THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

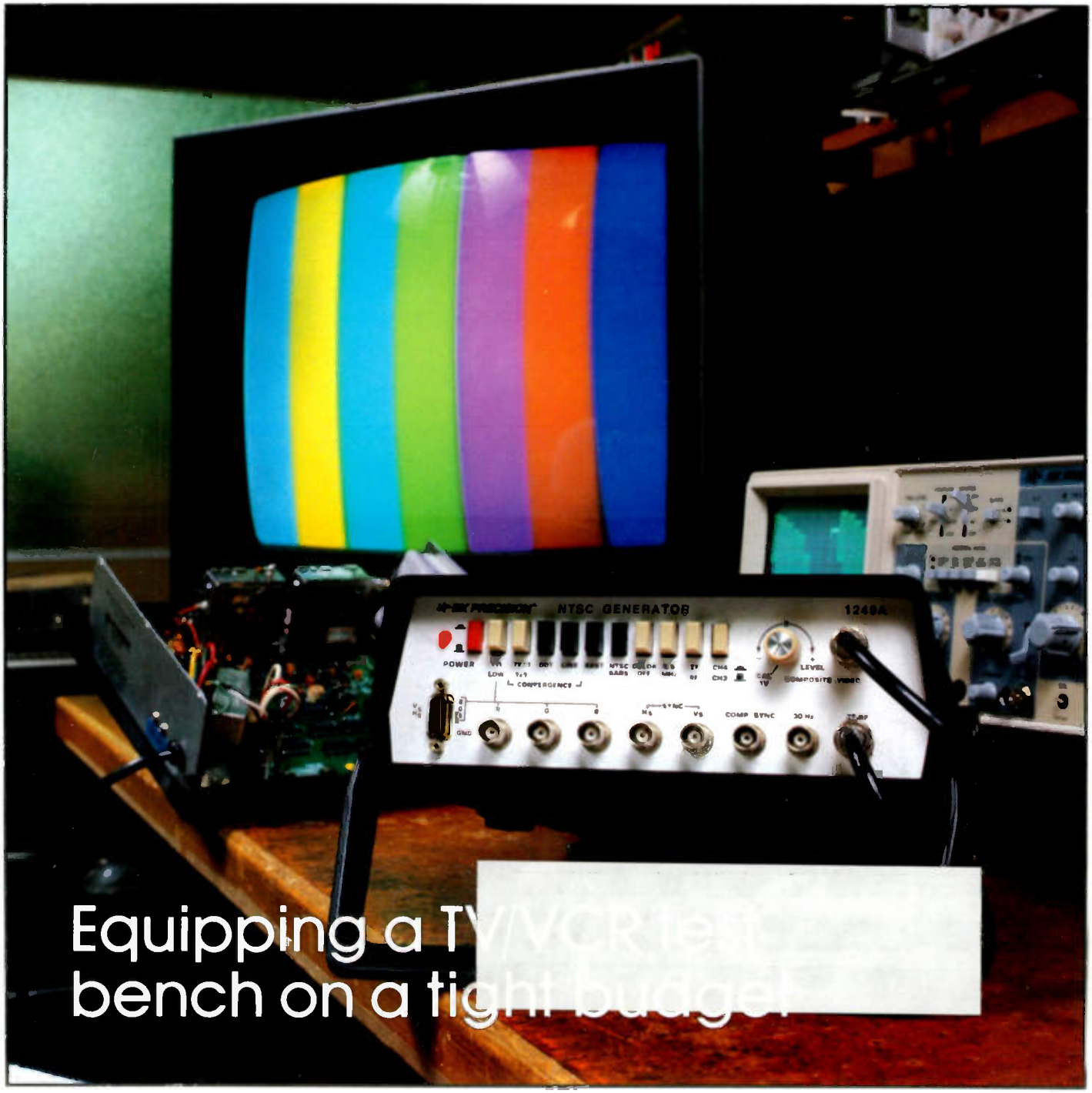
ELECTRONIC Servicing & Technology

T.M.

AUGUST 1991/$3.00

Continuing education in servicing

Replacement Parts Showcase

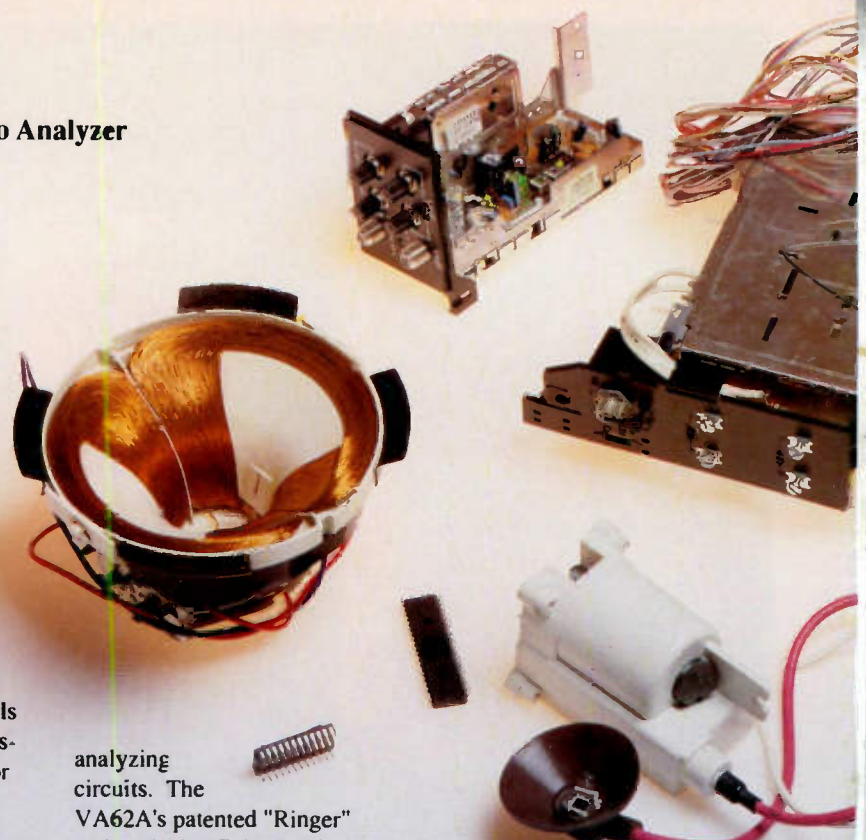


Equipping a TV/VCR test bench on a tight budget

Isolate These And Other Major Components In All TVs And VCRs—

Guaranteed Or Your Money Back!

VA62A Universal Video Analyzer



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* Based on a nationwide survey of users who reported an average time savings of 54% compared to their previous test equipment.

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**Using the optional Servo Performance Test Leads and Servo Performance Test Tape.*

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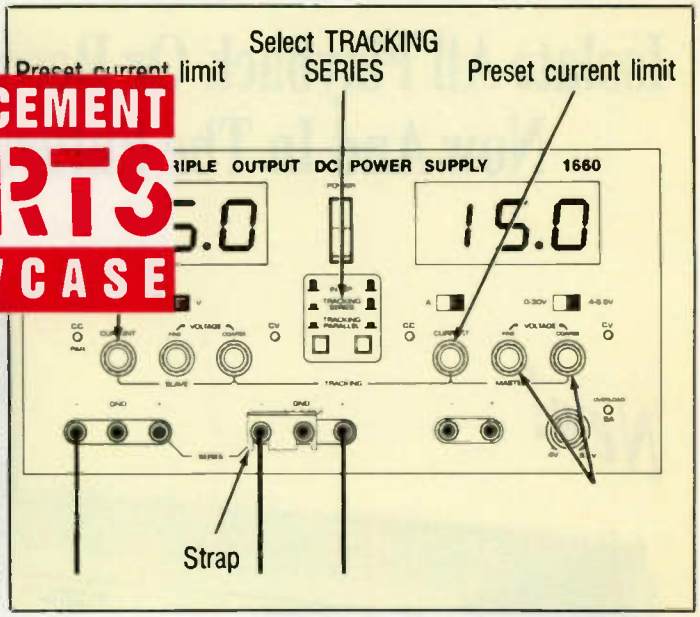

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SPECIAL ADVERTISING SUPPLEMENT

Replacement Parts Showcase

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS
ELECTRONIC
Servicing & Technology

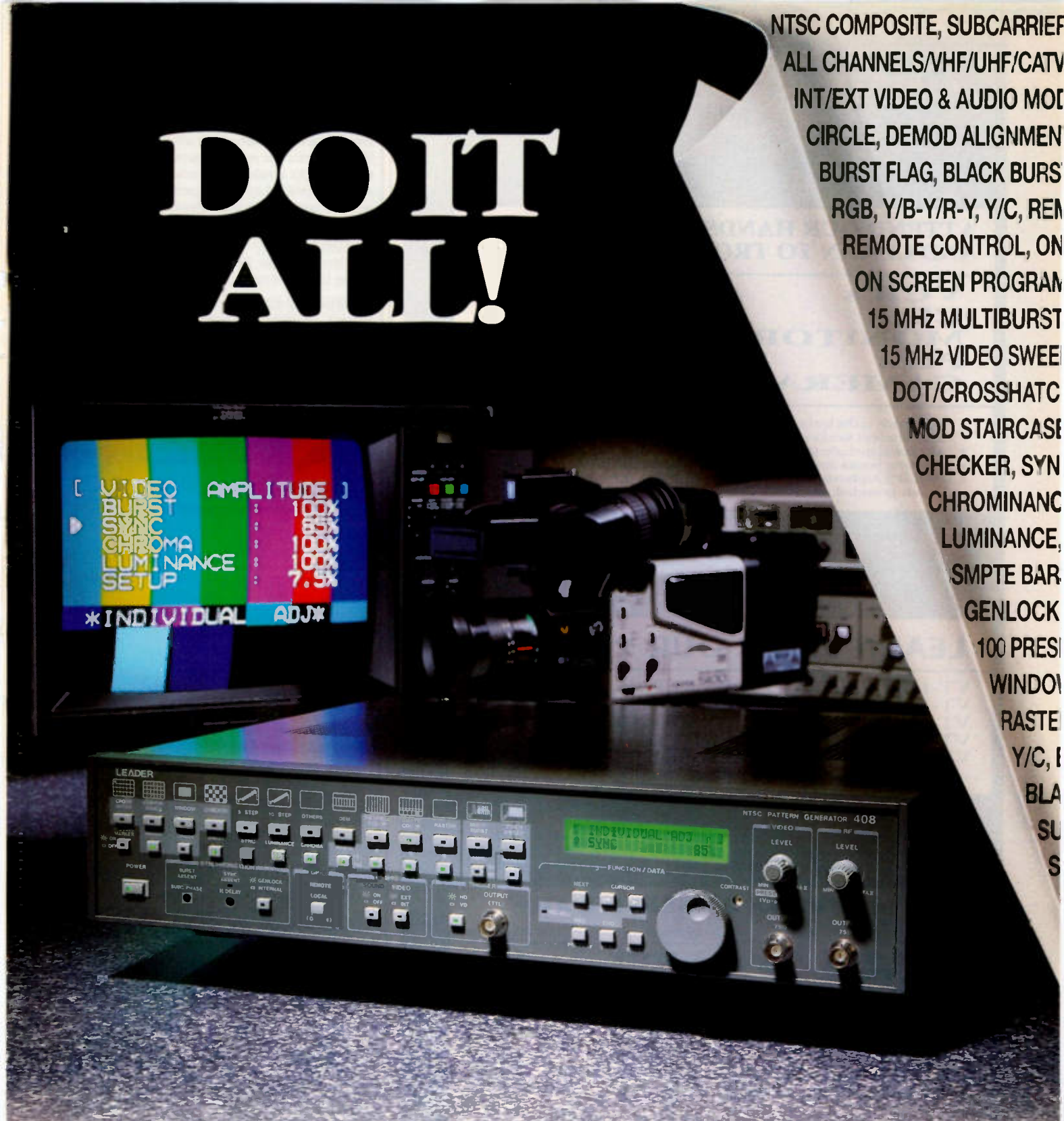
FEATURES

DEPARTMENTS

ON THE COVER

What test equipment is necessary to properly set up a TV/video test bench? The correct answer to that question will help you to obtain all the equipment necessary to efficiently service these products without spending money on test equipment you didn't need in the first place. *(Photo courtesy B & K Precision).*

DO IT ALL!



The world of technology has become much less simple than in times past. Equipment once run from a single **composite** feed may now be driven by **S-VHS, Hi-8,** or **component** signals, not to mention **VHF, UHF,** and **CATV.**
To meet all these expanding signal source needs —and more — Leader introduces the Model 408 general-purpose video test generator.

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THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC
Servicing & Technology

Electronic Servicing & Technology is edited for servicing professionals who service consumer electronics equipment. This includes service technicians, field service personnel and avid servicing enthusiasts who repair and maintain audio, video, computer and other consumer electronics equipment.

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Member, Electronic Servicing Dealers Association

Member, Electronic Servicing Dealers Association

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Overland Park, KS 66212
913-492-4857

Electronic Servicing & Technology (ISSN 0278-9922) is published monthly by CQ Communications, Inc., 76 N. Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. Second class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year $24, two years $36. Foreign countries—one year $30, two years $42.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801.

CQ Communications, Inc. is publisher of CQ The Radio Amateur's Journal, Popular Communications, Modern Electronics, CQ Radio Amateur (Spanish CQ), CQ Amateur Radio Equipment Buyer's Guide, CQ Amateur Radio Antenna Buyer's Guide, and Electronic Servicing & Technology.

Finding time to continue your education

Wouldn't it be nice if somewhere there was a package of information that you could pick up and start to study, that was a complete package of all the things a technician needs to know in order to be a good and competent servicer.

It might be a technical school course of study, or some other kind of training package, but once you've studied it that's all you need to know.

Unfortunately, life's never like that. No matter what you plan to do for a living, there's no set complete package of information that you can buy that will suffice for everyone for all time.

Much of the reason that this is so has to do with the fact that each discipline is both constantly changing and multifaceted. Take law for instance. A lawyer goes to school to learn the fundamentals of the law, but the study is so broad that once he begins to practice he will specialize in some specific area of the law: criminal law, corporate law, divorce, personal injury. The list goes on and on.

And the law is a constantly changing entity. As our society changes, the law must also change. New laws enacted by the legislature must be studied and taken into account. New decisions reached by courts all the way from the district courts to the Supreme Court change the way in which the law is interpreted.

The same is true of the training of an electronics technician. Most of the electronics technical schools, for example, teach the fundamentals of electronics: basic circuit theory, Ohm's law, Kirchoff's law, the characteristics of the components; that kind of thing. Once a student completes that kind of course and gets out into the world, he has to begin learning again, with the two-year degree as the starting point.

There are a number of reasons that this is so. For starters, there's only so much that can be taught in two years. Secondly, there are a number of different kinds of technicians. Some will go into industry where they will be involved in research, or development, or production. Other technicians will go into medical facilities as medical-electronics technicians. Still others will become consumer electronics servicing technicians.

While all of these technicians will need to know the basics of electronics, each group will need to develop knowledge in his own specialty, and this is best learned while working on that particular job.

Another reason that there will never be a nice complete package of knowledge that a technician can pick up and complete and be a fully knowledgeable technician is that the body of knowledge that a technician needs to be competent in a particular area is constantly changing, expanding. While schools do their best to keep up with the latest in technology, it's an impossibility to actually be able to do so. During the time it takes to create a textbook and other course material, a great deal of new material is being created by the engineers, technicians and manufacturers who design, develop and manufacture all of the new products.

The scariest thing about all of this is that the development of this technology appears to be escalating. Not so many years ago, the sum total of consumer electronics was radio and black and white TV. In its season, along came color TV. For a long time, consumer electronics was comparatively stable. Now in just the past ten years or so, we have been bombarded by the personal computer, the VCR, the camcorder, the compact disc player. In the near future we can probably expect to see much more advancement in consumer electronics.

The good thing about all of this is that if it were easy, then anyone could service consumer electronics products, and it wouldn't require the specialized knowledge that is so hard gained by technicians.

One of the reasons that the continuing study needed by servicing technicians becomes so difficult, at least for some, is that the business of servicing tends to be isolated, and frequently the technicians who need the training either do not become aware of its availability, or simply don't feel that they have the time to get away from the service center, even for a few days.

That's the reason that we present an article on the subject of training every year. The article, "Continuing education in servicing," in this issue presents information about training opportunities offered by product manufacturers, test equipment suppliers, associations, several different kinds of schools and more. Training is available in abundance for servicing technicians and service managers as well.

Once that becomes clear, then the biggest problem becomes how to determine which course, or which manual, or which video tape you should take advantage of first, and how and when to free up the time to do it. It is always difficult to find the time to spend studying some new aspects of electronics servicing, or to sharpen up some of the skills that have become rusty, but more often than not, that time is more than compensated for by the improved efficiency with which you are able to get the work done.

Nils Conrad Persson

Literature

Data sheet describes analog multimeters

A new 2-page, 4-color product bulletin is available from Simpson Electric Company. It describes the company's 260 series analog multimeters, including the models 260-8, -8P, 8RT and 8PRT. All feature standard and high-energy fusing in conjunction with a high quality diode network meter movement. The model 8P described in the new literature features an additional relay and overload protection that is resettable, plus audible continuity checking.

The text of the new product bulletin provides descriptive information on product features for the 260 series and the Model 150-2 Amp-Clamp adaptor which enables the testers to measure high currents up to 250A without circuit interruption.

The full-color brochure also includes complete specifications, ordering information, and a list of convenient accessories which include a 23-piece test lead set, padded nylon case and temperature adapters.

Circle (51) on Reply Card

SMT technical brochure

ESP solder plus of Lincoln, RI announces the publication of its new technical solder cream brochure for surface mount applications. The stable ESP solder creams feature long tack time, excellent pattern definition, and reliable reflow performance. New fine pitch and water-soluble creams are discussed. These ESP creams are formulated in screening, stenciling and dispensing grades.

Circle (52) on Reply Card

Semiconductor master replacement guide

Philips ECG introduces their 15th edition ECG Semiconductor Master Replacement Guide featuring over 21,000 additional cross references and over 300 new devices, including new product families.

With more than 262,000 crosses to Industrial and Entertainment part numbers, the 15th edition guide is a source of replacement information. Expanded selector guides are also provided to simplify choosing the best ECG replacement type for numbers that are not crossed. This latest ECG Master Replacement Guide includes a total of approximately 4,000 components making up the broadest available line of universal replacement semiconductors, and accessories.

Circle (53) on Reply Card

New product catalog

Projector-Recorder Belt Corp. is introducing a number of new items for their PRB line of products with the publication of their new 1991-92 distributor catalog. The new products being added to the PRB line are: Precision tools, including nylon delrin professional alignment tools which provide 100% coverage for the adjustment of coils and trimmers found in virtually every brand of computer, video game, TV and VCR; plus hemostats and tweezers in a variety of sizes and styles. Also featured are cold shrink tape; VCR tension bands; Molylube, washer, spring and E-Clip kits and a cleaning system for soldering iron tips, that doesn't excessively cool the tip.

Circle (54) on Reply Card

Catalog on soldering equipment, and electronic production aids

Ungar has published a new catalog describing its updated line of soldering and desoldering equipment and electronic production aids.

The 25-page illustrated color catalog describes features and benefits of Ungar surface mount rework systems, desoldering service centers, soldering systems, soldering/desoldering irons, heat guns and rechargeable cordless tools. Also featured is their new line of electronic manufacturing aids, including flushcutters, pliers and other hand tools; masking devices; dispensers; thermal wire strippers and assembly devices.

Circle (55) on Reply Card

Tool, tool kit, test catalog

Techni-Tool's 248 page, Catalog #41, now with easy to follow icons, is filled with more than 18,000 items from over 850 manufacturers. You can find products from electro-mechanical and assembly devices to electronic, telecommunication and field service tool kits. The catalog also features a full-line of items for aerospace production, computer maintenance and the fast growing field of surface mount technology. Techni-Tool offers a complete line of ESD, static control and clean room items.

Circle (56) on Reply Card

New course schedule

BMI announces a new course schedule for field service engineers and managers interested in reducing power cost and assuring safety, or in improving power quality for personal computers and other electronic devices. Classes listed are: Power Solving for the Industry Professional, Advanced Power Quality Lab, Problem Solving with the PowerScope, The PowerProfiler: Use and Application.

Circle (57) on Reply Card

Drop-proof DMM wattmeter

A drop-proof DMM/wattmeter is described in a two-page, four-color brochure from American Reliance Inc. This fact sheet details the electrical and general specifications of the 150W, plus application notes.

The meter measures dc and ac voltage and current resistance, it also provides audible continuity and diode test functions. It also measures ac watts true power, with input levels to 5500W. Two ranges of power measurement are provided, with resolution of 1W in the 2KW range and 10W in the 5.5 KW range. Power accuracy is specified for inputs from 47Hz to 65Hz. The basic dc accuracy of the instrument is 0.5%.

Circle (58) on Reply Card

Line of flyback transformers

Philips ECG introduces a new line of flyback transformers designed as direct replacements in television receivers and color and monochrome computer monitors.

The ECG flyback transformer line consists of 83 product types. A four-page catalog on ECG flyback transformers is available and cross references approximately 200 original equipment part numbers for 39 brands.

Circle (25) on Reply Card

Students win professional equipment gain head start on future employment

First, second and third-place winners of EIA/CEG's Electronic Skills Competition were announced following four days of intensive testing and demonstration at the 1991 International Summer Consumer Electronics Show.

Winners are:

- Jacob Docktor of Fargo, ND
- Eric Stratte of Spokane, WA
- Bradley Johnson of St. Paul, MN

Sponsored by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG), the competition allowed six students who recently completed a technical training program and are now employed in the consumer electronics industry to travel to Chicago, all expenses paid to compete for awards and recognition. The top three contestants won medals and professional test equipment: a dual-trace oscilloscope for first, a frequency counter for second, and a digital volt meter for third place. All six students were awarded professional butane soldering irons.

"This competition, which was cosponsored by the Vocational Industrial Clubs of America (VICA), gives students a boost toward developing a career as an electronics technician within one of the most exciting industries in the world. All prizes are basic tools every electronic technician needs, and winners of previous competitions have been hired by top consumer electronics companies," says Don Hatton, staff vice president of EIA/CEG's Product Services Department, which coordinated the event.

According to Hatton, the competitors diagnosed televisions, VCRs and compact disc players during the competition, which was held in the main exhibit area of the CES. They also displayed their skills at assembling and soldering an electronic product and demonstrated general theory knowledge of electronics. All six competitors were recent top finishers in the United States Skill Olympics sponsored by EIA and VICA. Three of the younger competitors are now eligible to represent the U.S. in the next International Competition to be held in Taipei, Taiwan in 1993.

"The partnership between EIA and VICA in programs such as these provides students with the opportunity to win equipment, trips and scholarships, which we believe will help to attract top candidates into the electronics servicing industry," says Hatton.

Larger screen color television sales up in April; compact camcorders account for strength in camcorder category

Video products continue to be strong sales performers in a still-unbalanced economy, with televisions larger than 27-inches and compact camcorders posting particularly impressive gains in April, according to statistics released by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Sales of color televisions larger than 27-inches were up 26.4 percent in April versus the same period last year, and compact camcorders rose 46.7 percent during the same period.

VCR decks and projection televisions join camcorders and large screen televisions as strong performers in April versus the same period last year. VCR decks posted a 14.1 percent increase for the month, and projection televisions gained 9.6 percent.

For the year-to-date, all video product categories are performing very well, despite the state of the current economy.

"Once again, we are proud to report that the consumer electronics industry is more than holding its own during some pretty tough economic times," says Gary J. Shapiro, EIA/CEG group vice president. "The industry's products are even showing strength at a time when real personal consumption expenditures on durable goods are down 10.8 percent in the first quarter of this year, chiefly due to a 24.1 percent first quarter annualized rate of decline for auto sales. All of these figures point to a strong future ahead for the consumer electronics industry." ■

Continuing education in servicing

By Conrad Persson

The invention of the integrated circuit has been perhaps the most pivotal invention in the recent history of electronics. This tiny device has made it possible to crowd so many semiconductor devices into a small place, inexpensively, that many electronics products that could barely have been conceived of thirty years ago are now commonplace. Products such as VCRs, digital audio and video disks and personal computers have gone in a few short years from being electronic wonders affordable only to the wealthy, to appearing in virtually every home in the U.S.

The existence of these products has created a sizable opportunity for consumer electronic servicing organizations. Along with the opportunity, however, has also come a need for training to service the products. While the circuit principles have not changed; Ohm's law and Kirchhoff's law still prevail; the complexity of the products has increased, and the approach to servicing these new products is different from the approach to servicing many of the older products.

Rethinking service

As a result of all of the changes that have come about because of the new circuitry, servicing the products requires a new approach to thinking about it. For example, even products that seem to be straightforward and very much like the products of years ago may be very different under the skin. TV sets, especially those that contain such enhancements as picture in picture, on screen readouts, and other advancements are likely to contain a great deal of complex, microprocessor circuitry. Every VCR is a complex system of mechanics and electronics that requires precise control to produce an acceptable picture.

Audio and video disc players have to have digital and computer circuitry in them in order to convert the digital bits on the disc back into the music that it represents.

In sum, no matter how innocuous and familiar any of today's consumer electronic products may look, they most likely contain circuitry that is at the cutting edge of today's electronics technology.

Servicing these products requires skills and equipment greatly advanced beyond the skills and equipment that was needed to service the products of a few years ago.

There is lots of help

Fortunately, today a lot of people and agencies know that it's in their best interests to see to it that there are technicians around who know how to service today's complex electronic products. Manufacturers of today's consumer electronics products want to have competent technicians on hand to service their products when they malfunction. Private and public schools want to attract students. Book publishers can sell a lot of books if they are able to publish good, helpful texts that will help technicians learn to understand and service consumer electronics products.

There has been a great deal of effort in these areas. Manufacturers and their organizations are churning out training materials and scheduling classes. Schools are increasing the availability of servicing courses. Book publishers are cranking out quantities of technical books.

One of the best, and least expensive sources of training for servicing of consumer electronics products is the Electronics Industries Association/Consumer Electronics Group (EIA/CEG) Product Services Department. This organization offers free 2-day and 5-day on site workshops for technicians who are actively working in consumer electronics servicing.

In addition, they also offer video cassettes, manuals and the like on a wide range of subjects from "Troubleshooting with modern electronic test equipment (Parts I and II)," to high-tech soldering and microprocessor troubleshooting, and more. These tapes are priced very inexpensively, just enough to offset the cost of producing them.

If you, or someone in your service facility is in need of training, you should at least explore what EIA has to offer. See their name and address in the listing in this article.

Doing it

Most consumer electronics servicing technicians are aware that they need to upgrade their skills. The problem is complex, but there are usually two questions that the technician needs to get answered: "What do I need to learn?" and "How do I go about learning it?"

It's important to analyze these questions thoroughly to determine beforehand exactly what it is you need to study. It's not enough to just say "I need to learn more about camcorders" and then to charge off to find a book, a home study course or a local school that might offer a course on camcorders. Do you just want an overview on camcorder technology for starters? Or do you really have a pretty good idea of how camcorders work and what you really need is a course in servos?

Once you set the specific goals, the question becomes how to achieve them. One simple but effective method might be to contact other technicians in your area. If you have a skill that they lack and vice versa, you might be able to arrange for a session in which you educate each other.

Self study

Another simple, although less effective method is to buy a book on the subject and study it yourself. Depending on a number of factors, including complexity of the subject, the quality of the book, and your own self discipline, this experience

Persson is editor of ES&T.

might bring anything from complete understanding of the material to fruitlessness. Home-study courses offer a major improvement over studying from books. The material is broken down into study units, someone tells you what is expected of you, and you get feedback through regular tests.

Schools and seminars

If time and money permit, a more effective way to learn is through structured class and lab courses. Here again, there are many avenues. Public and private technical schools throughout the country offer a selection of courses from the most elementary introductory courses to detailed theory and design. If you have the time and the budget to travel, manufacturers of home electronic equipment offer seminars on the operation and servicing of specific items to servicing technicians.

There are also many organizations, especially in the computer area, that offer seminars of a few days to a week or so, usually in a number of locations throughout the country.

In addition, manufacturers of test equipment and tools such as multimeters, oscilloscopes, soldering tools, etc. offer instruction in using their products. Some have books and pamphlets that help you understand the kinds of things you can do with their products, and others offer formal courses of study, some to do at home, others offer courses and seminars that travel to different areas of the country so you can take a formal course taught by the experts near home.

Identifying the available resources

A local school may have just the course you need listed in its catalog. One of the book publishers might have just the book or series of books to fill in the gaps in your knowledge. One of the associations related to home electronics equipment manufacturing sales or service may have just the item of information you need or be able to point you in the right direction.

Included in this article are several lists of companies and other organizations that offer some kind of training, but space doesn't permit a comprehensive list. There are a number of lists available that will provide someone who is serious about training many avenues to explore. For starters, take a look at the **ES&T** March Buyer's guide. That issue contains a large list of companies with addresses and phone numbers.

Try experimentation

Many of today's consumer electronics products are electromechanical, and it's frequently the mechanical portion of these products that cause problems. In understanding a mechanical system, it's frequently very useful just to open the unit up and watch how things work; even to introduce some problems to see what happens. I wouldn't suggest this approach to learning with a $600.00 hi-fi VCR, but some of the low-end units cost in the neighborhood of $200.00. If you take a look at the cost of books these days, or the cost of seminars, or even just the cost of lodging at a hotel or motel while attending a seminar, $200.00 is pretty cheap for a unit to take apart, observe, check with DMM and oscillo-

scope, and you might get a pretty good education from it.

Try the product manufacturers

Many of the manufacturers of consumer electronics equipment provide training in a number of ways. Some of the manufacturers restrict the training they provide to technicians from their own authorized servicing facilities. Others not only offer courses to anyone who is both qualified and interested, they make it a point to make their courses universally applicable.

In fact, Philips has made it a point to offer courses that are applicable not only to their products but to other product brands as well. Their literature states "GENERIC CLASSES - We teach skills that can be used on all brands." This manufacturer offers on-site training for personal computers, including Familiarization with DOS, personal computer repair, computer monitor repair, compact disc/video combination products, and compact disc digital audio, VCR and camcorder service, power supply service and more. These courses are offered in 20 cities throughout the country. In addition they offer video tapes, servicing software, service aids and more.

The listing of consumer electronics product manufacturers provided contains a listing of some of the manufacturers that according to the latest information available to us offer consumer electronics training. This list makes no pretension at being comprehensive. By all means, contact other manufacturers to find out what training courses and materials they might have available.

The test equipment manufacturers

The test equipment manufacturers not only know a great deal about the test equipment they sell, but they have become pretty familiar with the uses to which it might be put. They spend a great deal of time and go to great expense to talk to the engineers and technicians at whom they aim their instruments and find out what their problems and needs are. Armed with this information, they weigh the pros and cons of adding this or that feature to their product, or changing, or improving the product.

The test equipment manufacturers also recognize one other important fact: the more their customer knows how to apply their products, the more likely they will be to buy their product in the first place, to be happy with it once they've bought it, to recommend the company's products to a friend, and to buy that same brand the next time they need a piece of test equipment. In order to enhance the customer's or potential customer's understanding of the testing/diagnosing function in general and the company's product in particular, many manufacturers of test equipment offer courses, manuals, videotape courses, and other training opportunities.

For example, B&K Precision offers booklets such as a "Guidebook to Function Generators," a "Guidebook to Test Instruments," and a "Guidebook to Oscilloscopes." Sencore offers seminars throughout the country as well as their "Tech Tips" binder, the periodical "Sencore News" and other training materials.

Tektronix Oscilloscope Division puts out booklets such as "The XYZs of using a scope" and "Basic Oscilloscope Operation." They even sell a

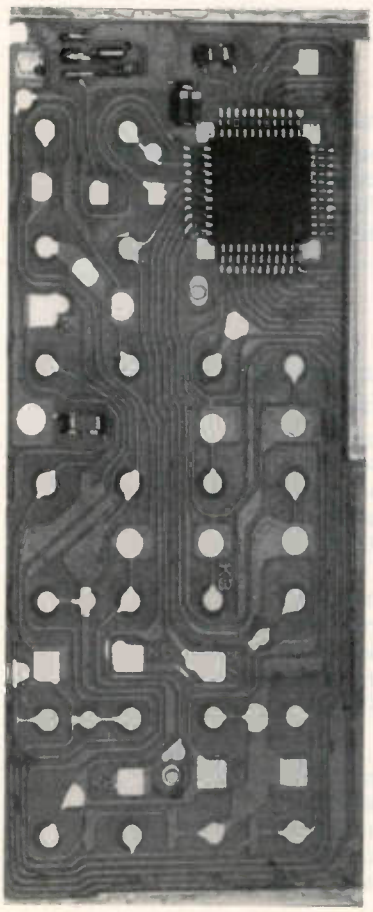
training kit that allows a scope user who needs to learn more about use of an osciloscope to practice on circuitry for which the scope traces are known. The Tektronix Television Business Division offers application notes such as "Basic NTSC Video Testing" and "Checking VCR Performance."

Hewlett-Packard offers manuals such as "The fundamentals of signal analysis" and "Feeling comfortable with digitizing oscilloscopes," that provide in depth information about the state of the art in circuits and signals, and the test equipment and techniques needed to study and understand it.

You should also check with any of the other well known manufacturers of test equipment to determine what kinds of training materials they have.

Learning about computers

Whatever reservations the experts may have had in the recent past about computers becoming consumer products, it has happened; they are. It's now possible to put together a low-end equipped 8088-based computer, including monitor and printer for



around $1,000. Advancing technology and competition among manufacturers and sellers is causing higher powered computers to come down in price correspondingly. And the increasing availability of useful, user-friendly low-cost software such as word processing, spread sheet, data base, desk-top publishing, accounting, on line data bases and more is making them more and more attractive to more and more people.

Furthermore, more people are establishing home offices, and along with fax machines and answering machines, personal computers are considered essential tools for the home office.

The result of this increasing population of personal computers in homes is that increasingly consumer electronics servicing technicians are having the opportunity to service personal computers. And while making the transition from servicing TVs and VCRs to servicing computers does take something of a mental adjustment, it's usually easier than it seems at first blush, for someone who has made a lifetime study and a

Trade associations

Electronic Industries Association/
Consumer Electronics Group
2001 Pennsylvania Avenue, NW
Washington, DC 20006-1813
202-457-4919

Electronics Representatives Association
20 E. Huron
Chicago, IL 60611
312-649-1333

Electronic Technicians Association
604 North Jackson St.
Greencastle, IN 46135
317-653-3849

Musical Instrument Technicians
Association, International
8216 Audrain Drive
St. Louis, MO 63121-4504
314-389-3290

National Association of Business
and Educational Radio (NABER)
1501 Duke St, Suite 200
Alexandria, VA 22314
703-739-0300

NARDA (National Association of
Retail Dealers of America)
NASD (National Association of
Service Dealers)
10 East 22nd Street
Lombard, IL 60148
312-953-8950

National Association of Service Managers
650 W. Algonquin Road, Suite 204
Des Plaines, IL 60016
708-640-8133

National Electronic Distributors
Association
35 East Wacker Drive
Suite 3202
Chicago, IL 60601
312-558-9114

National Electronic Servicing
Dealers Association
2708 W. Berry Street
Ft. Worth, TX 76109
817-921-9062

Technical book publishers

CRC Press, Inc.
2000 Corporate Blvd., N.W.
Boca Raton, FL 33431
407-994-0555

McGraw-Hill Book Company
1221 Avenue of the Americas
New York, NY 10020

MacMillan Publishing
Front and Brown Streets
Riverside, NJ 08075
800-257-5755

PCS Publications
PO Box 10492
Clearwater, FL 34617-8492
800-741-DATA
Fax: 813-446-3157

Prentice-Hall, Inc.
Rte. 9W
Englewood Cliffs, NJ 07632
201-592-2455

Tab Books
PO Box 40
Blue Ridge Summit, PA 17214
717-794-2191

Van Nostrand Reinhold Company
135 W. 50th St.
New York, NY 10020

Home study

Cleveland Institute of Electronics
1776 E. 17th St.
Cleveland, OH 44114
216-781-9400
Fax: 216-781-0331

Cook's Institute of Electronics
Engineering
Desk 15
PO Box 20345
Jackson, MS 39209

Electronic Institute of Brooklyn
4823 Avenue N
Brooklyn, NY 11234

Grantham College of Engineering
Gratham College Road
2500 S. La Cienega Blvd.
Slidell, CA 70460

Heath/Zenith
455 Riverview Rd.
Benton Harbor, MI 49022

National Institute of Technology
1701 W. Euless Blvd.
Euless, TX 76039

National Technical Schools
456 W. Santa Barbara Ave
Los Angeles, CA 90037

NRI Training for Professionals
McGraw-Hill Continuing Education
Center
4401 Connecticut Ave NW
Washington, DC 20008

Private trade schools

National Association of Trade and
Technical Schools
2251 Wisconsin Ave. N.W.
Washington, DC 20007

Consumer Electronic Equipment Manufacturers

Channel Master
PO Box 1416
Industrial Park Drive
Smithfield, NC 27577
919-934-9711

Curtis Mathes
1 Curtis Mathes Pkwy.
PO Box 21605
Athens, TX 75751
214-675-2292

Philips Service Company
PO Box 555
Jefferson City, TN 3776
615-475-0044
Fax: 615-475-0221

business of understanding and servicing electronics circuits.

These days it becomes yet easier as the number of organizations that offer training in computers increases, and in most cases the level of training gets better. The companies that offer computer related service training include not only companies that are traditionally computer oriented such as American Institute, Heath/Zenith, Learning Tree, National Advancement Corp., but also includes some of the companies that you might not think of as computer oriented, like Philips.

Don't remain in the dark

If you, or someone who works for you, is lacking in some of the important skills required to diagnose and service some of today's sophisticated consumer electronics products, it's almost a sure bet that there is someone out there, or more likely several someones who offer the training that's needed. If you don't find reference to the kind of training you need in the list that follows, perhaps a little sleuthing will lead you to just the training you need.

For example, do you need training on soldering and desoldering the new surface mount devices? Contact one of the manufacturers of soldering/desoldering equipment. Do you need information on applying an oscilloscope to diagnosis of some of today's sophisticated VCR circuitry? Try one of the well known test equipment manufacturers. The information is there; it's just a matter of finding it.

Some of the sources

The following text lists a number of correspondence schools, book publishers, associations, product manufacturers, and test equipment manufacturers whom you might want to contact for further information on what educational opportunities they have to offer. ■

Matsushita Services Company
50 Meadowland Parkway
Panazip: 2B-6
Seacaucus, NJ 07094
201-392-4695

Mitsubishi Electronics America, Inc.
5757 Plaza Drive
PO Box 6007
Cypress, CA 90630-0007
714-220-2500

Sony Corp. of America
Sony Service Company
Sony Drive
Park Ridge, NJ 07656
201-930-1000

Thomson Consumer Electronics
600 N. Sherman Drive
Indianapolis, IN 46201
317-267-5000

Toshiba America, Inc.
Consumer Products Business Sector
82 Totowa Road
Wayne, NJ 07470
201-628-8000

Zenith Sales Company
1900 N. Austin Avenue
Chicago, IL 60639
312-745-2000
Fax: 312-745-5149

Computer Training

American Institute
Institute for International Research
437 Madison Ave., 23rd Floor
New York, NY 10022
212-826-3340

Computer and Printer Repair
17 North Avenue
Norwalk, CT 06851
203-847-9111

Learning Tree International
6053 West Century Boulevard
PO Box 45028
Los Angeles, CA 90045-0028
213-417-8888
Fax: 410-2952

Mind Share
2202 Buttercup Drive
Richardson, TX 75082
214-231-2216
Fax: 214-783-4715

National Advancement Corp.
2730-J South Harbor
Santa Ana, CA 92704
714-754-7110

Test Equipment Manufacturers

B&K Precision
Maxtec International Corp.
6470 West Cortland Street
Chicago, IL 60635
312-889-1448
Fax: 312-794-9740

John Fluke Mfg. Co., Inc.
PO Box C9090
Everett, WA 98206
206-347-6100

Hewlett-Packard
100 Hanover St.
Palo Alto, CA 94304
415-694-2000

Sencore
3200 Sencore Drive
Sioux Falls, SD 57107
605-339-0100

Literature Coordinator
Tektronix
Television Business Division
MS 58-699
Beaverton, OR 97077
800-TEK-WIDE, ext. TV

Tektronix
Oscilloscope Division
PO Box 500, MS 39710
Beaverton, OR 97077
503-627-2010
Fax: 503-627-5593

Tentel
4475 Golden Foothill Parkway
El Dorado Hills, CA 95630
916-939-4005
800-538-6894

Equipping a TV/VCR test bench on a tight budget

By Bob Kral

If you must equip a bench position for video servicing, it can be a very expensive proposition. However, a prudent choice of equipment will keep your expenses under control.

Kral is Marketing Product Manager with Maxtec International, B&K Precision.

Equipment for the basic bench

You will need the following equipment:

- NTSC video generator
- 40 MHz dual-trace scope
- Triple-output dc tracking power supply
- Variable ac power supply
- CRT restorer/analyzer
- Multi-function DMM
- High-voltage probe
- 5MHz sweep/function generator
- 500 MHz multifunction counter.

Total cost of the above equipment will be in the neighborhood of $5,000.

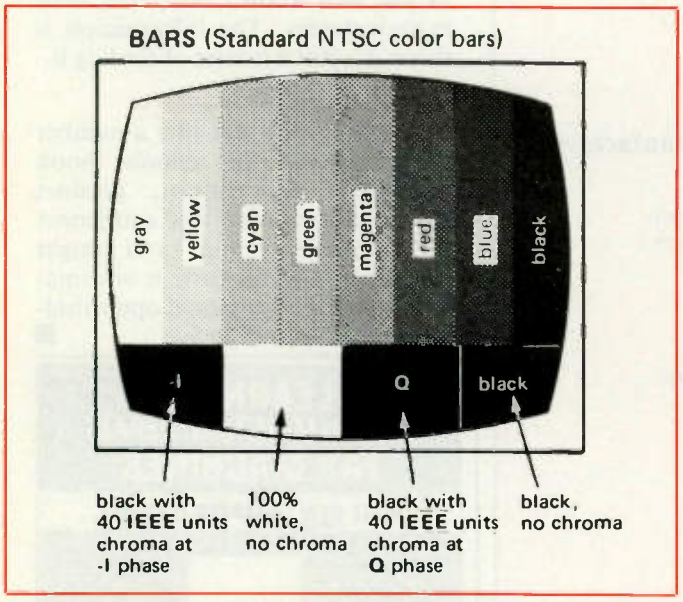


Figure 1. The NTSC color bar pattern is a basic test instrument for testing, troubleshooting and adjusting video equipment.

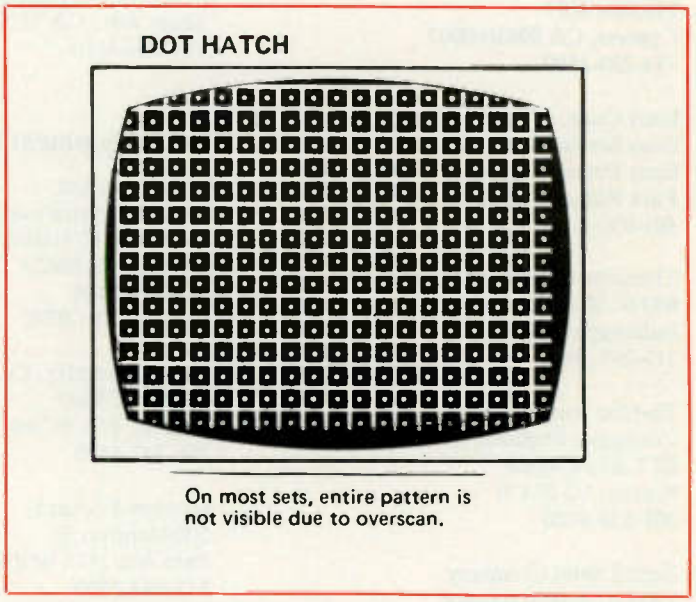


Figure 2. Dots and crosshatch patterns are useful for checking static and dynamic convergence.

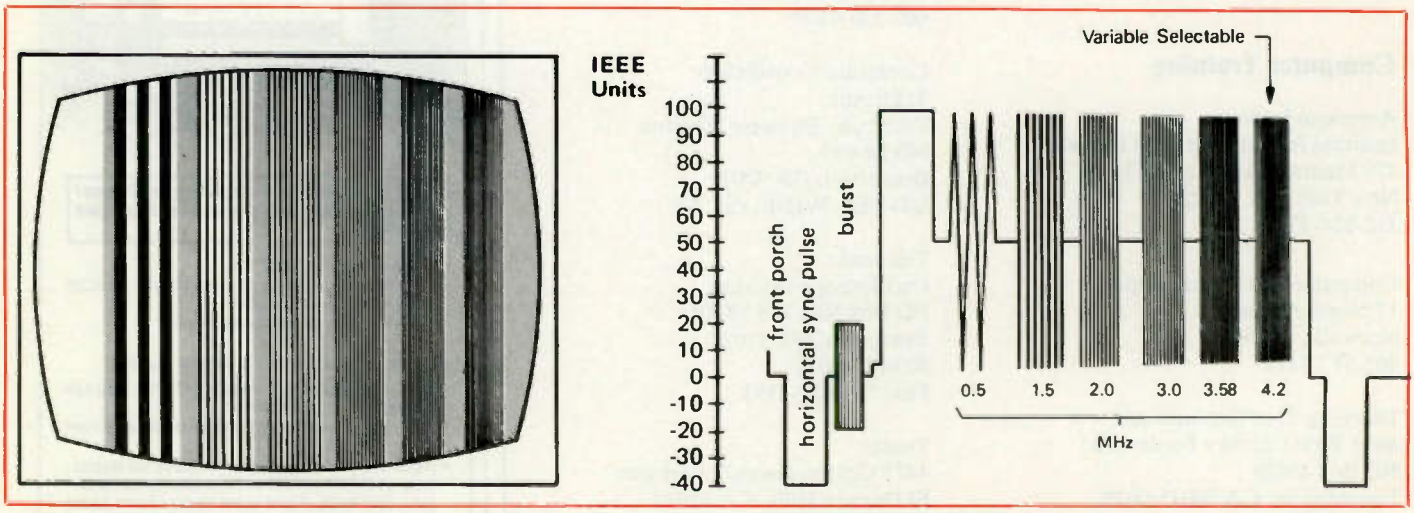


Figure 3. The multiburst pattern, equal amplitude steps of white and sine wave video at various frequencies, is used to check horizontal resolution and video bandwidth.

HIGH STAIRS

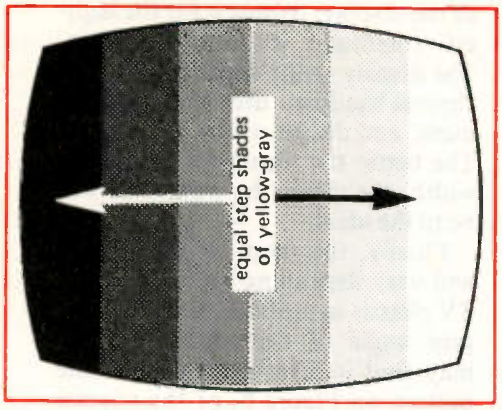


Figure 4. The staircase patterns contain five equal steps of increasing luminance with a constant chroma amplitude and phase. They are used to test amplifier linearity, to set VCRs' white clip level and to adjust VCRs'frequency equalization, and to check differential gain and differential phase.

NTSC video generator

This is the heart of the video bench. The NTSC color bar pattern (Figure 1) is *necessary* for testing, troubleshooting and adjusting video equipment. Usually, "NTSC" is specified by the manufacturer in service manuals. The NTSC color bar signal produces standard EIA colors at the prescribed luminance level (brightness), chroma phase angle (hue, the element that sets apart colors), and chroma amplitude (saturation), as set forth by the NTSC. Broadcasting studios and transmitting equipment use this test signal.

A non-NTSC color bar generator usually produces all hues at the same luminance level, with no luminance component, and the same chroma amplitude. This, of course, is not equivalent to the color signals being broadcast.

Useful features

Useful features of an NTSC generator include:

- TCXO Time Base—A temperature compensated crystal oscillator for sync, pattern, color burst, and chroma generation ensures the signals will be stable and will not drift.
- Outputs—Red, green, and blue outputs are used to test RGB color monitors.
- Dots and Crosshatch Patterns (Figure 2)—Useful for checking static and dynamic convergence.
- Multiburst pattern (Figure 3)—Equal amplitude steps of white,and sine wave video at various frequencies, used to check horizontal resolution and video bandwidth.
- Variable Multiburst—A variable multiburst frequency permits measurement of bandwidth cutoff frequency or maximum resolution.
- Sync Pulse Outputs—Needed for triggering an oscilloscope.
- IWQ Pattern (Figure 1)—The IWQ pattern has 7.5% black level and 100% white level. These are level references. They are used, for example, to adjust FM deviation and black and white clip level in VCRs, and to adjust or check luminance and chroma ratios.
- Staircase Pattern (Figure 4)—The staircase patterns contain five equal steps of increasing luminance with a constant chroma amplitude and phase. They are used to test amplifier linearity, to set VCRs' white clip level, to adjust VCRs' frequency equalization, and to check differential gain and differential phase.
- Full Field Multiburst (Figure 5) This pattern is a full screen of one specific multiburst frequency. It allows a thorough analysis of a circuit at a specific video frequency, and it may be used to check horizontal linearity. (The spacing between lines should be the same at the left, right, and center of the screen.
- RF and IF Outputs—These outputs facilitate servicing of TV and VCR tuners and IF sections. For example, performance of the VCR or TV should be as good with a signal input to Channel 3 or 4 as it is with composite video applied directly to the video. If not, the problem can be isolated by injecting RF or IF signals at various points to determine the point at which normal operation is lost.

Oscilloscope

We recommend at least a 40MHz scope, with X and Y inputs (a demodulator probe may prove to be a handy accessory). If you get the proper scope, you can most likely dispense with the expense of a vectorscope and waveform monitor.

The vectorscope pattern can be a valuable tool for troubleshooting color problems, including proper alignment and adjustment, if the normal vectorscope pattern is known. You will have to have a library of normal displays measured from various popular TV chassis in good

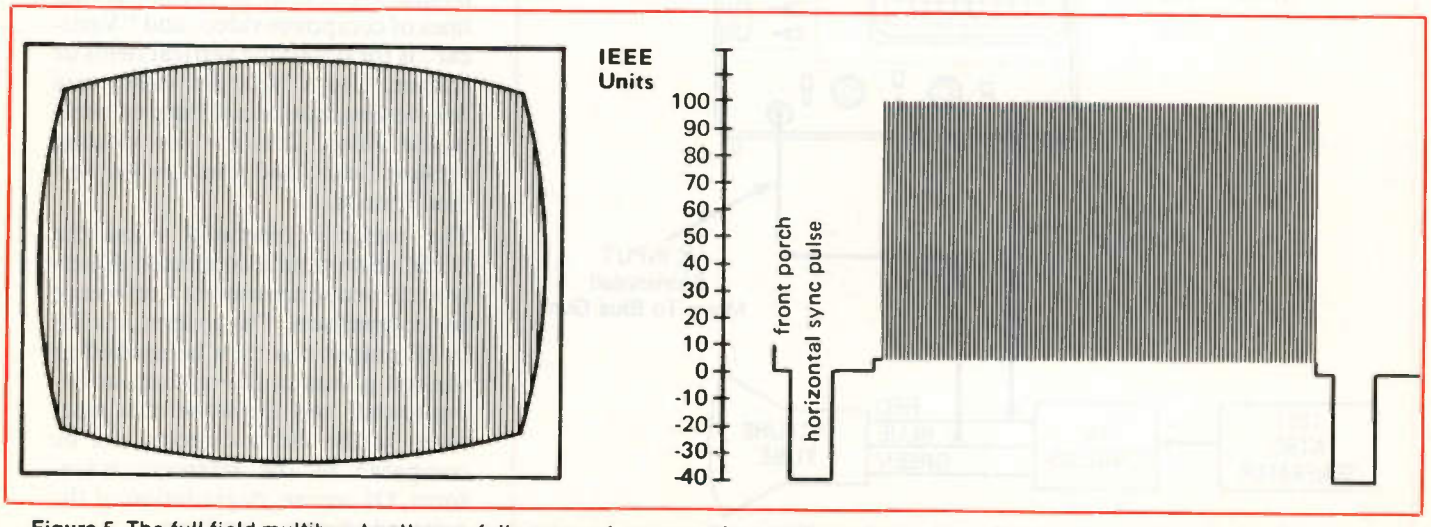


Figure 5. The full field multiburst pattern, a full screen of one specific multiburst frequency, allows a thorough analysis of a circuit at a specific video frequency, and it may be used to check horizontal linearity.

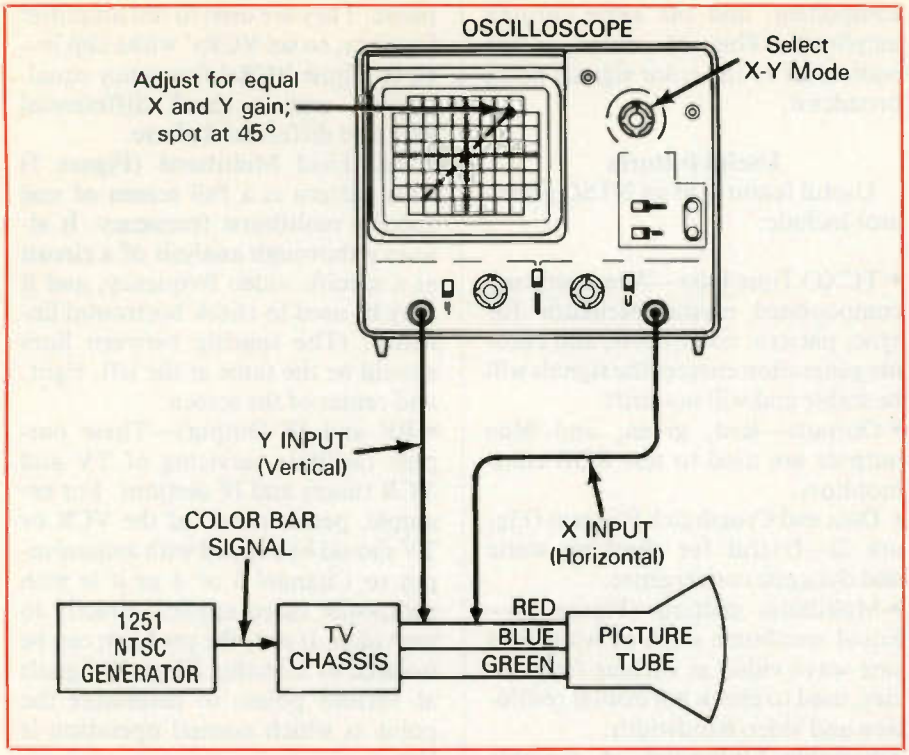


Figure 6. The oscilloscope can be used as a vectorscope by connecting it as shown here.

working condition. Normal patterns vary from one model TV chassis to another.

The scope as vectorscope

Figure 6 shows how to set up your scope as a vectorscope. After the initial adjustments are made, you can service picture tubes by connecting your scope as shown in Figure 7. Your display should be similar to Figure 8. However, the HUE control of the equipment you are testing will *rotate* the display, usually ±30 degrees. Adjust it to get close to Figure 8.

The COLOR control (chroma amplitude) will affect the *amplitude* of the display. Adjust it for the highest amplitude without distortion. The display shape depends upon the chroma bandpass, demodulator alignment, and design of the TV chassis. The better the alignment and bandwidth, the closer the waveform will be to the ideal.

Finally, the shape of the display will vary depending on whether the TV chassis uses 90-degree or 105-degree angle of demodulation. You may find it helpful to transfer the pattern on Figure 8, or the normal display from your library, to a sheet of transparent plastic, and attach it to the CRT on your scope.

Remember, if your color pattern generator is not NTSC, you cannot perform this test.

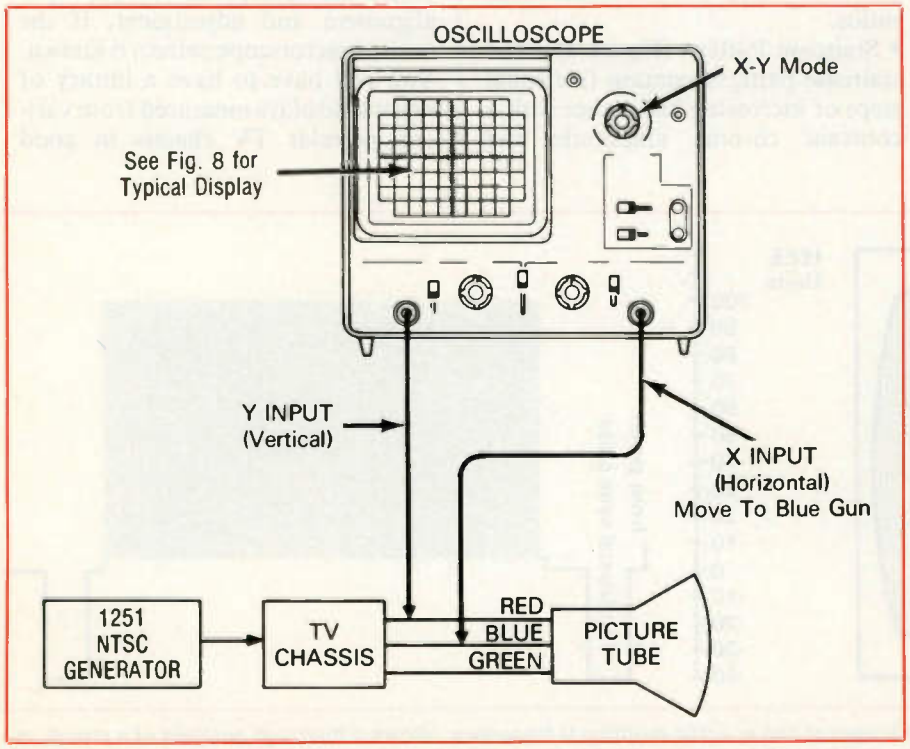


Figure 7. Connect the oscilloscope as shown here to service picture tubes.

The scope as waveform monitor

A waveform monitor, like the vectorscope, is actually a special-purpose oscilloscope. It is dedicated to high quality presentation of the standard 525-line 60Hz NTSC video signals. It is calibrated vertically in IRE units and in percent modulation. The horizontal scale is calibrated in microseconds per division.

To use a scope as a waveform monitor, connect a coaxial cable from the NTSC generator's VIDEO output jack to the vertical input of the scope (terminate into 75Ω). Run another cable from the NTSC generator's SYNC output jack to the scope's external trigger, and select external trigger mode on the scope. Your NTSC generator should have a SYNC switch with "Horizontal" and "Vertical" positions. The "Horizontal" position is for observing lines of composite video, and "Vertical" is for observing vertical fields or frames. Use a 10μs/div sweep rate for viewing horizontal lines of composite video, 2ms/div for viewing vertical fields, and 5ms/div for vertical frames.

The patterns generated when the NTSC generator is connected directly to the scope are used as a reference for comparison. The generator's RF or IF output can then be applied at various points in the equipment being tested, and the waveform measured at the video detector can be compared to the reference waveform. Of course, degradation of the pattern indicates a problem.

The advantage of a dedicated

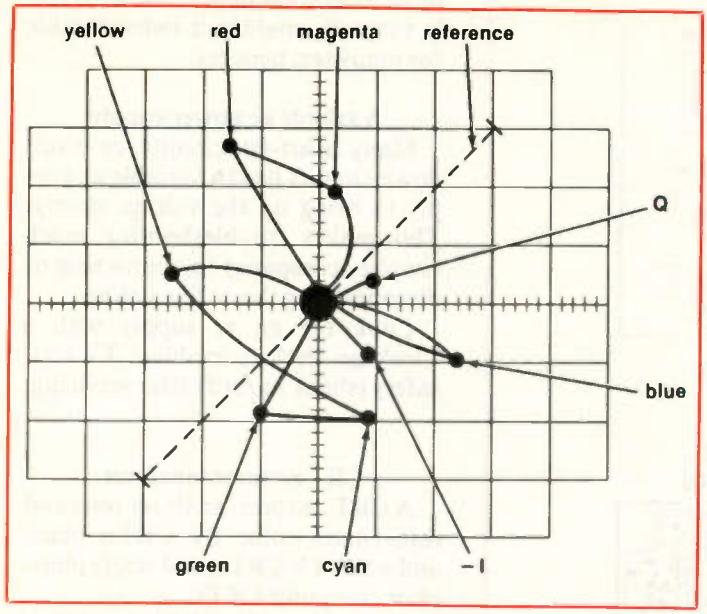


Figure 8. Adjustment of the HUE control of the TV set you are testing, will rotate the display, usually ± 30 degrees. Adjust it to get close to the display shown here.

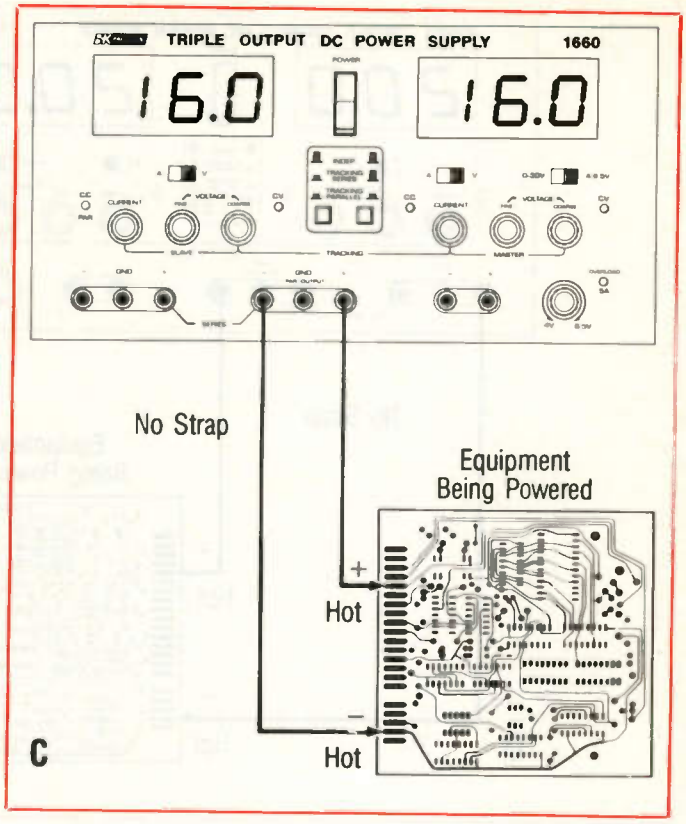


Figure 9. If an earth ground reference is not needed when using a triple-output tracking power supply, connections should be as shown.

waveform monitor is that it is a fully calibrated instrument with a calibrated display. Unlike the general purpose scope, a waveform monitor allows very accurate measurements of parameters such as frequency response and differential gain.

While waveform monitors and vectorscopes are very useful, you will have to spend at least $4,000 for the combination, while a standard, multipurpose 40MHz scope will cost under $900.

Triple-output tracking power supply

Triple-output tracking supplies have three voltage outputs. One may be fixed at 5V, or variable over a limited range, with 2A or more output for driving TTL circuits. The other two outputs usually have variable voltage, from 0 to the maximum value (e.g. 30Vdc) and variable current from 0 to some maximum value (e.g.,2A).

Tracking means that at the press of a button, the outputs of the two main supplies can be set using one adjustment knob. In other words, the output of the "B" or "slave" supply will "follow"or "track" the output of the "A" or "master" supply. In addition, the two supplies can be connected in series or parallel at the press of a button, and a variety of grounding arrangements are possible. Of course, all tracking supplies can be operated independently when the A and B voltages must be different.

Parallel and Series Tracking

When the two 30V, 2A main outputs are switched in parallel, this creates a 0-30V, 0-4A supply (the "master" or "A" supply's outputs are used). The "A" supply's controls set the current and voltage. If an earth ground reference is not needed, connections should be as shown in Figure 9. The center ground terminal is not used. Either the positive or negative terminal can be grounded by connecting to the center ground terminal, or the chassis or common of the circuit being powered can be grounded separately.

Series tracking is, of course, similar except that a single 0- 60V, 0-2A supply is then created, and the positive terminal of the "A" supply and the negative terminal of the "B" supply are used, as shown in Figure 10.

Split Tracking Supplies

Most triple-output tracking supplies can provide two positive voltages with a common negative, two negative voltages with a common positive, or one positive and one negative voltage with a common ground. The two voltages can be identical (tracking mode) or different (independent mode).

A digital clock may have two +12V inputs with a common negative. Figure 11 shows the power supply connections required to produce two identical positive voltages. The power supply is used in the tracking mode. If two different voltages are required, select independent operation. A device that uses both TTL and analog circuitry may require +5V and +15V, for example. Or to check a television's vertical oscillator and output circuits, you may have to supply 9V and 26V to the circuitry and monitor the output waveform on a scope.

Figure 12 shows connections for two negative voltages with a common positive. For identical voltages, select the tracking mode. For different voltages, use independent operation.

If a circuit uses op amps, identical positive and negative voltages are required with a separate common. The tracking mode would be selected (see Figure 13). For different voltages, the independent mode should be selected and connections made according to Figure 14.

A triple-output tracking supply is usually fairly expensive, as dc power supplies go. But it is cheaper than

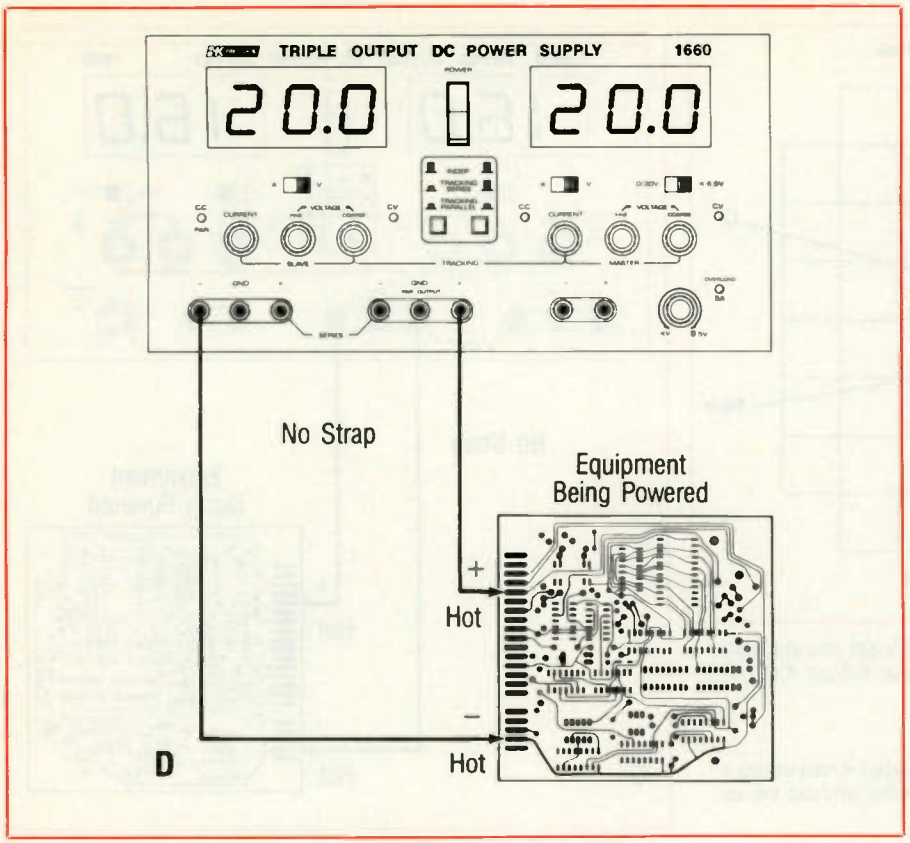


Figure 10. Power supply connections for series tracking.

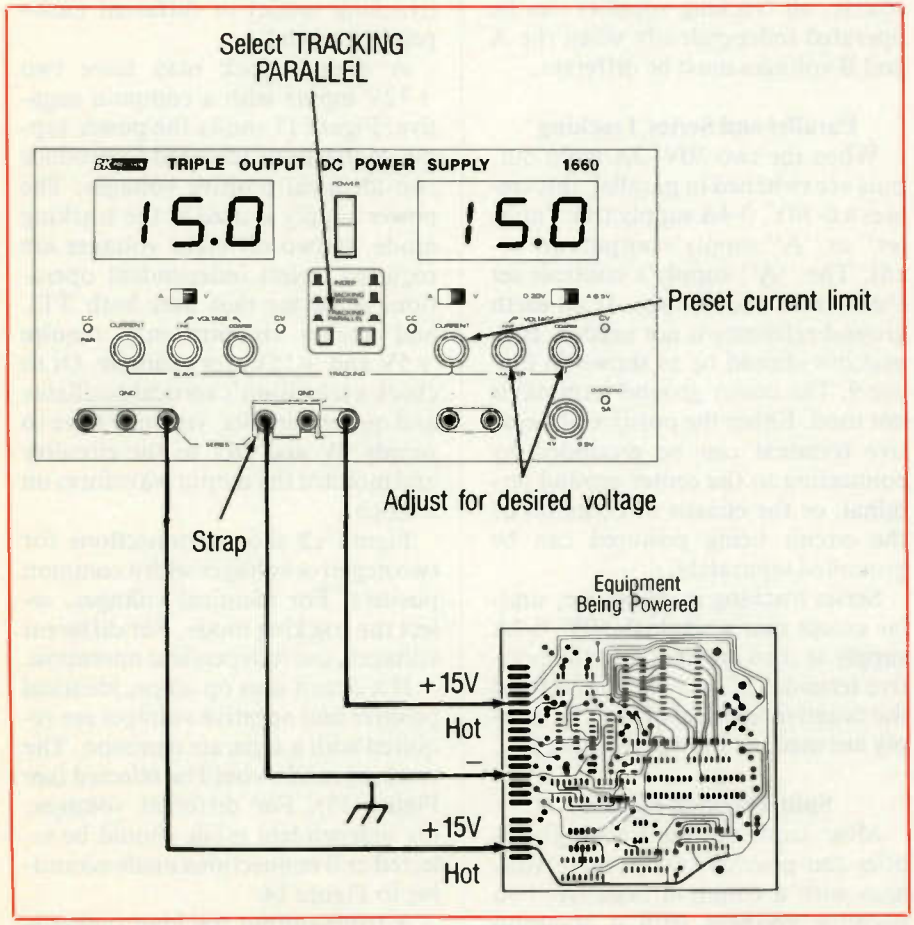


Figure 11. Connect the power supply as shown here to produce two identical positive voltages. The power supply is used in the tracking mode.

three separate supplies, and extremely versatile, making it indispensable for many test benches.

Variable ac power supply

Many start-up circuits or shutdown circuits need a variable ac supply to bring up the voltage slowly. This makes troubleshooting much simpler, compared to connecting or disconnecting the ac line voltage.

Look for an ac supply with a "leakage test" to evaluate TV sets' safety (shock hazard) after servicing.

CRT restorer/analyzer

A CRT restorer/analyzer tests and rejuvenates color TV CRTs, black and white TV CRTs, and single phosphor computer CRTs.

The restorer should test for different types of leakage. Cathode-to-cathode leakage cannot be repaired. Heater-to-cathode leakage cannot be repaired, either. However, grid-to-cathode leakage can be corrected using the restorer.

Other useful tests include cathode emission current tests, color tracking tests, and focus and life tests. The restorer can clean and balance the guns, eliminating surface contamination to restore tracking or increase CRT life. It can correct leakage and remove shorts between the control grid and cathode. And it can restore cathodes when the emission is below usable levels.

A CRT restorer/analyzer costs between $500 and $1,000, and can pay for itself in little time if you do a lot of CRT servicing.

Over 95% of all CRTs will be *as good as new* after restoration. Many service establishments guarantee their restorations for up to two years, with 100% of the restoration fee creditable toward a new CRT during that time period.

DMM and high voltage probe

For as little as $100.00, you can buy a multi-function DMM. In addition to the standard resistance and ac/dc voltage and current measurements, look for diode, transistor, and capacitance tests and a built-in frequency counter. The component testing capability is useful for checking any parts you have on hand, or want to replace. The frequency counter function is handy to have on

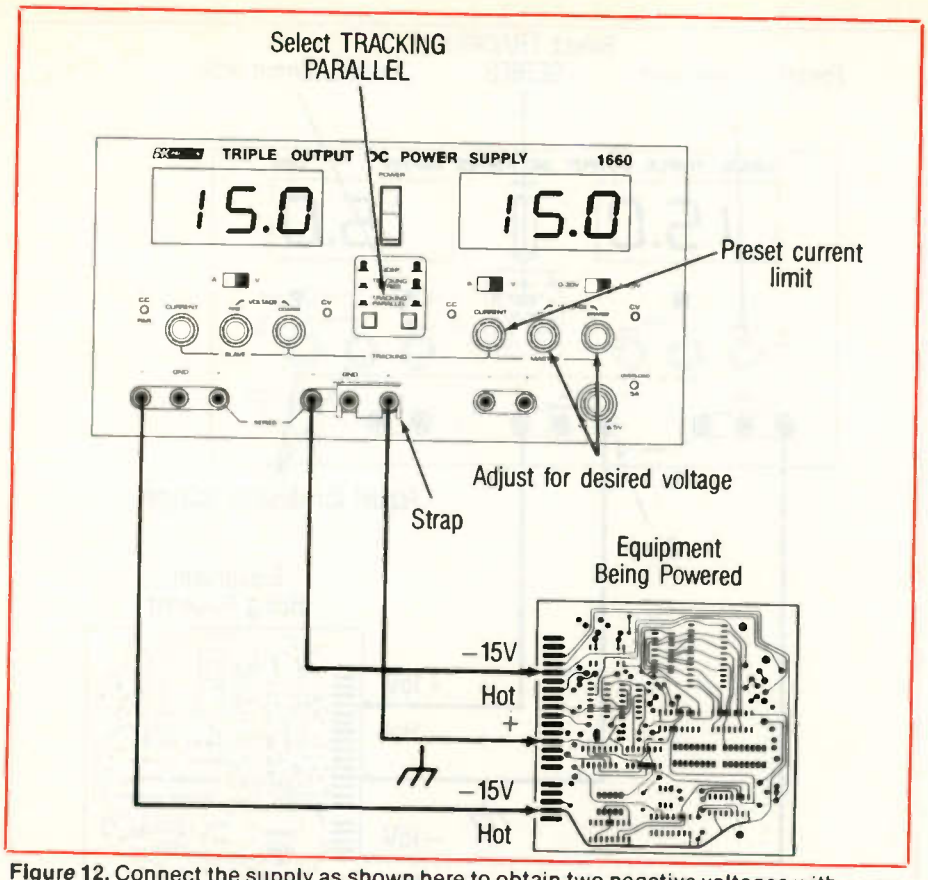


Figure 12. Connect the supply as shown here to obtain two negative voltages with a common positive. For identical voltages, select the tracking mode. For different voltages, use independent operation.

hand, especially considering that you may not need it often enough to justify the expense of a separate, dedicated instrument. DCV accuracy of 0.5% is adequate.

When you consider DMMs, look for high energy fusing. Most people are not aware that standard glass fuses can explode if a high voltage and current are applied accidentally. In a handheld multimeter, this is both a safety and reliability concern. Most manufacturers install 600V ceramic fuses, called "high-energy fuses," which solve the problem.

A high voltage multiplier probe is recommended for TV servicing. A suitable probe multiplies the DMM ranges by 1,000 so that, for example, 4V becomes 4,000V. A typical high voltage multiplier probe can measure up to 40,000Vdc and 20,000Vac.

Function generator and frequency counter

A frequency counter may *not* be needed. Counters are now built into DMMs, and also into function generators. If you decide you definitely want a counter, don't buy more than you need. A 10 PPM time base is very adequate for TV servicing. A 1 PPM TCXO timebase is needed only in special applications, such as checking and calibrating radio transmitters, and it adds considerable cost to the instrument. All you will need is a basic frequency counter; universal counters employ time interval, frequency ratio, period, and totalize functions, for which you will have little or no use.

A 5MHz function generator capable of frequency modulation is useful for checking the sound IF stage. A built-in counter is nice to have, and it is becoming more or less standard on function generators. Of course, its sine wave output is necessary for troubleshooting audio circuits.

General purpose function generators contain a variety of other features that may or may not be of use to you, depending on the equipment you plan on servicing. If, in addition to TV/video servicing, you plan on servicing AM and FM radio receivers, sweep operation will be important for tuner alignment. Square

wave, pulse, and gated pulse generation is useful for testing digital circuits. If variable symmetry is available, the pulse width can be narrowed to serve as clock pulses. Some generators have CMOS or TTL outputs, which are basically fixed voltage, variable frequency outputs suitable for the respective logic family.

Determine your needs, then equip your test bench

The heart of a basic, low-budget video test bench is an NTSC generator. A good one is worth the money. Other essential instruments are a scope, dc power supply, CRT restorer/analyzer, DMM, and high voltage probe.

To control costs, don't buy more than you need. Outline the type and volume of work that you are doing now, or that you anticipate doing in the future. Then buy equipment to satisfy those testing requirements. With thoughtful planning, you won't have idle equipment gathering dust on your test bench, nor will you have regretfully purchased test instruments that are inadequate for their intended purpose. ■

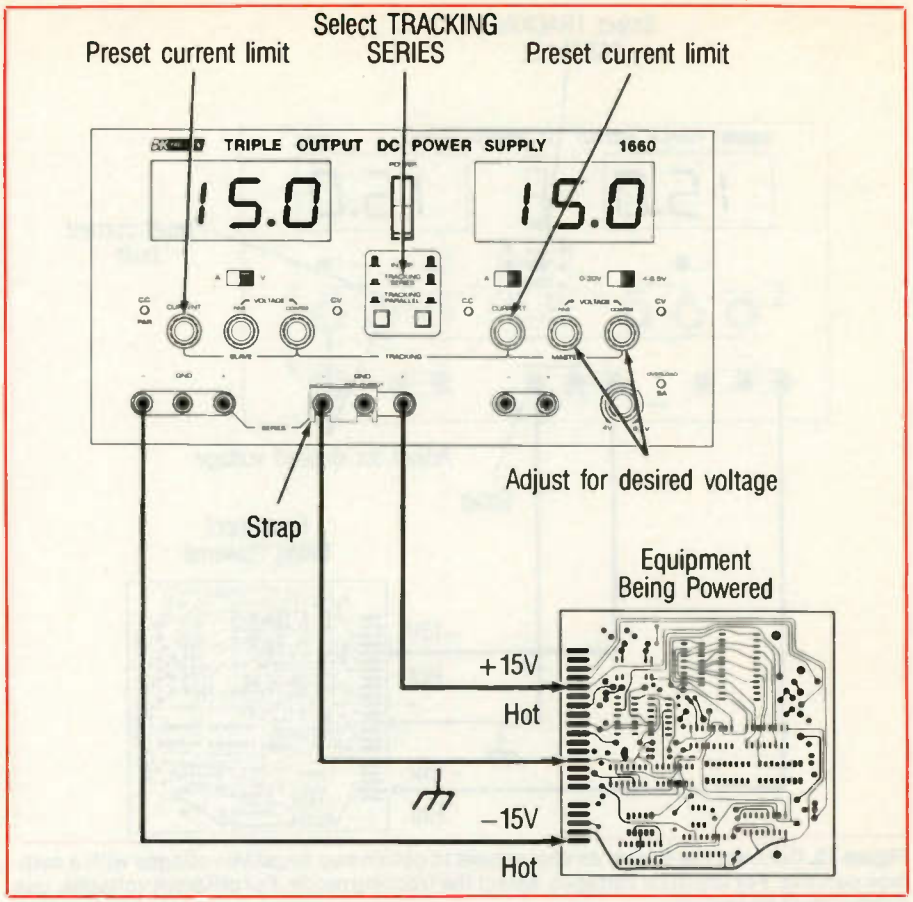


Figure 13. If a circuit uses op amps, identical positive and negative voltages are required with a separate common. The tracking mode would be selected.

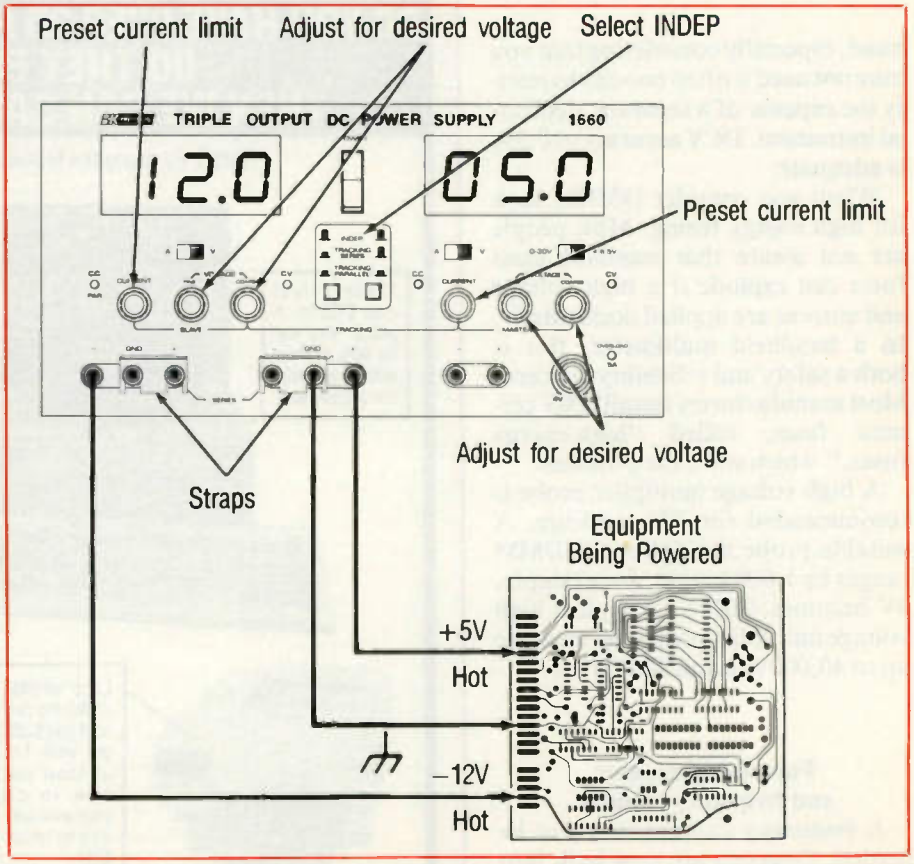


Figure 14. For different voltages, the independent mode should be selected and connections made as shown here.

Understanding and troubleshooting bipolar transistors - Part I

By Carl Babcoke

When new portable radios first were equipped with those strange and tiny new transistors, we technicians had no test equipment, except VTVM and VOM ohmmeters, to test the primitive germanium transistors. If that test equipment seems woefully inadequate, consider that this was at one of the area's largest wholesale distributors—most shops were not that well equipped.

Consequently, using an ohmmeter to test transistors and other solid-state components has a long (if not illustrious) past history.

Evaluating the electrical condition of transistors and diodes by measuring their various resistances is not incorrect, but it is not testing the important characteristics directly. For example, you can drive a nail by pounding it with a pair of pliers, which is slightly dangerous to knuckles, and not very quick, neat or accurate, but it is better than nothing. So it is with tests of solid-state via ohmmeter.

DC resistance readings are not one of the parameters used by factories to evaluate or test new solid-state components. Neither are resistances listed on specification sheets. Further, the ohmmeter readings of several "identical" new transistors usually are slightly different. These minor ohmic variations are not important. Large differences from average, however, could indicate a defect.

In summary, ohmmeter tests of a transistor's junctions do not provide "legitimate" testing information, but they are very useful when kept in perspective. As minimum, resistance tests can identify the polarity and any open, leaky or shorted junctions. Sometimes that much is sufficient for troubleshooting purposes.

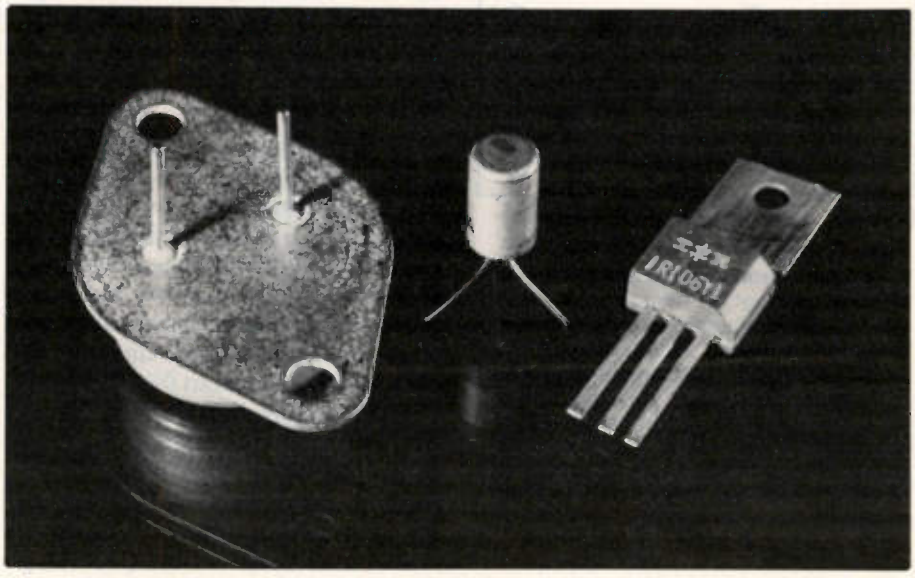


Figure 1. On the left is a power transistor in a TO-3 case. In the center is one type of small transistor in a TO-1 case that is mounted by soldering the leads to the circuit board. On the right is a TO-220 medium-power transistor that is designed for good heat dissipation.

Transistors simplified

Most transistors are constructed with a base of very thin "P" material that is diffused between the much larger emitter and collector slabs of "N" material (NPN type). Or, an "N" base is between two "P" slabs forming a PNP type. Therefore, the base polarity always is reversed from the polarity of emitter and collector. (See Figure 1.)

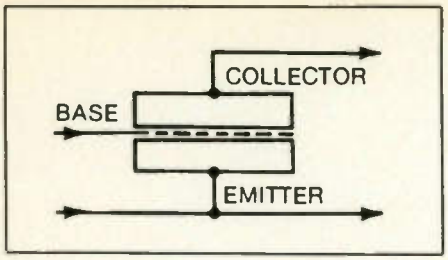
Transistors can be manufactured in either PNP or NPN polarity according to the materials used (Figure 2A). The nominal forward-bias dc-voltage for transistors is determined by the major elements used for base, emitter and collector. Germanium transistors require a minimum of 0.2V, and silicons must have a minimum forward bias of 0.6V before sufficient collector/emitter current flows and amplification occurs.

For certain kinds of troubleshooting, it's helpful to visualize a transistor as two diodes arranged as shown in Figure 2B. Of course, this does not account for the collector/emitter current that flows in normal transistor operation. But for now, we will view the transistor as two diodes.

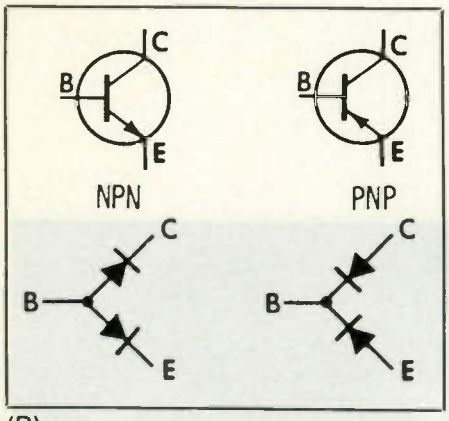
Using a simple meter

When the resistance-measuring function of any VTVM or volt-ohmmeter (VOM) is used, the meter's internal battery forces current to flow through the solid-state junction being tested, and the meter's scale and pointer indicate the amount of current, but calibrated in ohms.

For best accuracy during compari-



(A)



(B)

Figure 2. (A) Large pieces of semiconductor material form collector and emitter on opposite sides of the thinner base material. This base material is different from that of the collector and emitter. (B) The symbol of an NPN transistor is compared with equivalent diodes. Also, the symbol for a PNP transistor is compared with its equivalent diodes, shown below. Remember these comparisons and polarities when you test transistors with an ohmmeter.

Figure 3. When using the RX100 range of a VOM, connect to base and collector (or base and emitter) with appropriate polarity for the PNP or NPN transistor. A reading of 875Ω is shown by the meter, indicating it is a normal silicon NPN transistor.

son of these readings, use the same meter and ranges (one low range for forward conduction and another much higher range for leakage). That is because ohmmeters having different battery voltages will show different readings (currents through a junction). By the same reasoning, selection of another resistance range greatly changes all diode currents and the resulting meter readings. Notice that the problem is not the meter. Instead the solid-state junctions vary in resistance according to the applied dc voltage.

Perhaps these facts have clarified some of the unexplainable readings obtained before when you used VOM's to check transistors.

Testing is easy

At first thought, testing the resistances of diodes and transistors seems very simple—as easy as checking resistors. Of course, the theory is not complex, but complications arise from the various voltages and currents emitted by different ohmmeters, and from the non-linearity of the solid-state junctions (See Figure 3).

Some meters "match" the junction characteristics more nearly than others do. With VOMs and a few electronic meters and DMMs, a reading of some value always is possible.

But with other meters (including most DMMS) the only reading you will get will be "overrange." However, most of these overrange-prone meters have a separate single-range diode-test function.

This system of very-low-voltage (low-power) ohmmeter ranges for tests where diode conduction is not desired (in-circuit, for example) with a separate higher-voltage (high-power) diode test (for times when diode conduction is desired) is an excellent innovation. It supersedes an older plan of supplying two complete sets of ohmmeter ranges; with one set of ranges having very-low dc voltage to prevent diode conduction, and the other with comparatively high voltage that will cause diode/transistor junction conduction on all ranges.

This higher-voltage function often is called "high power," while the low-voltage ranges are called "low-power" ohms. However, the word "power" here is slightly misleading. The primary consideration is voltage and the current is secondary. This double system is very satisfactory, so long as you remember to change the selector switch at proper times.

Preparations for testing

Some precautions are necessary before we start testing transistors. Because of the low resistances involved, the ohmic contacts between test lead and transistor become very important. For example, the tip of a meter probe is so large in comparison to a transistor pin that making solid contact is very difficult without accidentally touching one of the other two or more pins that are nearby. In addition, the thin film of corrosion that so often forms on the probe end or the transistor pin causes intermittent contacts with erratic readings unless strong pressure is exerted. When you are testing an out-of-circuit tiny transistor, it's impractical to hold something behind the transistor pin so more pressure can be applied between probe and pin.

A better solution is to use a test lead that has a hook-type clip on one end and a small alligator-type insulated clip on the other end (See Figure 4). In fact, it's advisable to make up two or three leads (if commercial versions are not available from the wholesaler) because the hook can be used in many restricted areas where a solid connection without shorts or erratics is needed. Connect these hook/alligator leads as extensions of the original test leads, observing correct polarity. Disconnect these hook/alligator extensions when they are not needed.

My strong opinions were produced by bitter experiences. For example, one time I was trying to test different parameters of a transistor simultaneously by using three meters. At first the results were a chaos of erratic readings before I realized the test leads were solely responsible. Some of the better test leads were repaired by soldering around the crimped wire. Others were dumped, and new ones purchased. This stopped the erratic readings.

Learn from these misfortunes. One bad lead can sometimes cost several hours of frustrating search and testing. Here's a hint for testing these leads: use your lowest ohmmeter range with the regular ohmmeter leads connected to the end clips of the suspected test lead. Gently shake and move the suspected leads near the clips. Any slightest flicker of the nor-

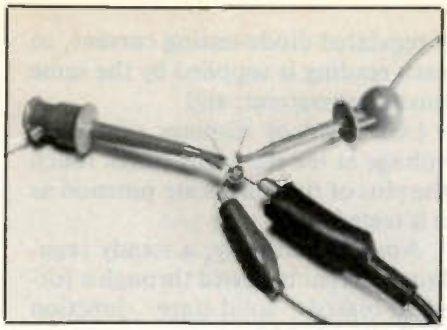


Figure 4. Around this old RF-type four-lead transistor are four different kinds of connecting clips. The two larger insulated alligator clips at the bottom illustrate the difficulties of connecting them securely without accidental shorts. In a real situation, the transistor leads would be much shorter, perhaps with the transistor almost touching the chassis. The larger alligator clip probably cannot be connected without causing shorts with the ground, other leads or transistor pins. The smaller alligator clip has a tendency for erratic connections between the alligator teeth and the transistor's tiny pin. Compare them against the two types of hook clips (shown at the top). For dependability, the hook type can't be beat.

mal near-zero reading is cause for repair or discard. Don't keep a bad one around—it'll only cause serious problems.

Identifying unmarked transistors

When you test any small, unknown and unmarked transistor, use a VOM ohmmeter to locate the pin that has approximately the same resistance to the other two pins—that pin is the base. If none of the three possible pairs shows conduction, perhaps the polarity is reversed (a transistor with all pins open is very rare). Therefore, reverse the ohmmeter leads and try again for readings.

After readings are obtained between the base and the two unknowns, look at the polarity of the ohmmeter leads that produced transistor conduction. If the base is positive relative to the other two pins, the transistor is an NPN type—but if negative, it is a PNP.

Tests to this point have identified the base pin and the polarity, but it seemed impossible to differentiate between collector and emitter, because the ohmmeter readings appear (at a casual glance) to be identical. But they are slightly different.

Many ohmmeter measurements of small silicon transistors from base-to-collector (B/C) and base-to-emitter (B/E) have shown consistently that the B/E path checks approximately 10% higher than the B/C path. (Note: this rough percentage does not apply to large power transistors where the B/E resistances tested 15% to 20% higher than the B/C resistances).

Therefore, virtually all transistor pins (base, emitter and collector) can be identified with good accuracy by using a medium-current VOM resistance range (See Figure 6).

Leakages

In addition to the ordinary opens, shorts and leakages across forward biased B/E and B/C junctions, a transistor can have leakages across reverse-biased B/E and B/C junctions. In many cases, these leakages are more severe with higher voltages applied. Therefore, the RX10K range of a VOM often is the choice for finding reverse-bias leakages—because of the ohmmeter's higher battery voltage. Temperature plays a part, with leakages becoming more severe as the junction becomes warmer.

There are no standards for leakages when measured by any kind of ohmmeter. Each technician must learn from experience how much leakage to tolerate before condemning a transistor. A few normal reverse-voltage leakage readings are shown in Table 1. These must not be considered as standards, merely examples.

Ohmmeter testing of transistor junctions is a somewhat frustrating occupation; even junction readings from a VOM's RX1 and RX100 ranges are only moderately stable and repeatable. And a RX10K range's higher voltages and lower currents produce high junction resistances where readings are changed by slight variations of temperature or changes of current.

For example, a junction might test a steady 320K early in the morning. Then by late afternoon, the reading might be 1MΩ. Also, during otherwise stable readings, the pointer will creep slowly as the junction is warmed slightly from the test current.

Fortunately, it seldom is necessary for us to work with high precision. When we measure the forward resistances of an NPN and find the B/E and B/C readings are almost equal, that forward test is good enough. However, select the RX10K range, reverse the polarity of the test leads and check for leakage across these same two junctions. If the reverse-polarity leakage reading is higher than about 50KΩ (or above 20KΩ with the RX100 range), the transistor probably is normal or without serious leakage.

Table 1.
Forward Bias Resistances

RX1	+B/−E = 14.1
	+B/−C = 12.9
RX100	+B/−E = 830
	+B/−C = 750
RX10 K	+B/−E = 8.7K
	+B/−C = 8K

Reversed-Bias Resistances (These Are All Leakage Measurements)

RX1	−B/+E = INFINITE
	−B/+C = INFINITE
RX100	−B/+E = INFINITE
	−B/+C = INFINITE
RX10 K	−B/+E = 230K
	−B/+C = INFIFNITE
	−E/+C = 530K
	+E/−C = 300K

LEGEND:
+B MEANS THE POSITIVE PROBE TOUCHES THE BASE
−E MEANS THE NEGATIVE PROBE TOUCHES THE EMITTER ETC.

Figure 5. All these resistance readings were taken from the same small transistor by the same VOM. Therefore, if you repeat any of the tests, the readings will be different. A simple code is used here to permit shorter descriptions of the meter range, test-lead polarity and connections to the transistor. For example, RX1 is the ohmmeter's range; +B shows that the meter's positive lead is connected to the base; −E indicates that the minus meter lead is connected to the emitter. All readings are in ohms.

The first group of six readings show the forward-bias resistances for the three ranges. This Table 1 shows both B/E and B/C readings, while Table 2 (shown later) lists only B/E readings for brevity.

The next group shows reversed-bias resistances (called leakages) plus E/C resistances in both polarities.

These readings are not standards; each individual transistor produces different readings even with the same meter and range. But most identical transistors should not deviate more than ±25%. Mathematical accuracy cannot be obtained when checking transistors with ohmmeters.

How to test ohmmeters and junctions

Over many years, multitudes of digital multimeters (DMMs) were designed and sold to servicers (See Figure 7). I gave many models an unbiased check-out, looking at the features and performances as they affect typical electronic servicing techniques.

In general, the first DMM models provided good, accurate dc-voltage ranges plus ohmmeter ranges of adequate accuracy. However, a depressing percentage of these ohmmeter functions could not produce satisfactory readings when measuring diodes and other solid-state junctions. A typical diode-resistance measurement caused some current flow through the diode or transistor junction, but the current often was not sufficient for accurate, stable or repeatable readings.

Since those pioneering times, the ohmmeter circuits and specifications have improved, becoming more complex. During the past few years, the DMM resistance/diode-test circuits usually can be grouped for identification into two categories, each having three major differences.

Characteristics of the first type of diode test include:

- a diode-testing function that is actually one of the ohmmeter ranges;
- test-probe current that varies with the readings;

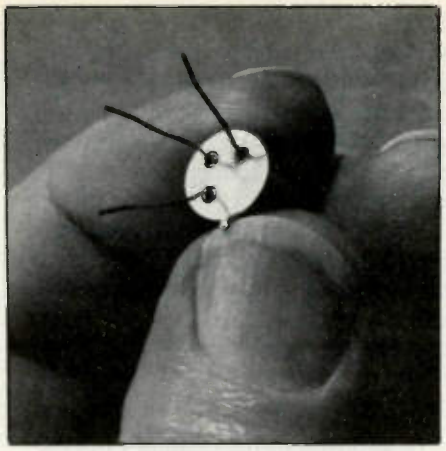


Figure 6. The three transistor pins is only one of several that have been used with small transistors. When viewing from the bottom, as shown, imagine a line between the pin on the left and the pin on the right. From the center of this line, imagine a 90° line leading to the remaining pin — it is the base. The pin on the right is the collector. Notice the different well where the collector's pin enters the body — with this transistor the pin and the internal collector also are connected to the transistor's metal case. Of course, the pin remaining at the left is the emitter.

- an LCD-readout that does not show the exact test-probe voltage, although the two can be almost the same at times.

In contrast, the second type of diode test has:

- complete separation of the diode test from the ohmmeter function;
- regulated diode-testing current, so each reading is supplied by the same unvarying current; and
- LCD readout displays of the dc voltage at the test leads which touch the pins of the solid-state junction as it is tested.

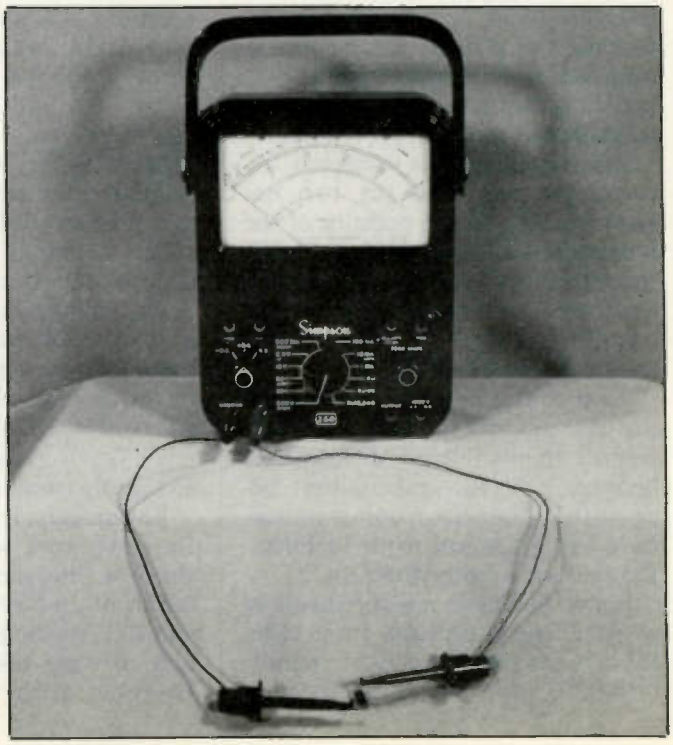
Note: Specifically, a steady regulated current is passed through a forward-biased solid-state junction while a dc voltmeter measures the dcV that is produced across the junction by the flow of constant current through the junction's resistance. This dc voltage drop is across the junction, the test leads and the LCD readout; all are in parallel.

Identification of these two types of DMM ohmmeters should be easy and positive from the characteristics discussed above. This can be confirmed by looking carefully at the markings on the panels of both meters.

Other important information can be useful. For example:

- In meters without a separate diode test, one or more resistance ranges often are used to test solid-state junctions. Tests showing opens, shorts and leakages are usually valid. Forward-biased tests of junction current, however, often are not satisfactory. With this type of function, results vary according to meter make and model, so the resistance/ohmmeter method should receive a low rating.

Figure 7. Readings from these five meters are recorded In Table 2, along with the brand and model number of each meter. The black-cased meter is the Simpson VOM, and the square meter with the large meter area is the RCA VTVM. From left to right, the DMMs are the Beckman, the B&K and the American Reliance.



• Some older DMMs featured a high-power/low-power dual-ohmmeter system. Usually a switch was operated to select the power desired. Results were good when the operator didn't forget to slide the selector switch. This is a good system, but now obsolete.

• A single voltage-readout constant current junction test, plus a separate set of low-power ohmmeter ranges probably is the best of the known systems, giving excellent results. I rate it better-to-best.

High power? Low power?

Sometimes we say, "the dc voltage measured across open ohmmeter probes (with nothing else connected) and the maximum ohmmeter current (two probes alone to a milliameter) determine whether the ohmmeter is high power or low power (see Table 2). This statement is true, but is incomplete.

Another part of the answer can be found by measuring the dc voltage across and the current through a transistor's B/E junction when connected to the ohmmeter. If comparisons are to be made, use the same transistor and meter for all measurements.

Testing a transistor or diode junction for ohmmeter voltage and current is very simple (see Figure 9), although it requires three meters. Incidentally, the same hook-up of equipment can be used to test ohmmeters; the system is versatile.

In fact, Table 2 was produced by the Figure-2 wiring of the same three meters. During tests for Table 2, the following results corrected one of my mistaken ideas that transistor B/E current stops *sharply* long before the descending B/E voltage reaches zero.

I found experimentally that this idea was not correct. As the ohmmeter was switched to each higher-resistance range, the B/E voltage and the B/E current decreased according to the range, until near the bottom of the 200μA range where the current apparently continued to decrease even after the reading went below 0.001μA — the lowest reading on the meter — without showing any signs of stopping. So if there is a B/E voltage below which no B/E current can flow, it must be lower than 0.3V for silicon.

Evaluating the meters

These connections of several meters can be used for evaluating the abilities of ohmmeters to test solid-state junctions. Or, with a suitable ohmmeter used as the source of power, the circuit can show the condition of solid-state junctions, via current and voltage readings as shown in Table 2. First, the open-probes (maximum) dc voltage from each range of the ohmmeter is obtained by not connecting any junctions to the testing-clip leads. The DMM voltagemeter shows the dcV reading. Just as easy to obtain is the shorted-probes (maximum) current, obtained by shorting together the clip leads at the transistor, and reading the current directly on the DMM current meter. Change the ranges of the current and voltage DMM meters as needed to obtain the best resolution.

Next, connect the two clip leads to the base and emitter (or base and collector) of the NPN transistor under test (reverse the two clip leads for a PNP transistor). Now, adjust the "power-supply" ohmmeter for the desired range, and write down the readings (soon they will be too numerous to remember accurately).

Highest accuracy of readings will be obtained if these simple steps are performed for each ohmmeter range that is to be used. A change from RX1 to RX10, for example, requires testing the open-probes maximum voltage and shorted-probes maximum current for these two ranges.

A list of information (such as Table 2) is an excellent way of keeping this type of data without mistakes. If similar but different individual transistors are tested in sequence on the same meters, the *open* and *shorted* readings of each range should require testing and recording only once per session.

For best accuracy, we usually recommend using a DMM range that shows maximum resolution (largest number of significant digits). For example, a reading of 0.147 is more accurate than 0.15. Some DMMs have different internal voltage drops (called "burdens") for the various dc-current ranges. This can cause changes in the readings between some adjacent ranges. There is an easy solution: watch the voltage-DMM reading while you change the current-meter's range between 20mA, 2mA and 200μA. If the base/emitter DMM voltage reading does not change very much, just choose the one of those three ranges that provides the best resolution. Or, if two current-meter readings are widely different, use the lower-current reading.

This is an important general statement: For consistent readings, the connecting test leads should have heavy-duty wires, 18 to 20 gauge, with good banana plugs for the meter ends and hook-type clips for the transistor under test. The results will be well worth the trouble. It is not necessary to test all your ohmmeters the Figure 2 way, but it is very instructive.

After a little experience with the method—Surprise!—you might find that testing transistors and ohmmeters this way is not complicated, and the results might be valuable to you.

Analyzing meter characteristics

An analysis from Table 2 can be very enlightening and also frustrating. If we judge only by probe and current, the 3.14V and 1.13mA of the American Reliance 200Ω range should qualify it as a high-power ohmmeter; but it is not! The important missing piece of information is the slight voltage regulation of 20% (3.14V vs 0.643V = 20%; and the strong 75% regulation of current (1.13mA vs 0.85mA = 75%).

In contrast, the ohmmeter supply voltage from the Beckman 200Ω range has very stiff voltage regulation of 96% (0.42V vs 0.403V = 96%), and the current regulation is a very weak 0.007% (1.73mA vs 0.5μA = 0.007%).

Either little voltage regulation and moderate current regulation (as in American Reliance) or good voltage regulation with virtually no current regulation (Beckman) can produce excellent low-power ohmmeter results. You can make similar tests and many others by using the Figure 2 diagram. Two DMMs are required in addition to the ohmmeter and diode under test.

Overrange indication

Question: why does any silicon diode connected to the American Reliance meter activate the overrange (OR) signal on the readout when the 200Ω range places 0.643V at 0.85mA on a diode? The voltage and current appear to be more than sufficient to rate a high-power ohmmeter rating. The answer is found in using the di-

Table 2. Meter Ohms Range	Open-Probe Voltage	Shorted-Probe Current	B/E Diode Voltage	B/E Diode Current	Diode Resistance (Calculated)
AMERICAN RELIANCE AR-460D (DMM)					
200	3.14	1.13mA	0.643V	0.85mA	756.5 OR
20K	3.11V	0.14mA	0.515V	0.01mA	51500 OR
2M	0.86V	——	0.314V	——	—— OR
BECKMAN 310 (DMM)					
200	0.42V	1.73mA	0.403V	0.5μA	800K OR
20K	0.41V	0.018mA	0.393V	0.4μA	980K OR
2M	0.34V	——	0.270V	——	—— OR
RCA WV98B (VTVM)					
RX1	1.59V	140.8mA	0.840V	67mA	12.54
RX100	1.59V	1.58mA	0.646V	0.94mA	687
RX0K	1.58V	.00158mA	0.515V	0.011mA	46900
SIMPSON 260 (VOM)					
RX1	1.58V	102mA	0.802V	63mA	12.7
RX100	1.58V	1.27mA	0.604V	0.77mA	780
RX10K	8.38V	0.070mA	0.533V	0.07mA	7.5K
B&K 388-HD (DMM - "TEST BENCH")					
200	2.11V	0.85mA	0.638V	0.56mA	1160 OR
20K	0.787V	0.035mA	0.489V	0.0045mA	1.2M OR
2M	0.370V	0.002μA	0.286V	——	—— OR

NOTES:
1. OR MEANS OVERRANGE
2. BECAUSE THE SIMPSON HAS ONLY THREE RANGES, ONLY THOSE EQUIVALENT RANGES OF THE OTHER METERS WERE USED.
3. THE BECKMAN AND B&K METERS HAVE EXCELLENT SEPARATE DIODE TESTS.
4. THE B&K METER HAS A SEPARATE TRANSISTOR TEST WITH PLUG-IN SOCKET

Figure 8. Data from these five meters show the wide range of voltages and currents from different ohmmeters, and the effects those have upon the transistor junction under test. Notice that the only open-probe similar voltages were from the VTVM and the VOM that have 1.5V batteries, and they also produced somewhat similar diode resistances. Of course, all three DMMs overranged on all ranges, and their readings could not be seen, but the calculated resistances of these three on all ranges were vastly different. As stated in the text, these readings apply only to the one individual transistor used for the tests. For example, I had another transistor that read almost 1V where the table shows only 0.802V!

ode voltage and current to calculate the resistance of the test diode, which is 756.5Ω. And of course, a 756.5Ω resistor on the 200Ω range absolutely will cause overrange, and this diode does.

"That's easy to fix," someone will say, "just change to the 20KΩ range." But that isn't any better because the lower diode voltage and current (0.515V at 0.01mA) of the 20KΩ range produces a calculated 51.5KΩ. Of course, this is much too high for the 20KΩ range, and the overrange is activated again. As higher ranges are selected, the same sequence happens, causing each to show overrange. It should be clear now, that the American Reliance meter has low-power ohmmeter ranges for silicon.

All VOMs are high-power ohmmeter types which do not have or need overrange — an excessive reading or a pinned pointer tells the story. However, there are precautions about using VOMs for testing transistors. If you want the most accurate readings, the VOM internal batteries need replacement more often than those in other test equipment.

This was noticed in the RCA VTVM (with 7 resistance ranges) and the Simpson VOM on the RX1 ranges after a short time of testing.

The shorted-probe current on these ranges drifted until full scale dropped to about half reading before the test was stopped. After new cells were installed, the shorted probe currents were much higher than before any testing began, and did not slowly drop as before. Hint: a battery reading of almost 1.5V is not enough for this application; a new one tests about 1.55 + V.

Before we leave the VOMs and Table 2, notice the large B/E currents of 67mA and 63mA from diode voltages of 0.840V and 0.802V. We can't recommend such high power for small transistors, although power transistors should tolerate it. One indication of excessive power and internal heating is the tendency of readings to drift noticeably; this is a danger signal. That's why RX100 (not RX1) is recommended for small-transistor forward-voltage tests. However, RX10K is the best compromise for reverse-voltage leakage tests.

We recommend that you keep handy for future use the transistor/ohmmeter testing schematic of Figure 2 and the actual test results of Table 2. It is very educational and not difficult for you to perform the tests shown here.

However, you must expect somewhat different figures. Part of these tests were made several months ago, but when additional tests were to be made, unfortunately the same transistor could not be found, so all tests were made again with another transistor. These figures are accurate on-

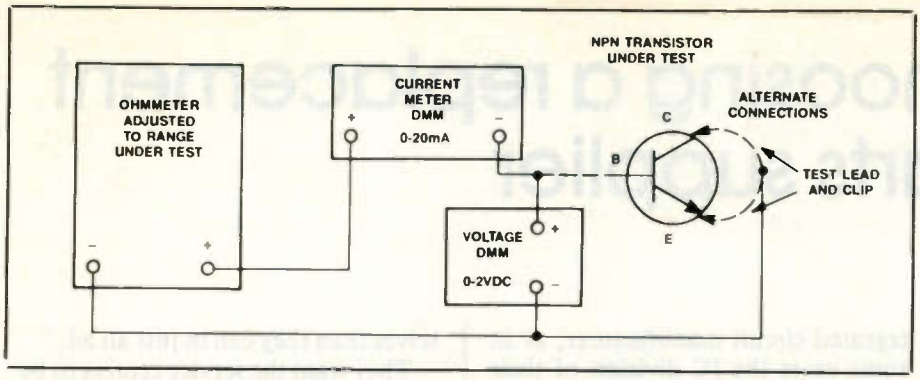


Figure 9. Use this method of connection to test a transistor or diode junction.

ly for this individual transistor, although they should be within ±25% of those you would compile.

DCV regulation with diodes

Some technicians have said that a diode attempts to maintain a constant voltage (its characteristic voltage) across itself when the diode's dc current is varied. Table 2 helps illustrate this truth., Notice when the Simpson VOM was used that:

- The B/E voltage decreased from 0.802V on the RX1 range to 0.604V on the RX100 range −24.7%;
- also, the B/E current decreased, from 63mA to only 0.77mA;
- both voltage and current now are known, so the current is divided into the voltage to produce the calculated resistance of about 780Ω, a large increase from the previous value of 12.7Ω.

Obviously, this junction attempted to maintain a fixed B/E voltage, regardless of a current decrease of 81 times and a resistance increase of 61 times. The base voltage decreased by only 24.7%. That's not bad regulation.

When you see a diode in a schematic, try to determine its primary function. Diodes are useful for many more functions than for rectification alone.

In some circuits, a diode (or several in series) can provide a moderate amount of regulation along with some voltage drop. Do *not* replace such a diode with a resistor giving the same voltage drop, as this destroys the regulation.

Sometimes a diode regulates the B/E voltage of a transistor that is used as a dcV regulator. The regulation is not much better than that given by the diode, but much more power can be regulated. A few diodes are wired in series with B+ lines, each diode providing a small and constant voltage drop of 0.7Vdc to 1Vdc in circuits where that is needed, but without the heat and poor regulation a resistor would give. Also, some diodes are used as dcV switches; forward bias in *on* and reverse bias is *off*.

Notice that B/E or B/C junction can be used to replace diodes in some of these applications.

Coming next

To this point, we have viewed a transistor as two diodes. This is convenient for many tests, but it is not enough — diodes do *not* amplify. Whole transistors will be covered in Part 2. Topics will include simple tests and test jigs that can give strong indications of transistor total current and/or amplification. And finally, the old subject of transistor curve tracers will be covered lightly for the educational values. ■

It is with deep regret that we announce that Carl Babcoke, author of this article, who was editor of Electronic Servicing & Technology for 11 years, retiring in 1981, died June 1, 1991.

Carl was a Certified Electronics Technician, and was a service manager for RCA Corp. from 1955 to 1969. He wrote several books for technicians, including "RCA Monochrome TV," "The RCA TV Service Manual," and "The New Way to Service Color TV." He co-authored several other books, including "Color TV Servicing Made Easy, Vols 1, 2 and 3." Until December 1989, Carl remained directly associated with **ES&T** editing some of the more technical servicing articles. Until his death, Carl was **ES&T**'s Consumer Servicing Consultant, and continued to be active in electronic experimentation and writing for **ES&T**, as evidenced by this article, and the sequel which will appear next month.

Carl was a most highly respected and loved member of the electronics servicing community, and he will be missed.

REPLACEMENT PARTS SHOWCASE

Choosing a replacement parts supplier

Ask any servicing technician or manager what their two biggest problems are, and it's a good bet that one of the problems mentioned will be locating replacement parts to bring a TV or VCR, or other consumer product back to life. It's a better than even bet that the other problem mentioned will be finding service literature.

More and more no-name products are being sold, with nary a clue as to who made the unit or where the service center can go for parts and information. More and more of the circuitry is highly sophisticated, with unique components for which no one but the manufacturer has the replacement. What can a service center do when faced with this increasingly common problem?

The answer is to talk to a good replacement parts distributor, the kind who's responsive to the service center's needs.

The nature of the problem

Today's consumer electronics products are more sophisticated than most people realize. In many cases these days a consumer electronic product is far more than a product; it's an intricate system.

Take a VCR, for example. There's the electromechanical portion of the system, which loads the tape and records or plays it. There's the electronic portion that manipulates the video signal. There's the control section, which makes sure that all other sections work properly together, and just for good measure senses conditions such as the presence of moisture or end of tape and shuts down the system if there's danger or damage.

Because there are so many components with so many specific characteristics, designers of today's sophisticated consumer electronic products have a wide choice of ways in which to design the circuits for the product they want to build. If they should want to achieve a function but they don't want to do it with the components available, they can go to an integrated circuit manufacturer, or in some cases the IC division of their own company, and have a new, proprietary IC designed and fabricated.

All of this leads to a huge variety of components that the technician will encounter any time he services a product. The problem is compounded by the fact that each manufacturer has his own part numbering system. In many cases, when a technician has identified a particular faulty component, he can find a cross reference that will allow him to determine if he has an equivalent in stock. Unfortunately, in as many cases, there is no cross reference, and even if the service center has a needed part on hand, no one is aware of it.

What to do

There are many things that can be done to make finding the right replacement component easier. The most obvious is to obtain copies of every cross reference that exists and become familiar with them so that when a part is needed it can be identified. Some of the cross references are available free from manufacturers through distributors, and some cost a pretty good chunk of change. If a technician adds up all the long distance calls, and all the time spent on the phone, to say nothing of the toll charges for those long distance calls, any cost for cross references might be found to be money well spent.

Talk to a good distributor

Whether you've identified the replacement component needed to complete servicing of a product through your own research, or if you've come up with a blank, obtaining a part from the distributor is your next step.

Just as with any supplier, distributors are not all equal in their commitment or ability to solve your problem. The advertisers who are represented in this special advertising supplement have taken this opportunity to tell you a little more about themselves than they can in just an ad.

They want the service centers to be aware of what kind of facilities they have, what kinds of people work for the company, the efforts they are making at customer satisfaction, and how to contact them when you need a replacement component.

Here are some of the questions we asked the manufacturers and distributors to address in their articles:

- How many locations do they have?
- How often are they able to fill orders from stock?
- What payment options do they offer—open order account, credit card?
- How soon after receipt of an order do they ship?
- Do they have a toll free number?
- What ordering options do they offer?
- What is their return policy
- Do they offer a warranty?
- Is there minimum order amount?
- What shipping options do they offer?
- What special services do they offer?
- Do they have a research department to help technicians find a specific part?

When you're searching for a replacement part supplier you can count on for convenience and service, keep some of those questions in mind. Just finding someone who stocks the part isn't the only consideration. If you have to wait until you fill a large minimum order amount before you order, or if you have to wait weeks for the part to arrive, you're stuck with a defective TV and probably an irate customer.

The impulse to order from the first name in the book might be high, but take the time to ask some questions. It could save time, money and aggravation. The following section will give you a good head start in answering some of those questions. ■

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Chemtronics has created a new class of chemicals—the E-Series. They are industry's first expanding series of high tech alternatives, engineered to meet the needs of today's electronic applications.

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REPLACEMENT PARTS SHOWCASE

PHILIPS

Philips Consumer Electronics Company

Service Parts, 907 Snapp Ferry Road
P.O. Box 967
Greeneville, TN 37744-0967
Rush Hotline: 800-851-8885

MIND IF WE DO A LITTLE BRAGGING?

Some may say we are bragging when we proudly state that, at Philips, intelligence runs in our family. And in a way, we suppose we are, but only because long ago we realized that our success depended upon our customers' success. Many years ago, Philips Service Company started surveying Servicers and Dealers to find out what we could do to make them more successful. We wanted to find out what hassles you faced . . . like wasted time on the phone, parts delays and customer returns. Obviously, we wanted to reduce your nonproductive time because the more time you spent working, the more parts we sold. We took those survey results and have gone to our customers again. This time, however, to find out how we were doing.

Well, the new survey results are in! And once again, Dealers and Servicers have rated Philips the best source in the Parts business, by far. In fact, when asked to compare Philips with the top ten other manufacturers in ten different categories, service shops ranked Philips number one in eight of those categories. In the other two, you ranked us number two. So our competitors may say we are bragging when we say that intelligence runs in our family. And all we can say is thanks, because thousands of Servicers and Dealers all across the country are telling us how much they like being **PARTS SMART.**

When you call, Sales answers. With all the answers.

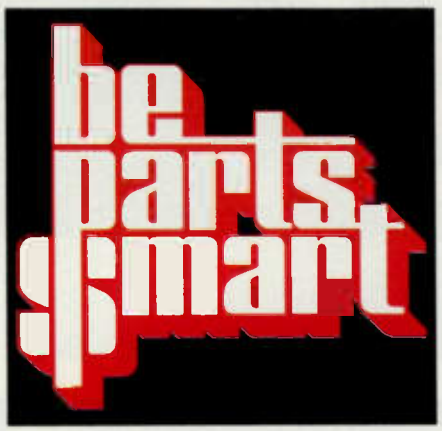
Dial our 800 number and you should get through in less than thirty seconds. And you will get a sales representative who knows what you're talking about.

You ranked up number one in Telephone Accessibility and Representative Service.

The Parts you need are available.

Almost every part in a Magnavox, Philips, Sylvania, or Philco product is always in stock. If for some reason it's backordered, your representative will give your a shipment date. And will notify you of any change.

You ranked us number one in Parts Availability.



OEM quality parts ensure good-as-new repairs.

Philips OEM replacement parts are designed to specific engineering standards for maximum life and best performance.

You ranked us number one in Parts Quality.

Prices are competitive.

It's not easy to make the highest quality parts for the lowest prices. Our parts are now the best value in the business.

You ranked us number one in Overall Pricing and number one in Timeliness of Returned Credits.

Same day shipment. Second day delivery. And we pay the freight.

Call before 8PM Eastern Time and your order will be shipped the same day, delivered UPS 2nd day delivery. This is our regular service for Dealers and Servicers.

You ranked us number one in Delivery Speed.

Now BE PARTS SMART; call us with your next order. And while you are at it, ask us about our Daily Special! Every day, Philips Service Company Family members are offered Daily Promotions—every thing from Philips Soldering Stations to Remote Controls and Modules—each specifically designed to help the Servicer work smarter, not harder, with Philips.

For special offers and promotions, you ranked us number one, too.

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PHILIPS

Presenting 16,000,000 Smart reasons & one *Very* Smart reason to buy Philips OEM Parts

We can give you millions of reasons for being part of the Philips Service Company family. For starters, we stock over 16 million quality replacement parts and accessories in one of the world's largest parts distribution centers. Everything from state-of-the-art test equipment to the smallest of SMD's. But what's more, as thousands of smart Dealers and Servicers know, at Philips **Total Customer Satisfaction** is our Number 1 priority.

Philips Service Company – where one stop shopping, toll free ordering, same day shipment, and free delivery – makes it easy for you to **Be Parts Smart.**

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To Order or For More Information Call Our Rush Hotline or Your Philips Parts Distributor.

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RUSH / HOTLINE

OR ORDER BY FAX 800-535-3715

REPLACEMENT PARTS SHOWCASE

MCM Electronics

650 Congress Park Drive
Centerville, OH 45459-4072
800-545-4330
FAX: 513-434-6959

MCM Electronics is a company of dedicated people committed to offering only the best electronic parts, components and service to the customer.

Because needs in the electronic industry are constantly changing, MCM Electronics continually and thoroughly researches the market and reacts to the changing demands. And MCM is constantly in touch with national and international manufacturers to bring both commonly used and the hard-to-find products to its customers. In fact, three full-sized catalogs are mailed each year, and the last issue introduced more than 800 new items. MCM is a full-line distributor for RCA/GE replacement parts and an exclusive distributor for MultiTech/DynaTech. We also carry other fine brand names including: Chemtronics, Fluke, Panavise, Sams Photofacts, Weller, Xcelite and many more.

Sale flyers are mailed regularly which feature specially priced products. These flyers keep the customers continually informed of new items that are being added.

The Sales/Customer Service Department has been thoroughly trained to answer all calls on the toll-free lines promptly and efficiently. These representatives are professionals who can provide immediate information on stock availability and pricing. They are available Monday through Friday, 7:OO. a.m. to 8:OO p.m. EST, and Saturday 9:OO. a.m. to 6:OO p.m. EST. Orders can be placed after hours with a national toll-free number; ensuring service 24 hours a day, seven days a week. Also, MCM has highly trained electronic technicians available to answer the customers product questions.

The company's Distribution Center houses an enormous inventory of parts and components. Every order is pulled and double-checked to strive for timely and error-free shipment. Because more than 17,000 of the items in the catalog are stocked and ready for shipment, orders are shipped within 24 hours.

Even though most orders are shipped by UPS, MCM offers a broad range of shipping options. Customers can establish Net 30 accounts or have their orders shipped COD, charged to MasterCard or Visa, prepaid or picked up at the Distribution Center's Will Call area. There is a $20 minimum order for COD, checks and open accounts, and a $25 minimum for MasterCard and Visa orders.

For more information and a free catalog subscription, call 1-800-543-4330. (In Canada, call 1-800-824-9491; in Dayton, OH, call 513-434-0031).

ES&T Manufacturers' schematics **PROFAX**

August 1991

Profax Number

Hitachi
CT1947/CT19A7 Color TV.....3079

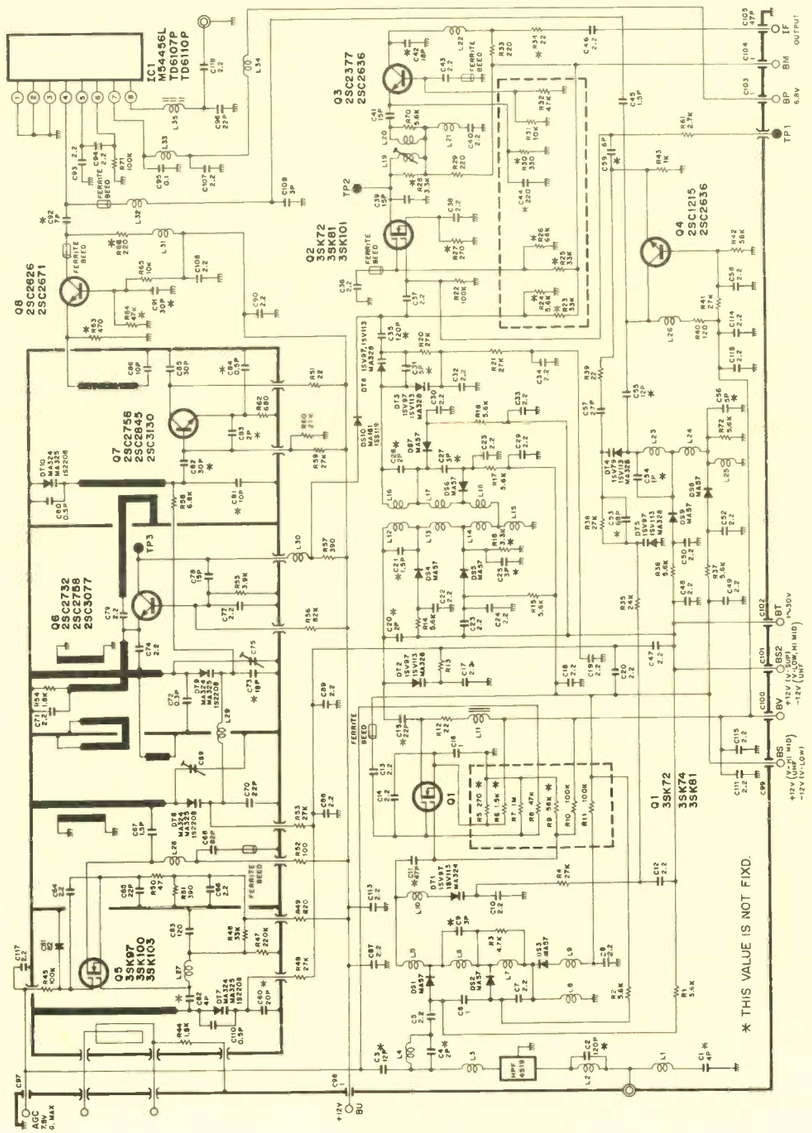
TUNER CIRCUIT DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

TUNER CIRCUIT DIAGRAM (ET-446)



SELECTOR P.W. BOARD

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

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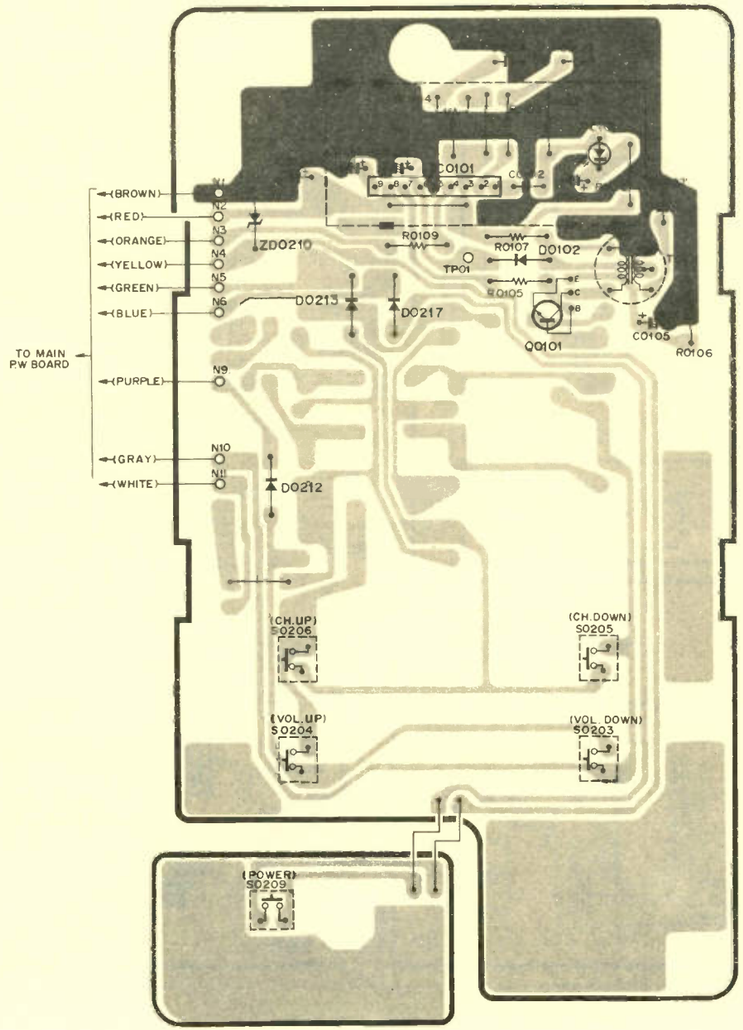
This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



BASIC CIRCUIT DIAGRAM

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PROFAX Manufacturers' schematics 3079

BASIC CIRCUIT DIAGRAM

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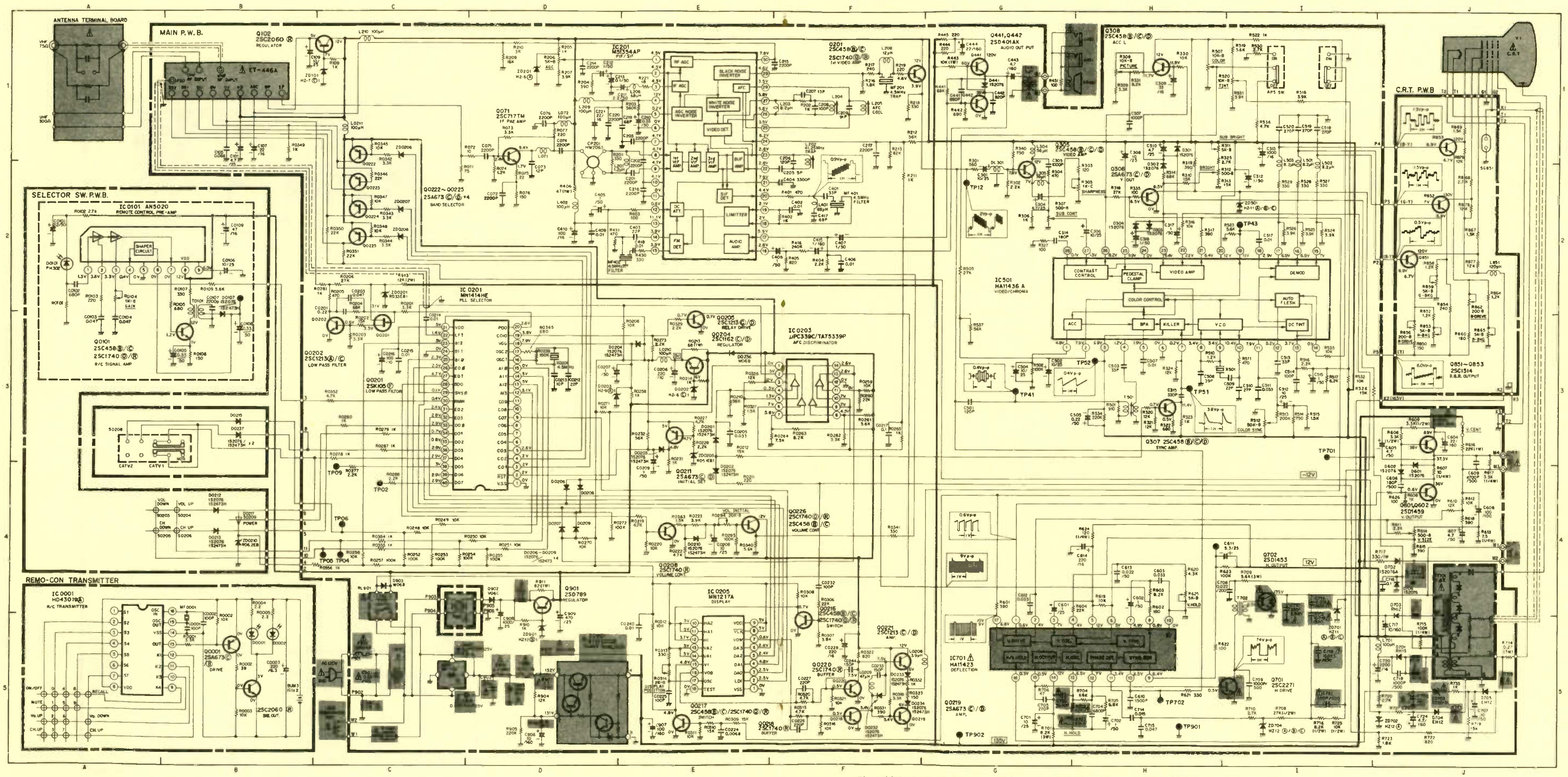
All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.

PRODUCT SAFETY NOTE: Components marked with a ⚠ and shaded have special characteristics important to safety. Before replacing any of these components, read carefully the PRODUCT SAFETY NOTICE of this Service Manual. Don't degrade the safety of the receiver through improper servicing.



- Since this is a basic circuit diagram, the value of the parts is subject to be altered fro improvement.
- All DC voltage to be measured with a tester (100kΩ/V).
  Voltage taken on a complex color bar signal including a standard color bar signal.

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MAIN P.W. BOARD

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MAIN P.W. BOARD

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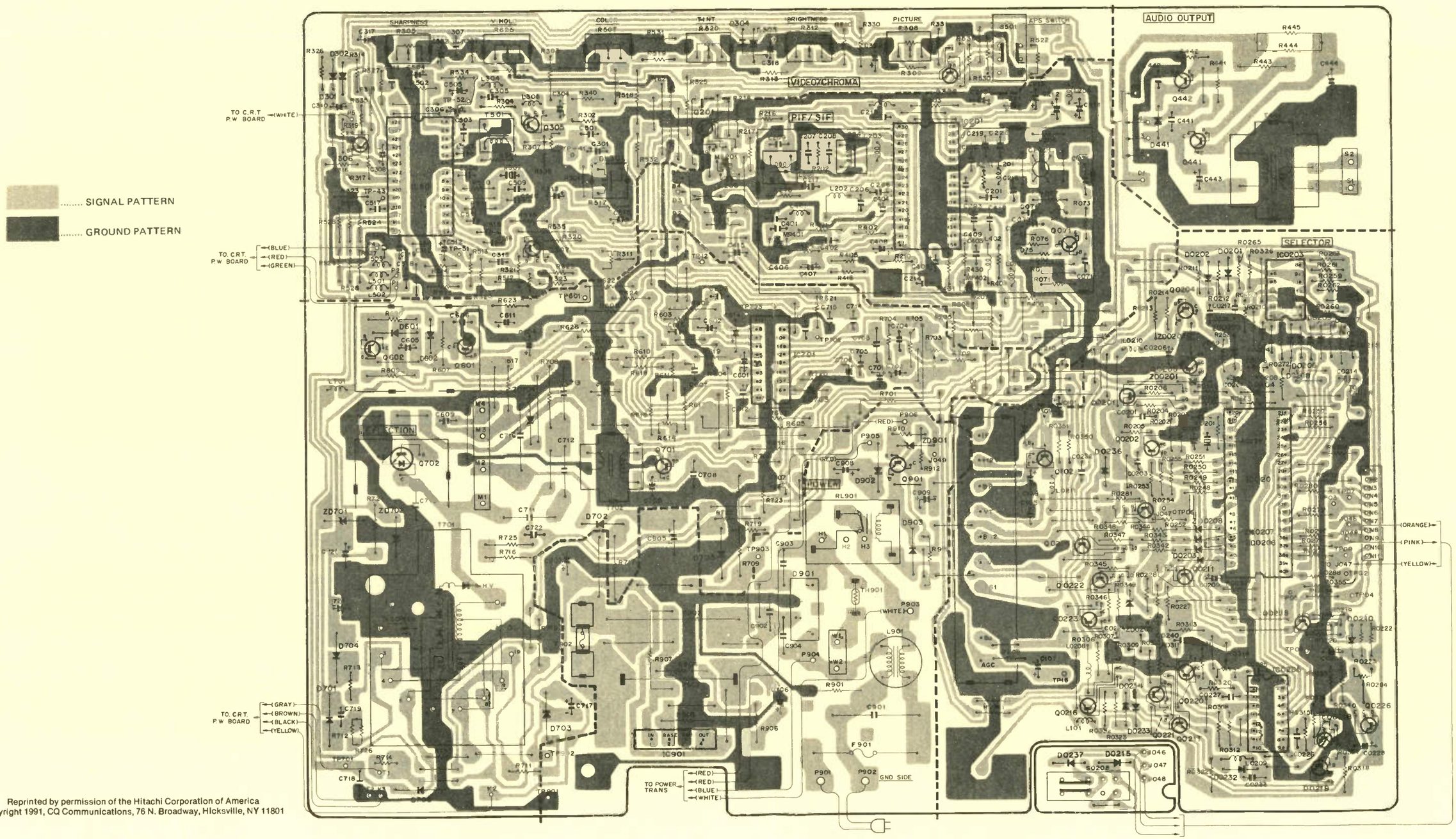

HITACHI CT1947/CT19A7 COLOR TV

WIRING DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

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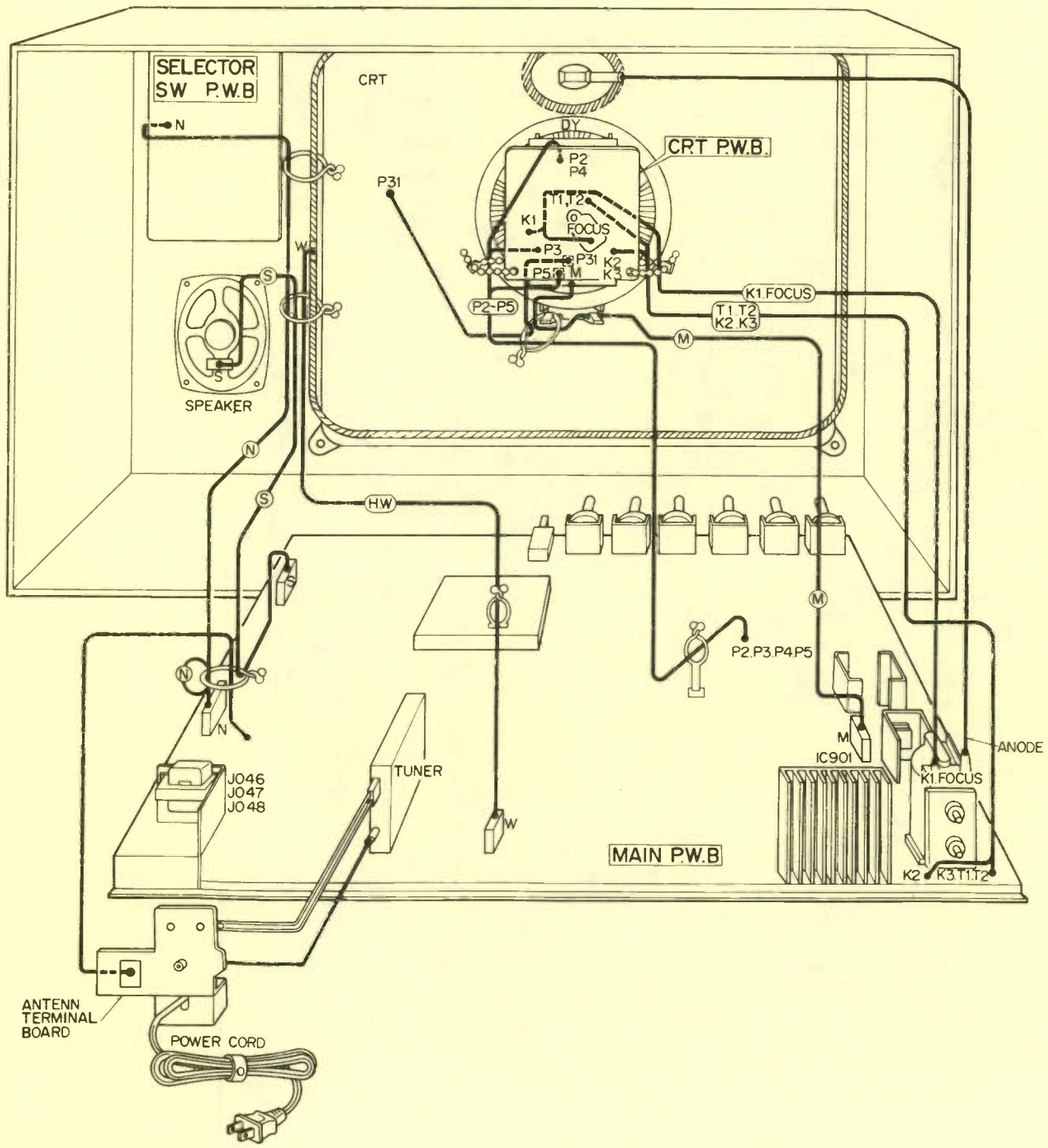


This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.

TECHNICAL CAUTIONS

[CHECK OF HIGH VOLTAGE HOLD DOWN CIRCUIT]

Checking of the high voltage hold down circuit operation

1. Turn the switch of the set OFF.
2. Connect a high voltage voltmeter between the CRT anode and the chassis ground (K3) as shown in Fig. 1.
3. Short circuit between the R605 (B+) and R902 using a jumper wire as shown in Fig. 2.
4. Set Brightness/Picture controls to max.
5. Turn the switch of the set ON after setting the AC input voltage to 0V, and then gradually increase the AC input voltage and check that the picture disappears when the high voltage is less than 31.0KV.
6. Turn the switch of the set OFF immediately after checking that the picture disappears.
7. Remove the adjusting jig and the voltmeter.

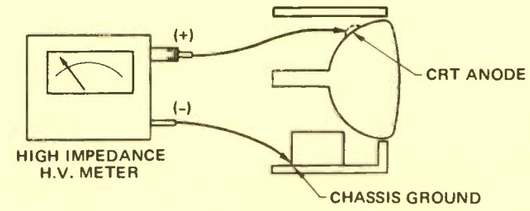


Fig. 1 Connection of H.V. Meter

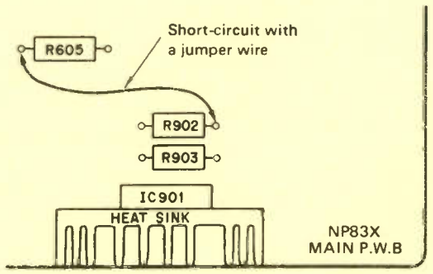


Fig. 2

CONTROLS

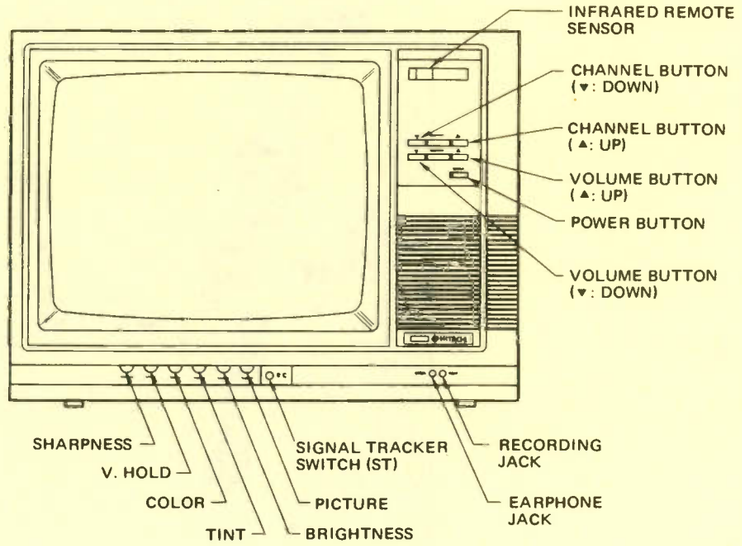


Fig. 3

PanSon Electronics

268 Norman Avenue
Greenpoint, NY 11222
800-321-4870
FAX:718-383-2425

REPLACEMENT PARTS SHOWCASE

For nearly 20 years, PanSon Electronics has been helping electronics dealers and service centers stay abreast of product changes, manage their parts inventories, and build their margins. In 1973, we were the first OEM parts distributor in the United States. Today, we're the largest independent parts distributor in the nation, with more than 2 million parts in stock and ready to ship. We're franchised with Sony, Panasonic, Sharp, JVC, RCA, GE, Hitachi, Aiwa, Optonica, Technica and Quasar.

A company-wide commitment to the best service in the business

At PanSon, we have a state-of-the-art, custom designed computer order and information system to make sure you know the status of every order, every day. And we have a staff of capable, knowledgeable Sales Representatives to help you get the information you need on backorders, special orders, installation and troubleshooting.

- Accurate parts information—when you call for parts, our computer system enables us to provide complete information on price, availability and ETA. Our computer operators validate all parts and part numbers ordered, to ensure you get what you need.
- On-shelf availability—PanSon Electronics carries thousands of different parts for virtually every manufacturer, and we have more than 2 million parts in stock, ready to ship. Our fill-rate for orders is 80-85%, compared to 40-60% for many distributors. And we can get back-orders and special orders quickly, with a specific ETA.
- Same-day shipping—If you place your order by 4:00 p.m., EST, we guarantee to ship in-stock parts the same day, if necessary.
- Consistent low pricing—Our purchasing strength and volume, coupled with the efficiency of our own operations, enables us to keep our costs down and pass the savings on to you.

Responsiveness through programs like P.A.R.T.S.

The PanSon P.A.R.T.S. Program is designed to help you build your business, and an Account Representative will be assigned to help you take full advantage of the program.

- Price guarantees—PanSon P.A.R.T.S. customers are guaranteed warranty pricing consistent with warranty claim (NARDA) forms, with reimbursement through most major manufacturers. We also offer additional discounts to our Online Computer Link customers.

Ordering, Shipping and Returns—PanSon P.A.R.T.S. customers have access to our toll free order lines and to research services. We guarantee same-day shipping on in-stock parts ordered by 6:00 p.m., EST. If we can't ship the same day, we'll pay the shipping. We also pay the shipping on all back orders.

PanSon P.A.R.T.S. customers can return up to 3% of annual net purchases with no re-stocking charges on in-stock items, in June and December. Or you can contact our Parts Department for a Return Authorization number anytime. You can also return defective parts for replacement within 90 days of installation with a P.A.R.T.S. Defective sticker with no prior Return Authorization requirement. Additionally, PanSon P.A.R.T.S. customers have access to service literature that is out of print or on back order. If we have it on file, we will send you a copy at our cost.

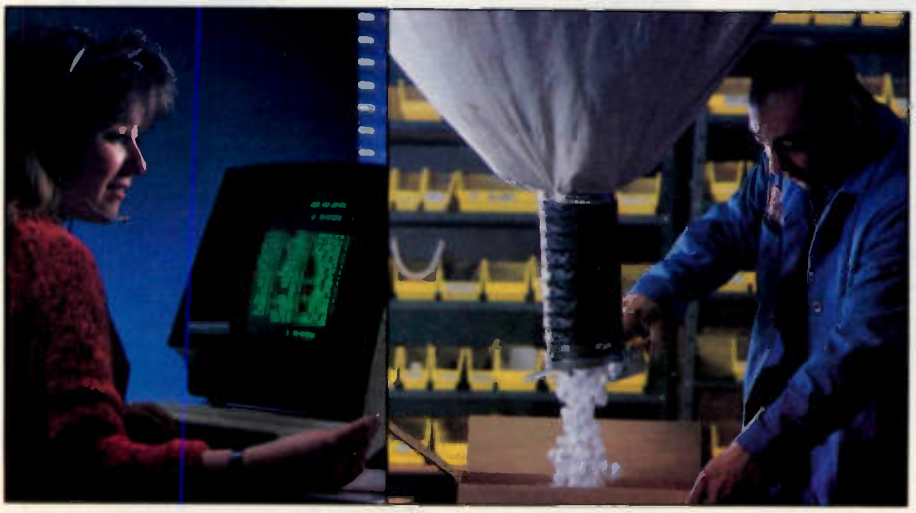
- Management Reports—PanSon customers receive management reports to help project parts stocking levels and plan future sales, including: Bonus Points Recap; Open Order by Item Number; Open Order by Order Number; Account Recap (for Open Account customers); and Quarterly Sales Reports.

The PanSon On-Line Computer Link

The PanSon On-Line Computer Link is the easiest and most accurate way of ordering your parts. This is your link to our computer-based ordering and information network, at your service 24 hours a day, 7 days a week. Just connect to our mainframe with your computer and modem and you'll have access to our tremendous database. The program includes the following services:

- Price & Availability—To give an immediate quote to your customer.
- Estimated Time of Arrival—On-line information supplied by the manufacturer for an ETA on all backordered items.
- Order Entry—Place an order 24 hours a day, 7 days a week
- Job Tickets—Linking each part you order to your own internal records.
- Management Reports—For tracking sales trends, parts orders, and backorders.
- Model & Description—Order your parts by model and description, and get instant price and availability.
- User Bulletin Boards—To communicate with other users around the country.
- 2 Day Air—Receive shipments 2 Day Air at surface delivery prices.
- Semiconductor Search—Input a semiconductor number to instantly cross-reference and display Manufacturers, Price & Availability for over 28 manufacturers & over 300,000 semiconductors.
- Our shipping and handling policy actually saves you money

All UPS ground orders now carry a shipping rate that actually decreases the more you order.



SPECIAL ADVERTISING SUPPLEMENT

REPLACEMENT PARTS SHOWCASE

Easy Tech, Inc

2917 Bayview Drive
Fremont, CA 94538
Tel: 1-800-582-4044 (USA Only)
Fax: 1-800-582-1255 (USA Only)
Tel: 1-415-770-2345 (International)
Fax: 1-415-770-2346 (International)

One of the biggest problems a buyer encounters is a lack of inventory when they are ready to place an order. This is especially true for "spare parts" or small quantity orders. More significantly, most distributors are not interested in one and two piece orders which do not meet their minimum order, even if they have the parts in stock. We recognize this problem and, as a result, EasyTech was formed especially to cater to the small user, whether they are a technician, OEM, R&D facility, school or hobbyist.

Our group of employees has been in the electronics mail order business for a combined 54 years and know what it takes to meet the demands of this small, but very important user group. We have over 2,000 individual line items in inventory at our Fremont facility (shown above) at all times. We do everything in our power to avoid backorders, but should one of our suppliers let us down, we will ship the item to you freight prepaid upon receipt.

For items that are in stock, we will ship all orders received by 3PM (PST)/6PM (EST) the same day at no extra charge. If we fail in this commitment, we will upgrade your order to the next fastest delivery service at no extra charge to you.

You will see a small portion of the items we offer on the attached page, however, a complete product line is shown in our 1991 catalog. Please call for your free copy today, and it will be mailed the same day via first class mail. We are always looking for input on other items that you would like to see in our 1992 catalog. We look forward to receiving your suggestions. Let us customize our company according to your needs.

Call toll-free today and ask for Blair or Staci in sales. They are waiting to help you in any way possible. Your call is important to us.

MATH COPROCESSORS

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Order #	Price	Description	Pins
80C287A12	99.95	Intel 12Mhz For 80286 CPU Based Laptops	40
80387-16	169.95	Intel 16Mhz For 80386 CPU Based Computers	PGA68
83D87-16	149.95	Cyrix 16Mhz For 80386 CPU Based Computers	PGA68
83D87-33	299.95	Cyrix 33Mhz For 80386 CPU Based Computers	PGA68

COMMODORE COMPUTER CHIPS

Order #	Price	Description	Pins
6502	2.95	MPU with Internal Clock	40
6510	13.95	CPU (906107-01)	40
6520A	3.75	Peripheral Interface Adapter 2Mhz	40
6522	2.95	Versatile Interface Adapter	40
6526A	13.95	Complex Interface Adapter 2Mhz (906108-02)	40
6532	3.95	128x8 RAM, I/O and Timer Array	40
6545-1	3.75	CRT Controller	40
6551A	3.75	Asynchronous Comm. Interface Adapter 2Mhz	28
6567	22.95	Video Interface Chip (906109-01) VIC-II (For C64)	40
6581	11.95	Sound Interface Device (906112-02) 12V	28
8701	6.75	Clock Chip (251527-01)	16
82S100PLA	15.95	For C64 (U17) and C128 (906114-01) No data available	28

EEPROMS (Electrically Erasable)

Order #	Price	Organization	Pins
9346	2.75	1024 Bit Serial, 5V Read/Write	8
2816A35	3.45	2048x8 350ns, 5V Read/Write	24
2817A25	6.75	2048x8 250ns, 5V Read/Write (Pin 1 – Ready/Busy)	28
2864A25	8.95	8192x8 250ns, 5V Read/Write (Pin 1 – N/C)	28
28C64-25	9.95	8192x8 250ns, 5V Read/Write CMOS (Pin 1 – N/C)	28
28C256-25	26.95	32,768x8 250ns, 5V Read/Write CMOS	28

EPROMS (UV Erasable)

Order #	Price	Organization	Speed	Prog. Volt.	Pins
MM5203Q	2.25	256x8 2K	1000ns	25V	24
TMS2516	4.25	2048x8 16K	450ns	25V	24
TMS2532	6.95	4096x8 32K	450ns	25V	24
TMS2564	5.95	8192x8 64K	450ns	25V	28
TMS2564-50	4.75	8192x8 64K	500ns	25V	28
TMS2716	5.95	2048x8 16K	450ns (±5V, +12V)	25V	24
2708	4.75	1024x8 8K	450ns (±5V, +12V)	25V	24
2716	3.45	2048x8 16K	450ns	25V	24
2716-1	3.95	2048x8 16K	350ns	25V	24
27C16	4.25	2048x8 16K	450ns CMOS	25V	24
2732	3.95	4096x8 32K	450ns	25V	24
2732A20	4.75	4096x8 32K	200ns	21V	24
2732A25	3.45	4096x8 32K	250ns	21V	24
2732A45	2.95	4096x8 32K	450ns	21V	24
2732B45	4.25	4096x8 32K	450ns	12.5V	24
27C32	4.75	4096x8 32K	450ns CMOS	25V	24
2764-20	3.95	8192x8 64K	200ns	21V	28
2764-25	3.75	8192x8 64K	250ns	21V	28
2764A15	4.45	8192x8 64K	150ns	12.5V	28
2764A20	3.95	8192x8 64K	200ns	12.5V	28
2764A25	3.25	8192x8 64K	250ns	12.5V	28
2764A45	2.95	8192x8 64K	450ns	12.5V	28
27C64A15	3.95	8192x8 64K	150ns CMOS	12.5V	28
27128-20	6.75	16,384x8 128K	200ns	21V	28
27128-25	5.95	16,384x8 128K	250ns	21V	28
27128A15	5.75	16,384x8 128K	150ns	12.5V	28
27128A25	3.95	16,384x8 128K	250ns	12.5V	28
27128AOTP	2.95	16,384x8 128K	250ns One Time Prog.	12.5V	28
27C128-15	5.95	16,384x8 128K	150ns CMOS	12.5V	28
27256-15	5.75	32,768x8 256K	150ns	12.5V	28
27256-25	4.75	32,768x8 256K	250ns	12.5V	28
27256-30	3.45	32,768x8 256K	300ns	12.5V	28
27C256-15	5.95	32,768x8 256K	150ns CMOS	12.5V	28
27C256-25	4.25	32,768x8 256K	250ns CMOS	12.5V	28
27512-20	6.95	65,536x8 512K	200ns	12.5V	28
27C512-12	8.95	65,536x8 512K	120ns CMOS	12.5V	28
27C512-15	6.95	65,536x8 512K	150ns CMOS	12.5V	28
27C512-25	5.95	65,536x8 512K	250ns CMOS	12.5V	28
27C010-15	11.95	131,072x8 1MB	150ns CMOS	12.5V	32
27C020-15	34.95	262,144x8 2MB	150ns CMOS	12.5V	32

8000

Order #	Price
8031	3.55
80C31	7.25
8035	1.75
8039	1.75
80C39	3.75
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8085A	2.95
8085A2	3.55
8086	4.45
8088	4.25
8088-1	7.25
8088-2	6.25
8155	2.45
8155-2	3.75
82C11	5.95
8212	2.45
8214	3.85
8216	1.35
8224	2.45
8237A	3.75
8237A5	4.15
8243	1.95
8250	5.75
8251A	2.25
8253	1.95
8253-5	2.25
8254	4.55
8254-2	5.95
8255A5	2.75
8256	10.75
8257	2.25
8259	1.95
8259-5	2.25
8271	42.95
8272	3.75
8274	6.55
8275	18.95
8279-5	3.45
8284A	2.25
8286	2.95
8288	3.75
A80286-10	19.95
N80286-12	21.95
N80L286-8	11.95
R80286-12	26.95
R80286-6	9.95
82C284-8	4.95
82C284-12	19.95
82288-8	4.95
82288-12	19.95
8741	9.95
8742	14.25
8748H	8.95
8749	9.95
8751	24.95
8755	11.95

DYNAMIC RAMS

Order #	Price	Organization	Speed	Pins
4116-12	1.45	16,384x1	120ns	16
4116-20	.85	16,384x1	200ns	16
4816A4	.55	16,384x1 Single +5V	250ns	16
4416-12	2.25	16,384x4	120ns	18
4416-15	1.95	16,384x4	150ns	18
4161-15	4.95	65,536x1 Video RAM	150ns	20
4164-10	1.95	65,536x1	100ns	16
4164-15	1.55	65,536x1	150ns	16
4164-20	1.25	65,536x1	200ns	16
41264-12	6.95	65,536x4 Video RAM	120ns Skinny Dip	24
41464-80	3.25	65,536x4	80ns	18
41464-12	2.75	65,536x4	120ns	18
41256-80	2.15	262,144x1	80ns	16
41256-10	1.95	262,144x1	100ns	16
41256-12	1.85	262,144x1	120ns	16
41256-15	1.75	262,144x1	150ns	16
41257-80	3.75	262,144x1 Nibble	80ns	16
41257-12	3.25	262,144x1 Nibble	120ns	16
51258-80	4.95	262,144x1 Static Column	80ns	16
514256-80	7.25	262,144x4	80ns	20
514256-10	6.95	262,144x4	100ns	20
511000-80	7.25	1,048,576x1	80ns	18
511000-10	6.95	1,048,576x1	100ns	18
511000-12	6.55	1,048,576x1	120ns	18
511001-80	8.25	1,048,576x1 Nibble	80ns	18
511001-10	7.95	1,048,576x1 Nibble	100ns	18

STATIC RAMS

Order #	Price	Organization	Speed	Pins
2101	1.65	256x4	450ns	22
2111	1.75	256x4	450ns	18
2112	2.45	256x4	450ns	16
5101	3.95	256x4 CMOS	450ns	22
2114L20	1.49	1024x4 Low Power	200ns	18
2114L25	1.15	1024x4 Low Power	250ns	18
2114-45	1.05	1024x4	450ns	18
2148-3	1.95	1024x4	55ns	18
2149-35	3.75	1024x4	35ns	18
2147-3	3.75	4096x1	55ns	18
20C71-25	6.75	4096x4 CMOS	25ns Skinny Dip	24
6168-45	3.25	4096x4 CMOS	45ns	20
6116LP1	2.95	2048x8 CMOS Low Power	100ns	24
6116LP3	2.75	2048x8 CMOS Low Power	150ns	24
6116-1	2.75	2048x8 CMOS	100ns	24
6116-3	2.25	2048x8 CMOS	150ns	24
6516-45	4.25	2048x8 CMOS	45ns Skinny Dip	24
7C128-55	3.95	2048x8 CMOS	55ns Skinny Dip	24
8128-15	2.15	2048x8	150ns	24
6264LP10	4.95	8192x8 CMOS Low Power	100ns	28
6264LP15	3.95	8192x8 CMOS Low Power	150ns	28
6264-10	4.75	8192x8 CMOS	100ns	28
6264-15	3.75	8192x8 CMOS	150ns	28
8167-55	3.45	16,384x1	55ns	20
62256LP10	6.75	32,768x8 CMOS Low Power	100ns	28
62256LP15	6.25	32,768x8 CMOS Low Power	150ns	28

Z80A, Z80B, Z80-8MHZ, Z8000

Order #	Price	Description	Pins
Z0803008PSD	9.50	Serial Communications Controller 8Mhz	40
Z80A	1.25	CPU (MK3880-4) (780C-1) 4Mhz	40
Z80A-CTC	1.55	Counter Timer Circuit (MK3882-4) 4Mhz	28
Z80A-DART	3.95	Dual Asynchronous Receiver/Transmitter 4Mhz	40
Z80A-PIO	1.85	Parallel I/O Interface Controller (MK3881-4) 4Mhz	40
Z80A-SIO/0	3.95	Serial I/O (TxCB & RxCB Bonded) (MK3884-4) 4Mhz	40
Z80A-SIO/2	3.95	Serial I/O (Lacks SYNCB) (MK3887-4) 4Mhz	40
Z80B	2.45	CPU (MK3880-6) 6Mhz	40
Z84C0008	5.95	CPU 8Mhz (CMOS)	40
Z84C1008	10.95	DMA (Direct Memory Access) 8Mhz (CMOS)	40
Z84C2008	5.95	PIO (Parallel I/O Interface Cont.) 8Mhz (CMOS)	40
Z84C3008	5.95	CTC (Counter Timer Circuit) 8Mhz (CMOS)	28
Z84C4008	8.95	SIO/0 8Mhz (CMOS)	40
Z84C4108	8.95	SIO/1 8Mhz (CMOS)	40
Z84C4208	8.95	SIO/2 8Mhz (CMOS)	40
Z8530	4.55	Serial Communications Controller	40

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51-FOX1101	3214007	26.50
51-FOX1101A	3220011	37.50
51-FOX1101B	3220013	34.95
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51-FOX1102	3714002	26.67
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51-FOX304	101-214-006-03	20.75
51-FOX305	101-214-007-03	20.75
51-FOX306	101-214-009-03	20.75
51-FOX307	101-220-002-03	24.50
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51-FOX504	FCC-1415GL	23.00
51-FOX505	FCC-2015GL	23.33
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51-FOX507	FCM-2015AL	
	2859-129-0101	
	2859-137-0104	25.00
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	FCK-1415AL	
	2859-135-0108	19.75
51-FOX509	FCK-1412E01	19.75
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51-FOX514	FCR-2615AL	
	2859-154-0532	
	TLF70152	27.00
51-FOX515	FBC-1215AL	
	2859-089-0106	6.95
51-FOX516	FBC-1245CL	
	2859-087-0100	6.95
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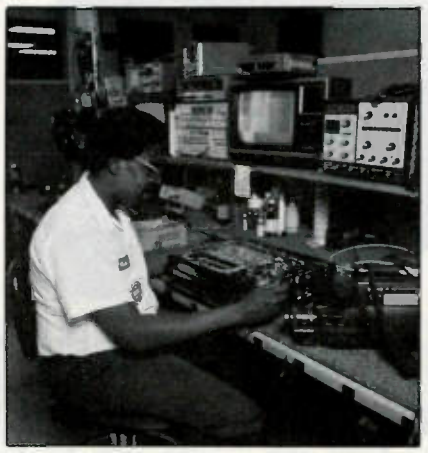

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Hurley Electronics (C/V/M) • 318 16th St., San Diego 92101 • 619-235-6245 • FAX 619-235-0436

Hurley Electronics (C/M) • 2101 N. Fairview, Santa Ana 92706 • 714-971-2992 • FAX 714-971-5033

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Signal Electronics Supply, Inc. (C/M/A) • 589 New Park Ave., West Hartford 06110 • 203-233-8551 • FAX 203-233-8554

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Herman Electronics (C/V/M/A) • 1365 N.W. 23rd St., Miami 33142 • 305-634-6591 • FAX 305-634-6247

Layco, Inc. (C/V/M) • 501 South Main St., Crestview 32536 • 904-682-0321 • FAX 904-682-8820

Vance Baldwin (C/A/M) • 2207 S. Andrews Ave., Fort Lauderdale 33316 • 305-523-3461 • FAX 305-523-3464

Vance Baldwin (C/M/A) • 1801 NE 2nd Ave., Miami 33132 • 305-379-4794 • FAX 305-373-8855

Vance Baldwin (C/V/M/A) • 1007 N. Himes Ave., Tampa 33607 • 813-870-2606 • FAX 813-870-1088

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Buckeye Vacuum Cleaner (V) • 2870 Plant Atkinson Rd., Smyrna 30080 • 404-351-7300 • FAX 404-351-7307

Wholesale Industrial (C/M/A) • 5925 Peachtree Corners East, Norcross 30071 • 404-447-8436 • FAX 404-447-1078

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Panasonic Hawaii, Inc. (C/V/M) • 99859 Iwaiwa St., PO Box 774, AIEA, HI 96701 • 808-488-1996

ILLINOIS

B-B & W, Inc. (C/V/M) • 2137 S. Euclid Ave., Berwyn 60402 • 708-749-1710 • FAX 708-749-0325

Hesco, Inc. (V) • 6633 North Milwaukee Ave., Niles 60648 • 708-647-6700 • FAX 708-647-0534

Joseph Electronics, Inc. (C/M/A) • 8830 N. Milwaukee Ave., Niles 60648 • 708-297-4208 • FAX 708-297-6923

Union Electronic Dist. (C/V/M/A) • 16012 S. Cottage Grove, South Holland 60473 • 708-333-4100 • FAX 708-339-2777

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G & A Distributors, Inc. (C/V/M/A) • 635 N. Hydraulic St., Wichita 67214 • 316-262-3707 • FAX 316-262-6494

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Major Distributing Company (C/M/A) • 449 S. 16th St., Paducah 42003 • 502-443-5345 • FAX 502-444-6237

Service Electronics Supply (C) • 1046A New Circle Rd., NE, Lexington 40505 • 606-254-5786 • FAX 606-231-9684

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Fairway Electronics (C/V/M) • 3040 Waterview Drive, Baltimore 21230 • 301-576-8555 • FAX 800-955-2119

Fairway Electronics (C/V/M/A) • 4210 Howard Ave., Kensington 20895 • 301-564-1440 • FAX 800-955-1358

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Remcor Electronics (C/M/A) • 10670 Nine Mile Rd., Oak Park 48237 • 313-541-5666 • FAX 313-398-1016

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Tri-State Electronics (C/V/M) • 605 W. Fortification St., Jackson 39203 • 601-355-3431 • FAX 601-353-1567

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Manhattan Electronics, Inc. (C/V/M) • 1101C E. 76th Terrace, Kansas City 64131 • 816-361-9440 • FAX 800-255-6239

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Dale Electronics (C/V/M/A) • 7 E. 20th St., New York City 10003 • 212-475-1124 • FAX 212-475-1963

Green Tele-Radio Dist. (C/M/A) • 84-00 73rd Avenue, Glendale 11385 • 718-821-1114 • FAX 718-821-3987

GMB Sales (C/V/M/A) • 140 Terminal Rd., Setauket 11733 • 516-689-3400 • FAX 800-635-0596

Mill Electronic Supply (C/V/M/A) • 2026 McDonald Ave., Brooklyn 11223 • 718-336-4575 • FAX 718-627-4023

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Panson Electronics (C/V/M/A) • 268 Norman Avenue, Greenpoint 11222 • 718-383-3400 • FAX 718-383-2425

Radio Equipment Corp. (C/A) • 196 Vulcan St., Buffalo 14207 • 716-874-2690 • FAX 716-874-2698

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United Teletronic Parts (C/M) • 3860 10th Ave., New York 10034 • 212-569-2330 • FAX 212-567-3725

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Fox International, Inc. (C/V/M/A) • 23600 Aurora Rd., Bedford Heights 44146 • 216-439-8500 • FAX 800-445-7991

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Diversified Parts (C/V/M/A) • 2104 S.E. 9th Ave., Portland 97214 • 800-338-6342 • FAX 800-962-0602

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CRS Electronics (C/M) • 818 Brownsville Rd., Pittsburgh 15210 • 412-431-7700 • FAX 412-431-5666

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Jabbour Electronics (C/V/M/A) • 1744 Cranston St., Cranston 02920 • 401-944-2570 • FAX 401-944-8570

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Currey's, Inc. (C/V/M) • 1027 8th Ave., S. Nashville 37203 • 615-242-4221 • FAX 615-242-4223

Mills Morris Co. (C/V/M/A) • 677 Phelan Ave., Memphis 38101 • 901-774-9810 • FAX 901-946-5603

Shields Electronics Supply, Inc. (C/V/M/A) • 4722 Middlebrook Pike, Knoxville 37921 • 615-588-2421 • FAX 615-588-3431

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Electronic Component (C/V/M/A) • 2401 Bissonnet, Houston 77005 • 713-528-1543 • FAX 713-528-1046

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M-Tronics (C/V/M/A) • 3201 West Ave., San Antonio 78213 • 512-340-4069 • FAX 512-340-4569

Porter Burgess Co. (C/V/M) • 1233 Levee St., Dallas 75207 • 214-741-5161 • FAX 214-744-9430

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Sherman Electronics (C/V/M) • 1701 Morgan Ave., Corpus Christi 78404 • 512-888-9454 • FAX 512-888-4942

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VCP International Inc. (V) • 2285 Merritt Dr., Garland 75040 • 214-271-7474 • FAX 214-278-5981

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Avec Electronics Corp. (C/M) • 711 Granby St., Norfolk 23510 • 804-627-3502 • FAX 804-627-1710

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Avec Electronics Corp. (C/M) • 2009 Williamson Rd., Roanoke 24012 • 703-344-6288 • FAX 703-344-0081

Fairway Electronics, Inc. (C/V/M) • 2304 Chamberlayne Ave., Richmond 23222 • 804-321-7255 • FAX 800-955-7043

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Dealer Office Equipment Inc. (A) • 19300 W. Janacek Court, Waukesha 53186 • 414-784-7850 • FAX 414-784-3241

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(as of 1/2/91)

Matsushita Services Company, 50 Meadowland Parkway, Secaucus, NJ 07094

REPLACEMENT PARTS SHOWCASE

Premium Parts +

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800-558-9572;
FAX: 414-473-4727

Premium Parts + Electronics Company is a leading distributor of electronic parts, supplies and information for the electronic industry. Until recently we called ourselves Prime Electronics Co., however, we are now Premium Parts + Electronics Company because it's a better description of just who we are and the quality service and products we deliver.

Premium Parts + customers come first in everything we do. Satisfying them is our goal. From the product manager who selects the items we offer in the catalog, to the telephone sales representative who takes your order, to the shipping specialist who sends the order on its way . . . we all work to provide our customers the best possible products and service.

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Premium Parts + offers a free 139 page catalog listing over 10,000 popular items. Our catalog is also the source for the complete PRB Line Replacement Belt System. It contains all the information you need to order just the right replacement belt for most electronics equipment. Premium Parts + also can provide you with a complete Electronics Technician's Reference Library. This package of reference materials includes the PRB Cross Reference Belt Guide, the PRB Measur-A-Belt, the latest Premium Parts + Catalog, plus a selection of the latest electronic reference data sheets available. This $15.00 value library of materials is yours free when requested with orders of $150.00 or more.

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REPLACEMENT PARTS SHOWCASE

Russell Industries, Inc.

300 Lawson Blvd
Oceanside, NY 11572
516-536-5000
FAX: 516-764-5747

Russell Industries has supplied top quality replacement components into the electronics distribution market for over 25 years.

Current product categories include antennas, solderless terminals, heat shrinkable tubing, rubber bumpers and grommets, flyback transformers, fuses (through their Seneca division) and VCR repair parts including belts and idler wheels (through their EVG division).

All products are marketed by a network of over 1500 recognized distributors throughout the entire continental United States and Alaska and Hawaii.

Russell Industries is famous for their policy of "same day shipping and no back orders." Their knowledgeable and courteous customer service department is ready to assist in any situation from taking orders to locating and cross referencing difficult hard to find parts.

Cataloging and literature are a high priority at Russell. Constant updates are published to reflect on current trends in the industry. All catalogs are available on a no charge basis.

Russell has maintained efficient operations through continual innovation. One of the first companies in America to utilize a toll-free (800) number (in use since 1972) they have recently added a toll-free (800) fax number to improve customer communications.

Existing product lines are periodically reviewed to guarantee that new items are being added as necessary. Entire new product categories are frequently introduced in order to allow customers "one stop shopping."

The latest product category to be introduced is Russell's full line of replacement flyback transformers for television. As with all other Russell merchandise, the quality of the transformers has been stringently tested. Over 100 types are now available to replace almost any requirement. Look for computer monitor flybacks to be introduced in the near future.

Family owned and operated, Russell Industries is firmly committed to the electronics servicing business. Russell Industries will continue to invest and innovate in order to provide the best products and services available in the industry.

SPECIAL ADVERTISING SUPPLEMENT

Circle (86) on Reply Card

REPLACEMENT PARTS SHOWCASE

Philips ECG

1025 Westminster Drive
Williamsport, PA 17701
Tel: 800-526-9354

Long recognized as the leader in the dynamic semiconductor replacement market, this year Philips ECG proudly marks its silver anniversary in supplying the broadest line of replacement semiconductors available to this fast-changing industry.

Geared toward the needs of the commercial, industrial/MRO, computer, home entertainment and communications markets, Philips ECG offers a wide range of universal replacement semiconductors, including transistors, integrated circuits, SCRs, TRIACs, rectifiers, diodes, optoelectronic devices, and others. The 1991 ECG Semiconductors Master Replacement Guide (15th Edition) cross references over 262,000 industry part numbers to their equivalent ECG replacements and features data for about 4,000 total ECG devices.

Over the years ECG Semiconductors Master Replacement Guides have always been considered by those who use and depend upon them— the electronic equipment servicers—to be the most accurate and comprehensive single source of replacement information available. This year's edition is no exception: containing over 21,000 additional cross references and data for more than 300 new ECG parts, the guide adds new digital and linear ICs, transistors, diodes and rectifiers, SCRs, TRIACs, optoelectronics, IC protectors and accessories.

Since its introduction in 1966, the ECG brand name has been synonymous with superb quality, positioning Philips ECG as the leading replacement semiconductor supplier, with a reputation for excellent customer service and technical support for a quarter-century.

"Throughout the years, we've ensured our customers prompt delivery on a broad range of quality electronic products," said Donald R. Kronenwetter, Vice President and General Manager. "Our concept of universal replacement has enabled us to establish a broad range of semiconductors that replaces more industry part numbers than any other line. This means distributors and repair facilities can enjoy the benefits of a greater parts inventory with fewer stocked items and at substantial savings."

In addition to semiconductors, Philips ECG products include electromechanical and solid-state relays, I/O modules, cube timers, surge suppression devices, audio-video parts and servicing accessories, flyback transformers, NiCad batteries, capacitors, flameproof resistors, cable TV converters, TV remote controls, TV accessories, circuit designers, test equipment, aerosol chemicals for electrical and electronics applications, solder wire, desoldering braid and antenna rotators. These lines are continuously monitored and updated to ensure that Philips ECG customers receive the latest in state-of-the-art technology.

Philips ECG products are sold only through authorized distributors. More than 600 distributors in over 900 locations throughout the U.S. and Canada maintain sufficient inventories to generally provide off-the-shelf service. For special situations, "Hot-Line" service is available to provide product delivery within 24 hours.

"We are especially proud of our company's continuing accomplishments," said Mr. Kronenwetter. "Teamwork and enduring business relationships have both contributed to our success during the past quarter century."

The company looks now to the next 25 years to continue the tradition of being the first name in the electronic component replacement industry.

Philips ECG is a division of Philips Components, a North American Philips Company.

To locate the nearest Philips ECG distributor, consult "Electronic Equipment and Supplies" in the telephone directory yellow pages or call toll-free, 1-800-526-9354.

A GenRad linear test set is used to help assure the quality of ECG op amps, comparators, voltage regulators and FETs, just one of many tests designed to ensure the continued success of the electronics servicer.

A top-of-the-line, automatic test system is used to verify that ECG discrete components meet quality specifications. As well as testing each devices electrical parameters, the equipment produces hard copy records of many ECG component types.

ECG® Replacement Parts And Tools Fit 31 VCR Brands.

New catalog covers RF modulators, VHS and Beta heads, idler wheel assemblies, pinch rollers, belts, opto-sensing devices and more. All meet or exceed OEM specs. Lists over 2400 crosses. Service aids include test cassettes, jigs, tools, cleaning materials. Ask for a copy at 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

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Philips ECG

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PHILIPS

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REPLACEMENT PARTS SHOWCASE

MAT Electronics

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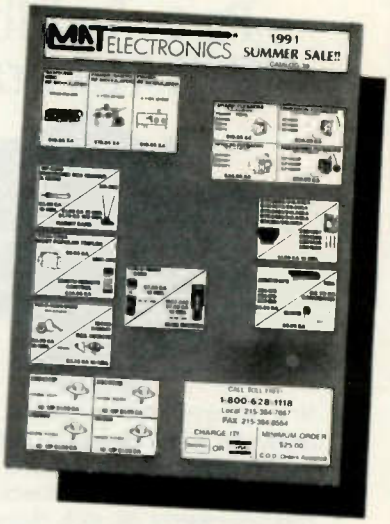

MAT Electronics is a full-line parts distributor that gears its inventory to the TV, VCR and stereo repair industry. The company's parts are used by technicians, engineers, trade schools, hobbyists and manufacturers.

MAT Electronics stocks an extensive line of replacement accessories as well as one of the largest selections of semiconductors in the nation.

The company publishes an easy-to-read 56-page catalog with thousands of items, all of which are inventoried in the company's computer, enabling customers to check availability within seconds.

With its huge overseas imports, as well as domestic sources for components, the company is always current with the industry-always emphasizing what is new in electronics components—for VCRs, TVs and stereos.

MAT Electronics takes great pride in its ability to accommodate the varied needs of all its customers. The company normally ships within 24 hours of your order; however, it offers UPS red and blue labels to ensure even faster delivery service if it is needed.

The company has friendly and knowledgeable telephone operators waiting to take your phone call and courteously deal with any questions you may have about any electronic part—even if you don't see it in the catalog, ask for it!

MAT Electronics knows that there are certain risks involved in mail-ordering certain components, and that is why the company guarantees 100% of all products for 90 days from purchase date. Volume discounts are always available. The company's toll-free lines are open now and waiting for your phone call. Just call 800-628-1118.

SPECIAL ADVERTISING SUPPLEMENT

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2SD1426	SANYO	$1.99ea
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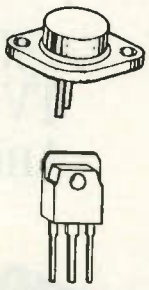
STK4273	SANYO	$9.95ea
STK5441	SONY	$13.00ea
STK563F	SONY	$10.50ea
STR3115	SANKEN	$4.95ea
STR30120	SANKEN	$4.95ea



REPLACEMENT FLYBACKS

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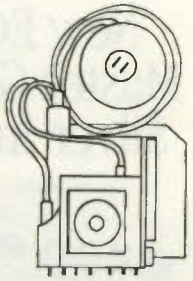
SHARP FLYBACK	F1588	$29.95ea



FLUKE

MODEL	PRICE
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75	$125.00ea
77	$165.00ea
83	$215.00ea
85	$255.00ea
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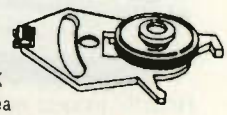
RCA ORIGINAL DC TO DC CONVERTER 163818 SALE PRICE $9.95ea



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Circle (76) on Reply Card

Hurley Electronics

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Santa Ana, CA 92706
714-971-2992
800-244-8753 (CA); 800-4HURLEY (US)
FAX:714-971-5033

REPLACEMENT PARTS SHOWCASE

Hurley Electronics offers more than 30,000 parts from three warehouses, all available for same-day shipping. A powerful on-line computer helps locate parts numbers from the component description and provides cross reference information between manufacturers.

The company started in business in 1953, when John C. Hurley moved to southern California from his home in Nebraska. Driving a station wagon full of parts and possessed of an idea, he drove around southern California offering parts and advice to TV dealers in the area. He settled in Santa Ana and opened the first Hurley Electronics. Customers have always meant a lot to Hurley's and John's Motto "Earn the Business" is still a key to Hurley's success.

For over 38 years, Hurley has supplied the industry with parts from RCA, GE, NAP, Zenith, Panasonic, Sony, JVC; semiconductors and relays from Philips ECG; chemicals from Chemtronics and belts idlers and tires from EV Gain.

Hurley carries a full line of test equipment including B&K and Leader, and offers servicing literature including over 2500 Sams Photofact folders and VCR manuals as well as OEM manuals.

Antenna business is still a major factor in Hurley's business, in spite of the inroads of cable delivery systems, and the company offers a full complement of items from manufacturers such as Blonder/Tongue, Channel Master, Winegard, TDP and Channel Plus.

Fliers are mailed regularly, informing customers of new products as well as specially priced items.

Shipping methods are flexible to meet customers needs, and include COD, Net 30 accounts are available. Hurley also accepts MasterCard, Visa, Discover and American Express.

Operating hours are Monday through Friday 8:30AM to 5:00PM and the company can be reached via toll-free telephone numbers. For the convenience of customers, Hurley also makes available 24-hour fax lines.

Hurley Electronics can also be contacted at these other locations: 318 16th Street, San Diego, CA 92101, (619-235-6245, 800-255-9113, Fax 619-235-0436); 730 West Spruce, San Bernardino, CA 92410, (714-885-0721, 800-637-2901 (CA), Fax 714-889-3811).

REPLACEMENT PARTS SHOWCASE

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Mastering Electronics, by John Watson; McGraw-Hill Books, 427 pages $19.95-soft.

Watson emphasizes the systems and applications of modern technology. The book covers both the fundamentals and the theory of electronics and presents material on compact discs, camcorders and TRVO systems. Scores of detailed circuit diagrams provide an opportunity for hands-on experience with construction projects. This book should be an ideal resource for hobbyists and technical professionals who work in fields other than electronics.

McGraw-Hill Publishing Company 11 West 19th Street, New York, NY 10011; (212) 337-5945 or 337-5951.

Microwave Oven Repair 2nd Edition, by Homer L. Davidson; TAB Books, 384 pages, $19.95 - paper.

In Microwave Oven Repair - 2nd Edition, one of the most respected names in appliance repair provides clear, step-by-step instructions and hundreds of detailed working illustrations and photographs for tackling virtually any microwave oven problem. Homer L. Davidson has updated and expanded this popular manual to include: coverage of the newest microwave oven models and features, maintenance and troubleshooting guidance, practical information on today's microwave circuitry, including more than 100 all-new circuit diagrams, the latest test procedures used by major appliance manufacturers, specific solutions to more than 200 common microwave over malfunctions.

TAB Books Blue Ridge Summit, PA 17294

Understanding Digital Troubleshooting 3rd Edition, by Don L. Cannon; 286 pages, $24.95 - paper.

This technical book provides a guide to maintaining digital systems, today's most-reliable electronics. Whether using digital electronics as a hobby or as a career, this book shows readers how to implement the most effective digital design possible. Beginning with an introduction to basic engineering concepts and electronic fundamentals, this book teaches readers how to locate faults in digital systems and make repairs.

Macmillan Computer Publishing 1711 N. College Ave., Suite 140, Carmel, IN 46032.

Op-Amp Circuits and Principles, by Howard M. Berlin, 287 pages, $19.95 - paper.

This book features and explains a low-cost, electronic building block, Op-Amp circuits. Presenting the fundamentals in easy-to-understand, no-nonsense text, the book provides hobbyists students, engineers and technicians with the facts to make the right electronic connections. Readers learn how and when to use differentiators, integrators, current and voltage regulators, oscillators, active filters, and power-supply circuits. Illustrations, definitions, and 14 skill centered experiments reinforce learning. Op-Amp circuits and Principles gives professional information on the Norton amplifier, waveform generation and implementation, state-variable filters and active filters, as well as the effects on performance.

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Test your electronics knowledge

By Sam Wilson

1. Which of the following is a thermistor that has a positive temperature coefficient?

A. Sensistor
B. P100
C. PT-C

2. Which of the following refers to the number of signal events per second?

A. WPS
B. EVS
C. Baud

3. Which of the following can be used to compare two microprocessors from two different manufacturers?

A. ABA Test
B. Benchmark
C. A test

4. The electric field of a transmitted signal is horizontal that is, parallel to the surface of the earth. The signal is

A. horizontally polarized
B. vertically polarized

5. You are going to measure the resistance of R_1 in the circuit of Figure A.

A. Use the low-power ohms feature of your ohmmeter
B. Make sure the negative lead of the ohmmeter is at point x and the positive lead is at point y. Otherwise, you will forward bias the transistor and read R_2 in parallel with R_1

C. Both choices are correct
D. Neither choice is correct

6. An input terminal of a certain integrated circuit is marked CS as shown in Figure B. A logic probe shows there is a logic 1 being delivered to that input terminal, so, the integrated circuit is

A. in operation
B. not in operation

7. Two pure sine wave signals are being applied to an audio amplifier. The output is checked for additional frequencies. This is

A. a useless test
B. one method of testing an audio amplifier

8. The transistor amplifier in Figure C is biased for Class A operation. A pure sine wave is applied to the input; and, a spectrum analyzer shows harmonic frequencies in the output signal. Which of the following should be done first?

A. Disconnect the transistor from the circuit. Replace it with one known to be good.
B. Assume the sinewave input signal doesn't have sufficient amplitude to drive the amplifier.

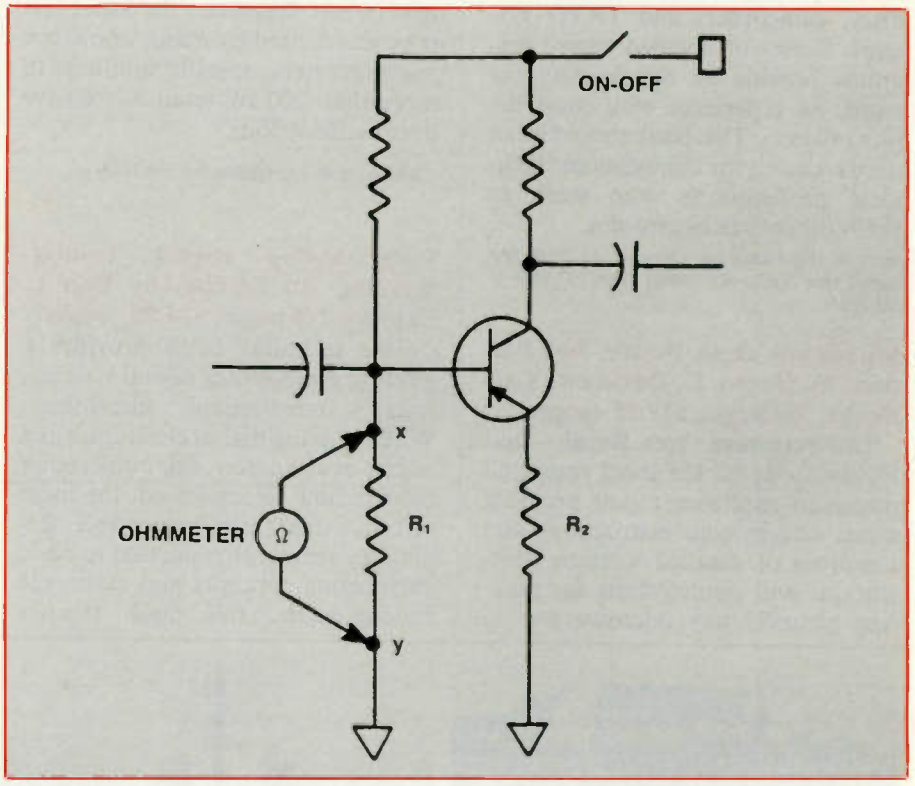

Figure A.

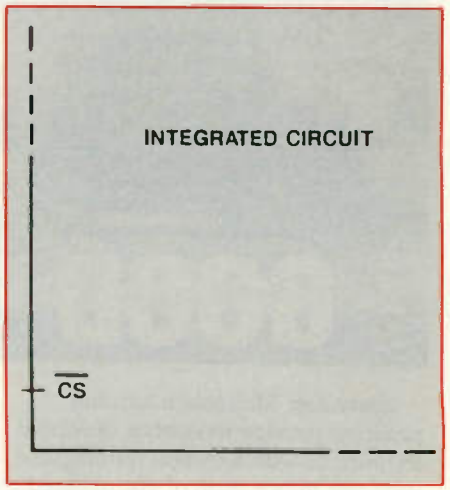

Figure B.

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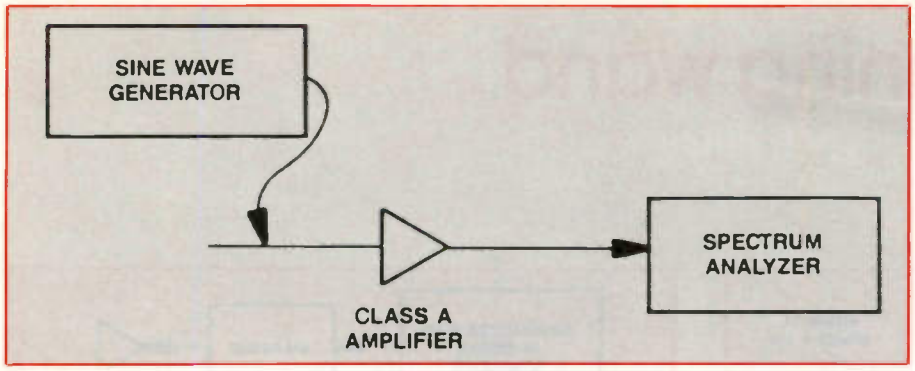

Figure C.

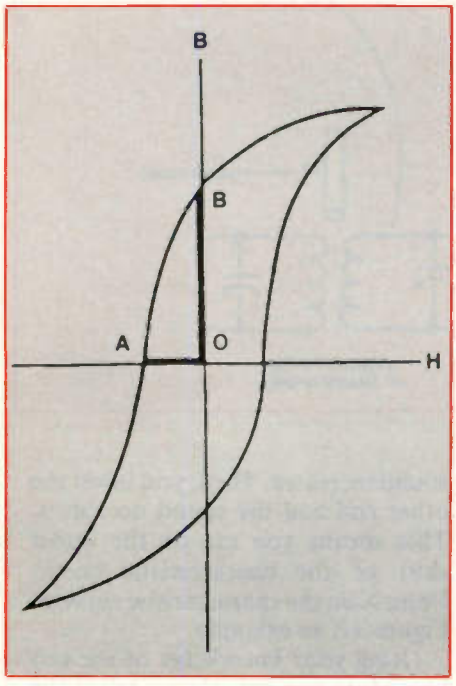

Figure D.

C. Make sure the input signal amplitude is not overdriving the amplifier.
D. Increase the power supply voltage to see if the harmonics are removed.

9. The smallest change in value that can be detected by a measuring instrument is called its

A. sensitivity in ohms/volt
B. accuracy index
C. differential index
D. resolution

10. On the magnetic hysteresis curve in Figure D the segment marked AO is called the _____.

BONUS QUESTION -
According to the experts, if you are going to jump start your new V8 Hypolux four-door sedan,

A. connect the positive jumper cable first, then the negative jumper cable.
B. connect the negative jumper cable first, then the positive jumper cable.
C. you must connect both jumper cables at the same time.
D. it doesn't matter which jumper cable you connect first.

What do you know about electronics?

Using your tuning wand

By Sam Wilson

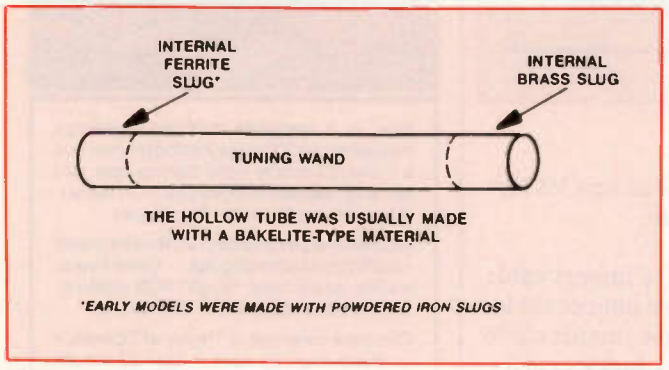

Figure 1.

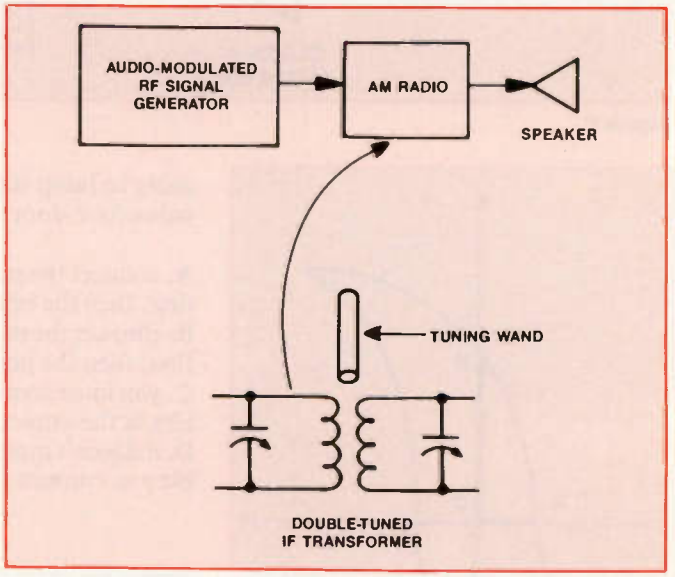

Figure 2.

In order to follow along with this discussion, get your tuning wand and get ready. You will have to look in the very bottom of your tool box to find it. It looks something like a plastic straw with a ferrite slug in one end and a brass slug in the other end. See Figure 1.

The test setup is shown in Figure 2.

Let's assume you want to check a receiver IF tuner circuit to see if it is properly tuned.

First, you insert the ferrite end of the tuning wand into (or nearly into) the IF coil. In this case you note that the sound output decreases.

Then, you insert the brass end of the tuning wand into (or nearly into) the transformer core. Again, sound decreases.

Then, you insert the brass end of the tuning wand into (or nearly into) the transformer core. Again, the sound decreases.

The result of this test tells you that the tuned circuit is properly tuned. You are sure of that because you remember some very basic theory. Inserting the ferrite slug increases the inductance of the coil. According to the equation for resonant frequency [f_r] that decreases the resonant frequency of the tuned circuit.

$$f_r = 1/(2\pi\sqrt{LC})$$

Increasing the denominator of a fraction reduces the value of the fraction. Inserting the brass end reduces the inductance and increases the resonant frequency of the tuned circuit. (Decreasing the denominator of a fraction increases the value of the fraction.)

Both increasing and decreasing the resonant frequency is detuning the circuit and reducing the output. Therefore, the circuit is tuned as shown in Figure 3.

You can think of it this way - if you tuned this circuit with a variable capacitor [or, with a variable inductance] you would get exactly the same result. If tuning the circuit (using any method) to a higher and lower frequency decreases the output in both cases, the circuit must be properly tuned.

Suppose you insert the ferrite end of the tuning wand and the output sound increases. Then, you insert the other end and the sound decreases. That means you are on the upper skirt of the characteristic curve. Point X on the characteristic curve of Figure 3 is an example.

Using your knowledge of the test procedure you can always tell if the circuit is tuned to the high side or low side of the desired resonant frequency. You make the necessary slight adjustment and check with your tuning wand again.

With one or two slight adjustments you can tune the circuit to its proper resonant frequency.

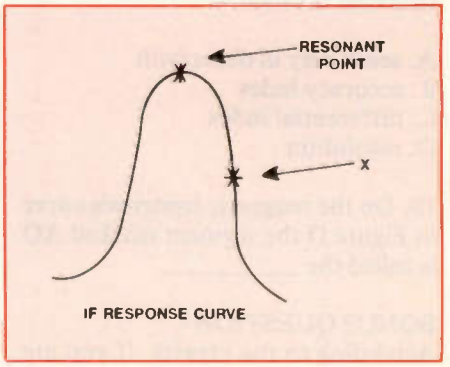

Figure 3.

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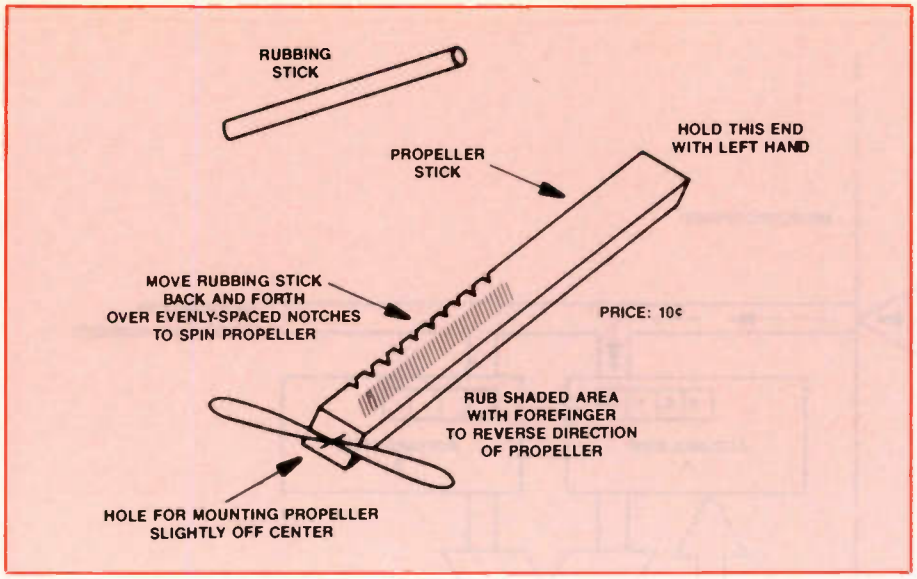


Figure 4.

Before you go to the trouble of writing to tell me you have lost your tuning wand and asking where you can buy another one, think about this: Would *you* go to the expense of setting up a company to manufacture a 50¢ item for one guy who lost his tuning wand?

The reason I bring the next subject up is that we are talking about resonance.

Surviving a depression

What I tell you is now true. During the big depression there were guys that survived by selling a toy that had many different names. Examples are "propeller stick" and "Whoopsie Diddles." They were sold in parking lots, playgrounds, and wherever people gathered.

Figure 4 shows how they are made. When you rub the stick along the notches the propeller turns in one direction. Then, you yell something silly [like "Whoopsie Diddle"] and, at the same time, you move the stick a very short distance so that your forefinger rubs back and forth along the side of the propeller stick. You still move the stick over the notches. Rubbing the side with your finger reverses the direction of the propeller. The device works on the principle of mechanical resonance.

There just *may* have been people in parking lots selling tuning wands too.

Talking with your computer

In a previous issue we reviewed some basic computer terms. Continuing that subject, we will now follow the procedure, used by a microprocessor, to multiply two numbers. To get this thing down to the basic essentials we will start by using a microprocessor in a calculator to add the numbers. The microprocessor is sometimes called a microcomputer. It can do all kinds of arithmetic problems if it is properly set up.

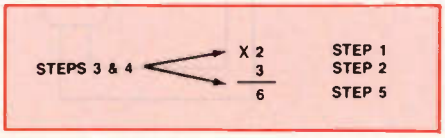


Figure 5.

We are going to compare the procedure used to multiply two numbers using a pencil and paper with the procedure for multiplying with a calculator. When you use a pencil and paper you are using the paper as a memory. Refer to Figure 5.

Step 1. - Enter the first number on the paper (memory).
Step 2. - Enter the second number on the paper (memory).
Step 3. - Enter the line and multiplication sign.
Step 4. - Using the procedure (called the algorithm) stored in your brain's Read Only Memory (ROM) and the multiplication table that is also stored in your brain's ROM, perform the multiplication.
Step 5. - Display the result on the paper (memory).

Your brain was programmed early in grade school to make it possible for you to solve the problem on paper. Two very important things have

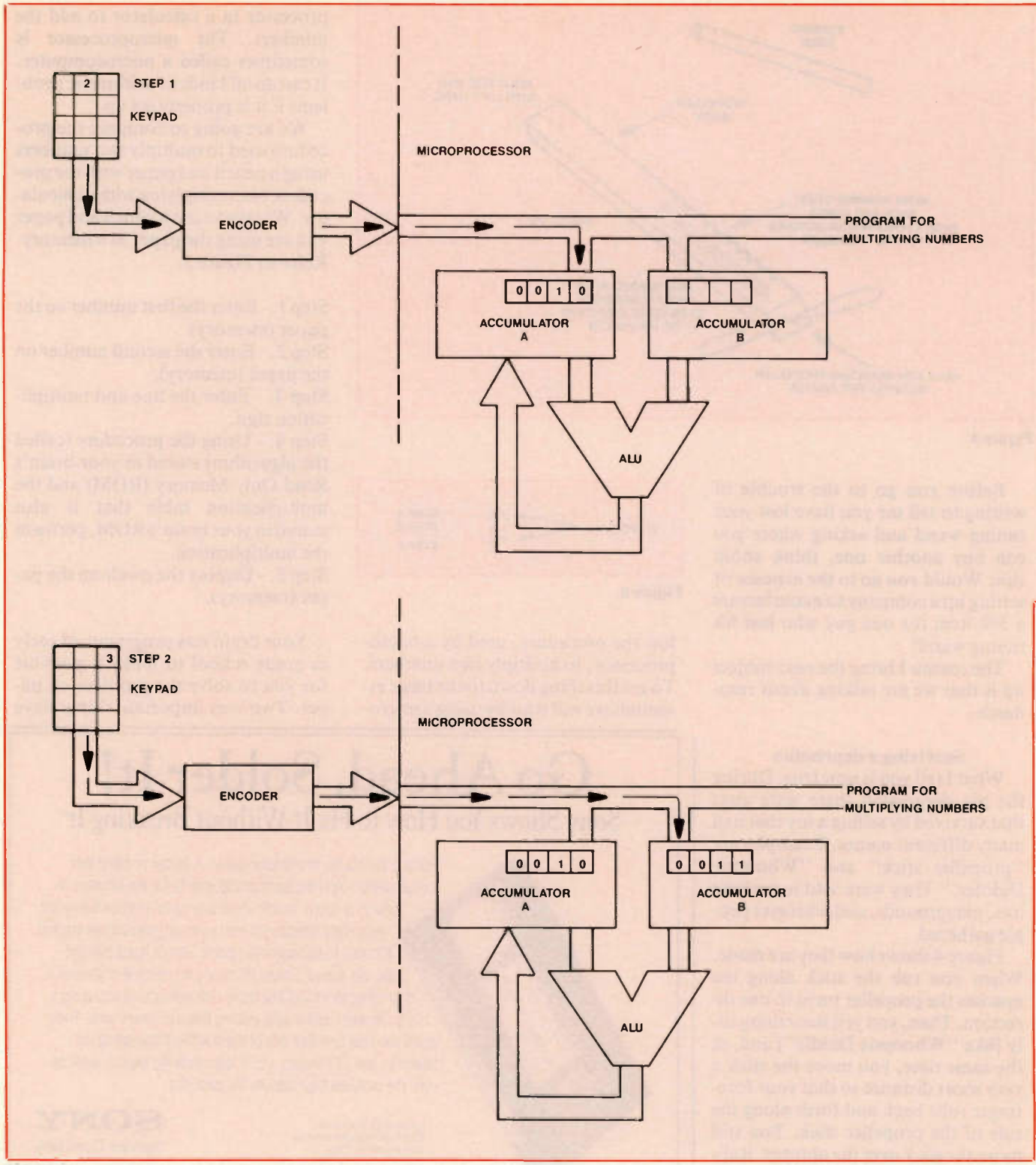


Figure 6.

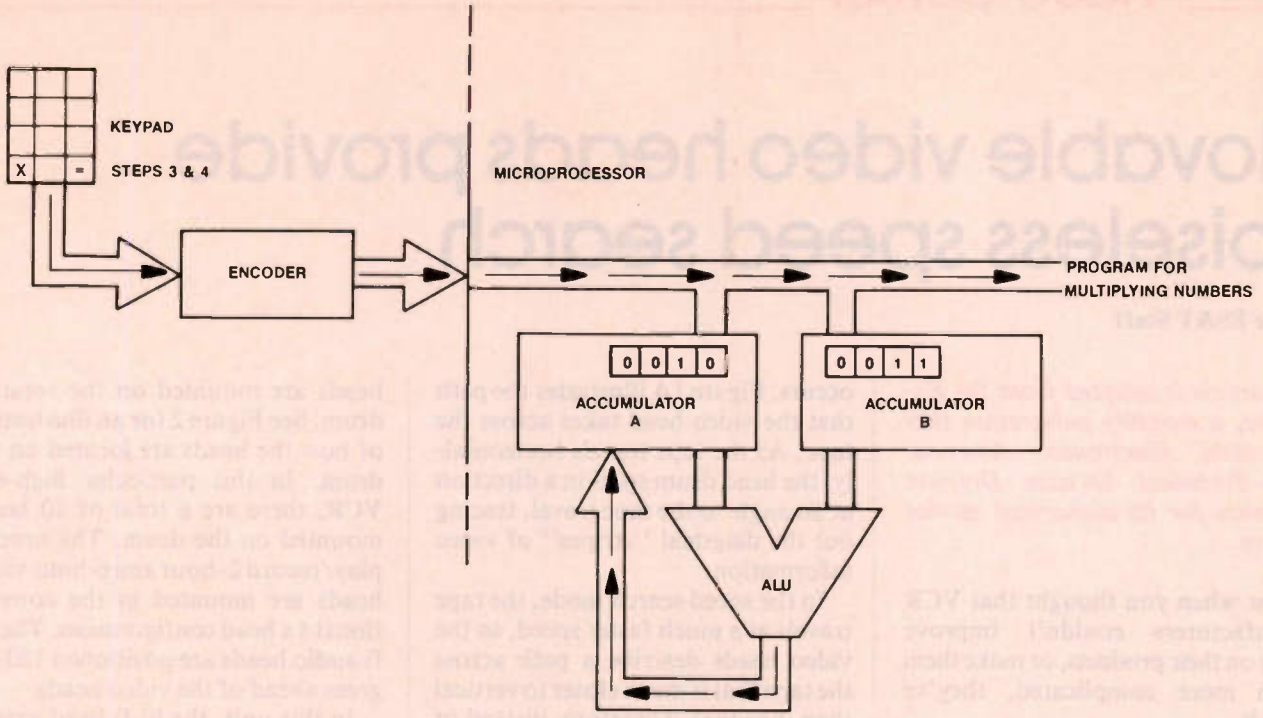
been stored in your brain by one of your teachers in an early grade:

- The multiplication table - You know that 2 x 3 is equal to six. You know that because the multiplication table is stored in your brain.
- The algorithm - The procedure for solving the problem has been stored in your brain's ROM by a teacher.

In order to deliver numbers to the microcomputer inside the calculator you push numbered keys on a keypad. The microcomputer can only work with numbers and codes in binary form, that is, in combinations of 1's and 0's. In other words, the press on the key must be changed to a binary number.

The *encoder* in Figure 6 converts each keypress to the corresponding binary numbers. So, if you press the number 3 key there will be a binary three (0011) delivered to a short-term memory.

When using the paper and pencil, you started by writing the number 2. The paper serves as a short-term memory. In the microcomputer the short-term memory is called a *regis-*



ter or *accumulator*. The object of the first step is to store the number 2 for future use.

Next, you push the number 3 on the keypad. In this case, you are storing the second number in a different accumulator.

How do you know to store the two numbers in your paper and pencil solution? Your algorithm - stored in your brain's ROM in the 3rd grade - tells you that this is the procedure for multiplying two numbers.

After drawing the line and affixing the multiplication sign on the paper - to remind you of the procedure - you multiplied the numbers and stored the result on the paper.

If the problem is being solved by the microprocessor the result is stored in a register or in an accumulator. Of course, you have written over the number which was previously stored there, but, it doesn't matter because you are finished with that number.

The multiplication is performed in a section of the microprocessor called the ALU [Arithmetic Logic Unit].

Figure 6 summarizes the steps of the multiplication problem using the microprocessor. Two accumulators are shown for storing the numbers to be multiplied, but not all microcomputers are made that way. Some have only one accumulator (or, register). In that case the second number is delivered directly to the ALU.

Step 1 - Enter 2 on the keyboard. That delivers a binary 2 to the first accumulator which is a short-term memory.
Step 2 - Enter 3 on the keyboard. That delivers a binary 3 to the second accumulator which is also a short-term memory.
Step 3 and 4 - Punch the X (multiplication) and equal signs on the keyboard. It tells the microcomputer to use the algorithm in ROM that has been placed there by the manufacturer. The algorithm says to multiply the two numbers in the ALU and store the result in the first accumulator.
Step 5 - Using the procedure stored in ROM by the manufacturer, display the numbers.

Let me point this out before I get a rash of letters from indignant readers. The illustration in Figure 6 is *not* for a complete calculator/microprocessor. We will add to it in the next discussion of this subject.

At this point we have reviewed some of the parts of the calculator system that are used to perform the 2 x 3 multiplication problem. However, the calculator will not work yet because a few more sections are needed. In the next segment of this discussion we will talk about the use of a clock signal and a program counter.

Then we will discuss the actual circuits used to make the accumulators, encoders, program counters, etc. ■

Movable video heads provide noiseless speed search

By the ES&T Staff

This article is adapted from the Expander, a monthly publication that Mitsubishi Electronics America, Inc.—Technical Services Division publishes for its authorized service centers.

Just when you thought that VCR manufacturers couldn't improve much on their products, or make them much more complicated, they've done it.

Historically, VCRs designed for home use produce noise bars across the picture in both the forward and reverse search modes. The number of noise bars is directly proportional to the tape speed during speed search, with the number of bars increasing as the tape speed increases.

The VCR engineers at Mitsubishi have come up with a way to get rid of those nasty noise bars. All they had to do was to add a set of video heads to the head drum that could move up and down relative to the circular face of the head drum, as the drum rotates and the tape is pulled past the head drum. Neat trick!

Why the noise

Here's an analysis of why the noise occurs. Figure 1A illustrates the path that the video head takes across the tape. As the tape travels horizontally, the head drum spins in a direction at an angle to the tape travel, tracing out the diagonal "stripes" of video information.

In the speed search mode, the tape travels at a much faster speed, so the video heads describe a path across the tape that is much closer to vertical than diagonal. Therefore, instead of tracing out the recorded stripe of information, the head traverses more than one video track (see Figure 1B).

Because a video head will only pick up signals from a video track that is at the same azimuth angle, the left azimuth head in Figure 1 picks up signal only when crossing a left azimuth track. When crossing a right azimuth track, only noise is produced. Conversely, the right azimuth head generates noise when crossing a left azimuth track. The absence of signal from scanning opposing azimuth tracks produces the noise bars in the picture when the VCR is in the speed search mode.

Moving heads

The two speed-search movable heads are mounted on the rotating drum. See Figure 2 for an illustration of how the heads are located on the drum. In this particular high-end VCR, there are a total of 10 heads mounted on the drum. The normal play/record 2-hour and 6-hour video heads are mounted in the conventional 4 x head configuration. The hi-fi audio heads are positioned 120 degrees ahead of the video heads.

In this unit, the hi-fi head assemblies also house the flying erase heads, used to minimize color distortion at the start of a recording and at points during the recording where record pause is activated.

The two new movable heads (MV) are 180 degrees apart and are positioned midway between the hi-fi and video heads. Both heads are left azimuth, and therefore will pick up signal only from a left azimuth video track.

A simplified illustration of one moving head is shown in Figure 3. The head is mounted on an actuator assembly that is within the drum. Current through the actuator coil moves the head vertically, controlling the height of the head. There is one actuator for each moving head.

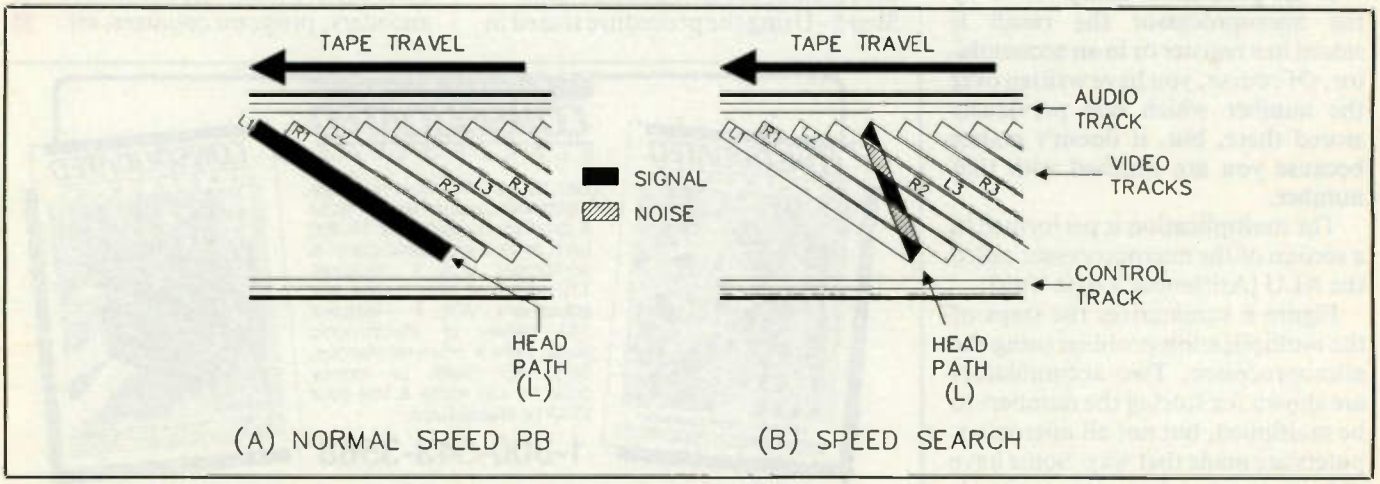
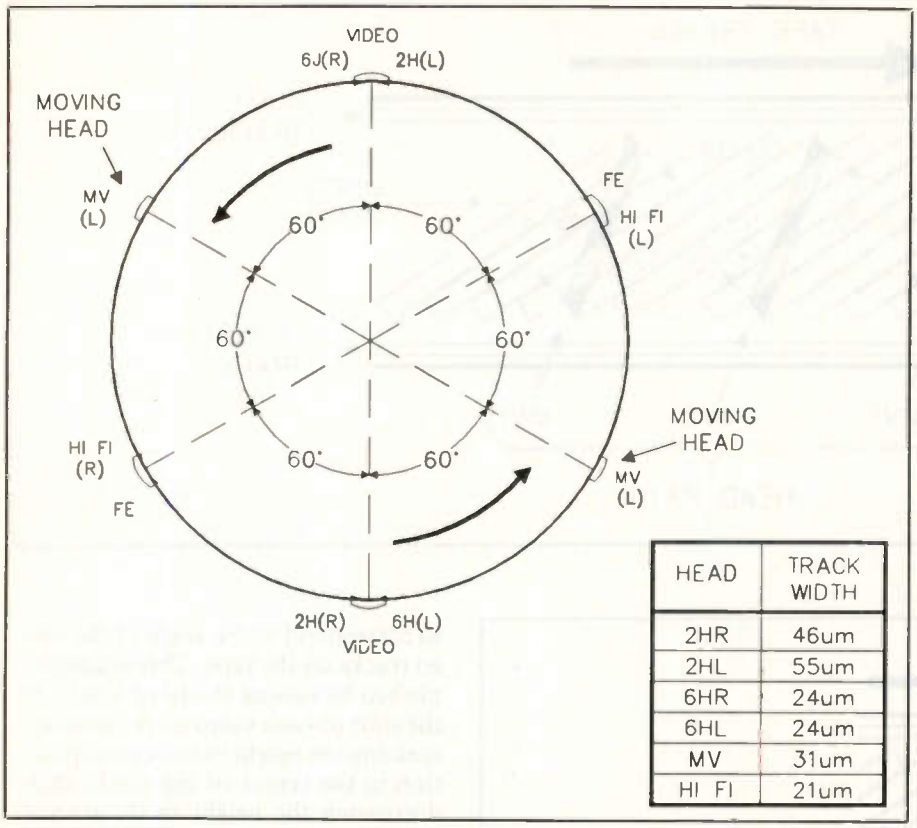


Figure 1



HEAD	TRACK WIDTH
2HR	46um
2HL	55um
6HR	24um
6HL	24um
MV	31um
HI FI	21um

Figure 2.

The drive signal for the moving head actuators is coupled to the rotating drum through a brush contact assembly mounted on the top of the drum.

Eliminating noise bars

Figure 4 shows the path of the movable heads across the tape during speed search when the head height (relative position of the head between the top and bottom flat surfaces of the drum) is not changed. Keep in mind that both movable heads are left azimuth tracks, and noise is produced when crossing right azimuth tracks. This results in noise bars similar to those encountered in conventional speed search.

To prevent the movable heads from crossing opposing azimuth tracks, the head path must be altered

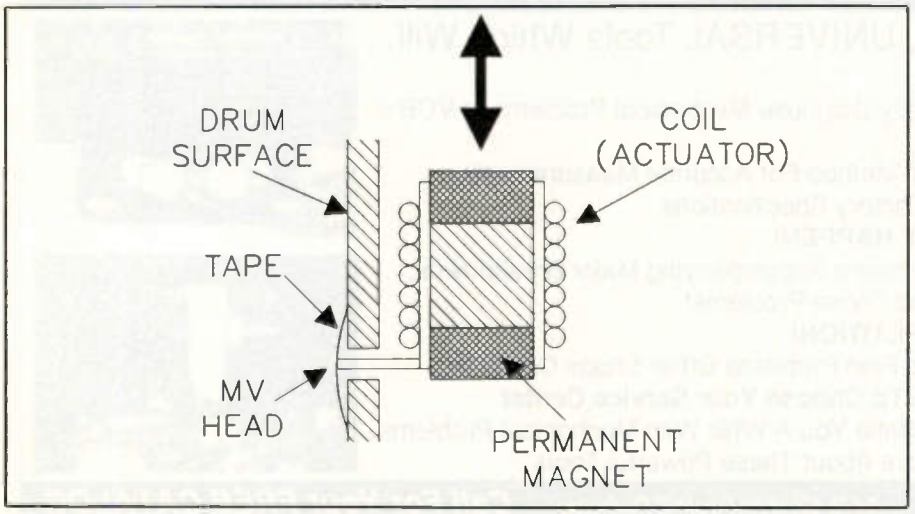


Figure 3.

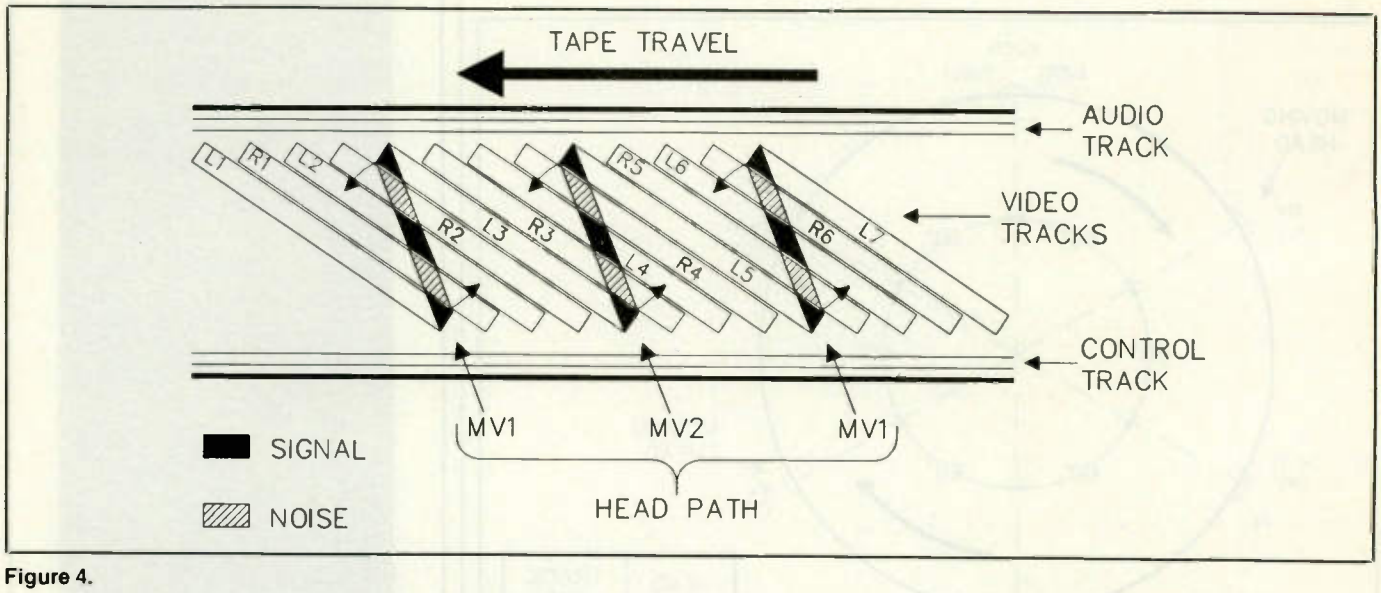


Figure 4.

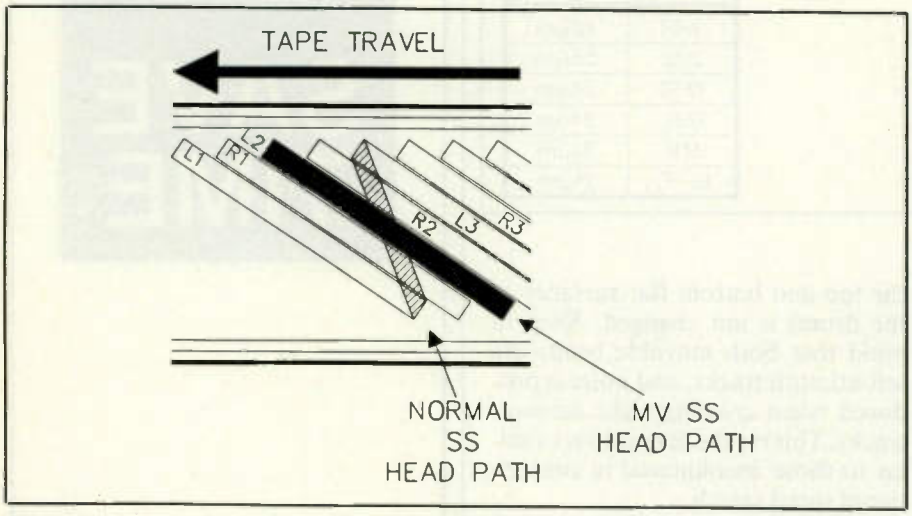


Figure 5.

to correspond to the angle of the video tracks on the tape. This is accomplished by raising the head height at the start of each video track, then decreasing the height to its normal position in the center of the track, then decreasing the height to its normal position in the center of the track, then lowering the height as the head moves toward the end of the track.

The effective change in the head path by varying the head height is illustrated in Figure 5. Note that the altered head path and video tracks traverse the tape at the same angle. Because the head no longer traverses right azimuth tracks, it doesn't produce any noise. ■

Answers to the quiz

1. A - With a sensistor the resistance goes up when the temperature goes up. Although thermistors with negative temperature coefficients are more often discussed, both positive and negative temperature coefficients are available.

2. B - This question and answer defines the term baud.

3. B - There have been cases where benchmarks could be used for troubleshooting, but, a diagnostic is better for that job.

4. A - The polarization is determined by the electric field.

5. A - Note that the procedure described in choice B will forward bias the transistor. That is NOT a good test procedure.

6. B - The CS symbol stands for NOT CHIP SELECT. A logic 0 is required at this terminal to get the IC into operation.

7. B - Remember that heterodyning cannot occur if the amplifier is linear. The test is used to check for harmonic distortion.

8. C - There should be *no* harmonic frequencies on the output when a pure sinewave is delivered to the input. One possible cause of output harmonics is that the input signal amplitude is too high and clipping is the result. If clipping occurs the output will be rich in harmonics.

9. D - The best instruments will respond to very small differences in input.

10. coercive force - It is the amount of magnetic force required to eliminate the magnetism at the end of a cycle. The amount of magnetism - called *remanence* or residual magnetism - is indicated by line BC.

BONUS QUESTION - The experts claim there is less chance of a spark using the procedure in choice A. There is an old proverb that says "whenever you have a choice between two things, take a third choice." In other words *don't jump start your new car!*

Audio distortion

By the ES&T staff.

When the customer brings in an audio system with the complaint that "it just doesn't sound right," the problem is very likely some kind of distortion. It might be caused by a change in the value of a component as it has aged, causing the operating point to shift from its design value. Or it might be caused by different rates of aging of transistors in a push-pull stage, causing a discontinuity in the stage's amplification characteristic.

There are basically three kinds of distortion that result when an audio system alters the waveform that it was designed to amplify without changing it. They are *harmonic distortion, frequency distortion,* and *intermodulation distortion (IMD).* Harmonic and frequency distortion can occur with just a single frequency applied to the amplifier. Intermodulation distortion only occurs when two or more signals are applied.

Harmonic distortion, often called "total harmonic distortion" or THD, occurs when the waveshape is clipped or limited in amplitude, producing unwanted harmonics. This type of distortion is often the result of changes in the values of the components in the system as they age that result in insufficient dynamic range in one of the amplifier stages.

Another type of harmonic distortion occurs when the middle portion of the waveform is altered. This is called "crossover distortion" and is caused by an unmatched "push-pull" stage in the amplifier output.

You can visualize harmonic distortion by thinking in terms of a sinewave. As you recall, a sinewave has no harmonics. But as the top and bottom are clipped off, a sinewave begins to resemble a squarewave, and a squarewave consists of a sinewave plus an infinite number of odd harmonics.

Frequency distortion is sometimes called "phase distortion." This type of distortion is caused by the inability of the amplifiers to properly amplify all the harmonics that make up the waveform. A small range of frequencies, or all frequencies above or be-

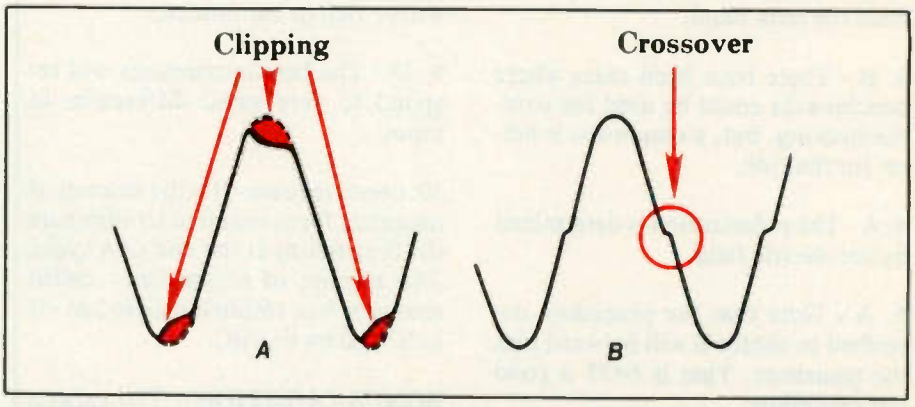


Figure 1. (A) Harmonic distortion occurs when the top or bottom of a waveform is clipped off by an amplifier. (B) Crossover distortion, which is a result of improperly matched stages in a push-pull amplifier is also a type of harmonic distortion.

Adapted from the Sencore booklet "Taking the Mystery out of Audio."

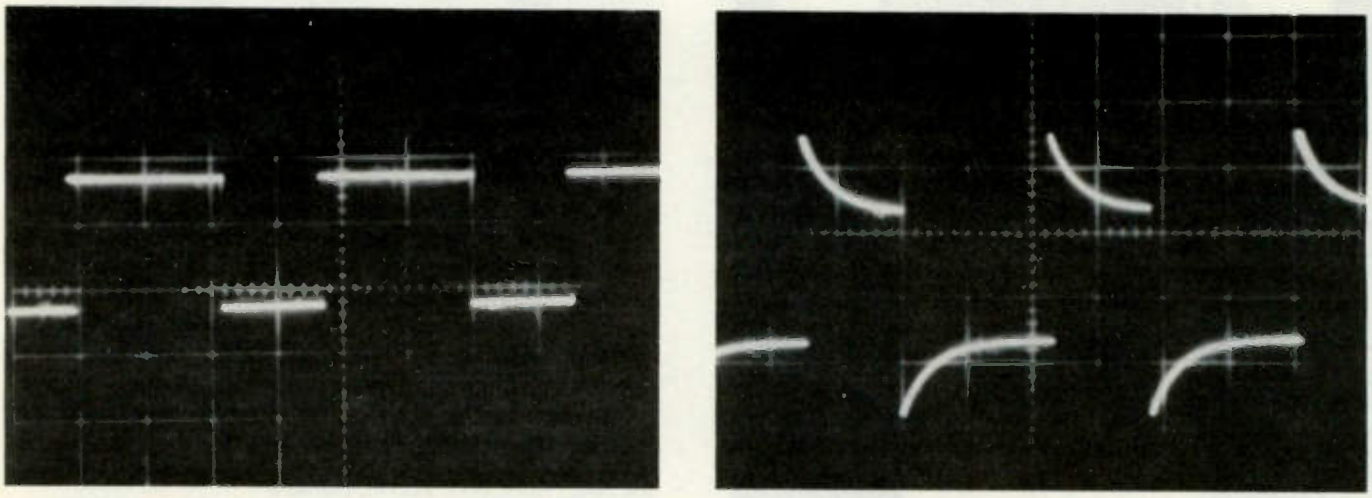


Figure 2. These scopeface waveforms show the results of phase (or frequency) distortion in an amplifier. The top waveform is the input signal and the bottom waveform is the output.

low a certain point, may receive proper gain, but may be shifted in phase compared to the input waveform. In any case, the result is that some harmonics are altered and the reproduced waveform is not symmetrical with the input.

Of course, since waveforms other than a pure sinewave theoretically contain an infinite number of harmonics, it may seem that all amplifiers, which have finite bandwidth, must cause frequency distortion. However, if the amplifier provides a flat response for all frequencies up to the 10th harmonic of the fundamental (that is, amplifies them all equally), there will not be any *measurable* amount of distortion.

Intermodulation distortion occurs when two or more signals mix together in an amplifier. The mixing is the result of nonlinearities in the amplifier (an improperly biased transistor, for example) which causes different amounts of amplification. When this happens, the output of the amplifier will contain the original frequencies plus the sum and difference frequencies.

Don't confuse mixing with adding. In normal operation, all of the input signals are added together by the amplifier, but the output contains just the information from the input signals. When an amplifier mixes the input signals, however, the output contains the input signals plus new signal frequencies and waveshapes that were not present in the applied signal. ■

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Information on Anova Electronics Model 8000C Control center/modules. Company is defunct. Owners, user's or service manuals needed. Would also consider additional units. *Randy Bray 6715 Eberlein Ave Klaurath Falls, OR 97603, (503) 884-1406.*

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