO shift registers. The only significant difference is the parallel output lines, used on the SIPO register, would be absent on a SISO.

The SIPO shift register consists of a cascade chain of Type-D flip-flops that have their clock lines tied together.

Recall the rules for Type-D flip-flops: data can be transfered from the D-input to the Q output *only* when the clock input is HIGH. The input can change at will, and the output will remain the same, as long as the clock line is LOW. But if the clock line goes HIGH, the Q output will follow the D input. The Q output will retain the last valid input data present before the clock dropped LOW again.

This rule can be applied to the situation shown in figure 2, where we show the transmission of a single bit of data, from the left to the right, through a SISO shift register.

At the occurrence of the first clock pulse, the input line is HIGH. This point is the D-input of flip-flop FF1, so a HIGH, which is applied to the D input of the second flip-flop (FF2), remains after the clock pulse disappears.

When the second clock pulse arrives, FF2 sees a HIGH on its D-input, and FF1 sees a LOW on its D-input. This situation causes a LOW at Q1 and a HIGH at Q2.

The third clock pulse sees a LOW condition on the D-inputs of FF1 and FF2, and a HIGH at the input of FF3. The third clock pulse then, causes Q1 and Q2 to be LOW and Q3 to be HIGH.

One step at a time

Note that the SISO input remains LOW after the initial HIGH during clock pulse number 1. This means that the single HIGH condition will be propagated through the entire SISO shift register, one stage at a time. The HIGH bit will shift one flip-flop to the right each time a clock Pulse arrives.

If the data at the input had changed, then the bit pattern at that input will be propagated through the shift register.

The shift register shown in figure 1 is a five-bit, or five stage, register (any bit length could be selected). On the sixth clock pulse, therefore, the HIGH is propagated out of the register, so all flip-flops are now LOW (i.e. Q1 = Q2 = Q3 = Q4 = Q5 =).

The SISO shift register can be made into a SIPO device by adding parallel output lines at Q1, Q2, Q3, Q4, and Q5.

One use for the SIPO register is serial-to-parallel binary code conversion. For economic reasons, digital data is usually transmitted as a serial stream of bits; i.e. the bits of the digital word are sent over a communications channel (telephone or radio link) one bit at a time. But most computers and other digital instruments use data in parallel form. Parallel data

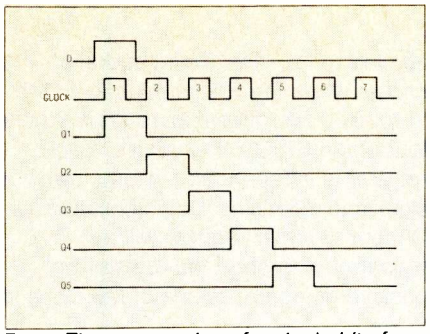


Fig. 2 The progression of a single bit of information through a serial in, serial out shift register.

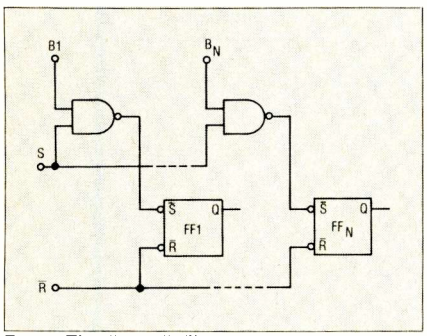


Fig. 3 The "parallel" entry shift register.

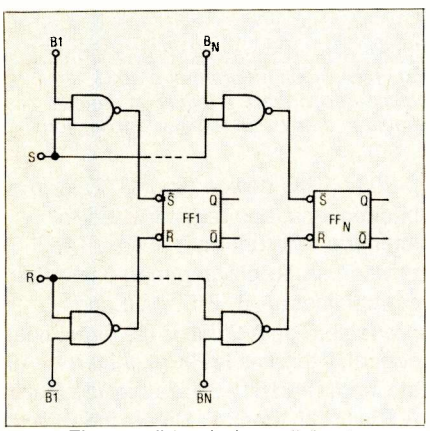


Fig. 4 The "jam" loaded parallel entry register.

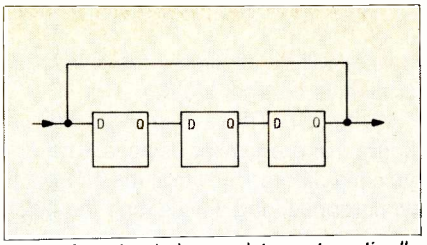


Fig. 5 A recirculating register automatically rewrites the data back into the device.

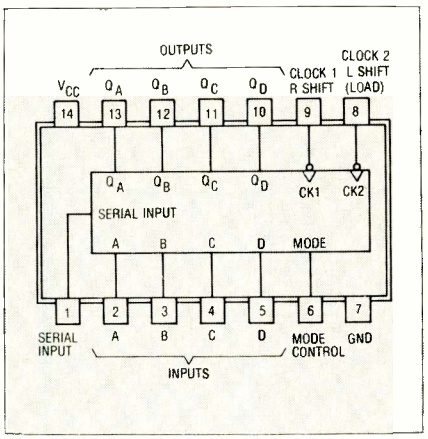


Fig. 6 A basic, four bit PIPO register.

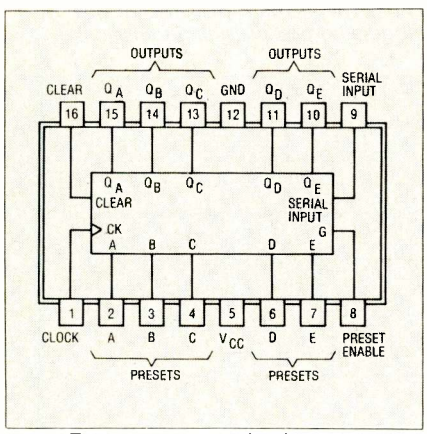


Fig. 7 This 7496 is a "right shifting" PIPO device.

transfer is more expensive, but is considerably faster than serial transmission. If, for example, we have an eight bit system, we would need an eight stage SIPO shift register to convert the serial code to parallel form. The code is entered into the SIPO register one bit at a time, so that after eight clock pulses, the first bit will appear at Q8, and the last bit at Q1.

Random entry

Parallel entry shift registers are faster to load than serial input shift registers. This is because a single bit can be changed, if needed. In the serial type, to change a single bit of data requires us to ripple through the entire contents.

There are two basic forms of parallel entry: *parallel* and *jam*.

In parallel entry, shown in the partial schematic of figure 3, the register must first be cleared (i.e. all bits set to zero) by bringing the *reset* line momentarily LOW. The data that is applied to inputs B1 through BN can be loaded into the register by momentarily bringing the *set* line HIGH.

The jam entry circuit of figure 4 is able to load data from B1 through BN onto the other inputs. While this may not look superior at first glance, it is because IC shift registers using this technique have internal inverter stages at the complement inputs. These have their inputs connected to the non-complemented inputs, so the outside user never sees the complementing process.

A recirculating shift register is shown in figure 5. Since the output of a serial shift register allows the outside world to see only one bit at a time, we must empty the entire contents of the shift register in order to read these contents. But that would ordinarily destroy the data, because the input would be HIGH or LOW during the entire operation. A single read operation, then, would fill up the register will all one's or zero's.The recirculating shift register connects the output (serial output) back to the input, so that a read operation would automatically rewrite the data back into the shift register.

Memory scopes

Medical memory oscilloscopes have non-fade displays based on the recirculating shift register. They digitize the vertical signal, and store the resulting digital words in a recirculating register. By rapidly reading the serial output data into a digital to analog converter (DAC) connected to the vertical amplifier of the 'scope, we can display the trace "non-fade" style by continuously refreshing the data on the screen of the CRT.

There are quite a number of TTL and CMOS integrated circuit shift registers. Some of the devices which will be considered here are 7495, 74164, 74165, 4014, 4015, 4021, 4034, and 4035.

7495. Figure 6 shows this 4-bit PIPO shift register. This register can be parallel loaded, and will shift to the left or to the right. If the *mode* control is LOW, the 7495 is in the shift mode. In this condition, high-to-low transitions on the R-shift line will cause the data to shift one place to the right for each clock pulse. Similarly, high-to-low transitions on the L-shift line will cause the data to shift left one position for each clock pulse.

If the *mode* control pin is made HIGH, then we can enter data present on the A-B-C-D inputs which is transferred to the respective outputs.

7496 This shift register (figure 7) is a right-shifting, PIPO device. Stage A is the closest to the input , while stage E is closest to the output. If the *clear* input is momentarily brought LOW, then all outputs go to zero. We can preset the outputs to any desired bit pattern by first bringing the *preset enable* pin HIGH. One glitch is that a 1 already in a data location cannot be preset to zero, unless the clear operation is performed first.

74164. The 74164 shift register (figure 8) is an eight bit SIPO or SISO device. Note that there are two serial inputs. One is normally held HIGH, and data is applied to the other. Also, the *clear* input is an inverted input; i.e. it is normally kept HIGH, and is then brought LOW when a clear operation is to be performed. Negative-going pulses applied to the

clock input causes data in the shift register to be shifted one place to the right.

74165. This register (figure 9) is also a SISO/SIPO device. In normal operation, the *clock inhibit* input is held LOW, and the *shift/load* terminal is held HIGH. Positive-edge transitions of the clock pulse will shift data one place to the right. Presetting, or parallel-loading, of the register will be allowed if the *shift/load* terminal is brought LOW.

4014/4021. These shift registers (figure 10) are similar devices. The principle difference is that the 4014 is a synchronous load device, and the 4021 is an immediate load. They can be used as SISO or PISO registers. To make it a paralel register, the P/S terminal (pin no. 9) is made HIGH, and an 8-bit word is applied to P1 - P8. Serial operation occurs when the P/S terminal is LOW.

4015. This register (figure 11) is a dual four stage SISO/SIPO device. Each register is independent, with its own clock and reset pins. Data applied to the D-input of either register will be propagated through the register on positive-going transitions of the clock pulse.

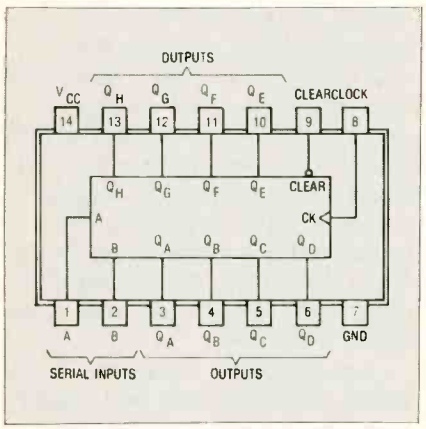


Fig. 8 The eight bit 74164 is usable either as a SIPO or SISO device.

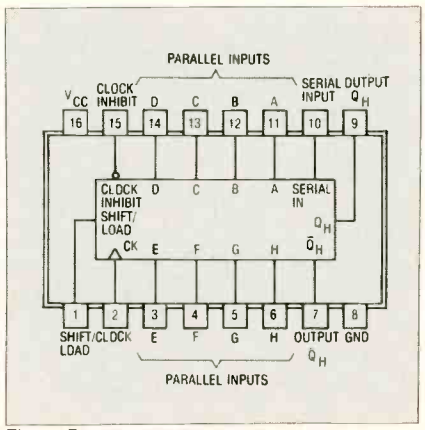


Fig. 9 The 74165 SISO/SIPO device triggers on positive going transitions.

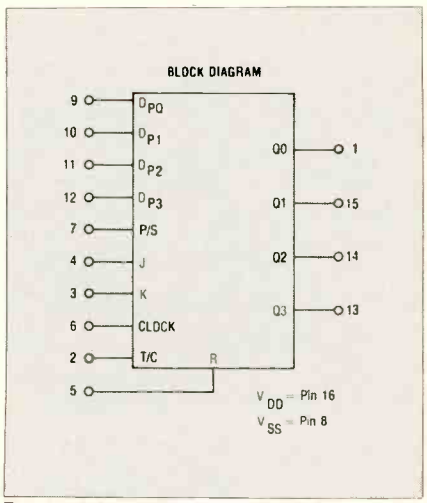


Fig. 13 A block diagram of a 4035, considered virtually a universal register usable in many shift register applications.

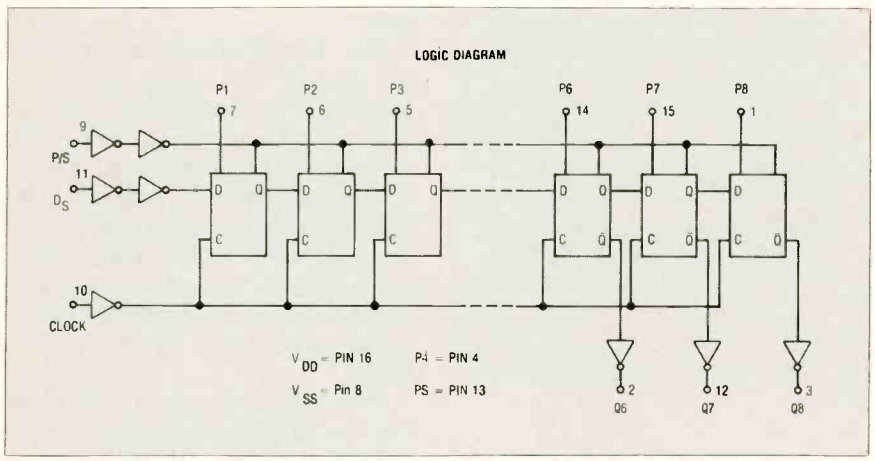


Fig. 10 The difference between the 4014 and 4021 is that one is a synchronous load device while the other serves as an immediate load.

4034. This device (figure 12) is a bi-directional bus register used to interface different data buses. The device can be programmed using four control lines: A/B, P/S, A/S, and A/enable. The A/B line is the directional control. If this line is HIGH, then A1 - A8 are inputs and B1 - B8 are outputs. But if A/B is LOW, thenB1 - B8 are inputs and A1 - A8 are outputs.

A/enable line will allow the A1 - A8 outputs to be in a tri-state (high impedance) mode. A/enable LOW effectively disconnects the A-outputs. If both the direction control and the A/enable are LOW simultaneously, then the data on the B-inputs will be held in the register for later delivery to the A-bus.

The A/S line allows either asynchronous or synchronous operation of the device. If A/S is held HIGH, then all data changes immediately when the input data changes. Alternatively, if the A/S is LOW, then the data can change state only on positive-going transitions of the clock pulse.

The P/S line allows selection of parallel or serial operation.

4035 This device (figure 13) is almost universal, and can be used in almost any shift register application. **ETD**

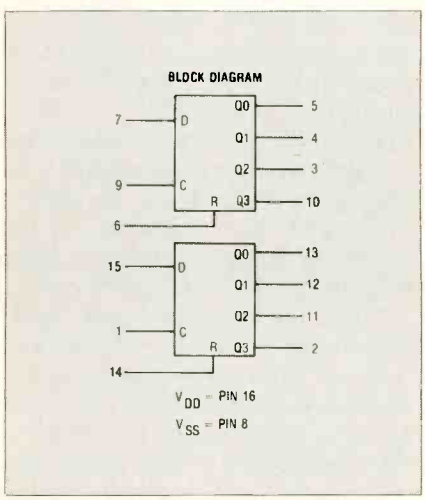


Fig. 11 A dual, four stage SISO/SIPO device, the 4015.

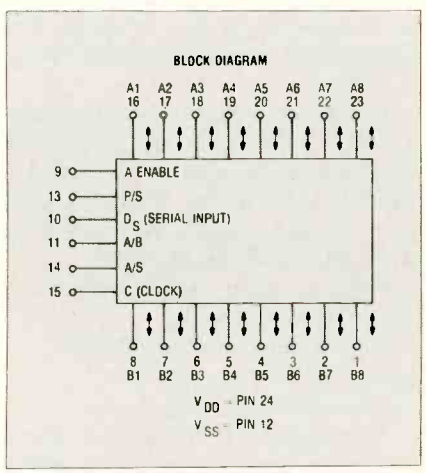
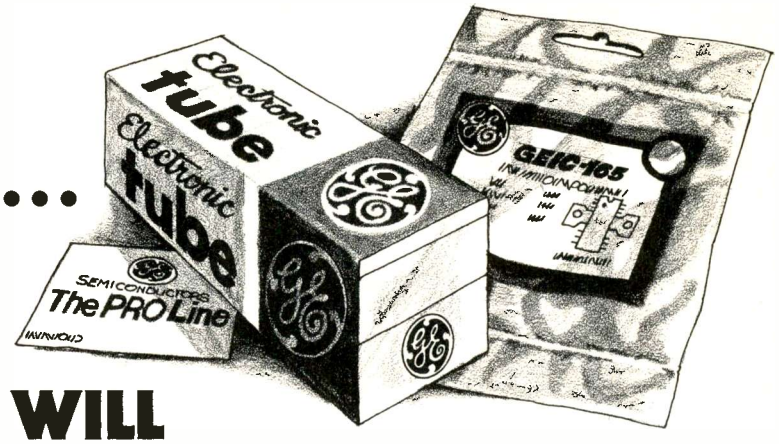
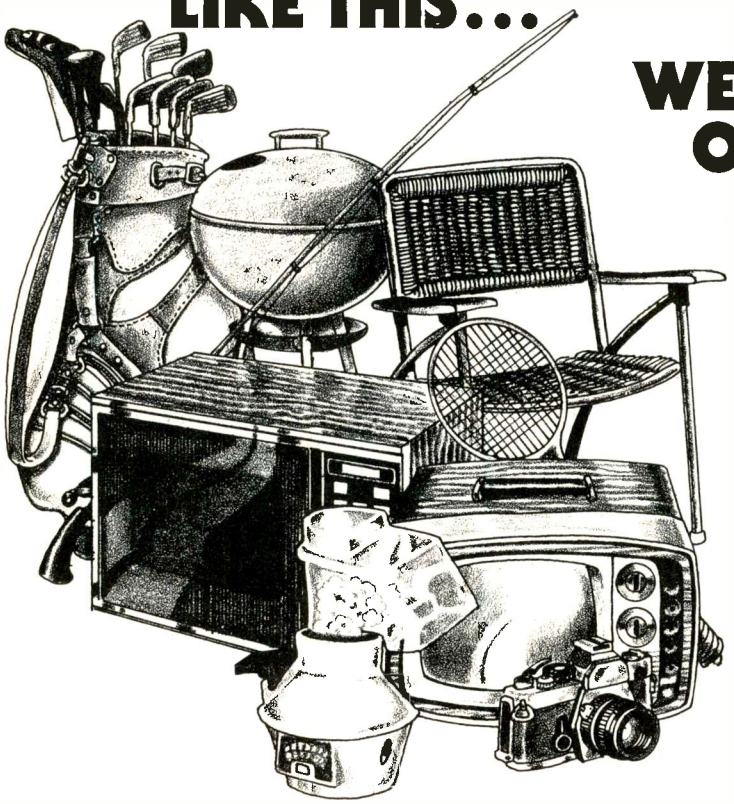


Fig. 12 The 4034 is a bidirectional register used to interface various buses. It may be programmed using four control lines.

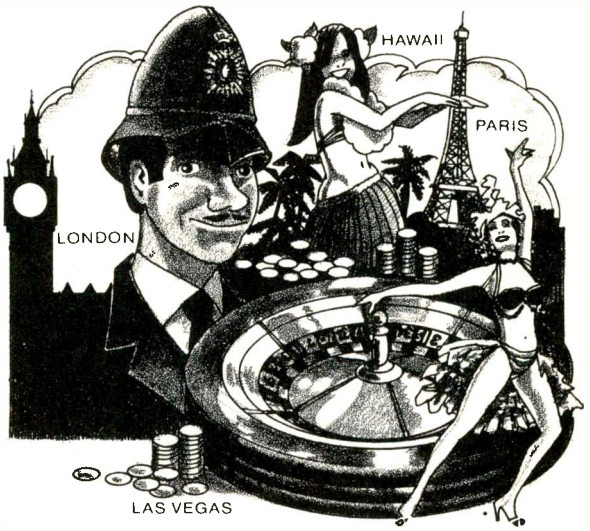
IF YOU BUY ENOUGH OF THESE...



GENERAL ELECTRIC WILL GIVE YOU AN AWARD LIKE THIS...



OR A FABULOUS WEEKEND FOR TWO AT ONE OF THESE FUN-FILLED PLACES:



See your General Electric Distributor today if you haven't received complete details about our all-new "pro plus" Award Program. Remember: you earn "pro plus" points for GE semiconductor bags, tripler box tops and GE receiving tube flaps. And, if you should find a GE monogram sticker in one of the bags, it's worth an extra 20 "pro plus" points!*

*Mix cash and points for bigger prizes. Full details in Monthly Bulletins once you enroll.

DEADLINE: November 30, 1979

Tube Products Department—Owensboro, Kentucky 42301

Clip Bonus Coupon
20 "pro plus" Bonus Points
Limit one per customer

GENERAL ELECTRIC

Pro Plus Headquarters
P.O. Box 6863 • Chicago, Illinois 60680

The Sanyo 91C90

Microprocessor control*

More and more television receiver controls are being developed to leave less and less to chance, to owner misadjustment. Sanyo's 91C90's chassis tuner control system is an excellent example of this.

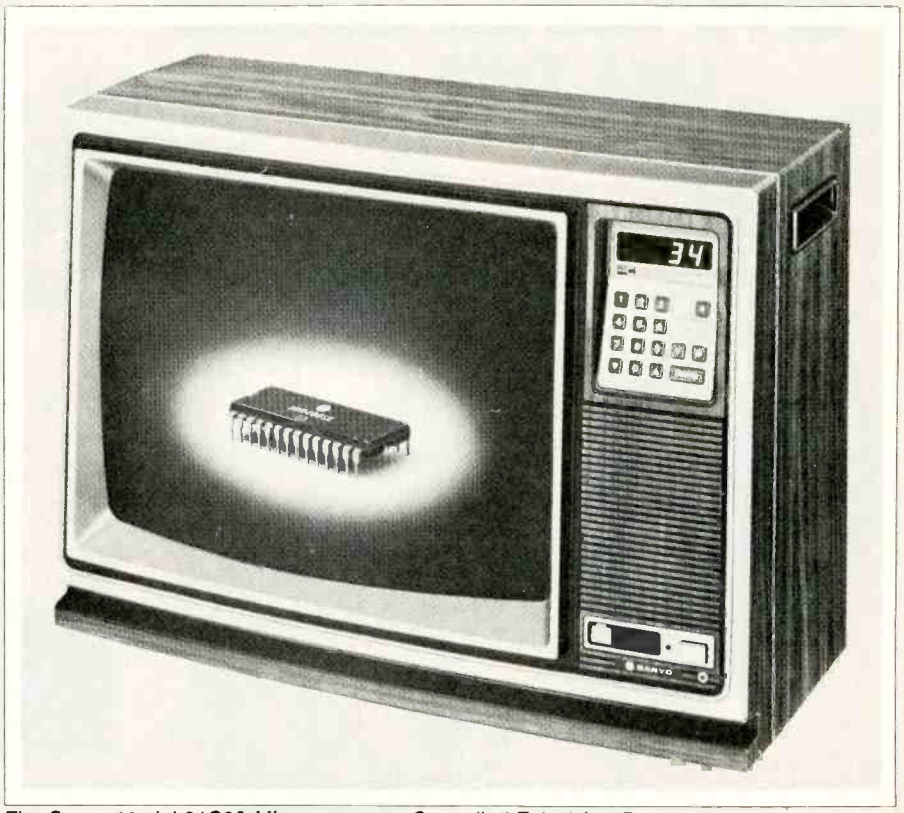
By Walter H. Schwartz

The Sanyo 91C90 is an example of how the tuning and remote control systems of current TV's are beginning to look more complex than the main chassis. The 91C90's chassis (schematics will appear in December TEKFAX) is an excellent example of the use of integrated circuits to keep component count down while providing ever more complex internal function. It uses 5 IC's and about 20 transistors. The tuners use seven transistors; the control system uses 5 or 6 IC's and about 25+ transistors. This has become the most interesting—and unfamiliar—part of a TV; a description of the 91C90's tuner control system follows.

The phase-locked-loop synthesizer eliminates the need for standard AFT and microprocessor control also provides remote control functions and channel recall.

The system samples and divides the tuner local oscillator output and compares it by means of a phase detector with a crystal controlled reference, the accuracy of which is reportedly on the order of one part in 10^8. If the local oscillator deviates higher in frequency a correction voltage of one polarity is developed to correct it. If it deviates low the opposite polarity is developed.

*Illustrations courtesy Sanyo Electric Inc.



The Sanyo Model 91C90 Microprocessor Controlled Television Receiver

VHF CHANNEL 2 — 13					
Channel Number	Tuner Local OSC (MHz)	Divide Ratio	4 Byte Hexadecimal Code	Tuning Voltage (V)	Pre-Scaler Output (MHz) (PLL input)
2	101	808	0 3 2 8	2.3	1.578
3	107	856	0 3 5 8	4.3	1.671
4	113	904	0 3 8 8	7.2	1.765
5	123	984	0 3 D 8	13.0	1.921
6	129	1032	0 4 0 8	20.5	2.015
7	221	1768	0 6 E 8	7.0	3.453
8	227	1816	0 7 1 8	8.6	3.546
9	233	1864	0 7 4 8	9.8	3.640
10	239	1912	0 7 7 8	11.4	3.734
11	245	1960	0 7 A 8	13.2	3.828
12	251	2008	0 7 D 8	15.3	3.921
13	257	2056	0 8 0 8	19.1	4.015

Fig. 1 VHF Channel tuning information

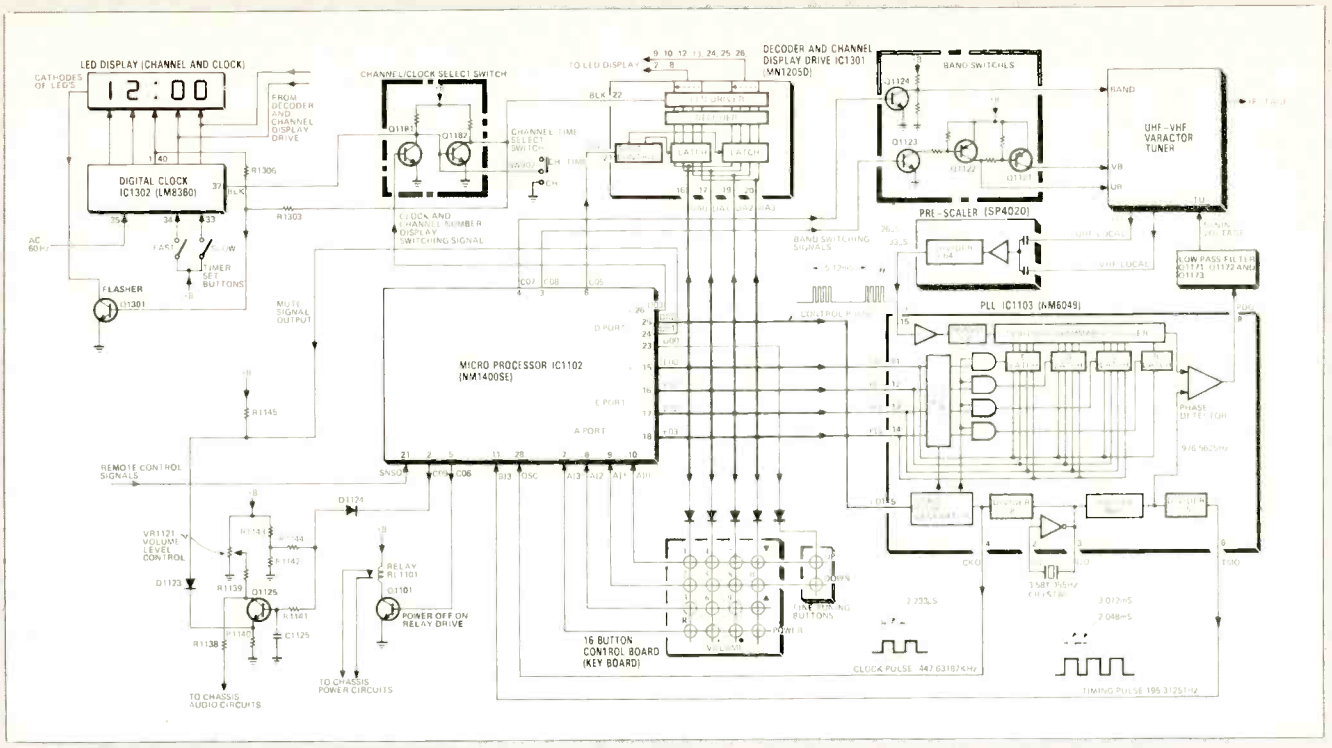


Fig. 2 Synthesizer tuning system block diagram

To do this—IC's have outwardly simplified matters considerably—requires, of course, voltage tunable varactor UHF-VHF tuners, a phase-locked-loop, the central microprocessor, a prescaler, a decoder and channel display driver and the channel display which doubles, incidentally, as a clock display (Fig. 2).

To compare the VHF-UHF local oscillators to a low frequency fixed reference, the prescaler and dividers reduce by an appropriate ratio, the oscillator frequency for the desired channel (see Fig. 1 for VHF tuning data; UHF is similar; the divide ratios are greater).

When numbers corresponding to the desired channel are entered into the microprocessor by the selector switches it sends out the proper binary code to the programmable divider (divide ratios in Fig 1). The local oscillator has previously been divided by 64 in the prescaler and by two just ahead of the programmable divider. For example, referring to Fig. 1, Channel 5's local oscillator frequency is 123MHz, this prescaled by 64 to 1.921MHz. It is further divided by 2 in the PLL IC and then divided by 984 by the programmable divider producing a frequency of 976Hz which is compared with the 976Hz reference in the phase detector/resulting in a tuning control voltage of 13 volts. If the channel selection is changed to Channel 2, the programmable divider ratio becomes 808; the output of the programmable divider becomes about 1200Hz; and the phase detector output voltage drops tuning the local oscillator lower in frequency. When the oscillator output drops enough, the output of the programmable divider is again 976Hz and the local oscillator is locked to 101MHz for Channel 2.

The phase-locked-loop

The phase-locked-loop involves the tuners, the prescaler, and the PPLIC (see the right side of Fig. 2). Since the oscillator output of the tuners ranges from 101 to 931MHz, it is too high for direct application to the programmable divider directly, since the divider's upper frequency limit is about 10MHz. Consequently we need a prescaler divide number of about 100; for speed and simplification of circuitry the ratio should also be binary.

The prescaler consists of two amplifier stages driving an IC containing six flip-flops in series. Each flip-flop divides by two for a total division of 64. The prescaler output, therefore, ranges from 1.578125MHz for channel 2 to 14.546875MHz for Channel 83 (Fig. 3).

The output of the prescaler is divided by two in the PPL IC producing a frequency in the range of 800KHz to 7.25MHz, before being applied to the programmable divider.

The programmable divider contains 13 flip-flops and can divide by any number from 1 to 8192; ratios from 792 to 7464 are used (Fig. 4).

The input to the programmable divider from the microprocessors is done four bits at a time. Five latches (storage registers) are used. One is used to store the number of the register to be loaded ("A" latch) and the other 4 (B, C, D, E) are used to store the divide ratio. The latches are loaded in sequence:

1. Latch "A" is loaded with the address data for Latch "B"
2. Latch "B" is loaded with the most significant bit (MSB) of the divide-by-number
3. Latch "A" is loaded with the address for latch "C"
4. Latch "C" is loaded with the next four bits of the divide-by-number
5. Latch "A" is loaded with the address data for latch "D"
6. Latch "D" is loaded with the next four bits of the divide-by-number
7. Latch "A" is loaded with the address data for Latch "E"
8. Latch "E" is loaded with the four least significant bits (LSB) of the divide-by-number

This sequence is under the control of the microprocessor, as illustrated in Fig. 5 and is repeated approximately 195 times per second. About 1/3 of the microporcessor time is used for programming the programmable divider. The other 2/3 is used to scan the keyboard, update the channel number display and adjust the Volume.

Since binary digits are used in this system each four bit word (byte) can represent any number from 0 to 15 (hexadecimal).

The output of the programmable

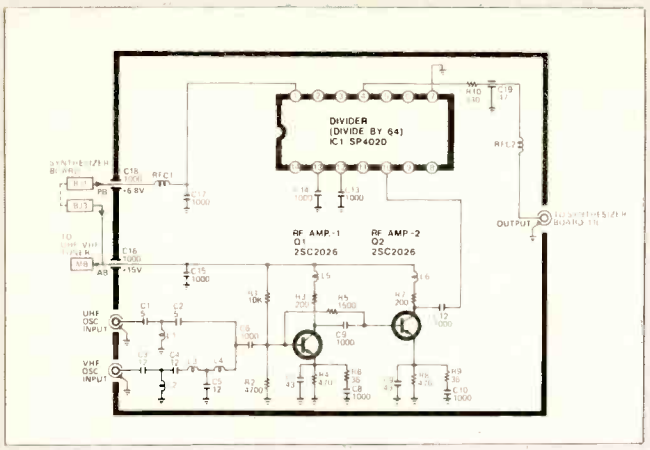


Fig. 3 Pre-scaler circuit

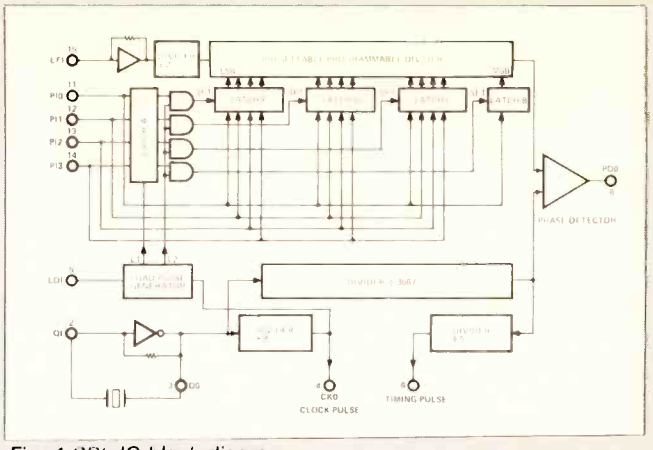


Fig. 4 PPL IC block diagram

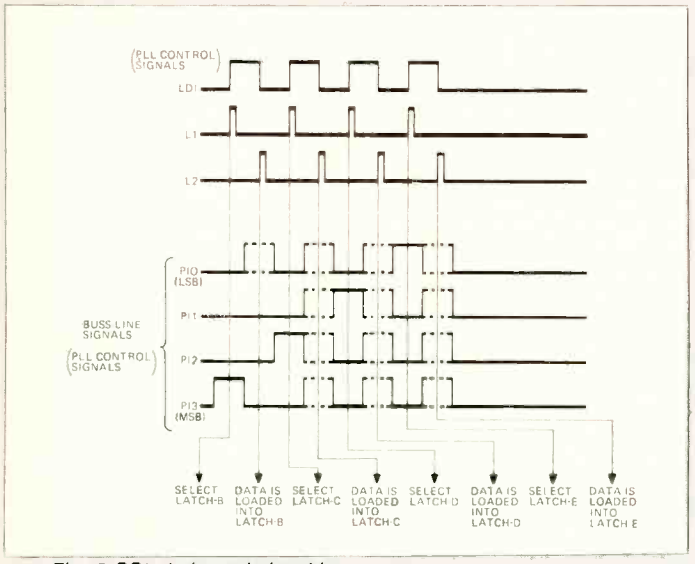


Fig. 5 PPL timing relationships

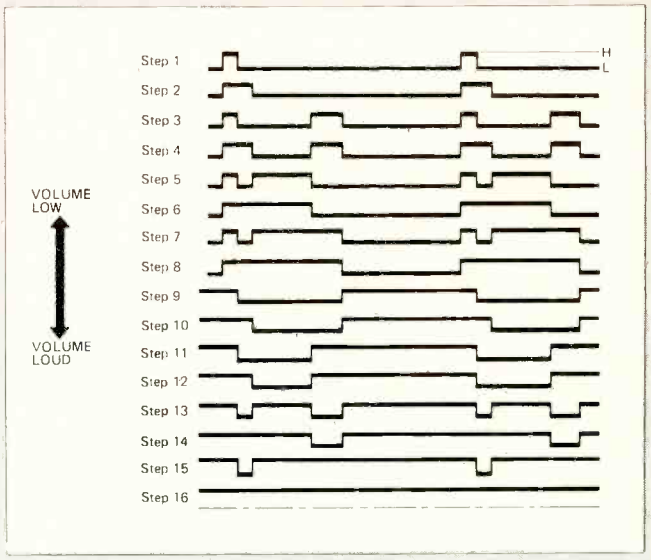


Fig. 6 Volume control signals.

divider is compared with the reference, as explained previously, by the phase detector. The output of the phase detector is a pulse, the width of which depends on the phase error. A low pass fitter (Q1171, 1172, 1173, Fig. 1) follows the phase detector to convert the pulses into a dc control voltage. When a frequency higher than 976Hz is applied to the phase detector its output is a negative pulse, resulting in a decrease in tuning voltage. As the frequency (and phase) approach the reference frequency the pulse narrows until at phase lock a very narrow pulse is all that is required to maintain the correct tuning voltage.

The microprocessor

The microprocessor is the heart of the frequency synthesizer tuning system. It responds to commands from the keyboard, control buttons and remote control receiver and; 1) it locks the PPL on frequency by commanding the programmable divider; 2) it causes the varactor tuner to perform band-switching operation; 3) it produces and feeds the signals along the Buss and digit control lines to the Decoder and Channel Display Driver stage which is provided for displaying the number of the selected channel; 4) it controls the switching of the LED unit which displays clock time or the number of the selected channel. Clock time is normally shown on the LED display, but, when any of the channel selection, fine tuning, channel recall and power Off-On buttons on the control board is pressed, the display is switched from clock time to the channel number; 5) it supplies the signal for controlling power Off-On operation; 6) it supplies the signal for sound volume control; 7) it decodes the signals which come from the remote control transmitter and performs the operations described above just in the same way as when such control signals are supplied from the 16-button control board.

The microprocessor IC controls the whole operation of the Tuning System by generating various output signals to carry out a variety of functions designated by users through function buttons mounted on TV front or the remote transmitter. The following are the input signals and their terminals used for the microprocessor; input signal A10-A13 (7-10) from 18 buttons, remote control signals input SNSO (21), timing pulse input B13 (11), and clock pulse input OSC (28).

The rest of terminals of microprocessors are for output signals, the functions of which are as follows; The output lines of terminals E00-E03 (15-18) are called Buss line. From this Buss Line, different kinds of output signals for various functions are sent out. The Buss Line Signals include: a) signals to control the PLL (the signals to determine dividing ratio of programmable divider), b) signals for Channel Number display, c) signals to detect address of user function buttons (when user presses any one of the function buttons, a specific Buss Line Signal runs through to one of the terminals A10-A13 (7-10) of the microprocessor to tell which function key is pressed.)

The signals a) and c) are continuously sent out from the microprocessor in a specific sequence. Signal b) is generated and sent out only when the channel selection button(s) either on TV

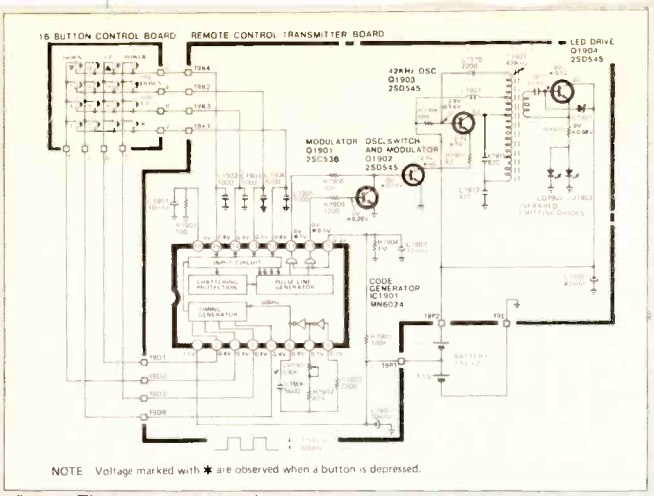


Fig. 7 The remote control transmitter

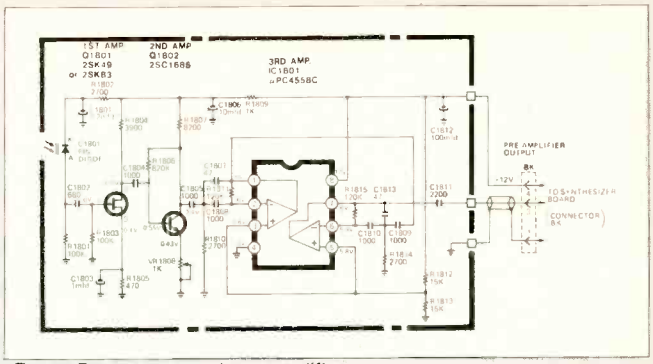


Fig. 8 Remote control preamplifier

set or Remote Transmitter is pressed.

The various signals are applied through the Buss Line to the IC's (1C1103 and 1C1301). The necessary signals are selected and extracted at those IC's with the aid of Control Pulses also supplied from the microprocessor through different routes. The PLL uses only those signals needed for presetting the Programmable Divider. The Decoder and Channel Display Drive (1C1301) use only those signals related to channel number display.

As mentioned earlier, the signals used for selecting and extracting only necessary signals at each IC are called Controll Pulses. The Control Pulses are sent from terminal D02 (25) of the Microprocessor to terminal LD1 (5) of the PLL. Likewise, they are also sent from terminal C05 (6) of the Microprocessor to terminal DSEL (21) of the Decoder and Channel Display Drive.

The decoder and channel display driver is the stage where the (binary coded) channel number signals which come along the buss and digit control lines from the microprocessor are decoded into the two-digit signals before being applied to the LED display.

The decoder and channel display drive block is connected to the channel/clock select switch and is controlled by it.

The digital clock counts the 60Hz line signal and, after the decoding process, uses it as the signal to drive the LED display for hours and minutes display. Time-setting operation is controlled by the "fast" and "slow" reset buttons on the subcontrol unit in which an integrated circuit is employed. The digital clock IC is also controlled by the channel/clock select switch.

The channel and clock switching signals from the microprocessor control the On-Off operations of the digital clock block and the decoder and channel display stage; when the channel display signal is applied to the channel/clock select switch from the Microprocessor, the decoder and channel display drive is switched on and the output of the digital clock is cut off and the channel number goes on display. When the time display signal is applied to the switch from the microprocessor, the output of the digital clock drives the LED display and the output of the decoder and channel display drive is cut off; the LED display then indicates hours and minutes.

Signal for the display switch is applied from terminal D03 (26). When function switches on Control Key Board are not pressed, terminal D03 (26) remains low. If any one of the Channel Selection keys, fine tuning keys, channel recall key or power Off-On key is pressed, terminal D03 (26) goes high. However, the level of terminal D03 goes back to low automatically, five seconds after releasing the key.

Channel/Clock Select Switches (Q1181 and Q1182) are connected to terminal D03 (26). The collectors of these switches are then connected to blanking terminals of both Digital Clock (C1302) and Decoder and Channel Display Drive (1C1301). The blanking terminal of 1C1302 is BLK (37), and BLK (22) for 1C1301.

When terminal D03 (26) goes low, Q1181 is turned off, while, Q1182 is turned on. Meanwhile, the blanking terminal of Digital Clock 1C1302 goes high and the blanking terminal of Decoder and Channel Display 1C1301 switches to low. As a result of the foregoing process, Digital Clock 1C1302 generates and sends out signals for TIME display and no signals for channel number display are applied from Decoder and Channel Display Drive 1C1301; the LED display shows only TIME.

Conversely, when terminal D03 (26) goes high, the blanking terminal of Digital Clock 1C1302 switches to low. Meanwhile, the blanking terminal of Decoder and Channel Display Drive 1C1301 changes to high. As a result, only the signals for channel number display are generated; no signal for TIME display is sent out; only the CHANNEL NUMBER is displayed on LED display.

Other functions

Terminals C08 (3) and C07 (4) are the output terminals for Band Switch Signals. C08 (3), signals are for switching from VHF to UHF. When any channel number which is lower than No. 14 is addressed to the microprocessor, terminal C08 (3) becomes low. On the other hand, when a channel number that is over 13 is addressed, terminal C08 (3) changes to high. C07 (4), signals are for switching VHF Low Band to VHF High Band, and vice versa. When any channel number under 7 is addressed to the microprocessor, the terminal C07 (4) becomes low. Meanwhile, when any channel number over 6 is addressed, Terminal C07 (4) goes high. These signals for Band Switching are then applied to switching transistors (band switches Q1121—Q1124) to change bands in the Tuner.

Power Off-On Switch Signals are sent out from terminal C06 (5) which is connected to Power Off-On Relay Drive Q1101. This terminal activates only when the "POWER" button of Control Key Board on the set or on the Remote Control Transmitter is pressed down; i.e., the terminal alternates from high to low and vice versa, only when "POWER" button is pressed, to turn the set on or off. Keys on the Control Key Board are functional only when Terminal C06 (5) is high (when TV set is turned on). Whenever the terminal is low (when TV is turned off), all keys on Control Key Board are inoperative except the Power button. Regardless of the condition of terminal C06 (5), buttons used fdor time-adjustment always remain functional.

continued on page 46

Pioneer's dynamic range monitoring

A look at the CT-700

Detecting peak levels during recording is essential for minimum distortion and to maintain proper signal to noise ratios. Here's the circuit that does it.*

Pioneer's CT-700 Front Loading Cassette Tape Deck

More than 10 years have passed since the first introduction of cassette tape decks. Performance has greatly increased during that period and is now advancing to a level of sophistication which once belonged to middle-class reel-to-reel tape decks.

A fine example of this sophistication is the CT-F1000 three-head cassette tape deck with an efficient monitoring system during recording, which was introduced by Pioneer in 1977.

CT-F1000 is now acknowledged as the top-ranked three-head cassette deck. A newer deck, CT-F700, is a two-head cassette deck which is designed to set the standard of performance in its class.

CT-F700 incorporates a number of features which are not found on other competitive models. One of those features is the system which monitors the dynamic level during recording through the use of a third meter as a recording bias adjustment system.

As you may already know, setting the recording level when you record with a tape deck can be difficult at times, and even harder when recording through microphones.

Compared to reel-to-reel tape decks, the task is almost twice as difficult on a cassette tape deck.

These are the characteristics of cassette decks which contribute to the problem:

1) The tape is narrow.
2) The magnetic coating of the tape is thin.
3) The speed of the tape is slow.

These facts result in the following:

1) The level of magnetic saturation is lower than in reel-to-reel decks.
2) The level of hiss is higher.
3) A greater number of high frequencies are dropped out.

In short, the dynamic range is narrower.

Figure 1 shows the characteristics of cassette tape decks vs. reel-to-reel decks.

Now let's consider the recording signal. Figure 2 shows a recording signal's wave form. Generally speaking, there is considerable difference between the peak and the average levels of the signal. When recording with the average level set too high (REC level setting too high), the signal will be clipped at its peak due to the magnetic saturation of the tape.

On the other hand, if the REC level setting is too low, S/N will be aggravated by tape hiss noise as mentioned above although no saturation will occur at the peaks. In order to record signals that have a difference between peak and average levels without distortion and deterioration of S/N, it is necessary to know how high the peak level is.

The system to detect this peak level is

**The above article has been reprinted from* Tuning Fork, *No. 3, a publication of Pioneer Electronic Corporation, Tokyo, Japan.*

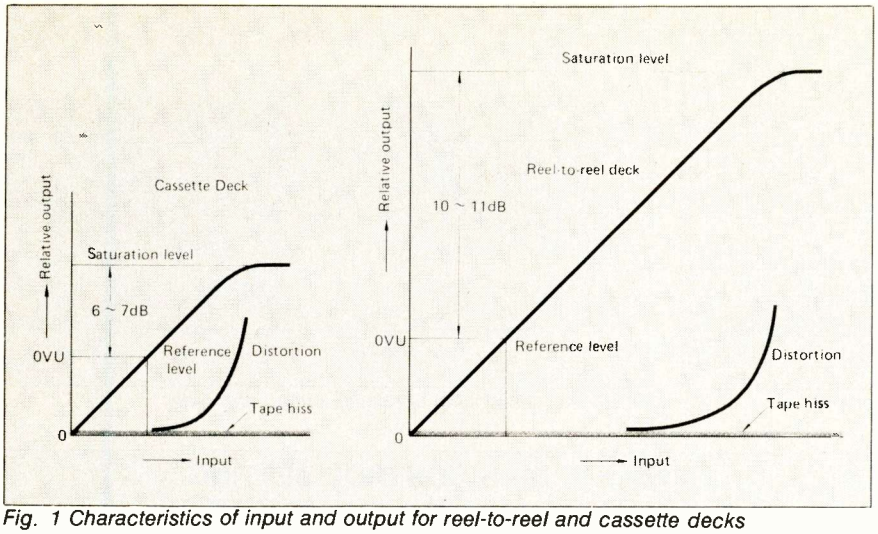


Fig. 1 Characteristics of input and output for reel-to-reel and cassette decks

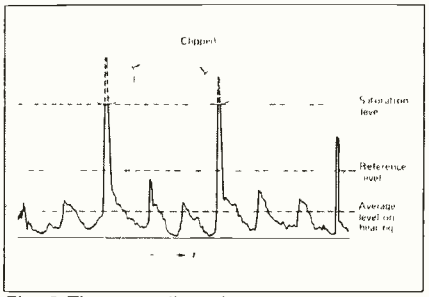


Fig. 2 The recording signal

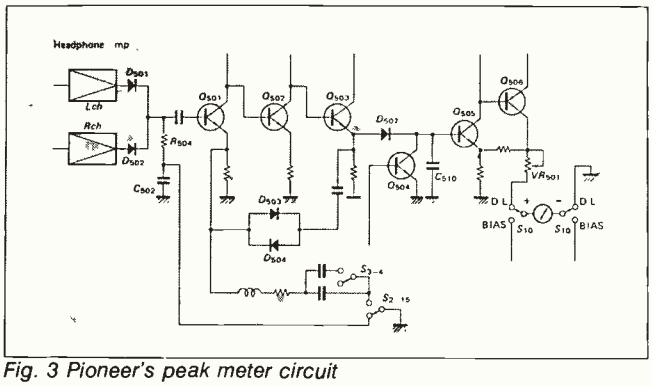


Fig. 3 Pioneer's peak meter circuit

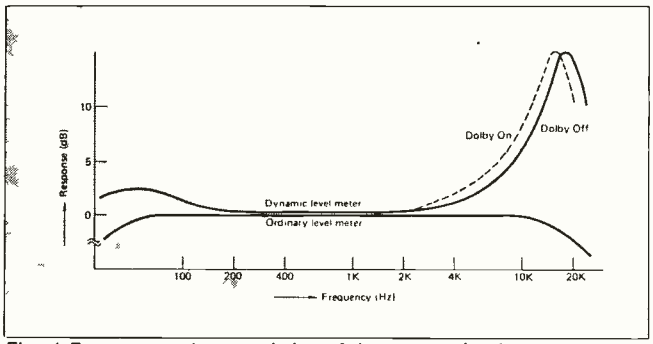


Fig. 4 Frequency characteristics of the meter circuit

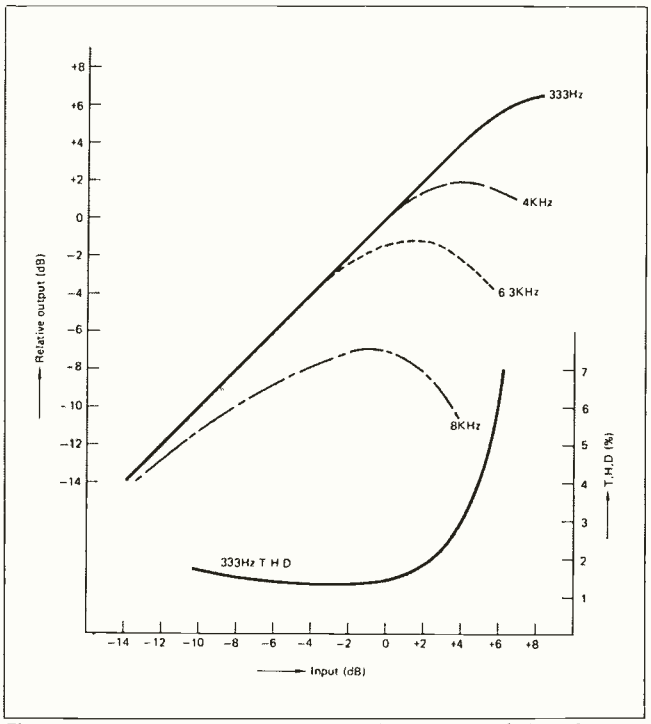


Fig. 5 Relative input and output distortion characteristics of cassette tapes

associated with the third meter.

The third meter

Figure 3 shows the third meter drive circuit (peak meter circuit). The Q_{501}, Q_{502}, and Q_{503} form the three-stage direct-coupled amplifier and carry out logarithmically-compressed amplification because D_{503} and D_{504} are inserted into the feedback loop from the emitter of Q_{503}. The logarithmically-compressed amplified signal is rectified by the D_{507}, the peak is detected by C_{510} and DC amplification is accomplished by Q_{505} and Q_{506}. Q_{504} is a muting transistor which prevents deflection of the meter needle when power is on.

As you can see in Figure 4, this meter circuit has flat frequency response during playback, with increasing response at both high and low ends during recording.

In general, while recording with a cassette tape deck, the following points can be made concerning frequency range of input signal and level setting:

1) At low frequencies, if the recording level is raised, the distortion increases (see Figure 5).
2) At high frequencies, the saturation level of the magnetic tape decreases along with the increase of frequencies.

Accordingly, as the frequency of the recording signal rises, the signal saturates in the lower level and characteristics of input and output are aggravated (see Figure 5).

On the other hand, as level meters usually have flat frequency response characteristics, they cannot read frequency (components) of the input source. Consequently, even though you set the recording level as you think fit by monitoring the level meters, distortion will occur as the output level decreases at high frequencies due to the magnetic saturation if the high-frequency spectrum of the source is strong. Also, if the low-frequency spectrum of the source is strong, the distortion will sharply increase at low frequencies due to the low-frequency compensation of the recording equalizer.

This is why the frequency characteristics of the third meter during recording appear as shown in Figure 4.

In order to increase response a little in the lows and a lot in the highs, the level

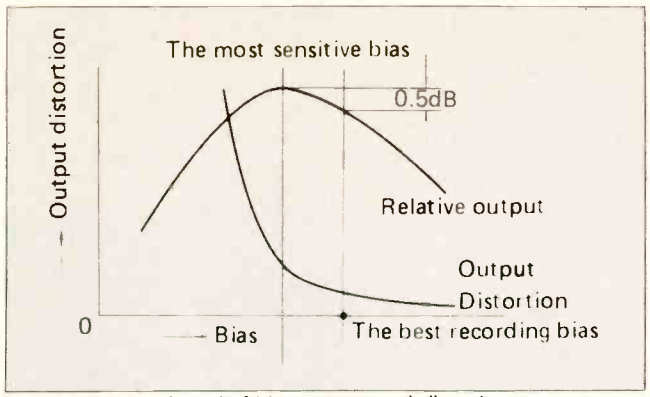


Fig. 6 Relation of level of bias, output and distortion

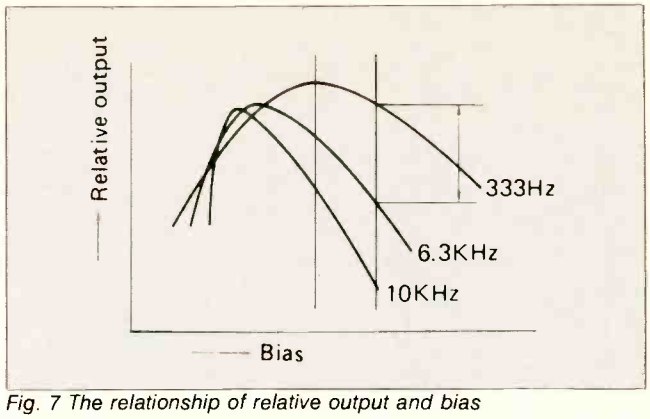


Fig. 7 The relationship of relative output and bias

meter over-responds slightly in the lows compared with the middle range and by a considerably larger deflection in the highs. In the case of recording with Dolby On, this dynamic-level meter works even more effectively. Recording characteristics with Dolby On boost the high-frequency range. Therefore, when you set the recording level higher, the margin of high-frequency signals to saturation level becomes small. In order to prevent this situation, the meter response at high frequencies is increased by approximately 2dB as compared to when Dolby is Off. It then becomes easy to set the recording level without distortion even if the high-frequency level is a little bit over.

Furthermore, the third meter works during playback as a peak level meter whose frequency characteristics are flat. The peak-level meter detects peaks of larger signals of both channels, shows the peak indication in dB and can instantly respond to the pulsive sound. This is very effective for setting the output or for monitoring during dubbing from another tape deck.

Setting the recording level

Turn the meter switch to "DYNAMIC LEVEL." Set the input-level control at a level so that the deflection of the dynamic-level meter does not exceed +6dB, even though the VU deflection is within +3dB against the peak signal of the program source.

In some program sources (especially in the case of direct recording using microphones), levels of signals vary greatly, so be sure to constantly monitor the dynamic-level meter when recording.

CT-F700s other big feature is its recording bias adjusting system. The value of the bias added to the head when recording is chosen to maximize output and minimize distortion during playback, while taking into consideration "dropout" during the process.

Usually the point where the output is

TABLE 1. BIAS CONTROL SETTING

Brand of tape		Bias control position (%)	EQ switch position
BASF	LH C-60	−15 (−10～−20)	STD
	LH C-90	−10 (−5～−15)	
	LN C-60	−20 (−10～−20)	
	LN C-90	−10 (−5～−15)	
	LH SUPER C-60	−15 (−10～−20)	
	LH SUPER C-90	−10 (−5～−15)	
AGFA	SUPER COLOR C-60	−10 (−5～−15)	
	SUPER COLOR C-90	−10 (−5～−15)	
	SUPER DYNAMIC C-60 +6	−10 (−5～−15)	
	SUPER DYNAMIC C-90 +6	− 5 (0～−10)	
SCOTCH	LH C-60, C-90	−20 (−10～−20)	
	CRYSTAL C-60, C-90	0 (−5～+5)	
	MASTER C-60, C-90	+ 5 (0～+10)	
TDK	D C-60, C-90	−15 (−10～−20)	
	SD C-60, C-90	−10 (−5～−15)	
	ED C-60, C-90	−10 (−5～−15)	
	AD C-60, C-90	+10 (+5～+15)	
MAXELL	LN C-60	−10 (−5～−15)	
	LN C-90	− 5 (0～−10)	
	UD C-60, C-90	+10 (+5～+15)	
	UD XLI C-60, C-90	0 (−5～+5)	
FUJI	FL C-60, C-90	−15 (−10～−20)	
	FX C-60	0 (−5～+5)	
	FX C-90	+10 (+5～+15)	
	FX Jr C-60, C-90	+ 5 (0～+10)	
	FX DUO C-60, C-90	0 (+5～−10)	
SONY	LN C-60	−15 (−10～−10)	
	LN C-90	−10 (−5～−15)	
	HF C-60, C-90	0 (−5～+5)	
SONY	DUAD C-60	0 (−10～+10)	FeCr
	DUAD C-90	−10 (0～−15)	
BASF	FERROCHROM C-60	0 (−10～+10)	
	FERROCHROM C-90	−10 (−5～−15)	
SCOTCH	CLASSIC C-60, C-90	−15 (−5～−15)	
AGFA	CARAT C-60	0 (−10～+10)	
	CARAT C-90		
BASF	CHROME C-60	− 5 (0～−15)	CrO_2 (Chrome) Auto-matically selected
	CHROME C-90	−10 (−5～−15)	
SCOTCH	MASTER 70μs EQ C-60	0 (−5～+5)	
TDK	SA C-60, C-90	0 (−5～+5)	
	KR C-60, C-90		
MAXELL	C-60 CR, C-90 CR	−10 (−5～−15)	
	UD XLII C-60, C-90	−15 (−5～−15)	
FUJI	FC C-60	−15 (−5～−15)	
	FC C-90	−10 (−5～−15)	
SONY	CR C-60, CR C-90	+10 (+5～+13)	
AGFA	STEREO CHROM C-60	0 (−10～+10)	
	STEREO CHROM C-90		

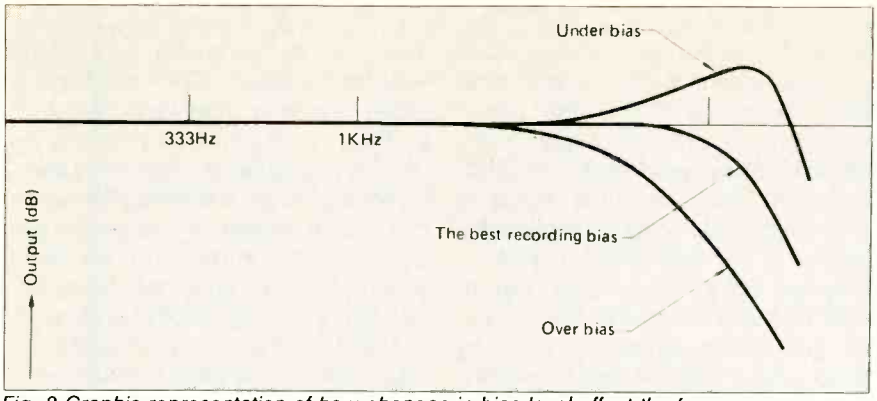


Fig. 8 Graphic representation of how changes in bias level affect the frequency response

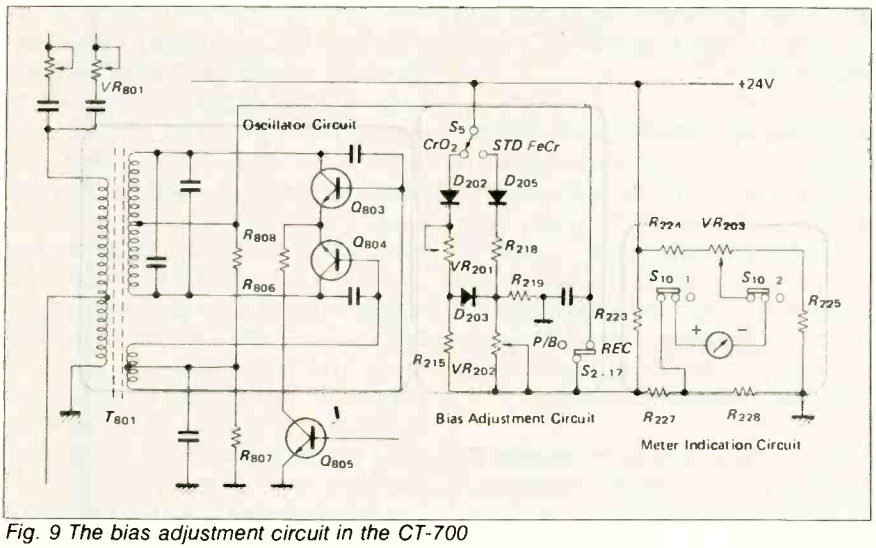


Fig. 9 The bias adjustment circuit in the CT-700

0.5dB under the most sensitive point after increasing the bias from the most sensitive bias point is considered the best recording bias (see Figure 6).

Figure 6 shows the relation of bias, output and distortion of 333Hz signal, but what about the high frequency?

As you can see in Figure 7, when the frequency of recording signal becomes higher, the relative output decreases to the signal of reference frequency (333Hz).

The decreased volume of this relative output depends on the bias level.

How this fits into the relationship between the frequency of the recording signal and the relative playback output is shown in Figure 8.

Moreover, the frequency characteristics of this bias level depend on the kinds of tapes being used. On CT-F700, the best level can be set to accommodate any tape you use by continuously changing bias level and reading the scale of the third meter simultaneously.

The bias adjustment is adjusted at VR_{202} by changing the bias and collector voltage in the bias oscillator circuit.

The following table shows the voltage between Point B and the ground at three points - minimum, center, maximum points - at VR_{202}.

Min.	Center	Max.
30V	42V	56V
40V	49V	56V

Since the bias current is almost directly proportional to the voltage on point B, it can be changed within -29% +33% when using STD or FeCr tape, and within -18% to +14% with CrO_2 tape.

The third meter reads the voltage on point A. A bridge circuit is incorporated in order to clearly show the indication of the meter.

Figures of the third meter scale (STD, FeCr and CrO_2) are indications for bias adjustment and have no units.

There are many kinds of tapes on the market. The bias control positions of leading brand tapes are shown in table 2. When a tape is being used for the first time, set the bias control according to this table.

Consequently, according to program sources or your favorite source of sound, optimum recording quality is possible by adjusting the characteristics of the high end. **ET/D**

BULLETIN BOARD

Hickok Electrical Instrument Company has recently published a vest pocket size **short form catalog** that offers descriptive information, photos and specifications for all major test instruments in the Hickok line. Included are oscilloscopes, counters, multimeters, generators and transistor testers. Copies of the new short form catalog may be obtained from Hickok distributors or by writing to Hickok Electrical Instrument Co., 10514 Dupont Ave., Cleveland, OH 44108.

Whether you are in business for yourself or are thinking about it, **"Service Shop Management"** by Dick Glass is required reading. A few exceptionally successful shop operators perhaps know—and practice—everything contained therein but it is full of food for thought for the rest of us. It has been long agreed by everyone with practical experience of the situation—that business management is the most difficult, trying and neglected aspect of most small service businesses. Dick Glass points out the factors you must understand to run yours profitably, the pitfalls of not really understanding costs and how to figure them correctly. Know your costs, in detail, know how much you must charge to cover them, make a decent comfortable wage and a proper return on your investment, and set your charges accordingly; Dick tells you how; if you don't you are just fooling yourself; you will go broke even though you will be working long hours with all the work you can handle. "Service Shop Management" by Dick Glass, Howard W. Sams and Co., Inc., No. 21602 soft cover $9.95, at your Sams distributor.

New Catalog '79 from Quam-Nichols Company lists 150 different speakers for industrial, general replacement, communications, mobile radio, commercial sound, automotive, musical instrument, and high fidelity use. It also features auto hi-fi and tractor/radio replacement speakers, ceiling baffles and line transformers. For a copy contact your Quam speaker distributor.

Each of us can use a good **general TV service reference book.** Unfortunately the reference/text books fall behind the state of the art very quickly, even before, they are published. "Color and Black & White Television Theory and Servicing" by Alvin A. Liff, is brand new and the most up to date general text we've seen. It does a good job of covering the basics of TV transmission and reception and covers solid state circuitry quite well. It does not cover the newest IC circuitry; it's simply impossible to be absolutely up to date in any publication; it's nevertheless a valuable book for reference or review. 672 pages, hardbound, Prentice-Hall, Inc., $18.95.

Klein Tools has announced a **new booklet which covers the proper use and care of hand tools** including pliers, screwdrivers, wrenches, striking and struck tools, vises, clamps, snips, tool boxes, chests and cabinets. The 88 page, 2 color booklet, contains illustrations which show how to select the proper tool for various jobs, the care and maintenance of tools and many of the hazards which can result from misuse of tools. The procedures and practices covered in this booklet represent the consensus of opinion of the leading hand tool manufacturers in America, all members of the Hand Tools Institute. The booklet is available through Klein's electrical and industrial distributors. Single copies available free on request from Klein Tools. 7200 McCormick Rd., Chicago, IL 60645.

Techni-Tool's **new tool catalog,** No. 24, for 1979-1980 is now available. It contains 209 fully illustrated pages of over 10,000 individual items for electro/mechanical assembly, maintenance and lab work. The color section displays a full line of tool kits and cases for both professionals and experimenters. Techni-Tool's exclusive "Design-A-Kit" form offers the individual a quick, efficient method for designing his own custom tool kit. This catalog is a central source for tools from 650 individual manufacturers. All products are priced and delivery is stated to be "off the shelf." Copies free from: Techni-Tool, Inc., Apollo Rd., Plymouth Meeting, PA 19462.

A new Semiconductor Catalog and Cross Reference (Catalog X79) has recently been issued by *Workman.* The new manual includes 80 new WEP types and reportedly contains over 150,000 cross references. For a copy see your Workman distributor or write Workman Electronic Products, Inc., P. O. Box 3828, Sarasota, FL 33578. ET/D

TEST INSTRUMENT REPORT

For more information about this instrument, circle 150 on The Reader Service Card in this issue.

The VIZ WR515B Color Bar Signalyst™

Compact and versatile

By Walter H. Schwartz

Another color bar generator! But we really shouldn't call these modern pattern generators, color bar generators anymore. As a rule they do a lot more than simply supply a few simple color and dot/bar patterns and the VIZ WR515B is no exception.

The front panel is deceptively simple, four controls, two coaxial (BNC) connectors, three banana jacks, but the inside contains about 33, fourteen and sixteen pin IC's and a few transistors—my count may not be absolutely accurate; they are mounted on three boards separated by shielding and hard to see without complete disassembly; the schematics and logic diagrams cover eight manual pages.

These IC's make possible a variety of patterns with a stability unheard of a few years ago. Three color bar patterns are available. The first is color bars less burst. This pattern has no color burst to lock the 3.58MHz oscillator and is therefore useful in adjusting its free running frequency. The set's color killer, however, must be defeated also, since burst usually actuates it. The second pattern is "Normal" color bars without a luminance pedestal. The sixth bar, blue, is marked for easy identification—no more wondering where which is—and the amplitude is adjustable over a 0 to 200% range. The third pattern is color bars with luminance, the usual gated rainbow pattern put out by color bar generators. The next three patterns are uniform red, blue or green raster and are intended for purity checks. This is extremely handy. No more disturbing set up to view individual color rasters. The seventh pattern is a color trio; the top half of the screen is red, the lower left one fourth is blue and the lower right is green. This is useful for pix tube and matrix tests; turning down the brightness should cause first the green, then the red and finally the blue to disappear. The next pattern is a Grey Quad, four different densities of grey, each filling one quadrant of the screen. This has obvious use in checking gray scale tracking and also can be used, among other purposes, to check relative sensitivity. The output of the WR515B can be turned down until snow appears and the relative attenuator setting noted. The hatch dot pattern furnishes at once, all the patterns necessary for complete convergence, however, if you prefer a standard dot pattern, that is available also, with the center dot isolated, by having the dots immediately above and below it ommitted, for easy location and identification. Super pulse, switch position eleven, is a rectangular white area in the center of the screen. It is useful for ringing, smear, video peaking and other tests and also provides an unmistakable video wafeform for scope signal tracing. The last position on the switch, spring loaded to return to super pulse, produces an interlaced sweep for those newer sets that experience vertical instability on noninterlaced signals.

Outputs are available on either channel 3 or 4 (factory determined) and at IF and video frequencies. Scope triggers, horizontal and vertical, are available, as is 4.5MHz sound carrier. All signals, line widths and spacings are crystal controlled.

A conversion kit is available to change the RF oscillator from channel 3 to 4 or 4 back to 3 if necessary. The RF and IF oscillator can be peaked with a demodulator probe.

A network consisting of resistance, capacitance, an ordinary diode and a zener diode prevents accidental damage to the WR515B when using it for signal injection of video. It is protected from direct connection of dc from +160 to −50V. The video output impedance is 75 ohms which allows driving most points in video circuits without disconnecting any components.

The WR515B operates from 110-130V 60 Hz (ac) measures 3-⅜ × 8-⅝ × 6-½ inches and weighs 5 lbs.

Complete with test cable, BNC to F adapter, a direct/isolation head, a 75 to 300 ohm adapter and an excellent instruction and applications manual, the WR515B sells for $275. ETD

WHAT'S BETTER THAN SPEED READING?

SPEED LEARNING

(SPEED PLUS COMPREHENSION)

Speed Learning is replacing speed reading because it's easy to learn . . . lasts a lifetime . . . applies to everything you read . . . and is the only fully accredited course with the option of college credits.

Do you have too much to read and too little time to read it? Do you mentally pronounce each word as you read? Do you frequently have to go back and re-read words or whole paragraphs you just finished reading? Do you have trouble concentrating? Do you quickly forget most of what you read?

If you answer "yes" to any of these questions — then here at last is the practical help you've been waiting for. Whether you read for business or pleasure, school or college, you will build exceptional skills from this major breakthrough in effective reading, created by Dr. Russell Stauffer at the University of Delaware.

Not just "speed reading" — but speed reading-thinking-understanding-remembering-and-learning

The new *Speed Learning Program* shows you step-by-proven-step how to increase your reading skill and speed, so you understand more, remember more and use more of everything you read. The typical remark made by the 75,000 slow readers who completed the *Speed Learning Program* was: "Why didn't someone teach me this a long time ago?" They were no longer held back by the lack of skills and poor reading habits. They could read almost as fast as they could think.

What makes Speed Learning so successful?

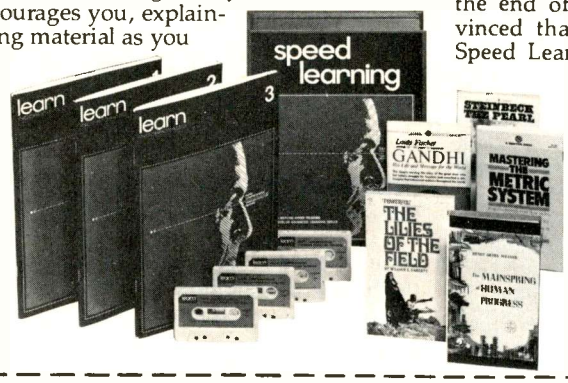
The new *Speed Learning Program* does not offer you a rehash of the usual eye-exercises, timing devices, costly gadgets you've probably heard about in connection with speed reading courses or even tried and found ineffective.

In just a few spare minutes a day of easy reading and exciting listening, you discover an entirely new way to read and think — a radical departure from anything you have ever seen or heard about. Research shows that reading is 95% *thinking* and only 5% eye movement. Yet most of today's speed reading programs spend their time teaching you rapid eye movement (5% of the problem) and ignore the most important part (95%) *thinking*. In brief, *Speed Learning* gives you what speed reading *can't*.

Imagine the new freedom you'll have when you learn how to dash through all types of reading material *at least* twice as fast as you do now, and with greater comprehension. Think of being able to get on top of the avalanche of newspapers, magazines and correspondence you have to read . . . finishing a stimulating book and retaining facts and details more clearly and with greater accuracy than ever before.

Listen-and-learn at your own pace

This is a practical, easy-to-learn program that will work for you — no matter how slow a reader you think you are now. The *Speed Learning Program* is scientifically planned to get you started quickly . . . to help you in spare minutes a day. It brings you a "teacher-on-cassettes" who guides you, instructs, encourages you, explaining material as you read. Interesting items taken from *Time* Magazine, *Business Week, Wall Street Journal, Family Circle, N.Y. Times* and many others, make the program stimulating, easy and fun . . . and so much more effective.



Executives, students, professional people, men and women in all walks of life from 15 to 70 have benefited from this program. Speed Learning is a fully accredited course . . . costing only 1/5 the price of less effective speed reading classroom courses. Now you can examine the same, easy, practical and proven methods at home . . . in spare time . . . without risking a penny.

Examine Speed Learning FREE for 10 days

You will be thrilled at how quickly this program will begin to develop new thinking and reading skills. After listening to just one cassette and reading the preface you will quickly see how you can achieve increases in both the speed at which you read and in the amount you understand and remember.

You must be delighted with what you see or you pay nothing. Examine this remarkable program for 10 days. If, at the end of that time you are not convinced that you would like to master Speed Learning, simply return the program and owe nothing. See the coupon for low price and convenient credit terms.

Note: Many companies and government agencies have tuition assistance plans for employees providing full or partial payment for college credit programs.

In most cases, the entire cost of your Speed Learning Program is Tax Deductible.

EARN PROFESSIONAL & COLLEGE CREDITS

Speed Learning is approved for credit by the following professional and educational institutions:

- **Foundation for Accounting Education** 20 CPE Credit Hours
- **American Management Association** 1.9 Continuing Education Units
- **National Society of Public Accountants** 20 Continuing Education Hours
- **College Credit** 3 credits from the National College of Business

Details and registration forms included with each program.

OFFERED INTERNATIONALLY BY

- **Institute of Electrical & Electronics Engineers**
- **American Chemical Society**
- **National Association of Life Underwriters**

learn INCORPORATED 113 Gaither Drive, Mount Laurel, N.J. 08054

HBJ-1-ET/D-1079

Please send me the Speed Learning Program at $89.95 plus $3.00 for handling and insured delivery.

Please check the method of payment below:

☐ Check or money order enclosed for items ordered. New Jersey Residents add 5% sales tax.

☐ Please charge my credit card under the regular payment terms: ☐ Bank Americard ☐ Master Charge Interbank No. _____ ☐ American Express ☐ Diners Club

Card No. _____ Exp. Date _____

I understand that if after 10 days I am not delighted in every way, I may return the materials and obtain a full refund with no questions asked.

Name _____

Address _____

City _____ State _____ Zip _____

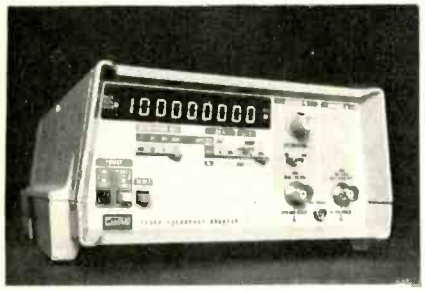
x Signature _____

If you don't already own a cassette player, you may order this Deluxe Cassette Recorder for only $49.95. (Includes handling and delivery.)

Check here to order ☐

— Outside U.S.A. $99.95 + $3 surface mail — airmail extra —

NEW PRODUCTS



1300 MHz Counter

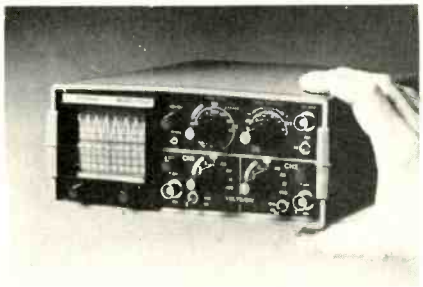
Circle No. 135 on Reader Inquiry Card

The new Fluke 7220A bench/portable frequency counter offers 1300MHz performance. From 5Hz to 125MHz, the high impedance, direct-count input (Channel A) is used. From 50MHz to 1300MHz, the 50 ohm prescaled input (Channel B) is used. On Channel A, a wide-range (x1-to-x100) continuously adjustable analog attenuator and a switch selectable 100kHz low-pass filter allow the instrument to count reliably over a wide range of input signal conditions, maintaining reportedly excellent sensitivity and noise rejection. Designed for use in communications applications, a special shield surrounds the electronics for EMI protection. Other standard features include burst measurement capability, manually selectable 100Hz to 0.1Hz resolution, rapid access gating, and a 9-digit LED display. Two low-power, high-accuracy, ovenized oscillators are available as options. Temperature stabilities are $\pm \times 10^{-7}$ (0-40° C), or $\pm 3 \times 10^{-8}$ (0-40°C). Low power means that the 7220A can be carried into the field while its oscillator remains powered-up on internal rechargeable batteries, so no warm-up is required. The price is under $900.

Miniscope

Circle No. 136 on Reader Inquiry Card

Ballantine's new Series 1020, 12MHz dual trace oscilloscope measures 8 inches wide by 7⅜ inches deep and 3¼ inches high and weighs approximately five pounds. It operates on 12vdc drawing less than 1 ampere; a power converter is available for ac operation. Ballantine reports that a new CRT was developed for the Series 1020 to maintain a bright sharp trace; the screen area is 8 × 10, 5mm divisions. Input sensitivity ranges from 0.005v/division to 2v/division and sweep rates ranges from 100 ns/division to 100ms/division. The price is $785 for the dual trace model; a single trace version costs $595.



Flushcutters

Circle No. 137 on Reader Inquiry Card

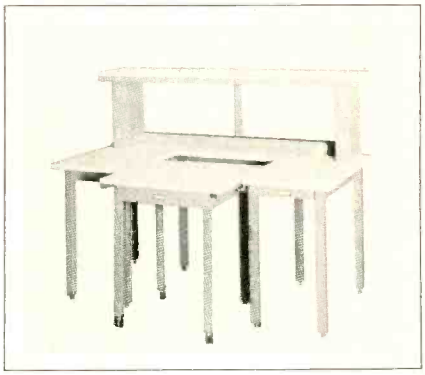
A new series of low cost electrical lead flushcutters designed to provide extended cutting life is being introduced by *Electronic Production Equipment Corporation.* The EPE Super-Shear Series features a blade bypass that reportedly creates a shearing action for clean and easy cutting with reduced dulling. Suitable for cutting hard materials such as Kovar and Dumet, they are made of specially heat treated, high carbon tool steel. The first tools in this series include the standard cutters Model 007, and Model 007S with safety clip to retain cut off leads. Supplied with a polished, corrosion-resistant, plated finish, the EPE Super-Shear Series incorporates a return spring guaranteed for the life of the tool. The 5 in. long shears are fitted with replaceable, insulated

cushion grip handles, and can be provided with conductive handles for use at conductive work stations. The EPE Super-Shear Series is priced at $8 each for the Model 007, and $9.50 each for the Model 007S, with quantity discounts offered.

Shop Benches

Circle No. 138 on Reader Inquiry Card

Production Industries, Inc. has recently introduced "Systems Benches" a modular workbench with a removable production cart. The benches are available in a variety of height, width, lenth configurations with modesty and end panels, instrument shelf and electrical outlets. Eight colors are available; the tops are white/linen pattern Texlin plastic laminated to 1¼ inch particle board. The unit illustrated with cart but less wiring would be priced at about $850 list. Carts alone are priced in the $160 range.



CCTV Test Pattern Generator

Circle No. 139 on Reader Inquiry Card

The Signal Source 12 is a new television test instrument reportedly designed to meet the requirement for a high quality, lower cost instrument suitable for performance verification and maintenance of television equipment operating at the 525/60 scan rate. It produces, on a single display, a video pattern with Resolution, White Reference, and Gray Scale segments for optimum setup of a display device. BAR, DOT, and FLAT FIELD patterns can be used to evaluate scan size, linearity, and brightness uniformity. The instrument is small and lightweight, housed in a cabinet convenient for por-

table field use or laboratory bench use. It operates from 120V ac, and is priced at $895.00.

Pocket Data Terminal

Circle No. 140 on Reader Inquiry Card

A miniature data terminal of tool-kit size has recently been introduced by *G. R. Electronics*. The device sends and receives all 128 ASCII codes. The last 30 characters received are held in memory for access through a built-in 16-segment alphanumeric display. Applications could include troubleshooting, debugging, status monitoring, information retrieval and small-scale reprogramming. The case measures 3 by 6 inches; the terminal has 48 keys and is provided with a 25-way connector for RS232/C compatibility.

DMM

Circle No. 141 on Reader Inquiry Card

Data Tech has recently introduced the model 30L, a 3½ digit multimeter for bench/portable applications. The 30L has a 0.1% basic accuracy and measures dc voltage to 1.5kv, ac voltage to 1.2kv, has six ohms ranges and five ranges each of ac and dc current to 2 Amperes. It offers battery operation, HV, RF, and demodulator probes, a rack mount and carrying case as options. The list price is $169.00

18 and 26GHz Frequency Counters

Circle No. 142 on Reader Inquiry Card

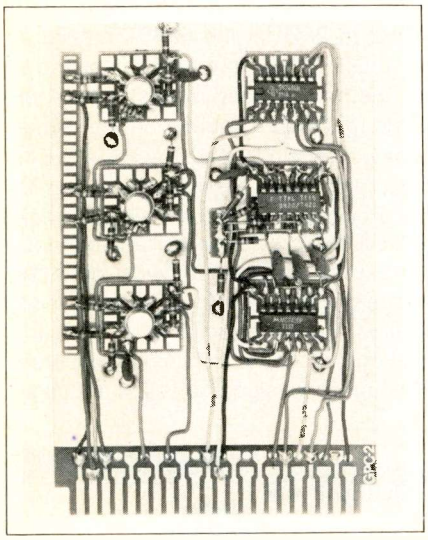
Systron-Donner has introduced two new microwave counters that offer performance technical features not commonly available until now. The top of the line Model 6246A measures frequency from 20Hz to 26GHz; the 6245A measures to 18GHz. This new series is stated to be the smallest and lightest bench/portable microwave counter on the market today, measuring 8⅜ in. wide, 13½ in. deep and 4¾ in. high, and weighing 12 lbs. Power consumption is 35 w. Models 6245A/46A provide simplified frequency measurement over a wide dynamic range of inputs and high levels of modulation. Signals as small as -25dBm and as large as +27dBm can be measured. With adjacent signal rejection and high-

speed tracking capabilities, these counters are reportedly ideal where modulated signals are encountered. Other features include an overload warning indication, 10-digit LED display, optional remote programming via the IEEE-488 interface bus, and a choice of higher stability optional oscillators. 18GHz Model 6245A: $3,750, and 26GHz Model 6246A: $4,250.

Breadboarding System

Circle No. 143 on Reader Inquiry Card

The *Wainwright Instruments* breadboarding system consists of "solder mount," strips and squares which can be attached by means of pressure sensitive



adhesive to a ground plane and in turn have component leads soldered to them. A variety of solder mounts and ground planes are available as are enclosures for prototyping or constructing finished instruments. Components of the system are sold as separate items or in kits.

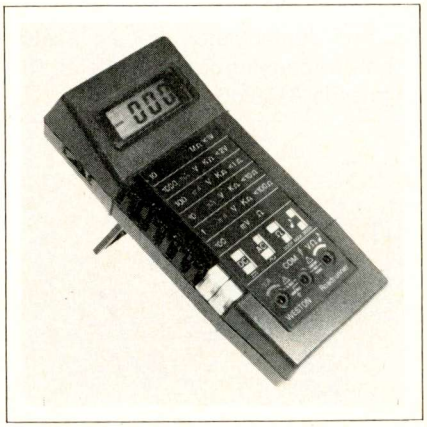
Clamp-on Ammeter

Circle No. 144 on Reader Inquiry Card

Triplett has just introduced a new clamp-on ammeter/ac voltmeter designated the Model 30. It features a one inch opening and a "Memo-Loc" pointer to permit out of sight measurements. Meter ranges cover 0-300 ac amperes in six ranges, 0-600Vac in three ranges and a ten ohm center scale ohmmeter range with an optional adapter. A leather carrying case is also available. The price is $65.00.

Audio response™ DMM

Circle No. 145 on Reader Inquiry Card

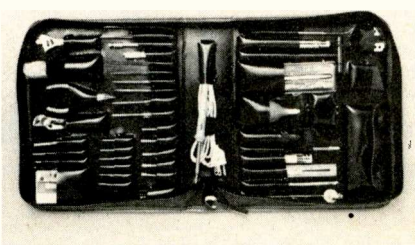


Weston has just announced the addition of the Model 6100, a 3½ digit LCD audio response™ multimeter to its test equipment line. Five ranges <1V, <2V, <1 ohm, <10 ohm, <100 ohm of the audio response function allows rapid testing without looking at the meter. Additionally the 6100 offers ac/dc volts, ac/dc current, and resistance functions in 24 ranges. It has a color coded panel and push button switches for hand held operation. Its basic accuracy rating is 0.5% of reading (dc volts) and the price is under $150.

Miniature and subminiature tool kit

Circle No. 146 on Reader Inquiry Card

Jensen Tools Inc. offers a new miniature and subminiature precision tool kit designed for scientists, electronic technicians and instrument mechanics who work primarily on intricate devices and



fine assemblies. The JTK-24 contains more than 120 tools in a 10½ × 12½ in. multi-pocketed padded zipper case. The JTK-24 is intended for servicing, repair and assembly of electronic equipment, optical and photographic equipment, office machines, test equipment and flight instruments. Included in the kit are miniature screwdrivers, nutdrivers, pliers, wrenches, spline and hex keys, needle files, precision drills, optical aids and soldering equipment.

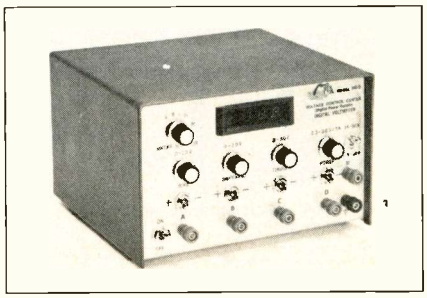
5 Digit Universal Counter

Circle No. 147 on Reader Inquiry Card

In addition to its test equipment line, *Non-Linear Systems* has a line of digital panel meters and counters, with 15 basic models. One of the most versatile of these instruments is the Model RC-5, 5 function, 5 digit, Universal Counter. It operates as an event counter, a frequency counter, a time interval counter, a period counter, and a frequency ratio counter. Crystal countrolled time base settings are .01, 0.1, 1.0 and 10 seconds. Function and time base are programmed internally by jumpers. Accuracy is ± 1 digit plus time base accuracy, typically 50 PPM. It comes in DIN/NEMA style case with 0.5 inch LED readout.

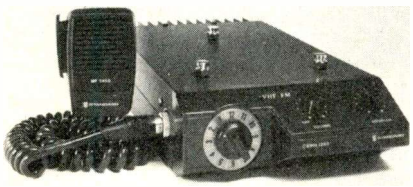
Power Supply/DMM

Circle No. 148 on Reader Inquiry Card



PTS Electronics new regulated power supply/DMM includes a 0-30vdc 5 amp supply and three low current supplies, 0-15vdc 50 ma, 0-20vdc at 100ma and 0-30vdc at 200ma. The digital voltmeter can be used independently or to monitor any of the supplies to a reported accuracy of 0.05%. the price is $269.95 with a one-year limited warranty. ET/D

DEALER'S SHOWCASE



Telephone Dialer

Circle No. 151 on Reader Inquiry Card

Hi-Tek Consumer Products Division has announced the availability of the Autotouch M-40 Automatic Telephone Dialer, reportedly capable of storing up to 40 frequently dialed telephone numbers in its memory. Each number in the M-40 can be dialed with the touch of a single button, eliminating the process of dialing and redialing important and frequently-used numbers. In addition, two buttons can be used consecutively to place overseas calls automatically. The Autotouch dialer pad can also be used to dial numbers not in the memory, thereby converting rotary dial phones to push-button. A recall button automatically re-dials the last number called, whether or not it is in the memory. The Hi-Tek M-40 is stated to be protected against loss of memory due to an AC power failure. A built-in batter power supply saves the memory, eliminating the need to reprogram the dialer. The price is $199.95.

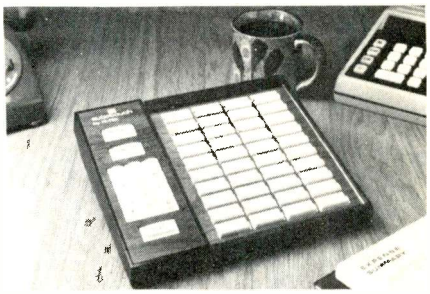
Distribution Amplifier

Circle No. 152 on Reader Inquiry Card

The Eagle Series of distribution amplifiers has recently been introduced by *Trans USA Corporation*. Reportedly designed for CATV systems, they are stated to be capable of handling up to 30 channels simultaneously with no perceptible distortion.

Business Radio

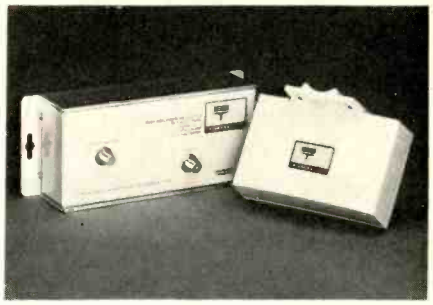
Circle No. 153 on Reader Inquiry Card



A new 60 watt VHF/FM business two-way radio is now available from *Standard Communications Corp*. Designated 890L-60, this transceiver is available with one, two or 12 channels and is designed for operation in the 138-174 MHz range. It incorporates a built-in 8 ohm speaker, external speaker jack and utilizes separate transmit and receive crystals for maximum flexibility. The 890L-60 measures 6 ½ in. wide × 2 ⅜ in. high × 9 ¾ in. deep and comes complete with a dynamic microphone.

MATV Amplifiers

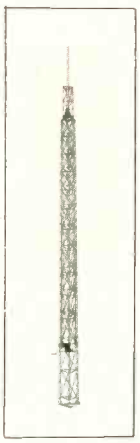
Circle No. 154 on Reader Inquiry Card



Blonder-Tongue's new "Galaxy Plus" amplifiers are stated to cause no TV signal degradiation when used in moderate size MATV or home installations. The system consists of a low noise mast mounted preamplifier and an indoor amplifier/power supply. Two UHF/VHF and a VHF only models are available, all designed for use with coaxial cable. All are reportedly lightning and power line surge protected and feature built in FM traps. Each is complete with mounting hardware and cable connectors.

Crank-up Towers

Circle No. 155 on Reader Inquiry Card



Aluma Towers crank-up steel towers are available in heights of up to 60 ft. All towers are reportedly electric welded and rust treated before a final aluminum spray finish. All other hardware is sprayed or galvanized. Aluma Tower also has a line of stack-up towers for heights of up to 200 ft. and also manufactures a full line of aluminum towers.

Auto Radio FM Booster

Circle No. 156 on Reader Inquiry Card

Russell Industries FREM-1 is a self contained unit producing a maximum of 12dB gain across the 88-108MHz band. The off-on switch bypasses the unit to avoid interfering with AM reception; an LED indicates the unit is on. ETD

Let the Real Estate Investing Letter show you HOW TO MAKE THE MOST OF YOUR REAL ESTATE INVESTMENTS with this special no-risk introductory offer.

In times like these, it's important to get the best advice you can. That's why you should be getting the **Real Estate Investing Letter**—the nation's largest paid-circulation real estate investment publication.

Every monthly issue gives you 10 fast-reading pages of information, interpretation and analysis. You get sound, up-to-date and USABLE advice . . . the kind you need to **protect** your assets and **build** your holdings.

The Real Estate Investing Letter. It's like sitting down with experts.

As a subscriber to the **Real Estate Investing Letter,** you'll join thousands of investors, managers, brokers, and builders. You'll read articles by leading authorities covering all areas of the real estate investing field, from investment planning, strategies and analysis to financing, insurance, and taxes . . . from mortgages and legal matters to landlord/tenant affairs.

The subjects of some recent feature articles indicate how useful the **REI Letter** can be to you. Consider these!

- **New Alternatives to Conventional Mortgages**
- **Maxi-Money with Mini-Shopping Centers**
- **Auditing Your Investment Performance**
- **How to Buy Raw Land**
- **Tenant Screening: Recognizing Danger Signals**
- **3 Ways to Appraise a Property**
- **Reducing Your Largest Operating Expense: Property Taxes**
- **Keeping Your Equity Lean: When To Refinance**
- **Single Family Homes: The Advantages of Buying to Rent**
- **Advantages of Rehabilitating Apartments for Low-Income Tenants**

But feature articles aren't all. You'll benefit from the **REI Letter's** regular columns and departments as well. **"Update"** alerts you to fast-breaking news and trends. **"Mistakes to Avoid"** helps you steer clear of costly errors. **"Readers' Forum"** answers your toughest questions. And **"In Brief"** gives you two full pages of mini-reports that have a bearing on the profitability of your holdings.

MONEY-BACK GUARANTEE. If you're not completely satisfied with the **Real Estate Investing Letter** after reading your first three issues, let us know and we'll send you an immediate, full refund—no questions asked. The issues and "15 Outstanding Strategies" are yours to keep in any case.

And all articles are briefed for quick comprehension.

With coverage like this, it's no wonder the **Real Estate Investing Letter** has become so well respected.

What it says to subscribers is only one reason. **How** it presents information is significant, too. The **REI Letter** is written in clear, concise language . . . and to avoid possible confusion, technical terms are defined, common abbreviations are explained, and helpful graphs and charts are liberally used.

Meet the people who put it together for you:

The **REI Letter** is published by United Media International, a subsidiary of the publishing company Harcourt Brace Jovanovich, Inc.

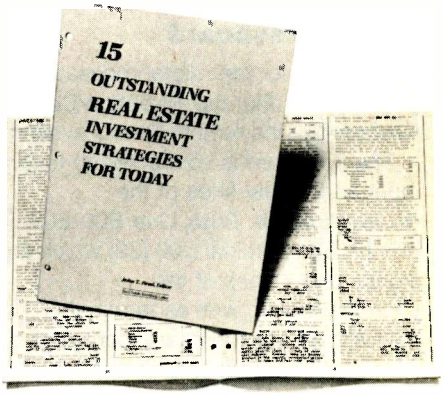
Our editors know real estate first hand—and communicate their knowledge in the clearest, most concise way possible.

John T. Reed, Editor. Apartment building owner with years of experience in real estate brokerage and property management. Frequent guest speaker at apartment owners associations. Author of **Apartment Investing Check Lists.**

Thomas O'Dea, Senior Contributing Editor. Manager of property acquisitions and operations for the General Investment Development Company. Vice President of Oxford Development Corporation.

Giles Kemp, Executive Editor. Harvard MBA. Professional writer and editor for publications including **Business Monthly** and **Money Management Digest.**

Subscribe now and receive this valuable free report.



Subscribe to the **Real Estate Investing Letter** now, and you'll receive a free 26-page report entitled "15 Outstanding Real Estate Investment Strategies for Today."

"15 Outstanding Real Estate Investment Strategies for Today" covers such areas as investing in office buildings . . . inflation . . . vacation homes . . . mini-warehouses . . . second mortgages. . . buying property in default . . . and duplexes.

This report is yours **free** with your subscription.

A one-year subscription to the **REI Letter**—that's 12 monthly issues—is just $35. And the subscription price is fully **tax deductible** if you use the **Letter** for business or investment purposes.

Clip and mail the coupon today!

I WANT TO GET MORE FROM MY REAL ESTATE INVESTMENTS

☐ Please enter my one-year (12 issues) subscription to the **Real Estate Investing Letter** for $35. And rush me "15 Outstanding Real Estate Investment Strategies for Today" as my free bonus.

☐ I prefer a short-term trial subscription. Send me the next three issues for $10—payment enclosed. (I understand that this short-term offer does not entitle me to receive the bonus—and that I must enclose payment to take advantage of this trial.)

Name_____

Street_____

City_____ State_____ ZIP_____

☐ Enclosed is my check or money order. ☐ Please bill me.
Charge my ☐ Master Charge ☐ American Express ☐ BankAmericard/VISA

Account Number_____ Expiration Date_____

Signature_____

Real Estate Investing Letter, 306 Dartmouth Street, Boston, MA 02116

H91607

SANYO

continued from page 31

Volume control is in sixteen steps controlled by the microprocessor. The volume key produces sixteen different pulse trains from the microprocessor which are converted to a control voltage by Q1125. As the pulses get longer, the bias on Q1125 increases, the collector voltage decreases which raises the volume level (Fig. 6). To mute between channels and during Off-On operation terminal D01 (24) goes high, and turns off Q1125; the high collector voltage then turns off the audio.

Control keyboard

Commands for the microprocessor originate in either the 16-button Control Keyboard or the remote control system.

The keyboard is connected to both input and output lines of the microprocessor. Buss Line E00-E03 (15-18) and terminal D00 (23) which are signal output lines of the microprocessor, well as terminal A10-A13 (7-10) which are input lines of the microprocessor are connected to the keyboard. A group of switches laid out as shown in Fig. 1 is called a Matrix Keyboard. From Buss Line and terminal D00 (23), signals for Control Keys (Board) are generated. The microprocessor traces these signals back through the input terminals to single out the function key which is pressed by the user.

The Buss Line contains signals not only for the control keyboard, but also for other controls. Signals for the control keyboard, as well as for the PLL and channel display are applied from the microprocessor. At the input terminals A10-A13 (7-10) of the microprocessor, and gates are provided in order to extract only those signals related to the control keyboard and not Buss Line Signals. The timing of these gates is controlled inside the microprocessor.

Remote control

The remote receiver has three major sections; 1) the remote preamplifier (Fig. 2) receives the infrared signal by means of a PIN diode. The output of this diode is applied to the gate of Q1801 (a FET) for impedance matching. Most of the gain is provided by the second and third amps. The third amp is a dual operational amplifier. Feedback in these amplifiers and the input high pass filters shape the band pass characteristics so that the gain is zero at dc, and essentially open loop (maximum gain) at 42KHz. The total gain of the preamplifier is 100dB; 2) signals from the preamplifier are amplifed further in a band pass amplifier at 42KHz. A diode clamp eliminates signals below approximately 1 v. The detected output then is applied to 3) a schmidtt trigger pulse shaper. This signal then is applied to the SNSO input of the microprocessor.

The remote transmitter (Fig. 8) emits a pulse modulated infrared beam. An IC, provides pulse generation and keyboard decoding. An LC oscillator operating at 42KHz is modulated by the pulse signal from the IC and drives infrared emitting LED's. ET/D

NEW FIELDS

continued from page 19

technical capability related to the repair of the display chassis itself than the service organizations within our own existing TV service marketplace!

Would not a service technician be well-advised to seek out these software and service organizations and create an awareness of the repair service that our existing TV service people can provide?

We are close to the day when most small business and most mid to higher income bracket households will have a computer...it may need service! ET/D

CUT YOUR AD BUDGET LATELY?

Honesty compels us to admit that you're not alone.

Whenever the cost/price squeeze gets really tough, it's a temptation to regard advertising as a cost . . . and to cut.

Not at every company, however.

In recent years, a significant change has taken place in the thinking of many management men about advertising budgets. No longer are appropriations cut automatically when the pressure is on.

Why?

For a number of reasons. Among them are:

1. *With the growth of the marketing concept,* advertising is no longer looked upon merely as an expense, but as an integral part of the company's marketing mix.

2. *Firms that maintain advertising during recession years do better in sales—and profits—in those and later years.* That was proved conclusively in studies of five separate recessions made by ABP and Meldrum and Fewsmith.

3. *The cost of a salesman's call today makes it imperative to make maximum use of advertising.* The average cost of an industrial sales call soared to a record $96.79 according to the latest report by McGraw-Hill's Research Laboratory of Advertising Performance. Yet studies show that a *completed* advertising sales call—that is, one ad read thoroughly by one buying influence—literally costs only pennies. Why deny yourself such efficiency?

4. *In some cases, there is no way to reach customers except by advertising.* The "Paper Mill Study" shows (1) the number of buying influences in the average plant is far greater than marketers are aware of, (2) the vast majority of these influences are unknown to salesmen, (3) no salesman has the time to contact all influences even if he knows them.

5. *Selling costs are lower in companies that assign advertising a larger role in marketing products.* So advertising is an investment in profit, just like a machine that cuts production costs.

6. *Memories are short.* There is an estimated 30% turnover every year among buyers. It isn't surprising, then, that lack of advertising contact can quickly result in loss of share of market.

7. *Most down periods turn out to be shorter than expected.* The history of every postwar recession is that it didn't last as long as predicted. Why gamble your market position for short-term gain?

8. *Consider lead time.* Very few products sold to business and industry are bought on impulse. The advertising you are doing—or missing—right now will have its effect years from now.

9. *Advertising works cumulatively.* It would be nice to think that every reader reads all of your ad. We know it doesn't work that way. To be most effective, advertising must have continuity.

10. *Did your competitor cancel his budget, too?* If not, you may be taking a big risk.

11. *Will you lose salesmen?* They know that their chance of getting an order is better if they are backed up by advertising. Can you be sure of keeping them when they learn that that support has gone?

12. *You know better.* Survey after survey of executives shows that they expect a *drop* in sales if advertising stops.

But there is need for efficiency . . .

whenever advertising budgets are being assembled—never more than in these inflationary times. Significantly, a recent survey shows that nearly 40% of the average budget for advertising to business and industry is invested in business publication space and preparation. That's *more than double* the next largest item.

Why? Because specialized business publications remain the most effective and efficient method of reaching target audiences in business, industry and the professions.

And we can prove it.

Write for your copy of "The ABP Library of Publishing, Advertising & Marketing" to American Business Press.

☆ABP

American Business Press, Inc.
205 East 42nd Street
New York, N.Y. 10017
212 661-6360

CLASSIFIED

RATES: 40 cents per word (minimum charge, $10). Bold face words or words in all capital letters charged at 50 cents per word. Boxed or display ads charged at $50 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad. Send ad copy with payment to Dawn Anderson, ELECTRONIC TECHNICIAN/DEALER, 1 East First Street, Duluth, MN 55802.

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

FOR SALE

Picture Tube Rebuilding Equipment with or without TV Service Department. Produce 48 Quality Tubes per week. Sell to Distributors, TV Shops and Retail. Everything you need for a Profitable Business. Very Reasonable. Write R. Nass, 23 Terry Lane, Pomona, NJ 08240.

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

Obsolete hard-to-get tubes and vibrators, reasonable. Send your needs—Morris Radio & Television, Danbury, CT 06810. TF

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

LAKESIDE INDUSTRIES

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

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

GENUINE SONY SEMICONDUCTORS—CHECK THESE PRICES!!
EG. 1-9/ 10-24—SG613-8.50/7.30-SID 30-15 2.60/2.30, -2SC867A 5.10/4.90-2SC1114 5.50/4.80-2SC1358 6.50/5.70, -2SC124 1.50/1.30-2SC634A 0.45/0.41. Contact us for complete list of Japanese semiconductors and pricing information. Bescor, 547 S. Broadway, Hickville, NY 11801 (516) 822-3988

Full line GTE Sylvania receiving tubes at 70% discount full warranty replacement. Original Sony-Panasonic Electrolytics Imfd-50v 25¢, 2200Mfd-50v $1.99, 47Mfd-160v 35¢, 10Mfd-25/50v 25¢. Write Jeff Tauber, Redcoat Electronics, 66-15 Thornton Place, Forest Hills NY 11374, (212) 261-9479.

REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S89633 etc. $19.95. Magnavox 361380-1 $21.95 etc. Sylvania, G.E. etc. $17.95 to $22.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 655 Jerricho Turnpike, Huntington Station, N.Y. 11746. 516-549-3925 TF

ELECTRONIC STUDENTS SERVICE TECHNICIANS-Service/Repair TV receivers the easy way with the **WAVEFORM ANALYSIS CHART** and test procedure-$9.95 postpaid-**TELEVISION SERVICE AIDS** 548 Cooke St. Honolulu, HI 96813. 10/79

LINEAR AMPLIFIER, 2-30 MHz, 100 or 200 watt solid state. 300 MHz COUNTER. Modulation BOOSTER. Omnidirectional BASE ANTENNA. Plans $3.00 each. $10.00/all. Catalog of others. **Panaxis** Box 130-ET10 Paradise, CA 95969

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

Sams CB Photofacts. 1-100 $2.00 each; 100-213 $2.50 each. Rise Communications, 1206 green St., Warner Robins, GA 31093. 912-923-7006. 10/79

TUBES—Receiving, Industrial and Semiconductors, factory boxed. Free price list. Low, low prices. **TRANSELECTRONIC INC.** 1365-39th Street, Brooklyn, N.Y. 1218E 800-221-5802, 212-633-2800.

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

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

PAYMENT MUST ACCOMPANY ORDER. WE'LL BILL RATED FIRMS

NAME_____ COMPANY_____

STREET_____

CITY_____ STATE_____ ZIP_____

MAIL AD COPY TO: DAWN ANDERSON, ELECTRONIC TECHNICIAN/DEALER, 1 EAST FIRST STREET, DULUTH, MN. 55802.

RATES: 45 cents per word (minimum charge, $15). Bold face words or words in all capital letters charged at 60 cents per word. Boxed or display ads charged at $55 per column inch (one inch minimum). For ads using blind box number, add $5 to total cost of ad.

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

SONY-PANASONIC-RCA-ZENITH-EXACT REPLACEMENT PARTS-LARGE INVENTORIES-SEND PART OR MODEL NUMBERS-WILL UPS OR COD-GREEN TELE RADIO DISTRIBUTORS, 172 SUNRISE HIGHWAY, ROCKVILLE CENTRE, N.Y. 11570. TF

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

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

COLOR PICTURE TUBE REBUILDING EQUIPMENT. SEMIAUTOMATIC ELECTRONICALLY CONTROLLED PROCESS. COMPLETE TRAINING. Call or write Atoll Television, 6425 W. Irving Park, Chicago, IL 60634. Phone 312-545-6667. 11/79

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

MATV-CATV INSTALLERS Get lowest prices on antenna accessories, fastest service from **ANTSCO CORPORATION.** Call collect, ask for catalog & prices. All orders shipped same day. Sierra Madre, CA. 91024. 213-355-2510. 1/80

Just starting a TV Business? Have most test equipment you need at a reasonable package price. L. Johnson, 314 Mine Road, Fredericksburg, VA 22401 703-898-1968

Your Business Card imprinted on handy 3½ x 4 **Monthly Calendar.** 300 only $59.95. Additional 100's $14.95. Send business card with check. Volume House Distributors, 83-05 98th Street, Woodhaven, NY 11421.

SAMS PHOTOFACTS 1 thru 1800-$2500.00. 1277 Radio & T.V. Tubes $1,000.00. J. Kolysko, 12 Alexandria Ave., Ticonderoga, NY 12883, Telephone 518-585-7621.

TV Tuner Cleaning Aid. Polish wafer contacts, dry method. Works every time. Hundreds of uses on one stick. Send $2.00 to Beverly Ross, 6206 N. Francisco, Chicago IL 60659.

BUSINESS OPPORTUNITIES

Florida's Booming West Coast. RCA Sales & Service Shop. Same location 24 years. Grossing over 100,000 complete inventory, equipment, 1974 Dodge van, 40,000 miles. Price $34,500 Write ET/D Box 128.

T.V. Stereo Sales And Service. Business For Sale. Warranty Service Center. For Soundesign Stereo Systems. Also T.V. Sales. Established over 20 years in south Jersey. Includes all stock and merchandise, new modern equipment. Has fantastic potential. Must sell business due to health problems. Cherry Hill T.V. Service. 11 West Main Street. Maple Shade, NJ 08052 (609) 667-8881. 11/79

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

TV Sales and Service for sale. Well established dealership. Excellent location on 5 acres of prime commercial property in Alpena, Mich. Good gross sales. Business showroom and shop attached to a 4 bedroom house. (Now has many commercial accounts). McGirr Reality, 1020 W. Chisholm, Alpena, MI (517) 354-3482. 11/79

CHICAGO-TV REPAIR SHOP AND USED COLOR TV'S SALES. Established 5 years. Zenith factory authorized service center. Net approx. $28,000. Thriving business choice location, owner moving to California for personal reason. MUST SELL! Price only $7,400, including fixtures and over 40 used color TV's. Also available picture tube rebuilding equipment $3,400, will train to operate. Call or write Atoll TV, 6425 Irving, Chicago Illinois 60634, Phone 312-545-6667. Hours 1-8.

TV & Stereo Sales & Service Business for Sale. Large profitable antenna & tower business. Displays of Hardwick microwaves, auto stereo systems, & audio accessories. Authorized Sylvania dealer. $90,000 yr. gross. Located in small Iowa town, friendly people, excellent place to raise family. No money down. North Central Electronics, Box 317, Burt, Iowa 50522. (515) 924-3800.

BROADCAST STATION. Start your own any type! Unique Cable FM station operation-investments/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:", Box 130 ET10, Paradise, CA 95969

TV sales and service in southeast North Dakota established 21 years. RCA dealership with growth potential for energetic technician. Presently one man operation. Reply ET/D Box 129.

TV Servicing Business, $25,000 takes all. Low overhead. Contact Stan Listzwan, 9909 E. Creek St., Tucson AZ 85730. 602-889-4910 or 885-3137. 11/79

SATELLITE TELEVISION-MOVIES, SPORTS, ETC. BUILD OR BUY YOUR OWN EARTH STATION. Send $3.00 for information Satellite Television, Box 140, Oxford, NY 13830.

WANTED

WANTED: Vertical rotary burner type necking and sealing machine for picture tubes. R.E.W. Electronics, Rt. 2 Barrington, N.H. 03825. 603-742-0717. 10/79

Wanted: Audio Recording Equipment of all ages and varieties. (415) 232-2933.

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

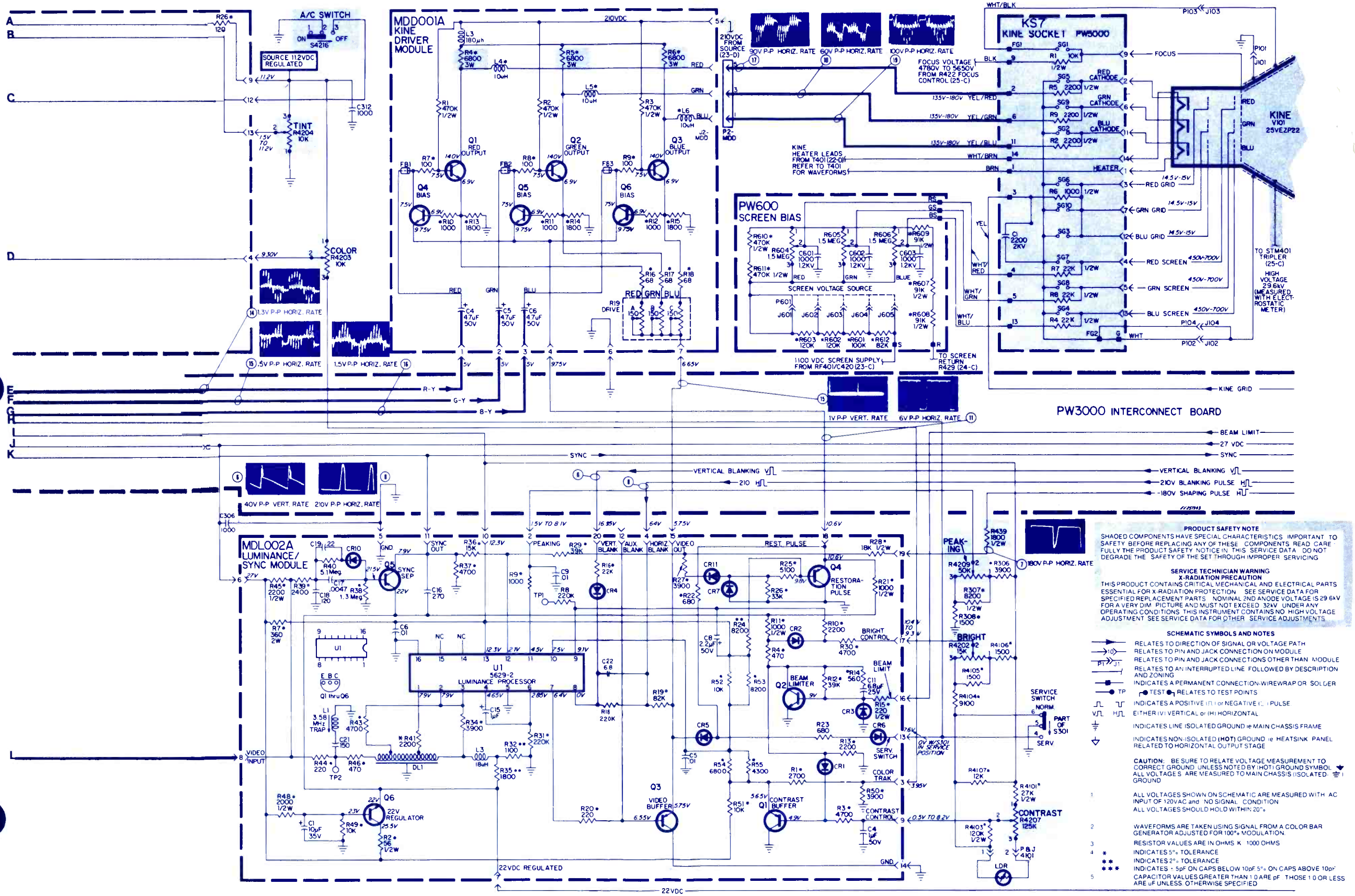
HELP WANTED

TUNER TECHNICIAN 18 months experience or more. Unique opportunity. 40% commission on labor, 5% on parts, and 40% on additional shipping charges. Send resume to P.O. Box 6456, Oakland Park, FL 33309. 10/79

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

AD INDEX

ADDITIONAL INFORMATION NEXT PAGE



PRODUCT SAFETY NOTE

SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE IN THIS SERVICE DATA DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING

SERVICE TECHNICIAN WARNING X-RADIATION PRECAUTION

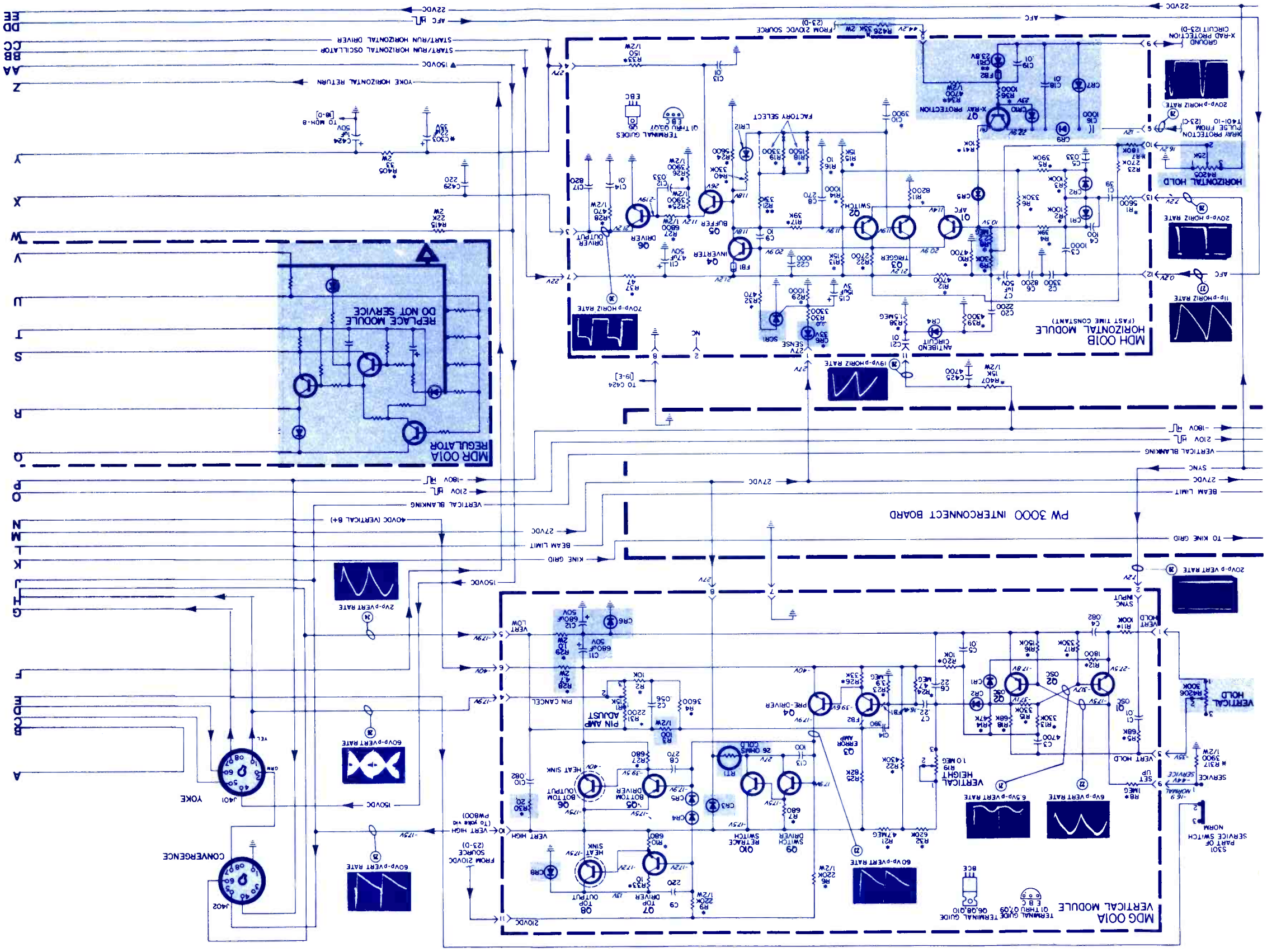
THIS PRODUCT CONTAINS CRITICAL MECHANICAL AND ELECTRICAL PARTS ESSENTIAL FOR X-RADIATION PROTECTION SEE SERVICE DATA FOR SPECIFIED REPLACEMENT PARTS NOMINAL 2ND ANODE VOLTAGE IS 29 6kV FOR A VERY DIM PICTURE AND MUST NOT EXCEED 32kV UNDER ANY OPERATING CONDITIONS THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT SEE SERVICE DATA FOR OTHER SERVICE ADJUSTMENTS

SCHEMATIC SYMBOLS AND NOTES

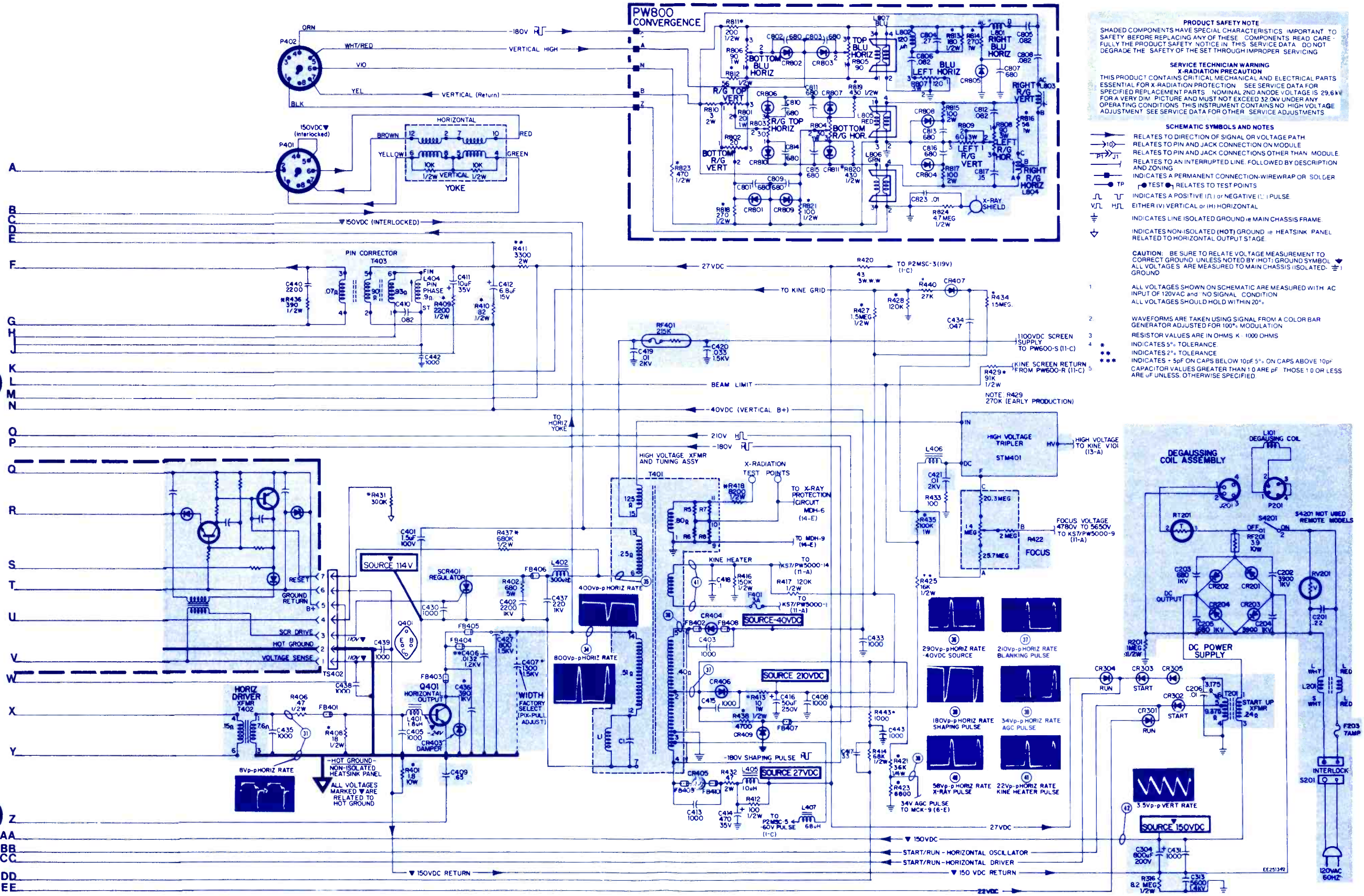
- RELATES TO DIRECTION OF SIGNAL OR VOLTAGE PATH
- RELATES TO PIN AND JACK CONNECTION ON MODULE
- RELATES TO PIN AND JACK CONNECTIONS OTHER THAN MODULE
- RELATES TO AN INTERRUPTED LINE FOLLOWED BY DESCRIPTION AND ZONING
- INDICATES A PERMANENT CONNECTION-WIREWRAP OR SOLDER
- TP TEST RELATES TO TEST POINTS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

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

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



RCA
Color TV Chassis
CTC 92



PRODUCT SAFETY NOTE

SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE IN THIS SERVICE DATA DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING

SERVICE TECHNICIAN WARNING
X-RADIATION PRECAUTION

THIS PRODUCT CONTAINS CRITICAL MECHANICAL AND ELECTRICAL PARTS ESSENTIAL FOR X-RADIATION PROTECTION SEE SERVICE DATA FOR SPECIFIED REPLACEMENT PARTS NOMINAL 2ND ANODE VOLTAGE IS 29.6kV FOR A VERY DIM PICTURE AND MUST NOT EXCEED 32.0kV UNDER ANY OPERATING CONDITIONS THIS INSTRUMENT CONTAINS NO HIGH VOLTAGE ADJUSTMENT SEE SERVICE DATA FOR OTHER SERVICE ADJUSTMENTS

SCHEMATIC SYMBOLS AND NOTES

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

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

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

1813

SHARP
Color TV Model
19C68A

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

OCTOBER • 1979

SAFETY PRECAUTION:

A. Service personnel should be thoroughly familiar with safety procedures before attempting repairs.
B. ⚠ and shaded components have special characteristics important to safety. For continued protection, replacement parts must be idential to those used in the original circuit.
C. The use of a substitute replacement part which does not have the same safety characteristics as the factory recommended replacement parts shown in this service manual may create shock, fire, x-radiation or other hazards.
D. Before returning the receiver to the customer, to make leakage current measurements:
1. Between all exposed metal parts and any exposed metal parts having a return to chassis, and
2. Between exposed metal parts and earth ground.
(Refer to the IMPORTANT SERVICE NOTES appearring on page 2.)

SAFETY NOTE:

1. *DISCONNECT THE AC PLUG FROM THE AC OUTLET BEFORE REPLACING PARTS.*
2. *SEMICONDUCTOR HEAT SINKS SHOULD BE REGARDED AS POTENTIAL SHOCK HAZARDS WHEN THE CHASSIS IS OPERATING.*
3. *THE CHASSIS IN THIS RECEIVER IS HOT. (CONNECTED TO ONE SIDE OF THE AC LINE) USE AN ISOLATION TRANSFORMER BETWEEN THE LINE CORD AND POWER RECEPTACLE, WHEN SERVICING THIS CHASSIS.*

NOTE:

1. *The unit of resistance "ohm" is omitted (K-1000 ohms M-1 Meg ohm).*
2. *All resistors are 1/4 watt, unless otherwise noted.*
3. *All capacitors μF, unless otherwise noted P-μμF.*

VOLTAGE MEASUREMENT CONDITIONS:

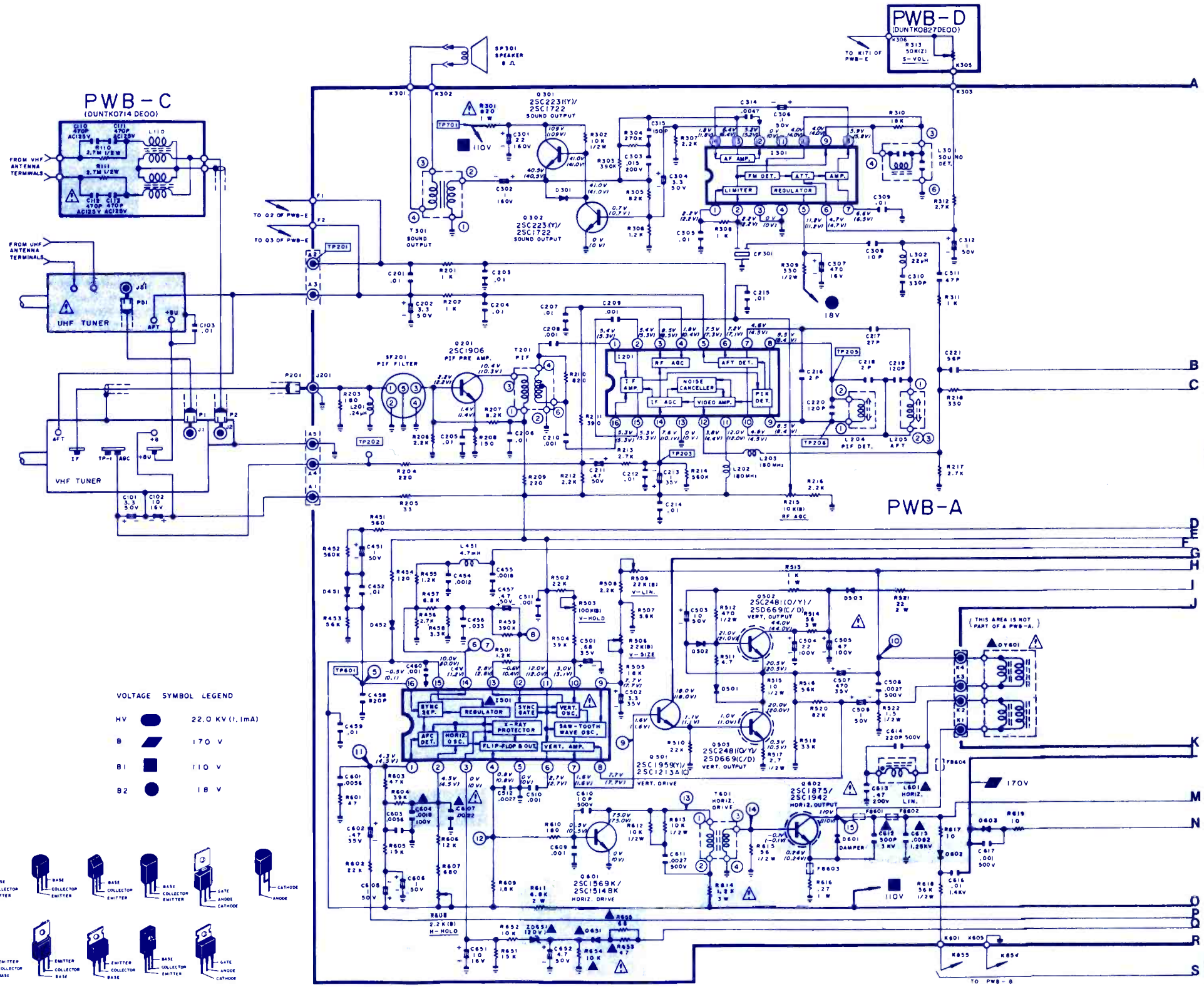
1. *DC voltages are measured with VTVM placed between points indicated and chassis ground, line voltage set at 120V AC and all controls set for normal picture unless otherwise indicated.*
2. *Voltage in parenthesis measured with no signal.*
3. *Voltages without parenthesis measured with 1000μV B & W or Color signal.*

WAVEFORM MEASUREMENT CONDITIONS:

Color bar generator signal of 1.9V peak to peak applied at pin 26 of I801.

CIRCUIT PROTECTION

The entire receiver is protected by a 4.0A (F7C1) fuse, mounted on PWB-A, that is wired into one side of the AC line input.

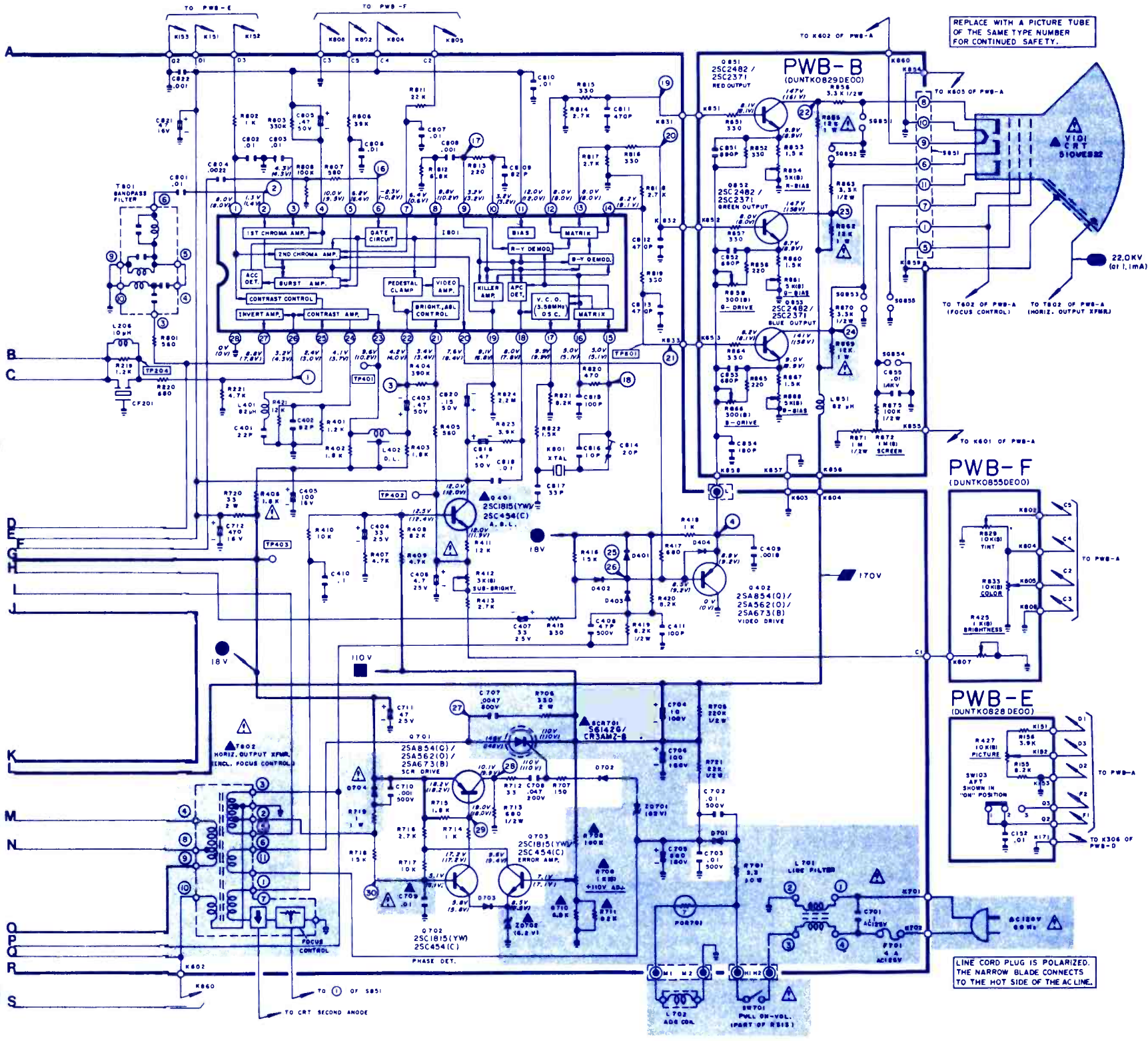


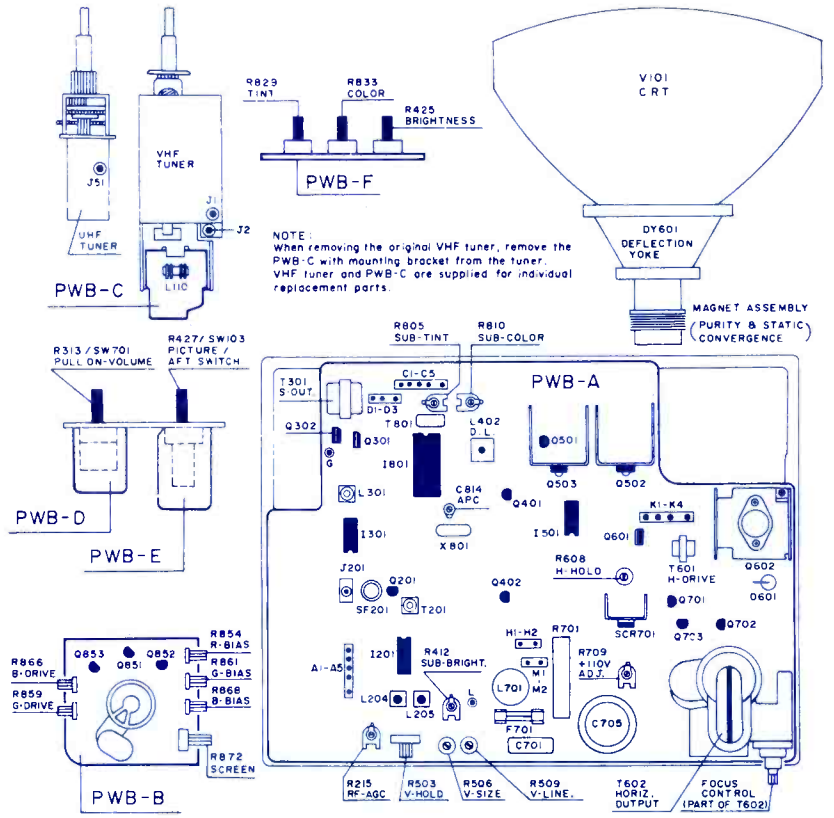
VOLTAGE SYMBOL LEGEND

HV	⬬	22.0 KV (1.1mA)
B	▰	170 V
B1	■	110 V
B2	●	18 V

⚠ *AND SHADED COMPONENTS: SAFETY RELATED PARTS, ▲ MARK: X-RAY RELATED PARTS.*

SHARP
Color TV Model
19C68A





(1) 1.9Vp-p	(2) 0.47Vp-p	(3) 0.9Vp-p	(4) 10.2Vp-p	(5) 2.1Vp-p	(6) 8.1Vp-p	(7) 8.1Vp-p	(8) 1.6Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Vert. Rate	Horiz. Rate	Vert. Rate
(11) 6.4Vp-p	(12) 1.65Vp-p	(13) 230Vp-p	(14) 1.9Vp-p	(15) 900Vp-p	(16) 6.5Vp-p	(17) 0.7Vp-p	(18) 0.52Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate
(21) 4.1Vp-p	(22) 140Vp-p	(23) 115Vp-p	(24) 130Vp-p	(25) 15.5Vp-p	(26) 1.2Vp-p	(27) 250Vp-p	(28) 1.4Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate	Vert. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate

1814

QUASAR
B&W TV Chassis
TX-493

OCTOBER • 1979

ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

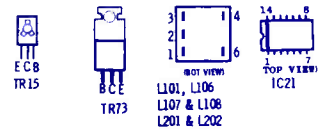
NOTES:
UNLESS OTHERWISE SPECIFIED: CAPACITOR VALUES LESS THAN 1 IN MF, ALL OTHERS IN PF. RESISTORS ARE 10%,1/2W UNLESS SPECIFIED.

VOLTAGE MEASUREMENTS
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A VTVM. ±20%.
2. LINE VOLTAGE MAINTAINED AT 120V AC
3. TAKEN WITH ALL CONTROLS AT NORMAL OPERATION.
4. WHERE TWO VOLTAGES SHOWN
   AIR SIGNAL(tuner on strong channel)
   NO SIGNAL (tuner between channel) ant. term. shorted, mid. noise)

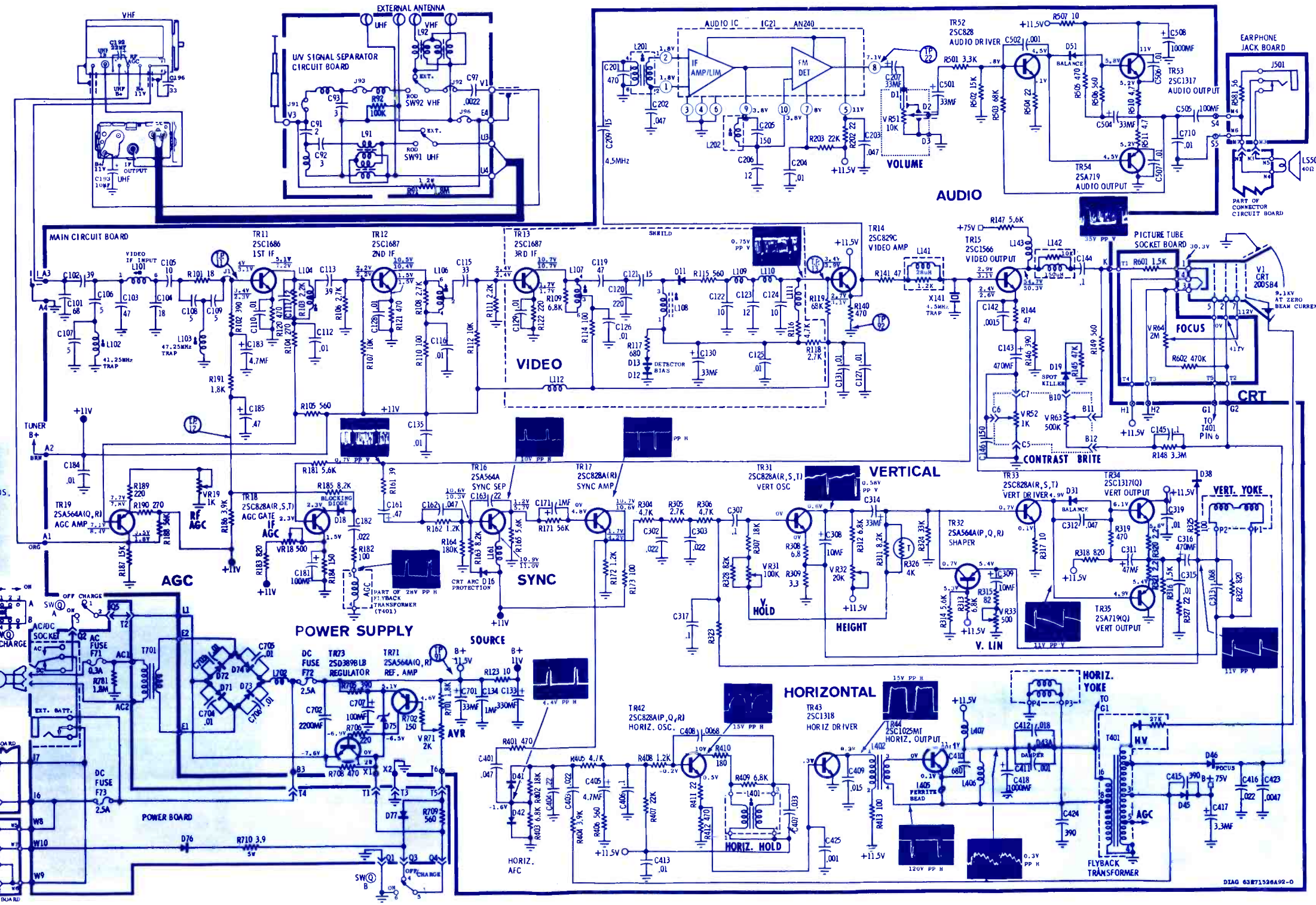
WAVEFORM MEASUREMENTS
1. TAKEN FROM POINT INDICATED TO CHASSIS WITH A WIDE-BAND OSCILLOSCOPE.
2. OSCILLOSCOPE SYNCED NEAR SWEEP RATE INDICATED.
3. TAKEN WITH AIR SIGNAL. ALL CONTROLS AT NORMAL OPERATION.

● INDICATES WIRE WOUND TERMINAL ON BOARD.

⬚ INDICATES OFF PANEL COMPONENTS.



SERVICE TECHNICIAN: IMPORTANT NOTE
THIS RECEIVER HAS BEEN DESIGNED TO MEET OR EXCEED APPLICABLE SAFETY AND X-RADIATION PROTECTION AS SPECIFIED BY GOVERNMENT AGENCIES AND INDEPENDENT TESTING LABORATORIES.
TO MAINTAIN ORIGINAL PRODUCT SAFETY DESIGN STANDARDS RELATIVE TO X-RADIATION, SHOCK AND FIRE HAZARD, THE PARTS SHOWN IN THE SHADED AREAS OF THIS SCHEMATIC MUST BE REPLACED WITH IDENTICAL REPLACEMENT PART NUMBERS SHOWN IN THE REPLACEMENT PARTS LIST OF THE SERVICE MANUAL.
FOR OPTIMUM PERFORMANCE AND RELIABILITY, ALL OTHER PARTS SHOULD BE REPLACED WITH COMPONENTS HAVING IDENTICAL SPECIFICATIONS.



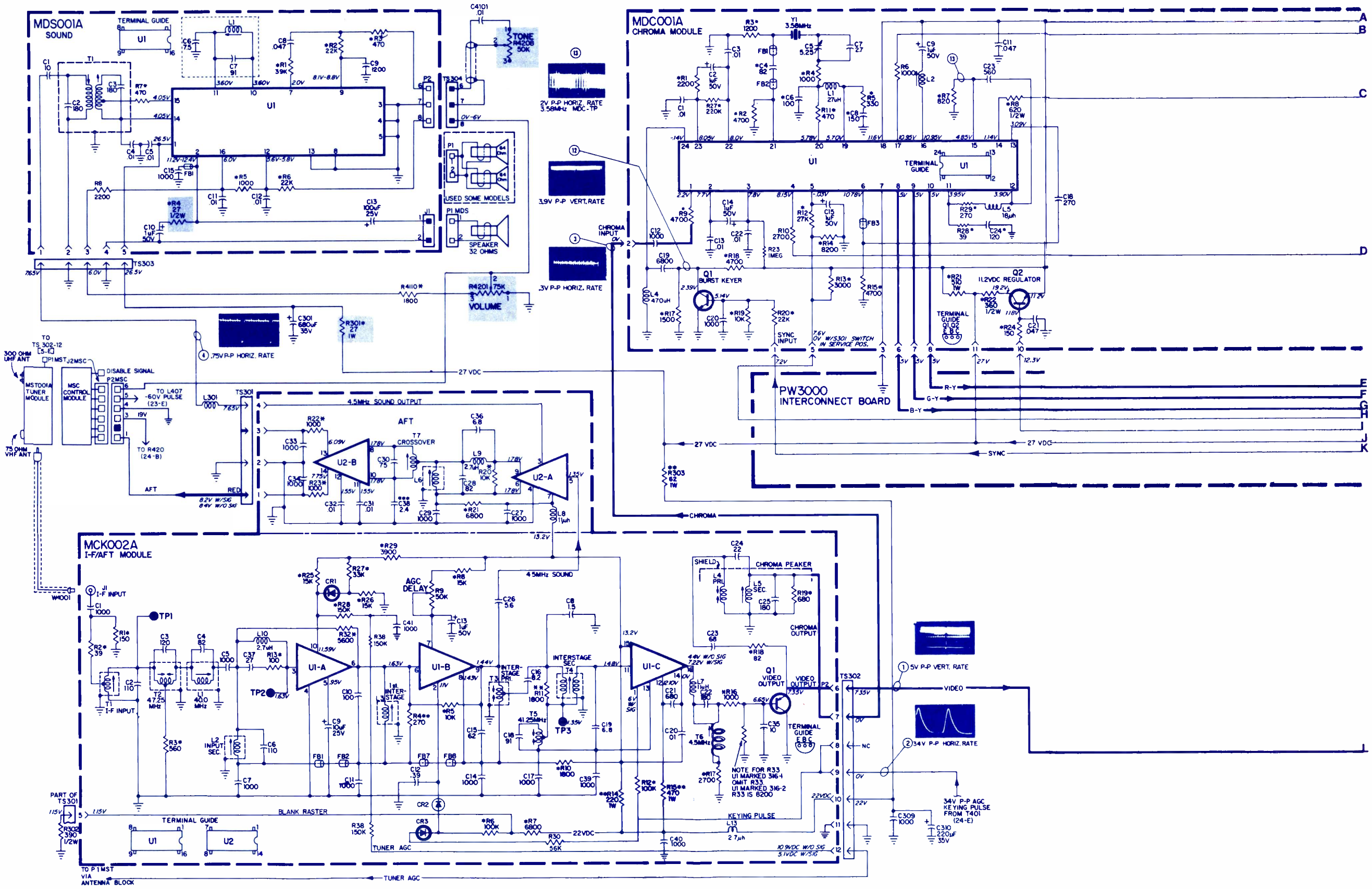
1812

RCA
Color TV Chassis
CTC 92

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

OCTOBER • 1979



ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

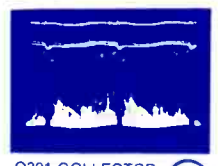
1811

RCA
B&W TV Chassis
KCS 204

OCTOBER • 1979

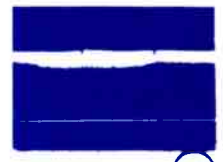

AGC KEY PULSE
H RATE 35V P-P
1

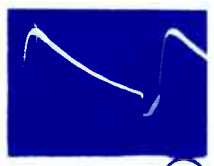

4.5MHz SOUND
V RATE 2V P-P
2


Q301 COLLECTOR
V RATE 4.7V P-P
3

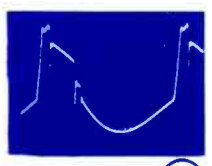

Q301 EMTR (VIDEO)
V RATE 2V P-P
4

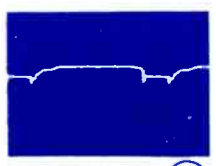

HORIZ SYNC
H RATE 15V P-P
5


VERT SYNC
V RATE 15V P-P
5

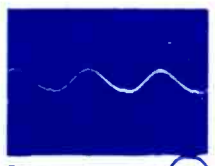

JCT CR501/502
H RATE 8V P-P
6


HORIZ FEEDBACK
H RATE 3.5V P-P
7


Q501 HORIZ OSC
H RATE 25V P-P
8


Q502 BASE
H RATE 12V P-P
9

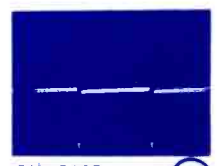

HORIZ PULSE-XFMR
H RATE 177V P-P
10


B+18VDC SOURCE
V RATE .05V P-P
11


KINE HTR PULSE
H RATE 39V P-P
12


+80VDC
V RATE 3V P-P
13


Q602 BASE
V RATE 6V P-P
14


Q604 BASE
V RATE 1.5V P-P
15

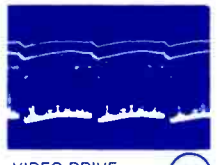

Q606 BASE
V RATE 45V P-P
16

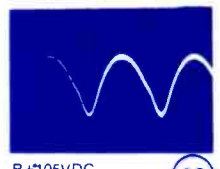

Q607 COLLECTOR
V RATE 1V P-P
17

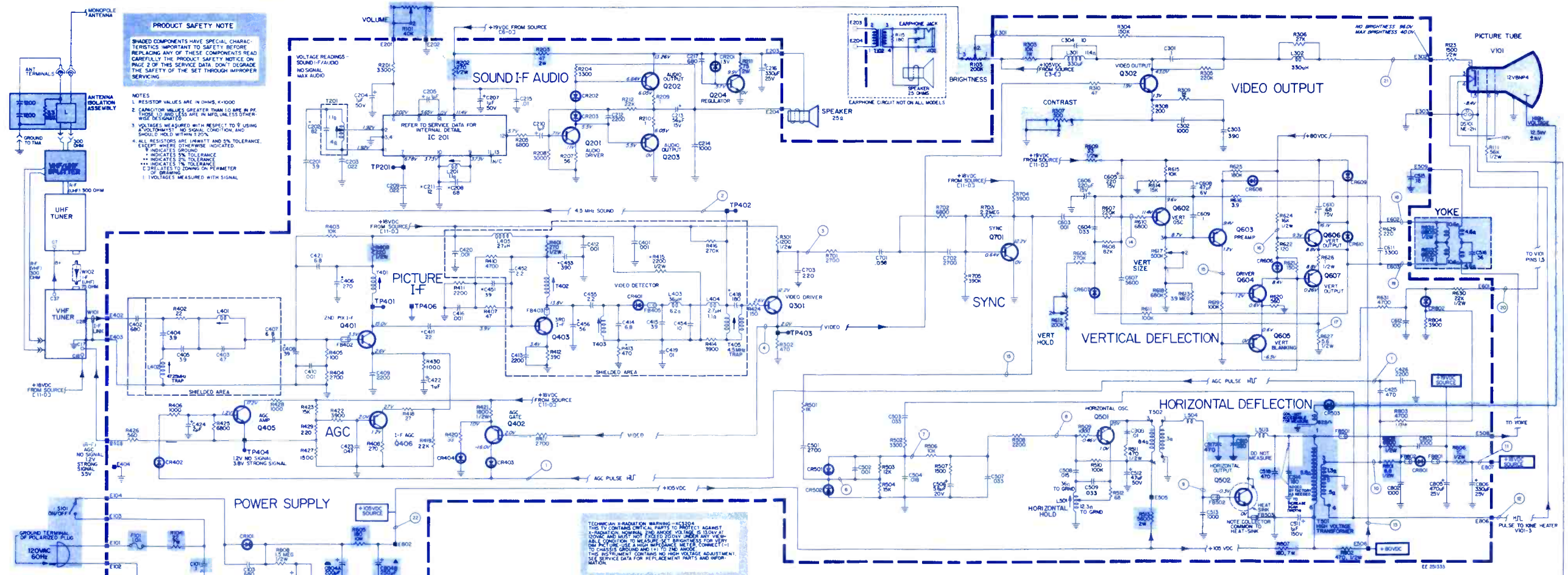

VERT DEFLECTION
V RATE 2.8V P-P
18


VERT DEFLECTION
V RATE 48V P-P
19


KINE BLANKING
V RATE 78V P-P
20


VIDEO DRIVE
V RATE 76V P-P
21


B+105VDC
V RATE .3V P-P
22



AVAILABLE NOW! ONLY$3.95
Add $1.00 for shipping.

JAPANESE TRANSISTOR SUBSTITUTION MANUAL

An invaluable Japanese to Japanese substitution guide for approximately 3000 transistors

- Covers the 2SA, 2SD, 2SC and 2SD series
- Introduction includes a guide to understanding Japanese transistors
- A 90 page, 8½ by 11" soft cover book

PARTS PROCUREMENT PROBLEMS

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

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

TYPE	25-UP	10-24	1-9
2SA 473	.45	.55	.60
2SA 483	2.00	2.20	2.50
2SA 484	1.50	1.75	1.95
2SA 485	1.40	1.60	1.80
2SA 489	1.10	1.25	1.40
2SA 490	.70	.80	.90
2SA 493	.45	.53	.59
2SA 495	.30	.35	.40
2SA 496	.50	.64	.70
2SA 497	1.00	1.20	1.30
2SA 505	.50	.64	.70
2SA 509	.30	.35	.40
2SA 525	.50	.64	.70
2SA 530	1.50	1.70	1.90
2SA 537A	1.50	1.70	1.90
2SA 539	.40	.45	.50
2SA 545	.45	.53	.59
2SA 561	.30	.35	.40
2SA 562	.30	.35	.40
2SA 564A	.20	.27	.30
2SA 565	.70	.80	.90
2SA 566	2.50	2.70	3.00
2SA 606	1.00	1.20	1.30
2SA 607	1.10	1.25	1.40
2SA 624	.70	.80	.90
2SA 627	3.10	3.30	3.60
2SA 628	.30	.35	.40
2SA 634	.40	.45	.50
2SA 640	.30	.35	.40
2SA 642	.30	.35	.40
2SA 643	.30	.40	.45
2SA 653	1.90	2.10	2.40
2SA 659	.35	.40	.45
2SA 661	.50	.64	.70
2SA 663	3.65	3.80	4.20
2SA 666	.35	.40	.45
2SA 671	.80	.90	1.00
2SA 672	.30	.35	.40
2SA 673	.35	.40	.45
2SA 678	.35	.40	.45
2SA 679	4.20	4.40	4.90
2SA 680	4.20	4.40	4.90
2SA 682	.80	.90	1.00
2SA 683	.30	.35	.40
2SA 684	.35	.40	.45
2SA 695	.40	.53	.59
2SA 697	.40	.53	.59
2SA 699A	.50	.64	.70
2SA 705	.40	.53	.59
2SA 706	.85	1.00	1.10
2SA 715	.60	.70	.80
2SA 719	.30	.35	.40
2SA 720	.30	.35	.40
2SA 721	.30	.35	.40
2SA 725	.30	.35	.40
2SA 726	.30	.35	.40
2SA 733	.20	.27	.30
2SA 738	.40	.53	.59
2SA 740	1.50	1.70	1.90
2SA 743A	.85	1.00	1.10
2SA 744	4.20	4.40	4.90
2SA 745R	3.80	4.00	4.40
2SA 747	4.20	4.40	4.90
2SA 748	.70	.80	.90
2SA 750	.35	.40	.45
2SA 755	.80	.90	1.00
2SA 756	2.30	2.40	2.65
2SA 758	3.40	3.55	3.90
2SA 764	3.80	4.00	4.40
2SA 765	3.10	3.30	3.60
2SA 774	.40	.45	.50
2SA 777	.50	.64	.70
2SA 794A	.60	.70	.80
2SA 798	.50	.55	.60
2SA 814	.70	.80	.90
2SA 815	.60	.70	.80
2SA 816	.50	.64	.70
2SA 818	.70	.80	.90
2SA 837R	2.50	2.70	2.90
2SA 839T	1.30	1.45	1.60
2SA 908	8.60	8.80	9.80
2SA 913	.70	.80	.90
2SB 22	.30	.35	.40
2SB 54	.20	.27	.30
2SB 55	.40	.53	.59
2SB 75	.35	.40	.45
2SB 77	.35	.40	.45
2SB 173	.30	.35	.40
2SB 175	.20	.27	.30
2SB 176	.30	.35	.40
2SB 178	.35	.40	.45
2SB 186	.20	.27	.30
2SB 187	.20	.27	.30
2SB 202	1.10	1.20	1.30
2SB 220	.90	1.10	1.20
2SB 303	.30	.35	.40
2SB 324	.30	.35	.40
2SB 337	.70	.80	.90
2SB 346	.30	.35	.40
2SB 367	1.10	1.25	1.40
2SB 368B	1.80	2.00	2.25
2SB 379	.70	.80	.90
2SB 381	.30	.35	.40
2SB 400	.30	.35	.40
2SB 405	.30	.35	.40
2SB 407	.80	.90	1.00
2SB 415	.30	.35	.40
2SB 434	.80	.90	1.00
2SB 435	.90	1.10	1.20
2SB 440	.40	.53	.59
2SB 449	1.30	1.45	1.60
2SB 461	.90	1.10	1.20
2SB 463	.90	1.10	1.20
2SB 471	1.10	1.25	1.40
2SB 472	2.10	2.50	2.80
2SB 473	.80	.90	1.00
2SB 474	.70	.80	.90
2SB 481	.90	1.10	1.20
2SB 492	.60	.70	.80
2SB 507	.80	.90	1.00
2SB 509	1.10	1.20	1.30
2SB 511	.70	.80	.90
2SB 514	.70	.80	.90
2SB 523	.70	.80	.90
2SB 526C	.70	.80	.90
2SB 527	.90	1.10	1.20
2SB 528D	.70	.80	.90
2SB 529	.70	.80	.90
2SB 530	3.20	3.40	3.70
2SB 531	1.80	2.00	2.25
2SB 536	1.00	1.20	1.30
2SB 537	1.00	1.20	1.30
2SB 539	3.20	3.40	3.70
2SB 541	3.20	3.40	3.70
2SB 554	5.00	6.00	6.60
2SB 556	3.20	3.40	3.70
2SB 557	2.10	2.50	2.80
2SB 561B	.35	.40	.45
2SB 564	.40	.53	.59
2SB 595	1.10	1.40	1.50
2SB 596	1.10	1.40	1.50
2SB 600	5.00	6.00	6.60
2SC 183	.40	.53	.59
2SC 184	.40	.53	.59
2SC 281	.30	.35	.40
2SC 283	.40	.53	.59
2SC 284	.80	.90	1.00
2SC 317	.40	.53	.59
2SC 352A	2.00	2.20	2.50
2SC 353A	1.40	1.60	1.80
2SC 367	.60	.70	.80
2SC 369	.30	.35	.40
2SC 370	.20	.27	.30
2SC 371	.30	.35	.40
2SC 372	.20	.27	.30
2SC 373	.20	.27	.30
2SC 374	.30	.35	.40
2SC 375	.30	.35	.40
2SC 377	.30	.35	.40
2SC 380	.20	.27	.30
2SC 381	.35	.40	.45
2SC 382	.35	.40	.45
2SC 383	.35	.40	.45
2SC 387A	.35	.40	.45
2SC 388A	.40	.53	.59
2SC 394	.20	.27	.30
2SC 403	.30	.35	.40
2SC 430	.50	.64	.70
2SC 454	.30	.35	.40
2SC 458	.20	.27	.30
2SC 460	.35	.40	.45
2SC 461	.35	.40	.45
2SC 478	.60	.70	.80
2SC 481	1.30	1.40	1.50
2SC 482	1.10	1.25	1.40
2SC 484	1.30	1.40	1.50
2SC 485	1.30	1.40	1.50
2SC 486	1.30	1.40	1.50
2SC 493	3.00	3.20	3.40
2SC 495	.45	.55	.60
2SC 496	.45	.55	.60
2SC 497	1.10	1.25	1.40
2SC 509	.35	.40	.45
2SC 510	1.30	1.40	1.50
2SC 515A	.80	.90	1.00
2SC 517	2.50	2.70	3.00
2SC 535	.30	.35	.40
2SC 536	.30	.35	.40
2SC 537	.30	.35	.40
2SC 627	1.30	1.45	1.60
2SC 631	.35	.40	.45
2SC 632A	.35	.40	.45
2SC 634A	.35	.40	.45
2SC 680	1.90	2.10	2.40
2SC 681A	3.00	3.25	3.50
2SC 684	.80	.90	1.00
2SC 693F	.20	.27	.30
2SC 696	1.00	1.20	1.30
2SC 708	1.30	1.45	1.60
2SC 710	.20	.27	.30
2SC 711	.20	.27	.30
2SC 712	.20	.27	.30
2SC 715	.30	.35	.40
2SC 717	.35	.40	.45
2SC 727	1.00	1.20	1.30
2SC 730	3.00	3.20	3.40
2SC 731	2.50	2.70	2.90
2SC 732	.20	.27	.30
2SC 733	.20	.27	.30
2SC 734	.20	.27	.30
2SC 735	.20	.27	.30
2SC 738	.20	.27	.30
2SC 756	1.50	1.80	2.00
2SC 756A	1.50	1.80	2.00
2SC 763	.35	.40	.45
2SC 772	.30	.35	.40
2SC 773	.35	.40	.45
2SC 774	1.00	1.20	1.30
2SC 775	1.40	1.60	1.80
2SC 776	2.00	2.20	2.50
2SC 777	3.00	3.25	3.50
2SC 778	2.90	3.20	3.40
2SC 781	1.90	2.10	2.40
2SC 783	2.10	2.50	2.80
2SC 784	.30	.35	.40
2SC 785	.35	.40	.45
2SC 789	.80	.90	1.00
2SC 790	.80	.90	1.00
2SC 793	2.00	2.20	2.50
2SC 799	2.00	2.20	2.50
2SC 828	.20	.27	.30
2SC 829	.20	.27	.30
2SC 830H	2.50	2.70	3.00
2SC 838	.35	.40	.45
2SC 839	.30	.35	.40
2SC 853	.70	.80	.90
2SC 867	3.20	3.40	3.70
2SC 867A	3.20	3.40	3.70
2SC 870	.35	.40	.45
2SC 871	.35	.40	.45
2SC 895	4.20	4.40	4.90
2SC 897	2.00	2.20	2.50
2SC 898	2.50	2.70	3.00
2SC 900	.20	.27	.30
2SC 923	.20	.27	.30
2SC 929	.20	.27	.30
2SC 930	.20	.27	.30
2SC 941	.20	.27	.30
2SC 943	.35	.40	.45
2SC 945	.20	.27	.30
2SC 959	1.00	1.20	1.30
2SC 971	.70	.80	.90
2SC 982	.70	.80	.90
2SC 983	.50	.64	.70
2SC 1000	.35	.40	.45
2SC 1012	1.20	1.40	1.50
2SC 1013	.50	.64	.70
2SC 1014	.50	.64	.70
2SC 1017	.80	.90	1.00
2SC 1018	.60	.70	.80
2SC 1030	1.80	2.10	2.40
2SC 1047	.35	.40	.45
2SC 1051	3.40	3.55	3.90
2SC 1060	.70	.80	.90
2SC 1061	.70	.80	.90
2SC 1076	30.00	35.00	39.00
2SC 1079	3.40	3.55	3.90
2SC 1080	3.40	3.55	3.90
2SC 1096	.45	.55	.60
2SC 1098	.50	.64	.70
2SC 1111	2.10	2.50	2.80
2SC 1114	4.20	4.40	4.90
2SC 1115	2.50	2.70	3.00
2SC 1116	3.20	3.40	3.70
2SC 1116A	3.40	3.55	3.90
2SC 1124	.80	.90	1.00
2SC 1127	.80	.90	1.00
2SC 1161	1.30	1.45	1.60
2SC 1162	.70	.80	.90
2SC 1166	.20	.27	.30
2SC 1167	3.80	4.00	4.40
2SC 1170B	3.80	4.00	4.40
2SC 1172B	3.20	3.60	3.95
2SC 1173	.50	.55	.60
2SC 1175	.35	.40	.45
2SC 1177	11.00	12.60	14.00
2SC 1189	1.00	1.10	1.20
2SC 1209	.30	.35	.40
2SC 1211D	.30	.35	.40
2SC 1212A	.80	.90	1.00
2SC 1213	.30	.35	.40
2SC 1215	.35	.40	.45
2SC 1222	.20	.27	.30
2SC 1226	.50	.55	.60
2SC 1226A	.50	.55	.60
2SC 1237	1.80	2.00	2.25
2SC 1239	2.20	2.70	2.90
2SC 1279	.50	.55	.60
2SC 1306	1.30	1.45	1.60
2SC 1307	1.90	2.10	2.40
2SC 1310	.20	.27	.30
2SC 1312	.20	.27	.30
2SC 1313G	.20	.27	.30
2SC 1316	4.20	4.40	4.90
2SC 1317	.20	.27	.30
2SC 1318	.35	.40	.45
2SC 1325A	6.50	6.90	7.60
2SC 1327	.20	.27	.30
2SC 1330	.50	.55	.60
2SC 1335	.50	.55	.60
2SC 1342	.45	.53	.59
2SC 1344	.45	.53	.59
2SC 1358	4.20	4.40	4.90
2SC 1359	.30	.35	.40
2SC 1360	.50	.55	.60
2SC 1362	.35	.40	.45
2SC 1364	.35	.40	.45
2SC 1377	3.20	3.40	3.70
2SC 1383	.30	.35	.40
2SC 1384	.35	.40	.45
2SC 1396	.45	.53	.59
2SC 1398	.70	.80	.90
2SC 1400	.35	.40	.45
2SC 1402	3.00	3.20	3.40
2SC 1403	3.20	3.40	3.70
2SC 1407	.50	.55	.60
2SC 1419	.60	.70	.80
2SC 1444	1.60	1.80	2.00
2SC 1445	2.50	2.70	2.90
2SC 1447	.60	.70	.80
2SC 1448	.70	.80	.90
2SC 1449	.60	.70	.80
2SC 1451	1.00	1.10	1.20
2SC 1454	3.20	3.40	3.70
2SC 1475	.80	.90	1.00
2SC 1478	.50	.55	.60
2SC 1509	.50	.55	.60
2SC 1567	.60	.70	.80
2SC 1567A	.60	.70	.80
2SC 1584	6.00	6.30	7.00
2SC 1586	6.50	6.90	7.60
2SC 1624	.60	.70	.80
2SC 1626	.60	.70	.80
2SC 1628	.60	.70	.80
2SC 1647	.70	.80	.90
2SC 1667	3.00	3.20	3.40
2SC 1669	.90	1.00	1.10
2SC 1674	.30	.35	.40
2SC 1675	.20	.27	.30
2SC 1678	1.10	1.25	1.40
2SC 1679	3.00	3.20	3.40
2SC 1681	.30	.35	.40
2SC 1682	.30	.35	.40
2SC 1684	.30	.35	.40
2SC 1687	.40	.45	.50
2SC 1688	.35	.40	.45
2SC 1708	.30	.35	.40
2SC 1728	.70	.80	.90
2SC 1730	.45	.53	.59
2SC 1756	.50	.55	.60
2SC 1760	.70	.80	.90
2SC 1816	1.50	1.75	1.95
2SC 1856	.45	.53	.59
2SC 1885	.45	.53	.59
2SC 1908	.30	.35	.40
2SC 1909	1.80	2.00	2.25
2SC 1945	4.50	5.00	5.60
2SC 1957	.60	.70	.80
2SC 1969	3.60	4.00	4.40
2SC 1973	.70	.80	.90
2SC 1975	1.30	1.70	1.90
2SC 1978	5.40	6.00	6.60
2SC 2028	.50	.64	.70
2SC 2029	1.50	1.80	2.00
2SC 2074	.80	.90	1.00
2SC 2076	.50	.64	.70
2SC 2091	.90	1.10	1.20
2SC 2092	1.80	2.00	2.25
2SC 2098	3.20	3.40	3.70
2SC 2166	1.40	1.60	1.80
2SD 72	.50	.64	.70
2SD 77	.35	.40	.45
2SD 90	1.30	1.45	1.60
2SD 91	1.30	1.45	1.60
2SD 92	1.30	1.45	1.60
2SD 93	1.60	1.80	2.00
2SD 118	2.90	3.20	3.40
2SD 130	1.10	1.25	1.40
2SD 187	.35	.40	.45
2SD 201	2.30	2.40	2.65
2SD 202	3.40	3.55	3.90
2SD 218	2.50	2.70	3.00
2SD 234	.60	.70	.80
2SD 235	.60	.70	.80
2SD 261	.35	.40	.45
2SD 287	2.50	2.70	2.90
2SD 300	4.50	5.00	5.60
2SD 313	.60	.70	.80
2SD 315	.60	.70	.80
2SD 325	.60	.70	.80
2SD 330	.60	.70	.80
2SD 350	3.80	4.00	4.40
2SD 380	5.20	5.40	5.95
2SD 381	.85	1.00	1.10
2SD 424	3.80	4.00	4.40
2SD 425	2.90	3.20	3.40
2SD 426	3.10	3.30	3.60
2SD 427	1.80	2.00	2.25
2SD 525	.90	1.10	1.20
2SD 526	.60	.70	.80
2SK 19BL	.50	.55	.60
3SK 22Y	1.40	1.60	1.80
3SK 39	.90	1.10	1.20
3SK 40	.90	1.10	1.20
3SK 41	1.30	1.45	1.60
3SK 45	1.30	1.45	1.60
AN 203	1.40	1.60	1.80
AN 214Q	1.50	1.70	1.90
AN 239	4.20	4.40	4.90
AN 247	2.50	2.70	3.00
AN 274	1.50	1.75	1.95
AN 313	3.00	3.20	3.40
AN 315	1.80	2.00	2.25
BA 511A	1.80	2.00	2.25
BA 521	1.90	2.10	2.40
HA 1151	1.50	1.75	1.95
HA 1156W	1.60	1.80	2.00
HA 1306W	2.00	2.20	2.50
HA 1339	2.50	2.70	3.00
HA 1339A	2.50	2.70	3.00
HA 1342A	2.50	2.70	3.00
HA 1366W	2.50	2.70	3.00
HA 1366WR	2.50	2.70	3.00
LA 4031P	1.80	2.00	2.25
LA 4032P	1.80	2.00	2.25
LA 4051P	1.80	2.00	2.25
LA 4400	1.90	2.10	2.40
LA 4400Y	2.00	2.20	2.50
LA 4420	2.00	2.20	2.50
LD 3001	2.00	2.20	2.50
MS 1513L	2.00	2.20	2.50
STK 011	3.80	4.00	4.40
STK 013	7.60	8.00	8.80
STK 015	4.20	4.40	4.90
STK 435	4.50	5.00	5.60
STK 439	7.90	8.00	8.80
TA 7045M	2.00	2.20	2.50
TA 7055P	2.00	2.20	2.50
TA 7061AP	.90	1.10	1.20
TA 7062P	1.10	1.25	1.40
TA 7203P	2.50	2.70	2.90
TA 7204P	2.00	2.20	2.50
TA 7205P	1.60	1.80	2.00
TA 7222P	3.40	3.55	3.90
TA 7310P	1.30	1.45	1.60
TBA 810SH	1.90	2.10	2.40
TC 5080P	5.00	5.20	5.80
TC 5081P	3.00	3.20	3.40
TC 5082P	3.40	3.55	3.90
UHIC 001	4.20	4.40	4.90
UHIC 002	4.20	4.40	4.90
UHIC 003	4.20	4.40	4.90
UHIC 004	4.20	4.40	4.90
UHIC 005	4.20	4.40	4.90
uPC 20C	2.10	2.50	2.80
uPC 563	1.90	2.10	2.40
uPC 575C2	1.30	1.45	1.60
uPC 576	1.90	2.10	2.40
uPC 592H	.70	.80	.90
uPC 1001H	1.90	2.10	2.40
uPC 1008C	4.20	4.40	4.90
uPC 1020H	1.90	2.10	2.40
uPC 1025	1.90	2.10	2.40
uPC 1154	2.00	2.20	2.50
uPC 1155	2.00	2.20	2.50
uPC 1156	1.90	2.10	2.40
uPD 861	8.00	8.40	9.50
uPD 857	8.00	8.40	9.50
uPD 858	6.00	6.30	7.00
PLL 01A	3.00	4.20	4.60
PLL 02A	5.00	5.20	5.90
PLL 03A	7.60	8.00	8.80
C-3001	1.30	1.45	1.60
2SC F8	2.20	2.70	2.90
4004	1.90	2.10	2.40
4005	2.00	2.20	2.50
SG 613	5.20	5.40	5.95
78L05	.90	1.00	1.10
MPS U31	1.50	1.70	1.90
SN 7400	.15	.17	.19

PRICES MAY CHANGE WITHOUT NOTICE **COD ORDERS WELCOMED**

Minimum order $5.00 Ohio residents add 4% sales tax Add $1.00 postage and handling
Quantity discount prices Ask For Our Complete Price List Manufacturer Inquiries Welcomed
All parts guaranteed against factory defect

TOLL FREE TELEPHONE
NATIONWIDE 800/421-2841 **LOCAL 213/533-1221**
OHIO 800/421-2877
Hours Mon-Fri 10-7 Sat 11-5 (EST)

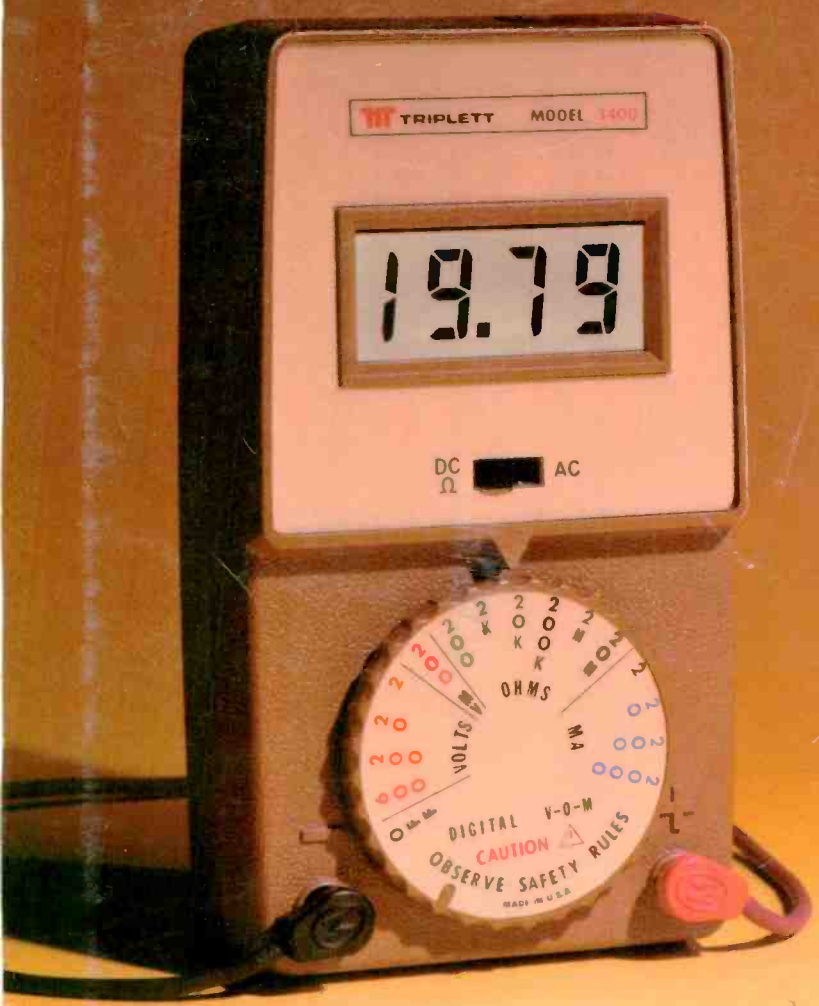
IMMEDIATE SHIPMENT WITHIN 48 HOURS ON ALL TRANSISTORS IN STOCK

FUJI-SVEA ENTERPRISE
a Division of Fuji Svea Incorporated
P.O. Box 40325 Cincinnati, Ohio 45240
Telex 21-4732

Circle No. 122 on Reader Inquiry Card

THE NEW performer.

Model 3400 has features that upstage other compact DVOMs.



Built to fit your hand and budget, the new Model 3400 (shown actual size) is loaded with features. Like a color coded single range switch for one-hand selection of all functions . . . overload protection for all ranges and 200 hour minimum battery life . . . time-saving automatics including auto-zeroing, auto-polarity, auto low-battery and auto-overrange indication . . . easy to read .5"LCD readout.

Six functions and 24 ranges, typical DC accuracy .5% Rdg, including High and Low Power Ohms for sensitive IC testing, makes the Model 3400 ideal for design, production and maintenance testing, vocational tech training schools, commercial electronic equipment test and measurement use.

1. HAND SIZE, 3½ digit, single range switch —6 function, 24 ranges with Hi and Low Power Ohms, Auto-zero and Auto-polarity.
2. OVERLOAD PROTECTION—Protected up to 600 volts on all ranges with special 2 fuse arrangement.
3. BATTERY LIFE—200 hour minimum with 9V battery, display includes low battery indication.

ONLY $140

Includes test leads, new screw-on insulated alligator clips for the probe, 9V alkaline battery, plus instruction book and 1 year warranty.

For a demonstration, contact your Triplett distributor, Mod Center or representative.

Triplett Corporation, Bluffton, Ohio 45817
(419) 358-5015, TWX (810) 490-2400.

THE MARK OF QUALITY 75TH ANNIVERSARY

Triplett performance... a tough act to follow

...Circle No. 104 for information
...Circle No. 105 for FREE demonstration

TRIPLETT®