THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

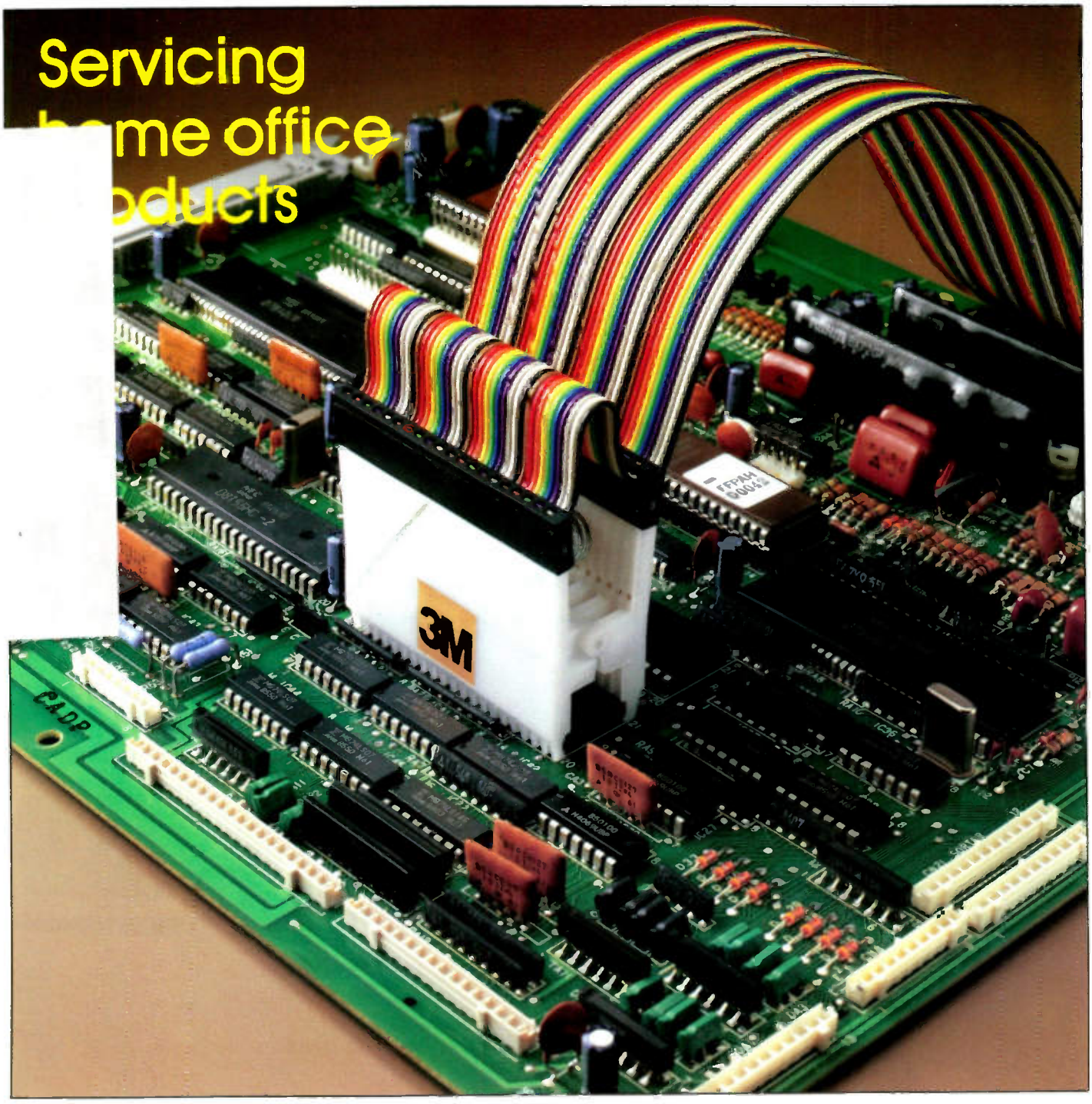
ELECTRONIC Servicing & Technology

T.M.

July 1990/$3.00

Servicing the RCA CTC111 TV

Troubleshooting step by step — The unijunction transistor



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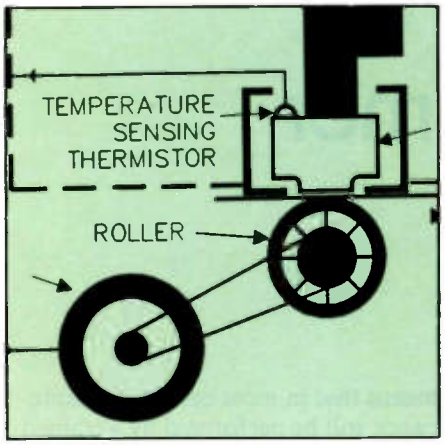

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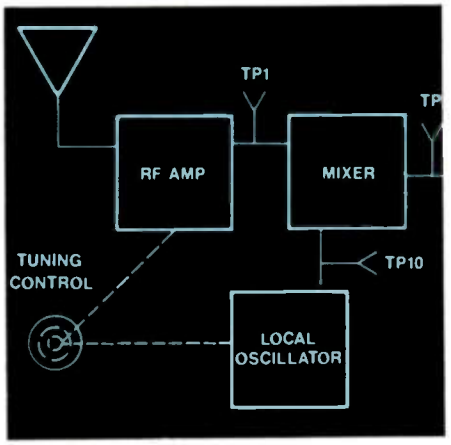

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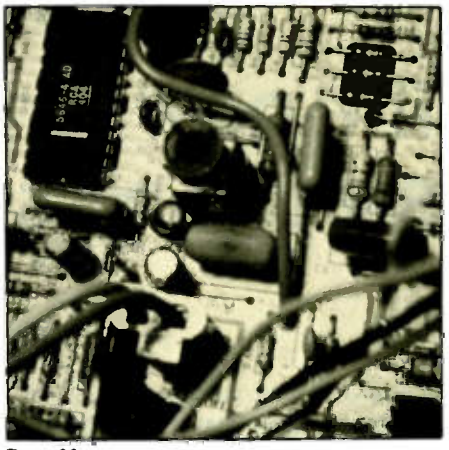

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FEATURES

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS
ELECTRONIC
Servicing & Technology

DEPARTMENTS

ON THE COVER

Advanced electronics technology, like integrated circuits and digital circuitry, make products like telephone answering machines, computers and fax machines, which were until recently only affordable to large organizations, available to the home office worker. This creates a whole new class of product that is a candidate for servicing by consumer electronics service centers. These products will, however, require some additional test equipment and accessories, like the IC test clip. *(Photo courtesy 3M).*

The new synergy in consumer electronics servicing

One of the advantages of the most recent consumer electronics products is that they provide not only a servicing challenge to the technician and service manager, but a tool as well.

Almost every consumer electronic product that has been introduced recently has provided electronics technicians not only with new products to service, but with products that can help in their own business.

The VCR, for example, because of its electromechanical nature, quickly became the bread and butter product of astute consumer electronics service centers. But besides being a product that needs servicing with some degree of regularity, the VCR also became a tool that servicing shops could put to use.

For example, it didn't take long before manufacturers of TV's, VCR's stereo equipment and even electronics test and servicing equipment, like DMM's, oscilloscopes, soldering tools, recognized that the VCR was a wonderful tool with which to instruct the technicians who would be servicing their products, or using their products in servicing of other products. Now videotapes on just about every aspect of servicing are available to any service center.

A lot of service centers are doing a very nice business servicing computers: IBM, compatibles, Commodore, and more. They're finding that floppy disk drives , especially, are needing cleaning. Printers fail from time to time, and even the computer itself and the monitor need servicing on occasion. But more frequently, people who are using computers for all kinds of purposes find that they are befuddled by the interaction of many different kinds of software, and need help getting things sorted out.

But besides being a product to service, computers are increasingly becoming a tool for service centers to use for a number of purposes. For example, with the right kind of software, a consumer electronic service center can simplify just about every administrative task required of a servicing business. A computer can generate the customer's claim check and the job ticket that accompanies the product through the servicing process. In addition, the computer can keep track of the status of the product being serviced, including such things as the identity of the servicing technician, whether the product has been attended to, whether parts have been ordered, and when the product is ready to be picked up.

But in addition to use as an information gathering and presentation tool, the computer can, with the proper hardware and software, be used as a diagnostic tool. For example, there are products, consisting of add-in boards and software that can turn a computer into a high quality digital storage oscilloscope, a frequency counter, or a recording digital multimeter.

The personal computer can also be used as a teaching device, in much the same manner as the VCR. The right kind of software can lead a technician through a programmed learning course and make him much more effective as a technician.

Facsimile machines, only recently added to the inventory of consumer electronics/home office products, are another product providing service centers with both a service opportunity and a potent tool. As pointed out in an article in this issue, fax machines require regular maintenance, which requires tools and specialized supplies to perform. This means that in most cases the maintenance will be performed by a trained technician. And someone will have to diagnose and correct problems when malfunctions occur. Some manufacturers of fax machines feel that this will be the consumer electronics servicing technician.

Fax machines are a powerful tool of service centers as well. On frequent occasions, when I've listened to technicians and service managers talk about the time wasted on the telephone trying to order parts from a busy parts distributor, the members of the more successful organizations invariably propose a solution: "send it by fax."

Sending the parts order by fax has a twofold benefit. It's not necessary to sit with the phone to your ear waiting for a human to come to the phone at the other end; you transmit your order and someone at the other end takes care of it when he's free. In addition, there's far less chance of error in filling the order because the person at the distributor end of the communication has a paper copy of the order so it's not necessary to transcribe a verbal order: a process that's rife with opportunity for error.

One of the benefits of using a tool that you also service is that each exposure to the product in one of its aspects reinforces the other. When you use a computer or send a fax, you become more familiar with its features and will be more adept at using it as a tool.

Nils Conrad Persson

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New technology featured in seminars at NPEC'90

The theme for the upcoming 1990 National Professional Electronics Convention (NPEC '90) is preparing technicians to service products of the new technology. The week long affair will be held August 5-11, 1990 at the luxurious, but affordable, Las Vegas Riviera Hotel.

Instructors will be able to participate in all technical seminars as well as special instructor's rountable sessions. All seminars are open to anyone registered for the convention at no additional charge.

Management training at the week-long convention features "Quality and Customer Relations-The Competitive Edge," by Connie Sitterly. Technicians and managers will get a chance to test their skills, if they desire during optional CET (Certified Electronic Technician) and CSM (Certified Service Manager) testing. The testing is tentatively scheduled for Friday, August 10.

Full-convention registration prices include numerous sponsored meals, admission to the Trade Show, golf and tennis outings, all technical and management seminars, and many other activities. Rates at the door are $225 per adult and $125 for the special children's program, ages 5-18. However, anyone registering before June 30 may do so for $180 for the first registrant, $160 for each additional adult from the same family or business, and $100 per child. For more information contact NPEC '90, 2708 West Berry St., Fort Worth TX 76109; (817) 921-9061.

SBA offers videos to teach business skills

Small business owners can now learn marketing, selling and financing strategies at home, thanks to a new video library created by the U.S. Small Business Administration (SBA) and Bell Atlantic.

Anyone with a VCR can learn critical business techniques in the comfort of his or her own home and small business people can save time and money and get the information they need fast. Each videotape and workbook package is available for $30 from the U.S. Small Business Administration, Dept A, P.O. Box 30, Denver, Colorado 80201.

1990 Consumer electronics industry annual review available

Compiled by the Communications Department of the Electronic Industries Association's Consumer Electronics Group (EIA/CEG) this profile and history of a rapidly changing $44-plus billion retail industry traces the development of consumer electronics product categories such as video, audio, home information equipment and personal electronics.

In addition, this authoritative source of information contains useful statistics on industry-wide sales trends, product by product. All data was compiled by the Electronic Association's Marketing Services Department, which has developed comprehensive statistical reporting programs for over three decades.

For additional copies contact EIA/CEG Communications Department, 2001 Eye Street, N.W., Washington, D.C. 2006.

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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P.O. Box 12487
Overland Park, KS 66212
913-492-4857

Electronic Servicing & Technology (ISSN 0278-9922) is published monthly by CQ Communications, Inc. 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. Allow six weeks for delivery of first issue and for change of address. Printed in the United States of America.

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.

Literature

Test and measurement catalog

Fluke Mfg. Co., Inc. offers a new 20 page catalog called "Your Complete Guide to PC-based Instrumentation Systems." This catalog features a broad selection of PC-controllable products and system software. The catalog highlights over 125 instruments in catagories such as digital multimeters, digital storage oscilloscopes, signal sources, counters and time/counters. Also featured is Fluke's line of test and measurement and data acquisition software packages for PC-based systems. The catalog is offered at no charge.

Circle (111) on Reply Card

Electronic shielding design kit

The new electronic shielding design kit from Micro-Circuits Co., Inc. is now available for consultants, business owners and home owners. The kit shows how to use the low-cost NR2HF rubber paint shielding to prevent unreliable performance of computer, medical, security, recording, and communications equipment caused by the rising tide of electricle interference.

Circle (112) on Reply Card

Fact sheet on soldering irons

People who work with soldering irons can learn how to extend the life of their equipment with a fact sheet issued by Weller Division of Cooper-Tools. The fact sheet offers many tips on working with soldering iron tips. It is a good reminder for assemblers and technicians that the tip of a soldering iron should have adequate coverage.

Circle (113) on Reply Card

Static control catalog

A newly expanded, 50-page catalog is now available from *Plastic Systems.* Designed to serve as a tutorial guide to proper static control, the catalog covers basic static control, work stations, mobile personnel, measurement test and control, and static awareness. Each section is prefaced by a tutorial article describing specific static control problems and the products needed to alleviate them.

Circle (114) on Reply Card

Equipment catalog

A source book of products for testing, repairing and assembling electronic equipment is now available from *Contact East.* The 148-page 1990 General Catalog contains products for engineers, technical managers, production managers and technicians. Introduced in this edition is test equipment, static protection products, soldering supplies and stations, oscilloscopes, precision hand tools and tool kits.

Circle (115) on Reply Card

Test and prototyping equipment

Global Specialties is offering a 36-page catalog of electronic testing and prototyping equipment. The catalog features a line of breadboarding products, logic test equipment, power supplies, a logic analyzing system and PC troubleshooting products, including slot extenders and expansion boards. New products featured are a portable protocol analyzer, a data acquisition board for PC, and a hand-held low-cost logic analyzer.

Circle (116) on Reply Card

Test instrument/accessories catalog

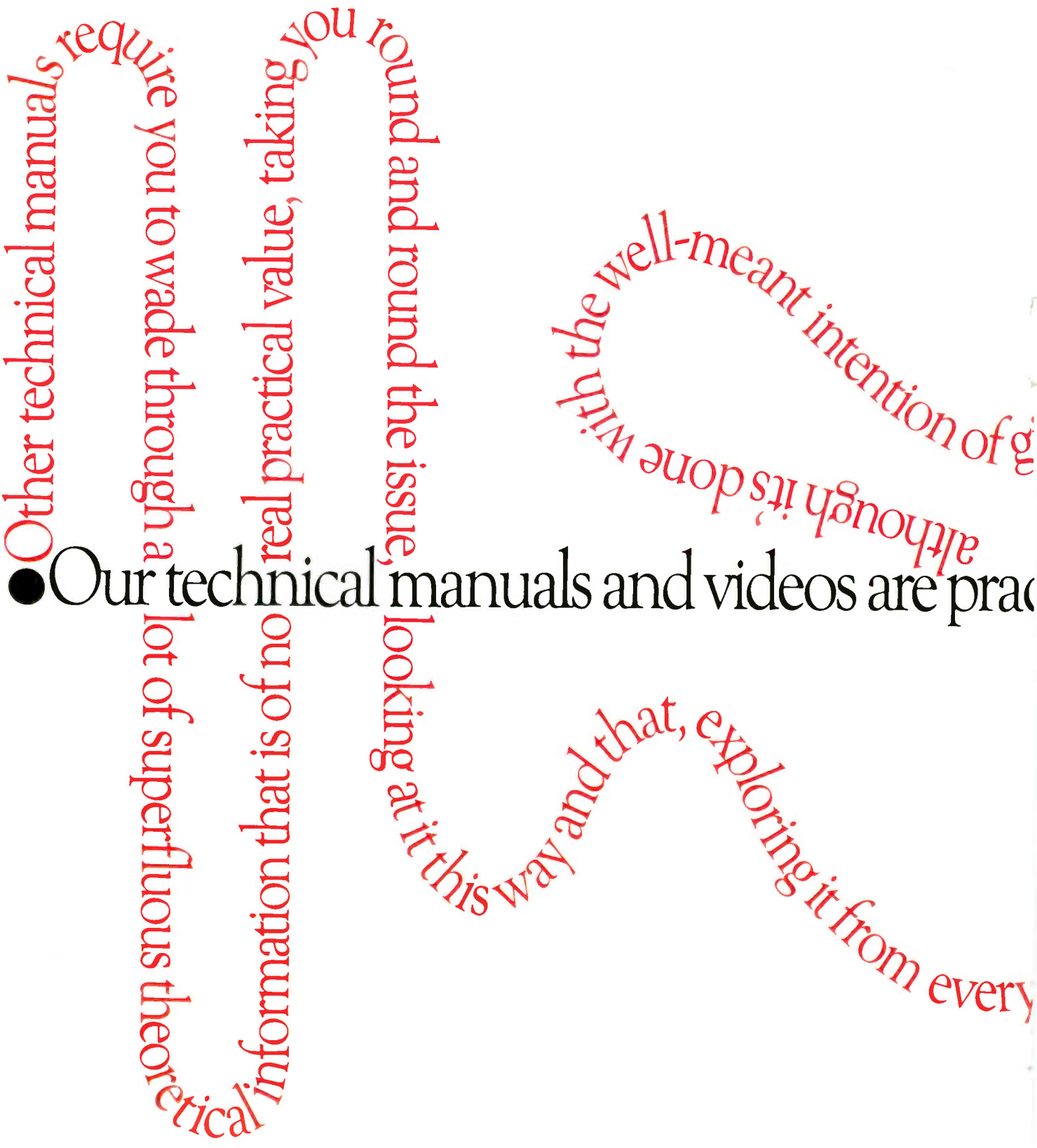
The B&K Division of *Maxtec International* has released a 68-page catalog, BK-90, covering the company's line of electronic test instruments, including digital storage and analog oscilloscopes, IC testers, digital multimeters, signal and function generators, power supplies, component testers, video test instruments, probes and accessories. The catalog provides performance and mechanical specifications, both in listings and in summary comparison charts.

Circle (117) on Reply Card

Testing product catalog

A.W. Sperry, Inc. offers catalog MC-600, Issue D, featuring the company's complete line. A selection of several new inexpensive electrical testers and indicating devices have been added to the line, including a 4-way voltage tester, two continuity testers, a combination screwdriver and voltage tester, two electrical testers, a 3-wire circuit analyzer and a battery tester.

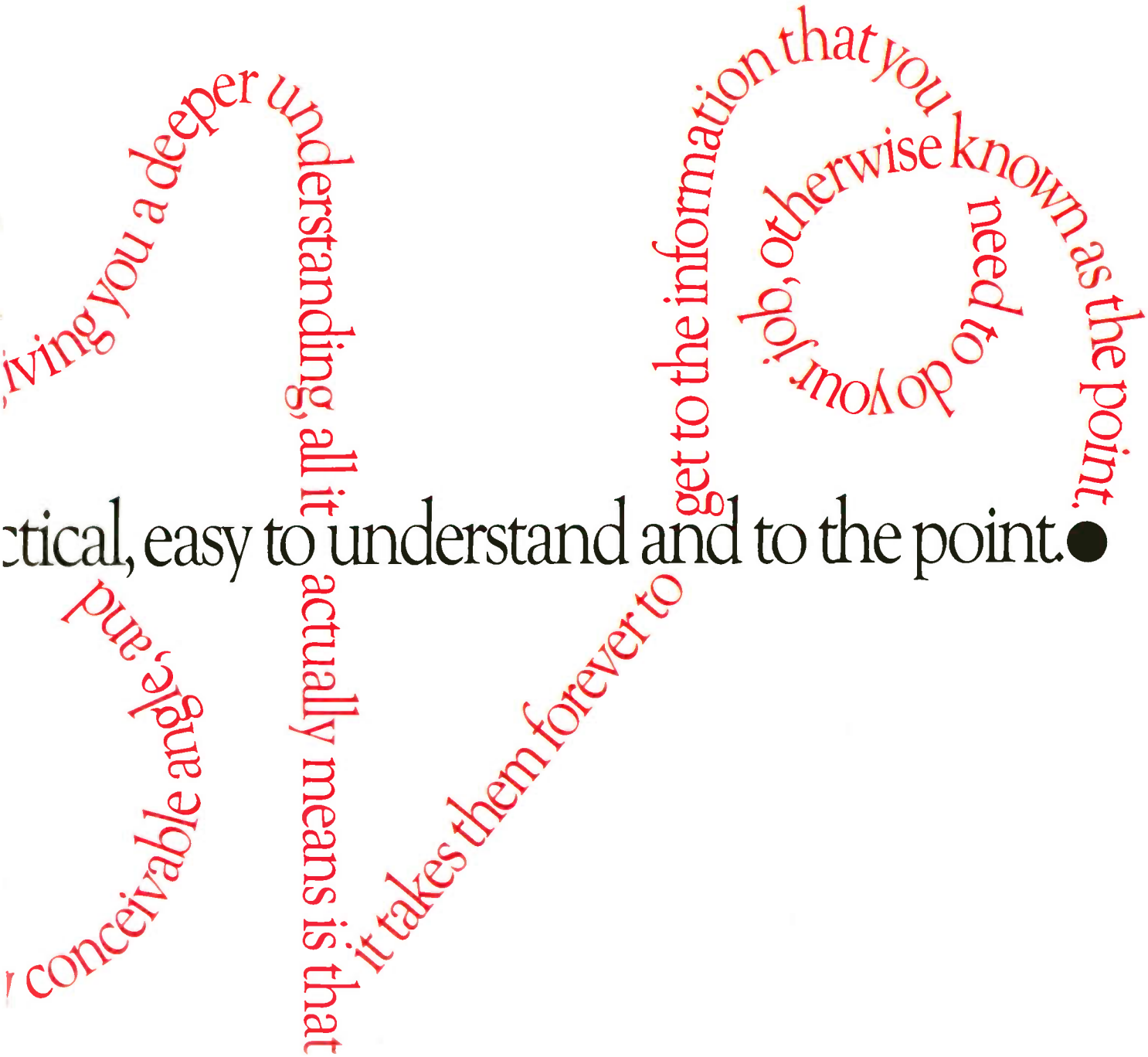
Circle (118) on Reply Card



If you want the shortest distance between a problem and a solution, look no further than our troubleshooting guides.

Whether they're for VCRs, CD players, fax machines, projection or direct view TVs, each one gives you the answers you need both quickly and simply. And thanks to our on-screen video indexing, those answers are easy to locate.

But for all the invaluable help our manuals and videos can offer, they are surprisingly inexpensive, ranging from



just $40 to $100. For example, there is our step-by-step fax training video (part #TT-107) at $89.95.

If you would like to place an order, call 1-800-553-7278. Or for a free copy of our brochure (simply-worded and to-the-point, of course), write to Mitsubishi Technical Services Division, 5757 Plaza Drive, Cypress, California 90630.

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Servicing home office products

By Conrad Persson

The home office is a reality. For less than $3,000, a consultant, writer, or other person who works with ideas and paper can obtain telephone, answering machine, computer, fax and copier and set up shop as an open collar worker.

Most of these home office products have at least a couple of things in common: one, they are expensive enough to warrant repair rather than automatic replacement, and two, they have electromechanical parts that require periodic cleaning, and that wear and occasionally break. Many consumer electronics servicing organizations are finding that servicing home office products is a lucrative business.

Persson is editor of **ES&T**

The telephone

Take for starters the telephone. Just a short time ago, everything that had to do with the telephone system in a residence was the responsibility of the local telephone operating company, including all the wiring and jacks throughout the house. Even the telephone was leased from old Ma Bell. If the phone didn't work, the consumer just contacted the telephone company and out came a technician to fix whatever the problem was, no charge.

That's changed a lot. Now consumers can own their own telephones. Not only that, but whether they like it or not, now they own all of the telephone wiring in the house. Now if anything goes wrong with the telephone system up to the customer's premises, the phone company takes care of it. If anything goes wrong with the telephone system on the customer's premises the telephone company takes care of it—for a fee that works out to around $40 to $50 for a trip charge, and a labor charge for anything over a certain amount of time.

Because the phone lines are now the customer's responsibility the customer can have anyone they choose install or service them; especially if

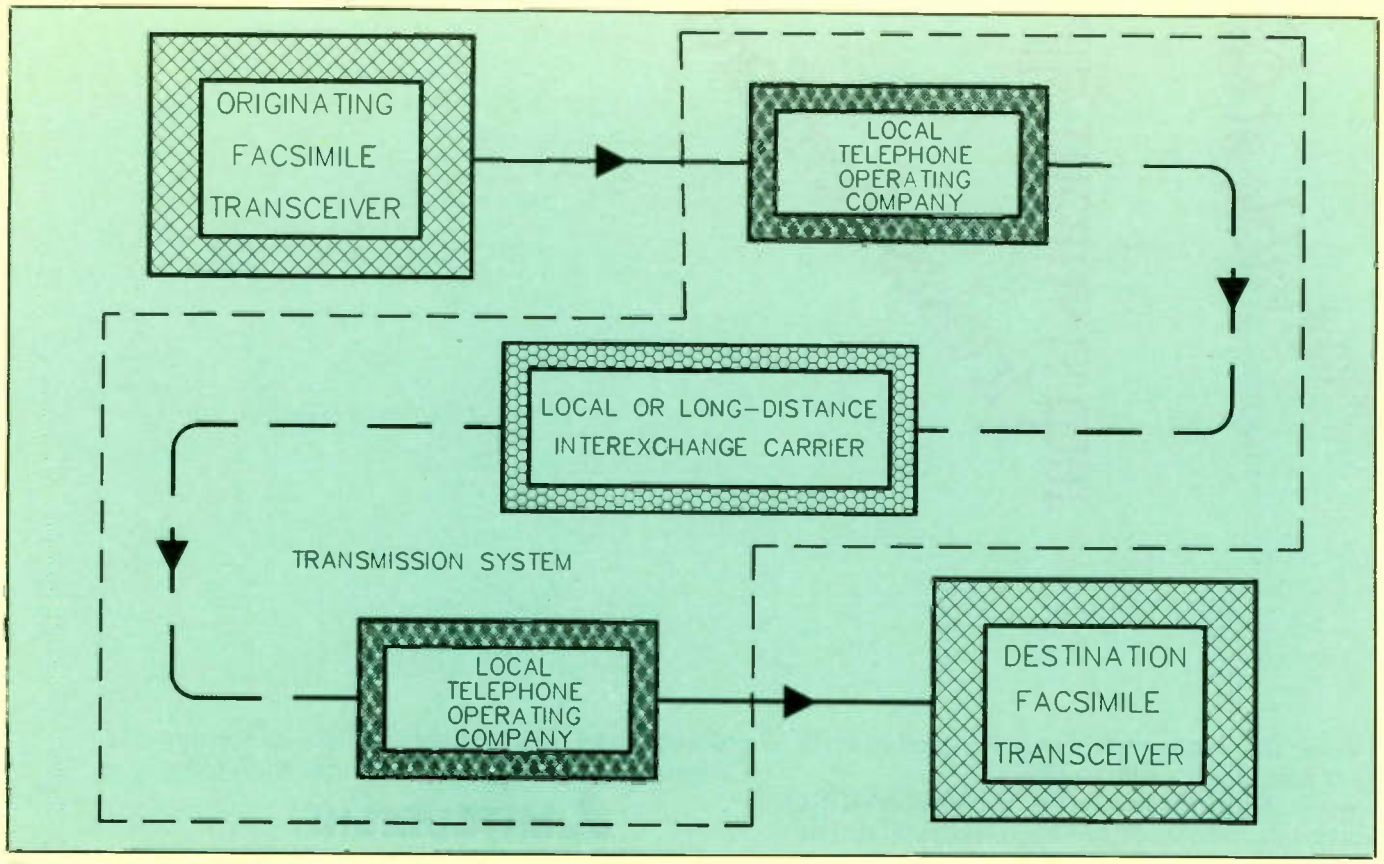

Figure 1. A basic facsimile system consists of the facsimile transceivers at both ends and the communications system connecting them.

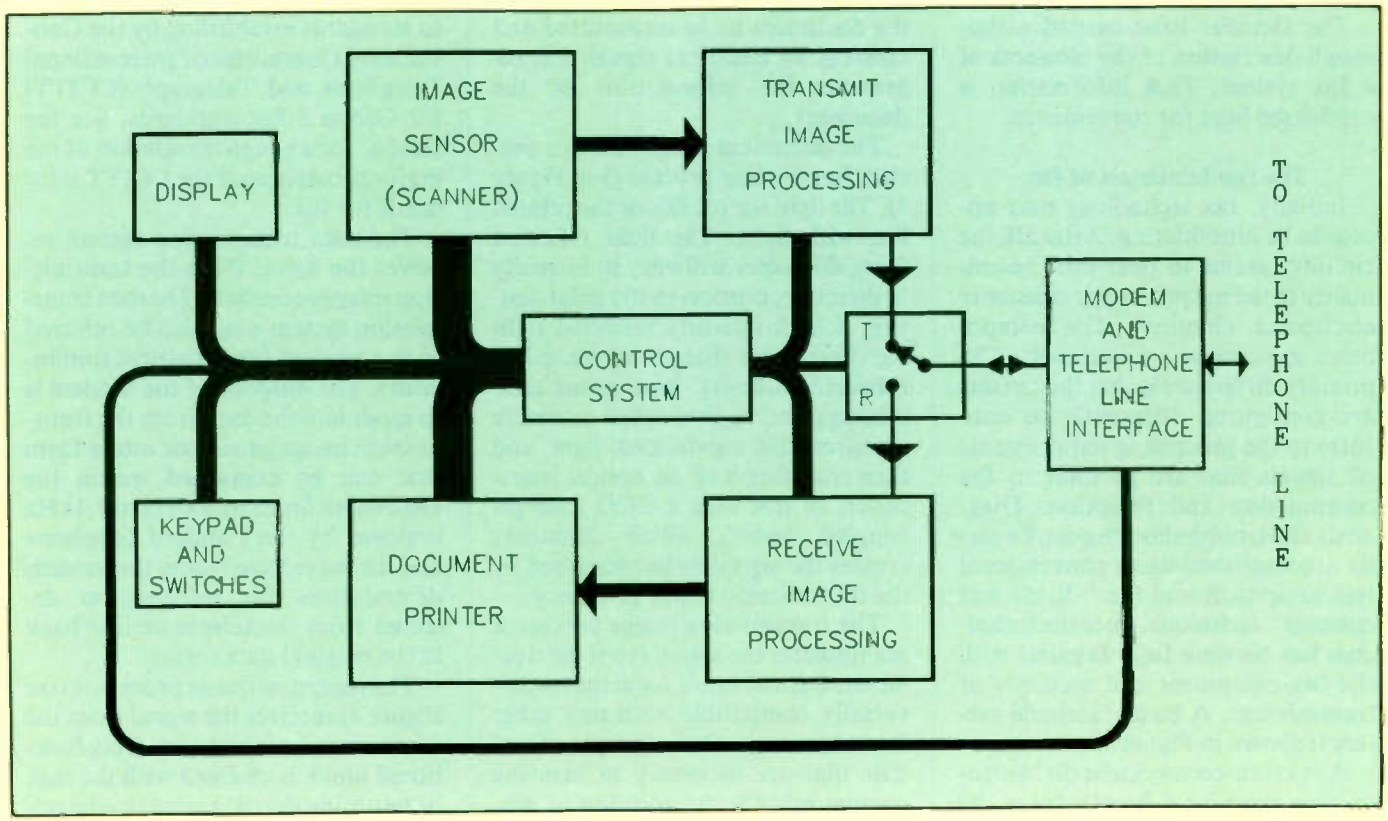

Figure 2. A typical facsimile transceiver in the transmit mode.

that someone can do the work less expensively or more efficiently, or both. In some cases, the person doing this work less expensively and/or more efficiently is the local consumer electronics service center.

Divide and conquer

If one of your customers requests that you service his telephone equipment or system rather than pay the phone company's rather stiff rate, there are several simple tests that you can perform that will help you track the problem to the cause.

For starters, if it's one of the newer systems that has a box on the outside wall of the house where the service enters, that's the dividing line. Anything on the upstream side of the box is the phone company's responsibility; anything on the downstream side of the box is the customer's responsibility. It's fairly easy to tell where the problem lies. Inside the box is a modular connector (or more than one if there's more than one line coming into the house). If there's a problem with the phone system, you can open up the customer's side of the box (the other side is sealed, and belongs to the phone company). If you plug a known-good phone into the jack here and the problem persists, the problem is in the phone line coming in, and you should refer the customer to the telephone company, which will repair it at no further charge.

If, on the other hand, you find that the telephone works just fine connected to this jack, the problem is in the house and the customer will have to pay, regardless of who fixes the problem, so you might as well be the one to do the fixing. The next step is to track down the actual cause of the problem. As the telephone system in the house consists of little more than a few wires and a few connectors, finding the problem should not be very difficult. Start by unplugging all of the phones on the line then plugging the known good phone into the modular connector closest to the service entrance and working down the line. When you find a point where the problem occurs, check out the connections to the connector and the wiring upstream from the problem connector, until you localize the problem.

Here's a quick tip: if you're working on a two line system and you want to know which line is connected to a given jack, just dial 640-222-2222. A computerized voice will speak the number that you're dialing from.

Facsimile

Facsimile, or fax, is a product that was almost unknown in the office setting, home or otherwise, until just a few years ago. Then all of a sudden, almost overnight, people in offices everywhere were sending information by fax.

The reason for the sudden change is simple: fax became more convenient to use. Until recently, the technology used didn't offer the speed, convenience or flexibility to integrate well into the office environment. The machines were complicated to use, in some cases requiring a specially trained operator, or photographic processing of the copy, or both.

During the past twenty years, the technology of facsimile has improved rapidly, in step with the advances in semiconductor technology. Digital microcircuits helped reduce the size and power consumption, and accelerated the design of the digital

encoded fax machine. These machines allow the transmission of a document in less than a minute, and automate most of the document processing.

The October issue carried a thorough description of the elements of a fax system. That information is condensed here for convenience.

The fundamentals of fax

Initially, fax technology may appear to be intimidating. After all, the circuitry seems to bear little resemblance to the more familiar consumer electronics circuitry. The components are similar, nonetheless. The primary difference is that the circuits are configured differently to conform to the processing requirements of signals that are peculiar to fax transmission and reception. Diagnosis and troubleshooting can be easily accomplished using conventional test equipment and the "divide and conquer" technique, once the technician has become fully familiar with the fax equipment and methods of transmission. A basic facsimile system is shown in Figure 1.

A fax transceiver can be divided into five functional blocks (plus the power supply) that must be understood to effectively service the machine. (See Figure 2.)

The document scanner, or image sensor, is responsible for scanning the document to be transmitted and creating an electrical signal that represents the information on the document.

The document is scanned in a precise, line-by-line process (See Figure 3). The light source floods the printed line with light. The light reflected from the paper will vary in intensity in direct proportion to the print density: a high-intensity reflected light for those areas that are white, a low reflected intensity from areas containing print. A fiber optics assembly captures this modulated light and then transfers it to an optical transducer, in this case a CCD (charge-coupled device), which ultimately creates the signal to be processed by the transmission image processor.

The transmission image processor manipulates the signal from the document scanner into a form that is universally compatible with any other fax transceiver. One example of signals that are necessary in assuring compatibility is the addition of motor control signals necessary to synchronize the motors and other mechanical functions within the transceiver. This circuitry also ensures that the transmitted data will adhere to standards established by the Consultative Committee of International Telephone and Telegraph (CCITT) for Group 3 fax standards. See the sidebar for a rough translation of the major provisions of the CCITT standards for fax.

The data transmission system receives the signal from the transmission image processor. The data transmission system may also be referred to as a modem (modulator/demodulator). The purpose of the modem is to modulate the data from the transmission image processor into a form that can be contained within the bandwidth limits of 300Hz to 3.1kHz imposed by the standard telephone line. In the receive mode, the modem demodulates the information detected from the telephone line back to the original data form.

The reception image processor (see Figure 4) receives the signal from the data transmission system. This functional block is charged with the task of returning the data signal to the ori-

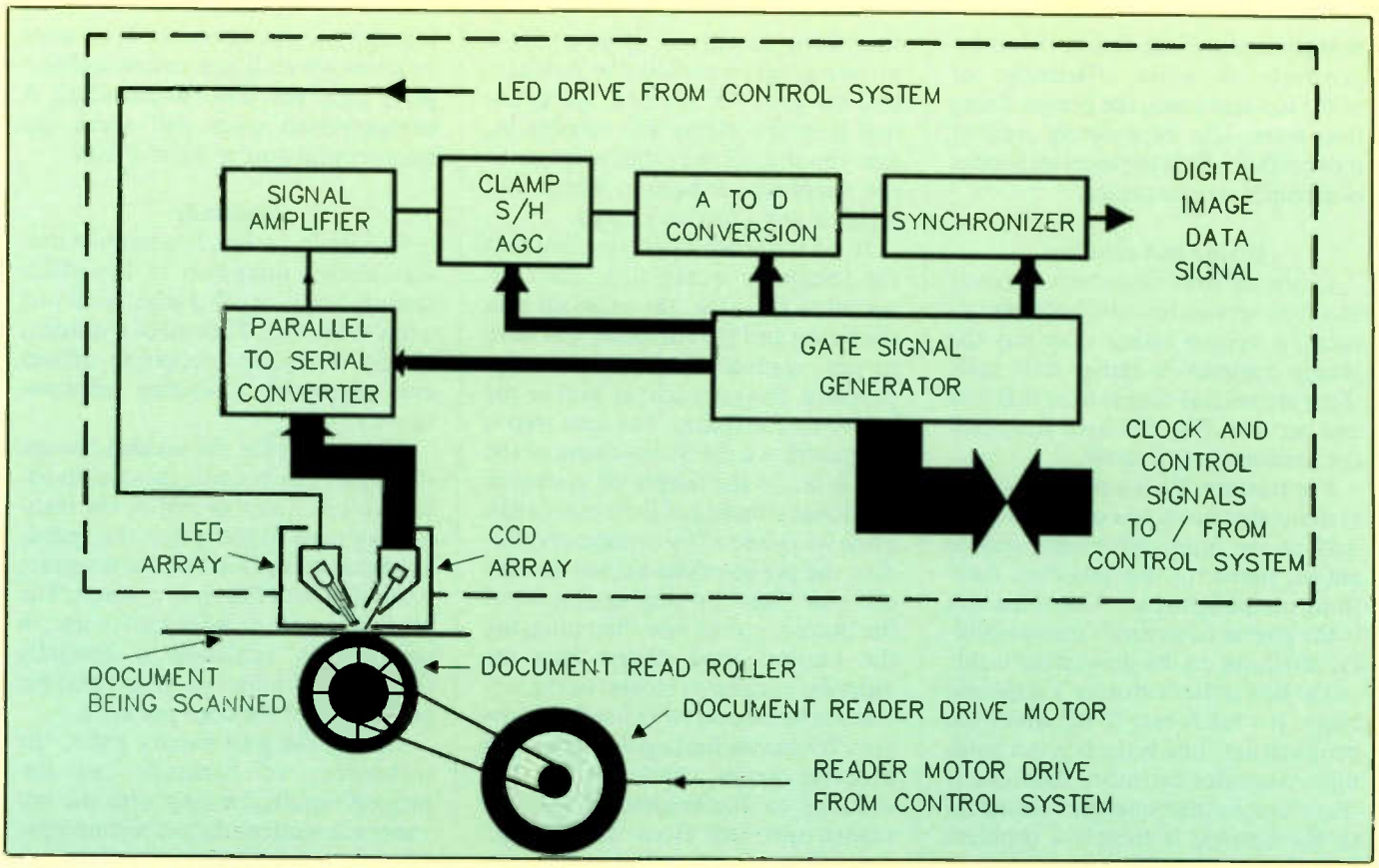

Figure 3. The contact image sensor (document scanner) converts the information on the document into an electrical signal which will be processed by the image processing circuits and transmitted over the communications line.

ginal document form before manipulation by the transmission image processor. Part of this process includes the extraction of the control signals used to drive the motors in the receiving fax machine. The resulting document information signal is then coupled to the document printer.

The document printer used by most fax machine manufacturers is a thermal printer. A thermal printer operates by supplying a current, modulated by the information to be printed on the document, to individual resistor elements that are in contact with the paper. As these resistor elements heat up, the chemically treated paper will turn black at the point of contact. This process occurs using the same line-by-line format as the document scanner.

To efficiently diagnose and repair fax problems, you need to understand the concepts of operation as presented here, plus the communication process and telecommunication equipment problems.

Servicing facsimile equipment

Servicing of facsimile equipment includes two distinct subdivisions: periodic cleaning and preventive maintenance and diagnosis and repair of malfunctions. Many facsimile machine manufacturers recommend that they be inspected at least once a month, and cleaned if necessary. If any part of the paper path needs cleaning, the entire unit should be cleaned. Frequency of cleaning will depend on a number of factors:

1. The environment in which the unit is used. If the area is clean, cleaning will be needed less often than if the area is dirty.
2. Quantity of documents processed.
3. Quality of thermal paper used.
4. Degree of care taken by the operator.

This cleaning is something that will ordinarily be performed by a servicing technician and not by the operator, for the simple reason that it requires tools and entails a certain amount of disassembly.

For this cleaning, the technician needs to be equipped with the following:

Materials

- A container of pure alcohol for cleaning the rollers and other parts of the paper path. Freon TF may also be used for this purpose. Do not use Freon TMC, as it contains a lubricant.
- A container of a general-purpose cleaner for cleaning the cabinet and any other exterior parts. Again, check the documentation for the particular unit. One manufacturer recommends cleaning the exterior with a soft cloth and specifies that cleaning fluids should not be used.
- A quantity of 4″ by 4″ squares of lint-free gauze or fabric. As an alternative, lint-free disposable wipes such as Kim-Wipes may be used. Note that paper towels should not be used if lint-free wipes are specified. Paper towels produce lint, which can cause the transceiver to malfunction if it winds up in the wrong place.
- A thermal head cleaning stick as recommended by the manufacturer.
- A blower brush, similar to the products used for cleaning photographic lenses, for blowing dust from the unit.
- Soft paper towels or soft cloth for cleaning the exterior parts.

Tools

- Screwdrivers
- Needle nose pliers

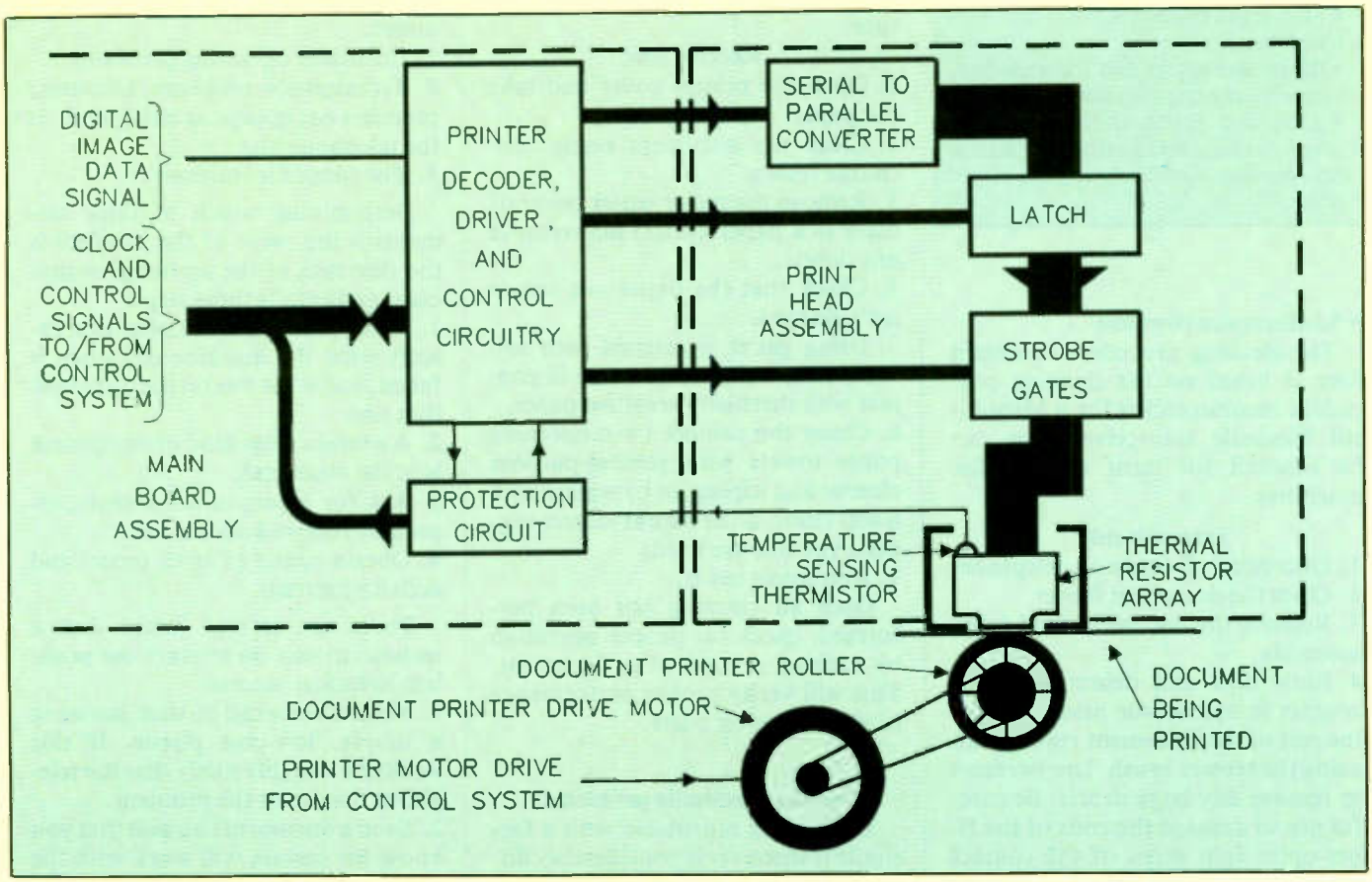

Figure 4. The thermal document printer converts the received facsimile signal to a duplicate of the transmitted page.

Major provisions of the CCITT standards for fax

Here is a rough, non-technical translation of the major provisions of the CCITT standards for fax. The Consultative Committee of International Telephone and Telegraph (CCITT) has established standards to which all manufacturers of fax machines must adhere. Currently, Group 3 standards represent the current technology available for use on the standard public telephone line. To achieve communication between two separate fax machines, both machines must support the same group of standards. Some Group 3 machines do possess the capability of falling back to Group 2 standards.

Group 2
- AM analog process
- transmission speed fixed to two to three minutes per page
- AM signals are sensitive to line conditions
- fair to poor copy quality is now uncommon (copy quality limited by scanning resolution; low speed limits usage to medium volume)

Group 3
- digital technology permits high image quality
- high-quality documents in 20 to 40 seconds per page
- high-speed facilitates use in high-volume locations
- digital technology best for error-free, long-distance transmissions
- additional features: time/day/date stamp, transmitter identification stamp, transmission verification, auto speed select.

- Medium size tweezers

The cleaning procedure described here is based on the cleaning procedure recommended for a Mitsubishi facsimile transceiver, but can be adapted for most modern fax machines.

Transmit side

1. Disconnect all cords: ac, telephone.
2. Open the document feeder.
3. Remove the document feed roller assembly.
4. Blow dust and debris from the contact image sensor assembly and the rest of the document reader path using the blower brush. Use tweezers to remove any large debris. Be careful not to damage the ends of the fiber-optic light pipes of the contact image sensor assembly, or the entire contact image sensor assembly will have to be replaced.
5. With a gauze pad moistened with alcohol, clean the read roller. Clean this roller first, or use a clean gauze when you clean it.
6. Clean the paper separator.
7. Clean any metal plates that come in contact with the paper.
8. Clean the feed roller and attendant plates.

In all of these procedures, use only enough alcohol to get the rollers clean. The rollers must be completely dry before the machine is placed back in operation.

Once everything is clean, reassemble the unit, and exercise all the moving parts to be sure that there is no binding before turning the transceiver back on.

Most modern facsimile transceivers do not require any periodic lubrication. The motors are permanently lubricated at manufacture, and all other moving parts turn in either permanently lubricated bearings or in plastic bearings that don't require lubrication. On some machines, the gears have a light coating of silicone lubricant to reduce noise. This lubricant should be replenished if the machine becomes excessively noisy. Check the manufacturer's specs to be sure.

Receive side

1. Open the printer cover and take out paper.
2. Clean the document reader discharge rollers.
3. Remove the paper cutter cover (if there is a paper cutter) and remove any debris.
4. Check that the paper out sensor isn't clogged.
5. Using gauze moistened with solvent, clean rollers that come in contact with thermally-sensitive paper.
6. Clean the cabinet by moistening paper towels with general-purpose cleaner and wiping, or by wiping with a soft cloth, if the manufacturer suggests you not use fluids.
7. Reconnect cords.

Once all cleaning has been performed, check for proper operation by making a copy of a document. This will verify proper performance of all transceiver parts.

Solving facsimile problems

Diagnosing a problem with a facsimile transceiver is considerably different from diagnosing a problem with most other products that a consumer electronics servicing technician deals with. When dealing with a fax machine, a technician is also dealing with possible problems in the telephone line on the customer's premises, the telephone carrier line, the phone equipment on the premises of the person at the other end of the phone line, and the facsimile transceiver at the other end.

You will also find that there are occurrences that cause intermittent problems, which cannot be corrected by any kind of service. For example, one fax machine we're aware of has had problems with its paper cutter, hanging up at each page. Something like this can make the sender think that there's a problem at his end. Another apparent problem that can occur on a fax machine is for the paper to run out with no one in attendance. Atmospheric disturbances, such as severe thunderstorms anywhere along the transmission path may cause momentary interruption of a transmission.

Because of this unique situation, there are three categories of facsimile transceiver problems. When problems are reported, the first task of the technician is to determine which of these categories the problem falls under:

1. Customer operating problems.
2. Transmission problems: Customer premises equipment at either end, or the telephone line.
3. The facsimile transceiver.

Determining which of these elements is the cause of the problem is the first task of the servicing technician, and entails these steps:

1. Determine from the operator exactly what the machine did when it failed, and what was on the display at that time.
2. Ascertain what kind of equipment is at the other end.
3. Ask for copies of documents, especially received documents.
4. Obtain copies of error report and activity journals.

There are several things that a technician can do to start the problem isolation process:

1. Make a voice call on that line using a simple, low-cost phone. If this works, it is highly likely that the telephone line is not the problem.
2. Send a document to a unit that you know for certain will work with the unit that's exhibiting problems. If

that works, you have determined that the problem is not with the machine you're working on.

3. Try making a copy of a document with the suspect transceiver. If the unit makes an acceptable copy you have verified the operation of a large portion of the transceiver.

One thing to keep in mind is that occasionally, a fax machine with non-standard features may have difficulty communicating with another fax machine, even though both are operating perfectly.

Problems with the phone line

While occasional, random transmission or receptions problems should be considered a normal occurrence, consistent problems merit in depth investigation. A first question should be "Are both local and long distance transmissions affected." If they are, one way to determine if it's the equipment or the line is to connect the fax to another phone line if one is available and then try transmitting to one or two machines on which problems have been encountered. If the problem clears up, the problem is in the phone equipment.

Further investigation is warranted in this case. Is there other equipment connected to the line on which problems have occurred? If other equipment is connected to the line, disconnect it and try transmitting on that line again. If the transmission works properly, the problem is that other equipment. It may be that there's nothing wrong with that other equipment; the problem may be caused by a phenomenon known as "loading."

Even when a telephone is "off-hook," the ringer is connected to the line. Every phone is marked with its REN (ringer equivalent number). By federal law, the total of RENs of all phones connected to a phone line may be no greater than 5. Some telephone companies specify no greater than 4. If the total exceeds this figure, problems may be encountered. If the phone line is not up to spec, problems might occur even if the total of all RENs of phones on the line is less than that.

In any event, facsimile transceiver manufacturers recommend that no other telephone equipment be connected to the line used by the fax machine, unless it's connected through an "exclusion" device that's part of the fax itself. That's a relay that keeps the telephone disconnected from the line until the operator picks it up.

Fax works fine locally but not on long distance

You will occasionally encounter problems such that the fax works fine for local transmissions but will not work with one or more locations over long distance lines. When this occurs, try an alternate long distance carrier. If you're in an area where equal access is in effect, you can call the operator and request the five-digit access code(s) for alternative long distance carrier(s). If the transceiver works on this alternative system, the problem was with the original long distance carrier.

In the case where problems occur with only one long distance location, the problem is most likely with the connection of the long distance line at that location.

Making manual adjustments

In most cases, any adjustments to the facsimile machine required by a particular line are made automatically during the "handshaking" routine at the beginning of transmission. If all attempts to correct transmission line problems have failed and an apparently good fax transceiver consistently has problems, then manual adjustments are called for in accordance with the manufacturer's specifications. You must keep in mind that there will probably be some negative side effects of these changes.

The automatic corrections made during handshake are intended to provide optimum transmission. Some of the manual adjustments may reduce the speed of transmission, resulting in higher telephone costs and longer operating times.

If problems persist after making manual adjustments, the problem is probably in the equipment.

We will go into more detail about diagnosing and correcting facsimile transceiver equipment problems in a future issue. ■

The portion of this article that describes facsimile operation and servicing is adapted from the 1989 Facsimile Machines Technical Training Course (videotape and workbook) available from Mitsubishi Sales America, Cypress, CA.

Thyristors from A to Z: UJTs

By Bert Huneault, CET

The unijunction transistor (UJT) is another natural companion of thyristors. For example, in numerous applications a UJT is the trigger device used to supply the gating pulses needed to fire an SCR. Before examining UJT-controlled SCR circuitry, a brief review of UJT principles is in order.

Figure 1 shows that the unijunction transistor is a three-terminal device featuring a single P-N junction. The terminals at opposite ends of a slab of N-type silicon are referred to as base 1 and base 2. A P-type emitter is fabricated into the side of the slab, closer to base 2 than to base 1, as seen in (a). The emitter and the slab form a P-N junction. The UJT is equivalent to a diode connected between the emitter terminal and the junction of the R_{B1}-R_{B2} voltage divider representing the internal resistance of the silicon slab; see Figure 1(c).

Because the N-type silicon is lightly doped, the interbase resistance is fairly high—typically between 5K and 10K at room temperature—when no emitter current flows. Because of the off-center position of the emitter, R_{B1} is greater than R_{B2}.

We can now study the characteristics of this UJT equivalent by hooking it up in a dc circuit. In Figure 2(a) we apply 12V across the base terminals and leave the emitter terminal open. Assuming values of 5K and 1K for internal resistances R_{B1} and R_{B2}, respectively, it's evident that the voltage at the cathode of the equivalent diode (point P in the voltage divider network) is +10V relative to the grounded B1 terminal. With 0V applied to the emitter, the P-N diode is obviously reverse biased. With 6K of total interbase resistance and 12V applied, a current of 2mA flows through the silicon slab.

If we apply a small positive voltage to the emitter, as in Figure 2(b), we find that the I_{BB} current stays at 2mA as long as the diode junction remains reverse biased. But if we gradually increase V_{EE}, we observe that the I_{BB} current suddenly jumps up to about 12mA when the emitter voltage reaches a value of about 10.6V.

Here's why: due to the +10V potential at the cathode of the equivalent diode (point P), any emitter voltage less than 10.6V keeps the diode reverse biased. But with 10.6 or 10.7 volts applied to the emitter, the silicon junction becomes forward biased. When this happens, emitter current (I_E) starts flowing as holes from the heavily doped P-type emitter are injected into the lower section of the N-type slab, creating a highly conductive path (low resistance) between the emitter and the B1 terminal. As a matter of fact, the lower portion of the slab becomes saturated with charge carriers, causing a drastic reduction in R_{B1}, e.g. down to 50 ohms in Figure 2(b).

Since the internal resistance between emitter and base 1 virtually becomes a short circuit, the interbase resistance is reduced to only 1K and I_{BB} increases to 12mA. The transistor remains in this latched condition as long as the emitter current is maintained above a certain minimum holding value—usually a few milliamps. If we decrease V_{EE} until I_E is reduced below that minimum, the UJT becomes unlatched and reverts back to its original high resistance condition, as in Figure 2(a).

Note that once the p-n junction becomes forward biased and emitter current starts flowing, the potential difference between emitter and base 1 drops sharply due to the sudden reduction in R_{B1}. The UJT is said to exhibit negative resistance because the emitter voltage actually decreases while its current increases. This negative resistance is stable and reliable enough to be used in applications such as oscillators.

UJT relaxation oscillator

The unijunction transistor is widely used in relaxation oscillators, sawtooth generators and trigger circuits. A basic relaxation oscillator is shown in Figure 3. It features two output signals: a sawtooth waveform as well as positive pulses suitable for thyristor triggering.

The circuit is called a relaxation oscillator because the UJT conducts only briefly, remaining in the nonconductive state (relaxing) most of the time. It reminds me of some of my not-too-successful former students!

When dc voltage is applied, the emitter is in the open circuit state and C1 begins charging toward +20V through R1; the charging time constant is controlled by the resistance of R1. As soon as the voltage across C1

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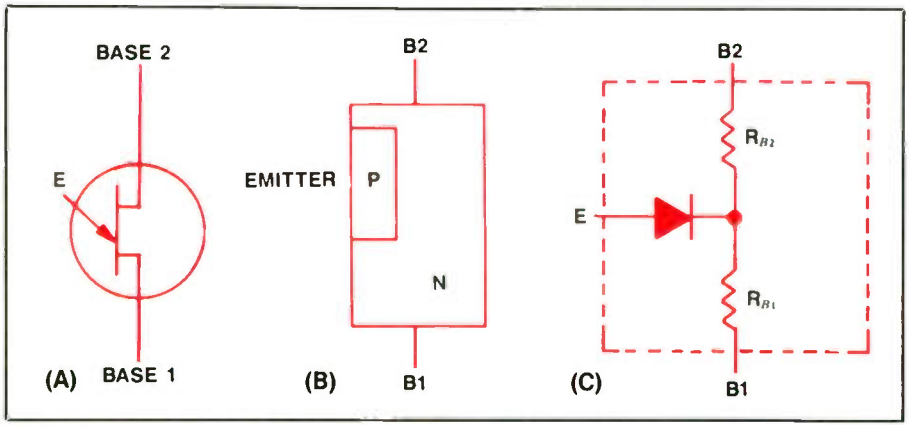

Figure 1.

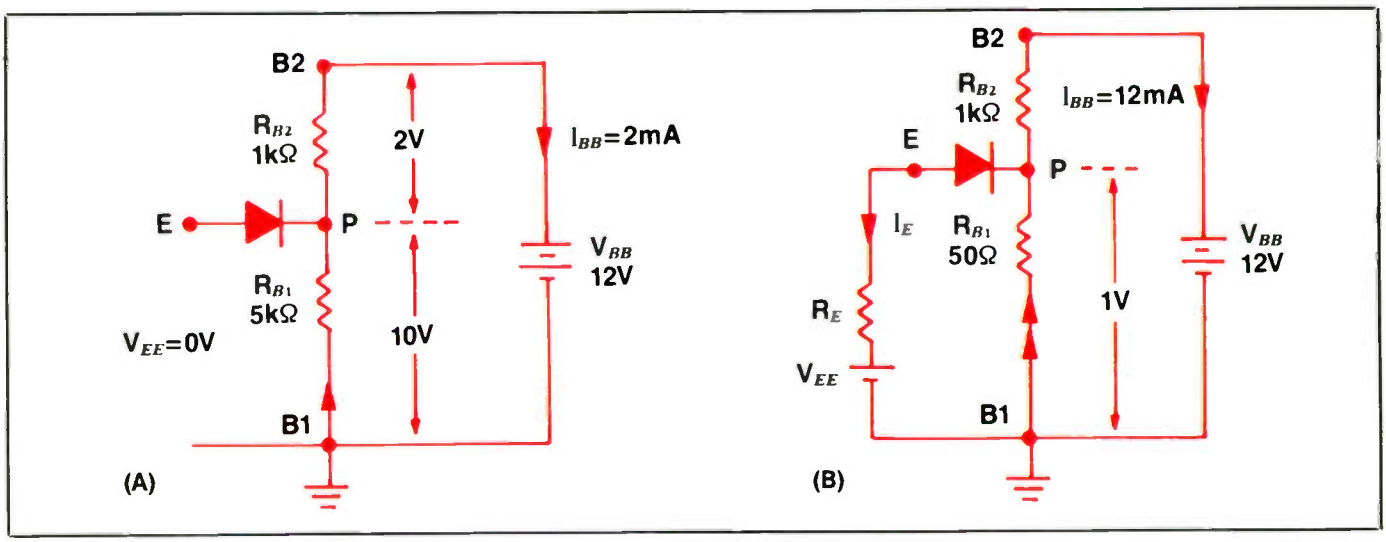

Figure 2.

rises sufficiently to forward bias the UJT's p-n junction, the emitter closes, i.e. the transistor enters the conduction state. This causes C1 to quickly discharge through the 47-ohm R3 and the low internal resistance (R_{B1}) of the UJT.

As soon as the capacitor's discharge current drops below the emitter's minimum holding value, the UJT unlatches and reverts back to the non-conducting state, allowing C1 to begin charging again. This on-off, charge-discharge action repeats itself indefinitely, giving us a reliable oscillator circuit.

Because the charging time constant is much longer than that for discharge, the voltage waveform available at the emitter is a sawtooth; the oscillator is therefore a useful sawtooth generator. In the brief period when the UJT is conducting during each oscillator cycle, the C1 discharge current flowing through R3 produces a short-duration positive pulse at the B1 terminal. These sharp pulses can be used to trigger thyristors such as SCRs and triacs.

Note that because R1 determines C1's charging time constant, the rheostat controls the pulse repetition rate (frequency) of the oscillator. R2 compensates for the effects of temperature changes, thus maintaining a stable firing point. Its resistance is typically a few hundred ohms.

UJT-triggered SCR

Let's wrap up this article with a practical application, mating a UJT with and SCR in a circuit that can be used as a lamp dimmer, heat controller or motor speed control. The circuit, shown in Figure 4, features a UJT relaxation oscillator which is synchronized with the 60Hz ac line and controls the conduction angle of the SCR.

D1 rectifies the 60Hz ac, supplying the necessary dc voltage for the UJT circuit. The dc is regulated by 20V zener diode D2. Let's follow the circuit action from the beginning of the ac line's positive alternation. As line A becomes more positive, so does point C at the output of rectifier D1. This reverse biases the zener diode. The rapidly rising voltage at D2's cathode causes the zener diode to

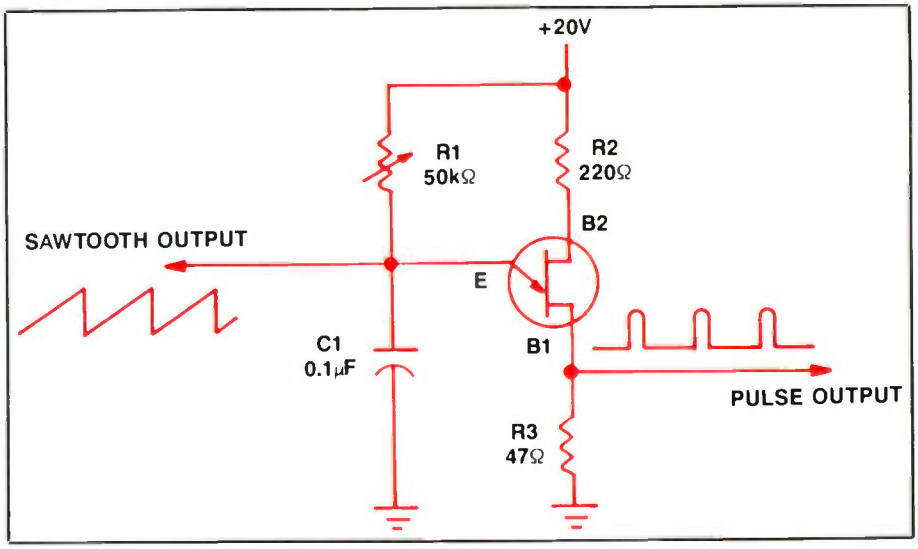

Figure 3.

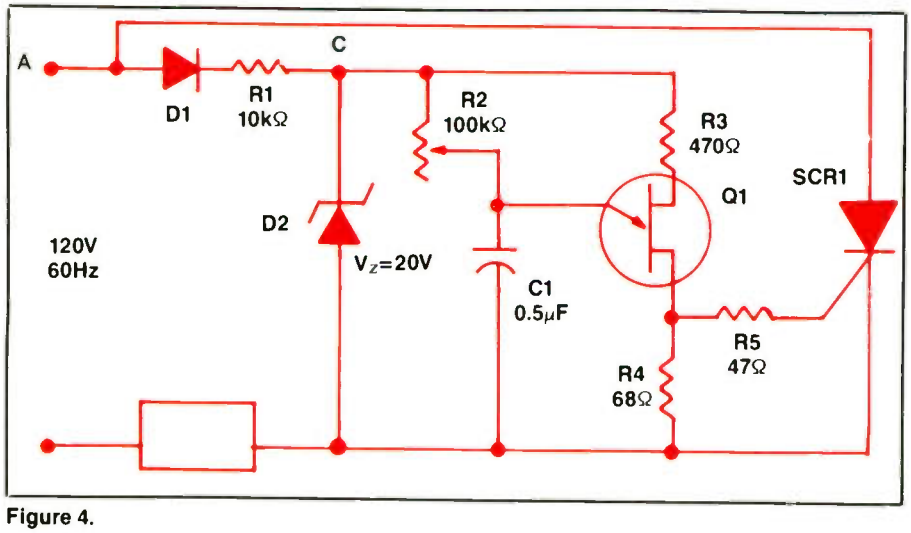

Figure 4.

start conducting (avalanche) early in the ac cycle, clamping point C at the +20V level from then on. This has the effect of suddenly applying +20V to the UJT relaxation oscillator which is similar to the one in Figure 4.

After a period of time determined by the R2-C1 time constant, the C1 voltage becomes high enough to turn Q1 on, resulting in a positive pulse at the top of R4. This positive voltage is applied through R5 to the gate of the SCR, firing the latter into conduction and energizing the load.

The SCR continues to conduct during the remainder of the positive alternation of line voltage. Note that while the SCR is conducting, the voltage across it (between points A and D) is virtually zero. Obviously, then, the voltage across D2 also drops to zero. The zener diode comes out of avalanche and both it and the UJT stop functioning. Furthermore, C1 does not begin to recharge after firing the UJT, as it normally would in a free-running relaxation oscillator.

The complete circuit remains inoperative during the negative alternation of line voltage because neither the SCR nor rectifier D1 can conduct with a negative anode. During the next positive alternation, the previous sequence of events is repeated. Therefore, rather than being free-running, the UJT oscillator is synchronized by the 60Hz ac line.

Adjusting the resistance of R2 allows the UJT and SCR to fire earlier or later in each cycle, thereby controlling the conduction angle (duty cycle) of the SCR. If the load is a dc motor, R2 thus becomes the speed control; if the load is a lamp or heating element, R2 serves as brightness or temperature control.

A future article will examine other practical uses of SCRs, including TV receiver applications, and take a peek at light activated SCRs, also called photo-SCRs. ■

Troubleshooting step by step

By Thomas G. Vlazny

Troubleshooting is a highly individualized skill; some technicians seem to be able to put their fingers on the problem's cause immediately, whereas some seem to struggle. Most technicians will eventually solve the problem, but time and cost will vary.

A logical step-by-step method of troubleshooting can help you perform your job more efficiently. The pattern of the steps is an important aspect of troubleshooting, and the best results will be obtained if they are followed as listed to present a logical thought pattern. There are few basic assumptions made:

- You are familiar with the equipment.
- Technical manuals and/or schematics are available.
- The recommended test equipment is available.
- The repair parts are readily available.

With these items in place, we can begin the step-by-step method of troubleshooting.

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Step one—
Recognize the symptom

In this step, you take advantage of your familiarity with the equipment to recognize that there is a problem. The problem can be as difficult to see as an intermittent loss of sync, or it may be as obvious a fault as failure to read a computer disk. Whatever the nature of the problem symptom, with experience you will become more and more familiar with the equipment, and the symptom will be-

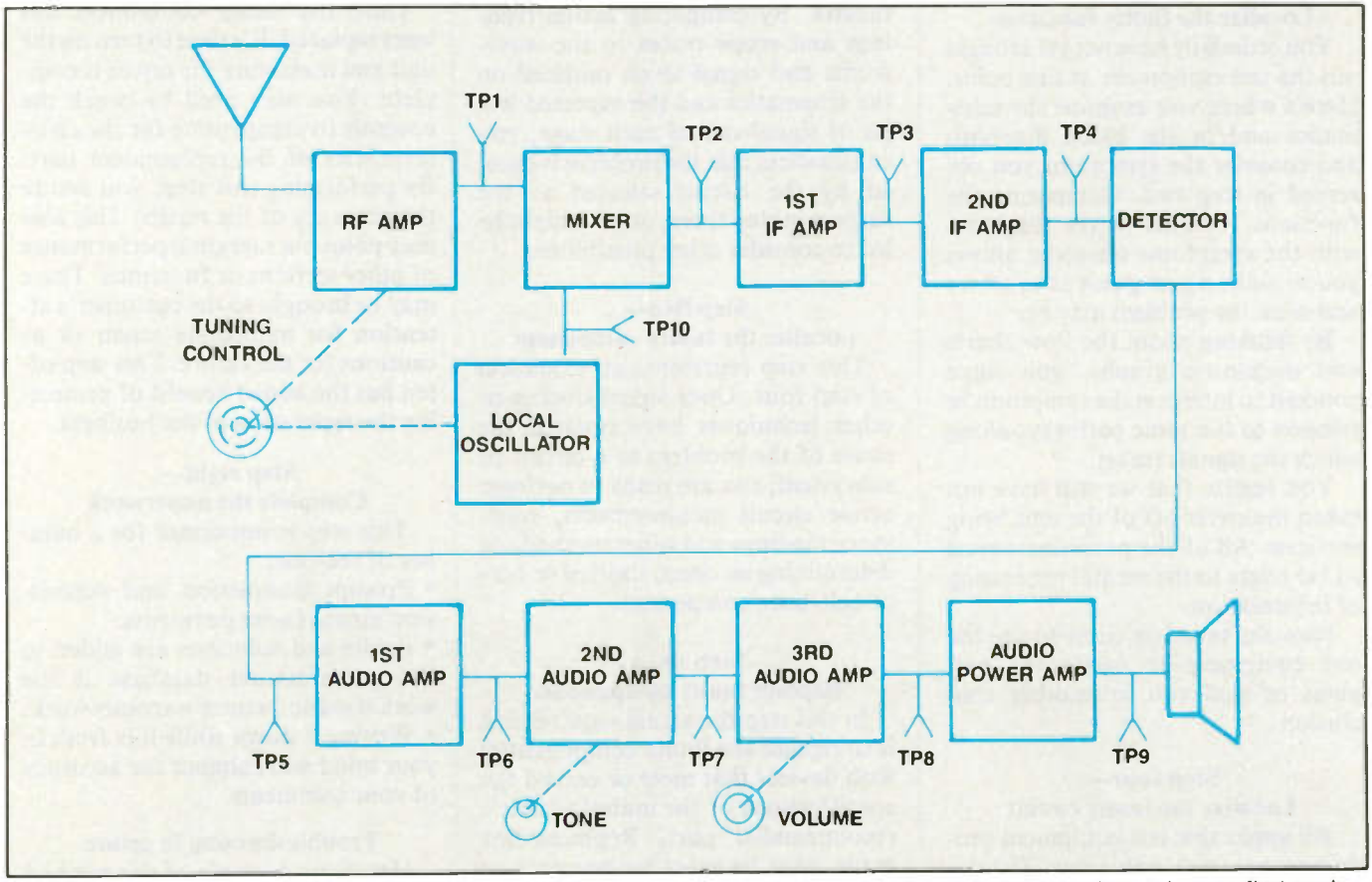

Figure 1. If the volume control works but the tuning and the tone controls have no effect on this radio receiver, take your first readings at TP4 and then TP5. By taking oscilloscope readings here, you can isolate the problem location to either the first or second half of the receiver.

come more recognizable. Initial troubleshooting time will decrease. The level of knowledge is the operating level of most shop technicians. However, it *must* be taught to less experienced technicians.

Step two—
Look at the functions

These are often called "front-panel" checks, although some of the controls will actually be at the rear of the set. This is the step where you determine whether the problem is a real hardware problem or one caused by faulty operational controls or misadjustment by the customer.

This step gives you a feel for what might be the cause of the failure. On rare occasions, test equipment may be used at this point, but more often it is advisable to use the same broadcast signals that are available to the customer. By using these signals, you can gain more insight into the nature of the problem.

Step three—
Localize the faulty functions

You ordinarily have not yet brought out the test equipment at this point. Here's where you examine the schematics and/or the block diagrams and consider the symptoms you observed in step two. Comparing the functions revealed in the diagrams with the symptoms observed allows you to make a best guess as to where and what the problem may be.

By thinking about the flow charts and diagnostic graphs, you force yourself to interpret the symptoms in relation to the same pathways along which the signals travel.

You realize that we still have not taken the cover off of the unit being serviced. All of the procedures used so far relate to the mental processing of information.

Now the time has come to use the test equipment to verify the best guess or lead you to another conclusion.

Step four—
Localize the faulty circuit

All applicable test equipment procedures are used in this step. The signal generator, sweep generator, digital logic probe, power meter and other specialized test equipment will help you track down the faults. The two most important pieces of test equipment any technician can have are a quality oscilloscope and digital multimeter. By comparing actual readings and scope traces to the waveforms and signal levels outlined on the schematics and the expected levels of signal out of each stage, you can confirm that the problem is caused by the circuit selected as the suspect in step three, or you might be led to consider other possibilities.

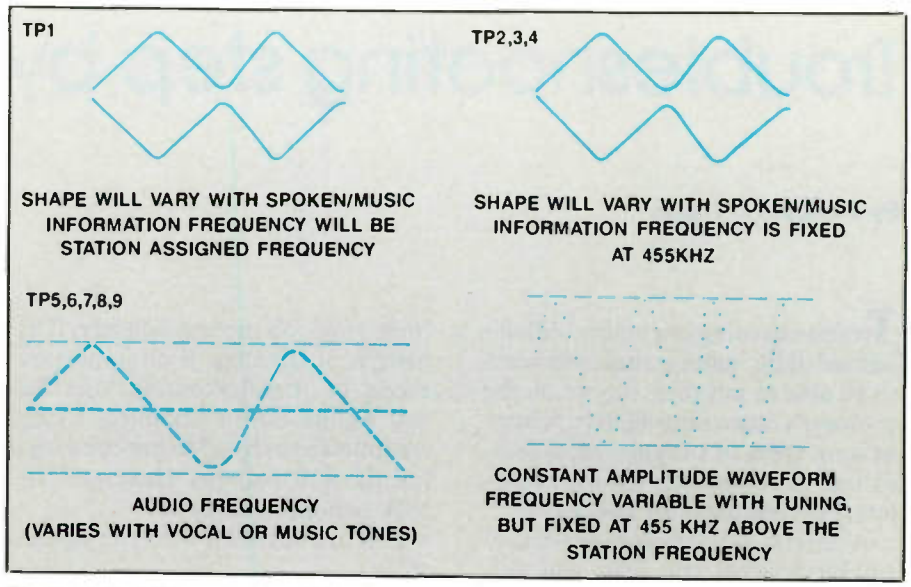

Figure 2. Oscilloscope readings can help isolate problems. In this case, oscilloscope readings indicate the problem is in the second half of the receiver.

Step five—
Localize the faulty component

This step represents an extension of step four. Once signal tracing or other techniques have isolated the cause of the problem to a circuit or subsystem, you are ready to perform active circuit measurements, resistance readings and other methods of determining an open, shorted or out-of-tolerance component.

Step six—
Replace faulty components

In this step the actual requirement is to replace the faulty component(s) with devices that meet or exceed the specifications of the manufacturer's recommended part. Replacements made must be exact replacement or acceptable substitutes only. Pay particular attention to safety items; these often have no acceptable substitute.

Step seven—
Test and align the product

Once the faulty component has been replaced, it's time to turn on the unit and make sure the repair is complete. You may need to tweak the controls to compensate for the characteristics of the replacement part. By performing this step, you assure the accuracy of the repair. This also may point out marginal performance of other sections or functions. These may be brought to the customer's attention for immediate repair or as cautions for the future. This step often has the added benefit of protecting the reputation of the business.

Step eight—
Complete the paperwork

This step is important for a number of reasons:

- Prompt completion and submission means faster payments.
- Faults and solutions are added to the manufacturer database if the work is manufacturer warranty work.
- Writing it down while it is fresh in your mind will enhance the accuracy of your comments.

Troubleshooting in action

Here is an example of this method using a simple radio receiver that will not receive any stations but does pro-

duce noise output. Following steps one, two and three, you will have used your senses and the tuning, volume and tone controls to verify the customer's complaint. Assume you have not found the following:

- Tuning control makes no difference.
- Volume control affects noise level.
- Tone control has no observable effect.

These indications are not enough to make a best guess. To pick out the faulty circuit, you should begin step four.

A good place to take your first readings would be at TP4 and then TP5. (See Figure 1.) By taking oscilloscope readings here, you can isolate the problem location to either the first half (RF,IF, local oscillator, detector) or the second half (audio,audio power or speaker) of the receiver.

For the purpose of our discussion, let's say that the signals here are normal. (See Figure 2.) This would indicate that the faulty circuit is in the second half of our receiver.

Your next reading would be taken at TP7, again splitting the suspect half of the circuitry in two. If the oscilloscope trace shows that there is no signal present, the use of a signal injection may help isolate the problem. Let's say that there is no signal at TP7, or that the signal at TP7 is not proper, but that signal injection at this point produces sound in the speaker. This fact would indicate that the fault lies between TP5 and TP7.

TP6 would be the last check in step four. If the signal is good into the amp but faulty out, you have isolated the defective circuit to audio amp2.

Now continue with the final steps of the method: Replace the bad components, test the operation of the receiver, and align the unit if it is needed.

Following these steps of troubleshooting aids everyone. From the technician's standpoint, it's just easier to solve the problem in a concise, orderly manner. The business benefits in terms of time and in protection for work performed. But perhaps most important, the customer knows that the repair and testing were complete and thorough. ■

Servicing the RCA CTC111 chassis

The tic-tic sound in a defective set usually indicates a defect in the horizontal-sweep circuit, its B + voltage, or the oscillator and driver signals.

By Homer L. Davidson

This receiver, new nine years ago, has had time enough for typical problems to surface. The CTC111 was the basis of many models having a wide range of picture tube sizes and other features. In addition, the CTC111 has evolved from the earlier RCA models, and since then it has been the center of many features and circuits used in later models. You should find value in studying these case histories.

Davidson is TV servicing consultant for **ES&T**

Early in 1981, RCA introduced the CTC111 chassis, and produced it in various forms for several years. As might be expected from any well-designed solid-state color TV receiver, these receivers have not been big troublemakers. However, some typical problems have developed with flybacks and other allied components in the horizontal-deflection and high-voltage circuits.

The case histories that follow illustrate some of the possible defects and repairs, and are not necessarily the most complicated or extensive.

Flyback or circuit?

In-circuit tests on the flyback of an ac-powered but dead CTC111 chassis are more difficult than with some other models because the IHVT flyback operation is essential for producing the + 130V supply and regulating it — but without the + 130V

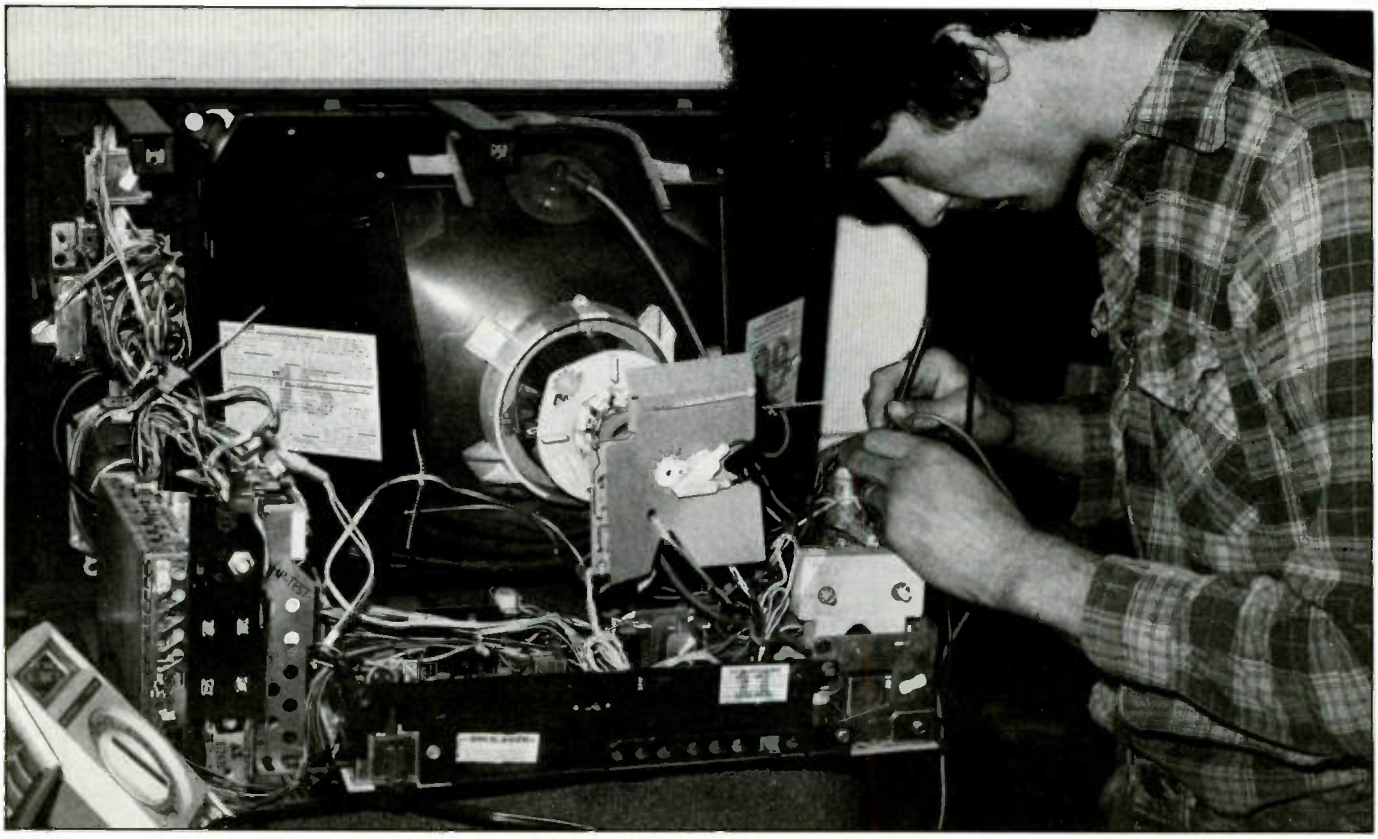

Photo 1. Diode resistance and voltage-drop measurements can reveal a great deal about the condition of a TV set, as in this RCA CTC111 chassis.

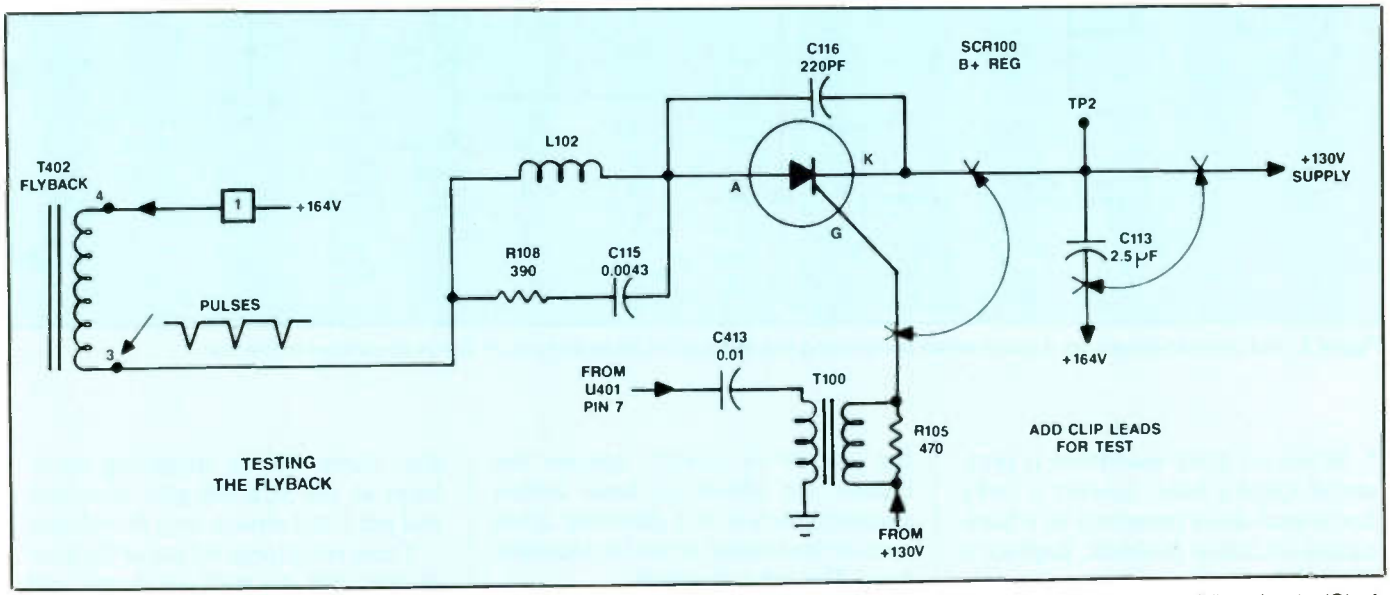

Figure 1. Prepare a CTC111 chassis for operation with very low acV power by adding one test lead between cathode (K) and gate (G) of SCR100, and clipping another lead across C113, as shown. This connects the + 164V supply to the + 130V supply, and eliminates the regulation permitting limited operation for trouble-shooting purposes.

supply, the horizontal sweep cannot operate. This impasse is solved at turn-on by the start-up circuit. (Horizontal overload or excessive high voltage terminate the + 130V supply via the shut-down circuit.)

Safe testing of defects that cause overloads calls for partial operation with the receiver powered by low line voltage, and the SCR100 voltage regulator disabled. This allows time for many dc-voltage readings and waveform examinations without danger of destroying components.

A scope, two clip leads and a variable-output isolation transformer are required to operate the TV at lower line voltages. Here is the procedure:

- Locate 2.5pF capacitor C113 and SCR100 (the HV-regulator SCR) on the chassis;
- Clip one test lead across the C113 capacitor (this also is TP1 to TP2);
- Securely clip another test lead between pin G (gate) and K (cathode) of SCR100, and the TV is ready for the first test (Figure 1).

Notice: Remote-controlled models cannot operate with low line voltage (without temporary changes) because the power relay might not close. Also, the CRT's filament is powered from the flyback transformer, thus making a raster impossible when the line voltage is too low. Therefore, adapt the TV by unplugging the P1MCR power plug (on the remote amplifier's main chassis), and connecting a jumper between pins 1 and 2 of power jack J1MCR. (Another method is not to remove the P1MCR power plug; instead, clip a test lead across terminals 1 and 2 of the K1 power relay.) Use whichever is easiest.

With the variable-voltage isolation transformer supplying ac power for the chassis, follow these steps:

1. Adjust the acV input power upward from 0Vac to whatever produces + 50V at the cathode terminal of SCR100, the regulator;
2. Slowly increase the input voltage until + 65V is measured at the collector terminal of the horizontal-output transistor Q404;
3. Operate for 30 seconds or so, then turn off the ac power and feel Q404 for any signs of excessive warmth. An overload in the flyback circuits or a leaky Q404 horizontal-output transistor causes the transistor to overheat. If you confirm that Q404 is leaky, replace it. If you replace Q404, perform this test again at low voltage to keep from damaging it if the problem is elsewhere.
4. Scope the waveform at the base of Q404—to confirm operation of the horizontal oscillator and horizontal driver circuits. Next, scope the Q404 collector (body or case) expecting to find clean horizontal pulses of much lower amplitude than those of normal operation (see Figure 2 schematic).
5. While the scope probe is connected to the Q404 collector (or terminal OC), carefully examine the Q404 collector waveform. Any excessive load on the flyback produces extra positive-going pulses between the normal ones, and causes Q404 to run too warm. Erratic spikes might be caused by arcing of the internal HV rectifiers.
6. Some windings of flyback T402 or diodes and components shown in the schematic of Figure 2 also can cause arcs and excessive loading when defective.

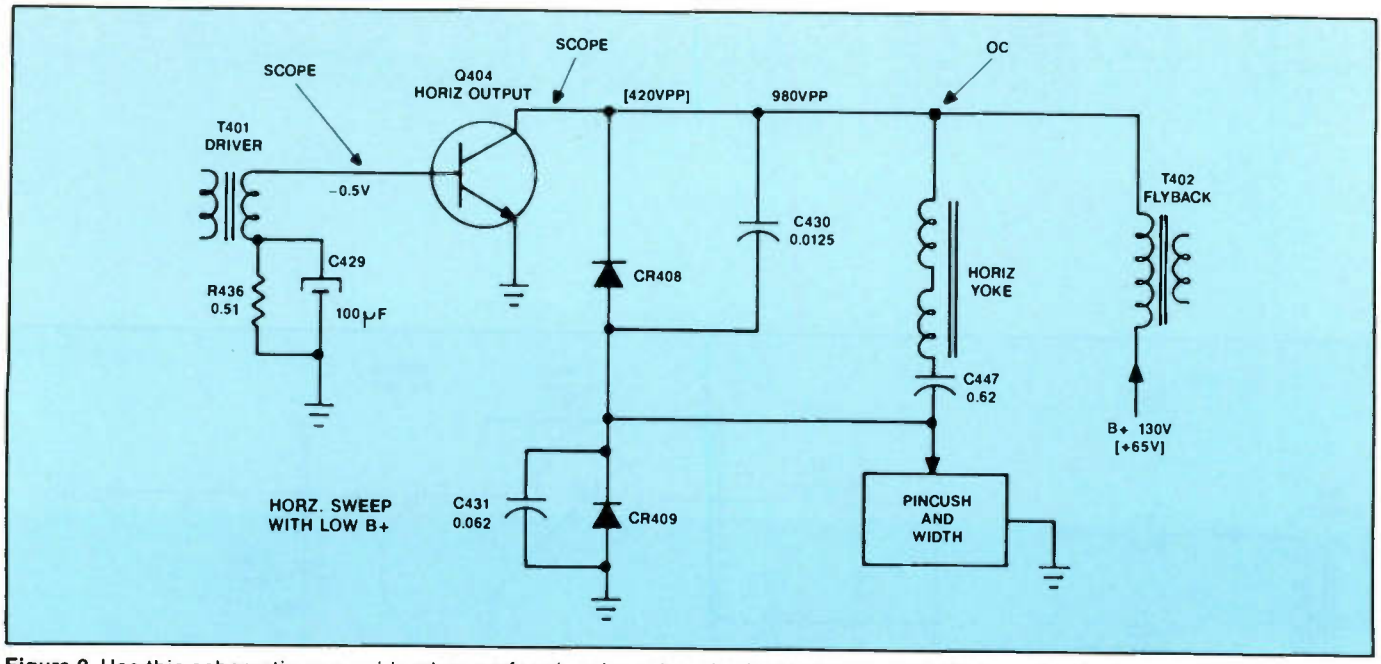

Figure 2. Use this schematic as a guide when performing the reduced-voltage checks of Q 404 described in the text.

7. When no drive waveform is present at Q404's base, suspect a leaky horizontal-drive transistor or a horizontal-oscillator problem. Replace it if it's defective.

8. If Q404 has a normal collector waveform of low amplitude and does not overheat, unplug the 120Vac power and disconnect the jumpers from the SCR100 circuit. Slowly increase the line voltage. If the normal 120Vac is reached without any problems, measure the + 130V supply. If the + 130V is correct, operate the chassis for about an hour before powering down and checking Q404 and the horizontal areas for excessive heat. The job is finished.

No raster—no HV

I was checking out a set that had no raster and no HV. No dc voltage appeared at the Q404 collector, but + 166.9V was measured at the anode (case) of SCR100, and no dc voltages were found at the gate and cathode. also, there was no triggering waveform at the SCR100 gate terminal, and pin 5 had almost zero dc voltage.

These symptoms led me to the conclusion that the start-up circuit and Q100 were not functioning correctly (Figure 3). Very low voltages of + 4.7V at base and emitter indicated a leaky transistor. This was verified after the transistor was removed for tests; a near short existed between base and emitter.

However, replacement of the Q100 start-up transistor did not solve the lack of sweep entirely. Suspecting a problem with the IC, I checked it first. But the resistance between pin 5 of U401 and ground was a reasonable reading of 787 ohms. With power on, pin 5 measured about zero volts, and a low B+ reading was taken from Q100's emitter. A DMM voltage-drop test of CR104 flashed on with an erratic reading before registering open steadily. CR104 was defective. I replaced Q100 and CR104, which solved the no-HV/no-raster symptom.

Note: Various schematics do not agree about the base-zener diode. Photofact 2126-2 has a CR113 zener, but 2038-1 and the RCA schematics show a 11K R103 resistor. If you must replace this component, check the component specification on the component itself, not the schematic or parts list.

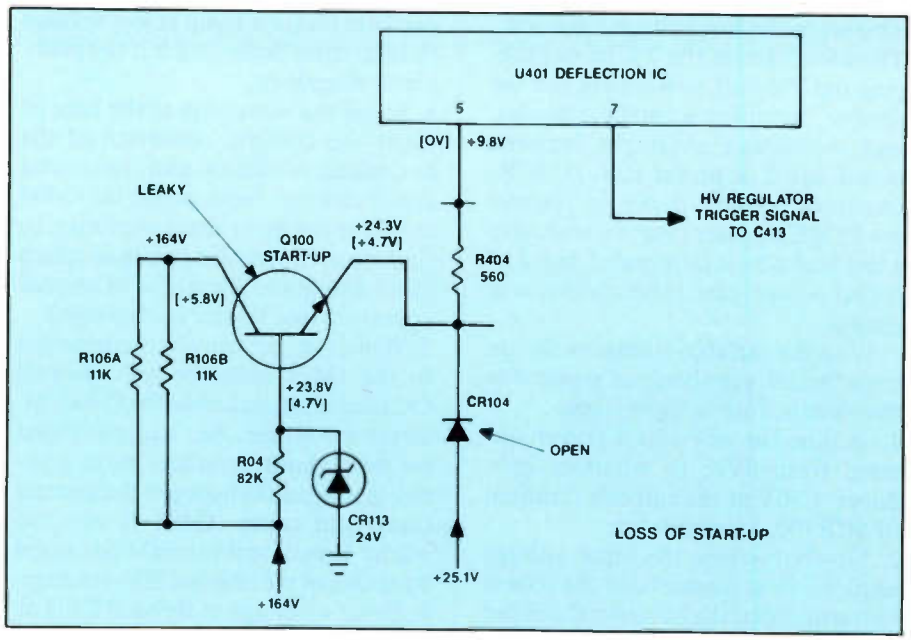

Figure 3. A leaky Q100 start-up transistor apparently overloaded diode CR104 (the B+ source for the start-up voltage), causing the diode to open. This removed all the + 10V regulated voltage that normally is at Q401 pin 5. Without that voltage, the horizontal oscillator cannot operate. Replacement of Q100 and CR104 cured the problem.

Dead with tic-tic sound

Another set I serviced was totally dead, and only a soft and continuous

CTC111 +164V Voltage at C105 or Lug 1		
Normal	+164V 4VPP	@ 120Hz
Shut-Down	+168V 1VPP	@ 120Hz
C105 Open	+145V 20VPP	@ 120Hz
Bridge Diode Open	+157V 10VPP	@ 60Hz

Table 1. The condition of dc voltage at C105 (the only B+ filter) can indicate several things such as: normal horizontal-deflection operations; a receiver in shut-down condition; an open C105 filter capacitor; or an open diode in the bridge rectifier of the +164V supply. Notice that the dc voltage, the ripple amplitude in PPV, and the hum frequency are tested.

tic-tic sound was heard near the flyback when power was applied. Although the tic-tic is a useful symptom and gives a general idea of the location of the problem, it does not point to any particular component. It is caused by the SCR100-regulator circuit attempting to regulate the +130V supply when its load current is virtually zero. Most of the load current is consumed by Q404, the horizontal-output transistor. Therefore, the tic-tic sound in a defective set usually indicates a defect in the horizontal-sweep circuit, its B+ voltage, or the oscillator and driver signals.

Dc voltage at C105 (the only filter capacitor for the +164V source) measured about 4V or 5V too high, and that is one symptom of either: failure to start-up; a good start-up followed instantly by shut-down; or shut-down. A first suspect is the horizontal-sweep circuit, and the second is the B+ circuit.

An ohmmeter test from the collector of the Q404 horizontal-output transistor to chassis ground revealed no short or leakage. Horizontal-drive Q403 transistor was testing in-circuit, then finally replaced with a new transistor. The problem persisted. Because Q404 remained a suspect, I made every possible in-circuit resistance test on it without results. Finally, because the low resistances of T401's secondary and 0.51 R436 (between Q404 base and the emitter ground) made accuracy difficult, I removed horizontal-output transistor Q404 from the chassis. When tested, the base-to-emitter path was found to be open.

Installation of a new Q404 horizontal-output transistor produced a normal picture without any tic-tic symptom.

Locating overloads

When scope waveforms show noise spikes (or added pulses between the normal ones) or transistor Q404 operates too warm, suspect overloading of the flyback by one of several possible sources.

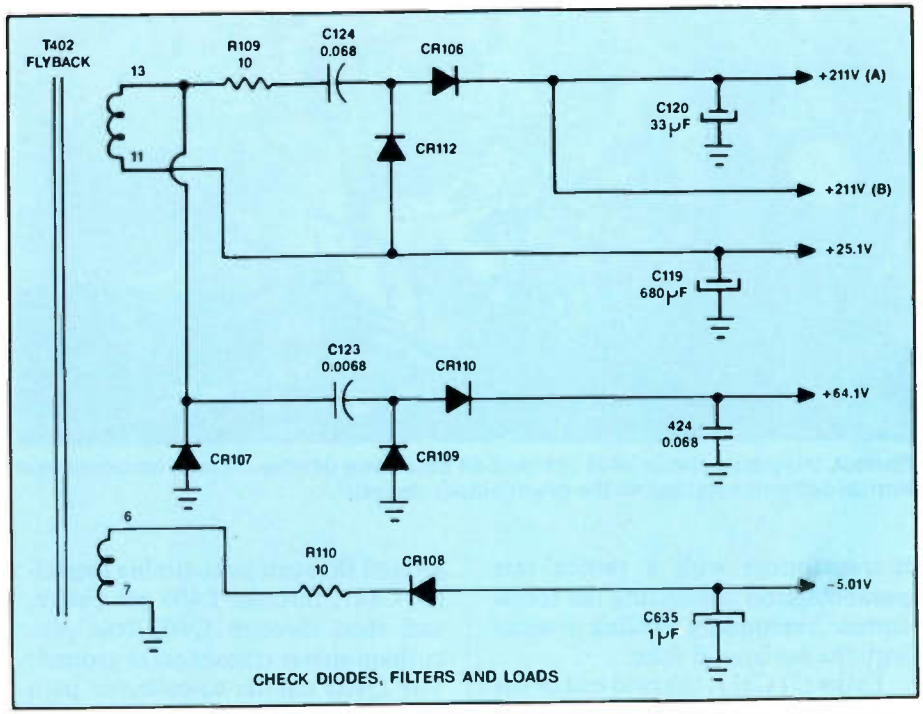

Figure 4. Leaking diodes, open filter capacitors or excessive current drain on a power supply reduces the output voltage. See text for details of how to test for these conditions and correct them.

Low-voltage diodes—First, test all diodes of all the low-voltage sources (Figure 4). Check them for forward condition with the voltage-drop test of the DMM. If you then have doubt about the diode, desolder one lead and repeat the test with the diode out of circuit. Test for leakage by using the ohmmeter function with reversed-polarity test leads. Zener diodes of the +16.6V and +11.4V supplies should be tested in the same way. Remember, zeners test as normal diodes in the forward-biased polarity, and have a specific breakdown voltage in the reverse-biased polarity. Ohmmeter reverse-bias leakage tests can be reliable as long as the maximum ohmmeter voltage is lower than the zener's breakdown voltage.

Of course, defective or overloaded components in these low-voltage supplies can give some symptoms of bad diodes. So disconnect the load from each low-voltage source and notice which load removes the horizontal-circuit overload. Do not disconnect the +25V supply, because it will stop all horizontal sweep.

Yoke and pincushion—When you suspect an abnormally low load in a yoke or pincushion circuit, remove the red lead from yoke-terminal OC and notice if the Q404 collector voltage increases and the high voltage decreases. Rotate the width control and notice if it affects the raster width. If not, suspect a problem in the pincushion circuit. Test the pincushion-circuit transistors (Q406 and Q405), and all diodes and capacitors, and replace any that have leakage. Inspect the terminals of L404 and L405 for broken leads or erratic connections.

One of these areas should have revealed the source of overload.

Pincushion correction

Before the introduction of the CTC111 chassis, right and left side-pincushion correction was performed by supplying the primary winding of

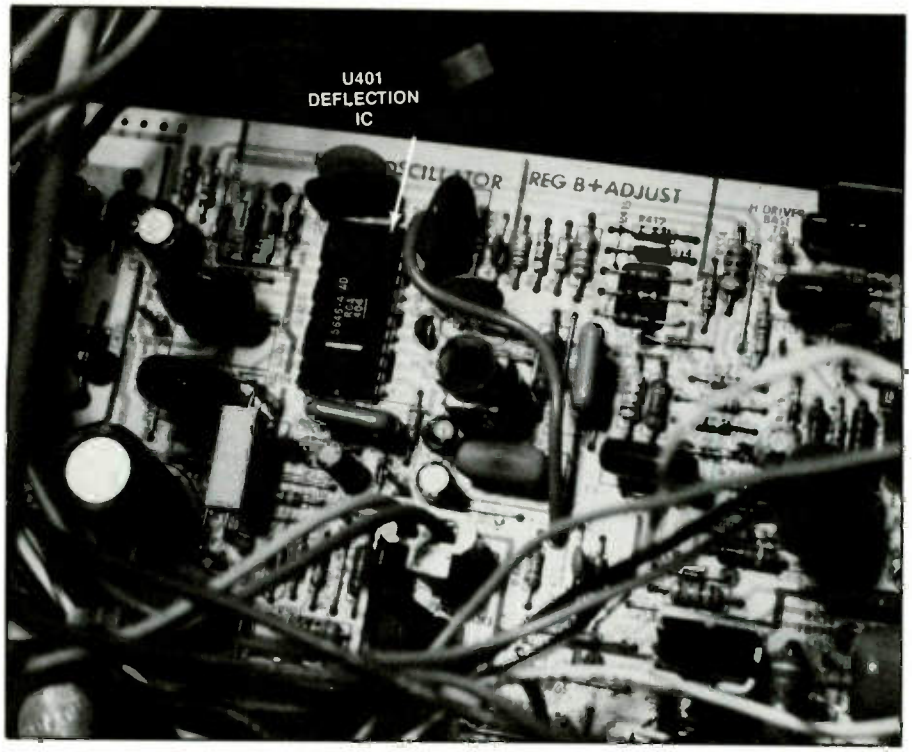

Photo 2. Integrated circuit U401 contains all solid-state devices for both horizontal and vertical deflection (except for the power-output stages).

a transformer with a vertical-rate parabola, and connecting the transformer's secondary winding in series with the horizontal yoke.

In the CTC111, the cold end of the horizontal windings returns to ground through yoke-tuning capacitor C447, through L404 pin choke, and then through Q405 (the pincushion-driver transistor) to ground. The Q405 emitter-to-collector path functions as a resistance that varies in a parabolic shape, thus modulating the horizontal-yoke current and with it the selective width. Of course, the actual circuit is more refined, as shown in Figure 5.

Horizontal-driver problems

In several CTC111 chassis the pincushion driver transistor (Q405) tested as shorted. Often when this transistor is shorted, the horizontal-output transistor (Q404) and the SCR100 B+ regulator will prove to be leaky or open. If you find and replace a defective Q405 driver transistor without additional checking, the SCR100 and Q404 might be damaged quickly when power is applied.

Next check CR408 and C430 for leakage. Either of these components can damage the pincushion driver transistor, Q405 (Figure 5). If there is doubt about the condition of C430, replace this retrace-tuning capacitor. CR409 has tested leaky in several chassis.

Blows 5A fuse

Symptoms were: no sound; no raster; and the 5A F100 power-line fuse was open. A shorted Q404 horizontal-output transistor usually is the cause of the blown fuse. But if the fuse and Q404 are replaced and then

(Continued on page 37)

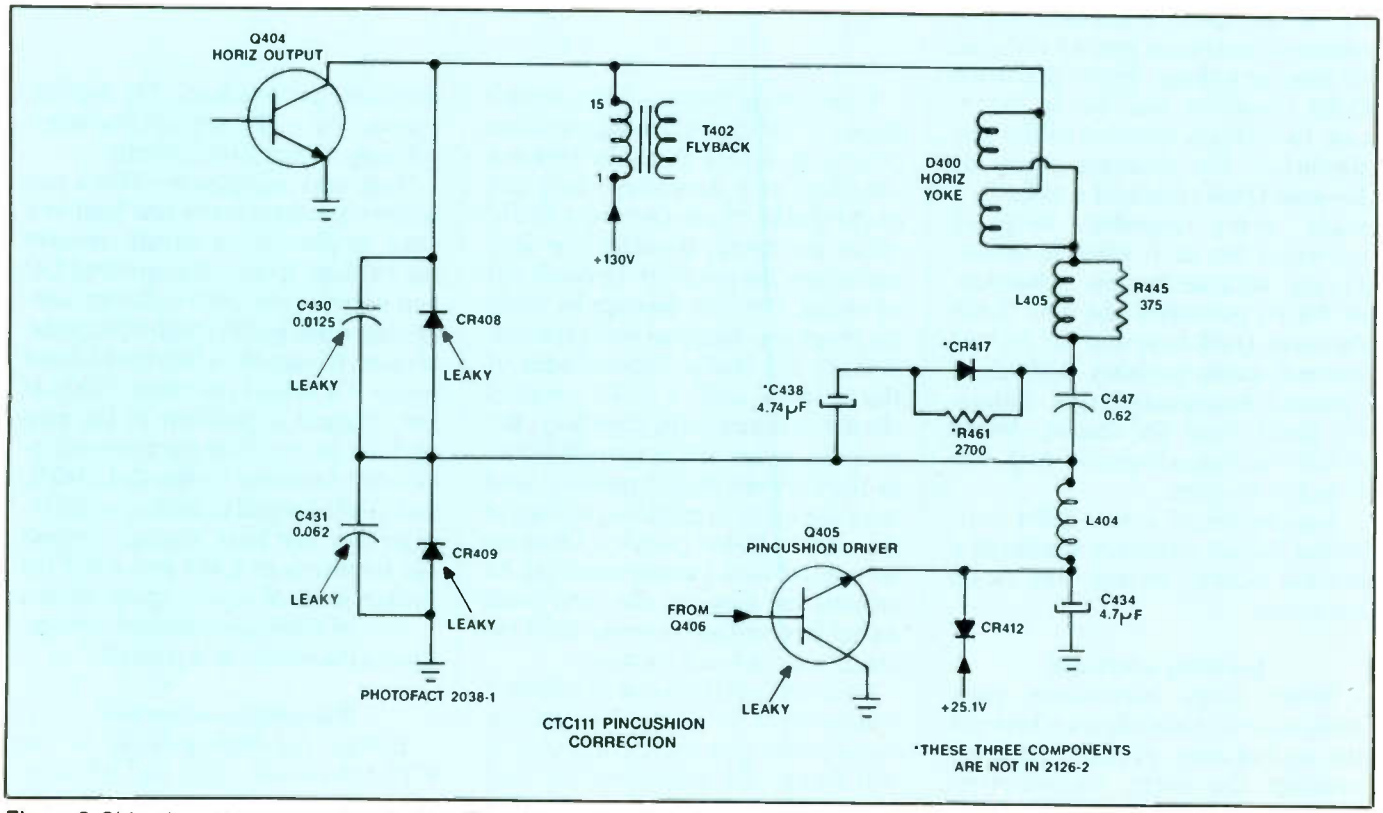

Figure 5. Side-pincushion correction in the CTC111 is accomplished by varying the horizontal-yoke current. Arrows point to components that fail often.

3066

ZENITH
PV454-IP
COLOR TV

PROFAX
Manufacturers schematics
JULY 1990

FOCUS CONTROL MODULE 9-179-01

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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.

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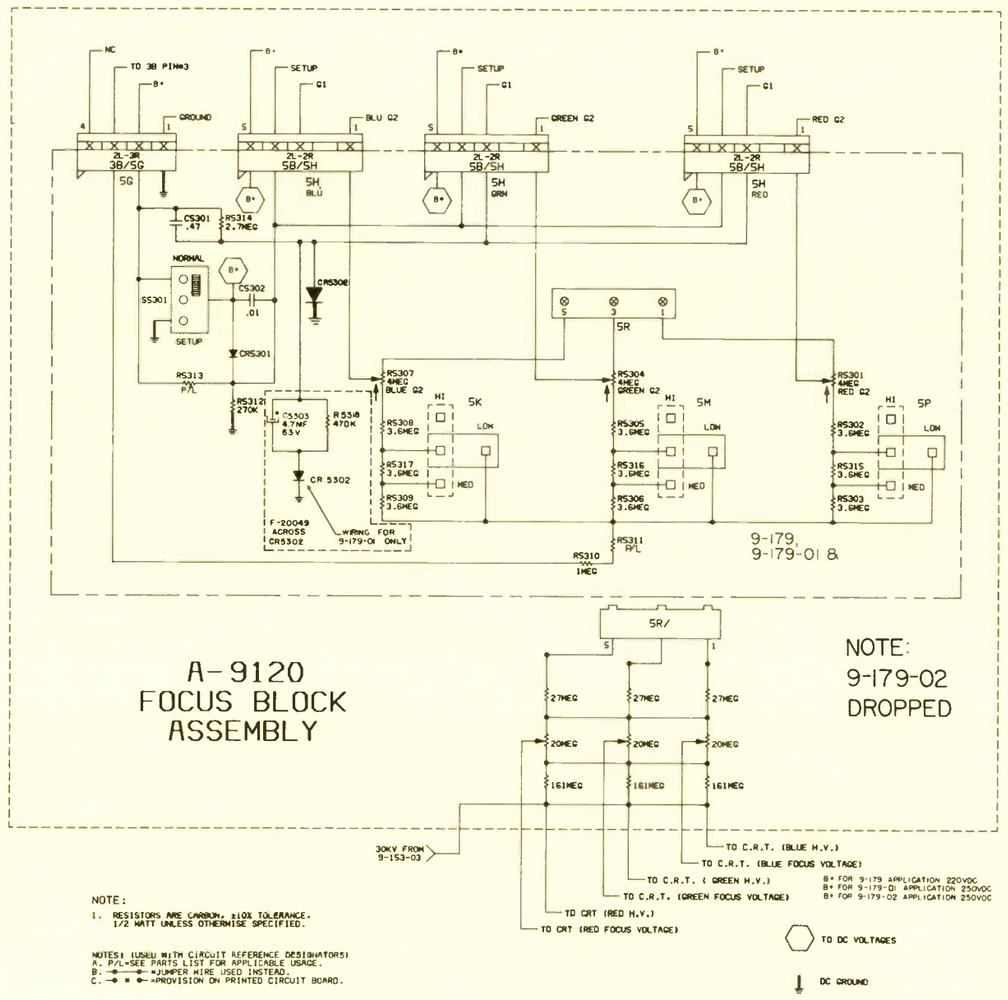
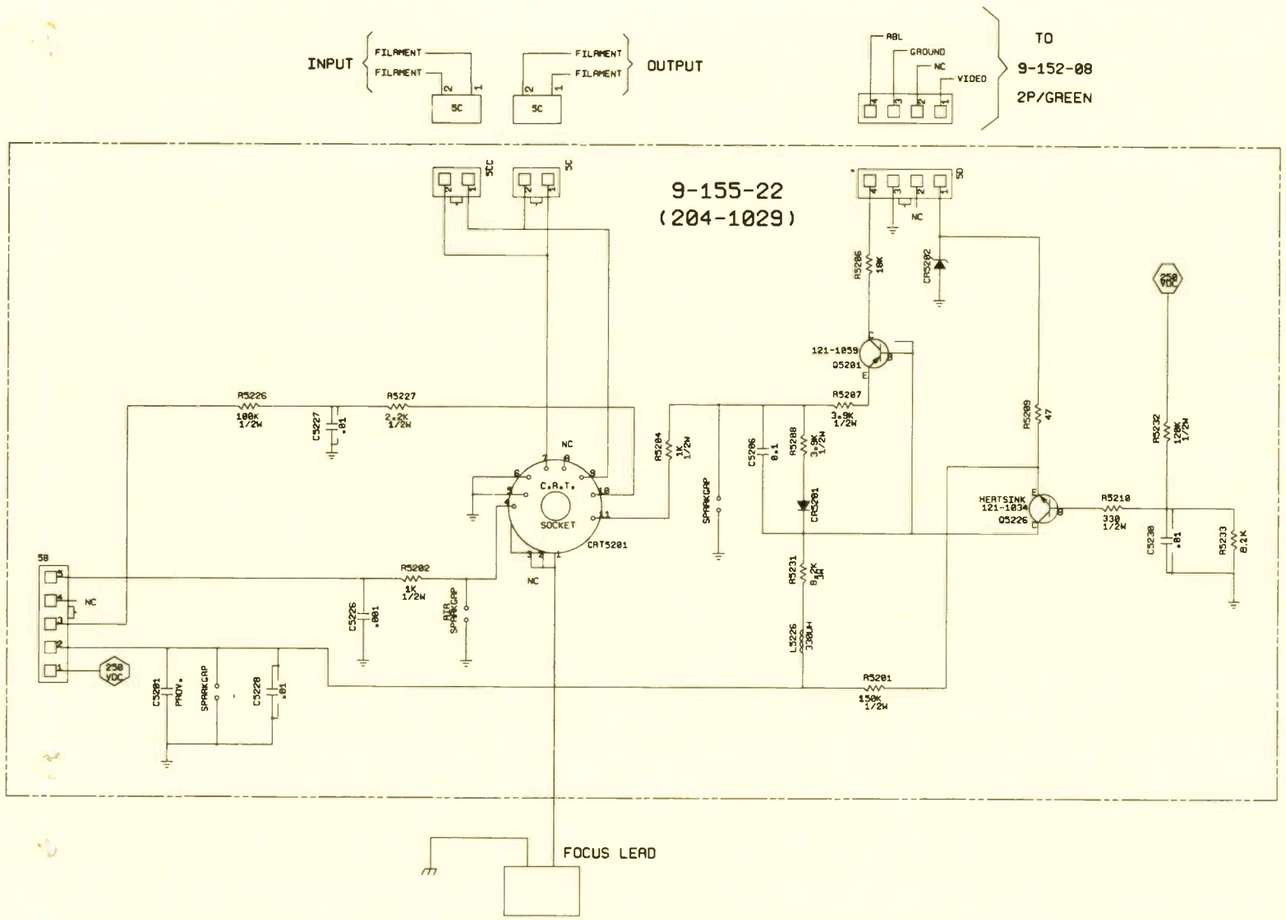
The other portions of this schematic may be found on other Profax pages.

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





CHROMA-LUMA-VERT-MODULE

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B&K Manufacturers schematics PROFAX 3066

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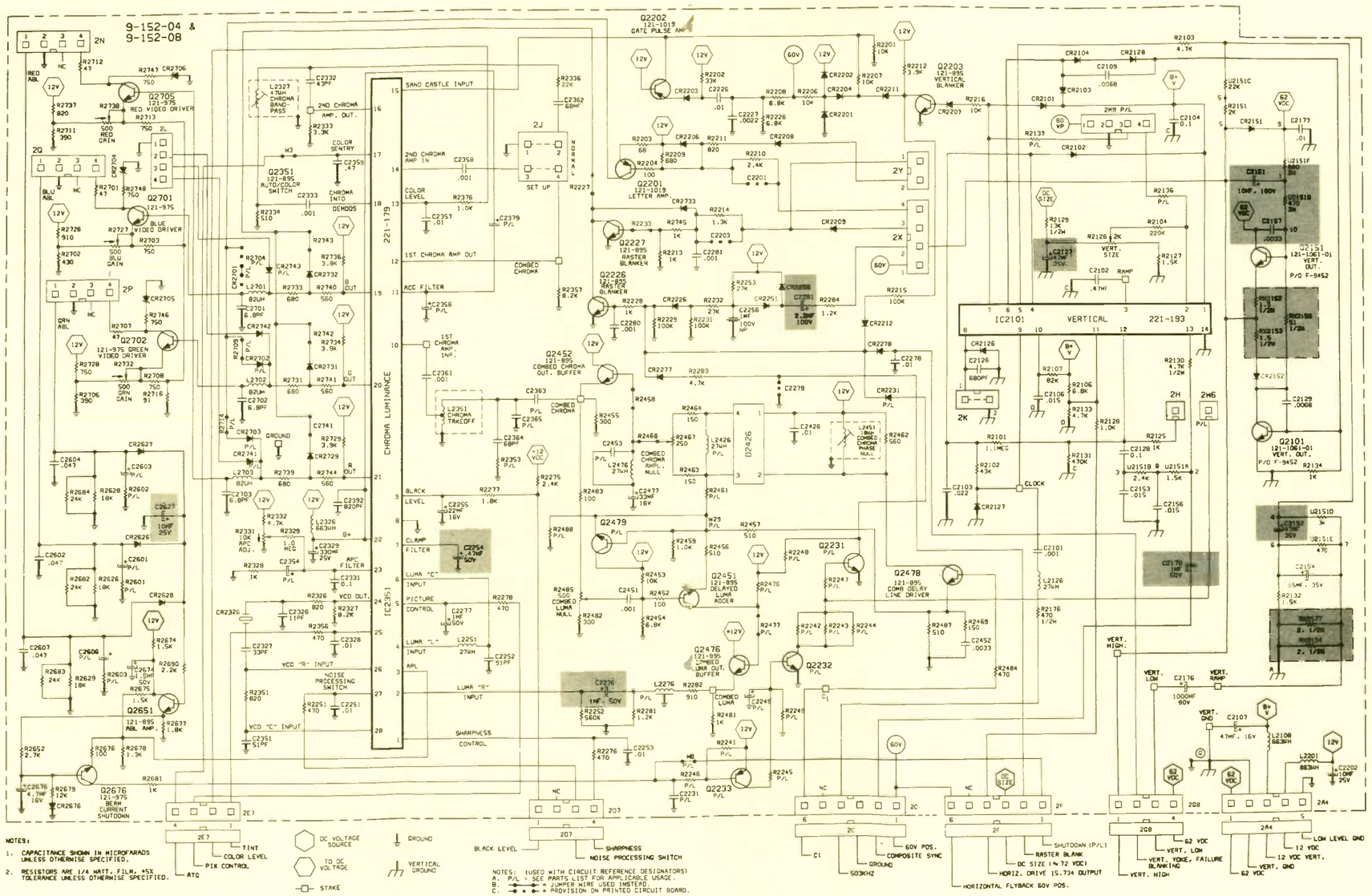

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HV POWER SUPPLY/HOR. SWEEP MODULE

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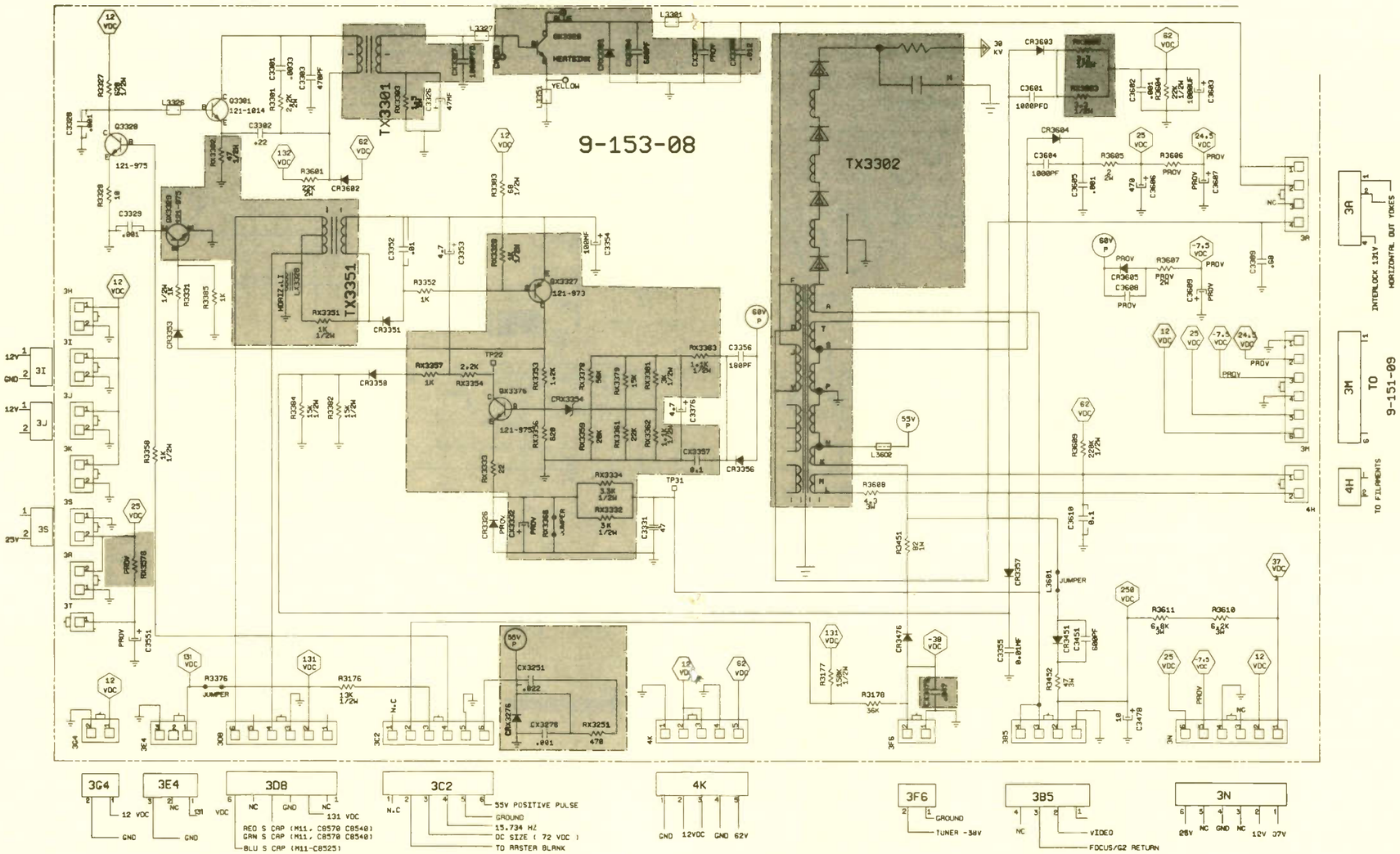

NOTES:
1. RESISTORS ARE 1/4 WATT, 5 PERCENT TOLERANCE UNLESS OTHERWISE SPECIFIED.
2. CAPACITORS ARE IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

NOTES: (VALUE TAGS WITH SPECIAL MEANINGS)
A. P/L = SEE PARTS LIST FOR APPLICABLE USAGE.
B. JUMPER = JUMPER WIRE USED INSTEAD OF NORMAL PART
C. PROV = PROVISION FOR A PHYSICAL PART IN THE LAYOUT ONLY.

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ES&T Manufacturers' schematics **PROFAX**

July 1990

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IF-RF-AGC

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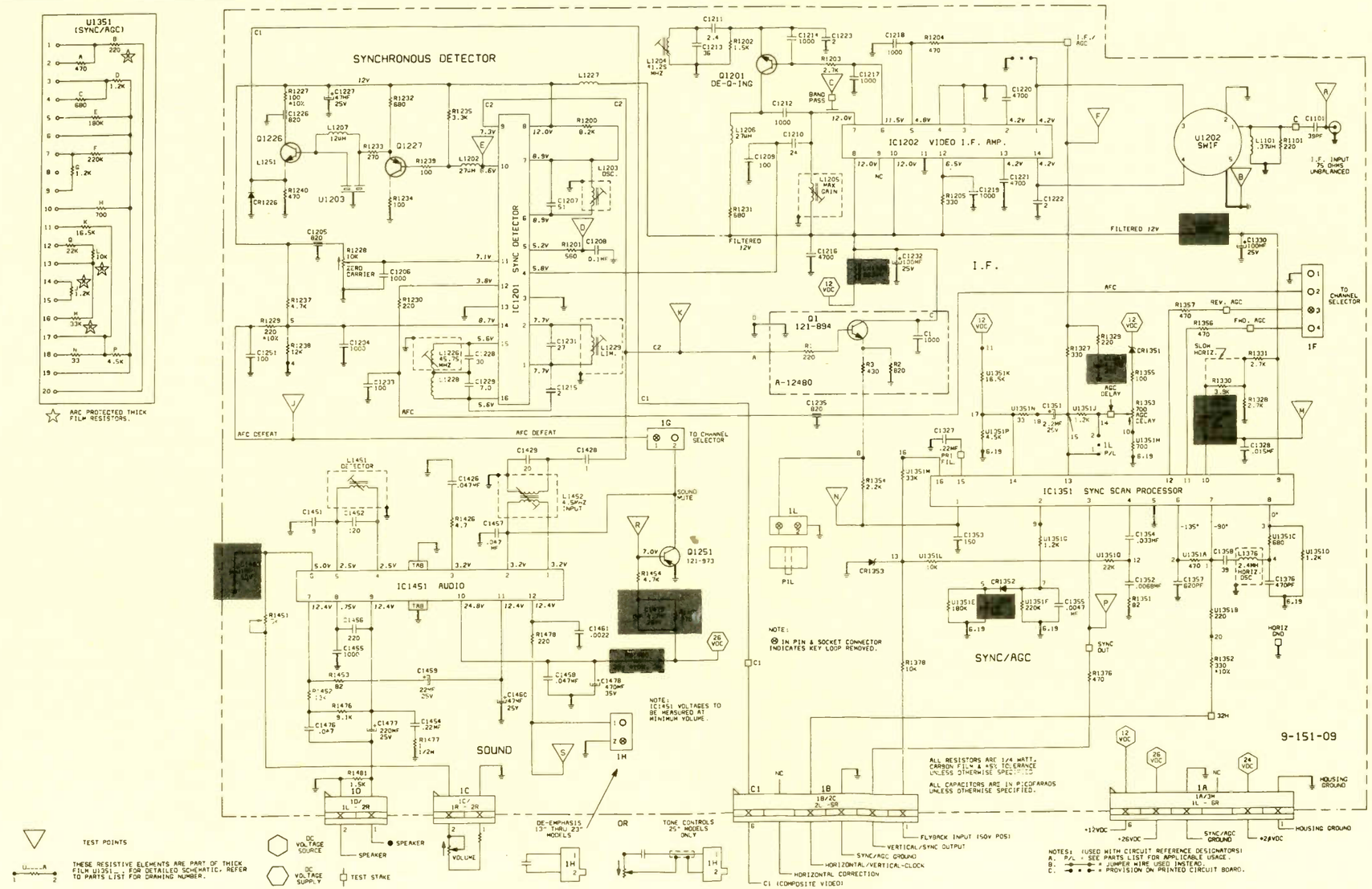

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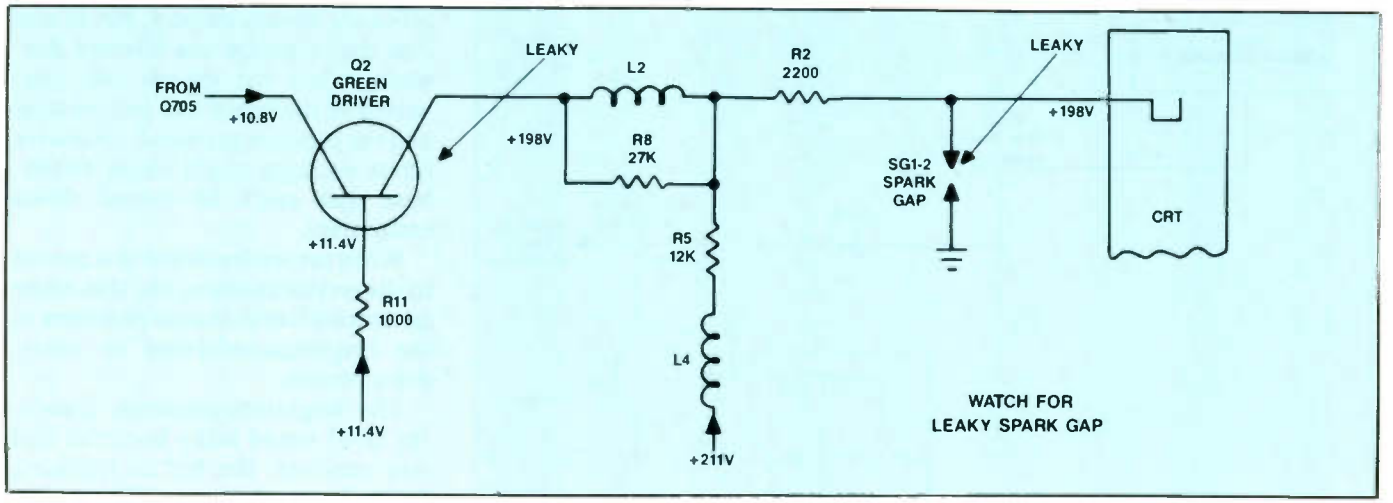


Figure 6. For brightness problems or missing colors, examine and test the spark-gaps mounted on the CRT socket.

tested with full power, the components will be blown again.

Therefore, it is necessary to test the chassis with low ac voltage. Connect the variable isolation transformer to the TV and adjust the ac voltage for about 30Vac at first. Increase the voltage slowly up to 65Vac, wait for about 30 seconds, then switch-off the power and check the Q404 horizontal-output transistor for excessive heating.

In this example, the case of Q404 was very hot from line power of only 65Vac, and the Q404 collector tested zero dcV. A strong overload of the flyback was indicated. Resistance measurements across CR408 and CR409 revealed a near-short in the CR408. (In some CTC111 chassis, both diodes are leaky, so always check C430 and C431 for leakage.)

Altogether, the F100 fuse, Q404, SCR100 and CR408 were replaced before the set would operate without blowing a fuse.

Excessive width

Excessive width from a CTC111 chassis can result from a defective C430 retrace capacitor. This retrace capacitor is physically made from two capacitors connected in series inside one molded body. If one section becomes shorted or seriously leaky, the overall capacitance is greatly increased, up to double the rated value, thus producing excessive picture width with a slight loss of brightness. Incidentally, excessive high voltage with a smaller picture results if C430 becomes open.

In some CTC111 chassis, a defective C430 can damage the flyback, the U401 deflection IC, the Q202 sound IC, SCR100 regulator, Q404 output, Q405 pincushion control transistor, CR408 damper diode and the CR409 pincushion damper diode. Check all these components when Q404 and T402 flyback transformer are defective. Remember to replace C430 when several components are found damaged at one time.

Green raster with shut-down

A commonly encountered symptom in the CTC111 is an excessively bright raster in any mixture of the three colors, or just one solid color, followed by shut-down. When this occurs, look for the defect in the power-type color-driver transistors, the picture tube, or the picture-tube circuits. When the symptom is excessive brightness of one color, followed by shut down of horizontal operation the defect is likely to be in the picture-tube circuits or in the CRT. A shorted CRT can shut-down the chassis.

If the raster has only one dominant color, go directly to the power-type driver transistor for that color. Measure all voltages and resistances to ground for the power stage. Insuffi-

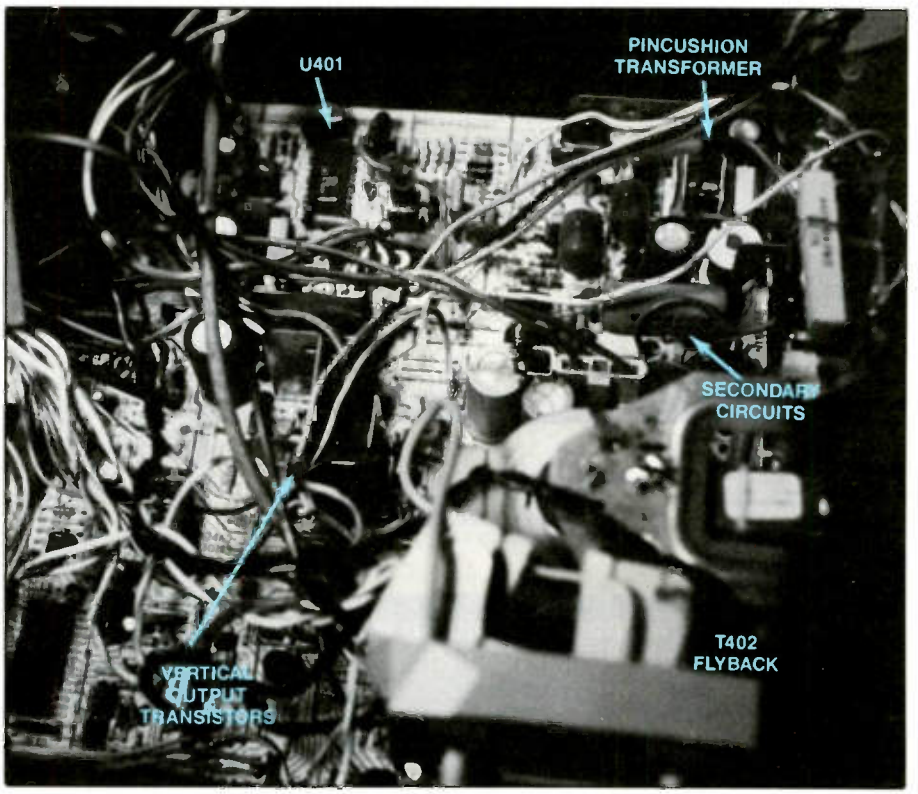


Photo 3. Before replacing the horizontal-output transformer (flyback), check to be certain the deflection yoke and all components of the circuit surrounding this flyback are normal.

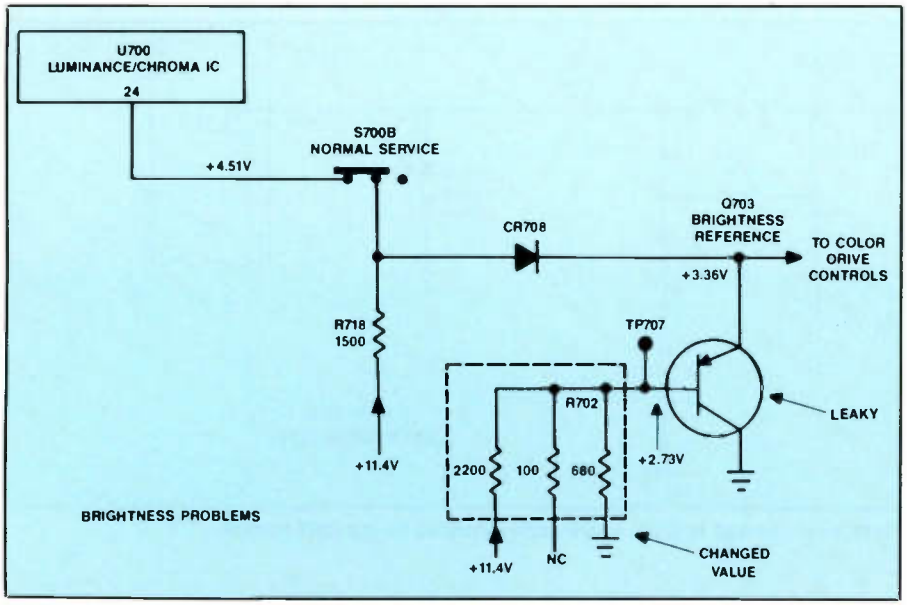


Figure 7. Defects that change the dc voltage at Q703's emitter will change the brightness of all three colors. Examine S700B service-normal switch for corrosion. Test Q703, CR708 and all resistors in R702, the brightness-reference resistors.

cient collector dc voltage might indicate the driver transistor is leaky or the CRT (or its spark gap) has leakage to ground. Measure the resistance from the spark gap of that color to ground; then remove the CRT socket and measure again. If the same resistance reading is obtained for both measurements, the CRT does not have internal leakage. Next, remember that a leaky spark gap operates the affected CRT gun with a positive grid (relative to the low incorrect cathode voltage), and the gun draws maximum current (with maximum brightness of the one color).

In this case, spark gap SG1-2 for the green gun had a low resistance (Figure 6). The entire socket assembly (which includes the spark gaps) was replaced and the color-temperature procedure performed. The receiver now showed a normal picture.

Brightness can't be reduced

In general, excessive brightness problems can result from a defective CRT, defects before the color drivers or their amplifiers, or a defective brightness-control circuit. Picture tubes are always suspect, but in one case the suspicion was diverted elsewhere when the chassis was connected to the bench test picture tube and the problem persisted. Excessive boost voltages might cause brightness that can't be turned down completely.

When the service switch was moved to the service position, the thin white horizontal line indicated problems in the brightness-reference or color-drive circuits.

The brightness-reference transistor Q703 tested leaky in-circuit and was removed. But before replacing Q703, I also checked CR708 in-circuit, using the DMM's diode test. CR708 was not defective, and installation of a new Q703 corrected the brightness problem.

In another CTC111 chassis, Q703 and the base-resistor network both were replaced to restore correct brightness and operation of the brightness control (Figure 7).

Weak locking and weak video

A slight jitter, weak locking, and faint video or no locking and a total loss of picture have been noticed in various CTC111 chassis. Either set up symptoms can occur when equalizer capacitor C311 (near Q304) has leakage. With a scope, test for sync compression in video at the Q301 emitter (or at terminal VO).

A low-resistance ohmmeter reading between the collector and emitter terminals of Q304 can indicate a leaky Q304 transistor or a defective C311 (Figure 8). Remove Q304 from the circuit board and measure again. If the defect is not very definite, replace Q304 and 68pF C311. C311 is located near the AFT-balance control.

Weak or no video

Almost any component in the video circuits can cause weak or missing video. Therefore, this problem was a real puzzler for several hours. At the input, the video appeared normal, but the amplified video was not. All U700 luminance/chrominance dc voltages were quite normal except for pin 7. Amplitude of the pin 7 waveform was insufficient and the dc voltage was too low (Figure 9).

Incidentally, the pin-7 waveform usually is called the "sandcastle" because of the shape. It is used inside U700 to decode various burst and blanker functions. The sandcastle's

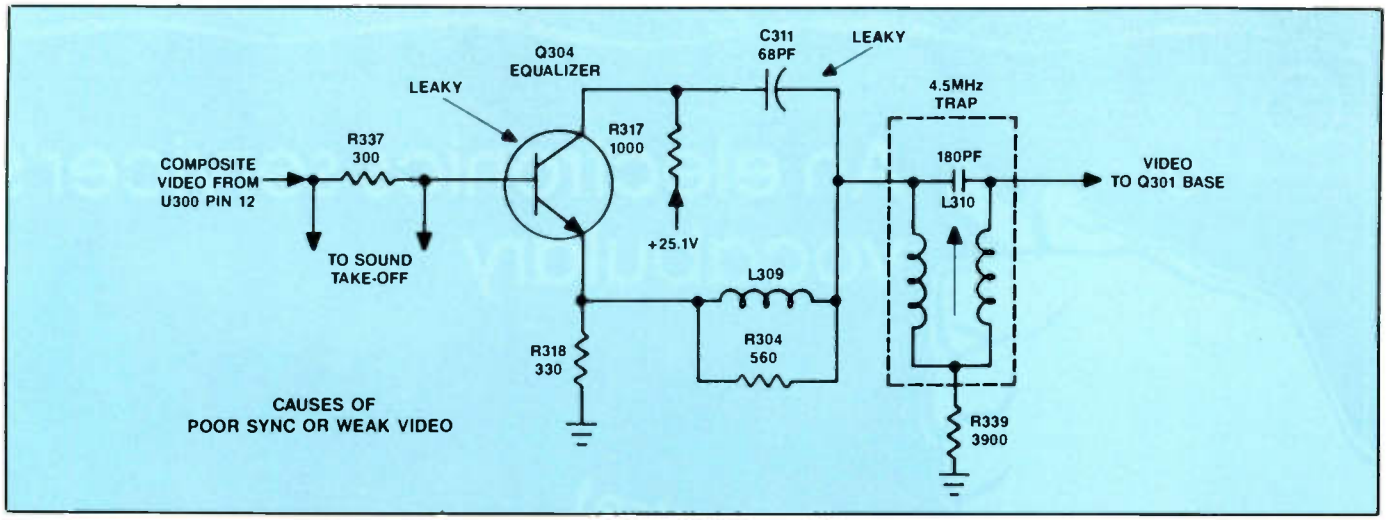


Figure 8. Some unusual locations for defects causing critical locking and/or weak contrast are around the Q304 equalizer transistor and pointed out by arrows.Begin testing by scoping the Q301 emitter for the amplitude and waveform of the horizontal-sync pulses.

exact waveshape and amplitude are very important for both color and B&W-video signals.

Burst-gate Q701 transistor and its surrounding circuits were normal, including the C710/L703 tuned circuit and the CR700 diode clipper (most problems are found in those stages). As a last resort, the thought came of replacing U700 IC. However, the branch of the circuit through CR707 (that supplied horizontal and vertical for blanking to pin 7) had not been tested. Q503, CR706 and CR708 checked good. However, CR707 showed severe leakage. At first this leakage was disregarded because of the other components in-circuit. Finally, I desoldered one terminal of CR707, and confirmed that it was very leaky. Replacing CR707 solved the weak video symptom.

Remember that the sandcastle waveform, when weak or distorted, can produce weak B&W video or weak chroma. It should be the first thing checked, and not the last.

Conclusion

Always have available the correct schematic (or a similar one) before starting to troubleshoot any color-TV chassis. For example, the RCA CTC111 horizontal circuits are very similar to those of the CTC115, CTC117, CTC118, CTC120 and CTC121.

With all these receivers, the horizontal-deflection circuits must be operating before dc voltages are developed by the low-voltage supplies that obtain power from the flyback windings. Also, regulation of the output-transistor's +130V supply cannot occur until several of the low-voltage supplies are operating.

Do NOT automatically replace the flyback before checking for overloads in flyback-supplied low-voltage sources.

Don't forget, the most trouble-prone components are transistors, ICs or diodes. When you find a leaky or shorted transistor, diode or IC, test other components that could have caused the solid-state component to overload and fail. ■

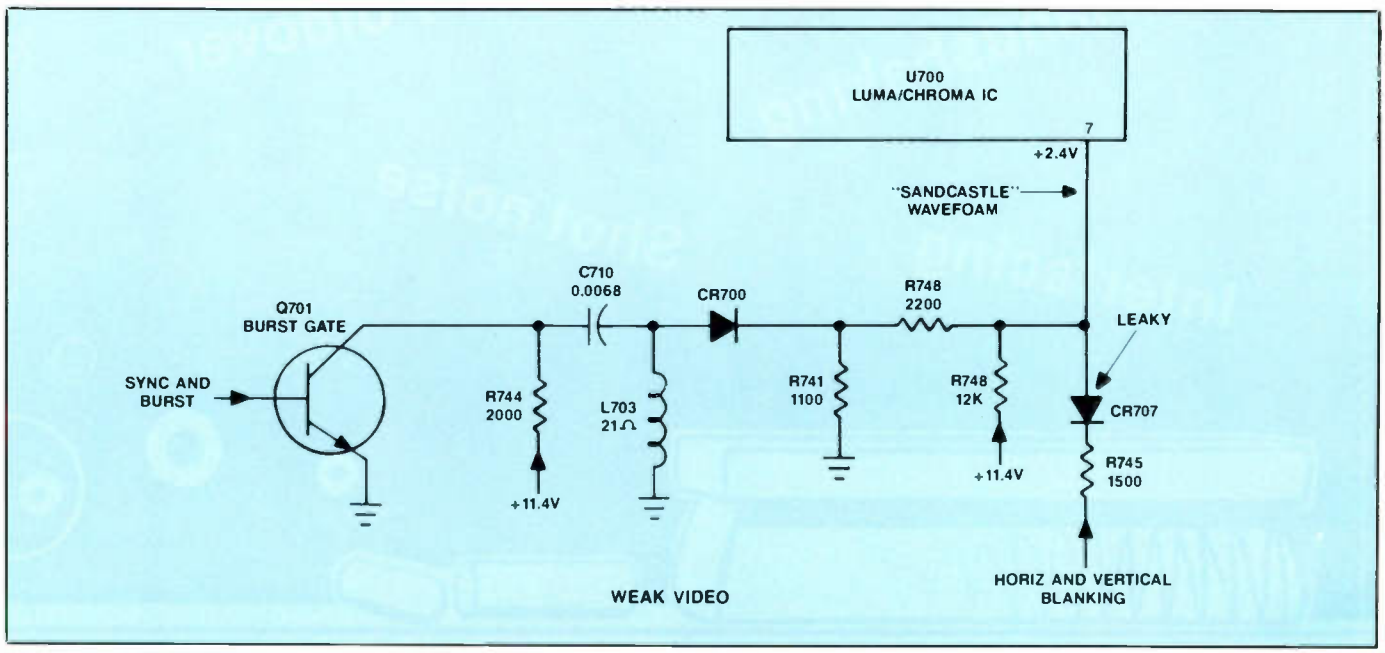
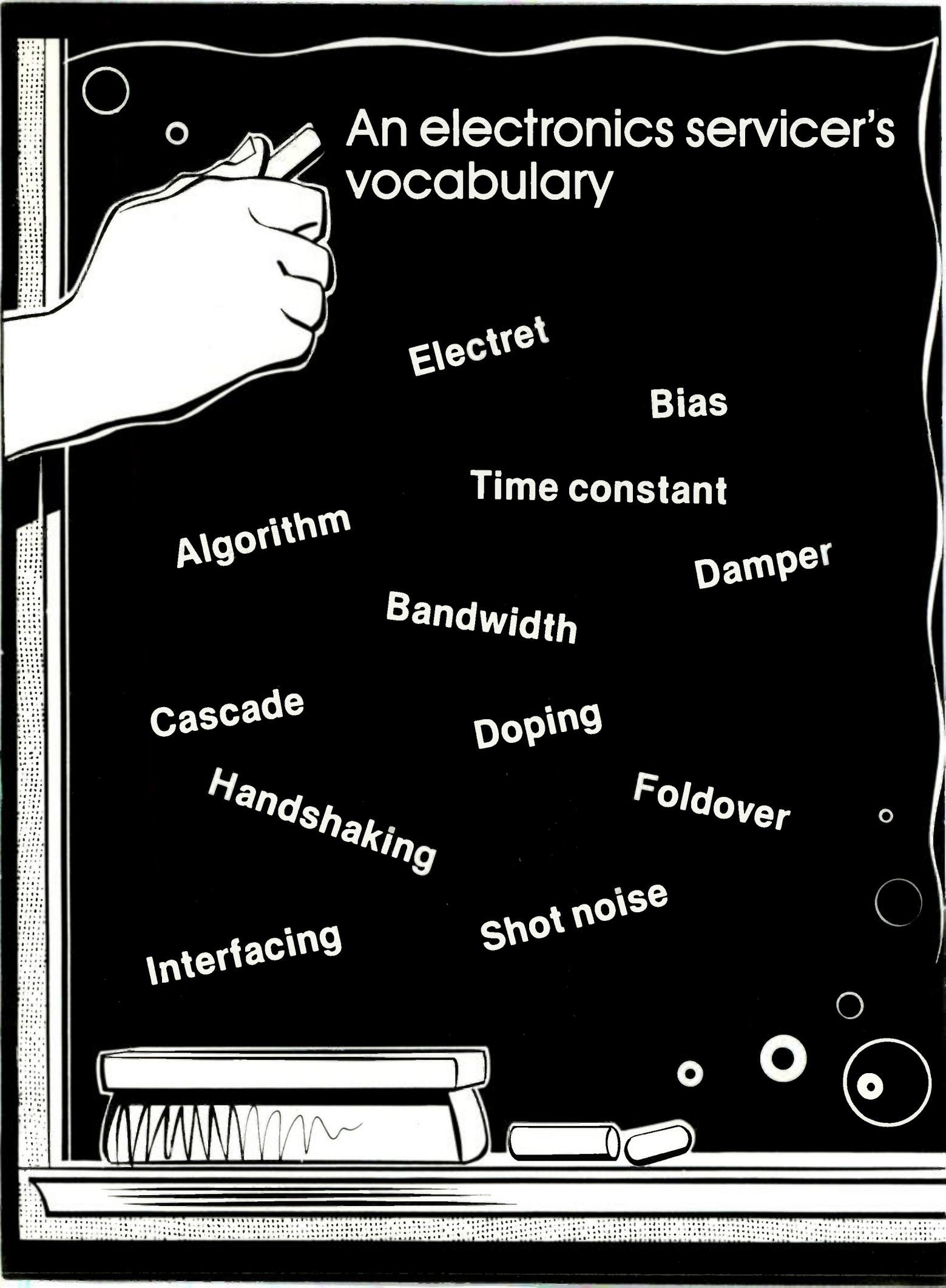


Figure 9. A misshapen or weak waveform at pin 7 can cause weak unstable video or color. Usually, the defective component might be Q701, L703, CR700 or R748.

An electronics servicer's vocabulary



By Conrad Persson

One of the major challenges to people who are involved with consumer electronics is simply to learn the language and keep up with the changes. The technology is changing so fast and new concepts are being introduced so rapidly that electronic servicers are facing whole new vocabularies.

For example, when the compact disc was introduced, it brought a new vocabulary and set of concepts of its own, partly based on audio and partly based on computers: tracking servos, information pits on the disc surface, A/D and D/A conversion, pulse code modulation. The same is true with VCRs, computers and other recently introduced consumer electronic products.

Compounding the problem of keeping up with the vocabulary in consumer electronics is the fact that many of the vocabulary words necessary to understand the traditional concepts either were never learned or, in some cases, are misleading. This list of vocabulary words is presented here in an effort to reinforce the concepts that they represent and to point out and clarify any misleading terms.

Acceptor-A substance added to a semiconductor to change its electrical properties so that it has an excess of holes. This changes the semiconductor from an intrinsic semiconductor to a P-type semiconductor.

Ac coupling-A method of coupling two circuit portions so that only the ac is coupled, and any dc is blocked. Use of a capacitor to block the dc component is typical in ac coupling.

Active device-A device, such as a transistor, that is capable of amplification.

Active filter-A circuit that consists not only of resistors and capacitors but also an active component. The active portion of the circuit is often an operational amplifier. This circuit provides amplification and filtering.

Admittance-The absence of opposition to ac current flow in a circuit-the opposite impedance.

Algorithm-This is one of those almost totally obscure words that only about three mathematicians and seven or eight computer programmers really understand. It's a sequence of steps used to solve a problem, usually applied to the case when a computer is being used to solve the problem.

Alpha-The current amplification of a transistor when it's connected in the common base configuration. Alpha will always be less than 1.

Anode-the positive electrode of a diode. When the voltage across the diode is such that the anode is positive with respect to the cathode, current will flow. More generally, the anode is the electrode of a device that attracts electrons.

Aquadag-The conductive coating placed on the inside and outside of the sides of a CRT to turn it into a giant capacitor. "Aquadag" is an aqueous solution of graphite; the term is short for acqua + deflocculated Acheson graphite. It is a trademark of the Acheson Graphite Company.

Automatic gain control (AGC)-Circuitry introduced into electronics products to keep output constant over a broad range of input signal amplitudes. ACG is accomplished when an amplifier is biased to be controlled so that it is near its maximum amplification when the input signal is small or zero. Feedback is then used to reduce gain when the amplitude of the input signal increases.

Automatic volume control-A form of automatic gain control that is used to keep the audio volume nearly constant over a wide range of input signal amplitude values.

Autotransformer-A transformer that uses a single winding for both the primary and secondary. Because the primary and secondary of an autotransformer are electrically connected, an autotransformer cannot be used for isolation.

Avalanche diode-also known as a Zener diode. An avalanche diode has a charateristic such that when reverse-biased it remains almost an open circuit, passing no current regardless of the value of the reverse voltage, until a value of voltage characteristic of the diode is reached. At that voltage-the avalanche voltage-the diode will conduct a current that rises abruptly. This characteristic is exploited to regulate voltage.

Back porch-The portion of the NTSC composite video waveform immediatley following the horizontel sync pulse. This portion of the signal is 3.7μ in duration. In color transmission it contains the color burst signal, which is used to synchronize the color circuits to assure accurate color reproduction.

Bandwidth-The range of frequencies over which a circuit operates, generaly defined as the range over which the output is within 3dB of the maximum output.

Base-The portion of a bipolar junction transistor between the emitter and the collector. A small change in base current can result in a larger change in collector current.

Beta-The current gain of a bipolar transistor in the common emitter configuration i_c/i_b. Beta [β] is also numerically equal to $\alpha/(1-\alpha)$.

Bias-The arrangement of dc voltages in a transistor circuit. The value and polarity of the bias voltages determine the operating characteristics of the circuit.

Bridge rectifier-An arrangement of four diodes that allows negative and positive excursions of the ac sine wave to be used in creating the dc output. The advantage is that full-wave rectification is more efficient that half-wave rectification. The disad-

Persson is editor of **ES&T**

vantage is that the output of the bridge rectifier cannot have a common ground with the ac input. Because of this, a hot chassis results. Precautions, such as the use of an isolation transformer, must be taken when you test a product using a bridge rectifier power supply.

Carrier-This is another unfortunate and confusing electronics term. This is the radio frequency wave that is modulated to transmit information. The term "carrier" implies, however, that it is needed to somehow "carry" the desired signal through space. But there are transmission systems, such as single-sideband suppressed-carrier, in which the "carrier" is suppressed before transmission, then must be reinserted at the reception equipment before the signal can be demodulated.

Cascade-A circuit arrangement in which the output of one amplifier is applied as the input of a following amplifier. The resulting gain is the product of the gains of the individual amplifiers.

CMOS (complimentary metal-oxide semiconductor)-This technology uses both NMOS and CMOS on the same chip in complimentary fashion.

Damper-In a TV horizontal-output circuit, a damper is a diode, placed across the yoke windings, that conducts after the electron beam has been deflected to extreme right of the screen, causing the yoke's magnetic filed to collapse and returning the electron beam to the center of the screen.

Darlington amplifier-An amplifier fabricated by connecting the collectors together and connecting the emitter of one transistor to the base of the other. The gain of this device is the product of the individual gains of each of the transistors.

Decibel-One-tenth of a Bel. The Bel describes the ratio of two values of power; dB = 10 log (P1/P2). The decibel is used because the Bel is usually a very large number.

Diac-A voltage-controlled trigger device that will conduct in either direction when the applied voltage reaches a value that is characteristic of the particular diac. Diacs were developed to control the conduction of triacs.

Differentiator-An RC circuit arrangement in which the input is across both the resistor and capacitor and the output is taken across the resistor. Differentiation is a mathematical concept in which the result of the differentation is the rate of change of the original mathematical expression. In electronics, the output of the differentiator is the equivalent of the rate of change of the input signal. For example, if the input of the differentiator is a square wave, the rate of change from zero to its dc value and from its dc value back to zero is infinite. Therefore, the output is a positive spike at the point where the square wave was changing in the negative direction. In each case, the initial spike is followed by a gradual curve toward zero following the well-known R-C time-constant curve. The closer the resistor is to zero, the closer the R-C time-constant curve comes to being a straight vertical line downward, and the closer the circuit is to being an ideal differentiator.

Digital-to-analog (D/A) converter-Once a computer or other digital device has manipulated information in binary form, it must read it out in some form that is meaningful to the humans who use the computer. The circuit in a digital system that performs this conversion is the digital-to-analog converter.

Direct coupled amplifier-An amplifier in which the stages are connected together directly without the use of a capacitor for blocking the dc component.

Donor-An impurity added to a semiconductor to give it an excess of electrons, thus turning it into N-type material.

Doping-The process of adding donor or acceptor materials to an intrinsic semiconductor to increase the number of electrons or holes in the material.

DOS (disk operating system)-The operating system that is employed by IBM computers and compatibles.

Drain-The element in a metal-oxide semiconductor that is analogous to the collector in a junction transistor.

Electret-Dielectric material that has been charged and retains its charge.

Electrostatic discharge (ESD)-The discharge of static electricity that occurs when an object with a static voltage charge is brought in contact with, or near, a ground potential. Because many of today's electronics products are manufactured using components that are susceptible to ESD, special precautions must be taken when a technician is working on one of these products.

Equalizing pulses-In the NTSC composite waveform, the six pulses that occur before and after the vertical sync pulse. The equalizing pulse is there to ensure that proper interlace is maintained.

Equivalent series resistance (ESR)-In a capacitor, the sum of the resistances of the leads, the plates, the dicelectric and other stray resistances that cause power dissipation and phase shift.

FET-Field-effect transistor.

Fiber optics-A system of communications transmission that transmits information via light in a thin fiber of glass or plastic, rather than via electromagnetic waves in a wire or through the air. The advantages of fiber optics are broad bandwidth and immunity to noise.

Field Strength-The strength of an electromagnetic signal, say from a broadcast antenna, at a given point in space.

Filter-An arrangement of resistors, capacitors and inductors used to pass certain frequencies and reject other frequencies.

Firmware-Computer programs that are contained in a relatively permanent form within the computer.

(Continued on page 58)

Test your electronics knowledge

By Sam Wilson, CET

For your answers to the following, enter one digit for each space provided

1. Write the value of π (pi) given as six figures:_.____.

2. Write the value of ϵ (epsilon) given as six figures:_.____.

3. The equation for resonant frequency is $x/\sqrt{LC}$, where x = 0._____.

4. If a base current of 1.5 milliamperes results in a collector current of 0.225 amperes, the transistor β is _____.

5. The most popular operational amplifier I.C. is the _____.

6. The time constant of a circuit having 250 pF capacitance in series with 1.2 megohm resistance is _____ microseconds.

7. The image frequency when a table model A.M. receiver is tuned to a station having a frequency of 1250 kilohertz is _.____ megahertz.

8. The hot resistance of a 100-watt light bulb on a 120-volt line is _____ ohms.

9. A cube that is one inch on each side has a volume of _____ cubic centimeters.

10. A 100-ft length of a certain transmission line has an impedence of 300 ohms. If you cut it into two equal lengths of transmission line, each will have an impedance of _____ ohms.

11. Bonus Question: There are eleven questions in this quiz. Give yourself _____ points for each wrong answer.

Answers are on page 56.

Wilson is the electronics theory consultant for ES&T

A spring cleaning checklist

By Glenn R. Patsch

While you are spring cleaning your service bench and office, you should consider doing this for the personal computers you use and provide service for. All too often a personal computer is serviced only when it breaks down. Just as a car requires a tuneup, oil change and inspection, your PC should be receiving the same kind of care.

Dust inside

Turn off the power and remove the ac line cord. Open up the cabinet and look inside. Use a vacuum cleaner with a small nozzle and vacuum out the dust. The dust will tend to accumulate near the intake and exhaust vents around the power supply where the fan is located. If the main circuit boards are very dusty you should vacuum them, exercising special care not to damage any of the components. Normally you would vacuum just the inside of the cabinet and the power supply area to remove most of the dust and leave the circuit boards alone. The idea is to remove most of the dust and make the cooling airflow more effective. I strongly discourage the use of a rag or any cleaning chemical to clean the inside of the computer.

Cleaning the cabinet

With the power still off, clean the exterior cabinet with a slightly damp cloth. This will remove most dust and grime. For stubborn dirt, use a small amount of a mild soap cleaner by applying it to a cloth and cleaning the cabinet. Chemtronics, as well as many other suppliers, offer a full line of cleaning products to make this job easier.

Dot matrix printer

Turn off the power to the printer and remove the ac line cord. If the printer has just been in use, allow the print head to cool off before servicing or cleaning. Dot matrix printers tend to accumulate a lot of fine white paper dust. This should be vacuumed up regularly. In some cases you will find it necessary to use a damp cloth to clean up all the dust.

Most printers have an easy way to open up the cabinet and get better access to the printing area for maintenance. I suggest removing the ribbon and cleaning off any ink from the printing area. Then vacuum up the dust. Why not put in a fresh ribbon while you're at it? Most users are surprised at how much difference in print quality a new ribbon makes. Wipe off or vacuum the exterior cabinet and paper feed paths of the printer to remove dust. Power up the printer and test that the ribbon has been correctly installed. Most printers have a built-in self test. For the IBM Proprinter XL, you press and hold the line feed button while you turn the printer on. For the IBM X24E and XL24E Proprinters, you press and hold the Propark key while you power up the printer for the self test.

The laser printer

Turn off the laser printer and remove the ac power cord. If the printer has just been used, allow it to cool before servicing or cleaning. The inside of the laser printer can get very hot. You should refer to the user's manual for specific instructions on cleaning. Open the printer and vacuum the fine dust that you'll find around the paper feed area. You may need to use a slightly damp cloth to get all the dust.

Hewlett Packard details the cleaning procedure for the LaserJet Series II printers in their user's manual (33440-90901) on pages 5-5 to 5-9 and the service manual (33440-90904) on pages 4-7 to 4-10. The manuals recommend cleaning the transfer corona wire using a cotton swab with isopropyl alcohol, cleaning the transfer guide with a damp cloth, cleaning the registration assembly with a damp cloth and cleaning the paper feed guide with a damp cloth. Try not to get any toner on your hands or clothes because it is difficult to remove.

Close the printer and clean the exterior with a damp cloth and vacuum up any dust, then power up the printer and run the self test to check the print density. For the HP LaserJet Series II, a small green print density dial is located inside on the left. The dial is numbered 1 to 9 with 1 the darkest, 9 the lightest, and 5 the recommended setting. As the toner gets low, you may want to turn the dial up a little. The self test for the HP LaserJet Series II is performed by holding down the Print Fonts/Test key until "05 Self Test" shows on the display. If you do not hold down the key long enough, the "06 Font Printout" will display causing pages of sample fonts to print. If you hold down the key too long, the "04 Self Test" will display, causing test printouts to print continuously. Press the On Line key to stop the continuous printing.

Tuning up the hard disk

Power up the computer and use the DOS CHKDSK command. Do not use CHKDSK or any other tune up software on a drive that is in use as a network drive. When you run CHKDSK, you should see a report showing the amount of total disk space, hidden files, directories, user files, available space, total memory and free memory. You should not see any error or warning messages about file allocation problems, or lost or cross-linked chains. If you do have a problem, you will need to use CHKDSK with the /F option to fix the problem. Refer to the DOS reference manual for the details of using CHKDSK.

Now is an excellent time to clean

Patsch is a consultant specializing in the selection, evaluation, and installation of IBM personal computer and compatible hardware and software

out files on your drive that are not being used. You may want to do a complete backup of the hard drive before removing any files. After removing unneeded files, you may want to unfragment the hard disk to allow it to perform better. As a hard disk fills up, the files on the disk become fragmented and a file is actually stored in parts in several physical locations on the disk. Unfragmenting the disk places all the different parts of the file in the same physical place. This allows programs to load faster and files to be read quicker.

Unfragmenting a hard disk can provide a dramatic speed improvement. The Norton Utilities has the SD (Speed Disk) utility for eliminating file fragmentation. The Mace Utilities has an UNFRAG utility to unfragment the hard disk. It's a good idea to do a full backup of the hard disk before using an unfragment utility.

Floppy disk drives

Clean the 5.25 inch and 3.5 inch floppy disk drive heads using a floppy-disk head cleaner. This takes only a few minutes and helps to clean off the oxide that builds up on the floppy disk head. Some systems use a special disk that soaks up a cleaning fluid, and is then placed into the drive and run by using the DIR command. If the floppy disk drive is designated a:, type DIR a:, and repeat the command several times. The alcohol solvent evaporates completely after a few minutes.

Video screen

Turn the power off, then clean the screen with an optical cleaning cloth, or with a cloth sprayed with a glass cleaner. Never spray cleaner on the screen. Monitors accumulate dust because of the electrostatic charge on the screen. The dust tends to cause additional glare and make the monitor hard to read. Depending on location monitors need to be cleaned daily or weekly. I strongly recommend a dust cover for the monitor. You may want to wipe off the exterior cabinet of the monitor with a slightly damp cloth and a mild cleaner. Vacuum the cooling vents to remove any dust.

Cleaning the mouse

Vacuum the bottom of a mechanical mouse, especially the small rotating ball. If the ball is very dirty, it can usually be removed by sliding a small circular holder to release it. The ball can then be removed and cleaned. Optical mice should be cleaned with an optical cleaning cloth or a cloth sprayed with glass cleaner.

The keyboard

The keys tend to get very dirty with heavy use. Power off the PC and clean the keys with a damp cloth and a mild soap or cleaner. If the keyboard is especially dirty you may need to vacuum up dust and dirt. I recommend a keyboard cover to protect the keys.

Backup

It's always a good idea to do a complete backup of the hard disk periodically. If the hard disk fails or has problems, a backup of all the files on it can really save the day. DOS includes a BACKUP command to make a backup on floppy disks. I recommend a utility like FASTBACK Plus from Fifth Generation Systems which works much better and faster.

Emergency bootup disk

Create a floppy disk that includes DOS by using the DOS FORMAT a:/S command to format a floppy disk. The /S option copies the DOS operating system to the disk. This disk will allow you to boot up the system if the hard drive fails. You may want to copy the config.sys file and any files it uses to configure the system. Also copy the autoexec.bat file to the floppy disk but rename it AUTOEXEC.SAV. This will allow you to recopy the autoexec file to the hard disk after it is restored to operation. The AUTOEXEC file usually includes a PATH command and several other commands that will work only if you are booting up from a hard drive.

Cables

Take a good look at all those serial and parallel cables that connect the printer, modem, scanner and other peripherals to the computer. Replace any that look bad.

Battery

When was the last time the battery inside the personal computer that keeps the system clocks running was changed? On an AT, 386, or PS/2 computer, the battery also allows a small amount of CMOS memory to keep the configuration information on the system. This might be just the disk drive information or a complete set of configuration data for a PS/2. The lithium batteries usually last between two and three years.

Reference, diagnostic, setup disks

Do you have the reference, diagnostic and required setup disks available for all the PCs you service? Would you be able to configure any one of the PCs if it experienced a failure requiring a battery change or hard disk replacement? Now is an excellent time to make a copy of the special configuration files needed to do this.

Power cords

Do any of the ac power cords look worn or frayed? Replace any cords that look bad. Keep a few spare cords available just for replacement.

With an annual spring cleaning, your PC and those of your customers, will continue with few problems. So while you're spring cleaning your bench, why not all those PCs? ■

More about capacitors

By Sam Wilson

To the Readers of This Column

Once in a while it is necessary to go over familiar ground. I know the subject of the first article this month has definitely been discussed before. But, please remember there are new and young readers who have not covered this subject with us.

I'll be brief, I promise. I appreciate your indulgence. Here are the quotes from the January 1990 article that reader Tom Gordon writes about:

A technician friend (who prefers to remain anonymous) sent me an article on capacitors that he believes disproves some of my statements in past issues.

What appears to be the most serious difference of opinion between my comments and the article was that the author said a capacitor "blocks dc." It is this statement, which appears to be a contradiction to everything I have said, that the technician most wanted to discuss.

When I say that a capacitor does not block dc, I mean it will not block a dc voltage. But when I read the article closely, I find that the author says that it blocks dc current. Barring a breakdown of the dielectric, I agree with that statement completely.

As to whether the capacitor blocks dc voltage, if you wish to take issue with me on that, let me tell you about a meeting I attended in Chicago. I decided to ask volunteers for a little experiment; it is illustrated in Figure 1. Everyone who assumed that the capacitor could not pass the dc voltage was simply to grab hold of the circuit terminals.

To all volunteers we offered a free steak dinner. All they had to do was prove me wrong by grabbing hold of the circuit.

Of course, you and I both know

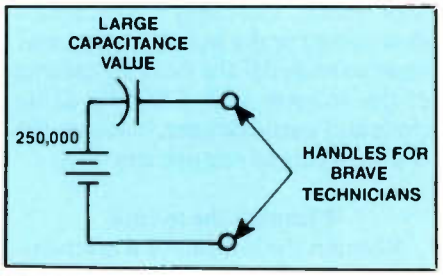


Figure 1.

what happens: When he touches the circuit, the capacitor begins to charge. The charging current through the person will be sufficiently high to make him think he is getting an idea.

In reality, no charging current could take place through the body unless there was already a voltage at the point to be touched. I'll repeat; capacitors do not block dc. But, in order to stay away from contention with people who are talking about dc current, I want to add this: They won't block a dc voltage.

I received two letters from reader Gordon on this subject. I have given quotes from the first letter and all of the second letter.

"Sam Wilson did much ballyhooing about a capacitor's ability to pass a dc voltage in your January issue. I would say he's half right. If a capacitor is sufficiently large, say several hundred microfarads or larger, it will pass a low frequency ac voltage. Under such circumstances the capacitor will charge to the dc source level and immediately discharge and remain discharged or nearly so."

Let me answer this before going to the second letter. There is no separate set of laws for large and small capacitors. They all require charge and discharge paths. You neglected to state what paths you are talking about. Capacitors don't just charge, and discharge.

Your letter is apparently directed to the question, "How long will the voltage remain on the capacitor terminal?" That, of course, depends upon the time constant of the discharge path. It is a function of the capacitance and the resistance of that path.

You have already directed your response to the question: How long will the charge last? THAT QUESTION WAS NEVER ASKED! "The implied question asked was is there a dc voltage?" You did not respond to that one. I made it very clear in the article that a capacitor does not block a dc voltage. There are no restrictions on that statement.

His Second Letter

Dear Mr. Wilson:

"I am in receipt of your letter of 3/27 regarding the ability of a capacitor to pass a dc voltage. I think the problem is more one of terminology than anything else. In your article (ES&T January '90) you used the term "does not block" with no restrictions. I interpret "does not block" to mean "passes," and that in a sense that a resistor in a closed circuit passes current (electrons) at a fairly constant rate and for an indefinite period of time assuming the dc voltage across the resistor remains constant. We know that that is not how a capacitor in a closed circuit, i.e., with a discharge path, passes a voltage. The circuit must be closed otherwise we would wonder what the capacitor passes its voltage to. If you had said that a capacitor will pass some steadily decreasing level of dc for as long as the time constant in question multiplied by about 5 allows I would have no objection. After that time is up the capacitor, of course, blocks the dc voltage. If the capacitor is large and there is sufficient resistance in the circuit the time constant may be several hours, but if the capacitor is small even with extremely high circuit resistances time constants are typically under one second

Wilson is the electronics theory consultant for ES&T.

and negligible for all practical purposes. See enclosed diagrams."

Tom Gordon

My answer to the second letter:

To show that the output voltage is equal to the applied voltage, I will use a very basic application of Kirchhoff's voltage law: Refer to Figure 2. The algebraic sum of the voltages around any closed loop is zero. Remember, the capacitor is not charged, so there is no voltage across it.

Using an easy convention, encountering a negative voltage will result in a voltage drop, and encountering a positive voltage results in a voltage rise.

Starting at point x and writing the equation in a clockwise direction:

$$+ V_A - V_C - V_B = 0$$

but, $V_c = 0$ because the capacitor is not charged. So,

$$V_A - V_B = 0$$

$$V_A = V_B$$

The voltage across the output terminals is equal to the applied voltage with no resistor across the output terminals!

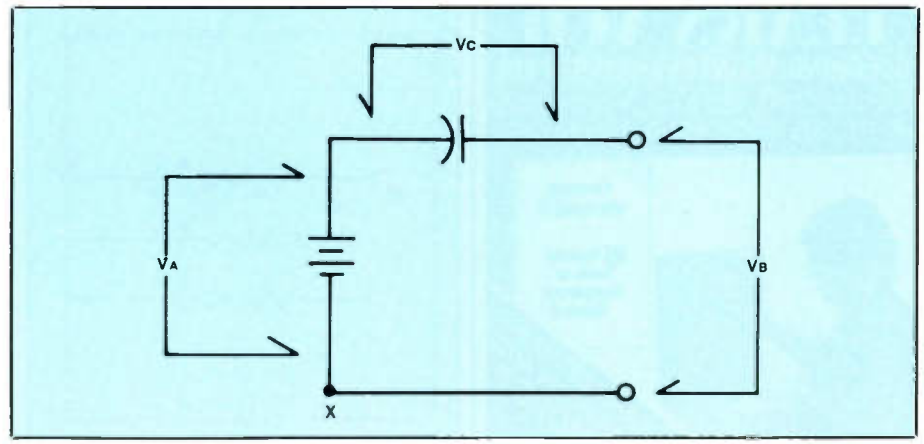


Figure 2.

Time constant does not enter into the discussion because there is no resistor across the output terminals so, there is no charging current.

I say again: In the circuit of Figure 2 the voltage across the output terminals is equal to the applied voltage! That means the capacitor "passes" the voltage.

FCC license information

Here is a message taken directly from the FCC Bulletin #FO-28 July, 1989: The Federal Communications Commission rules no longer require general radiotelephone operator licenses except in the Marine Aviation and International fixed public radio services. The commission discourages unnecessary license applications. Therefore, you should apply for a commercial radio operator license only if you require it for employment in one of the above three services.

General radiotelephone operator licenses are not required to maintain or repair stations in the private land mobile services. They do not authorize you to be a broadcast technician

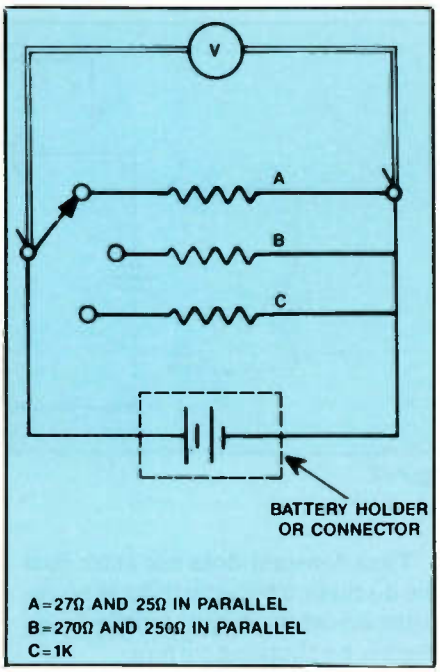


Figure 3.

or operator. If you plan to maintain and repair stations in such services seek technician certification from an appropriate user group organization.

Battery testing

The circuits of Figure 3 are useful for testing popular batteries. It is not designed for testing rechargeables.

Regulator/Power amplifier

When power supply voltage regulators have closed-loop feedback circuits, the feedback is degenerative.

A little known fact about closed-loop regulators is that they have characteristics similar to operational amplifiers when op amps are operated in the inverting mode. Saying it another way, an intergrated-circuit voltage regulator can be used as an audio power amplifier.

At my suggestion, Michael Smith of West Palm Beach, Florida connected the popular LM317T as an audio amplifier. His circuit is shown in Figure 4.

He reports that the amplifier performed satisfactorily, and has the advantage of relatively-high output power.

No attempt was made to measure the output impedance, or, to match the impedance to the speaker. However, the concept does suggest some interesting possibilities.

If I was going to experiment with improvements, I would search for an I.C. regulator with better (more linear) feedback characteristics for audio amplification.

Measure the output impedance, and use a speaker that matches that impedance. If there is no such speaker, use an output transformer to match the impedance.

Make a bode plot showing audio frequency response of various regulators.

If you decide to pursue this further, let me know what you find out. I'll print your letter in this column.

The LED regulator

Some time ago I wrote that a LED can be used as a voltage regulator. In fact, when reverse biased it has the same characteristic as a zener diode.

At the time I said I didn't know of anyone using that. I have received a letter from Bruce Hagan. He is a long-time friend living in Beckersville, Ohio. According to him, that application of LED'S is used in some compact disc players. ■

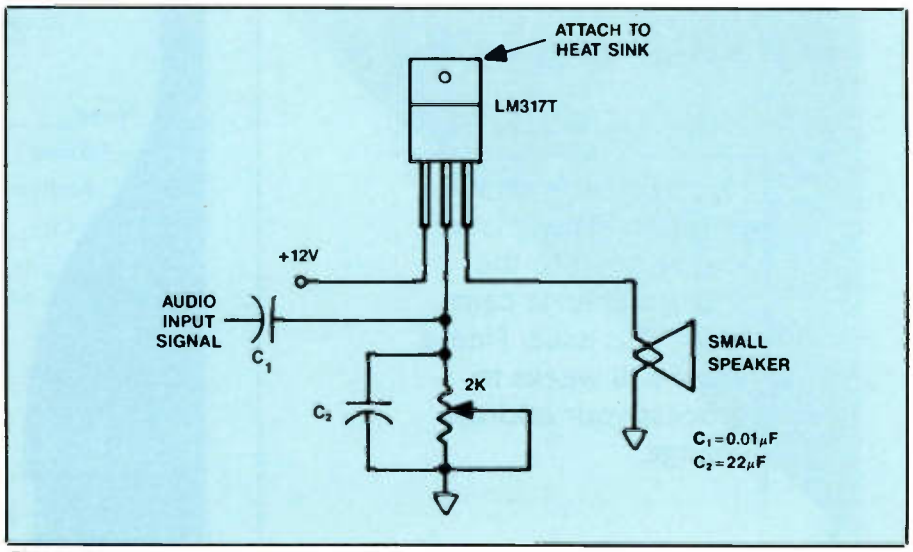


Figure 4.

Diagnosing problems in the bridged audio amplifier

By Craig N. Seelig

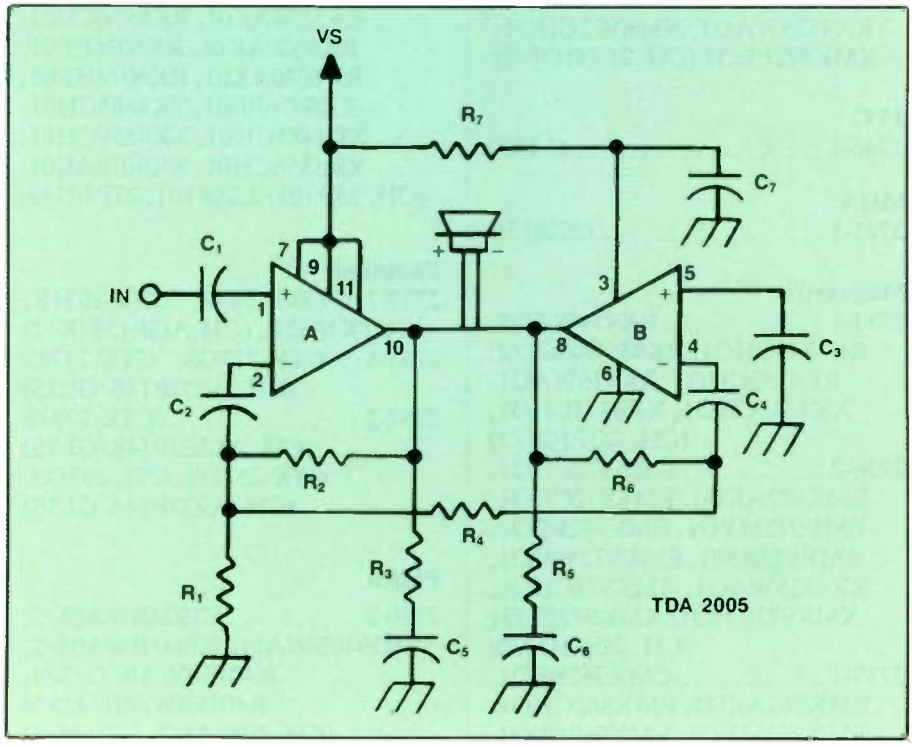
When you're working with the powerful audio systems in todays cars, you will probably run across a circuit configuration called the bridged audio amplifier.

Producing audio power in excess of five watts per channel from a (battery) power source limited to a nominal 12V, has led to the development of circuitry somewhat peculiar to mobile and portable electronic equipment. By employing bridged audio output circuits, manufacturers have been able to derive a fourfold increase in maximum audio power without increasing supply voltage. Whereas with conventional amplifiers the speaker negative terminal is connected to (chassis) ground, in a bridge (or BTL) configuration, the speaker negative terminal is connected to an identical audio amplifier which is supplying audio power of equal amplitude but 180 degrees out of phase. By using such a circuit, the maximum undistorted voltage swing, as measured across the speaker terminals, is doubled.

Seelig, an electronics servicing consultant, has spent the last 11 years doing circuit design, prototyping and troubleshooting for a car stereo manufacturing company.

Such circuits can be constructed of discrete bipolar transistors or ICs. However, IC manufacturers have made many ICs available which are specifically designed for bridge applications. These bridgeable ICs have two identical amplifiers on board with very closely matched quiescent voltages. Closely matched quiescent voltages allows dc coupling to the speaker, eliminating the need for the large output or dc blocking capacitors customarily placed between the speaker and the amplifier circuit. This yields the benefit of both a reduced parts count and improved low-frequency coupling to the speaker.

Consider the typical bridge circuit shown. Signal is applied to the non-inverting input of amplifier A, via C1. The offset, or quiescent, dc voltage is set internal to the IC so that ac reference only is required. This is provided by C2. R2 is the feedback resistor for amplifier A. The ratio of the value of this resistor to that of R1 sets the gain of the stage. A sample of non-inverted audio is developed across R1 and coupled to amplifier B via R4 and C4. Note that this audio is applied to the inverting input of amplifier B because its input must be 180 degrees out of phase with amplifier A. R6 is the feedback resistor for amplifier B, and the ratio of its value to that of R4 sets the gain of this amplifier. The ac input reference for amplifier B is provided by C3. R7 and C7 are part of the IC's power supply ripple rejection circuit. Because at ultrasonic frequencies the slew rate of the amplifier would cause the negative feedback to become regenerative, the high frequency response of the amplifier is cut off by R3, C5, R5, and C6.



When troubleshooting a bridge amplifier for no sound or distorted sound, first check the supply voltage. Next check the static quiescent dc voltage at the IC's output pins. This should be done with the speaker circuit open, as dc coupling through the voice coil could allow the quiescent voltage of a healthy amplifier to pull the voltage of a defective amplifier to normal. The static dc voltage measured at the output pins of the IC must be equal to one-half the supply voltage. Any departure from this is almost always due to a defective IC. In rare instances, though, a leaky or shorted capacitor is the culprit. If, by desoldering the input pins of the amplifier in question, the quiescent voltage is restored to normal. Suspect, a defective capacitor.

Thus armed with an understanding of the bridge circuit's operation, troubleshooting becomes a straightfoward matter. ■

ES&T periodically publishes reviews on books that are particularly applicable to our readers. We do not have any information other than that supplied below each review. Contact the publishing company for further ordering or pricing details.

Troubleshooting and Repairing Electronic Circuits, 2nd Edition, by Robert L. Goodman; TAB Books; 320 pages; $27.95 hardbound, $24.50 paperback.

This book is a first edition of an all-in-one guide to electronic circuit repair. The repair manual has helped tens of thousands learn professional techniques for diagnosing and repairing the circuitry used in every popular electronic device. This expanded second edition features easy to follow, step by step instructions for troubleshooting and repairing circuits in all major brands of the latest electronic equipment including electronic TV tuners, remote control systems, digital TV circuits, TV stereo sound, compact disc players and much more.

TAB books, Blue Ridge Summit, PA 17294-0850; 800-822-8138

The Electronic Image: Examining Basic TV Technology, by Michael A. Krunpnick; Knowledge Industry Publications; 145 pages; $45.00, $29.95 student edition.

This book offers a break from the traditional method of teaching TV theory which assumes that electronics is the only environment in which television can be understood. The Electronic Image is about broadcast technical theory-video not electronics. This is a unique text that clearly explains the fundamentals of television. Topics covered include perception, switcher theory, magnetic recording, videotape editing, audio sweeting and digital design.

Knowledge Industry Publications, Inc., 701 Westchester Avenue, White Plains, NY 10604

Electronic Troubleshooting Procedures and Servicing Techniques, by Sam Wilson; Prentice Hall; 304 pages; $37.00.

This book presents troubleshooting tests, servicing techniques and measurement procedures for components, circuits and systems. After first reviewing the basics of electronics as they apply to troubleshooting, this text offers several methods of zeroing in on a problem, including specific measurements and diagnostic methods. Component repair and replacement is briefly discussed and special problems are considered in detail. The content of this book includes special techniques for dealing with such tough problems as closed loops, distortion and intermittents. It also presents plans for specialized equipment that can be built at home, details several methods of zeroing in on a problem, including the symptom method, signal tracing and signal injection, and describes specific measurements for locating faulty components, circuits and systems.

Prentice Hall, Englewood Cliffs, NJ 07632; 201-767-5937. Also available from ISCET, 2708 West Berry St., Fort Worth, TX 76109; 817-921-9101.

PHOTOFACT

Emerson

2736-1 . . . . . CMK972CHO1, EMK972AKO1, EMK972CHO1, EMK972MYO1, EMK972PEO1, EMK972RSO1, EMK972WHO1, RX4325WAO1, XMK972CHO1, XMK972PEO1 (CH. 2ON1O1/2)

JVC

2746-1 . . . . . C-1329

MGA

2743-1 . . . . . CS2015R

Magnavox

2733-1 . . . . . RK434WAO1, RK4345CHO1, RK435WAO1/2, RK4353CHO1, RK436WAO1, XK4345CHO1, XK4353CHO1, (CH. 2OP1O1/3)

2736-2 . . . . . CMK972CHO1, EMK972AKO1, EMK972CHO1, EMK972MYO1, EMK972PEO1, EMK972RS01, EMK972WHO1, RX4325WAO1, XMK972CHO1, XMK972CHO1, XMK972PEO1 (CH. 2ON1O1/2)

2737-1 . . . . . CMX962PEO1, EMX962AKO1, EMX962CHO1, EMX962MYO1, EMX962PEO1, MK426OCHO1, PK426OCHO1, RX424OWAO1, RX426OWAO1, RX4331AKO1, RX4335CHO1, TK426OCHO1, TK4331CHO1, XMX962CHO1, XMX962PEO1, (CH. 19L1O2/4/6, 2OL101/2)

2738-1 . . . . . CMl992CHO1/2, CX9712AKO1, CX9714HPO1, CX9716PEO1, EML992CHO1/2, EML992PEO1/2, MX4476CHO1, PK4816PEO1/2, RX4816PEO1/2, XML992CHO1/2 (CH. 25N101/2)

2739-1 . . . . . CMX962PE21, CX4O1OWAO1/2, EMX962AK21, EMX962CH21, EMX962MY21, EMX962PE21, MK426OCH21, PK4O35CHO1/2, PK426OCH21, RX4029WAO1/2, RX424OWA21, RX4O35CHO1/2, RX424OWA21, RX426OWA21, TK426OCH21, XK4O29CHO1/2, XK4030CHO1/2, XK424OCH21, XK426OCH21, XMX962CH21, XMX962PE21 (CH. 13L4O1/4, 19L4O2/4/6)

2741-1 . . . . . MK4485CH01, PK4559CH01, PK6020AK01, PK6070AK01, RJ4559AK01/2, RK4482AK01, RK4485CH01, RK4490AK01, RK4492CH01, RK4910AK01, RK4916PE01, RK4960AK01, RK4964HP01, RK4966PE01, RK5541CH01, RK5554AK01, RK5556CH01, RK6020AK01, RK6026PE01, RK6070AK01, RK6074HP01, RK6076PE01, TK4485CH01, XK4485CH01, XK4559CH01, XK5556CH01, XK6070AK01, (CH. 25P101/2,26P101, 27P101/2)

Panasonic

2733-2. CTK-1O3OR, CTK-1031R, CTK1032R, (CH.AGP159/K12)

2735-1 . . . CTK-277OS, CTK-2778S (CH. AEDP148/GL7S)

2737-2 . . . . . CTK-2781S (CH. ALEDP148/GL7S) CTK-258OS, CTL-258OS, (CH. AEDP144/GL7S)

Philco

2730-2 . . . . . C3924BWA01/2, R3940BWA01, R3941BWA01/2, R4040BWA01/2/3/4, R4075BWA01/2/3/4 (CH. 19B104/7, 20B104/5)

2734-1 ..... R3971AWAO1/2/3, R4O4OAWAO1/2/3/4/5/6, (CH. 19C803, 2OC805)
2735-1 ..... R5085BWAO1/2/3, R6983BAKO1, R6985BPEO1, R7083BAKO1 (CH. 26C903/4, 27C904)

Quasar
2734-2 ..... TP2O2ODW (CH. ALDC177/GL7H2)
2738-2 .... TU2513DK, TU2517DP, YTU2617DK (CH. ADC160/GL7S2, YADC160/GL7S2)
2741-2 ..... SP2040DE (CH.AEDC183/GL7H1)

RCA
2740-2 ..... F26010WNF01, G26131TNC01, G26131TNKO1, G26131TNL01, G26133TNC01, G26133TNL01, G26135PNK01, G26137TNC01, G26137TNK01, G26137TNL01, G26139HPK01, X26021EBF01, X26023WNF01, X26040TNC01, X26040TNK01, X26041TNC01, X26041TNK01, X26048TKK01, X26049TKK01, (CH. CTC149C/G/H)
2746-2 ..... E13159EGF02, E13164GMC01, E13164GMF02, E13165FWC01, E13167WNF02, E13168NGF02, E13169GMC02, E13169GMF02, X13131EBC01/3, X13131EBF01/3, X13133WNC01, X13133WNF01/3, X13135EBC01, X13135EBF01/3, X13137WNF01/3 (CH. CTC145B/D/E/F/FC/G/HC)

Samsung
2744-1 ..... TC3643C

Sears
2726-2. 564.42355950, 564.42455950

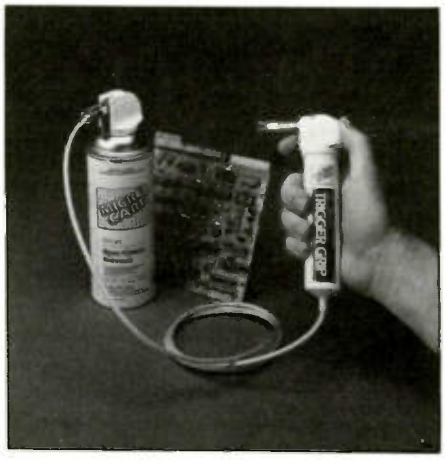
Sony
2742-1 ..... KV-13TR20/1 (CH.SCC-A81X-A, SCC-C48A-A)
2745-1 ..... KV-20TS20/1/2/3 (CH.SCC-B55M-A, SCC-B55N-A, SCC-B55S-A, SCC-B55V-A

Toshiba
2740-1 ..... CF1311J, CA14119 (CH. TAC8930/5
2745-2 ..... CX2047J, CX21479 (CH. TAC8903/8)

Zenith
2742-2 .... D2568W, SD2511G/G3, SD2513G/G3, SD2515N/N3, SD2527P/P3, SD2517P/P3, SD2569W/X/Y, SD2581H, SD2593W/Y, SD5539W, SD5557Y
2743-2 ..... D2500W, D2502G, D2504P, D2506W, D5534G, D5552H, S6520G, SD2501W/W3, SD2503G, SD2505P, SD2507N, SD2509H, SD5513G, SD5515G, SD5533G, SD5535G, SD5541H, SD5553H, SD5555G, SD5561G, SS6503G, SS6505P, SS6507H, SS6507N, SS6521G, SS6529P
2744-2 ..... SD2725H5, SD2729N5, SD2731G5, SD2731H5, SD2771R5, SD2777P5

Self-dispensing solvent system

A self dispensing solvent system, *Micro-Care* Spec Clean, is designed for a wide variety of PC board cleaning applications. Small amounts of solvent are dispensed from a hermet-

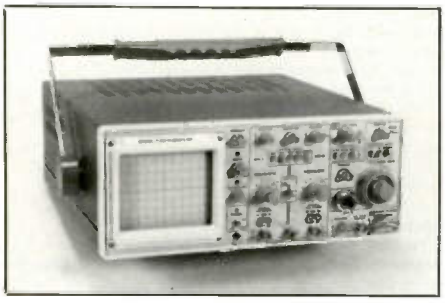


ically-sealed container through a brush attached to a trigger grip applicator, giving a constant supply of fresh solvent. The solvent is a non-flammable antistatic blend, effective in removing heavy concentrations of flux.

Circle (78) on Reply Card

Three-channel, eight-trace scope

The Model 2970 from *Brunelle Instruments* offers vertical bandwidth of dc to 60MHz, 3 channels and 8



traces. Additional features include variable hold-off function, dual coarse and fine adjustments, trace rotator and internal CRT illumination.

Circle (79) on Reply Card

Ratchet crimp tools

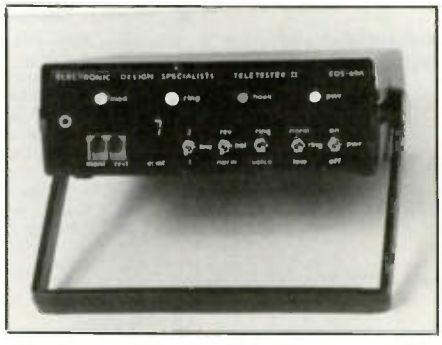
Ideal Industries offers crimpmaster ratchet crimp tools for repeatable, precise crimps that meet or ex-

ceed UL specifications. The tools are available in six variations to crimp insulated terminals, non-insulated terminals, BNC/TNC coax connectors, F-type connectors and telephone plugs. Interchangeable die sets have marked nests for easy and accurate selection and can be changed quickly with a screwdriver.

Circle (80) on Reply Card

Telephone equipment tester

Electronic Design Specialists offers the EDS-69A Teletester II, featuring dial tone, ring voltage, off- and on-line signals, DTMf number

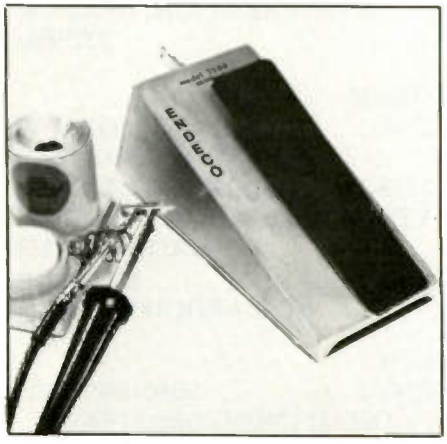


display, audio level indicators, off-hook indicator and two-line capability. The unit is available in both finished and kit form. A lower-cost version of the kit is available without the DTMF and dial tone options, which can be added later if the need arises.

Circle (81) on Reply Card

Power vacuum desoldering station

Leads Metal Products introduces the ENDECO Model 7300 spike-free power vacuum desoldering station, a foot-operated console that sits on the floor, not on the bench. The unit employs the company's patented process of timed maximum vacuum, followed by rapid expulsion of contaminants. The 750°F to 950°F iron enables the operator to heat leads and



desolder quickly, preventing overheating of the board and nearby components. The vacuum pulls solder quickly through multilayer boards and tight lead-to-hole clearances.

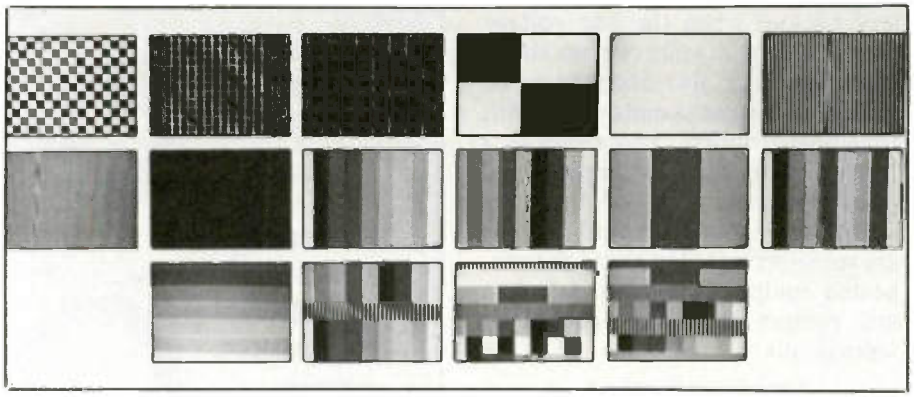
Circle (82) on Reply Card

Aerosol spray cleaner trigger

SafeWorld International offers the Can-Gun trigger that attaches to

an aerosol can to make spraying the contents easier for the operator. The ergonomically designed device incorporates a safety shield to protect the operator from being sprayed by the can's contents.

Circle (83) on Reply Card



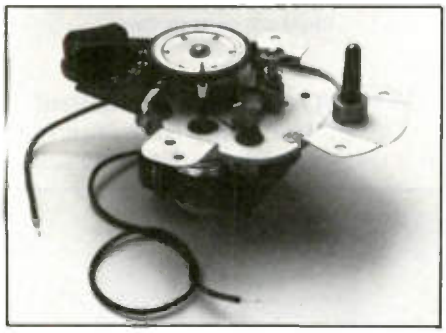
Handheld pattern generator

NCM Electronics has announced the availability of a handheld audio/video pattern generator with 16 patterns for testing, troubleshooting and aligning VCRs, TVs and computer monitors. The Mini Wonderbox features standard B&W and color patters, including NTSC color bars and bursts. In-house custom-designed LSI circuitry allows this capability to be placed in a package that measures 2.87 inches W by 8.38 inches L by 1.26 inches D, and weighing less than a pound.

Circle (85) on Reply Card

Replacement phono motor

Projector-Recorder Belt offers a general industry universal replacement motor (110V, 60Hz) for all 4-speed changers in most phonographs, such as Califone and Audiotronics.



Circle (86) on Reply Card

Ergonomic soldering station

Portasol Inc. introduces the Oryx SkyLab series of four professional soldering stations featuring ergonomic "space age" design and technological enhancements. The heart of the design is the tip, which incorporates the entire heating element and thermocouple. This keeps the handle lightweight and cool, and minimizes element failure because the element is changed with the tip. The handle is also slimmer, giving pen-like control. The series offers various combinations of presettable temperature, LCD temperature display and solder fume extraction.

Circle (87) on Reply Card

Picture tube restorer

Conway Manufacturing now offers two models of picture-tube restorers for TV or computer monitor CRTs, based on the original low-voltage, high-current Beltron patent; one a manual unit, and the other a simplified, microprocessor-controlled model. Both models feature a new isolation transformer and a regulated 0Vdc to 20Vdc filament circuit to accommodate newer CRT ratings. They can be used to test and restore either B&W or color tubes. Manual test/restore procedures are simple to perform. Automatic, processor-controlled test/restore routines with operator prompt messages are specifically designed for computer local area network preventive maintenance and repair.

Circle (88) on Reply Card

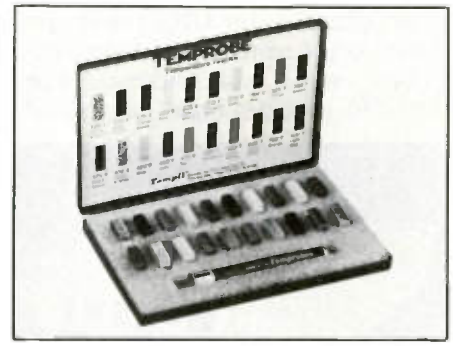
Coax cable stripper

Shattuck Industries introduces the Pro-Ax coax stripper, made of plastic, with a built-in tension spring, center pin cutter and slide adjustment to strip RG58, RG59 and RG6 cables. Two-level or three-level strips are made with interchangeable blade cassettes. Blades can be adjusted individually for various manufacturers cable dimensions.

Circle (89) on Reply Card

Temperature-indicating "crayons"

The *Tempil* test kit, available from HMC contains 20 temperature-indicating crayons, spaced at regular intervals between 125°F and 800°F, and a special holder. To use, the user marks the workpiece with one of the crayons before heating begins. When the crayon's temperature rating has been reached, the dry opaque mark changes to a distinct melted mark. The mark can later be removed using alcohol or water.



Circle (90) on Reply Card

Hi-lighting magnifier lamp

Dazor Manufacturing Corp. offers the Dazor 2000 magnifier lamp featuring a "floating arm" design, 13-watt compact fluorescent light source and advanced universal clamp-

on base designed to mount on any surface angle. The lamp is available in 3-diopter and 5-diopter crown-optical lenses for distortion-free magnification of + 75% at a focal length of 13 inches or + 125% at focal length of 8 inches respectively. The light is directed at an angle to highlight details of the object being viewed. The arm glides easily and has no exposed wires or springs.

Circle (91) on Reply Card

Single workstation power system

Now available from *Perma Power* is a under-monitor UPS power system/control center for desktop computers and workstations. The SPS-250 provides eight minutes of

250 VA backup power at full load capacity; 15-20 minutes at half load. The system also provides computer power regulation, switching to battery backup when the line voltage drops below 102 volts or rises above 132 volts. It is also designed to be placed under the monitor and with four power outlets, also serves as a control center for the computer and its peripherals. Two of the four outlets are backed up, and all four are surge-protected to guard the connected equipment against data loss and equipment damage caused by voltage spikes.

Circle (92) on Reply Card

Magnification light

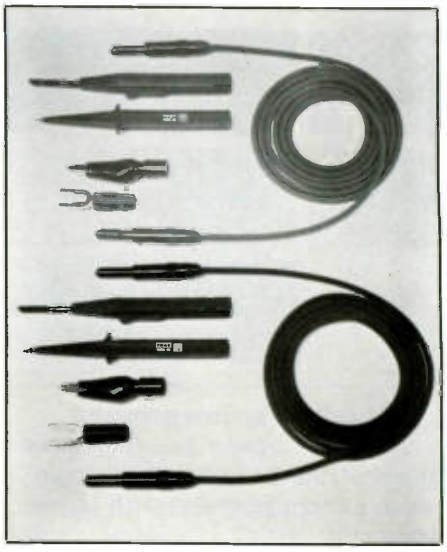
Waldmann Lighting Co. announces its newest magnification light known as the "Focus 7 Plus". The task light is designed to meet a wide range of close up inspection needs at any workstation. The light uses the new generation

13 watt compact fluorescent lamp which provides as much light as a 60 watt incandescent, but with 78% less energy consumption and heat. The lamp will last 10,000 hours. The large (6.5″ × 4.25″) 3-diopter lens gives an undistorted, broad field of view, reducing eye fatigue and improving productivity. The thirteen inch focal distance makes assembly with soldering equipment or hand tools very easy.

Circle (93) on Reply Card

Multimeter lead

New from *Test probes, Inc.* is the TLS2000, a silicon rubber multimeter lead for all makes of analog and digital meters equipped with standard 4mm input jacks. The silicon rubber cables are soft and flexible and even under extreme cold, are burn-resistant. Inter-



changeable accessories provide for a variety of measurement applications. The probes facilitate accurate measurements of low voltages and resistances because of their low contact resistance. It is offered in straight or right-angle plug versions and is priced 10-15 percent lower than competitive test leads.

Circle (94) on Reply Card

Low cost monitoring intermittent

The DC line Sentry from *Huntron* is a convenient and affordable solu-

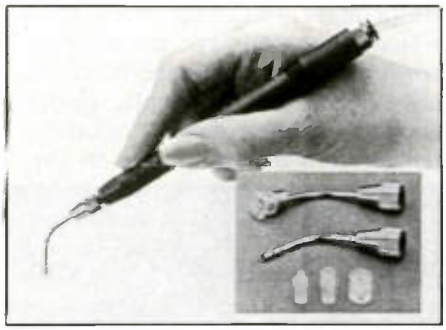
tion for monitoring intermittent DC power faults. Using the DC Line Sentry, technicians can monitor power supplies to learn whether a power supply has stayed within specified limits over a period of time. The DC Line Sentry is simple to use with compact design, easy to read LED status indicators and economical pricing.

Using the DC Line Sentry, technicians can monitor power supplies to learn whether a power supply has stayed within specified limits over a period of time.

Circle (95) on Reply Card

Vacuum pick

New from *Micro Electronic Systems* is a unique miniature vacuum pick up pen with the Venturi built right into the pen. It works, from any shop



compressed air system, and conversion from pressure to vacuum is done right in the pen. Ideal pressure is 80-90 psi at the input, which will give you well over 20 inches of mercury at the tip when operated with the forefinger over the valve hole. One of the unique features of the pen is the Silicone rubber suction cups. They are made with a unique "neck" that adjusts to whatever angle you approach the device you wish to pick up. Each pen comes with four different size tips for flexibility in varying size applications.

Circle (96) on Reply Card

Ozone-safe flux remover

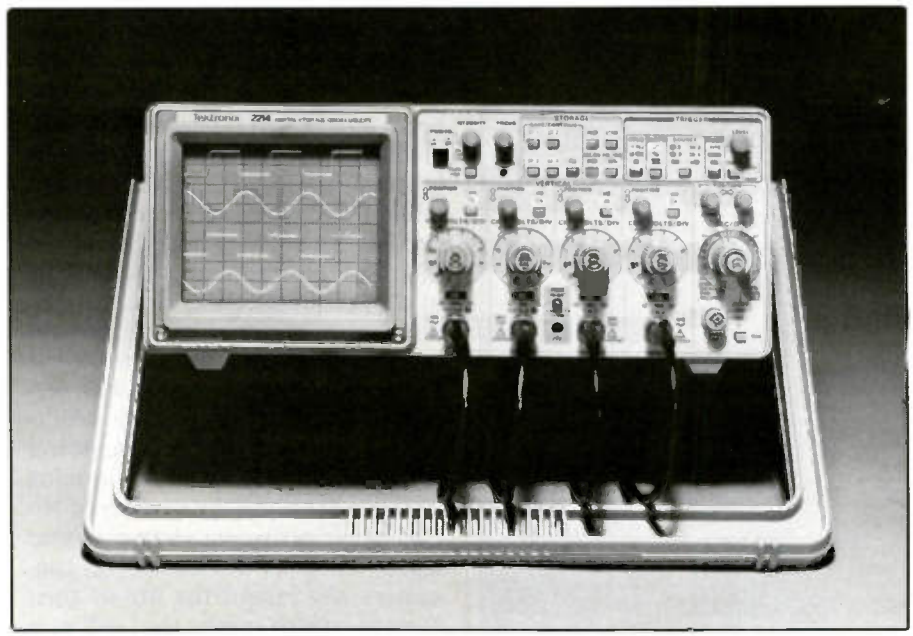
Chemtronics has offered Flux-Off, a post-solder defluxant that contains no regulated chlorinated fluorocarbons (CFCs). Developed in response to requests for better ionic removal in a non-CFC remover, the product is a stable mixture of a chlorinated solvent system blended with a variety of alcohols. The formula provides excellent solvency to remove rosin fluxes and residual production contaminants such as dirt, grease and molding compounds. Its low surface tension penetrates tightly-packed components, and the material evaporates, leaving no film or aqueous residue.

Circle (99) on Reply Card

Circuit repair kits

A new series of circuit repair kits are now available from *Circuit Repair Corporation*. The kits are used to repair damaged or missing surface mount pads, gold edge contacts, circuit traces and pads. Boards are restored to new factory-like condition by bonding in place dry film epoxy backed replacement circuits. No messy liquid epoxies are needed to bond the next circuit. The kits come complete with epoxy backed replacement circuits, a temperature controlled bonding iron, bonding iron tips, tools, supplies and a detailed instruction booklet.

Circle (97) on Reply Card



Four channel DSO

Tektronix has announced a new low cost, four channel analog/digital storage oscilloscope. The Tektronix 2214 is a long record length DSO with four complete channels based on a conventional 20 MHz real time oscilloscope. With an analog-to-digital converter system for each channel, this oscilloscope can concurrently acquire and display 16K samples per channel, at a maximum sample rate of 16 megasamples-per-second. With this performance and its hardcopy output interface, the 2214 is ideal for service and monitoring work in electromechanical, and process control applications.

Circle (98) on Reply Card

Answers to the quiz

Questions are on page 43.

1. 3.14159
2. 2.71828
3. x = 0.159
4. 150
5. 741
6. 300 [T = RC]
7. 2.160 Megahertz image frequency = (tuned frequency) + (2 × i-f frequency)
8. 144
9. 16.387 (1 inch = 2.54 cm, and $(2.54)^3 = 16.387$ cm^3
10. 300
11. 0.000 [no credit for wrong answers]

Products

Small parts storage bin

New from *Alcara System* is Lock-A-Bin. These bins are designed for the storage handling and transport of small parts. The plastic bin, regular and conductive, is molded in one piece with innovative features achieving maximum protection of parts, and can be connected both vertically and horizontally in any configuration. This is a first of a kind in small parts handling. It is a one-piece molded, closeable and locking bin available in both regular and conductive plastic. The bin protects its contents from dust and dirt and eliminates the danger of accidentally mixing parts. Kitting is accomplished by combining any number of bins either in any direction. The bin protects its contents from dust and dirt and eliminates the danger of accidentally mixing parts.

Circle (74) on Reply Card

Battery conditioning system

A new battery conditioning and charging technology from *Sure-charge Industries Inc.* has recently been announced. The battery will eliminate reduced capacity problems inherent to rechargeable Nickel Cadmium (Ni-Cad) batteries. The patent pending technology will extend the life of all Ni-Cad batteries. The use of conventional battery charges combined with improper use by the consumer will eventually decrease the battery's ability to deliver 100 percent of its rated energy. This results in fewer minutes of available power for the user. The new conditioning system will reduce the number of Ni-Cad batteries thrown away each year and by using the new technology consumers will extend the life of their batteries which means they will save considerable money over time.

Circle (75) on Reply Card

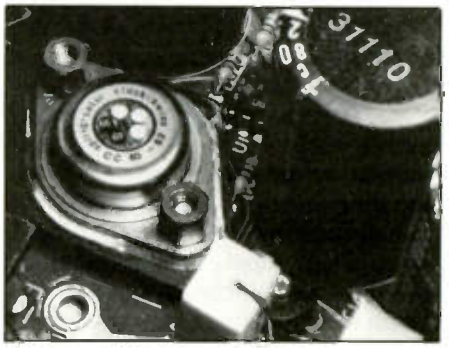
DMM with rotary switch, 3 digits

A.W. Sperry Instruments has introduced the DM-4200A, a 3-digit, rotary-switch DMM. Features of this pocket-size meter include a continuity buzzer, 150-hour battery life, recessed, safety-designed input terminals, a built-in tilt stand, overload protection, a diode test function, a battery test, an HFE transistor test. It also incorporates nine functions on 33 ranges.

Circle (76) on Reply Card

Temperature recording equipment

CelsiClock is the latest addition to the vast range of temperature recording equipment on offer from *SAT Inc.* The CelsiClock is an irreversible temperature recording clock label which measures and permanently records the maximum temperatures on any surface. This is a simple, reliable and economical method of recording temperature maxima levels on surfaces which are inaccessible by standard methods due to rotation, vibration under high voltage, or dangerous for any other reason. CelsiClock covers ranges from + 40 C up to 260 C in 8 separate labels. Each label is divided into 5 temperature sequences and numbers of the exceeded levels appear almost like magic. A free sample kit is available on request from *SAT Inc.*



Circle (77) on Reply Card

VCR mechanical replacement parts

Newly expanded from *Philips ECG* is the VCR mechanical replacement parts segment of the ECG Audio/Video parts and accessories line with the addition of 15 Idler wheels and assemblies, three Opto sensing devices and two belt kits for video cassette recorders. The catalog currently includes over 1500 additional cross reference listings for VCR belt kits, idler wheels and in addition it also includes audio and VCR test cassettes, VCR tape repair kit, adjustment tools, and replacement heads.

Circle (73) on Reply Card

The benefits of membership in a professional association

By William J. Lynott

A hectic travel schedule over the past year has left me with an increasing distaste for airports and hotels. On the plus side, my speaking engagements and consulting work have allowed me to meet or renew acquaintances with literally hundreds of successful service executives and entrepreneurs around the country. Here are a couple of the impressions that I came away with:

More than ever, I am convinced that membership in a good trade association is an extremely important part of the recipe for success in running a service business. Over the years, I have come to know virtually hundreds of service dealers on a personal basis. It is no coincidence, I believe, that servicers who belong to trade associations operate, on the whole, more successful and more profitable businesses than those who insist on doing it alone. When you stop to think about that, it's really no surprise.

I frequently ask the participants at trade association conventions that I attend just why they bother to come. Almost without exception, they tell me of the great value of swapping ideas and experiences with people who operate the same kind of busiess and have the same basic problems. If you have never attended a meeting, seminar or convention of your counterparts, it may be difficult for you to comprehend just how much is gained from this sort of contact.

The fact is that no one person, no matter how smart or experienced, can know it all. Running a successful service business today demands sharp management—the latest and best techniques and ideas. I personally know a number of very successful electronic service dealers who openly credit their success to active participation in their trade association.

In general, the same holds true for service managers. Exposure to the most accomplished professionals in their industry is regarded as one of the most valuable benefits of membership in a good trade association.

And of course, all of the better trade associations offer a variety of programs and educational materials designed exclusively to fit the needs of their members. The National Electronic Service Dealer's Association (NESDA), for example pioneered the use of the standardized warranty claim form for electronic service dealers. The National Association of Service Dealers (NASD), a division of NARDA, did the same thing for appliance servicers. These were invaluable contributions to the service industry, and they are just the beginning of the benefits offered by these organizations. Both offer a broad assortment of educational materials, seminars, and co-op programs for health insurance, credit card participation and the like. If you don't already belong to an appropriate trade association, I hope you will give yourself the advantage of joining one very soon.

Another impression that I have gained in my travels over the years is the consistent pattern of differences between the most successful servicers and those who are not so successful. Those who offer excuses tend to offer the same ones:

1. My competition is unfair.
2. My customers refuse to pay a decent rate so I can't raise my charges.
3. Nobody wants to do a good day's work anymore.

These excuses, or some variation of them, are almost sure to come up during conversations with service dealers who are struggling in their efforts to maintain a reasonable profit. And never mind the facts; their opinions are not easily changed.

It isn't fair to generalize, but it does seem to me that servicers in that category tend to be older and solidly set in their ways and opinions about what can or should be done. Never mind that there is a competitor on the next block who is getting rich while charging higher prices for his services, and never mind that his customers are loyal and happy with his firm.

A close look at struggling service dealers almost always reveals a general lack of direction and planning, refusal to update archaic operating techniques, and a serious failure to understand the role that marketing and customer relations play in a successful service business.

A visit to a highly successful service business, on the other hand, will usually turn up an owner who is hungry to learn about every new idea that is working for someone else. This type of service dealer is constantly on the lookout for new ideas to bring in new customers or improve day-to-day operations. He or she is always learning through contact with others or through reading and research.

While many service professionals are justifiably tired of hearing about it, the truth is that much of this state of affairs can be traced to the technical background of many electronic service dealers. A primary interest in things technical and no formal management training is not the sort of recipe that can be expected to produce championship business managers.

But it CAN . . . and has. All it takes is the recognition that there are better ways to do the things you do every day, and those better ways can be learned from others.

I know many service dealers who have done it. And you can be sure that there are many more who will follow. If you're not completely happy with the way your business has been going lately, maybe you'll be one of them. ■

Lynott is President of W.J. Lynott, Associates, a management consulting firm specializing in profitable service and management and customer satisfaction research.

(from page 42)

Firmware ordinarily consists of some kind of program that has been programmed into a read-only memory, so that the computer reads and follows the instructions every time the unit is turned on. In an IBM computer, for instance, the program that operates the disk drive at turn-on and reads in the operating system is in firmware.

Floating ground-A common point to which many of the components are tied, but which is not at true ground potential.

Flyback power supply-The transformer that generates the high-voltage potential from the horizontal retrace.

Foldover-A TV symptom that makes the screen appear as if the picture has been folded horizontally. This problem is usually caused by changes in the value of bias components in the base circuit of the horizontal output transistor. It can also be caused by changes in the values of the driver decoupling filter circuit.

Gain-The amplification factor (voltage, current or power) of an amplifier. This quantity is determined by dividing the output value by the input value.

Handshaking-During communications between two pieces of computer equipment, the transmitting computer must indicate that it will be transmitting and the receiving computer must confirm that it is ready to receive. The exchange of information to establish this is called handshaking.

Horizontal blanking pulse-A portion of the NTSC composite video waveform that causes the electron beam to be blanked during the retrace interval.

Increment-A small change in a quantity frequently expressed by the symbol δ (delta).

Integration-the mathematical process of determining the cumulative value of a quantity with respect to time. Graphically, it's the equivalent of finding the area under a curve. As an example, the integral of speed with respect to time is distance. In an electronic circuit, integration of an input circuit signal can be performed by placing an input signal across an R-C circuit and taking the output across the capacitor. Integration is the opposite of differentiation.

Interlacing-The process of creating a picture on the face of a TV picture tube in two fields that overlap. Without these overlapping fields and strong persistence, a TV picture with a single, noninterlaced frame would result in annoying flicker.

Intermediate frequency-In a communications receiving device, such as a TV or radio, it is desirable to convert the broadcast signal that is selected by the tuner to a frequency that remains constant regardless of the frequency of the broadcast signal. This allows the amplifiers to remain tuned to a single frequency. This constant frequency is accomplished by mixing the broadcast frequency with the signal from a local oscillator, which is changed in step with the tuner. The constant frequency of the difference output of the mixer is the intermediate frequency.

Intermodulation-A form of distortion that occurs when two signals of different frequencies are unintentionally mixed in some kind of electronics circuit.

Isolation transformer-A transformer that has a turns ratio of 1:1 and whose windings are carefully insulated from each other. The result is complete electrical isolation between the input and the equipment connected to the output. A product that has a hot chassis because it is powered through a bridge rectifier must be powered by an isolation transformer during testing. A grounded test instrument must be used if the test instrument ground and the sct ground will be connected together. Otherwise, severe damage to the set power supply, and possibly to the test instrument, may result.

Keystone distortion-A TV picture that is narrower vertically at one side of the screen than it is at the other side. This symptom is caused by a defective yoke.

Lissajous figure or curve-Named after Jules A. Lissajous, a French physicist of the 1800's. A Lissajous curve is formed by combining two mutually perpendicular simple harmonic motions. In electronics, Lussajous patterns are ordinarily formed on the oscilloscope by the input of two sinusodial waves. The patterns are used to determine such things as frequency, amplitude and phase relations of the waves.

Rise time-The time it takes for an electrical signal to rise from 10% of the maximum value to 90% of its maximum value.

Root mean square-In a current or voltage wave that is symmetrical about the x axis, the average value of the voltage or current is zero. To mathematically determine the effective value of the signal, square the mathematical expression for the signal, which changes the negative excursions. Then find the average (mean) value of the square of the function and the square root of this average value. The figure you have determined is the root of the mean of the square, or root mean square.

SAW (surface acoustic wave)-this device consists of piezoelectric material on which a pattern of interleaved metal fingers has been deposited. This device converts an electrical signal into an acoustic signal, then back from an acoustic signal into an electrical signal. Also called an interdigital transducer this device is used as a signal delay device. Because acoustic waves travel much slower than electromagnetic waves (typically 100,000 times slower) a SAW filter provides long delay times in a small space.

Shot noise-Noise caused by the random movement of electrons across a potential barrier, such as in a transistor or vacuum tube.

Time constant-In an RC or RL circuit, the characteristic time period determined by the product RxC, or RxL, in which the voltage across a capacitor or the current through an inductor increases to 63% of its maximum value or decreases to 37% of its maximum value. ■

Classified

Classified advertising is available by-the-word or per column inch. **By-the-word:** $1.65 per word, per insertion. Initials and abbreviations count as full words. Blind ads (replies sent to ES&T for forwarding) are $40 additional. Minimum charge: $35 per insertion.

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Contact Jeff Uschok, 516-681-2922, for information on frequency and pre-payment discounts, or to place your classified ad. Or send your order and materials to Jeff Uschok, Electronic Servicing & Technology, 76 North Broadway, Hicksville, NY 11801.

EQUIPMENT WANTED

TUBES WANTED- We buy receiving and transmitting tubes. Send your list for bid. New tubes in original boxes only. Also need radio. I.F. XFMRS. Antique Electronic Supply, 688 West First St., Tempe, AZ 85281. Phone 602-894-9503, Fax 602-894-0124. 3-90-tfn

RELIABLE FIELD STRENGTH METER With db scale, attenuators, built in spkr., V-U-FM frequency, rechg, batts., Lukas Appliance 305 Main St., Wray Co. 80758, 303-332-4411, M-F. 7-90-1t

FOR SALE

TELEVISION AND MONITOR TROUBLESHOOTING BOOKS: 336 Problems/Solutions, $12.00, 35 Steps to Easier Television Repairs, $15.00 Add $1.50 shipping. Refunds if not satisfied. Fred Jones, 407 Morningbird, Niceville, FL 32578. 12-89-tfn

REDUCED 85%, Diehl Mark 111 scanner $89. Diehl Mark V scanner $219. New. Restore remote control keypads with our conductive coating $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629. 608-233-9741. 6-90-tfn

TV TOUGH DOGS: 300 symptoms and cures. Send $9.95 to DAVIS TV, 11772 Old Fashion Way, Garden Grove, CA 92640. 10-87-tfn

COMPUTER AIDED TV/VCR REPAIR, 3,500 solutions. 37 manufacturers. Printout or IBM compatible hard drive, 5¼ disk, time saver. Quick scan by model, chassis, and stage. Send $90 to Electronic Solutions, 407 West Avenue "N", San Angelo, Texas 76903. 7-90-tfn

VHS-VCR Repair Solutions Sets I,II,III,IV,V. Each contains 150 symptoms and cures, cross reference chart, free assistance, $11.95 each all five $49.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 12-89-tfn

CASE HISTORIES: Over 700 TV symptoms and cures. Professionally prepared, satisfaction assured, $18. Mike's Repair Service P.O. Box 217, Aberdeen Proving Ground, MD 21005. 7-90-3t

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Central Maine TV and Sales service includes real estate equipment, inventory factory authorized owners-apartment upstairs. J.F. Singleton 207-564-7101 or 207-564-8234. 7-90-1t

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HELP WANTED: Experienced audio or TV technicians. Possibly even service manager positions. Medium sized and growing shop in beautiful Eugene, Oregon. 503-343-7683. 7-90-2t

Readers' Exchange

Readers' Exchange has been reinstated as a free service, effective with the February issue.

The following restrictions apply to Readers' Exchange:

- Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.
- Readers' Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Readers' Exchange submissions to:

Readers' Exchange
Electronic Servicing & Technology
76 N. Broadway
Hicksville, NY 11801

WANTED

Schematics for Ampex model PR10/CL10 tube electronics tape recorders catalog -4020231-02 (stereo), -02-96050-01 (mono); Melcor Model AB-247 power amplifier. *Michael Zuccaro, Voice and Video, 5038 Ruffner St., San Diego, CA 92126, 619-271-8294.*

G.E.C. DA42, DA100 tubes and appropriate sockets; books on tube audio amp design from 1950's. *J. Zekes, Box 15945-116A, Lenexa, KS 66215.*

Source for parts for Apple computers and printers. *R. Garcia, R.G. Electronics, Fairway Dr., Kelseyville, CA 95451, 707-279-1938.*

Service manual for Tektronix 503 scope, will buy or copy and return. *G.H. Lankford, 435 Baggett Cir., Lawrenceville, GA 30244, 404-921-3672.*

Good flyback for Quasar/Panasonic TV, P/N TLF14561B, new or used, must be cheap. *Mark Osburn, 3701 Carthage, Fort Smith, AR 72903, 501-646-7746.*

Schematic and operating manual for Yaesu-Musen Co. Ltd. frequency counter, Model - YC-355D, Serial - 4C410086. Will buy or copy and return. *Sam Marvosh, 514 Dunbar Dr., Henderson, NV 89104, 702-456-9902.*

Philco Part Number 15-37700-1, Horizontal processor I.C. used in model number C3532HMA and others. ECG Equivalent ECG-792. Both numbers discontinued. *Donald Nelson, 104 Franklin Street, Alexander City, AL 35010; 205-329-0509.*

Dud picture tube, Model - RNH613, Tube - A66AAMO3X; info on having picture tubes rebuilt; Sams Photofact folders 2551 thru 2564 and 2056 thru 2331, please call, fax, or send list; Sencore VA62. *Paul's Electronics, 11201/2 W. Bristol St., Elkhart, IN 46514, 219-264-2147, Fax: 219-262-8496.*

FOR SALE

Philips PM3217 50MHz scope, two-channel, delayed sweep with probes; B&K 2Mhz function generator, new in box; Fluke 77 DMM. All for $650 plus shipping. *Roberto, 213-272-7289.*

DSI 5600A 50Hz-512MHz frequency counter (needs calibration), $150; B&K 283 DMM, like new, $150; B&K 1460 scope, like new, $250; RCA WV-98C Senior Voltohmyst, $125. *George W. Crouch, 4018 Lillian Dr., Concord, CA 94521, 415-682-8841.*

Copy of government T/M maintenance manuals for receivers R-390A, 51S1 (Collins), R-388: $19 ea. R-220/URR, R-392, R-1051B/URR (solid state), SP-600JX: $25 ea. *D. Test, PO Box 9064-EST, Newark, NJ 07104.*

Complete Sencore video bench, includes SC-61 waveform analyzer and VA-62 video analyzer, plus much more. Never been used. Send SASE for complete list. *Jimmy Click, 115-B Park Circle, Starkville, MS 39759.*

Dandy-Dapter Universal CRT adapter, never used. $45 firm, I will pay shipping. *Mark Osburn, 3701 Carthage, Fort Smith, AR 72903, 501-646-7746.*

Sencore VA48, DVM 56A, FC51: all manuals included. *Fred Ingersoll, 6845 Lathers, Garden City, MI 48135, 313-427-0499.*

Sams Photofact folders -645 through -2296, $800 plus shipping. Serious inquiries only. *Jeff, 708-974-2262.*

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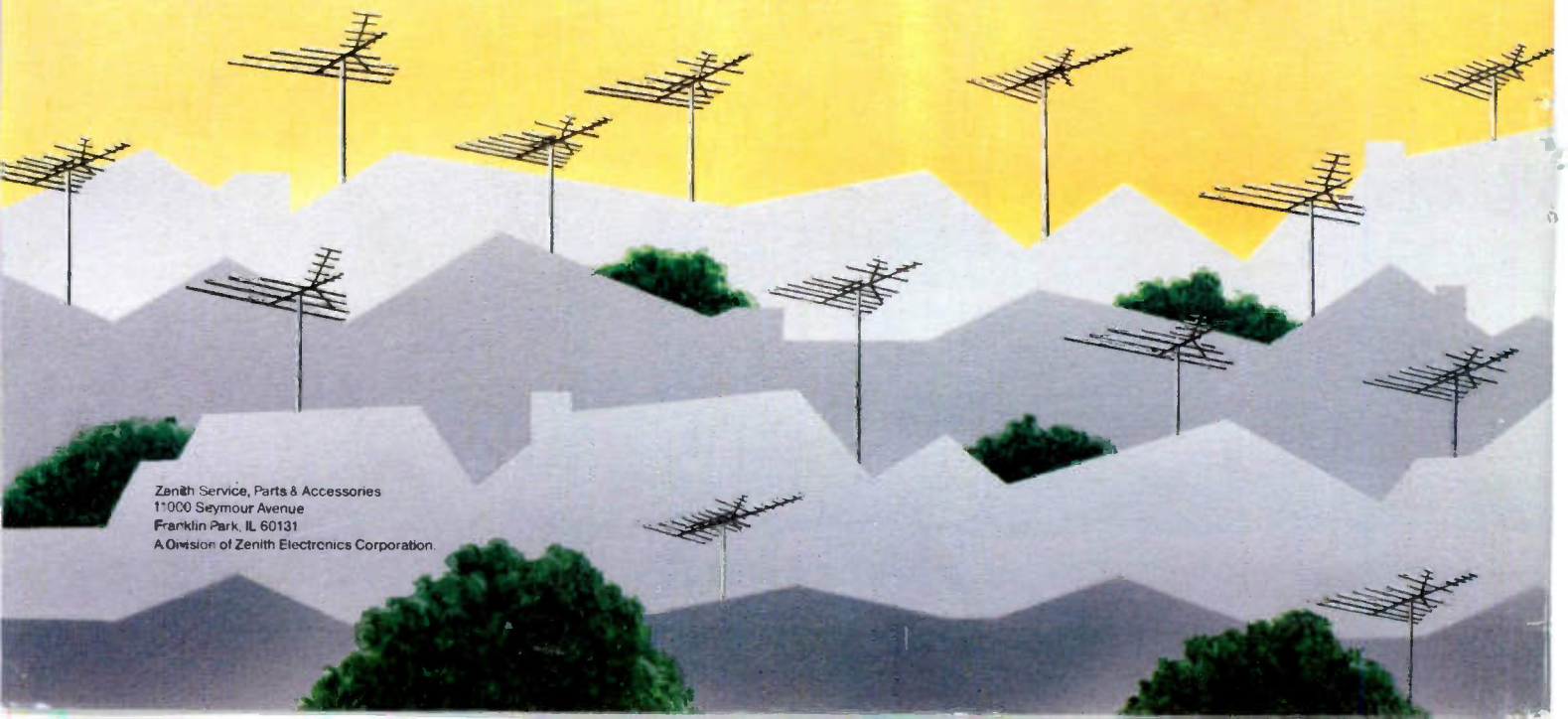

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