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ELECTRONIC TECHNICIAN/DEALER
LEADING THE CONSUMER AND
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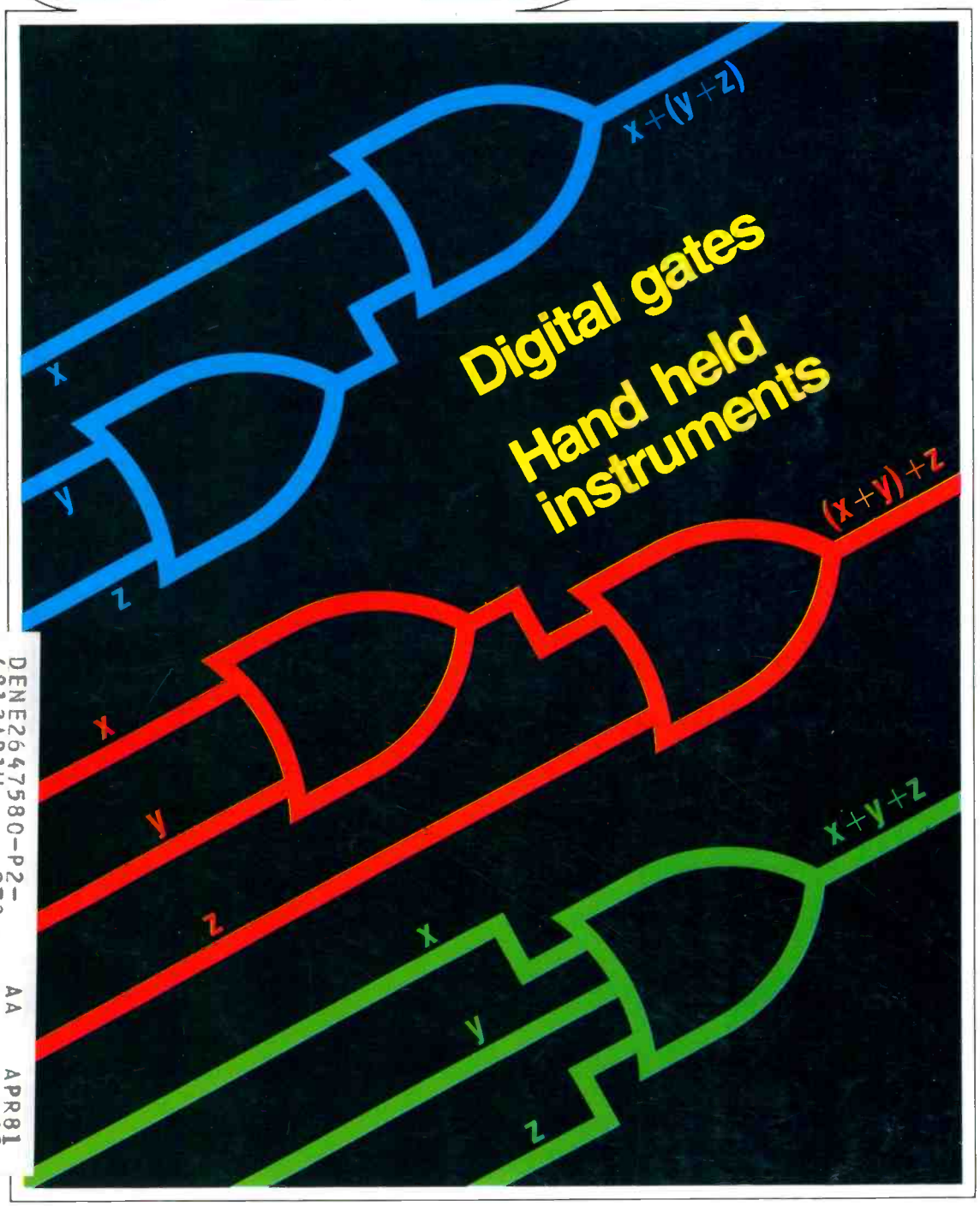

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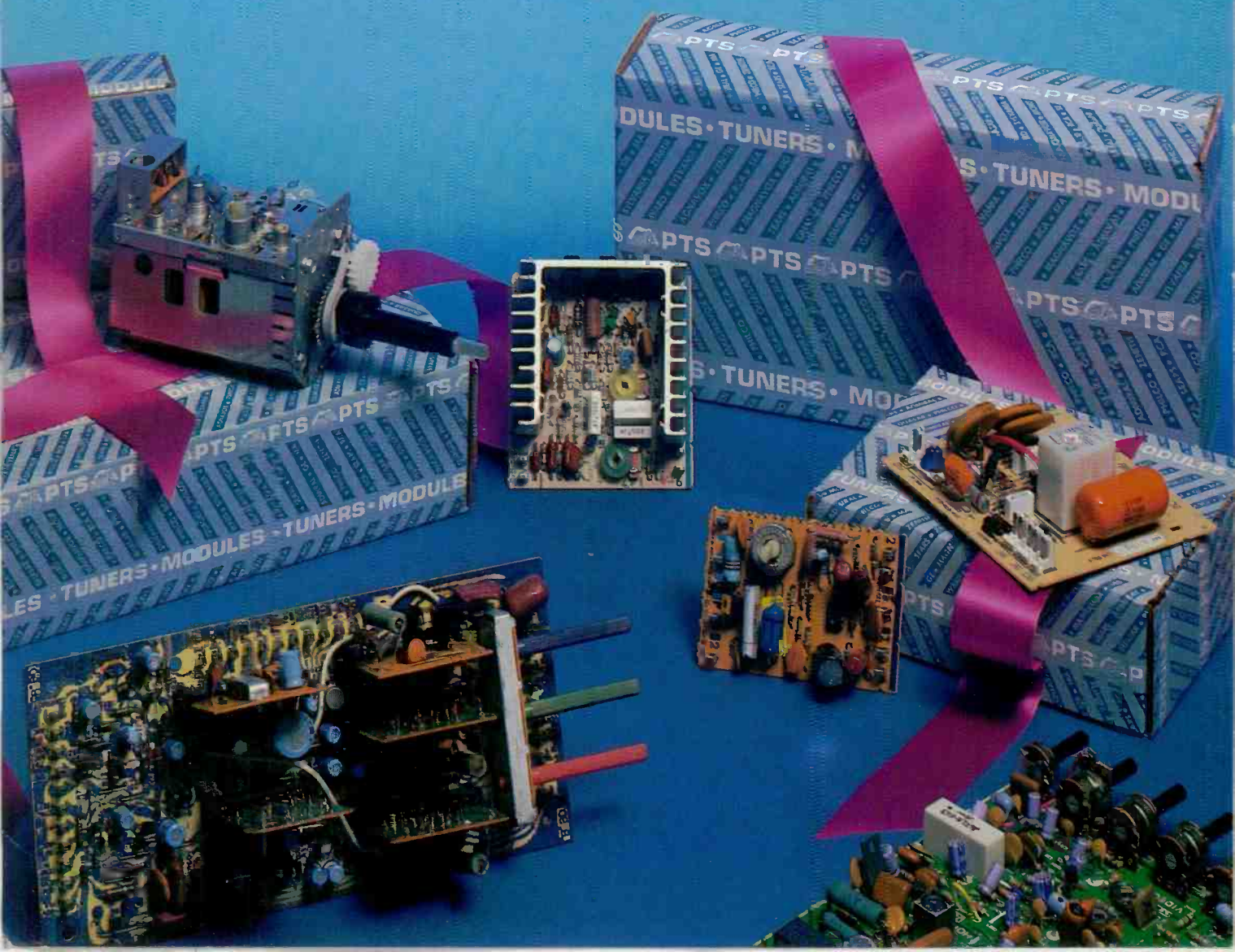

INDUSTRY REPORT

Zenith Recalls 67,000 TVs

Zenith Radio Corporation has sent out "recalls" on some 67,000 of its new 13 and 17 inch color television models introduced to distributors late last year.

The problem, according to Zenith, is a potential insulation failure that could result in a shock hazard. Zenith reports many sets are still on distributors shelves. Those already in homes will be repaired "in home."

NAB Committee Plans Radio Standards

A committee of the National Association of Broadcasters has planned meetings to help hammer out what it said it hopes will become industry-wide standards for radio receivers.

The NAB's AM/FM Receiver Performance Standards Committee said June meetings during the Summer CES in Chicago and possibly thereafter would attempt to set ground rules for radios to show they have met "minimum" standards set by NAB.

The proposed standards will deal with six classifications: AM monaural, AM stereo, FM monaural, FM stereo, AM auto/mono, and AM auto/stereo. Such technical characteristics, according to NAB, will determine quality of sound, maximum loudness, distortion ratings, range of pitch the radio is capable of reproducing, the ability to pick up distant stations, and the ability to separate stations.

Overall the standards are aimed at improved communication between broadcasters and receiver designers for the coordination of efforts in improving broadcast sound.

ETA Plans Canadian Convention

The fledgling Electronic Technician's Association (ETA, formulated last November, has chosen Ontario, Canada, as the site of its first annual convention tentatively set for early August.

According to ETA President Dick Glass, Kitchner, Ontario, approximately 60 miles outside of Toronto, was selected as the site to emphasize the "international character" of ETA—officially named Electronic Technician's Association—International. Glass said ETA hopes to draw many of its members from Canada and, in fact, has set up a separate Canadian membership division.

Glass also said the ETA membership now stands at the 500 level with at least 20 per cent of the members electronics instructors and 50 per cent from the traditional "dealer" category.

Regarding the planned convention, Glass reported the thrust would be toward lecture seminars on electronics, training for electronics instructors, and methods training for certification administrators.

Consumer Electronics now $15 Billion Industry

The Consumer Electronics Industry was a $15 billion a year business at the retail level in 1978, according to estimates by the Electronic Industries Association (EIA).

According to the EIA statement, the $15 billion figure was extrapolated from the $9.3 billion wholesale value of U.S. and foreign production sold to dealers. The major consumer electronics products included in the latest statistics are television receivers, seperate audio components, phonographs, tape equipment, radios and auto radios.

Major audio products totaled $5 billion in factory production and imports for 1978, EIA said, and that was up from the previous year's $4.3 billion. Total television accounted for $4.31 billion, up 13 per cent over the $3.8 billion recorded in 1977 at the factory production and import level.

The latter figures break down into a $3.27 billion valuation on color television receivers last year, according to EIA, an overall increase of 14 per cent for that category.

In addition, EIA said, while the consumer price index for all products has climbed 102.9 per cent since base year 1967, the CPI for television has climbed only 1.6 per cent during that period.

IHF Investigates Affiliation with EIA

The Institute of High Fidelity (IHF), which this April was forced to cancel its Second Annual Meeting in St. Louis for economic reasons, has announced that is has approached the Electronic Industries Association (EIA) regarding the possibility of affiliation.

According to IHF President Jerry Kalov the IHF board believes "the goals of our members and of our industry might be better served through an affiliation ..."

Kalov said however, stipulations that must be agreed to before any such affiliation could take place would be that IHF's New York office be maintained at least through 1980 and that IHF goals relating to component standards, statistics gathering, legislative activity, and industry advertising and promotion programs be maintained.

Color TV Sales Decline in April.

EIA figures on sales to dealers show an eleven percent decline relative to April '78. VCR's showed their first declines, possibly attributable to model changes, of about 21 percent after an earlier 80 percent gain over '78 for the first quarter.

ET/D

ELECTRONIC TECHNICIAN/DEALER
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JUNE 1979, VOL. 101, NO. 6

On the cover: Digital gates, the logical building blocks of data communications and computing technology, are discussed in our series on digital electronics. On the cover are shown three ways of adding voltages x,y, and z via the use of OR gates.

FEATURES

DEPARTMENTS

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FCC Seeks End to Cable TV Restrictions

In a move boisterously opposed by commercial broadcasters, the FCC has proposed an end to two restrictions on the cable TV industry.

The thrust of the rule changes would provide the viewing public with greater program selection opportunities, including options of viewing "distant stations" brought into their viewing areas via satellite and cable.

Calling the proposed rule changes "critical" to the expansion of the cable television industry itself, a spokesman said elimination would spawn the development of even more cable systems. Under existing FCC controls, commercial broadcast stations often have the authority to keep "distant station" signals from being rebroadcast in their viewing areas.

The outcome of the battle may hinge on which side is able to prove most effectively their contentions. Commercial broadcasters claim the rules changes would have a substantially damaging impact on their industry. Cable TV enthusiasts, on the other hand, presented the FCC with a battery of documents contending the rules changes would only—at worst—affect 1 percent of commercial broadcast stations audiences.

In a related, though separate ruling, the U.S. Supreme Court has ruled that New York State does not have the authority to control rates charged by cable TV stations for special programming services. Only the FCC has this authority, the high court ruled.

Currently states are permitted to regulate only rates charged for subscription to a cable system—not for special services. The FCC does not now regulate special programming charges. ET/D

CALENDAR

Following is a listing of the convention dates and contacts for associations serving the electronic technician servicing profession.

ETA-I (Electronic Technicians' Association International). Meeting Kitchener, Ontario, Canada, in early August (tentative). Contact Dick Glass, President, 7046 Doris Dr., Indianapolis, Ind., 46224 or call 317-241-7783.

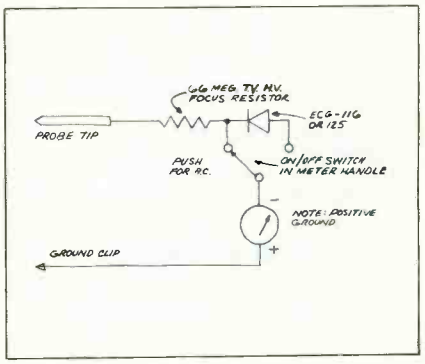
NATESA (National Association of Television and Electronic Servicers of America). Meeting Carson's Nordic Hills Resort, Itaska, Ill., Aug. 23-26. Contact Frank J. Moch, Executive Director, 5908 South Troy St., Chicago, Ill., 60629 or call 312-476-6363.

NESC (National Electronic Service Convention). Meeting Marriott Hotel, Tucson, Az., Aug. 13-18. Contact Marti McPherson, 1715 Expo Lane, Indianapolis, Ind., 46224 or call 317-278160.

LETTERS

MICROWAVE OVENS

In regard to an article in a November 1978 book on servicing microwave ovens: The appliance men have asked me if you can check the high voltage to the magnetron? They said at service meetings they were told ya can't do it. What they should of said is no one makes a meter to check the approximate 3KV at the tube. (At least, I've never seen one.) I modified a standard TV HV probe to measure 3600vdc and ac at the secondary of the HV transformer. I used a Pomona HV probe with a 36KV meter and on/off switch, and rewired it to do the job.



Very simple modification will give a fairly accurate dc and just an uncalibrated ac reading. A normal dc reading is approximately 3KV, ac approximately 750V. While you are checking the HV at the magnetron filament terminals, momentarily short across the filament terminals–not to ground–and if the 3.2 Vac is there, you'll get a little spark. Just a quick short won't hurt anything. You'll know if the filament and HV is there right away. If they are, the "maggie's" bad. I just removed the 600 megohm long resistor from the inside and soldered the 66 megohm directly to the probe tip. Run a wire down to the switch and you can take it from there.

John Russo
Service Center
603 East Oak
Santa Maria, CA 93454

EDITOR: This is a good idea since many multimeters are not equipped to measure these voltages. There are some meters with appropriate HV ranges, however. The 630 series of Triplett meters have a 6KV range available. The Simpson 260s have an accessory 5KV probe and the Hickok LX303 has a 10KV slip-over probe accessory (dc only). Remember, this measurement involves a rather high current source; it is dangerous, BE CAREFUL! There is a lot more current available than from a TV HV supply. **ET/D**

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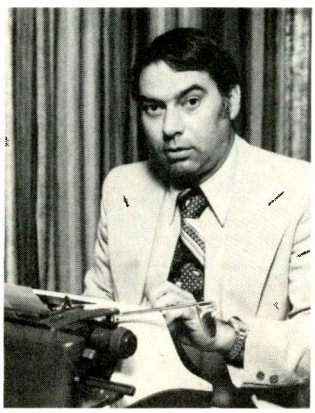


Our lead feature this month deals with the rapidly growing world of portable test instrumentation. The modern, compact, accurate, and relatively inexpensive, portable units we see coming off manufacturers' assembly lines are — for the most part — aimed at either the consumer electronics service market or the light industrial user.

Today's modern professional electronics technician has at his disposal every conceivable type of test instrument he could have wished for himself on the bench just five short years ago — and in many instances even more. There are capacitor checkers of several kinds, oscilloscopes so small they can be cradled in one hand, frequency counters of sophisticated accuracy and stability; of course the well-known digital multimeters and VOMs, and television signal test pattern generators of every description, some so small they can be stuffed into a shirt pocket.

Just listing the above mentioned pieces of test equipment is evidence enough — if you needed anymore — of the ever increasing demands on a technician's time and knowledge. It takes time and diligent study in many cases to really learn the full potential of a new piece of test gear.

Yet the important thing about the march of technology, as evidenced by the growth of the portable test instrument market, is that for the aggressive technician, the one who is interested in continuing education in electronics technology, the means are now available for him or her to relate to new areas. And, the equipment available to the professional technician will play no small roll in helping the professional to understand new fields.

Let's face it, as the world swings more and more into digitally controlled "clocked" circuits, closer to microprocessor control in virtually all types of consumer products, a state-of-the-art knowledge of state-of-the-art electronics test gear will very definitely be needed by the state-of-the-art technician who plans to forge ahead with progress.

So with this brief background, I would like to direct you to our lead feature, "Recent Trends in Portable Test Gear" (p. 20) in which ET/D takes you on a quick tour of some of the latest developments in portable equipment and points out some of the reasons why these changes are occurring ... now.

Sincerely,

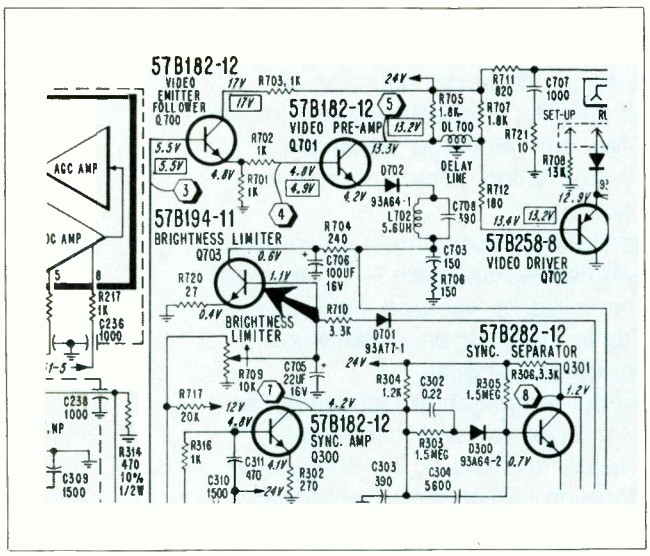
Richard W. Day

SERVICE SEMINAR

ADMIRAL

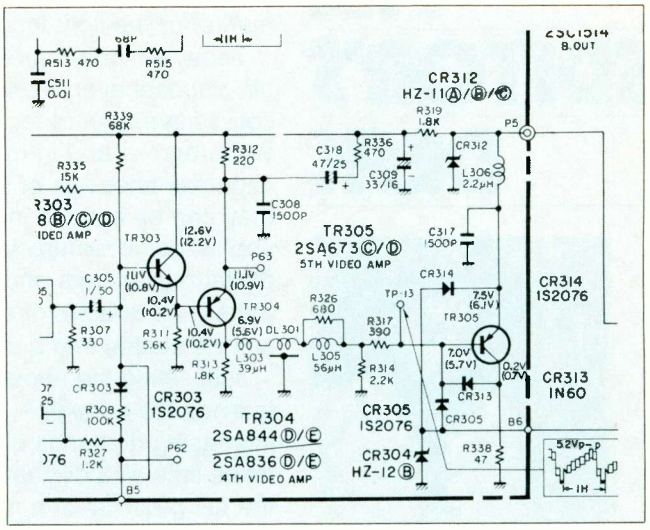
Color TV Chassis 9M45-No Raster—Sound and HV OK. Possible cause—Open Q703 (brightness limiter).

Excessive Brightness-Possible cause—shorted Q703. Note: According to Admiral (Tech Notes March '79) the EBC marking on printed circuit board for Q703 is incorrect. Check for correct markings when replacing.



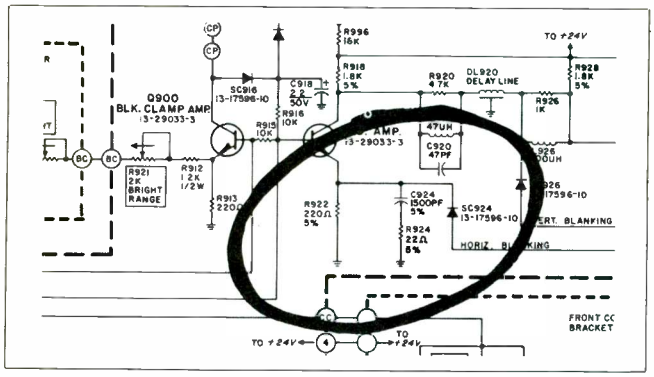
HITACHI

Color TV Chassis NP4SX-H2/L2—No video. Chroma causes apparently negative picture. Probable cause—open L-306 (in emitter of TR-305).



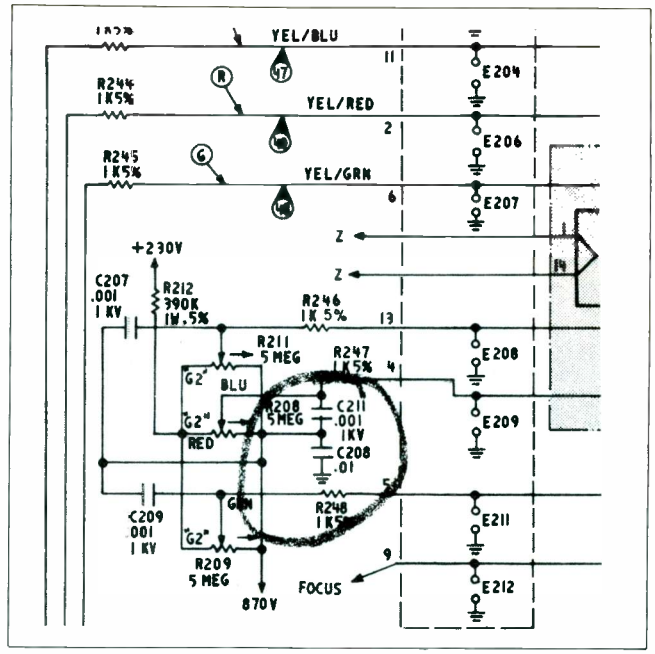
SYLVANIA

Color TV Chassis E21—No control of brightness Possible cause—shorted C924.

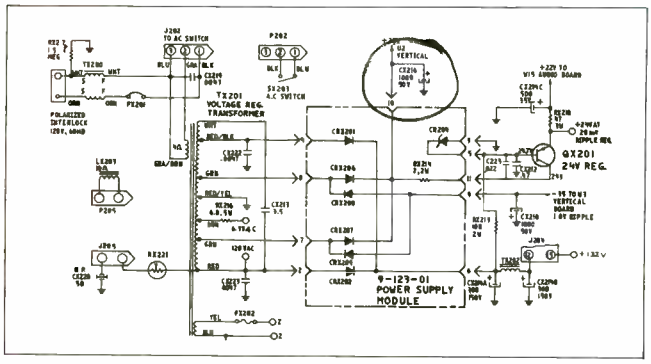


Color TV Chassis 19GC45—Hum bars, reduced height, distorted audio, no color. Possible cause—shorted CX216—low voltage power supply filter/capacitor.

No set up line, dark picture, green streaking. Possible cause—shorted C208 in red G2 circuit. **ET/D**



ZENITH



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GENERAL ELECTRIC

BULLETIN BOARD

Electronic Surplus fills the 36 pages of *Fair Radio Sales Co.'s* 1979 catalog. This catalog, listing perhaps the largest selection of surplus available from a single company, has come to be somewhat of an institution. The command set numbers are dwindling, but you can buy a TCS receiver for $19.95, and it's better than a command set anyway. In addition to communications and test equipment, Fair has great numbers of obsolete tubes at modest prices, and a variety of other components. Noticeably absent are the vast quantities of semiconductors most surplus outlets have. Fair does have some interesting IC board assemblies, but where else can you get a 3500V power transformer or a ½-hp 28V dc motor. For a free copy: Fair Radio Sales Co., P.O. Box 1105, 1016 E. Eureka St., Lima, OH 45802.

A wide variety of small mechanical components and materials many of which are useful in electronics, are offered in Catalog No. 8 by *Small Parts Inc*. The catalog includes wire markers, cable ties and clamps, "O" rings, perforated metal, spacers, both metal and nylon, nylon machine screws and nuts, shaft hardware, fiber rod, gears and couplings, tubing, shrinkable tubing, teflon sheets and a variety of other items. For a free copy write: Small Parts, Inc., 6901 N.E. Third Ave., Miami, FL 33138.

A new, full-color six-page brochure describing the complete line of B & K-Precision digital multimeters is now available from Dynascan Corporation.

Featured in the brochure are the Model 2830 and Model 2810 3-½ Digit DMMs, both with autozeroing, and the Model 283 3-½ Digit Lab DMM with high intensity LED display for maximum readability. All three are accurate to 0.5%. Also described is the Model 2800 Economy 3-½ digit Portable DMM with autozeroing and 1% dc Accuracy for cost-effective testing.

In addition, the brochure includes the Model TP-28 Solid-State Temperature Probe which measures temperature with almost any analog or digital voltmeter. The Model TP-28 can be used to measure the temperature of any surface, liquid or gas.

The brochure details the features, applications and specifications for all of these models. All specifications are listed on one page of this handy selection guide to simplify comparison of the features of the various models.

For a free copy of the brochure write: *B & K-Precision,* 6460 W. Cortland St., Chicago, IL 60635.

A brochure describing the new MINI-size 20/20 Electronic TV Antenna is available from Winegard. Intended for apartment, attic, garage or roof use, the 20/20 is stated to perform like an antenna twice its size. It is available as a basic antenna, with a rotor, with a signal amplifier or with both and is also available with an indoor pole lamp type mounting. Write *Winegard Co.,* 3000 Kirkwood St., Burlington, IA 52601.

A voice security terminal that protects speech transmitted over standard telephone lines while providing excellent voice recognition is described in a new brochure available from *General Telephone & Electronics Corp*. The four-color, eight-page brochure contains several block diagrams which depict point-to-point security, explains how voice is encrypted, how secure conference calls can be established, as well as providing operating models, data rates

and dimensions of the equipment. Designated Mark IV VST-6000, the system consists of a voice digitizer, an encryption/decryption device, and a wireline modem, according to David J. Doran, manager, Secure Voice Programs. Copies of the brochure may be obtained by writing to Michael Thurk, GTE Sylvania Inc., 77 "A" St., Needham Heights, MA 02194.

The 1979, used FM 2-way radio equipment catalog is available from *Gregory Electronics*. Gregory's catalog covers a wide range of used, warranted, General Electric, Motorola, and RCA, high band, low band and some UHF, mobiles, and base stations, portables, parts and accessories. Free from Gregory Electronics Corp., 249 Route 46, Saddle Brook, NJ 07662.

A brand new 1979 Semiconductor Catalog and Cross Reference is now available from *Workman*. This manual has been updated to reflect changes and additions through October 1978 and contains over 145,000 cross references. Catalog X78-2 is available from Workman distributors or direct from Workman Electronic Products, Inc., PO Box 3828, Sarasota, FL 33578.

Continental Resources, Inc. has just published its new 1979 **Electronic Instrument Rental Catalog** containing descriptions of over 1000 electronic test instruments available for monthly rental.

The 64-page catalog offers full specifications and monthly rates for latest model test and measurement equipment from leading manufacturers. Included are oscilloscopes, recorders, logic analyzers, microprocessor test systems, power meters, X-Y plotters, function generators, frequency synthesizers, and telecommunications test sets.

All Continental rental equipment is available for immediate delivery from eight nationwide inventory centers. Each instrument is fully tested, calibrated, and guaranteed to meet manufacturer's specifications for new equipment.

Free copies of the new 1979 Continental Electronic Instrument Rental Catalog are available directly from Continental Resources, Inc., 175 Middlesex Turnpike, Bedford. MA 01730.

"A Beginners Guide to Computers and Microprocessors—With Projects," by C.K. Adams. Here is an introduction to microprocessors that begins with a functional diagram of the 8080 and works through theory, programming techniques, hardware, circuitry and applications and gives details on building and programming a simple system using an 8080. $9.95 hard bound, $6.95 paperback. TAB Books No. 1015, *TAB Books,* Blue Ridge Summit, PA 17214.

Thor Electronics Corp., has recently announced that their new "Wholesale Pricing Guide" is available. The 40-page catalog lists over 10,000 types of Electron Tubes, semiconductors, integrated circuits and computer equipment.

Among the electron tubes listed are microwave, RF, photo multipliers, magnetrons, ignitrons, CRT's and numerical indicators. Also listed are broadcast, aviation and radar types.

In addition to the complete spectrum of diodes and transistors, other semiconductors listed are triacs, diacs, SCR's LED's OPTO couplers and OPTO isolators.

Represented in the integrated circuits listing are TTL, CMOS, microprocessor, memories, RAM, ROM, Uart's, voltage regulators, linear, digital and eprom.

The computer equipment listed consists of computer terminals, disc storage devices, printers and diskettes.

A copy of this catalog may be had by writing to *Thor Electronics Corp.*, 321 Penn. Ave., Linden, NJ 07036. ET/D

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And we will keep on sending you fresh information thru May 31, 1980 as new Zenith products are introduced...and new techniques for servicing Zenith products are developed.

1 

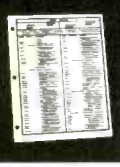
First of all, you will receive individual service manuals with step-by-step instructions, diagrams, charts, exploded views and photographs covering everything you need to know to service Zenith's newest product lines.

2 

Periodically thru the year, you will receive up-dated information, tips on servicing short cuts, and other important data as they develop.

3 

New product announcements will be sent to you, too...plus news of any new components kits and accessory items that could help improve your efficiency and your profit picture.

4 

Chassis parts lists will be simplified and your inventory requirements reduced, because we will group into a much smaller list of chassis families all parts that are identical in one or more chassis.

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The same for parts lists covering all cabinet models. They will be organized for you by model family to reduce the size of your cabinet parts lists as much as 90%...and greatly simplify your stocking procedures.

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But that's not all.

Also included with this wealth of technical information will be a unique self-training manual with audio cassettes that focus on engineering innovations incorporated in the 1979/1980 product year.

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NEWSLINE

RCA CLAIMS TO BE NO. 1 IN COLOR AND MONOCHROME SALES. According to Television Digest RCA's claims were based on an industry survey, disputed by Zenith, which showed RCA had a 20.2% share of color market to Zenith's 19.3% and 15% of B&W market to Zenith's 14.8% for first quarter '79. Other news from the RCA stockholder's meeting; RCA is possibly the world's largest color tube producer, making 5.8 million tubes in 1978. RCA Service Company has over a million appliance and TV service contracts.

SYLVANIA MARKS 70 MILLIONTH PICTURE TUBE. Sylvania has announced that it produced its 70 millionth television picture tube in March, climaxing a story that began at Salem, Mass., with the development of their first experimental CRT in 1931. Development of Sylvania's first color picture tube began in the 1950's with production underway by 1955. Presently Sylvania reports the availability of some 80 color and 150 black and white and data display CRTs.

SONY ENTERS COLOR CONSOL FIELD. As part of its new line aimed at the high end of the market Sony has introduced three 26 in. consol sets. According to Television Digest the two remote control models will sell at $1,150, the non-remote at 1,000. The new 100° Trinitron has a 341 sq-in. viewing area vs. 315 sq-in. for a 25 in. tube and weighs about 80 lb.

HITACHI OPENS US TV PLANT. Hitachi has announced it plans to be making up to 4,000 television sets per month by August in its new Compton, Calif., production facility. Hitachi, the last of the Japanese TV companies to build U.S. production facilities, had been seeking a U.S. production base since its joint venture with G.E. television was quashed by the U.S. government.

ISCET THREATENS ETA WITH LAWSUIT. The growing feud over control of professional certification programs between NESDA affiliated ISCET and the upstart ETA-I is about to break into the legal arena. According to ISCET Chairman Forest Belt, ETA's use of the initials "CET" for Certified Electronics Technician constitutes "fraud and deception" on technicians unaware of either association. According to Belt: "We at ISCET and NESDA have become convinced that the organization of ETA-I has been illegitimate from the start" and is "inciting industry confusion and dissension."

RCA ADDS RESISTORS TO LINE. RCA has announced the availability of 120 new flameproof resistors. According to RCA, the new additions to its current line are in low resistance ranges from .1 to 9.1 ohms in one-half, one, and two watt ratings. This range is of growing importance in modern solid-state circuitry. The RCA line now covers .1 to 1.5 megohms in one-quarter, one-half, one, and two watt ratings.

MICROWAVE OVEN COMPONENTS ANNOUNCED. Sylvania has announced the addition of nine high voltage rectifiers to its ECG semiconductor line. The new rectifiers are silicon avalanche devices which Sylvania reports will replace 77 high voltage rectifiers used by 16 oven manufacturers.

STRICTLY BUSINESS

The most effective, least expensive, and probably most all around important advertising that a servicer can do, is on the sides of his own trucks.

Experts tell us that a properly lettered truck driving the streets each day will make over a million impressions in the course of a year. At the small cost of lettering the truck, that's a lot of "bang for the buck."

Each model year, there is a tendency for trucks to come out in standard color combinations. Currently, the most popular combination is blue and white. With so many blue and white vans on the road, it becomes difficult for the consumer to spot your particular truck among the crowd. This is not a problem that is shared by the utilities. Their paint styles are so distinctive that you don't have to be able to read the name to identify the user. Cannot servicers be equally as innovative?

Do we have to confine our lettering to "ABC TV" or something much like it? It would seem a good idea to mention brands serviced ... or products serviced. We can also mention special services offered, as "RADIO DISPATCHED" or "SAME DAY SERVICE" or "COMPLETE PARTS STOCK." If you have a motto ... "SERVICE IS OUR BUSINESS" ... there is certainly room for that. And most certainly, include the company logo.

For most of us, color is our business, so why not *color* on our trucks?

Let's remember that there may be up to six panels available for your advertising message ... two doors, two sides, the back door, and for those who operate in neighborhoods with high-rises, the roof. For people looking down from third story windows, yours will be the only message they will read.

Your "billboard" should be an attractive one. You don't attract today's new customers with weary looking trucks, regardless of the message on the side. The trucks should be up-to-date, the paint job should be fresh, and of course, the trucks should be clean.

Anything really innovative, naturally, will have to be done by a sign painter. If your message is all in words though, you can obtain pre-spaced, die cut vinyl letters in four different colors and nine different sizes. All you do is strip off the backing ... and apply. If you want more information on die cut letters, just drop me a line (NARDA, 2 N. Riverside Plaza, Chicago, Illinois 60606).

Rember, you make those one million impressions a year whether you like it or not ... so make sure they are good impressions.

John Dooley

Mgr., NARDA's Service Division

Recent trends in portable test gear

Hand held reliability is the goal

ET/D surveys some recent products in the "portable" field and finds some surprising trends, including one unit which claimed almost three months continuous operation on one battery.

By Richard W. Lay

Being a professional electronics technician, speed and accuracy are more than just important to you. They are your life blood, money in your pocket, or if you will, the "whole ballgame."

The time a technician, bench or field, spends on a job is directly related to the technician's productivity ratio and the business' profitability. Bench speed and accuracy has been developed to highly sophisticated levels with the aid of some sophisticated and accurate test equipment.

Now, however, there are very dramatic changes occurring in the test instrument field which make it possible for the field technician to begin to approach the capabilities of a bench technician — should he choose to do so. The main reason is the rapidly growing field of portable test instrumentation.

When I say portable, I mean test units that can be placed in one hand, carried into the field and will — from that point on — provide generally from 8 to 2,000 hours of accurate and reliable battery operation. These "newcomer" units to the test equipment field are the low cost, fully assembled, battery operated family of test instruments.

This "new breed" is with us simply because of the spinoffs of space age research in battery and display panel technologies. Such units have made available to every "field tech" a much wider choice of test instrumentation — instrumentation compatible with field or bench use — than ever before.

Right now, the field of battery operated portables is filled with digital multimeters and portable VOMs, FET or otherwise. The relative design and manufacturing simplicity of these "workhorses" of the electronic service business make them the ideal candidate for this honor.

Tabulating the results of a "mini-survey" of test instrument manufacturers conducted recently by ET/D, we were able to identify 13 specific categories of what we considered to be portable test instruments applicable to the consumer electronics marketplace. Within these 13 product categories we found 125 various models of test instrument products with — as mentioned previously — the field of VOMs and DMMs far outstripping their nearest competitors. But, look for this gap to begin to narrow very quickly, especially in the area of digital, portable frequency counters.

Before going any further, it should be made clear that not all test gear makers responded to ET/D's survey. The results reported herein were taken essentially from information supplied by 21 manufacturing companies. Also, the figures introduced in this report will be absolute minimums. That is, any errors will be in favor of increasing the number of portable test instruments available, not in reducing the number.

Multimeters lead the way

ET/D was able to identify 78 specific types of portable, battery operated DMMs and VOMs, on the market from recent manufacturer's catalogs. (That's 63 per cent of the 125 various models on the market today.)

This broke down into 37 specific models of DMMs as opposed to 41 models of VOMs.

Although a "poor" second at this time in comparison to the multimeter category, portable counters showed the second highest number of units out in the field presently, with 10, according to our respondents. Among the companies now offering portable counters are B & K Precision, Continental Specialties, Non-Linear, Data Precision and Philips. As stated later in this article, advances made in temperature compensation circuits is the key to the expansion of the portable counter field.

It is virtually neck and neck insofar as the number of portable transistor tester models (9), color generators (7) and specialized signal analysts (6).

Rounding the results of our mini-survey, ET/D was able to identify three models of portable field strength meters, all offered by PTS Electronics, two versions of miniature battery operated oscilloscopes, from Philips and Non-Linear with a third company, Leader, eyeing the market seriously; two versions of capacitance meters, B & K and Data Precision, and six "miscellaneous" instruments.

In a latter grouping we found an electrolytic capacitor tester by Creative Electronics (see ET/D, May 1979, p. 38; a combination CB repair and test

(Editor's Note: We are including reader service numbers on the instruments in this report. Circle the number indicated on the reader service card.)

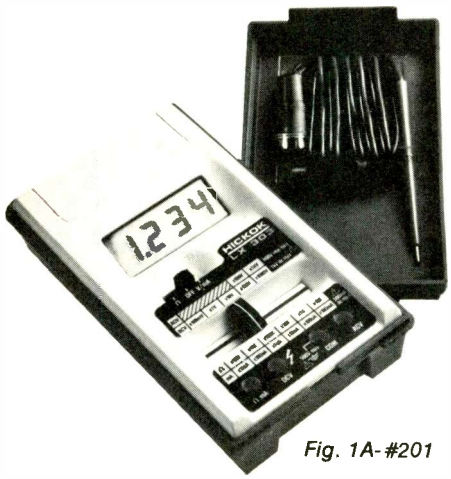

Fig. 1A-#201

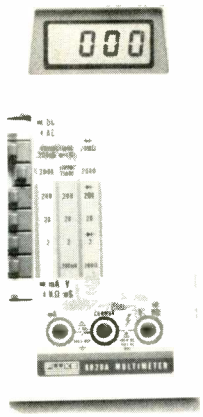

Fig. 1B-#202

Fig. 1C-#203

Fig. 1D-#204

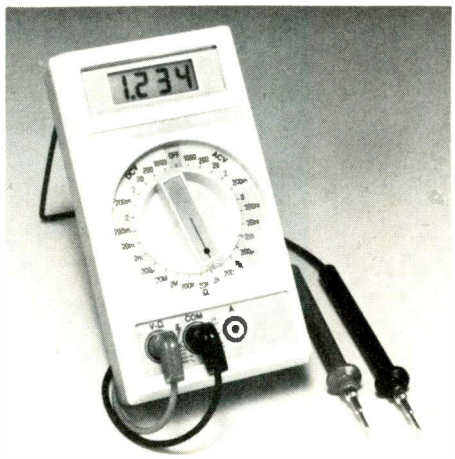

Fig. 1E-#205

Fig. 1F-#206

Fig. 1 - The marriage of LSI technology and low power LCD display panels has resulted in a "new breed" of digital multimeter characterized by these six products. The units range from (A) Hickok's Model LX303 with basic accuracy of 1% of reading for $75 to (B) Fluke's $175 unit with a basic DC accuracy of .25% of reading and it measures Mhos too (the reciprocal of Ohms). Also shown are (C) Triplett's Model 3400, $140 with accuracy of .5% of reading; (D) VIZ's WD751A, basic accuracy of .5% of full scale reading; (E) Beckman's "Tech 300" with an amazing estimated battery life of 2,000 hours from one 9 volt battery; and (F) Data Precision's Model 935 with a basic reported accuracy of .1%.

unit from Sencore; a microwave leakage tester from Simpson; a portable isolation transformer from VIZ.

Obviously, this latter unit — by nature cannot be battery operated — yet its smallness of size is of such noteworthy mention that we felt compelled to classify this AC operated unit among our definition of "portable" field gear.

Just one comment before we go further. In addition to the field of battery operated counters, two other categories of test gear seem prime candidates for increasing numbers of portable units. These are the capacitance meter and oscilloscope.

The great drawback with portable scopes at the present time is their relatively short operating time due to high power consumption and long battery charging times. Specs for these units generally find a 3-inch portable scope capable of about three hours of continuous operation before requiring a charge, which can take up to 16 hours. Future advances in battery technology should help ease this situation.

In regard to capacitance meters and the allied capacitor testers (i.e., Creative Electronics ESR Meter), there seems to be a growing demand for greater accuracy — hence some practical means of determining the specs of a capacitor in the field before blindly throwing it into some critically tuned circuit.

This is where units such as the capacitance meters can be of critical assistance. The ESR meter, on the other hand — which ET/Ds lab tests found to be exceedingly accurate — proved a virtually infallible method of testing for defective electrolytic capacitors — either *in or out of circuit.* What a time saver this unit can be.

Battery technology

Today's battery operated test equipment is being operated either with common zinc-acid "throwaways, " often one or two, 9-volt "transistor" type batteries, or the initially more expensive rechargeable nickel cadmium cells, which also require the purchase of special charging transformers (sold by the manufacturer).

Ni-Cads are capable of being recharged in anywhere from three to 16 hours, usually, and operate over wide

Fig. 2A-#207

Fig. 2B-#208

Fig. 2C-#209

Fig. 2D-#210

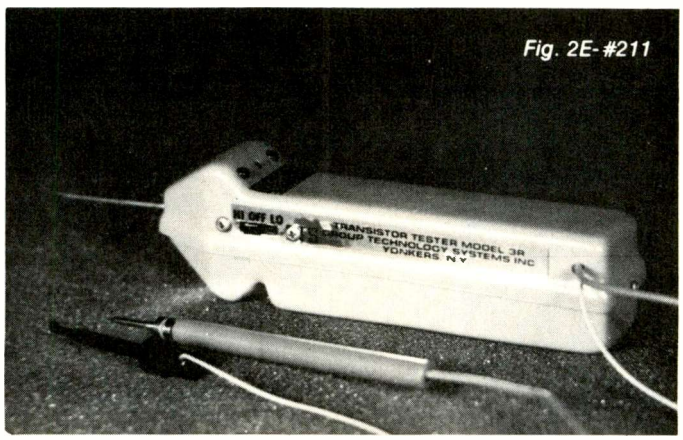

Fig. 2E-#211

Fig. 2 - These "miniaturized" transistor and semiconductor testers are representative of the troubleshooting equipment available to today's field technician in both in or out of circuit testing purposes. Shown are (A) Leader's 906; (B) B&K's Model 5101; (C) Hickok's Model 215; Sencore's Model TF4 "Pocket Cricket" (D); and the uniquely designed Model "3R" from Group Technology Systems (E).

temperature variations. Moreover, their high "recharge" rate in the long run often makes them more cost effective than the throwaways. Modern Ni-Cads may be recharged anywhere from 300 to 1,000 times before replacement is needed.

However, still another battery technology is developing on the horizon which would seem to hold great promise for the "portable" test gear industry. This is the rapid development of the "lithium cell."

According to Mallory Battery Company's Bruce McDonald and David Linden, lithium batteries pose an attractive alternative for portable test gear makers for a number of reasons. Among them: high voltage — cell potentials as high as 3.5 volts compared to the traditional 1.5 of most systems; high energy density — two to four times better than conventional zinc batteries; high power density which makes them capable of delivering power at high current and voltage; wide temperature operation characteristics; and flat discharge characteristics.

Another advantage of lithium, according to McDonald and Linden in a paper they presented at a recent Electro '79 Show, is that these batteries show superior shelf life characteristics ... "storage from five to 10 years at 70 degree Fahrenheit is projected; storage in excess of one year at 160 degree Fahrenheit has been demonstrated."

As an example of comparison between a traditional 9V transistor type radio battery under a 250 ohm discharge, the zinc carbon dropped from about 9.7 volts to 4.2 in 14 hours; the alkaline from 8.5 to 4.2 in 18 hours; and the lithium cell from 8.5 to 4.2 in 36 hours.

Among the applications for lithium batteries at the present time, according to the two authors, are in radio transceivers, aircraft and space industries as well as limited use in industrial and consumer areas. In regard to the latter area, the authors stated that the use of lithium cells "would easily double the service life of the equipment, reduce weight as the lithium cell is lighter than a conventional cell of the same size, and provide lower temperature performance and longer shelf life."

Current usage

Two types of rechargeable battery are in wide use, the nickel cadmium - NiCd - and the lead acid. The NiCd has many problems, among them is a long charging time or a complicated charging system to avoid damage from overcharging. Another problem is polarity reversal in individual cells without warning during discharging.

The more linear voltage/charging rate characteristic of lead-acid batteries makes overcharging protection very easy. Moreover lead-acid batteries have a better charge retention than NiCd.

Charging of the internal battery should be possible through an internal charging

Fig. 3A-#212

Fig. 3B-#213

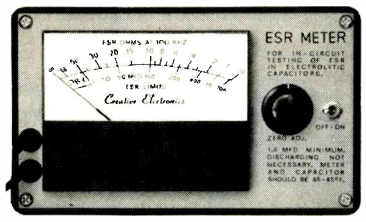

Fig. 3C-#214

Fig. 3 - One of the developing areas of portable equipment is the field of capacitor testers, once the realm of "laboratory only" type instrumentation. Three units currently on the market are (A) B&K's Model 820; (B) Data Precision's new Model 938, and (C) Creative Electronic's ESR (Effective Series Resistence) Meter. The capacitance meters are basically out of circuit testers while the ESR meter is designed to determine "go" or "no go" states in electrolytic capacitors either in or out of circuit.

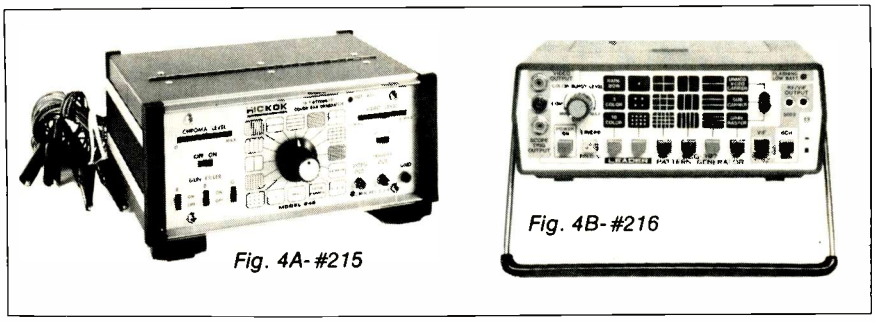

Fig. 4A-#215

Fig. 4B-#216

Fig. 4 - Two state-of-the art progressions on the standard color bar generator are offered in portable form by Hickok and Leader. Operating on two standard 9 volt batteries Hickok's Model 246 (A) offers 16 basic patterns. Leader's Model 397 (B) offers 18 patterns and operates on four "c" cells. Both have adjustable color burst and RF, IF outputs.

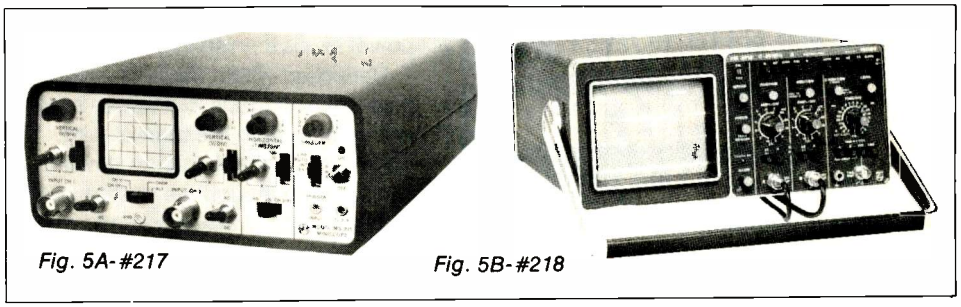

Fig. 5A-#217

Fig. 5B-#218

Fig. 5 - Still in their "infancy," portable oscilloscopes appear to be likely candidates for evolution in the portable market. Two companies at least are in (A) Non-Linear with its "mini" dual trace 15MHz, 4-by-5 cm CRT and Philips with two 25MHz versions; the Model 3212B is shown here (B). Obviously power requirements are still a problem with scopes. Philips is rated at 2.6 hours continuous use while Non-Linear says its unit will go for three hours.

Fig. 6 - Representative of the technologies now filtering into the home electronics test gear market is this Philips 6616, 1.3 GHz counter, base priced at about $1600. With the optional battery pack (priced at $210) this unit is capable of 24 hours operation. The development of oven contained crystal oscillators with low power drain is responsible for the greater accuracy of these portable counters. #219.

circuit, and be automatic whenever the instrument is connected to a line ac or dc source. Some form of warning when the battery is getting low is also useful - typically blinking the display ten or fifteen minutes before the power runs out allowing time for measurements to be finished.

Specifically in regard to frequency counters, laboratory standards have not been heretofore possible because to make meaningful use of high-stability crystal oscillators requires constant temperature control. Now, however, the development of oven-contained crystal oscillators with very low power consumption (less than 1 watt) permits the extension of instantaneous high stability of lab instruments to field applications (see ET/D, April, p. 15).

Display panels

The display for a portable instrument is an important factor - it must be good enough to be read under high ambient light conditions. It is not much use having an instrument which will go anywhere, if it is only possible to read the instrument display in a dark area.

The technological compliment to the advances in battery technology which is facilitating the growing trend toward portability in test gear is, of course, the development of low voltage display panels — LED and LCD displays.

The development of the LED is what led (no pun intended) directly to the lower power consumption in bench as well as portable units. LEDs, however, suffer from poor visibility in high ambient light. The LCD, of course, shows a tremendous improvement in the power consumption characteristics of display panels, but they in turn suffer from the problem of limited temperature range in comparison with gas discharge tubes and LEDs.

Your choice of display lies between planar gas discharge, light emitting diodes - LEDs - and liquid crystals. All have their advantages and disadvantages.

Planar gas discharge is very readable in high ambient light, and gives a very high efficiency light output for the power consumed. But it needs a high voltage with associated driving costs. And radiation from the HV switching can be a problem, although careful screening eliminates this problem.

LED displays

LEDs are relatively new and a still evolving technology. Basically low-voltage devices, there are few circuit problems. A LED display will work on the same power supplies as the other instrument logic. The standard red has been a critical drawback - the eye is not

very responsive to that color - but other colors are now becoming available.

Power consumption can be a problem. LEDs are relatively inefficient - consuming perhaps five times as much power as an equivalent gas discharge system.

Pulsed displays help cut power consumption and are the rule when seven or eight digits are being used. This approach cuts down on the amount of driving circuitry through multiplexing. Pulsing has the additional advantage of giving rise to light enhancement - a human phenomena whereby the eye retains high brightness levels. So a pulsed display can operate at lower power levels than steady-state displays.

Reflection within the light cell is a problem with LEDs, but newer systems are coming onto the market with increased contrast, cutting down this trouble. And though the cost of LEDs is still high, prices are falling and are in any case outweighed by the simpler circuits.

Liquid crystal displays are as yet less well developed. Again there is the problem of poor contrast, and these displays tend to be rather short lived. However a lot of work is going into researching the problems.

The inherent advantage is the very low power consumption of such displays, making them ideal for battery operation. But this can be outweighed by certain disadvantages, such as temperature dependence. Most liquid crystal displays have a very small temperature range.

How reliable?

Perhaps the most important consideration in choosing a portable instrument, and one of the most difficult to check - is the question of reliability. An instrument failure in the workshop is one thing, but an instrument failure in the middle of nowhere, miles from a workshop, is another matter.

You should always look for the following clues when looking inside an instrument. The smaller the number of components, the less chance there is of failure and the faster you will be able to locate and eliminate faults. Good accessibility is also a must.

Well-protected input channels also add to the instruments reliability. It is foolish to be without an instrument purely through some accidental overvoltage connection. Keep in mind that any input component which might burn out through overloading should be replaceable easily — without the need for workshop facilities. ET/D

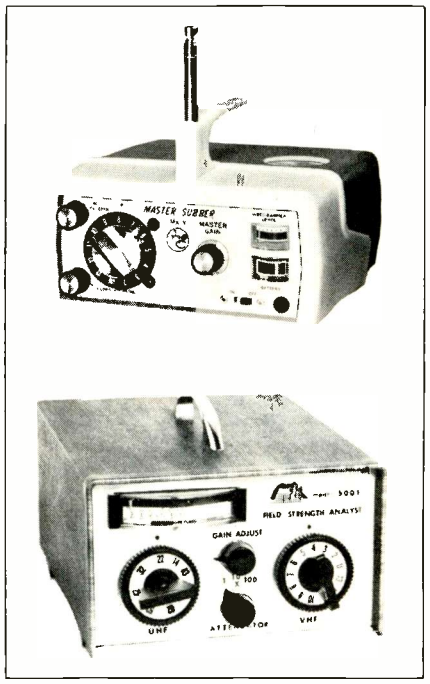

Fig. 7 - Two of the nine portable types of television tuner subs and field strength meters offered by PTS Electronics are shown above. Both operate on 2, 9-volt transistor type batteries. #220.

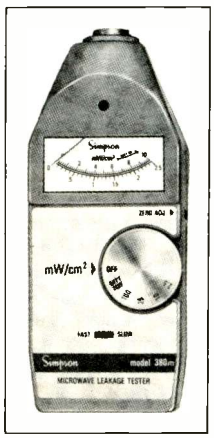

Fig. 8 - This microwave leakage tester from Simpson Electric Co. is typical of the new types of hand-held portables now coming into the test gear market. Similar audio level meters are now available and some manufacturers sell ancillary equipment to modify their digital multimeters into either light or temperature sensing meters. #221.

Fig. 9 - Weston Instruments Model 6000 DMM, operable over 350 hours from two 9-volt transistor type batteries, registered an industry "first" with its hold probe. This special accessory allows the measurement reading to be indefinitely displayed until specifically erased by the technician. #222.

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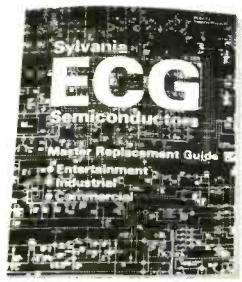

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Electronic noise and noise sources

A further look

You've heard it before. But how much do you really know about its origin and practical methods of controlling it? In this article the author discusses various types of noise and offers practical suggestions on controlling noise sources.

By Bernard B. Daien

To most technicians the word "noise" is synonymous with electrical or man made interference. But there is another, all pervading noise ... seen as "snow" on TV sets, heard as "hiss" in audio and communication equipment. This noise is the ultimate limiting factor in amplification. Once the gain is high enough to reach the noise level, further amplification is useless. Thus it is noise that limits the range of radio, TV, radar. And it is this noise that limits high fidelity, instrumentation, and on, ad infinitum.

Despite the fact that this noise is everywhere, all the time ... in the smallest resistor, and in the vastness of space, little has been written about it for technician use. In many cases, a clear understanding of noise permits practical means of reducing it. This article explains noise in an uncomplicated manner.

There are several common sources of noise in conductors, and semiconductors, and in space itself. We must sort them out in order to discuss them ... and to do this we must *look at* a few formulas ... the way we *look at* the formula for Ohms law, E = I R, and say, "The voltage drop increases when we increase the current through the resistor. It also increases when we increase the resistance." We are not actually calculating anything, we are merely using the formula as a short hand expression, to say a lot with a few symbols. If we try to say the same thing in words, we need several sentences for a simple formula like Ohms law.

Thermal noise

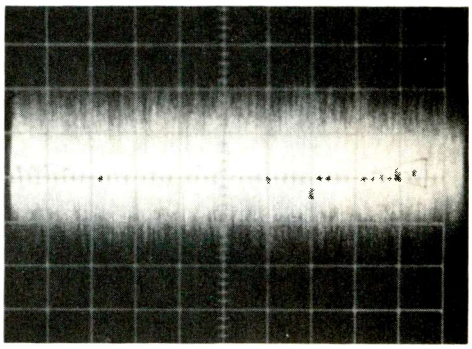
One major type of noise is "Thermal Noise." Heat causes electrons to vibrate. The higher the temperature, the more vigorous the motion. At any instant, with a large number of electrons vibrating, the number moving in one direction may be greater than the number moving in the opposite direction. Since moving electrons are "electricity," *a net movement* in one direction appears as a small "battery." Of course, the next instant the direction may reverse, and, over a period of time, the average is zero ... but *instantaneously*, there is a voltage.

You can look at it the way you look at the output of a power supply with ripple riding on the dc output voltage ... yet, measured on a slow reading voltmeter, all you read is the dc component. If you use a scope with fast response, and gain, the ripple is really there to see. So it is with thermal noise. Measure a resistor with a meter and you read zero average volts ... but put the resistor across the input of a high gain, low noise, wide band amplifier, and you can see the noise on a scope, or hear it on a speaker!

The formula that expresses this noise is:

noise in volts rms = $\sqrt{4\ k\ T\ R\ B}$

where k is a constant equaling 1.38 x 10^{-23} joules per degree Kelvin. T is temperature in degrees Kelvin, R is the resistance in ohms, and B is the bandwidth used in Hz.



Let's "look at" the formula. It says that the noise voltage is the square root of the factors on the right hand side of the equation, and that the noise increases if the temperature increases, or if the resistance increases, or if the bandwidth increases. Let's crank in some practical figures as examples, using room temperature of 25 degrees centigrade, which is 298 degrees Kelvin. (Zero degrees Kelvin is *minus* 273 degrees centigrade, and is the point where atomic motion stops.)

A 10,000 ohm resistor across the input of a perfect amplifier with a bandwidth of 20 kilohertz would generate just under 4 microvolts *rms*. Of course, that would be considerably larger if we used peak to peak volts ... especially with a nonsinusoidal waveshape! Consider that some tape heads put out only a few hundred microvolts, and you can see that you are already in trouble! Now if we increase the bandwidth to 4 megahertz, the noise increases to almost 80 microvolts rms. You can see that video amplifiers really have a noise problem due to the bandwidth. Note that this is the *theoretical minimum noise*. Practically, the noise is always greater due to the fact that resistors cannot be made with perfect quality.

Another kind of noise comes from

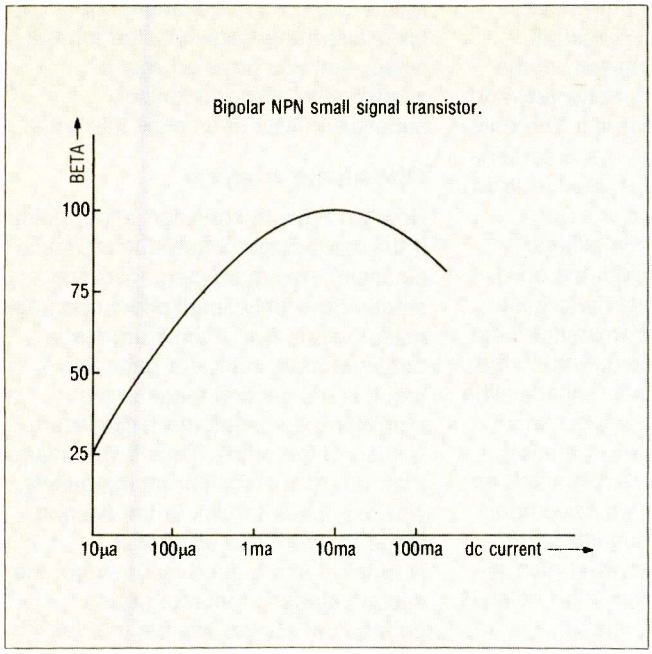


Fig. 1-The gain falls off at low current and at current above the level of the transistor's design.

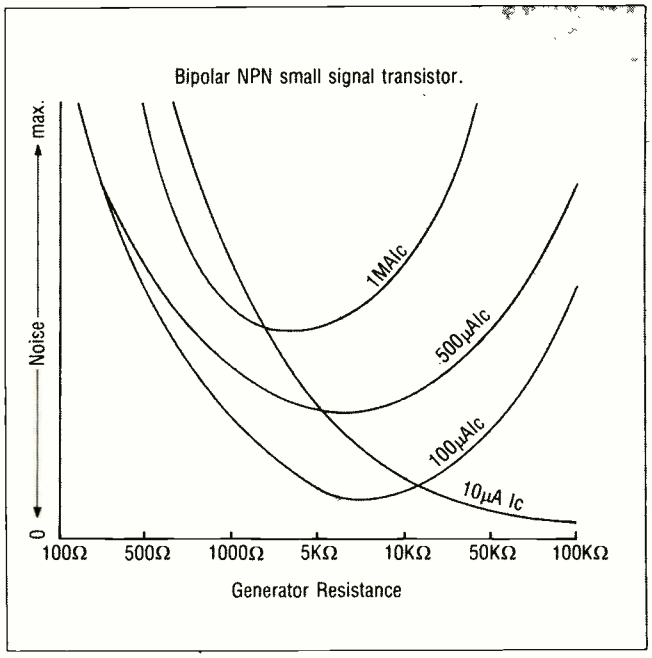


Fig. 2-Low collector current yields low noise, but requires a higher generator resistance to achieve lower noise.

outer space ... cosmic noise, sun noise, galactic noise ... many noises ... hundreds of noises. It is quite common for an antenna of a receiver to have ten times the calculated noise output, due to these outer space noises. The noise depends upon the direction the antenna is pointed, and the frequency being received, since noise from space is stronger on some frequencies, and in certain areas of space.

Current noise

Still another kind of noise is "Shot Noise," which is generated *as a result of a dc current flowing through a PN junction*. This noise is a noise *current*, and the formula is:

Noise current I RMS = $\sqrt{2qIB}$ where I is in amperes, q = 1.59 (10^{-19}) coulombs, and B is the bandwidth of the system in Hz. As before, the noise current is the square root of the factors on the right hand side of the equation. The noise current increases when the dc current through the junction increases, or if the bandwidth is increased. Since we have *two* junctions in a bipolar transistor, (EB and CB), the currents flowing through both junctions contribute to the total noise. Again, this is the theoretical, or minimum noise.

Another noise which occurs in transistors is "Excess Noise" also called "1/F" (One over F) noise, because it is inversely proportional to frequency, i.e., the lower the frequency, the *greater* the noise output. This phenomenon is not clearly understood, but at frequencies above one KHz it is not generally a problem. For those of you who think that cutting off high frequency response is the way to reduce noise, think about that one!

Another noise peculiar to semiconductors is "Popcorn" noise, so called because it sounds like popcorn popping when monitored on a low noise high gain audio amplifier. Viewed on a scope it appears like big bursts of noise, appearing at random, over and above the "hiss" type thermal and shot noise. This is due to the processing used when manufacturing the semiconductor, and can be eliminated by using another device, preferably from a different source. It can be considered a quality control problem.

Minimizing noise

Since the formula for shot noise tells us that the noise current increases when the applied dc current is increased, it would seem logical that operating the transistors in the input stages of a system, where the signal is very small, at low current, should give us the lowest noise ... and that is correct ... but there is an optimum current, below which noise may actually increase again. This is due to the fact that transistor gain falls off with most bipolar transistors as the current approaches zero. Of course, *at* zero current the transistor is cut off and the gain is also zero. This is illustrated in Figure 1, "variation in Beta versus current."

In general, *use a fairly high beta* transistor for low noise applications.

It should be noted that decreasing the emitter current in a bipolar transistor causes the base input resistance to *increase*. As a result generator impedance must be increased to provide the optimum impedance matching for purposes of achieving the lowest possible noise. This is shown in Figure 2, where current versus input impedance are plotted against noise. Lower emitter currents yield lower noise, *if* the generator impedance is raised. Conversely, higher emitter currents require lower generator impedances for the lowest noise.

Notice that even if the current is reduced to 100 microamperes, the best noise is obtained with a generator of about 7000 ohms, and if the generator resistance rises above 20,000 ohms the noise output starts to rise. What must we do if we have a generator with a high impedance? An input transformer tends to pick up stray magnetic fields, and limits the bandwidth. An electronic matching network introduces both thermal and shot noises as well as 1/F noise.

This problem is neatly solved by using a field effect transistor. The junction field effect transistor (JFET) is available in low noise types, and works very well at, and above 20,000 ohms generator resistance, with drain currents from 100 microamperes to 5 *milliamperes*. The noise tends to rise with *low* impedance generators on the

input ... so the JFET complements the bipolar transistor in this respect.

MOSFET applications

The MOSFET is quite another story. Most MOSFETs are quite noisy compared to other low-noise transistors ... but ... they have an extremely high input impedance and work very well with very high impedance generators. As you recall from the formula for thermal noise, noise increases as resistance increases. With generator impedances over ten megohms, the MOSFET starts to look good at wide bandwidths, since the generator noise is higher than the MOSFET noise. Other devices simply cannot handle these high impedance generators ... so in the area of *high source resistance* the MOSFET has lower noise than the other transistors.

This leads to some interesting practical results. I once had a portable public address amplifier of well known make that hissed at an objectionable level. Using the dynamic microphone that came with the amplifier required running the input transistor at a fairly high current for best impedance match and gain, but reducing the collector current, dropped the noise faster than the loss of gain, and the hiss practically disappeared after the input stage was rebiased to run at 100 µA collector current. The applied voltage was also reduced from 20 to 5 volts, with a further reduction in noise.

In general, reducing the voltage below 6 volts does not buy much, but when voltages of 12 volts and higher are applied, it is worthwhile to reduce the voltage to 5 or 6. Of course the collector load resistor should be adjusted when the collector current is reduced, a higher value resistor being used. And, a good low noise transistor is *always* indicated. They are available for a few pennies more than the run of the mill devices.

In another case, the high generator impedance was so mismatched that the output suffered noise degradation. In this case a bipolar transistor had to be replaced with a low noise junction FET in order to get a decent noise level. Such cases are quite common with poorly designed imported consumer products, despite the raves of certain writers who offer reviews of products.

Handling RF noise

High frequency RF and IF amplifiers have the same problems, but changing the emitter current also changes the transistor's internal capacitances, which are part of the tuning and neutralizing networks, and therefore cannot be altered. The only way to beat this one is make certain that a good transistor is used if noise is a problem. In a word ... "Don't tweak high frequency amplifiers." Those of you familiar with the solid state TV sets know that there is an "AGC delay" control in many of them. This control affects the current in the RF amplifier in the tuner. Misadjusting this control results in severe "snow" (noise), due to improper operating current, and impedance mismatch as a result of the factors we have been discussing. It is essential that the transistor have good current gain *at the operating frequency* if the noise is to be low. This means that in replacing transistors, a device must be chosen with a cutoff frequency several times higher than the operating frequency.

We will not discuss "circuit noise" which results from circuit design. For example, the circuit configuration known as the "cascode" circuit is low noise when compared to most other configurations. Mixers on the other hand can be very noisy unless carefully designed. Using a mixer as the input stage, as was done for so long in TV UHF tuners, results in poor signal to noise ratios. This type of noise can easily overshadow the kind of noise we are talking about here ... but for the purposes of this article we will assume that the circuitry is well designed.

Watch those resistors

Since the quality of a part often shows up in the amount of noise in the output, be warned that different types of resistors have widely varying noise outputs. The ordinary composition resistor is the worst. Carbon film and metal film resistors are better, and wire wound resistors (where permissible) are best. Cheap imported composition resistors can be murder, and should *never* be used in low level stages, such as audio preamplifiers, tuners, etc.

The above comment also applies to semiconductors. Inexpensive transistors are *not* tested for noise. Transistors tested for noise have a maximum noise specification, and cost a little more. Substituting a low noise transistor in a low signal level circuit can do wonders, and should be done when making repairs, since the better manufacturers of equipment often purchase transistors selected for low noise, and you have no way of knowing this. Semiconductor substitution lists often miss this point!

Checking states

Now we have to consider a finer point. If the input stage (where the signal is smallest), has good gain, following stages have only small effect upon the noise output. But, if the input stage does not have sufficient gain, the result is the second stage in the amplifier may contribute a significant portion of the noise. Thus if you insure that the input stage is running quietly, you may have to look at the second stage to see if it is also quiet. Normally, with a good input stage, the second stage is ignored, but as pointed out above, this can not be taken for granted under all circumstances. I have seen very noisy second stages which needed cleaning up, primarily due to poor quality transistors.

One way to *make* a good transistor noisy is to overload it ... exceeding voltage, current, or power ratings can *degrade* the noise characteristics of transistors, while other parameters seem to be relatively normal. It is a good rule, when transistors have been "zapped" or "cooked" to replace them, even if they seem normal!

Many systems have the choice of high, or low impedance inputs. Use of the wrong input results in a poorer signal to noise ratio. But what if the signal source lies somewhere between the two inputs? Because of the several variable factors involved, it is necessary to use the trial and error approach. Depending upon the transistor used, and the operating current, the noise may increase faster on the high, or low impedance, mismatch side. There is no hard and fast rule. Generally, if the system works, the installer is satisfied, but that *should not be the test*. Instead, the *signal to noise ratio* should be the deciding factor even if the system seems to be otherwise adequate. Looking at the weakest channel on a TV set, or listening to a low level passage on a tape player, may often be revealing.

Since 1/F noise increases as the frequency *decreases*, this sort of noise can be very troublesome in direct coupled circuits, such as DC amplifiers, instrumentation equipment, and some consumer products using such circuitry. It is advisable to make

sure that the system does *not* have a low end response that goes below the frequency actually required. The results of "extra" low end response is just 1/F noise, and nothing else.

There is justification for a higher response than needed, for the highest frequency to be passed by the system, since most wave shapes are not sinusoidal, and if reproduced, *all the harmonics* must be passed too, in order to preserve the wave shape. (And those of you who are familiar with operational amplifiers know about "slew rate.") The net effect is to prevent reducing the high frequency response of the system, (even though reduced bandwidth also reduces noise), by cutting the high frequency response of the transistor. There are some noise reducing systems that do cut the high frequency response, but this is done under controlled conditions, on a selective basis, and requires fairly complex circuitry.

Military systems

In military applications, such as missile guidance and radar, noise limits the range, and in these circumstances, every trick is used to reduce noise. You will recall that in the formula for thermal noise, temperature was a factor, and you might be asking yourself why we do not cool input stages to reduce noise. The military has done so, using liquid oxygen, liquid nitrogen, and other liquified gases to obtain very low operating temperatures for input stages. For other applications the cost is excessive. For example, if we assume that the input stage is running at 40 degrees centigrade (inside a piece of warmed up equipment) we are at 313 degrees Kelvin. To cut the noise by 30% we would have to reduce the temperature to 162 degrees Kelvin, which is minus 111 degrees centigrade! As you can see, it would take quite a refrigerator to produce the desired effect.

What about noise from outer space? If our antenna happens to point towards a hot spot in the sky, the result is noise. If we *must* aim in that direction, very sharply directive antennas are called for, to make sure that we aim at the station, and not at other noisy areas. Highly directional antennas are often used in big cities to minimize ghosts due to "bounce" reflections off tall buildings. In wide open fringe areas the emphasis is often placed on signal pickup (and side lobe response, and other directional characteristics are less considered). This is not the way to go when sky noise is a factor. Some antennas have been condemned as poor fringe area performers, on the basis of a single trial, where the antenna was pointing into sky noise. In almost every case, directivity goes hand in hand with the most desirable antenna characteristics, such as gain, low noise, etc. As a good rule, antenna directivity should be listed as a most essential factor for low noise performance.

Every effort should be made to minimize noise in systems, because once noise is mixed with the desired signal there is no practical way to remove it. The attempts to remove noise would be more productive if turned in the direction of reducing the generation of noise in the first place. Removing noise is so difficult, so costly, and generally so ineffective, that only large scientific efforts are productive. One such attempt is the computerized photographic enhancement of space pictures sent back by radio from our space probes, but such efforts are hardly in the realm of cost effective ventures.

Practical considerations

Another practical point! If the input stage gain is low, the second stage noise will become a factor. This is especially true under the following circumstance:

A tape deck feeds into a preamplifier, which in turn feeds a stereo amplifier. Both the preamplifier, and the stereo amplifier have gain controls. The user turns down the gain on the preamp, and turns up the gain on the stereo amp ... the result is noise. What happens is that with the preamp gain turned down the tape *signal* is reduced, but the noise output of the preamp, which is always present, is undiminished. Turning up the stereo gain now amplifies the preamp's noise. It's like the TV tuner, if we reduce the gain of the input stage (RF amplifier) in the tuner, the signal is reduced. Turning up the gain of the following stages now merely amplifies the snow.

Let's look at it another way. If the input stage of an amplifier is dead, the gain is zero, and the following stage sees a very weak signal which is due to the capacitive feedthrough of the circuitry. The weak signal is therefore very snowy, or hissy, or whatever, depending upon whether we are using a TV, or HIFI, etc. When you turn down

the gain of a preamp, you are simulating this set of conditions. The lesson is: *always run the input stage at full gain, unless you run into a signal too strong to handle* and must therefore reduce the gain. (On such a strong signal, noise will be of no consequence anyway.)

Applied to our preamp, the preamp gain should be run high, and the stereo gain reduced. Reducing the stereo gain reduces both the signal and the noise, together, but the signal will be healthy due to the good signal to noise ratio of the preamp, which is designed for low noise. The above drives home the point made earlier.

Noise vs. failure

Noise is often an indication of impending failure in semiconductors. Studies have shown that noisy zener diodes fail more often than quiet ones. Excessively noisy devices should be replaced as part of "preventive maintenance," even though they are not a problem at the moment. Since both thermal and shot noise are "wide band" noise, distributed uniformly over a very wide range of frequencies, they get into *all* circuits, appearing in audio, video, RF and IF, and even DC circuitry. As you can appreciate, a signal which appears in all circuits can be difficult to diagnose, because you find it everywhere you look. A noisy zener, pumping signals into the dc supply line is a good example of this sort of thing. One of the commonest methods of trying to cope with this problem is bypassing the defective device with a large capacitance, in an effort to "filter out" the noise. The proper way is to replace the offending noise source with a noise free device.

Both semiconductor, and equipment manufacturers are in business to make a profit. Some semiconductor types do not have noise specs, other similar devices do. What would you do if you were a semiconductor manufacturer? You would test the devices, sell the low noise ones for a little higher price, and the rest would be sold at a lower price. As a result the cheap "bargain transistors" have higher noise levels, but this is a fact the shop owner often fails to consider. Also, factory purchasing agents often buy at the lowest price, and wind up using high noise devices in low cost products. The cheapest of the "pocket" radios, selling for less than $5.00, use transistors rejected for noise and similar defects ... and they

continued on page 47

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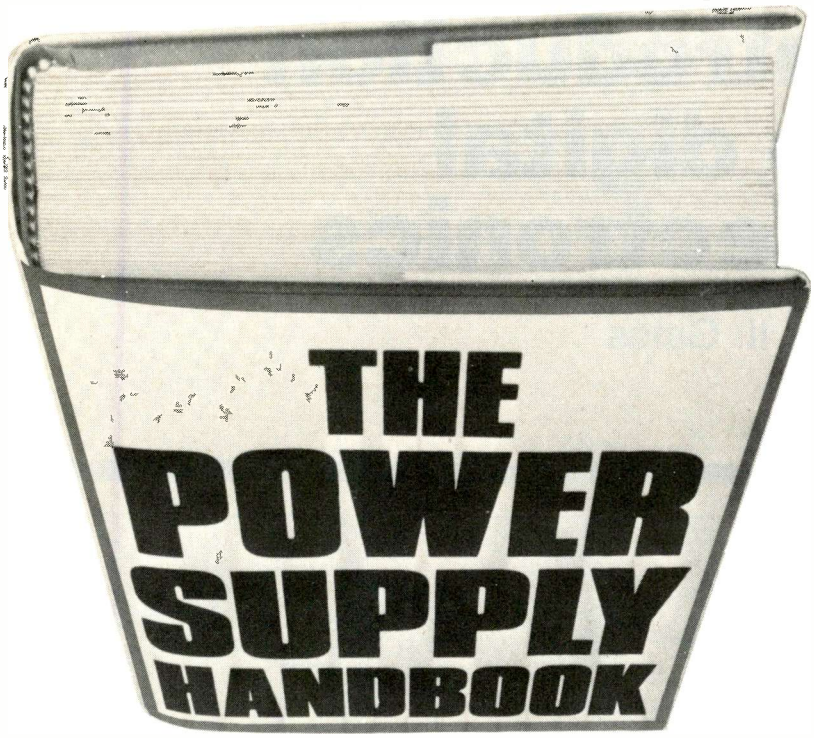

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T-69

Introduction to digital electronics

Part II: Gates

The gate is the basic building block of digital logic. In this second article of the series, various types of gates are discussed along with experiments to demonstrate their operation

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

A digital logic "gate" is a circuit that passes a signal, or refuses to pass a signal, according to a well defined set of rules. In this article we will discuss all of the basic types of logic gate commonly found in digital electronics: NOT, OR, AND, NOR, NAND, and exclusive-OR (i.e., XOR).

NOT gates (inverters)

The NOT gate is also called an inverter because it produces an output signal that is the opposite of the input signal. Recall that digital circuits only respond to two different voltage levels, HIGH and LOW. In an inverter circuit, then, the output will be HIGH when the input is LOW, and LOW when the input is HIGH. The circuit symbol for an inverter is shown in Fig. 1A. Note that any digital logic symbol with a circle on the output produces an inverted output. Similarly, if one or more inputs has a circle on it, that input is an inverted input.

The rules for inverter operation are shown in Fig. 2A, and are summarized below:

1. A HIGH on the input produces a LOW output.
2. A LOW on the input produces a HIGH output.

OR gates

An OR gate will pass a signal to the output if either input is HIGH. The symbol for an OR gate is shown in Fig. 1B, while the truth table is given in Fig. 2B. The truth table shows the rules of operation for the gate, which are also summarized below:

1. If both A and B inputs are LOW, then the output is LOW.
2. If either A or B inputs are HIGH, then the output is HIGH.
3. If both inputs A and B are HIGH, then the output is HIGH.

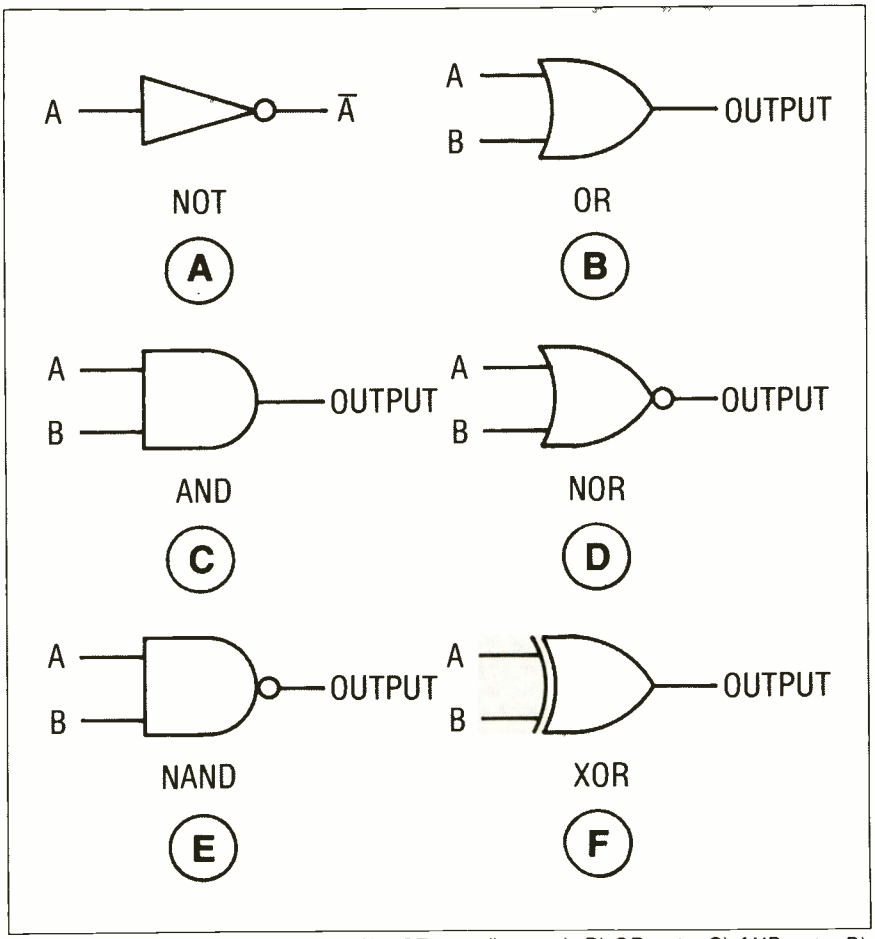


Fig. 1–Digital logic circuit symbols, A) NOT gate (inverter), B) OR gate, C) AND gate, D) NOR gate, E) NAND gate, and F) Exclusive-OR (XOR) gate.

AND gates

The AND gate is the opposite of the OR gate. It will produce a HIGH output only when both inputs are HIGH. The circuit symbol for the AND gate is shown in Fig. 1C, while the truth table is shown in Fig. 2C. The rules for AND gate operation are as follows:

1. If both A and B inputs are LOW,

Fig. 2–Truth tables for digital logic circuits. A) NOT gate (inverter), B) OR gate, C) AND gate, D) NOR gate, E) NAND gate, F) Exclusive-OR (XOR) gate.

INPUT	OUTPUT
1	0
0	1

Fig. 2A–Truth table for an inverter.

INPUT A	INPUT B	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	1

Fig. 2B–Truth table for an OR gate.

INPUT A	INPUT B	OUTPUT
0	0	0
0	1	0
1	0	0
1	1	1

Fig. 2C–Truth table for an AND gate.

INPUT A	INPUT B	OUTPUT
0	0	1
0	1	0
1	0	0
1	1	0

Fig. 2D–Truth table for a NOR gate.

INPUT A	INPUT B	OUTPUT
0	0	1
0	1	1
1	0	1
1	1	0

Fig. 2E–Truth table for a NAND gate.

INPUT A	INPUT B	OUTPUT
0	0	0
0	1	1
1	0	1
1	1	0

Fig. 2F–Truth table for an XOR (exclusive OR) gate.

then the output is LOW.

2. If either A or B inputs are LOW, then the output is LOW.

3. If both A and B inputs are HIGH, then the output is HIGH.

NOR gates

The NOR (i.e., NOT-OR) gate of Fig. 1D is an OR gate with an inverted output. The NOR gate is sometimes shown in textbooks and tutorial magazine articles as an OR gate followed by an inverter. The NOR gate symbol, therefore, is the regular OR gate symbol with a circle on the output.

The truth table obeyed by the NOR gate is shown in Fig. 2D, while the rules that it represents are summarized below.

1. If both A and B are LOW, then the output is HIGH.

2. If either A or B is HIGH, then the output is LOW.

3. If both A and B are HIGH, then the output is LOW.

NAND gates

The NAND (i.e., NOT-AND) gate of Fig. 1E is an AND gate followed by an inverter stage. It is, then, an AND gate with an inverted output. The NAND gate symbol is, therefore, an AND symbol with a circle on the output.

The truth table for the NAND gate is shown in Fig. 2E, while the rules of operation represented by the truth table are summarized below:

1. If both A and B inputs are LOW, then the output is HIGH.

2. If either input A or B is LOW, then the output is HIGH.

3. If both A and B inputs are HIGH, then the output is LOW.

TTL and CMOS examples

In Part I of this series, we described several different families of digital logic integrated circuits. Of these, several were considered obsolete, so will not be offered here. Of the currently used logic families, TTL and CMOS are the most popular, so our examples will be taken from them.

Note that a single magazine article cannot take the place of hundreds of pages of manufacturers data sheets and catalogs. So we will only describe some of the most common devices, leaving others for you to discover in the manufacturers data books and spec sheets.

NAND gates

In the TTL family the most popular NAND gate is the 7400, a device that frequently sells for less than 25¢! The pin-outs for the 7400 device are shown in Fig. 3A. Note that this is a multiple NAND gate, i.e., there are four independent NAND gates sharing a common power supply connection inside of the package. The 7400, then, is referred to as a quad two-input NAND gate.

The 7401 device is similar to the 7400, except that: the pins are different; and, it is an "open-collector" device. This means that a pull-up resistor in the 1 to 3.3K ohm range must be provided between the output of each gate and the +5 volt supply.

The 7403 is also an open-collector device, but uses exactly the same pin-outs as the 7400. Of these three, the 7400 is, by far, the most commonly found.

The 7430 device is an eight-input NAND gate. This device has eight different inputs. If any one input is LOW, then the output will be HIGH, it requires all eight inputs HIGH for the output to drop LOW. Because most microcomputers are eight-bit machines, the 7430 NAND gate is often found used as an address decoder.

The 7410 and 7420 devices are three- and four-input NAND gates, respectively.

In the CMOS line, we also have several different types of NAND gates. The 4011 is a quad two-input NAND gate reminiscent of the 7400. The current requirements, however, are much lower than those of the 7400, as fits the CMOS technology used in its construction.

The 4102 device is a dual four-input NAND gate, so all four inputs of either gate must be HIGH before its output will drop LOW. The 4023 device is a triple three-input NAND gate, while the 4068

is an eight-input gate reminiscent of the 7430 from TTL.

NOR gates

The 7402 NOR gate is, by far, the most common example from TTL. The pin-outs for the 7402 are shown in Fig. 3B. Note that this device uses different pin-outs than the 7400 NAND gate, and is logically different.

In CMOS, we find the 4001 device is a quad two-input NOR gate, the 4002 is a dual four-input device, and the 4025 is a triple three-input NOR gate. The 4078 is an eight input device.

AND/OR/XOR

Space will not allow us to dwell on the total lines from both TTL and CMOS. The rest of these types can be seen in Table 1. If you have a need for a pin-out diagram, then consult either the manufacturer's data books, or the appropriate chapters from Don Lancaster's *TTL Cookbook* and *CMOS Cookbook* (both published by Sams).

Experiments

The following experiments are designed to let you visualize the rules of operation for the various types of gates in a workbench environment.

The experiments are designed to be performed on the AP Products, Powerace 102, digital circuits breadboard. They may be performed on other makes, or without the breadboard, but the designations given in the instructions are for the Powerace 102. You will have to convert the instructions to whatever system that you are using.

When the instructions tell you to connect an input terminal, for example, to "L2" and "S2," this means that #22 or #24 solid jumper wires are to be run from that IC pin indicated to both switch S2 and LED indicator L2. L2 will be ON whenever the input is HIGH and OFF whenever the input is LOW.

Experiment No. 1

Inverter circuits: Use a TTL hex inverter type 7404. This device contains six independent inverters, but only one is used for this experiment.

Connect the 7404 as in Fig. 4. The output goes to L4, and the input goes to both L2 and S2.

1. Set S2 to "0." L2 should be out.
2. Observe L4 (on).
3. Set S2 to "1" (L2 should come on).
4. Now observe L4 and note the difference.

Experiment No. 2

NAND gates: Use a TTL type 7400 quad two-input NAND gate. Only one of the four gates is used. Connect the circuit as in Fig. 5A, and follow the procedure below.

1. Set both S2 and S3 to "0." L2 and L3 should be off.
2. Note L4, which should be on.
3. Set S2 and "1," and note the change in L2.
4. Observe L4 (on).
5. Reset S2 to "0" and set S3 to "1." L2 should be off and L3 is on.
6. Observe L4 (on).
7. Set both S2 and S3 to "1." L2 and L3 should both be on.
8. Observe L4 (off).
9. Compare the results of these steps with the truth table for the NAND gate (Fig. 2E), and the rules given in the text.

Experiment No. 3

Using the NAND gate as a switch to control the flow of clock pulses. This experiment is best performed on an oscilloscope, but the indicator lamps on the Powerace 102 can be used if no scope is available. If the oscilloscope is used, then use a clock frequency of 1000Hz, but if the LED (L4) is used, then the clock frequency must be 1Hz.

Connect the 7400 NAND gate IC per the circuit in Fig. 5B.

1. Set the clock frequency to 1000Hz (oscilloscope) or 1Hz (L4).
2. Set switch S2 to "0" (L2 should be off, or the scope Ch. A trace should be at zero).
3. Note Ch. B (or L4). Both should indicate a "0" condition.
4. Set S2 to "1."
5. Now observe Ch. B on the oscilloscope (or L4) and note the action. It should be observed that the output passes the clock pulses whenever the "control" input (i.e., in this case, pin No. 2) of the NAND gate is HIGH. This allows us to shut off the flow of pulses to circuits such as counters, etc., at will.

Experiment No. 4

NAND gate used as an inverter: Connect the circuit shown in Fig. 5C. If an oscilloscope is used, set the clock frequency to 1000Hz, and connect Ch. A to the input of the gate, and Ch. B to the output. If the LED indicators are used, then set the clock frequency to 1Hz.

Observe that, when both inputs of the NAND gate are connected together, the circuit operates as an inverter. This fact allows designers to conserve cost when an inverter is needed, and there is already one unused section of a NAND gate available.

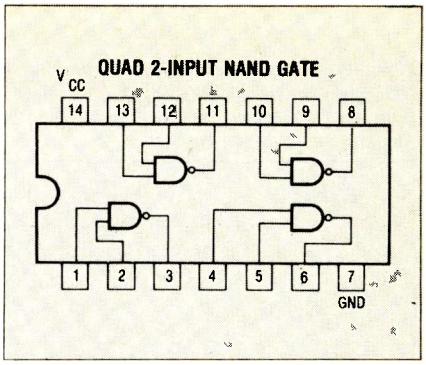


Fig. 3A–A TTL NAND gate, the 7400.

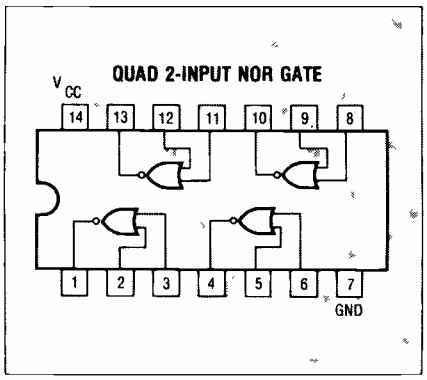


Fig. 3B–A TTL NOR gate, the 7402.

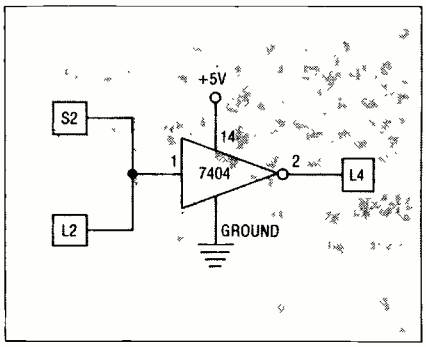


Fig. 4–Experiment No. 1

Experiment No. 5

Examine the truth table and rules given in the text for the 7400 NAND gate, and then try to think of one other way to use a NAND gate as an inverter.

Experiment No. 6

NOR gate: This experiment uses the TTL type 7402 NOR gate, and is essentially similar to the NAND gate experiment above. The results, of course, should differ due to the difference in the gate. Connect the circuit of Fig. 6A.

1. Set S2 and S3 to "0." L2 and L3 should remain off.
2. Note L4 (on).
3. Set S2 and "1." L2 should be on and L3 is off.
4. Note L4 (off).

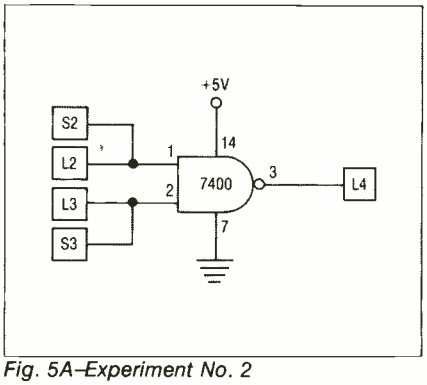


Fig. 5A–Experiment No. 2

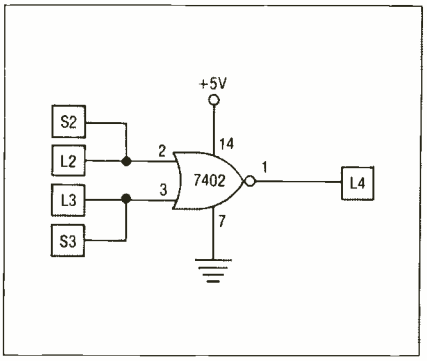


Fig. 6A–Experiment No. 6

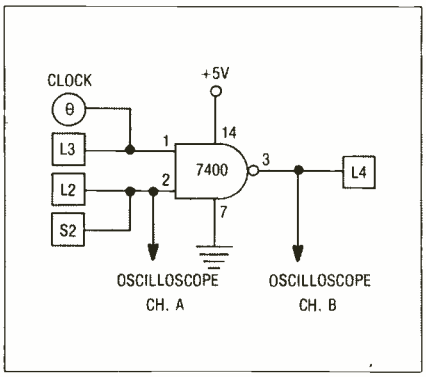


Fig. 5B–Experiment No. 3

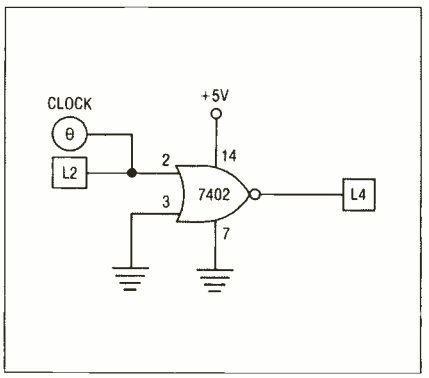


Fig. 6B–Experiment No. 7

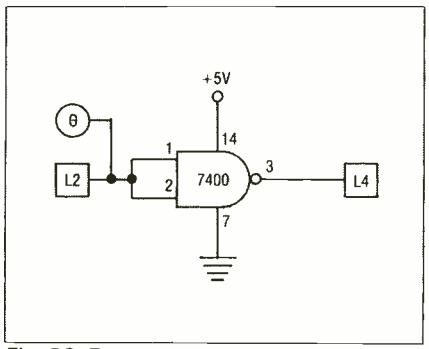


Fig. 5C–Experiment No. 4

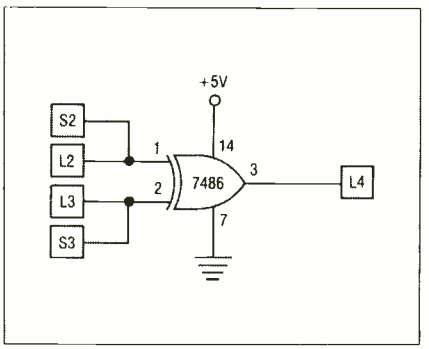


Fig. 7–Experiment No. 10

5. Set S2 to "0" and S3 to "1." L2 should be off, while L3 is on.
6. Note L4 (off).
7. Set both S2 and S3 to "1." Both L2 and L3 should now be on.
8. Note L4 (off).
9. Compare the results of this experiment with the truth table and text rules.

Experiment No. 7

NOR gate as an inverter. Use the same 7402 NOR gate as in Experiment No. 6. Set the Powerace 102 clock to 1Hz.

Connect the circuit shown in Fig. 6B. If you desire to use an oscilloscope, then connect Ch. A to the same point as 12 and connect Ch. B to the 7402 output (i.e., pin No. 1).

1. Connecting the circuit and applying the clock will cause the output light to blink out of phase with the input light (L2).
2. Compare this behavior with the rules given in the truth table (Fig. 2A) and in the text.

Experiment No. 8

Try and think of another approach to using the 7402 as an inverter circuit. Examine the rules of operation (i.e., truth table and those given in the text) for a clue.

Experiment No. 9

Use the rules of operation for the 7402 NOR gate to find a way to make a gated inverter similar to the NAND gate circuit of Fig. 5C.

Experiment No. 10

Exclusive-OR gates. This experiment uses a TTL type 7486 XOR gate to demonstrate the rules obeyed by the XOR gate. Connect circuit as in Fig. 7.

1. Set S2 and S3 to "0." L2 and L3 should both be off.
2. Note the status of L4 (off).
3. Set S2 and "1" and S3 to "0." L2 should be on, and L3 is off.
4. Note L4 (on).
5. Set S2 to "0" and S3 to "1." L2 should be off (indicating a LOW condition), and L3 should be on.
6. Note L4 (on).
7. Turn both S2 and S3 to "1." Both L2 and L3 should be on.
8. Note L4 (off).
9. Compare these results with the rules given in the truth table and in the text.

Experiment No. 11

Examine the rules given in the truth table and the text for the XOR gate, and think of a way to make an XOR gate behave as a non-inverting buffer.

Experiment No. 12

Examine the rules given in the truth table and text for the XOR gate, and think of a way to make the XOR gate think it is an inverter stage.

Next Month

In our next installment we will discuss RS and D flip-flops, and later, JK and master-slave flip-flops, built both from NOT, NOR and NAND gates and as TTL/CMOS/IC types. ET/D

Projection television, part II

More big pictures

Different manufacturers have adopted different optical system design philosophies, which in turn require different approaches in electronics

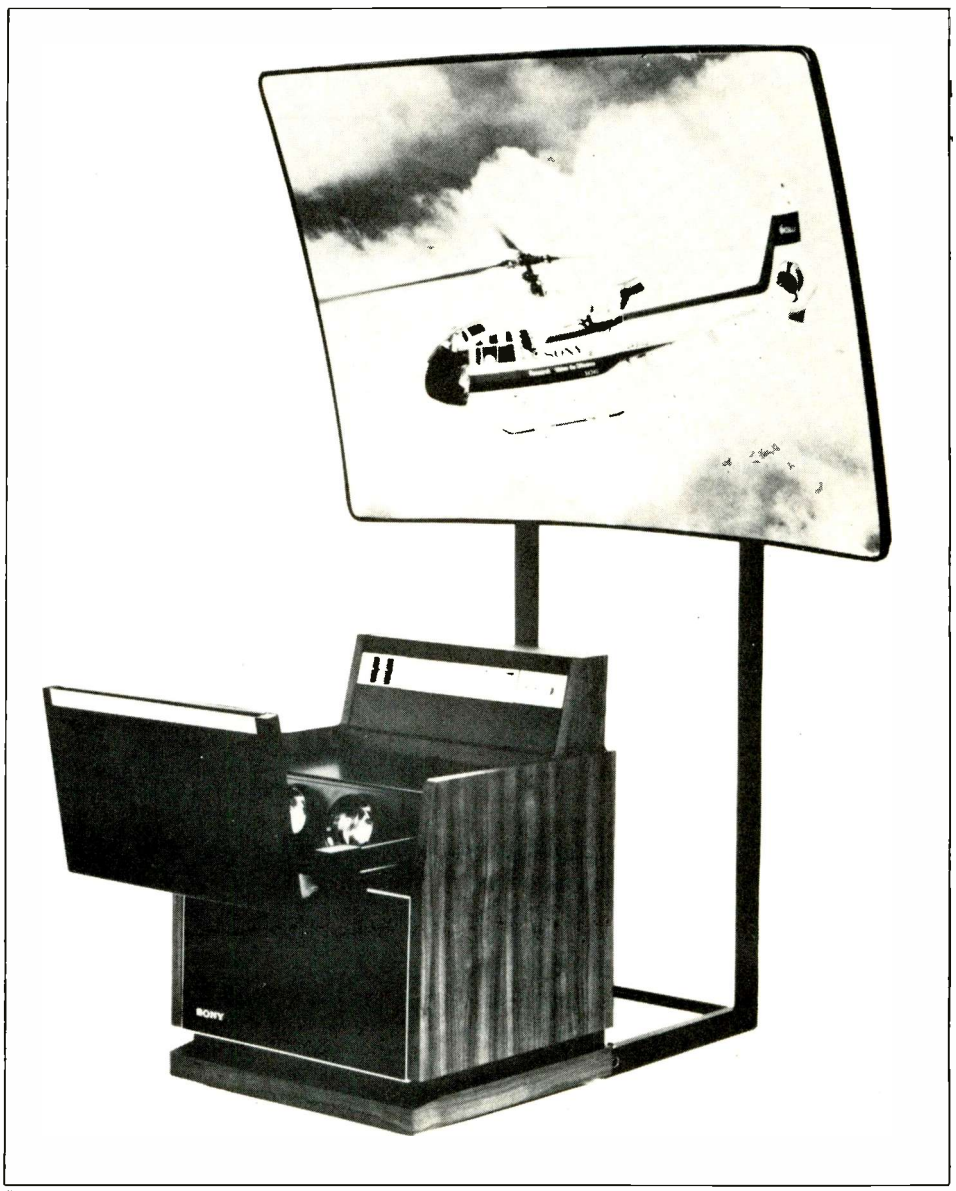
By Walter H. Schwartz

Continuing the discussion begun last month, we will examine the projection TV systems offered by GE, Sony, Panasonic, and Quasar.

GE widescreen 1000

GE offers a single unit projection set which looks much like a very large console. A lens system with a magnification of 3.71 and an F rating of 1.7, project the picture by way of two high efficiency front surface mirrors to a Fresnel lens screen of 45.7 in. diagonally measured, providing 1003 sq. in. of viewing area with a screen light output of 10-12 ft. Lamberts (Fig. 1).

The YP chassis used in the widescreen 1000 is very similar to the YM (see Fig. 2). (For a description of the YM chassis see ET/D October '76.) The changes made are those to properly operate a specially designed 13 in. black matrix, in-line gun picture tube. The high voltage transformer and deflection yoke have been "beefed up" to supply 31.6KV to the CRT. A 2200pf second anode filter capacitor has been added since the small 13 in. tube doesn't have enough



The Sony KP-7200, 72 inch screen projection system. (Courtesy Sony.)

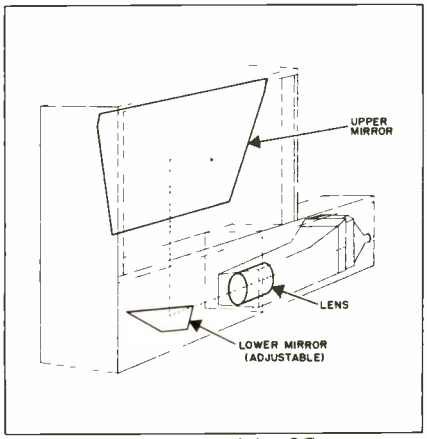


Fig. 1–Optical system of the GE Widescreen 1000. Mirrors direct the light from the projection lens onto the viewing screen. (Courtesy GE.)

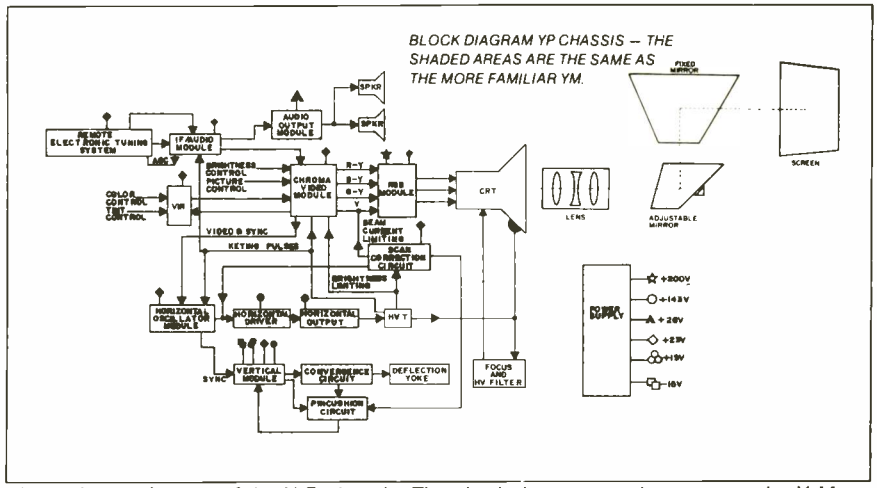


Fig. 2–Block diagram of the Y-P chassis. The shaded areas are the same as the Y-M. (Courtesy GE.)

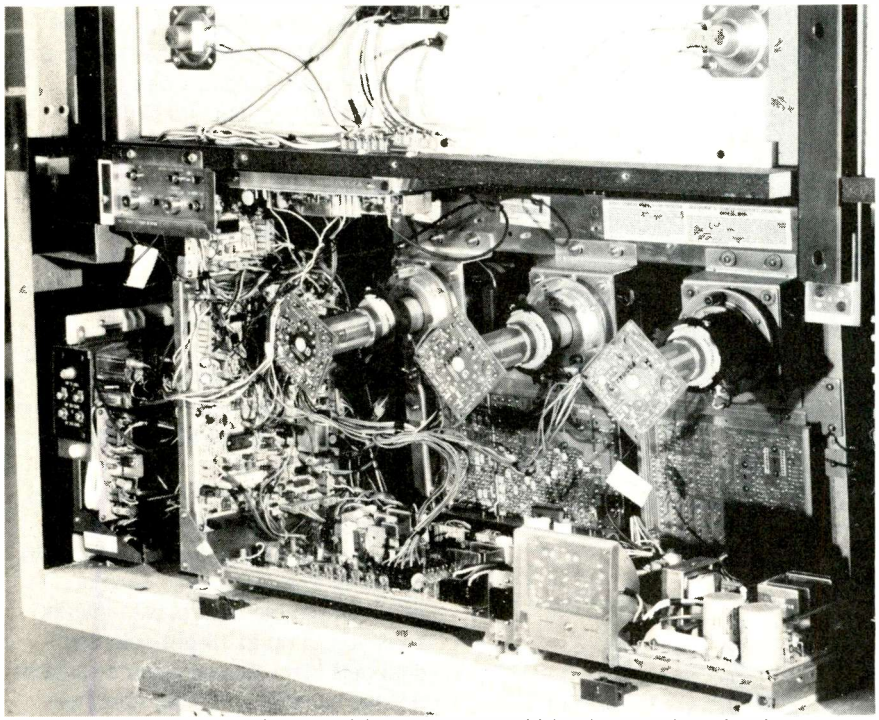


Fig. 3–The Quasar Projection Television Model PR6800QW interior view showing modular construction and the three CRTs. (Courtesy Quasar Electronics Company.)

Fig. 4–The panasonic CT-6000 Projection System.

capacity to filter adequately at the higher current level. Thirty kilovolts second anode voltage at better than two milliamps beam current means the tube is operating at more than 60 watts. Because of this high voltage/power level, X-ray protection has been increased. The CRT anode connection is covered with a box which is attached to the CRT funnel shield and there is a tunnel shield to the lens assembly, a flat plate at the end of the lens tunnel and a special brass convergence assembly clamp. All these shields must remain in place at all times when the power is applied. Because of the anode connector cover, the high voltage is measured indirectly. The focus voltage is measured and a meter correction factor is used. This factor: is meter correction factor $= \frac{200}{\text{meter impedance in megohms}}$ The high voltage is then focus voltage (as read) $\times$ (3 + correction factor). When taking this reading, the focus divider to focus pot lead must be shorted to ground. The high voltage must not be allowed to exceed 34.1 KV.

A problem unique to the YP is focus adjustment. Since the picture can be out of focus both optically and electrically, some means is necessary to determine which is causing the problem. To check optical focus, use a blank raster pattern from a cross-hatch generator, or otherwise remove all video from the screen. Look at the screen carefully. If the optical system is in focus, the phosphor dot pattern of the screen should be projected through the optical system clearly. You are looking at the tube face backwards through the optics and the dot structure should show up plainly.

Sony

While earlier Sony projection systems (VPP-500, about 1973, and KP-4000, about 1975) used special Trinitrons in a single tube arrangement to produce a picture of about 10 foot-Lamberts brightness, the current models, the KP-5000, 50 inch diagonal screen, and KP-7200, 72 inch diagonal screen, use three separate red, blue and green tubes to produce a maximum brightness of 60 foot-Lamberts for the KP-5000 and 30 foot-Lamberts for the KP-7200.

Optics are separate from the three 8 inch monochrome tubes which are arranged in a unique manner. The red and green tubes are mounted approximately horizontally before their

respective lenses. The blue tube is mounted vertically below the red tube and its light is combined with that of the red tube by a Dichroic mirror.

Electronically, the KP-5000/7200 systems are very complex using 220 transistors, 13 ICs and 159 diodes arranged on about 25 circuit boards. The "A" board is the video IF and detector, AGC, sound IF and detector and AFT. It uses 3 ICs and 2 transistors. The "BA" board is the chroma processing and video amplifier module. It also includes the sync separator and a cross-hatch generator. It uses two ICs and 27 transistors. The "BB" board performs R-Y amplifier, VIR, pedestal clamp and often functions with two ICs and 47 transistors. The "CB," "CG," and "CR" boards are blue, green and red output stages, one on each CRT socket.

The "D" board, the vertical oscillator, centering and output module uses a total of 43 discrete transistors. The "E" board is the horizontal output, horizontal centering, pincushion amplifier and output module. The horizontal output transistor is off panel on a heat sink. The "GB" board contains the horizontal oscillator, driver, HV regulator and protection circuitry. The "F" and "GA" modules are power supply regulators. The "H" boards, "HA" through "HE" contain controls, both customer and set up. The "X", "I", "M", "VA", "VB", and "VC" are all part of the tuning and remote control system and the "GC" is the damper, ABL module. The "Q" board has the audio output, video out, external video input circuits. Both models have infrared remote control.

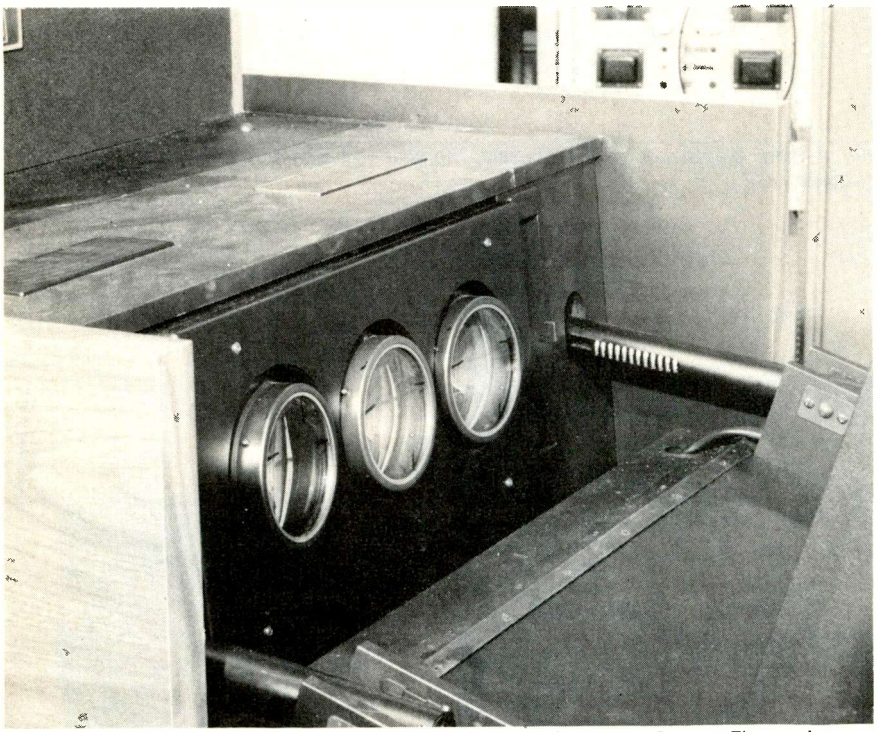


Fig. 5-The three lens system of the Quasar PR6800QW. (Courtesy Quasar Electronics Company.)

Panasonic and Quasar

Quasar and Panasonic are modular, three CRT systems, which share much of their basic circuitry. They are 60-inch one piece units (Fig. 3, 4). The projection tubes use Schmidt optics, are arranged in an in-line configuration, and produce a picture of approximately 50 foot-Lamberts brightness (Fig. 5).

These sets share 12 panels which comprise the major portion of the circuitry; the tuning systems are quite different. The Panasonic uses an up/down remote control with instant selection of up to 14 pre-selected channels. The Quasar uses a random access selection of all 82 channels, and has the capability to scan to seek higher or lower active channels.

Several interesting circuit features are apparent. Integrated circuits are used extensively to cut overall component count considerably.

The low voltage power supply uses a switching mode regulator somewhat reminiscent of the Motorola Quasar JA panel. A switching transistor with variable duty cycle compensates for load current or line voltage variations. Isolation of the output of the supply from the line is achieved through a photo coupler (Fig. 6). Q909 monitors the +24 volt source. An increase in Q909 base voltage causes an increase in base and collector currents, increasing the light intensity of the LED in the photo coupler. The photo transistor current increases lowering the base current in Q907,

continued on page 47

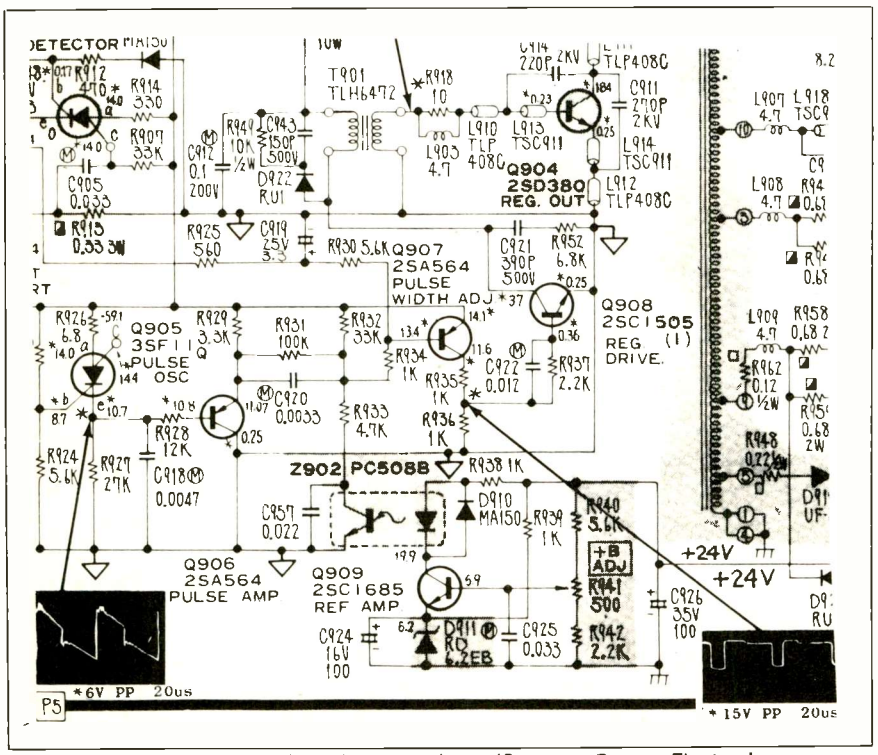


Fig. 6-The Quasar opto-coupler voltage regulator. (Courtesy Quasar Electronics Company.)

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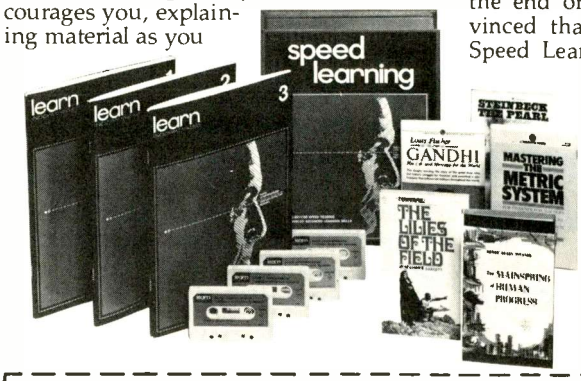

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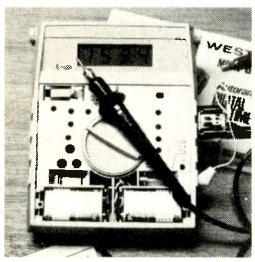
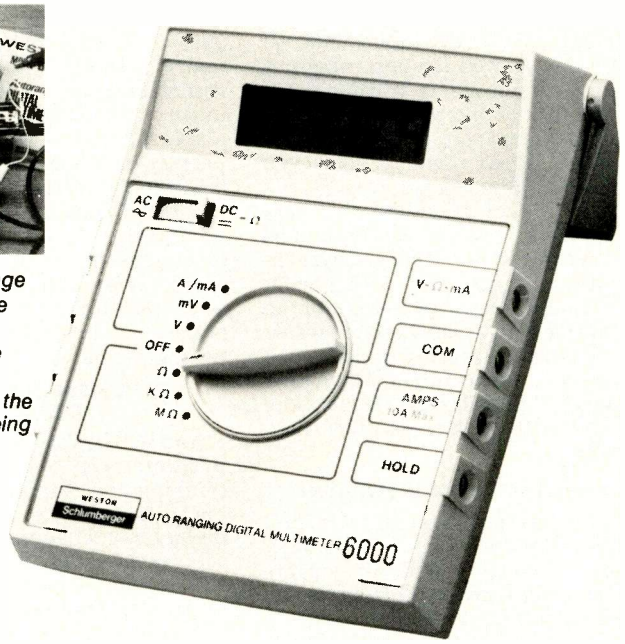
TEST INSTRUMENT REPORT

Weston's Model 6000 digital multimeter is really a shock resistant piece of battery operated test gear—in more ways than one.

Protected not only against the drop, kick or bounce (in fact Weston recommends you drop it to test its ruggedness) it is also virtually impossible to "burn out" with maximums of 1,500 on DC ranges, 1,000rms on AC, 15 amps in the high current reading mode, and 250/V/rms on resistance ranges.



View of unit with range panel removed. Note easily accessible adjustment pots, the batteries and fuse compartments, plus the 153.4mV reading being "held" by the mold probe.



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

Weston Model 6000 autoranging Digital Meter

A rugged competitor

By Richard W. Lay

It is a fully autoranging, 3½ digit liquid crystal display unit that is "specified" at 1,000VDC (10 Megohn input impedance), yet I read "-1,034" on an oscilloscope anode without any delerious effects.

I also dropped it several times on the (concrete) floor with no problems encountered. The unit is manufactured of resiliant plastic and the LCD display is cushioned against breakage, just push on it and you can feel it "give."

Its front panel rotary switch provides six functions: volts, millivolts, amps/milliamps, ohms, Kohms, and Megohms. Also, a two position slide switch selects AC,DC, or ohms.

There are 26 separate measurement ranges on the 6000. With the front panel rotary switch at mV the display will range from 00.1 to 199.9 in DC or AC modes; similar readings are obtained with the rotary switch in "A/mA." In the "V" position the unit provides autoranging from .001 to 1,000 AC or DC (Specified) without any type of supplementary probes.

With the rotary switch at "ohms", readings from 00.1 to 1.999 are obtained; in the "Kohms" slot, from .001 to 199.9; and in the "megohm" positions readings will autorange over .001 Megohm to 19.99 Megohm.

Two special input jacks, other than the "Com" and "volts/ohms/mA" inputs are provided. The "Amps" input—for readings over 199.9mA and up to 10 amps is one of them.

The other, however, makes the Model 6000 truly one of the most versatile and easiest to use meters on the market today. It is Weston's special "hold" input jack which permits the technician—working in an accessible area where he can't see the LCD display—to "touch" his circuit and preserve the reading until he can back out and take a look at the meter.

The 6000 will "hold" the reading (see illustration) until a slide switch on the handle of the probe is thrown. While this hold probe is optional, for an additional $25, I can highly recommend it for working in hard to get at circuits.

This special "hold" control operates via a dual banana plug which is inserted at the volts-ohms-milliamps and the "Com" plugs. A special pig-tail lead is then inserted into the "Hold" jack. This dual banana plug is of the stacking type and the black test lead can thus be inserted at the "Com" jack. The "Com" side of this dual plug is indicated by a polarizing tab on the side of the plug body.

Calibration adjustments are easily made without dismantling the meter. Simply snap off the front range plate and you will find all 13 adjustment pots plus the quarter amp fuse and the two 9-volt "transistor" batteries capable of over 350 hours of continuous operation, according to Weston.

Weston says when one or both batteries need replacement the until will continue to operate but the display blinks. Accuracy is said to be maintained for 10 to 20 hours thereafter.

Overrange indications are indicated when all three decimal points, the "thousands 1," and the "888" blink out of phase.

Among the options are a special model with pushbutton "manual" control which takes the 6000 out of autoranging mode, plus a pushbutton LCD backlight which permits its use in darkness.

The standard unit retails at a suggested list of $195. ET/D

NEW PRODUCTS

Digital Capacitance Meter

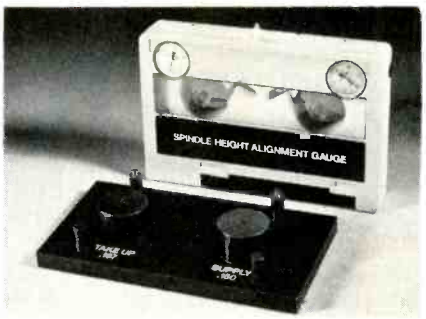
Circle No. 133 on Reader Inquiry Card

A new portable, digital, capacitance meter selling for $149, has been introduced by *Data Precision*. The 3½ digit Model 938 measures capacitance from 0.1 picofarad to 1999 microfarads in eight switchable ranges, with an accuracy of ±0.1% of reading ±1 digit, ±0.5pf. "The technique developed for the Model 938 works by directly measuring the ratio of change in charge (ΔQ) to the change in voltage (ΔV) of the unknown capacitor. This ratio, ΔQ/ΔV, is, by definition, capacitance. Using this technique, we can scale the readings easily to make measurements over a wide range while maintaining accuracy, stability, and measurement speed." Packaged in a plastic case similar to Data Precision's new Model 935 digital multimeter, the Model 938 features small size which fits easily in the palm of the hand, light weight and pushbutton switch range selection. A zero adjust is provided for compensating for the stray capacitance of test leads up to 20pf. Measurements are displayed on a half inch high liquid crystal display. An internal fuse prevents instrument damage from charged capacitors or in case of inadvertent connection to voltage sources. It will operate up to 200 hours from a single 9V alkaline battery. The price of the Model 938 is $149 (US delivery), including battery, spare fuse, clip leads, instruction manual, Certificate of Conformance to NBS Standards, and final QC test report. It is covered by a full 1 year warranty.

VCR Spindle Height Gauge

Circle No. 134 on Reader Inquiry Card

Memorex has announced a Spindle Height Alignment Gauge (SHAG) to quickly check spindle height and prevent VCR tape edge damage. A Memorex spokesman states that checking spindle height alignment took a technician up to four hours previously; the SHAG can do it in 30 seconds. The suggested retail price is $695.00.



Synthesized Signal Generator

Circle No. 135 on Reader Inquiry Card

An advanced synthesized signal generator has been introduced by *Racal-Dana*. Designated the Model 9082, the unit takes a novel design approach which combines synthesized performance with analog tuning

According to Racal-Dana, the 9082 has particular application in channelized radio communications where the need is to generate and control precise spot fre-

quencies. Offering amplitude, frequency and phase modulation capabilities, the unit also features automatic leveling over a frequency range from 1.5MHz to 520MHz.

Tuning is simplified, with frequency alteration possible via either a main tuning control or Racal-Dana's patented channel step switch.

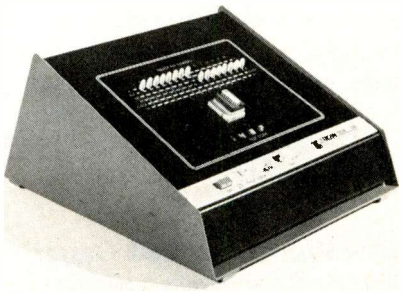
The synthesized step size in the 9082 allows setting to any of 10 channel spacings between 5 and 60KHz, so that as the main tuning control is adjusted, the output frequency will change in discrete, channel-related steps.

Frequency measurement is displayed by a built-in, 8-digit counter that continuously updates the LED display. The 9082's counter is a precision device utilizing an LSI chip with a maximum resolution of 10Hz at all frequencies and deriving an inherently high accuracy and stability from the internal frequency standard.

Digital IC Tester

Circle No. 136 on Reader Inquiry Card

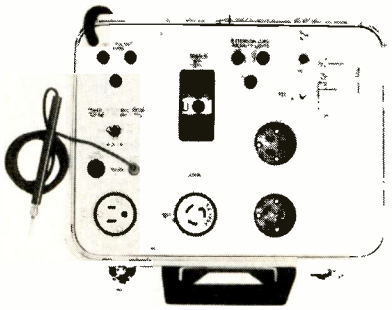
Electro Scientific Industries has introduced a compact IC functional tester. It rapidly evaluates digital integrated circuits of the TTL, DTL, and CMOS families in DIP configurations. Called the Model 1248, the instrument tests IC's in one to five seconds and determines whether the device inputs and outputs operate according to the required logic relationships. Advantages of this tester include the fact that it does not require a reference IC for comparison. It is a true functional tester, yielding an absolute result. Problems of IC interrelations, as when one IC drives a number of other gates or functions, are avoided. Only



one IC is tested at a time—the one in the socket; and there is not interference from associated devices as is often the case with mounted IC's. The price of the 1248 is $745.

Safety Tester

Circle No. 137 on Reader Inquiry Card



A new lightweight, rugged, all-in-one tester that checks for OSHA compliance of polarity, grounding and line leakage in 120 volt power tools, cord sets and receptacles is now available from *General Scientific Equipment Co.,* Philadelphia, Pa. The unit, called Multi-Check, provides simple visual indicators for "GO" or "NO-GO" operation, permitting a check of equipment in seconds. There are no scales to read, no readings to interpret. Instructions are printed on the

face of the unit. Multi-Check tests for correct wiring, reversed polarity, open hot wire, open ground, open neutral, hot and ground reversed, hot on neutral terminal, hot terminal unwired and neutral and ground reversed.

Auto-Tracking Multiple Output Power Supply

Circle No. 138 on Reader Inquiry Card

B & K Precision's new Model 1650 power supply offers a 5 volt dc 5 amp output and two separate 0-25 volt outputs at 0.5 amp. The two 0-25 volt supplies can be adjusted independently or B can be set to track at a constant percentage of A. Tracking is controlled by a pulse width modulated control signal coupled through an opto-isolator permitting complete electrical isolation of the two supplies. The 1650 also features current limiting and short circuit protection for all outputs. User net price is $275.

Replacement Semiconductors

Circle No. 139 on Reader Inquiry Card

Individually packaged replacement semiconductors are now available from *PTS Electronics, Inc.* Transistors, SCR's, IC's, diodes, rectifiers, zeners and other individual components for TV, audio, and electronic equipment repair are included in the new line. Development of the replacement line resulted after years of research, testing and actual application by PTS. The semiconductors—the same used by PTS—reportedly provide a new profit factor for the servicing technician/dealer by minimizing expensive callbacks and warranty returns.

Wire Wrap Tool

Circle No. 140 on Reader Inquiry Card

The compact, inexpensive WSU-2224 tool, from *OK Machine and Tool,* wraps, unwraps and strips wire, thanks to a unique built-in stripping blade. Designed for use with 22-24 AWG (0.65-0.50mm) wire on standard .030 × .060 in. (0.76 × 1.52mm) and .045 in (1.44mm) square posts. Reportedly takes minutes to learn to use and makes connections in seconds without solder. Priced at $12.75.

Portable Oscilloscope

Circle No. 141 on Reader Inquiry Card

A portable, compact oscilloscope, the OS253, has been introduced by *Gould, Inc.* This12MHz dual trace scope is a versatile instrument for a broad range of industrial, educational, and laboratory applications. The OS253 features 2mV/cm vertical sensitivity with ac, ground, and dc coupling; dual trace and X-Y capability; channel sum and difference; and a front panel trace rotate control. It measures only 5½ in. high by 12 in. wide by 18 in. deep, yet the display is a large, bright 8 by 10cm CRT.

Inexpensive VOM

Circle No. 142 on Reader Inquiry Card

A low priced five function VOM has recently been introduced by *VIZ Manufacturing Co.* The Model WV516B is a 2000 ohms-per-volt instrument with 3% dc

and 4% ac accuracy. Measurement ranges extend to 250V ac and dc, resistance up to 500,000 ohms, dc current to 250ma and dB from −20 to +22. The instrument comes complete with ohms battery and test leads for $19.95.

Video Modulator

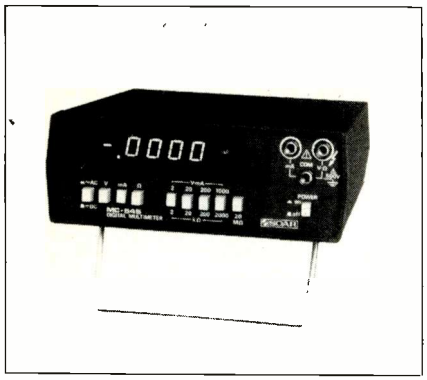
Circle No. 143 on Reader Inquiry Card

Crest Electronics Model RFM-34 is a audio-video modulator for use in closed circuit video and aural security systems, education RF distribution networks, MATV video and audio distribution and video tape playback. It accepts audio and output is on channels 3 or 4 standard (2 through 6 option). The list price is $200.

4½ Digit DMM

Circle No. 144 on Reader Inquiry Card

The *Soar* Model MC-545 is a 4½ digit bench-type multimeter that features five function modes (dcV, acV, dcmA, acmA, and Ohms) and provides automatic zero adjustment and polarity indication. The modes appear on the LED display. As an option, a BCD output (8, 4, 2, 1) can be provided for connecting the multimeter between a CPU and a digital recorder. This highly accurate instrument has a voltage measurement range of 2 to 1000 volts ac and dc; a current



measurement range (both ac and dc) from 2 to 1000mA, and a resistance measurement range to 200 megohms. Maximum indication is 19999 or -19999. The price is $289.95.

Frequency Counter

Circle No. 145 on Reader Inquiry Card

High accuracy, reliable, frequency/period measurements with bright, fluorescent displays are among the features of a new Model LDC-824S, a 520MHz digital frequency counter, recently introduced by *Leader Instruments Corp*. The manufacturer reports that its frequency counters are equipped with metal cases to assure effective shielding and provide 20mV sensitivity with pushbutton attenuators for stable triggering. The new 520MHz unit has a temperature stability of 1 PPM. The LDC-824S model is offered with an ovenized time base providing 0.03 PPM Stability (0-40°C) as an option. The counter has selectable gate time and frequency/period mode, as well as 1 Megohm (nominal) input impedance. The LDC-824S features an eight digit display, sells for $550 and carries a two year warranty.

Solderless Terminals

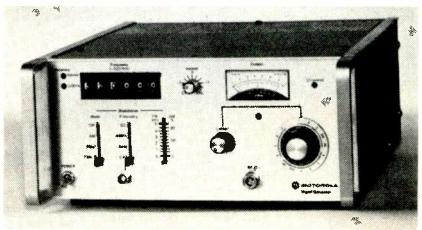
Circle No. 146 on Reader Inquiry Card

Neat, quick connections with stranded wire are now possible with fold over solderless terminals, available from *Waldom Electronics*. Designed to give a trim appearance, these terminals fold over to completely encapsulate stripped, stranded or solid wire ends for maximum contact with a binding screw or nut. They are available with or without an insulation grip, and in a single cup arrangement for "tap" connections. Their construction permits a binding nut or screw to sink into the soft copper, to serve as a lock nut. Waldom fold over solderless terminals accommodate wire sized #18 to 10 and stud sizes No. 6 to ½ inch.

Precision Signal Generator

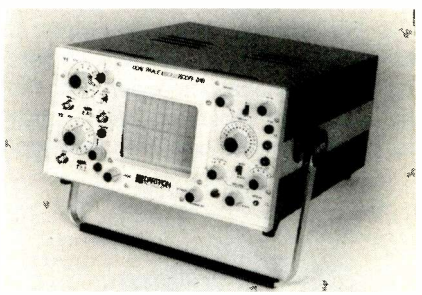
Circle No. 147 on Reader Inquiry Card

A new signal generator capable of frequency settings with a resolution of 1kHz has been introduced by *Motorola*. A frequency vernier provides a ±5kHz fine tuning range in the FM mode. After dialing the desired frequency, the accuracy lamp flashes until the unit achieves phase lock to the reference crystal. Accuracy is stated to be ±0.001%.



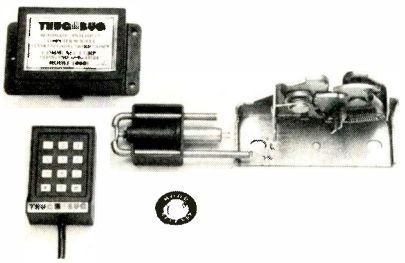
Dual Trace Oscilloscope

Circle No. 148 on Reader Inquiry Card



A five inch dual trace oscilloscope with single trace sensitivity of up to 1mV/cm is available from *Dartron*. Model D10 is a dual trace 10MHz triggered sweep instrument with sweep speeds from 100nsec/cm to 1.5sec/cm. Basic vertical amplifier senstivity ranges from 5mV/cm to 20V/cm and the D10 has the capability of cascading the Y1 and Y2 amplifiers for a maximum sensitivity of 1mV/cm. Other features include bright line automatic trigger, calibrator, gate output, sweep output, Z axis modulation, and X-Y capability. **ET/D**

DEALER'S SHOWCASE



Vehicle Anti-Theft Device

Circle No. 152 on Reader Inquiry Card

Commusec Corp. has announced the Thug Bug, its new solid-state anti-theft device that automatically interrupts the ignition system and locks the factory hood lock when the key is turned to the off position. The system consists of a central computer module, hood release button, and a thermal actuator hood lock. It is controlled by a calculator type keyboard mounted on the dash. The vehicle cannot be started or the hood opened until a 4 digit code is properly entered into the keyboard. The code is selected by the customer at time of installation. Optional audible alarm and other accessories are available.

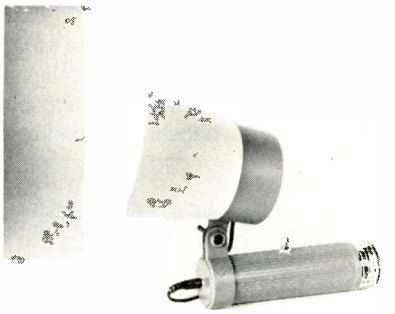
Antenna Rotator/System

Circle No. 153 on Reader Inquiry Card

Two new models of high performance antenna rotor systems, the Ham IV and the CD-45, have been introduced by *Cornell-Dubilier Electric Corp.*, Newark, NJ. The Ham IV is designed for large communication antenna arrays up to 15.0 sq. ft. wind load area when tower mounted. Highlights of the Ham IV include power braking, machined steel drive gears, and dual transformer circuitry. The CD-45 accommodates antenna arrays up to 8.5 sq ft wind load area when mounted in a tower and features a professionally-styled control unit, illuminated meter readout, all-steel drive components and automatic disc braking. Both the Ham IV and the CD-45 operate at low voltage control levels, with snap-action rotational controls. Suggested retail prices are $224.95 for the Ham IV, and $164.95 for the CD-45.

Mini-Megaphone

Circle No. 154 on Reader Inquiry Card

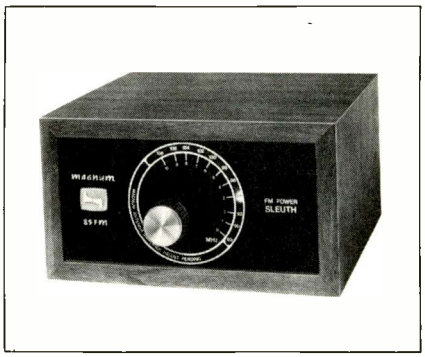


A new Mini-Megaphone is now available from *Robins Industries Corp.* Ideal for athletic events, auctions, marine and police use, tours, meetings, rallies, parades and other uses, Robins new Mini-Megaphone is reportedly the smallest and lightest completely self-contained megaphone available, weighing 14 oz "soaking wet" (about 1/5 of

conventional units). It features automatic level control, and solid-state circuitry and has a high impact plastic housing. It is powered by four standard penlight batteries which will last for 8 hours of intermittent use. The sound carries up to 1000 feet. The Mini-Megaphone #47-801 has a suggested list price of $43.00.

Tunable FM Antenna Amplifier

Circle No. 155 on Reader Inquiry Card



The Magnum FM Power Sleuth, a tunable FM antenna amplifier, is the initial product offered by *Audio Marketing by Von*. Designed for boosting fringe area FM reception, it is stated it can be used also in suburban areas where only indoor antennas may be used. Specifications include an RF gain of 35dB ± 5dB, a noise figure of 7dB, spurious rejection of 90dB minimum, and image rejection of 85dB minimum. It uses three RF stages and has a price of $150.

TV Camera

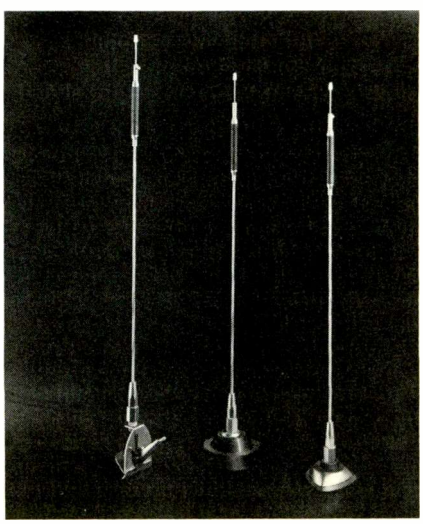
Circle No. 156 on Reader Inquiry Card

JVC now offers a black and white TV camera reportedly designed specifically for use with JVC VHS decks, VHS portable units and VHS ¾-in. units. It features full interlace scanning with a crystal sync generator, a through the lens view finder and a 2:1 zoom lens. The GS-1000 can be battery powered or operated from an AC power adapter. The suggested list price is $375.

Mobile Monitor Antennas

Circle No. 157 on Reader Inquiry Card

Channel Master has just introduced a new line of mobile, 4-band scanner antennas. With a 24 in. height, Mobile Monitennas reportedly deliver top performance on low and high VHF and on the two UHF bands. They are available with trunk-lip mounts, gutter mounts and extra strong magnetic mounts. Mobile Monitennas are constructed of stainless steel and triple chrome-plated brass. Their coils are hermetically sealed for weather protection, and each antenna comes with 100% shielded, RG-58 coaxial cable (Motorola plugs are attached.) Suggested retail prices range from $19.95 to $26.95. **ET/D**



NOISE

continued from page 29

sound like it! Oddly, I have found that some of the most expensive, and highly recommended HIFI imports, also use such devices, probably for the same reason.

Various schemes have been tried to improve the noise situation in low level amplifiers, including negative feedback and positive feedback. Under certain circumstances improvement has been noted, but most cases required manual adjustments and suffered from instability, and inability to reproduce results when parts are interchanged.

Good noise?

So far we have been talking about noise as if it was all bad, but the fact is that there are several uses for noise. Since noise is wide band, covering a great spectrum of frequencies, it is useful to amplify the output of a noisy junction to achieve what is termed "white noise" ... noise of random waveshape, amplitude and frequency. This noise is used in testing systems, and for "masking" signals. It is also used for simulating external noise sources. Without such noise it is very difficult to approximate the effects of noise by other means.

A great deal of information is generally available in engineering texts, but not much attention has been given to noise in practical texts. Using this article as a starting point, the reader should have little difficulty in dealing with the usual problems involving noise. ET/D

PROJECTION TV

continued from page 38

ultimately reducing the on time of the regulator Q904, and reducing the output voltage of the supply.

The possibility of operating the three small CRTs at over voltage and high beam current apparently causes some concern over possible X-ray production. Two horizontal oscillator disable circuits are used, each serving as a back up to the other. The first monitors the high voltage by means of rectified pulse from the horizontal output transformer. The second monitors the tripler output; either will shut down the horizontal oscillator if the high voltage rises beyond a specified limit.

A high voltage output transistor drives the high voltage transformer; a separate horizontal sweep transistor drives the paralleled horizontal yoke windings. A pincushion, keystone correction output supplies a corrective signal to the yokes also.

The CRTs are magnetically focused. Three focus regulators set and maintain the proper focus coil current, derived from the +24 volt supply.

The use of integrated circuits has simplified the schematics of these sets considerably, yet they are complex devices. The Quasar version uses 25 ICs and 124 transistors; Panasonic with its less complex tuning system, uses 22 ICs and 125 transistors.

Others

Several dozen manufacturers produce lens systems which can be attached to conventional television receivers to project enlarged pictures. Most of these use a bright small screen set—12 or 15 inch. The indicated screen brightness would seem to be in the 10 to 12 foot-Lambert range, requiring a darkened room for comfortable viewing. These systems offer the obvious advantage of lower price. A system with components from a company such as *Projectapix,* can be assembled to be sold for less than $1000, including the 12 or 15 inch color portable television receiver. ET/D

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

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

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Tektronix 564 Dual Trace w/store, cal man probes. Excl. cond. $620.00 Heath C.B.G. IG-28 MK-off (will pay shipping) Bolt Electronic Repair Service, 59-740 Amaumau Place, Haleiwa, Hawaii 96712.

Sencore Big Mack CRT Tester 100.00, Sencore CG-169 color generator 100.00, Sencore SS137 sweep analyzer 100.00, Telematic color test jig JC & ACCER 100.00 like new. Peter Campbell, 1710 Rhawn St., Philadelphia. PA 19111. (215) 722-6241.

Save Hundreds; American Made (AGC Optional) quality Head-Ends, V/V, U/V Converters, Camera Modulators. Factory prices. Send $5.00 (or letterhead). Box 809, Boynton Beach, Fla. 33435.

SAMS PROTOFACTS. Quick sale. Numbers 1 thru 1550. A few numbers missing. Excellent condition, $3,000. Call 617-688-8631 or Mrs. Round at 617-438-7331.

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

REPAIR TV TUNERS-High earnings, Complete Course Details, 12 Repair Tricks, Many Plans, Two lessons, all for $2. Refundable. Frank Bocek, Box 3236, Ent., Redding, CA 96001. T/F

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

Television Repair Shop Inventory. Stock of tubes, panels, parts, Service literature and full line of test equipment. Write to 325 S.E.4, Newton KS 67114.

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

BUSINESS OPPORTUNITIES

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

BROADCAST STATION. Start your own, any type! Unique Cabe FM station operation-investment/experience unnecessary! Receive free tapes, records. Get your FCC license! Much more. Free details. "Broadcasting:", Box 130-ET6, Paradise, CA 95969

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

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

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

Move to progressive front-range Colorado community. Established, growing TV sales and service. 1978 gross $120,000. All equipment new within last 18 months. Asking $35,000. Write ET/D Box 126. 6/79

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

WANTED

Wanted Tuning Shaft for Zenith Stereo X932, part number 76-1625. Contact J.J. Bidwell, B & B, T.V. Service, 3215 E. Main St. Endwell, NY 13760.

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.

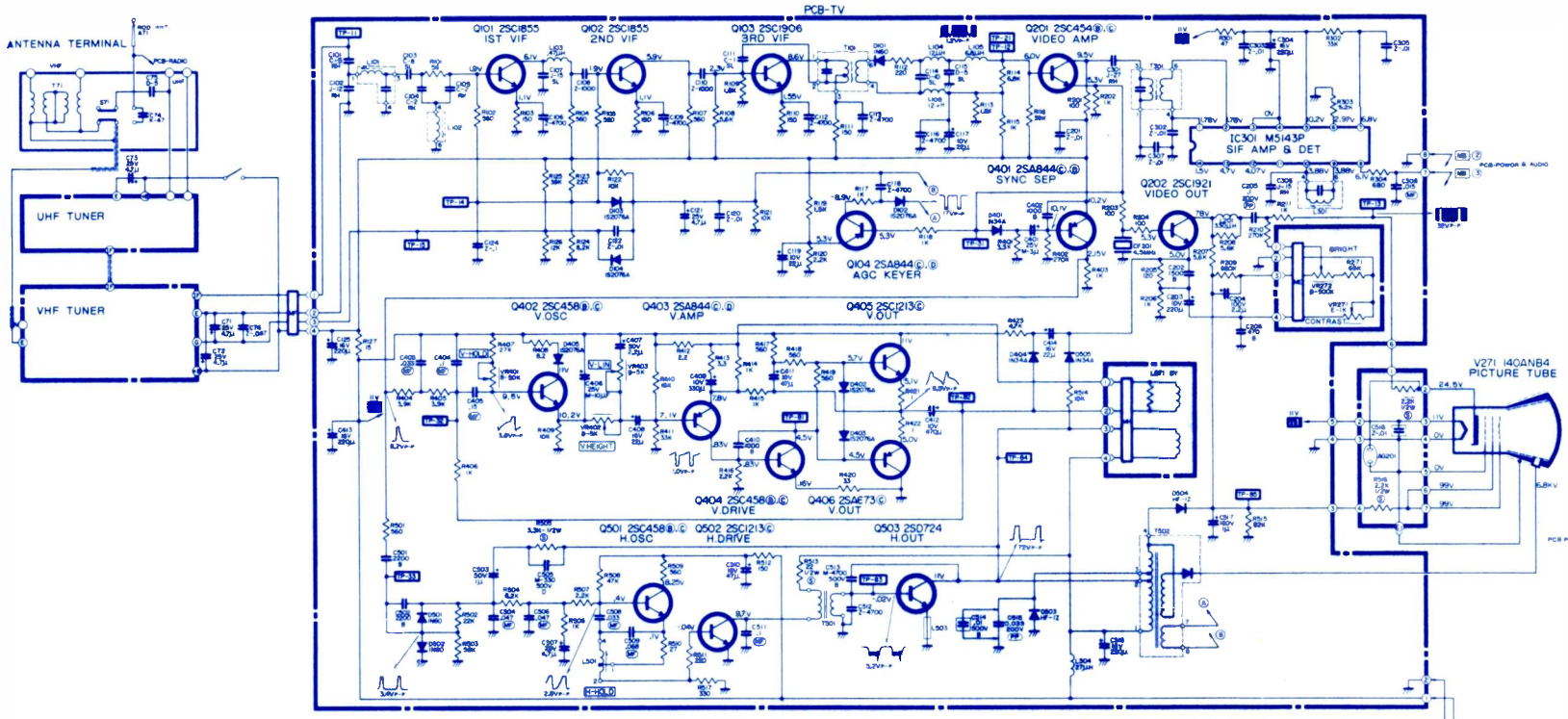
MANUFACTURERS: New Electronics distributor needs tube, transistor, antenna and other lines. ELECTRONIC MERCHANDISE WANTED. Elect. Dept. P. O. Box 4013, Deleware City, DE 19706. 8/79

AD INDEX

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

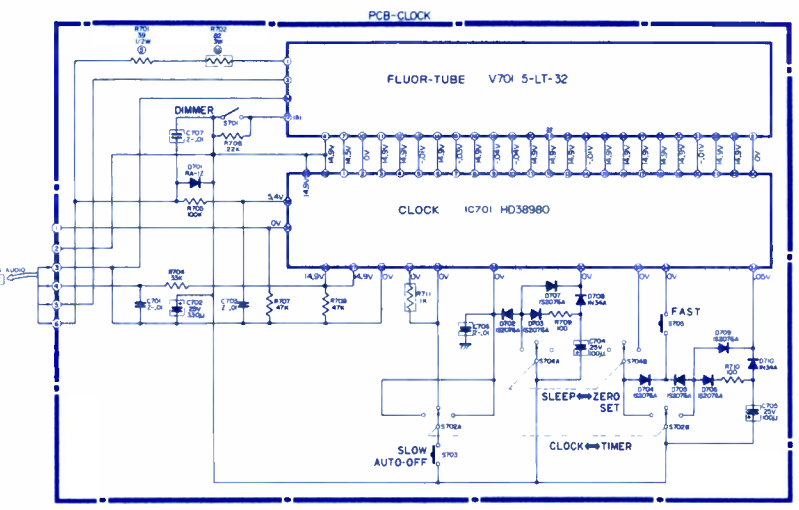
ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

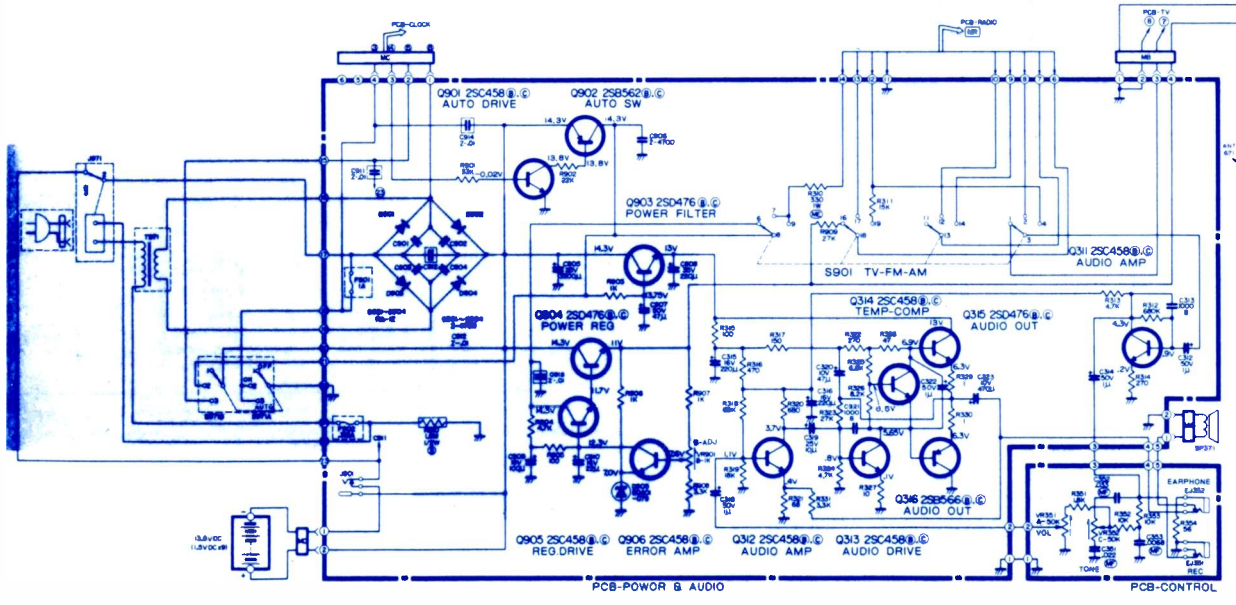
1792
MGA
B&W TV Model
BB-0580
JUNE • 1979

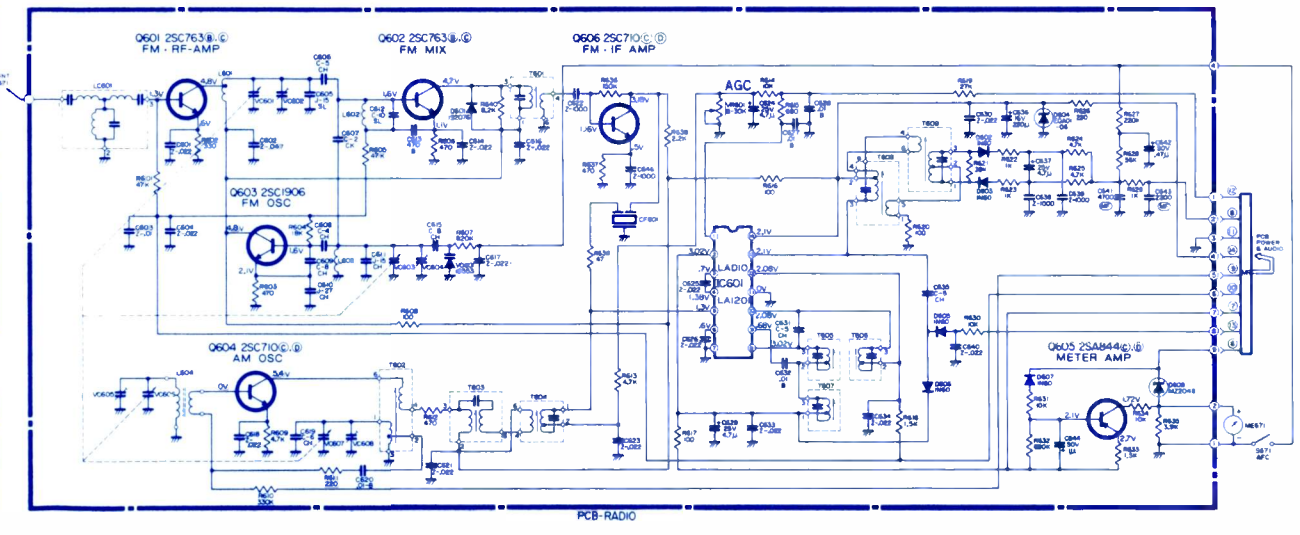


SHADED COMPONENTS HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE IN THE SERVICE MANUAL. DON'T DEGRADE THE SAFETY OF THE RECEIVERS THROUGH IMPROPER SERVICING.

SERVICE MAN WARNING
X-RADIATION PRECAUTION
THIS PRODUCT INCLUDES CRITICAL ELECTRICAL AND MECHANICAL PARTS ESSENTIAL FOR X-RADIATION PROTECTION.
TO AVOID POSSIBLE EXPOSURE TO X-RADIATION TAKE X-RADIATION PROTECTIVE MEASURES FOR PERSONNEL DURING SERVICING.
SEE SERVICE INSTRUCTIONS FOR SPECIFIED REPLACEMENT PARTS AND SERVICE ADJUSTMENTS.







1793

SHARP
Color TV Model
13C33A

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

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SAFETY PRECAUTION:

A. Service personnel should be thoroughly familiar with safety procedures before attempting repairs.
B. Shaded components have special characteristics important to safety. For continued protection, replacement parts must be identical, 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:

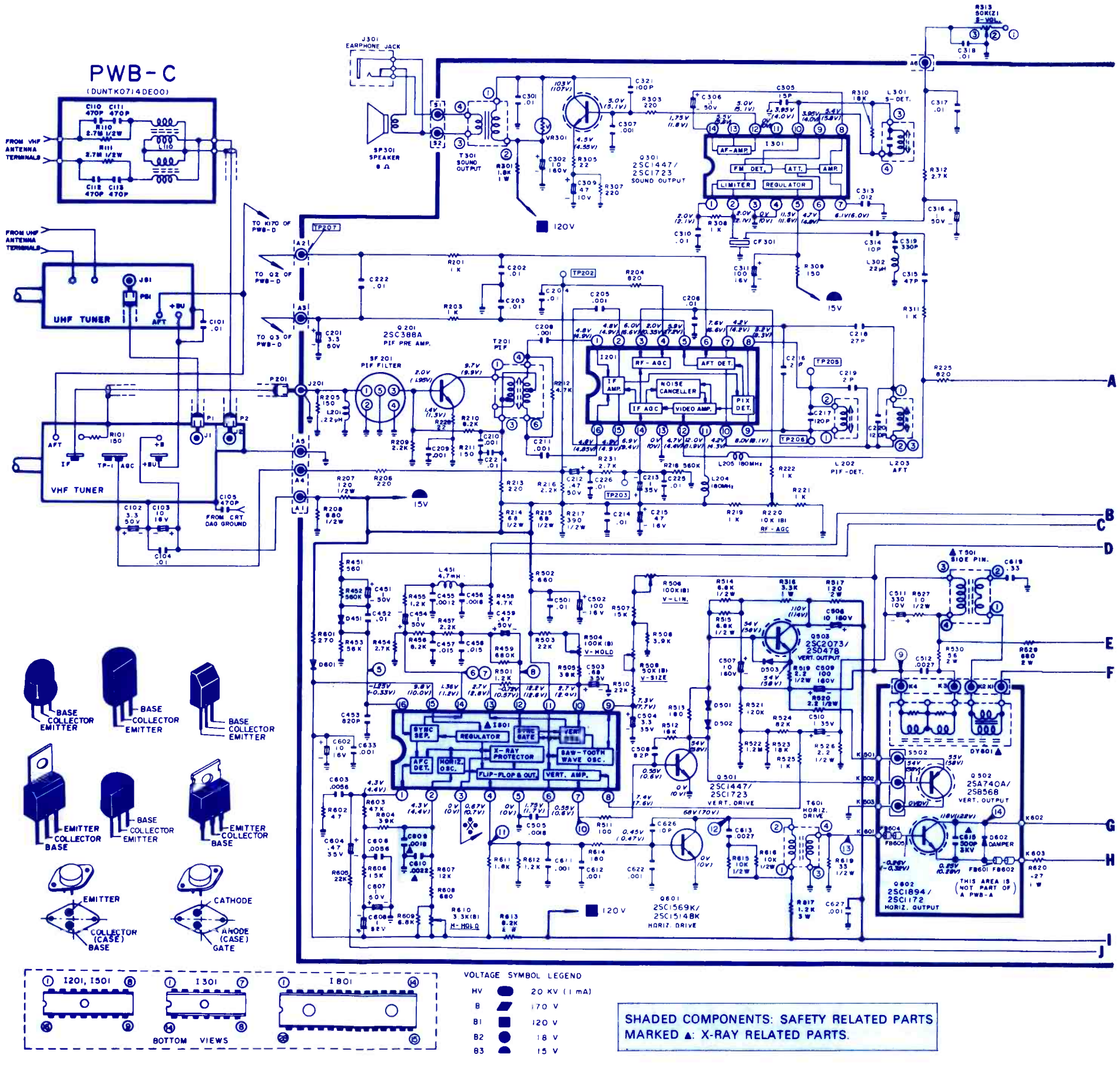
1. DISCONNECT THE AC PLUG FROM THE AC OUTLET BEFORE REPLACING PARTS.
2. SEMICONDUCTOR HEAT SINKS SHOULD BE REGARDED AS POTENTIAL SHOCK HAZARDS WHEN THE CHASSIS IS OPERATING.
3. THE CHASSIS IN THIS RECEIVER IS HOT. (CONNECTED TO ONE SIDE OF THE AC LINE) USE AN ISOLATION TRANSFORMER BETWEEN THE LINE CORD 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 2.4V peak to peak applied at pin 4 of 4.5 MHz Trap transformer (T202).

CIRCUIT PROTECTION
The entire receiver is protected by a 4.0A (F701) fuse, mounted on PWB-A, that is wired into one side of the AC line input. A 2.5A fuse, mounted on PWB-A, has been provided to protect the DC power supply.



SHARP
Color TV Model
13C33A

PWB-A
(DUNTK0661DE11)

PWB-B
(DUNTK0662DE01)

PWB-D
(DUNTK0667DE00)

PWB-E
(DUNTK0669DE00)

REPLACE WITH A PICTURE TUBE OF THE SAME TYPE NUMBER FOR CONTINUED SAFETY.

▲ V101 CRT 370DJB22A/ 370ECB22A/ 370FCB22A

20KV (at 1 mA)

TO T802 OF PWB-A (HORIZ. OUTPUT XFMR.)

TO ② OF R623 (FOCUS CONTROL)

TO AFT TERMINALS OF VHF/UHF TUNERS

TO PWB-A

TO PWB-A

SW101 A,B,C,D,E,F ACS-5 SWITCH SHOWN IN "ON" POSITION

NE1 ACB-5 IND.

L701 LINE FILTER

L702 ADD COIL

SW701 PULL ON-VOL. (PART OF R313)

AC 120V 60 Hz

LINE CORD PLUG IS POLARIZED. THE NARROW BLADE CONNECTS TO THE HOT SIDE OF THE AC LINE.

TO CRT SECOND ANODE

TO K854 OF PWB-B

TO K855 OF PWB-B

TO BASE OF Q651

TO N4

TO N2 OF PWB-A

TO N3 OF PWB-A

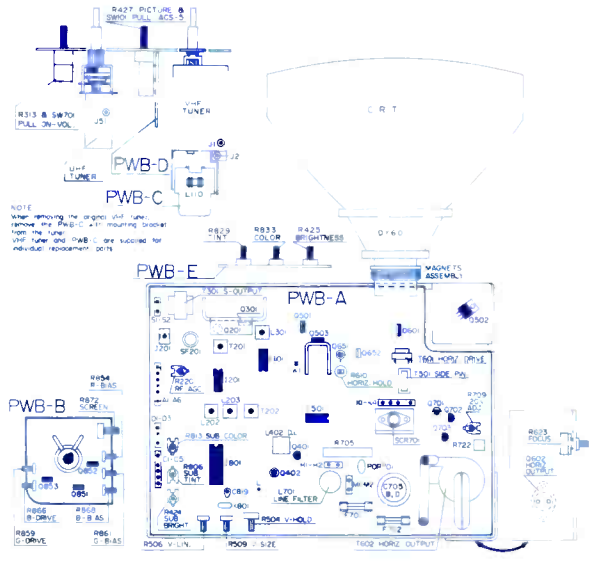
TO K155 OF PWB-D

TO K154 OF PWB-D

TO PWB-D

① 2.4Vp-p	② 3.5Vp-p	③ 1.28Vp-p	④ 10.2Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate
⑤ 2.9Vp-p	⑥ 8.1Vp-p	⑦ 8.1Vp-p	⑧ 1.7Vp-p
Horiz. Rate	Vert. Rate	Horiz. Rate	Vert. Rate
⑨ 92Vp-p	⑩ 0.58Vp-p	⑪ 1.85Vp-p	⑫ 170Vp-p
Vert. Rate	Vert. Rate	Horiz. Rate	Horiz. Rate
⑬ 21Vp-p	⑭ 920Vp-p	⑮ 4.0Vp-p	⑯ 0.42Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate
⑰ 2.2Vp-p	⑱ 0.84Vp-p	⑲ 2.0Vp-p	⑳ 96Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate
㉑ 90Vp-p	㉒ 76Vp-p	㉓ 13.4Vp-p	㉔ 13.4Vp-p
Horiz. Rate	Horiz. Rate	Vert. Rate	Horiz. Rate
㉕ 260Vp-p	㉖ 10.8Vp-p	㉗ 2.1Vp-p	㉘ 7.2Vp-p
Horiz. Rate	Horiz. Rate	Horiz. Rate	Horiz. Rate

CHASSIS LAYOUT

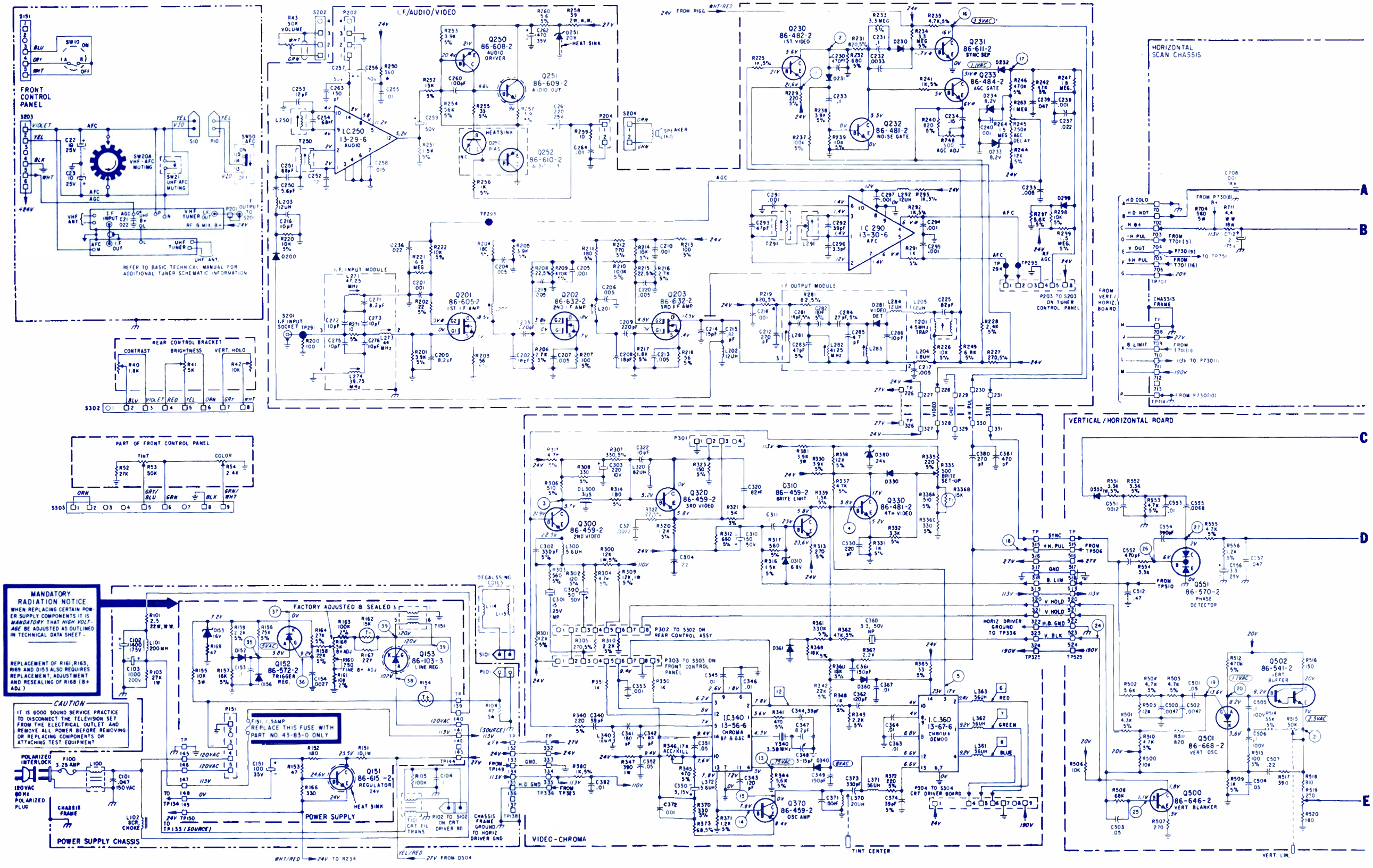


1794
CORONADO
Color TV Model
TV-16385A
TV-16343A

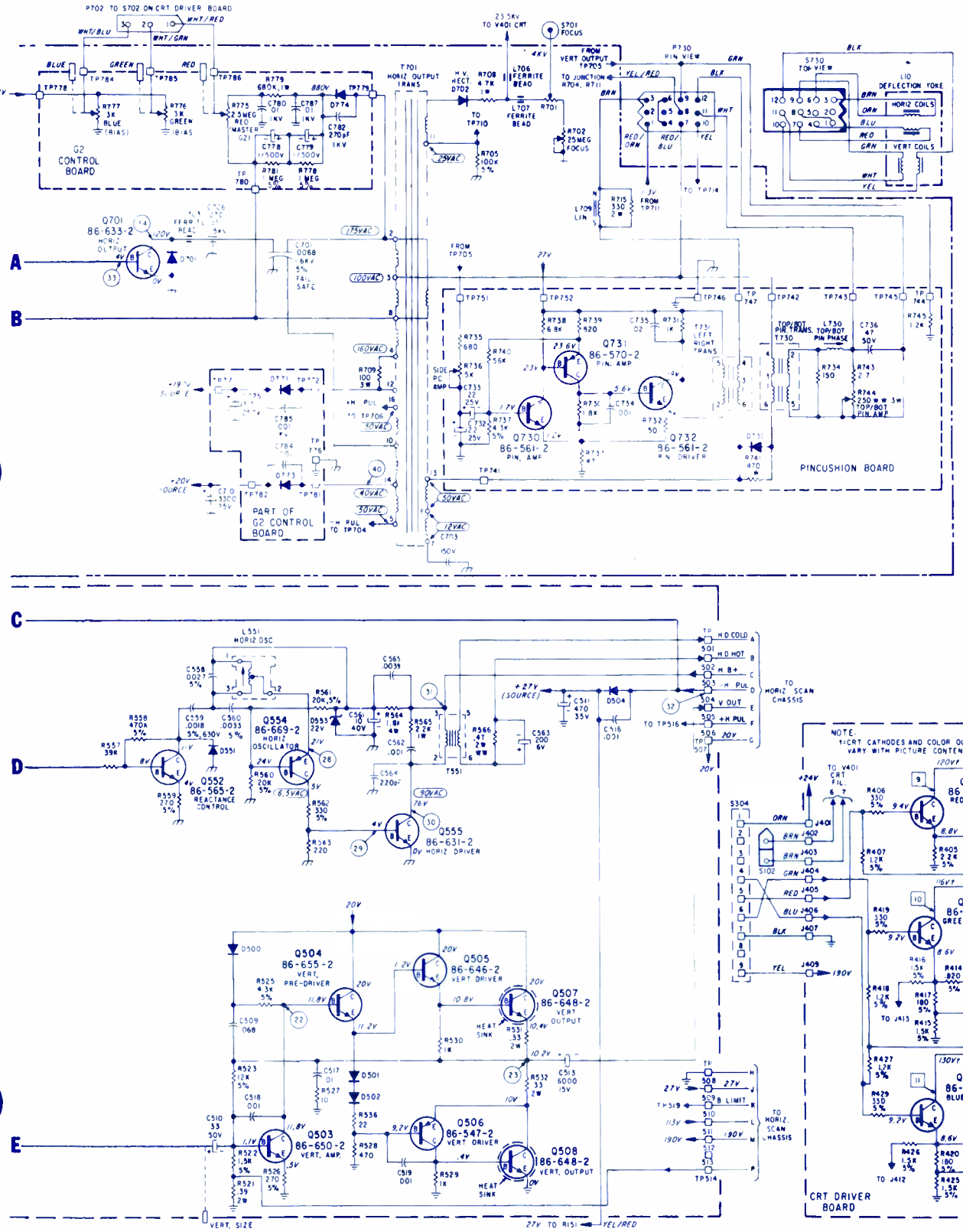
ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

JUNE • 1979



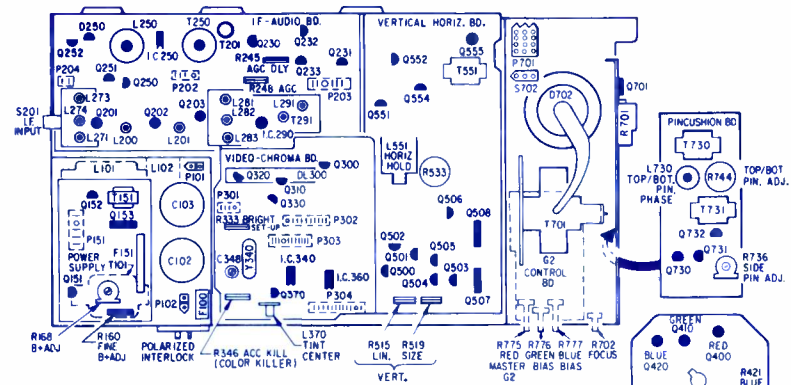
CORONADO
Color TV Model
TV-16385A TV-16343A



NOTES:
1. RESISTANCE IS SHOWN IN OHMS K=1000 MEG = 1,000,000.
2. ALL RESISTORS ARE 1/4 OR 1/2 WATT UNLESS OTHERWISE NOTED.
3. ALL CAPACITORS ARE MFD UNLESS OTHERWISE NOTED.
4. VOLTAGE MEASUREMENTS:
   A VOLTAGES WITH ASTERISK (*) CHANGE WITH SIGNAL STRENGTH AND VARIES WITH SCREEN ADJUSTMENTS. READING NO INPUT SIGNAL.
   B ALL VOLTAGES WERE TAKEN UNDER NORMAL COLOR SIGNAL CONDITIONS AND MEASURED WITH A VTVM WITH RESPECT TO GROUND VOLTAGE MEASUREMENTS MAY VARY DUE TO CHARACTERISTICS OF OF INDIVIDUAL METERS USED.
5. NUMBERS WITHIN ◯ CIRCLES, □ SQUARES REFER TO WAVEFORM NUMBERS. ◯ INDICATE LIVE COLOR SIGNAL. □ INDICATE RAINBOW GENERATOR SIGNALS.
6. GROUND SYMBOLS
   ⏚ INDICATES CHASSIS FRAME GROUND
   ⏚ INDICATES CIRCUIT BOARD GROUND.
7. (VAC) AC VOLTAGES AS READ ON SIMPSON 260 VOM (SERIES 3 OR HIGHER) USING OUTPUT JACK

PICTURE TUBE:
19VGKTC02 MODEL TV6-16385
19VEJTC02 MODEL TV6-16393

NOTE: *CRT CATHODES AND COLOR OUTPUT Q400, Q410 AND Q420 VOLTAGES WILL VARY WITH PICTURE CONTENT.



F100 LINE FUSE
F151 3A FUSE
Q151 REGULATOR (24)
Q152 TRIGGER REG
Q153 LINE REG.

Q201 1ST, Q202 2ND, Q203 3RD } I.F

Q230 1ST VIDEO
Q231 SYNC SEP
Q232 NOISE GATE
Q233 AGC GATE

I.C 250 AUDIO I.F DET
Q250 AUDIO DRIVER
Q251, Q252 } AUDIO OUT.
I.C 290 AFC

Q300 2ND VIDEO
Q310 BRITE LIMIT
Q320 3RD, Q330 4TH } VIDEO
I.C.340 CHROMA BP. & OSC.
I.C 360 CHROMA DEMOD.

Q370 OSCILLATOR AMP.

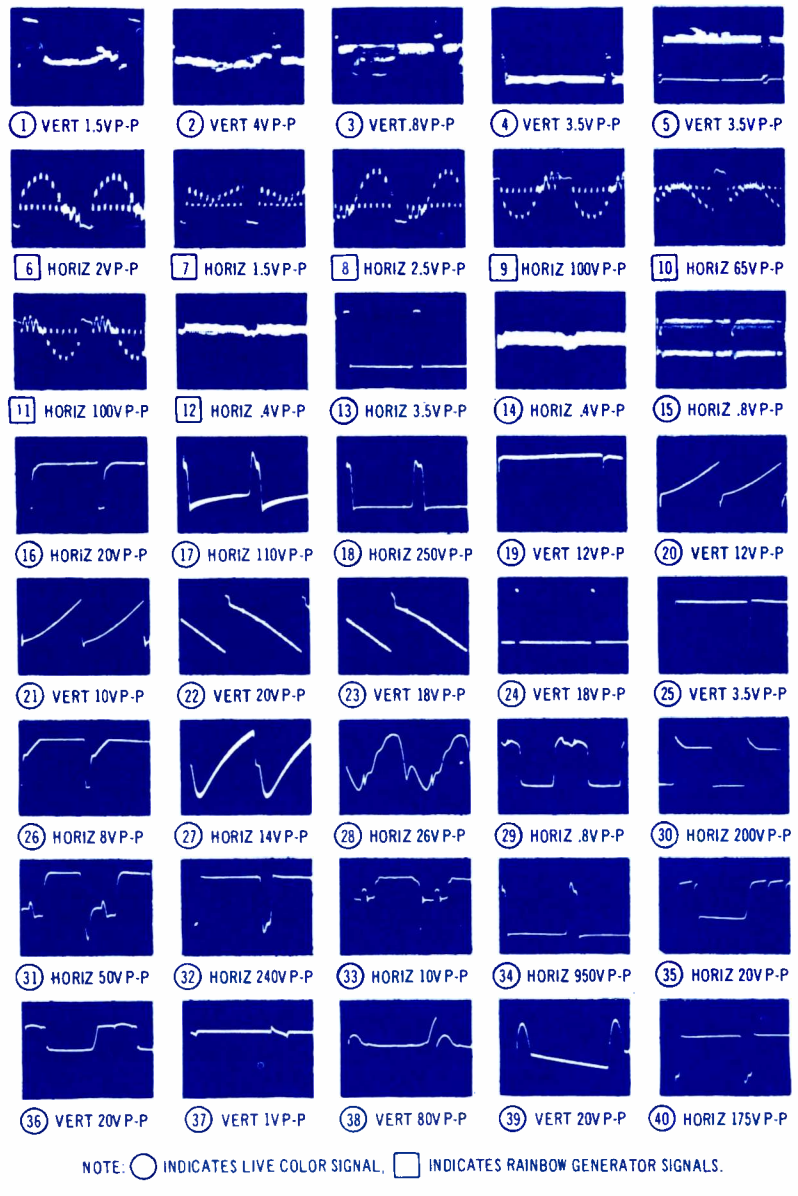
Q400 RED OUTPUT
Q410 GREEN OUTPUT
Q420 BLUE OUTPUT

Q500 VERT BLANKER
Q501 VERT OSC.
Q502 VERT BUFFER
Q503 VERT AMP.
Q504 VERT PRE-DRIVER
Q505 VERT DRIVER
Q506 VERT DRIVER
Q507 VERT OUTPUT
Q508 VERT OUTPUT

Q551 PHASE DETECTOR
Q552 REACTANCE

Q554 HORIZ OSCILLATOR
Q555 HORIZ DRIVER

Q701 HORIZ OUTPUT
Q730 PIN AMP.
Q731 PIN AMP.
Q732 PIN DRIVER

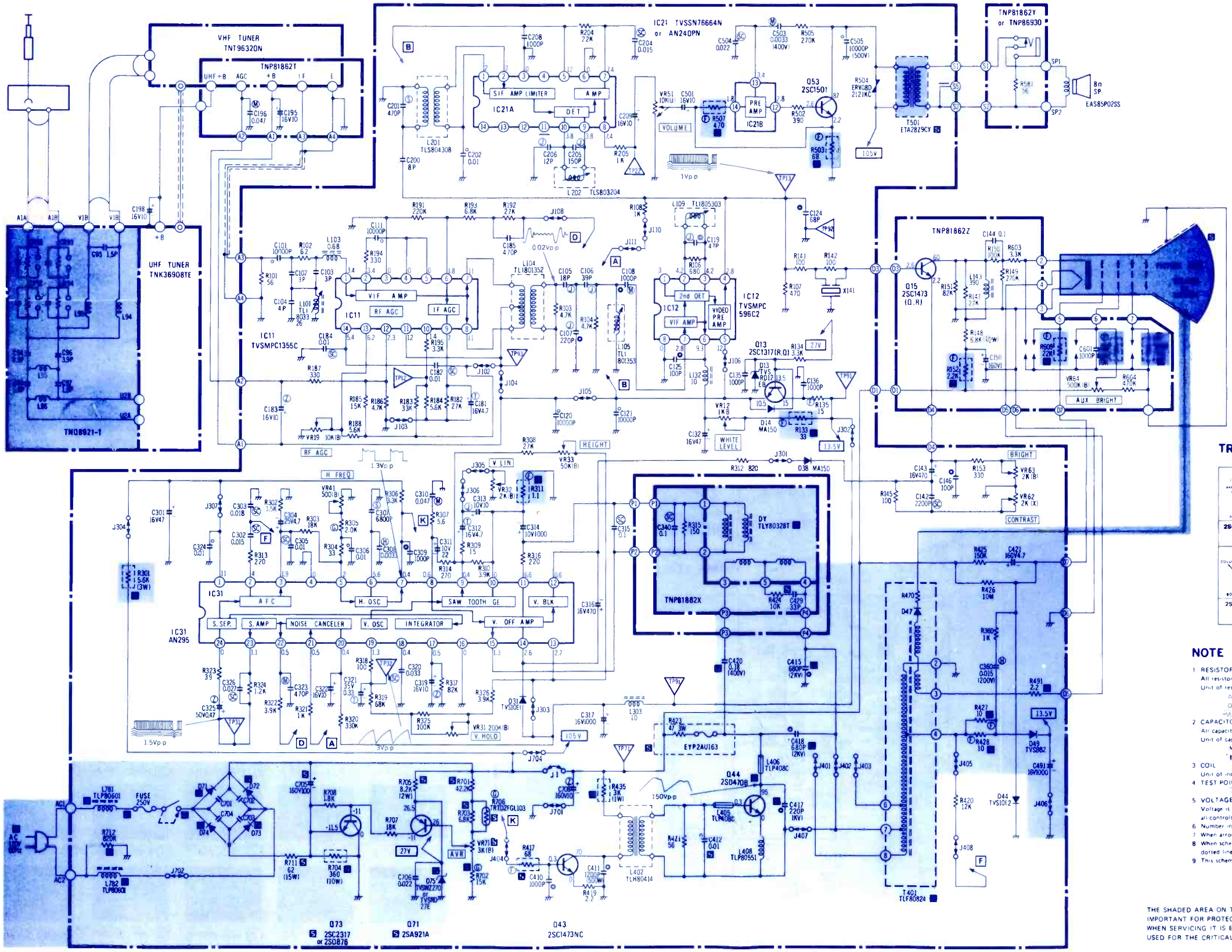


NOTE: ◯ INDICATES LIVE COLOR SIGNAL, □ INDICATES RAINBOW GENERATOR SIGNALS.

1795
PANASONIC
B&W TV Chassis
K-01A
JUNE • 1979

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS



TRANSFORMER TERMINAL INFORMATION

L101 L103 L105 L109 L132 L143
L201 L202

TRANSISTOR BASE INFORMATION

2SC1686	2SC1025MT	2SA564A 2SC1317 2SA719 2SC828 2SC1318 2SC829C 2SC828A	2SC1686 2SC1687
2SC563	2SD389BLR	2SC761 2SC948	2SC645

NOTE

1 RESISTOR
All resistors are carbon 1/4W resistor unless otherwise noted the following marks
Unit of resistance is OHM (Ω) (K=1,000 M=1,000,000)
△ Solid resistor ● Metal oxide resistor
□ Wire wound resistor Thermistor
Fuse resistor

2 CAPACITOR
All capacitors are ceramic 50V capacitor unless otherwise noted the following marks
Unit of capacitance is μF unless otherwise noted
M Polyester capacitor S Polystylene capacitor
Electrolytic capacitor

3 COIL
Unit of inductance is μH

4 TEST POINT
Test point position

5 VOLTAGE MEASUREMENT
Voltage is measured by a volt ohm meter with DC 20K OHM/V receiving normal signal, when all controls are set to the maximum position

6 Number in red circle indicates waveform number

7 When arrow mark (↗) is found, connection is easily found along with the direction of an arrow

8 When schematic diagram of a board is described in more than two places, they are encircled with dotted line (– – –)

9 This schematic diagram is the latest at the time of printing and subject to change without notice

IMPORTANT SAFETY NOTICE

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

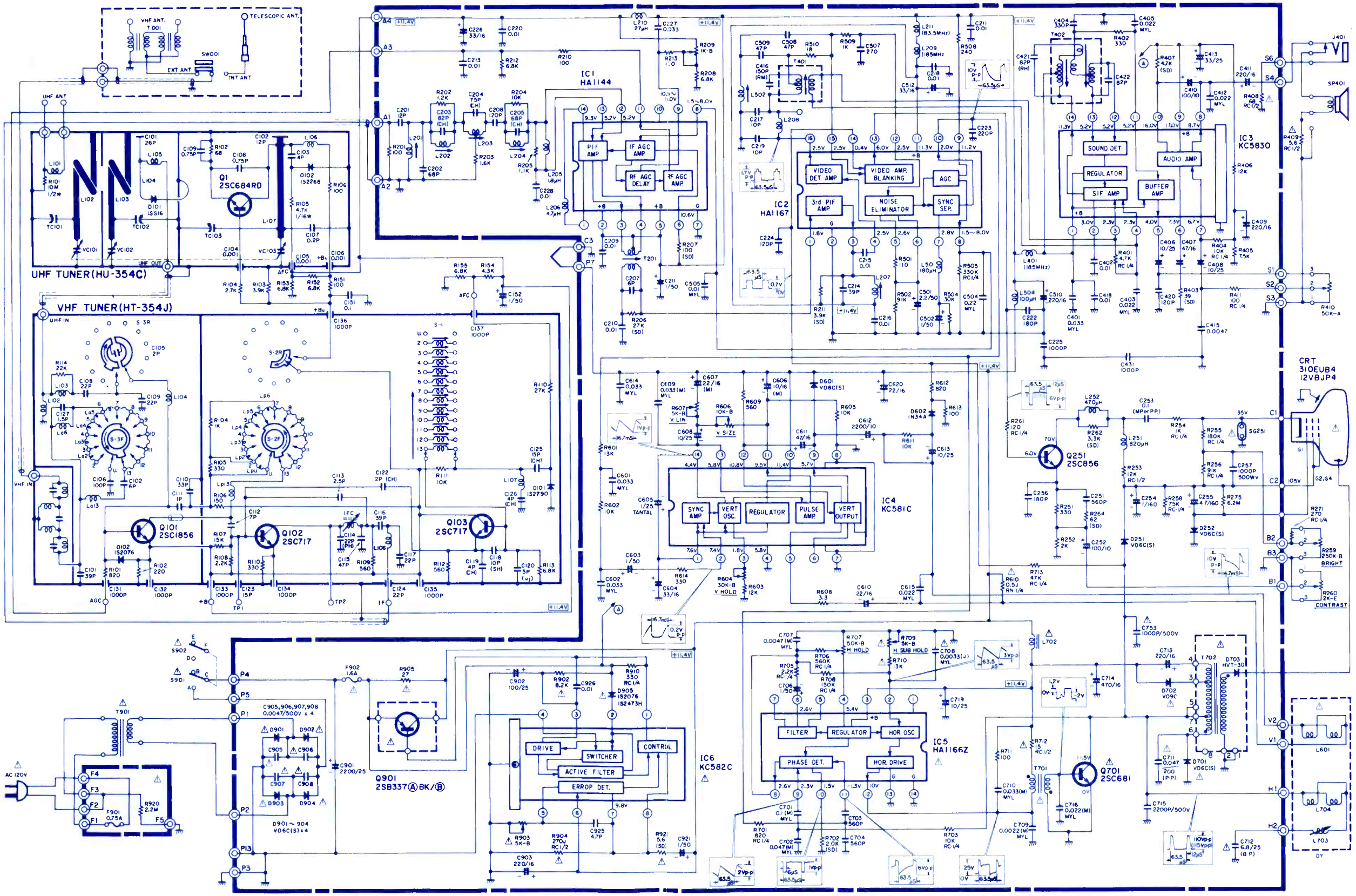
ET/D TEKFAX
COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

1796
HITACHI
B&W TV Chassis
SX

JUNE • 1979

CAUTION:

NO ATTEMPT SHALL BE MADE TO
ADJUST OR DEFEAT R709 AND R903.



1797

MIDLAND
B&W TV Model
15-038, 15-039

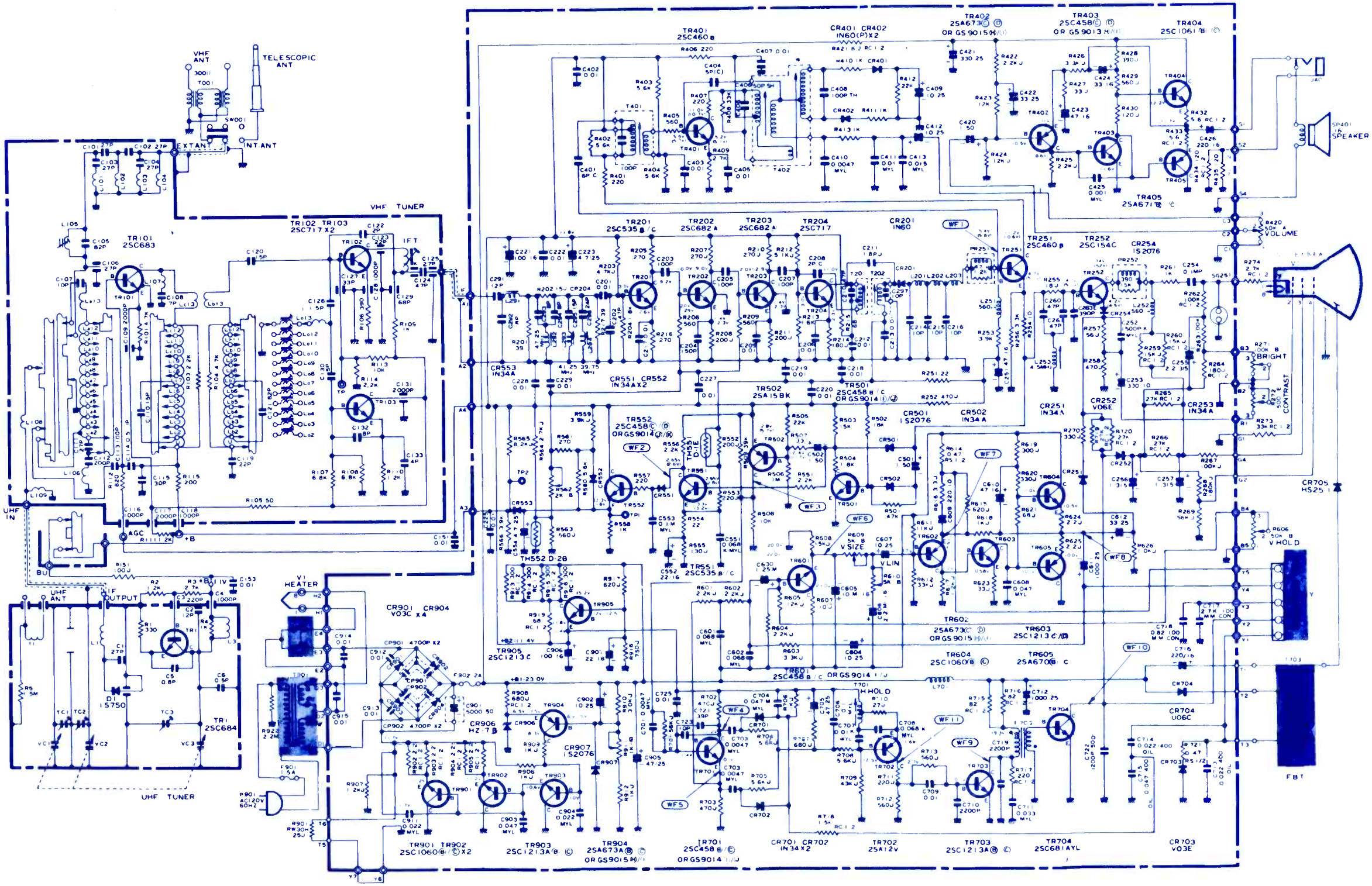
JUNE • 1979

ET/D TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS

PRODUCT SAFETY NOTICE

Product safety should be considered when a component replacement is made in any area of a receiver. The shaded area of this schematic diagram and the parts list designate components in which safety can be of special significance. It is particulaly recommended that MIDLAND cataloged parts be used for component replacement in the SHADED AREAS of this schematic. Use of substitute replacement parts which do not have the same safety characteristics as recommended in factory service information may create shock, fire or other hazards



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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 794	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 1075	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 1394	.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	.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
2SK 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
M5 1513L	2.00	2.20	2.50
STK 011	3.80	4.00	4.40
STK 013	7.60	8.00	8.80
STK 015	4.20	4.40	4.90
STK 435	4.50	5.00	5.60
STK 439	7.90	8.00	8.80
TA 7045M	2.00	2.20	2.50
TA 7055P	2.00	2.20	2.50
TA 7061AP	.90	1.10	1.20
TA 7062P	1.10	1.25	1.40
TA 7203P	2.50	2.70	2.90
TA 7204P	2.00	2.20	2.50
TA 7205P	1.60	1.80	2.00
TA 7222P	3.40	3.55	3.90
TA 7310P	1.30	1.45	1.60
TBA 810SH	1.90	2.10	2.40
TC 5080P	5.00	5.20	5.80
TC 5081P	3.00	3.20	3.40
TC 5082P	3.40	3.55	3.90
UHIC 001	4.20	4.40	4.90
UHIC 002	4.20	4.40	4.90
UHIC 003	4.20	4.40	4.90
UHIC 004	4.20	4.40	4.90
UHIC 005	4.20	4.40	4.90
uPC 20C	2.10	2.50	2.80
uPC 563	1.90	2.10	2.40
uPC 575C2	1.30	1.45	1.60
uPC 576	1.90	2.10	2.40
uPC 592H	.70	.80	.90
uPC 1001H	1.90	2.10	2.40
uPC 1008C	4.20	4.40	4.90
uPC 1020H	1.90	2.10	2.40
uPC 1025	1.90	2.10	2.40
uPC 1154	2.00	2.20	2.50
uPC 1155	2.00	2.20	2.50
uPC 1156	1.90	2.10	2.40
uPD 861	8.00	8.40	9.50
uPD 857	8.00	8.40	9.50
uPD 858	6.00	6.30	7.00
PLL 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

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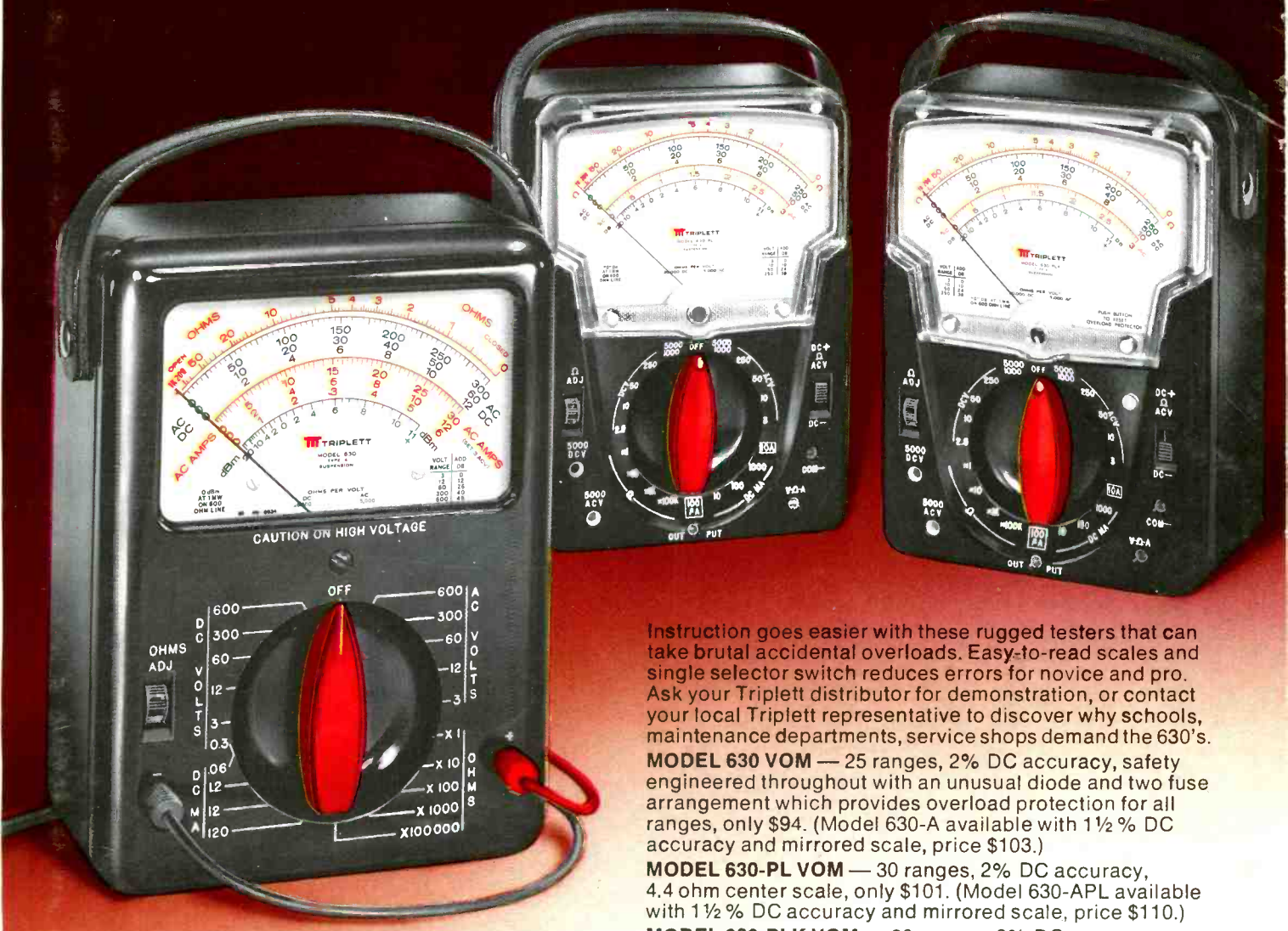

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