THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

T.M.

October 1996

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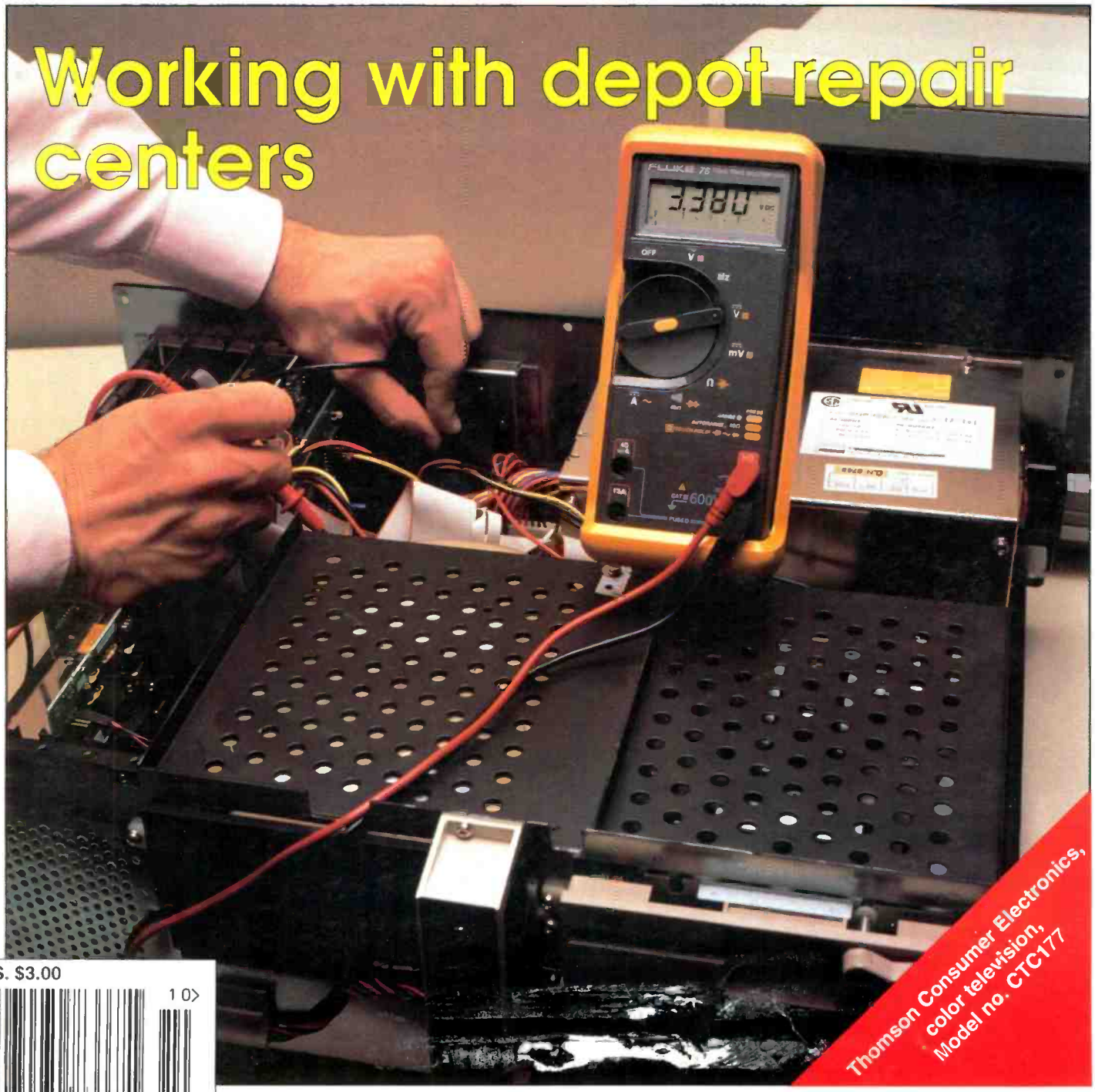

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THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

Volume 16, No. 10 October 1996

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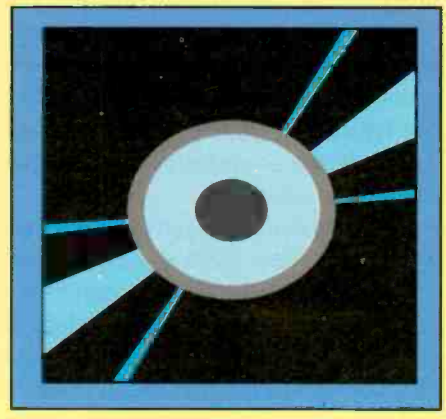
ON THE COVER

Because many of today's consumer electronics and home office products may require skills and equipment that it is not economical for a service center to possess, it makes sense for service centers to occasionally send some products out to a third party service organization, a service depot, to be repaired. *(Photo courtesy Fluke).*



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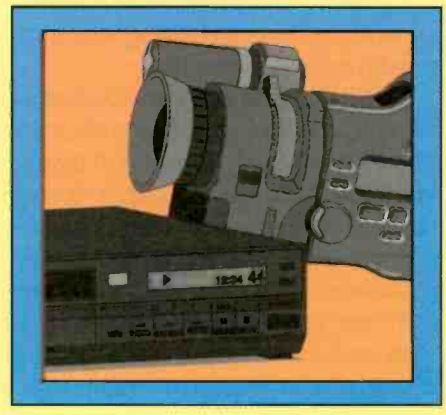

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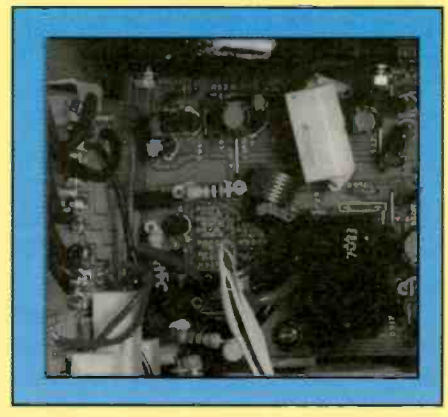

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The scheme of things

Consumer electronics products are complex products, manufactured of components whose operation is hidden from view and even when understood by a technician or an engineer is still usually abstract. Frequently a glance at the innards of a typical TV, VCR or CD player, even by a seasoned professional, reveals little useful information.

Things were bad enough in the old days when there were relatively few components and they were large enough to see easily, even by someone with defective eyesight, and point-to-point wiring could be followed. In those conditions, an astute technician could take a little time, locate a prominent component such as the ac line transformer, or a large electrolytic capacitor, draw a diagram of the area suspected to be faulty, and come up with a reasonably correct diagnosis.

In today's products, many components are difficult to see, even by someone with 20-20 vision, traces are so small they are almost invisible, and frequently on both sides of the printed circuit board, many components are proprietary and it's impossible to identify them without manufacturers' service documentation. Under such conditions, it's frequently blind luck if a service technician comes up with a correct diagnosis.

In many cases, even if he does come up with an accurate diagnosis, it may not be possible for the technician to determine the correct identification of the faulty component so he can order it.

In the world of today's consumer electronics servicing, it's absolutely necessary that the technician have as much information as possible, including the manufacturer's service literature, in order to provide proper service. Otherwise the attempt may prove futile.

But service literature is expensive, and in many cases hard to come by. Some manufacturers make their service literature available to anyone who will pay for it. But some manufacturers are reluctant to provide service information to any but authorized service centers. Some manufacturers, notably those of some low-cost computer monitors, don't seem to have any service literature available at all.

This magazine has attempted to alleviate some of those problems by providing, with the cooperation of some of the more generous consumer electronics manufacturers, schematic diagrams in the Profax section. At one time, again when products were relatively simple, it was possible to publish the schematic diagrams of several sets in a single issue. Today's sets have become so complex that frequently it's only possible to publish a portion of one schematic in the Profax section of any given issue.

Determining what sections of a given TV set or VCR to publish in the Profax section of a monthly issue is difficult. Since the schematic diagram of, say, a projection TV with stereo sound and picture in picture is so big we can only publish parts of it. But which parts?

In making these decisions, we have generally been very careful to make sure that the schematic diagrams are large enough to be read by any technician with either good eyesight or with corrected vision. If the symbols were too small to be seen easily, or if the readability of the type on the diagram was suspect, we make it bigger. This means that we sometimes discard almost as much information as we publish in a given Profax schematic diagram.

Some technicians to whom we have spoken recently have told us that they would rather have us print the Profax schematics at greater reduction so that we could print more of the diagram. After all, they have told us, they are used to dealing with the minuscule components and very small type of printed circuit boards. Moreover, they have magnifying glasses or magnifying lamps that they routinely use to view the tiny circuits and components, so they can magnify the Profax images as well.

Given that information, the staff at **ES&T** have decided to try an experiment. In some issues of the magazine in the future, we will print some Profax schematic diagrams in a size that may be difficult to read without magnification. If the reaction of readers is overwhelmingly negative, we'll sacrifice some information in order to print all Profax at a size that's readable without magnification. If the reaction is generally positive about printing of smaller, but more information-packed Profax schematic diagrams, we'll continue to do so.

The Profax Special Issue contest

While we're on the subject of Profax schematic diagrams, we just wanted to take this opportunity to remind all readers that our annual Profax Schematic Special Issue will be published in late fall of 1996, so don't forget to look for it. Furthermore, as we did last year, there will be a contest associated with that issue. Some of our advertisers will be providing us with products as prizes.

The contest will work like this. Each interested reader will fill out an official entry form. In order to be considered, the form must be filled out completely, including name, title (if any), company name, address, telephone number, city, state and zip. If any of this information is missing, the entry will be invalid.

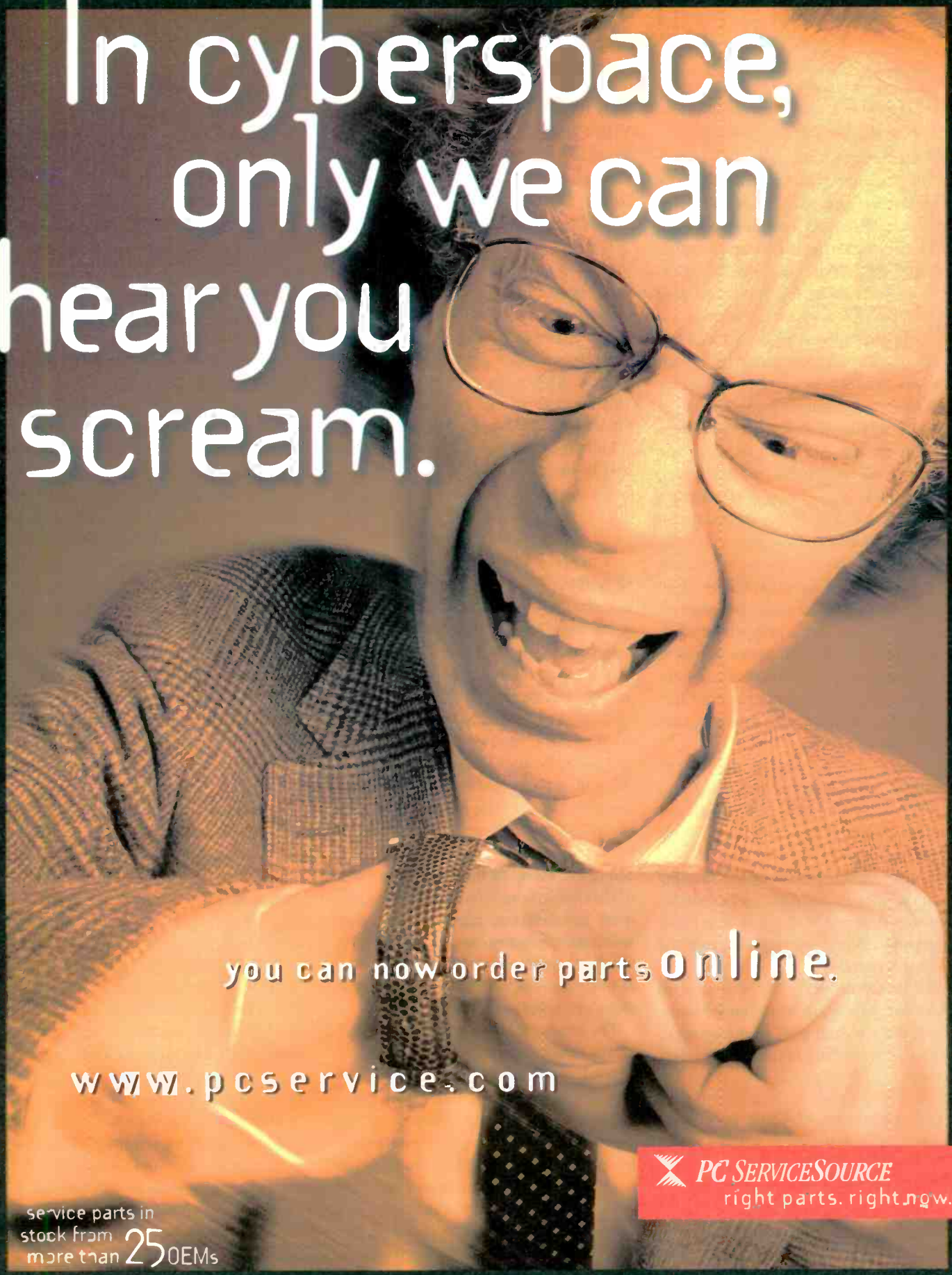
Then the entrant must check the name of only one manufacturer-provided prize that he would like to win.

A properly completed entry form will make the entrant eligible to win that prize that he has checked, as well as any of the main prizes that will be listed

So don't forget to look for the annual Schematic Special Issue this fall. Fill out the entry form promptly and completely as directed on the form, and send it in.

Good luck!

Nils Conrad Persson



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Group to develop test question pool for Electronic Industries Association, Electronic Industries Foundation

The Electronic Industries Association and its philanthropic sector, the Electronic Industries Foundation, have announced that the Chauncey Group International, Ltd., will provide contract support to their joint project to develop a pool of test questions to be used in the certification of work-ready electronics technicians.

The organization is a subsidiary of Educational Testing Service (ETS), best known as a long-time administrator of the SAT exams. It has nearly 25 years experience designing, developing, and administering occupational, certification, and professional assessment programs and brings to this task a level of experience, independence, and objectivity that is crucial to credibility and success.

EIA/EIF selected Chauncey because its experience encompasses the development of testing processes to measure effectively and fairly the competencies required for a variety of types of work. Extensive analysis of industry and education needs and desires predicted that both technical knowledge and practical competencies be tested.

Development of a bank or pool of test questions is the latest step in a multi-year EIF/EIA program that began with development of nationally accepted skill standards and measurement criteria created over a 36-month period under funding from the U.S. Department of Education. The current phase of the project is being supported entirely by funding from the electronics industry.

EIF President Molly M. Mannon said Chauncey will begin work immediately. She expects a draft pool of questions to be ready for industry review by October.

Blank Media

Unit shipments of blank audio and video tape were up seven percent in the first quarter of 1996, while dollar sales were flat compared to first quarter 1995. Unit shipments of tape products rose for the third consecutive quarter.

Sales of compact formats were strong in both unit and dollar terms in the quarter, gaining 11 and seven percent, respectively. The increase in compact format sales came from VHS-C type cassettes. VHS-C sales jumped 29 percent in unit terms in the first quarter, more than offsetting a six percent decline in 8mm sales. Dollar sales of VHS-C formats totaled $17 million, up 33 percent.

The audio tape market was bolstered by strong sales of Type I and digital formats. Type I audiocassette sales rose 14 percent, in unit terms, on volume of nearly 79 million. Dollar sales of Type I tape also rose in the first quarter, increasing a solid six percent. Shipments of digital audiocassette formats rose 22 percent in the first three months of the year to 278,000 units.

Full-size VHS tape sales rose four percent in unit terms, but dollar sales were down one percent.

SDA plans merger with ETA

A major action taken by delegates of ETA and SDA at the June 14-15 Annual Conventions in Faribault, MN was to put in motion plans to merge the two groups.

According to Dick Glass, who serves as President for both the not-for-profit groups, combining the two associations is a 'natural'. Since SDA was incorporated in 1991, the two groups have produced a number of joint association journals; shared conventions and seminars; shared booths at state and national trade shows; utilized common office space and staff and generally supported each other's activities. Many of the members of one of the two associations also belong to the other as businesses represented in each association in many cases are involved in Satellite, Antennas and SMATV, as well as other areas of consumer and commercial electronics sales and service.

The two organizations have worked together to help bring about the highly successful satellite college-level distance learning courses on C-Band Spacenet 3 (which is again being offered, starting August 23rd). In the past, the satellite training for dealers and technicians has dealt with MATV, antennas and basic electronics, in addition to industrial and computer electronics training. The August sessions will deal with basic-basic electronics on Friday afternoons, while in the evening, Certified Satellite Installer (CSI) preparation will be offered, in the clear, as well as the related FCC Commercial License prep. The Friday evening session will be three hours in length, every week for 16 weeks.

Merging of the associations will not mean any drastic changes for members of either. It is anticipated that there will be only benefits as SDA will no longer need to maintain separate tax and employee reporting and accounting and members of each group will receive communications and publications that were heretofore separate in most cases.

Dues-paid members of each group must be contacted and approval obtained before the merger initiative becomes a fact. Thus ETA has again elected two officers to represent its satellite technicians and dealers. SDA has likewise elected its normal slate of officers. Mr. Glass indicated that SDA's elected officers likely will become the Satellite Division of ETA's officers and that SDA's committee structure would be maintained.

Supporting membership by suppliers and allied companies who wish to back the efforts of the ETA and SDA has carried an annual fee of $175 in ETA and $250 in SDA in the past. It is likely one fee will be set for these associate members at $200 per year.

The officers of both groups are now working on details of the merger plan, with the new ETA Chairman, John Baldwin, CETsr, of Faribault, MN, and SDA Chariman, Phill Rosales, CSI, of Advanced Systems in Moline, IL working closely with the members of the Greencastle, IN headquarters staff.

ETA was incorporated in 1978. SDA in 1991. The joint convention location for 1997 is yet to be selected. At that time the merger will be formalized. The delegates to the Faribault, MN, convention did emphasize that they were enthusiastic about the convention format which utilizes a technical college for seminars and a hotel for rooms and banquet functions. This year's convention was held at Minnesota Riverland Technical College in Faribault, MN. An announcement about the 1997 location will be forthcoming.

(Continued on page 58)

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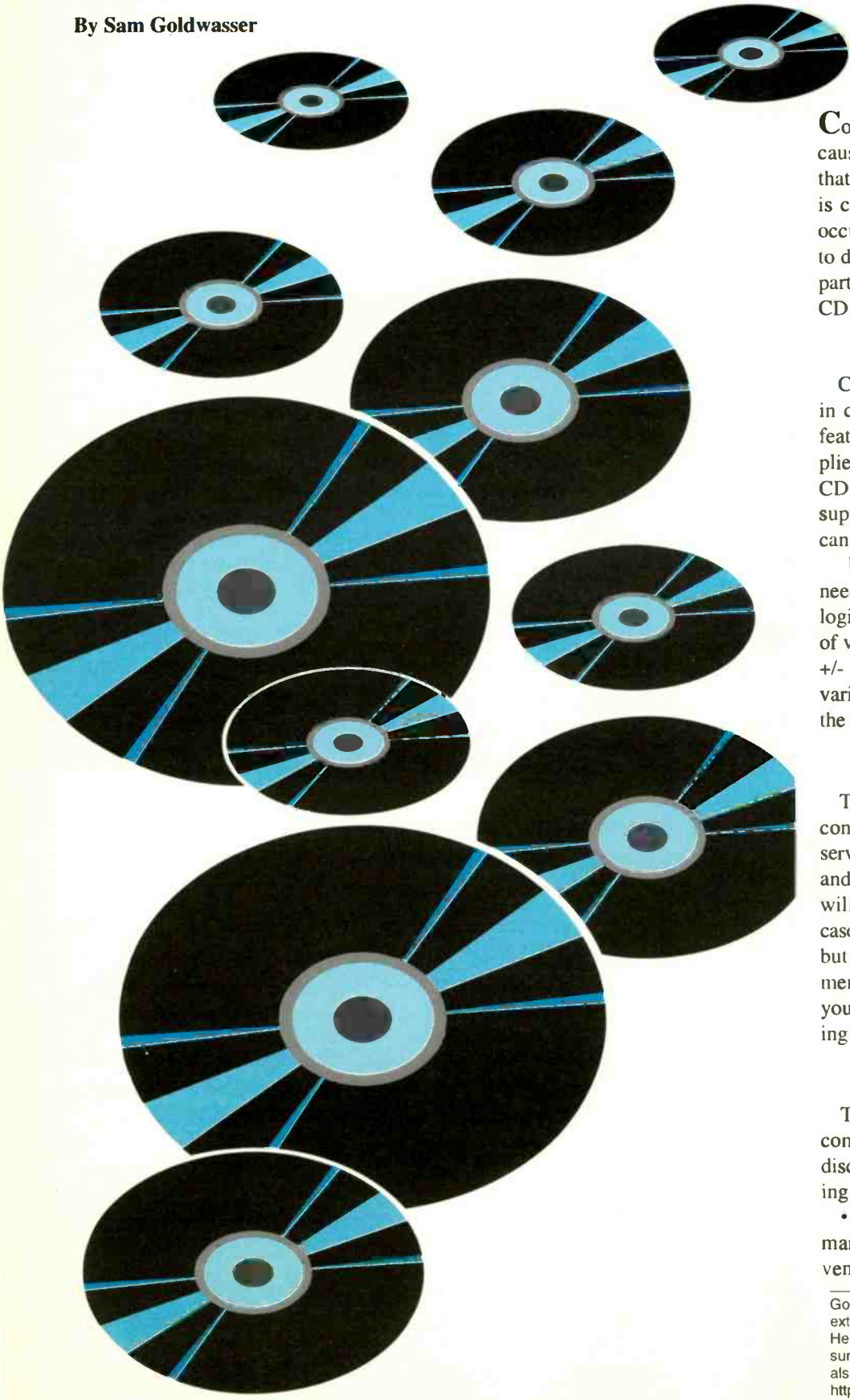
CD player fundamentals—Part I

By Sam Goldwasser



Compact disk players are complex because of the digital decoding of the music that is encoded on the disk. This process is complex, but many of the faults that occur in CD players are relatively simple to diagnose and repair. Part I of this two part article describes the construction of CD players.

Power supply

CD players that are designed to be used in component stereo systems normally feature linear power supplies. These supplies are reliable and easy to fix. Portable CD players are likely to use switching supplies, possibly sealed in a shielded can. These can be difficult to repair.

Usually, at least three voltages are needed for the circuits in a CD player: logic power (e.g. Vcc of +5V) and a pair of voltages for the analog circuitry (e.g., +/- 15V). However, some designs use a variety of voltages for various portions of the analog (mainly) circuitry.

Electronics board

The electronics board in a CD player contains the microcomputer controller, servos, readback electronics, audio D/A(s) and filters. Most servo adjustment pots will be located on this board. In many cases these adjustments are clearly marked, but not always. Do not turn any adjustment controls unless you are sure of what you are doing, and then only after marking their original positions precisely.

The optical deck

The optical deck includes all of the components required to load and spin the disc, the optical pickup, and its positioning mechanism:

• Loading drawer—Most portable and many lower cost CD players lack the convenience of a loading drawer. Most load-

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ing drawers are motor driven. However, some must be pushed in or pulled out by hand.

Common problems: loose or oily belt causing drawer to not open or close, or to not complete its close cycle. There can be mechanical damage such as worn/fractured gears or broken parts. The drawer switch may be dirty causing the drawer to decide on its own to close. The motor may be shorted, have shorted or open windings, or have a dry or worn bearing.

• Spindle/spindle table—When the disk is loaded, it rests on this platform which is machined to automatically center it and minimize runout and wobble.

Common Problems: Dirt on table surface, bent spindle, dry or worn bearings if spindle not part of motor but is belt driven, loose spindle.

• Spindle motor—The motor that spins the disk. Most often the spindle platform is a press fit onto the spindle motor. Two types are common: The first is a miniature dc motor (using brushes) very similar to the common motors in toys and other battery operated devices. The second type is a brushless dc motor using Hall effect devices for commutation. In very rare cases, a belt is used to couple the motor to the spindle.

Common problems: partially shorted motor, shorted or open winding, dry/worn motor bearings.

• Clamper—The clamper is usually a magnet on the opposite side of the disk from the spindle motor which prevents slippage between the disk and the spindle platform. The clamper is lifted off of the disk when the lid or drawer is opened. Alternatively, the spindle may be lowered to free the disk.

Common problems: Clamper doesn't engage fully, permitting disk to slip on spindle due to mechanical problem in drawer closing mechanism.

• Sled—The sled is the mechanism on which the optical pickup is mounted. The sled provides the means by which the optical pickup can be moved across the disk during normal play or to locate a specific track or piece of data. The sled is supported on guide rails and is moved by either a worm or ball gear, a rack and pinion gear, linear motor, or rotary positioner similar to that used in a modern hard disk drive. This list is in increasing order of performance.

Common problems: dirt, gummed up or lack of lubrication, damaged gears.

• Pickup motor—The entire pickup moves on the sled during normal play or for rapid access to musical selections. The motor is either a conventional miniature permanent magnet DC motor with belt or gear with worm, ball, or rack and pinion mechanism, or a direct drive linear motor or rotary positioner with no gears or belts.

Common problems: partially shorted motor, shorted or open winding, dry or worn bearings.

• Optical pickup—This unit is the 'stylus' that reads the optical information encoded on the disk. It includes the laser diode, associated optics, focus and tracking actuators, and photodiode array. The optical pickup is mounted on the sled and connects to the servo and readback electronics using flexible cables.

Common problems: hairline cracks in conductors of flexible cable causing intermittent behavior.

Components of the optical pickup

All of the parts described below are in the optical pickup. As noted, the optical pickup is usually a self-contained and replaceable subassembly. While optical pickups are precision optomechanical devices, they are remarkably robust in terms of susceptibility to mechanical damage.

• Laser diode—The laser diode emits infrared (IR) light, usually at 780nm. This is called the "near IR," just outside the visible range of 400nm to 700nm. The power output of the diode is no more than a few mW. The power level of this beam is reduced to 0.25mW to 1.2mW at the output of the objective lens. A photodiode inside the laser diode case monitors optical power directly and is used in a feedback loop to maintain laser output at a constant and extremely stable value.

Common problems: bad laser diode or sensing photodiode resulting in reduction or loss of laser output.

• Collimating lens—The collimating lens converts the wedge shaped beam of the laser diode into nearly parallel rays.

• Diffraction grating—In a "three-Beam pickup," the diffraction grating generates two additional lower power (first order) beams, one on each side of the main beam, which are used for tracking feedback. There is no diffraction grating in a "single-beam pickup."

• Cylindrical lens—In conjunction with the collimating lens, the lens provides the mechanism for accurate dynamic focusing by changing the shape of the return beam based on focal distance.

• Beam splitter—This device passes the laser output to the objective lens and disk and directs the return beam to the photodiode array.

• Turning mirror—Redirects the optical beams from the horizontal of the optical system to the vertical to strike the disk.

Common problems: dirty mirror. Unfortunately, this may be difficult to access for cleaning.

The previous four items are the major components of the fixed optics. Outside of damage caused by a serious fall, there is little that can go bad in this subassembly. Better hope so in any case—it is usually very difficult to access the fixed optics components and there is no easy way to realign them anyhow. Fortunately, except for the turning mirror, it is unlikely that they would ever need cleaning. Usually, even the turning mirror is fairly well protected and remains clean.

• Objective lens—The objective lens is a high-quality focusing lens, very similar to a good microscope objective. This lens has an N.A. of 0.45, and a focal length of 4mm. It is made of plastic with antireflection coating (the blue tinge in the center).

Common problems: dirty lens, dirt in lens mechanism, damage from improper cleaning or excessive mechanical shock.

• Photodiode array—This is the sensor which is used to read back data and control beams.

Common problems: bad photodiode(s) resulting in improper or absence of focus and weak or missing RF signal.

• Focus actuator—Since focus must be accurate to 1 micron (1μm), a focus servo is used. The actuator is actually a coil of wire in a permanent magnetic field like the voice coil in a loudspeaker. The focus actuator can move the objective lens up and down; closer to or farther from the disk based on focus information taken from the photodiode array.

Common problems: broken coil, damaged suspension (caused by mechanical shock or improper cleaning techniques).

• Tracking actuator—Like focus, tracking must be accurate to 1μm or better. A similar voice coil actuator moves the objective lens from side to side based on

tracking feedback information taken from the photodiode array.

Note: on pickups with rotary positioners, there may be no separate tracking coil, as its function is subsumed by the positioner servo. The frequency response of the overall tracking servo system is high enough that the separate fine tracking actuator is not needed. Common problems: broken coil, damaged suspension (caused by mechanical shock or improper cleaning techniques).

Classification of CD player problems

While there are a semi-infinite number of distinct things that can go wrong with a CD player, symptoms can be classified as a hard failure or a soft failure.

A hard failure is one that causes the unit to fail to operate at all, such as door opening/closing problems, disk is not recognized, no sound, or the unit totally dead.

A soft failure is one in which the unit operates in some fashion, but improperly, such as skipping, continuous or repetitive audio noise, search or track seek problems, or random behavior.

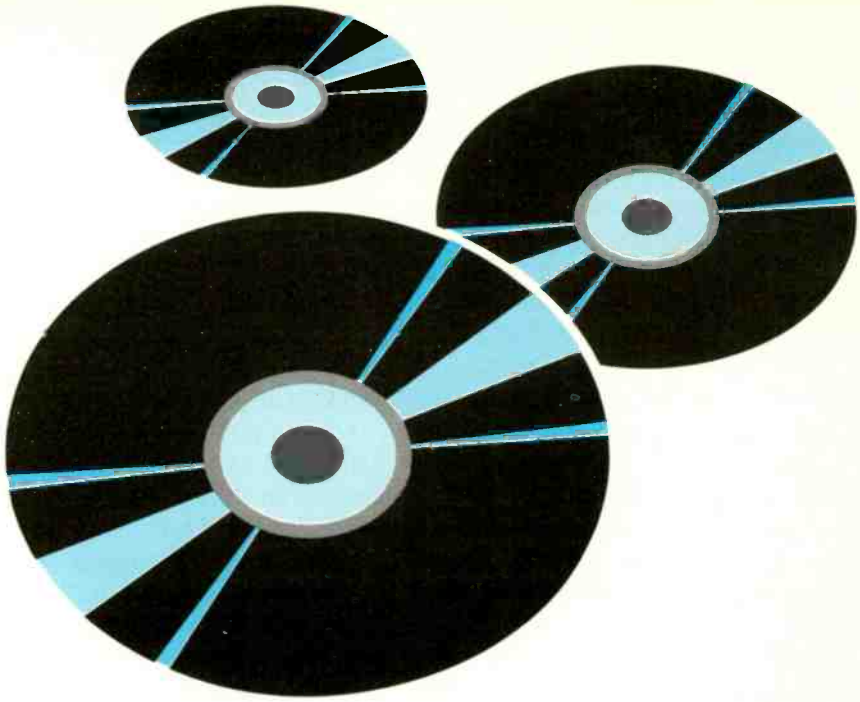
Both of these types of problems are common. The causes in both cases are often very simple, easy to locate, and quick and inexpensive to repair.

Most common CD player problems

While it is tempting to blame the most expensive component in a CD player, the laser, for every problem, this is usually uncalled for.

Here is a short list of common causes for a variety of tracking and audio or data readout symptoms:

- Dirty optics—This includes the lens, prism, or turning mirror.
- Drawer loading belts—worn, oily, flabby, or tired.
- Sticky mechanism—dirt, dried up/lack of lubrication, dog hair, sand, etc.
- Broken (plastic) parts—gear teeth, brackets, or mountings.
- Need for electronic servo adjustments—focus, tracking, or PLL.
- Intermittent limit or interlock switches—worn or dirty.
- Bad connections— solder joints, connectors, or cracked flex cable traces.
- Motors—electrical (shorted, dead spot) or mechanical (dry/worn bearings).
- Laser—dead or weak laser diode or power problems.



- Photodiode array—bad, weak, or shorted segments or no power.
- Bad/heat sensitive components.

Most frequent problem areas

The following two areas cover the most common types of problems you are likely to encounter. For any situation where operation is intermittent or audio output is noisy, skips, or gets stuck, or if some disks play and others have noise or are not even recognized consistently, consider these *first*:

- Dirty lens—This problem is especially likely if the location in which the player is used is particularly dusty, the player is located in a greasy location like a kitchen, or there are heavy smokers around. Cleaning the lens is relatively easy and may have a dramatic effect on player performance.
- Mechanical problems—dirt, dried up lubrication, damaged parts. These may cause erratic problems or total failure. The first part of a CD may play but then get stuck at about the same location.

If your CD player has a "transport lock" screw, check to see that it is turned to the "operate" position.

General inspection, cleaning, and lubrication

The following should be performed as general preventive maintenance or when any erratic behavior is detected. The lens, drawer mechanism, and sled drive should be checked, and cleaned and/or lubricated if necessary.

You will have to get under the clamp to access the lens (drawer loading models). Be gentle. No lubrication is needed, and none should be used anywhere in the lens assembly.

At the same time, you will have access to the spindle.

- Objective lens—Carefully clean the lens assembly. Be careful! The lens is suspended by a voice coil actuated positioner which is relatively delicate. A CD lens cleaning disk is nearly worthless except for the most minor dust, as it will not completely remove grease, grime, and condensed tobacco smoke products (yet another reason not to smoke), and the disk may make matters worse by just moving the crud around.

First, gently blow out any dust or dirt which may have collected inside the lens assembly. A photographic type of air bulb is fine but be extremely careful using any kind of compressed air source. Next, clean the lens itself. It is made of plastic, so don't use strong solvents. There are special cleaners, but alcohol (91% medicinal is acceptable, pure isopropyl is better. Avoid rubbing alcohol especially if it contains any additives) works fine for CD players and VCRs.

There should be no problems as long as you dry everything off (gently) reason-

ably quickly. *Do not lubricate!* You wouldn't oil a loudspeaker, would you?

When the lens is clean, it should be perfectly shiny with a blue tinge uniform over the central surface. If you can get to the turning mirror or prism under the lens without disturbing anything, clean that as well using the same procedure.

Do not use strong solvents or anything with abrasives—you will destroy the lens surface most likely rendering the entire expensive pickup worthless.

It is easy to be misled into thinking that there are much more serious problems at the root cause of disks not being recognized, audible noise, and tracking problems like skipping, sticking, or seek failures. However, in many cases, it is simply a dirty lens.

Spindle bearing

Check the spindle bearing (this is primarily likely to cause problems with repetitive noise). There should be no detectable side to side play, i.e., you should not be able to jiggle the platform that the CD sits on. If you find that the bearings are worn, it is possible to replace the motor (about $10 from various mail order houses), though removing and replacing the disk platform may prove challenging as a result of the usual press fit mounting.

The focus servo can compensate for a vertical movement of the disk surface of 1mm or so. A small bearing side play can easily cause larger vertical errors—especially near the end (outer edge) of the disk. Even if you are not experiencing problems due to bearing wear, keep your findings in mind for the future.

On some players there is a bearing runout adjustment screw on the bottom of the spindle if the spindle is not driven by a standard permanent magnet motor. I have seen this in a Sony Discman which had a custom motor assembly. A small tweak to this adjustment may correct a marginal spindle problem.

To access the drawer mechanism and sled drive in component units, you will probably need to remove the optical deck from the chassis. It is usually mounted by 3 long screws (one of which may have a grounding tab. Don't lose it. In portables, the bottom panel of the unit will need to be removed. Try not to let any of the microscrews escape! A good set of jeweler's screwdrivers is a must for portables.

Drawer mechanism

(If present)—Check for free movement of the drawer mechanism. Test the belt for life—it should be firm, reasonably tight, and should return to its original length instantly if stretched by 25% or so. If the belt fails any of these criteria, it will need to be replaced eventually, though a thorough cleaning of the belt and pulleys with isopropyl alcohol (dry quickly to avoid damaging the rubber) or soap and water may give it a temporary reprieve.

Also, check the gears and motor for lubrication and damage and correct as necessary. Clean and lubricate (if necessary) with high quality light grease suitable for electronic mechanisms such as moly lube or silicone grease. A drop of light oil (electric motor oil, sewing machine oil) in the motor bearings may cure a noisy or dry bearing.

Sled drive

Check the components that move the pickup including (depending on what kind of sled drive your unit has) belt, worm gear, other gears, slide bearings. These should all move freely (exception: if there is a lock to prevent accidental damage while the

unit is being transported the pickup may not move freely or very far). Inspect for damage to any of these components which might impede free movement. Repair or replace as appropriate. Clean and lubricate (if necessary) with just a dab of high quality light grease suitable for electronic mechanisms such as moly lube or silicone grease). A drop of light oil (electric motor oil, sewing machine oil) in the motor bearings may cure a noisy or dry bearing.

Try to play a disk again before proceeding further. I guess you most likely have already done this.

Lubrication of CD players

The short recommendation is: do not add any oil or grease unless you are positively sure it is needed. Most moving parts are lubricated at the factory and do not need any further lubrication over their lifetime. Too much lubrication is worse then too little. It is easy to add a drop of oil but difficult and time consuming to restore an optical pickup that has taken a bath in lubricant.

Never use any type of lubricant that is not expressly recommended by the manufacturer of the CD player. This includes any of the highly touted name brand lubricants on the hardware store shelves.

A light machine oil like electric motor or sewing machine oil should be used for gear or wheel shafts. A plastic safe grease like silicone grease or moly lube is suitable for gears, cams, or mechanical (piano key) type mode selectors. Never use oil or grease on electrical contacts.

Unless the unit was not properly lubricated at the factory (which is quite possible), don't add any unless your inspection reveals the specific need. In a CD player, there are a very limited number of failures that are caused by lubrication.

Note that in most cases, oil is for plain bearings (not ball or roller) and pivots while grease is used on sliding parts and gear teeth. If the old lubricant is gummed up, remove it and clean the affected parts thoroughly before adding new lubricant, oil or grease.

In general, do not lubricate anything unless you know there is a need. Never 'shotgun' a problem by lubricating everything in sight! You might as well literally use a shotgun on the equipment!

Part II of this article will diskuss some typical malfunctions associated with the CD player and will suggest some corrective measures you can take to fix them.■

Working with depot repair centers

By The ES&T Staff

There was a time when consumer electronics service centers performed all of the service work on a product that a customer needed to have repaired. These days, because such devices as laser printers and hard disk drives may require skills and equipment that it is not economical for a service center to possess, service centers now send some products out to a third party service organization, a service depot, to be repaired.

Actually, the first statement here is not entirely correct. Service centers have historically used some type of "depot" service center to help them service certain portions of some products. For example, service on mechanical TV tuners requires equipment and skills that the average service center does not wish to acquire. Therefore, when a TV being serviced needed a new tuner, the service center sent the tuner to a tuner service specialist and received a refurbished tuner in return to install in the set.

From the point of view of the service center, this was merely exchanging a faulty but repairable subassembly for a refurbished one. But it was in fact a form of depot repair. The same thing was true of replacing a TV picture tube with a rebuilt one. While the faulty tube was replaced with another, refurbished one, in effect, the service center had dealt with a service "depot."

Depot service makes sense

There are a number of reasons that a service center might want to have some of its work performed by a service depot. For example, a service center that traditionally services TVs and VCRs, decides that in order to survive in these difficult times that they will have to branch out into other areas, so they learn about personal computers and begin to service them.

After beginning to service personal computers, the service center finds that they don't have the facilities to deal with hard drive service. Moreover, while laser printers don't seem that difficult to service, at the moment they are not ready to

DEPOT REPAIR CENTERS

3E Corp.
Monitor Repair
165 Front Street
Chicopee MA 01013
413-594-2772
Fax: 413-594-7283
Monitors
Circle (3) on Reply Card

Air 1 USA Inc.
Micro Services Division
PO Box 3035
Pueblo CO 81005
719-566-0018
Fax: 719-566-0024
Monitors
Circle (4) on Reply Card

AMCOR
373 Route 46 West
Fairfield NJ 07004
201-575-5900
Fax: 201-575-8469
Printers
Circle (5) on Reply Card

Analog Technology Center Inc
62 Route 101A
Amherst NH 03031
603-673-0404
Monitors
Circle (6) on Reply Card

Cerplex Group, Inc
1382 Bell Ave.
Tustin CA 92780
714-258-5600
Fax: 714-259-1944
Computers
Circle (7) on Reply Card

Curtis Mathes Parts & Service
10911 Petal
Dallas TX 75238
214-494-6411
Fax: 214-494-1585
Television
Circle (8) on Reply Card

Datatech Depot, Inc.
1871 North Miller St.
Anaheim CA 92806
714-996-7500
Fax: 714-970-1670
Computers
Circle (9) on Reply Card

Depot America
1345 Campus Parkway
Neptune NJ 07753
800-648-6833 Fax: 908-919-1929
Computer printers
Circle (10) on Reply Card

Dot Shop, The
12025 NE Summer St.
Portland OR 97220
503-256-7585
Fax: 503-256-7588
Printheads
Circle (11) on Reply Card

Electrodyn, Inc.
501 E. Temperance St.
Ellettsville IN 47429
812-876-2522
Fax: 812-876-2533
Modules
Circle (12) on Reply Card

Electrohome
181 Cooper Ave.
Suite 100
Tonawanda NY 14150
716-874-3630
Projection TV
Circle (13) on Reply Card

Electroservice Laboratories
6085 Sikorsky St.
Ventura CA 93003
805-644-2944
Fax: 805-644-5006
Drives/Monitors/Electromechanical
Circle (14) on Reply Card

Fessenden Technologies
116 3rd Street
Ozark MO 65721
417-485-2501
Fax: 417-485-3133
Computers
Circle (15) on Reply Card

Genicom Corporation
1 Genicom Drive
Waynesboro VA 22980-1999
800-535-4364
Fax: 703-949-1500
Comp/ Monitors/ Printers/ Copiers
Circle (16) on Reply Card

tackle that type of product at the same time as they're beginning servicing of personal computers.

So the service manager does some research and finds that there are companies that are specialists in servicing disk drives, and other companies that are specialists in servicing laser printers. Some of these depot service centers will quickly turn around a disk drive or laser printer, and at a cost to the service center such that they can mark up the cost of the service to their customer, make a profit on the transaction, and still get the product back to the customer in a reasonable amount of time and at a reasonable price.

Total customer support

One of the advantages of using depot repair services is that it helps the service center avoid sending a valued customer to another service center, and possibly losing that business forever. Lets say that a customer who has been bringing in his TVs, VCRs and microwave ovens to you for years suddenly comes in and asks you to fix his computer monitor. You don't fix them, so you tell him he has to go to another service center.

If that service center services the entire gamut of consumer electronics products ,and personal computers and other office equipment included, you may just have said goodbye to that customer forever. After all, in these complex times in which we live we're all trying to make life simpler. One way to do that is to have all servicing of similar products performed by a single organization.

Another way to have handled that same customer would have been to take the product in (assuming that it's not an emergency situation),and then do a little research to see if there are companies that will service monitors on a depot basis. You could then send the monitor to the depot using some kind of express shipping, have it serviced there, usually fairly quickly, receive it back in operating condition, mark up the price of service, and return it to the customer.

Even if the markup only covered your cost of handling the product and didn't return any profit, it kept the customer coming back to you as the company that services all of his consumer electronics service. And if you eventually branch out into monitor service, the next time that

Gore Laboratories, Inc.
3 Northern Blvd
Amherst NH 03031
606-672-4673
Fax: 603-672-5652
Calibration
Circle (17) on Reply Card

Guardian Computer Support, Inc
1177 Quarry Lane, Suite F
Pleasanton CA 94566
510-846-3649
Computers
Circle (18) on Reply Card

HI-TEK Services, Inc.
1595 Crocker
Hayward CA 94544
510-489-8909
Fax: 510-489-5908
Computers
Circle (19) on Reply Card

C. Hoelzle Associates, Inc.
17321 Eastman Street
Irvine CA 92714-5523
714-251-9000
Fax: 714-251-9291
Printers, Scanners
Circle (20) on Reply Card

Hy Tec Dealer Service
4548 Parkbreeze Ct
Orlando FL 32801
407-297-1001
Fax: 407-297-4310
Computers
Circle (21) on Reply Card

Impact Printhead
10435 Burnet Rd
Suite 114
Austin TX 78758
512-832-9151
Fax: 512-832-9321
Printers, Monitors
Circle (22) on Reply Card

International Disk Svcs, Inc.
1530 Montague Expwy
San Jose CA 95131
408-432-0537
Fax: 408-434-1015
Computers
Circle (23) on Reply Card

Laser Wizard
705 General Washington Ave.
Valley Forge Business Center
Norristown PA 19403
610-539-4708
Fax: 610-539-1096
Laser Printers
Circle (24) on Reply Card

Mac Shack
28 Willow Pond Way
Suite LL3
Penfield NY 14526
716-377-9230
Fax: 716-377-9573
Macintosh Computers
Circle (25) on Reply Card

Magnetic Data Inc.
6754 Shady Oak Road
Eden Prairie MN 55344
800-328-3441
Disk drives
Circle (26) on Reply Card

Main Source Electronics
9260 Owensmouth Ave
Chatsworth CA 91311
818-882-7500
Fax: 818-882-7785
Computers
Circle (27) on Reply Card

Man & Machine, Inc.
3501 Hamilton St.
Hyatsville MD 20782
301-277-3760
Fax: 301-779-1455
Computers
Circle (28) on Reply Card

Matrix Components
13581 Pond Springs Rd
Ste 315
Austin TX 78729
512-258-7590
Fax: 512-219-0021
Computers
Circle (29) on Reply Card

Meltek, Inc.
3 Victor Square
Scotts Valley CA 95066
408-438-4986
Fax: 408-438-3459
Computers
Circle (30) on Reply Card

Mesa Systems, Inc.
420 Leisure St.
Livermore CA 94550
510-443-9491
Fax: 510-443-9499
Laser Printers, Dot Matrix Printers
Circle (31) on Reply Card

Micro Medics
6625 Jarvis
Niles IL 60714
847-647-1010
Computers
Circle (32) on Reply Card

Module Exchange
706 Space Way
Duncanville TX 75137
214-298-1212
Fax: 214-283-1778
Consumer/Computer
Circle (33) on Reply Card

NorthStar MatrixServ
7101 31st Avenue N
Minneapolis MN 55427
612-591-0009
Fax: 612-591-0029
Computers/Printers
Circle (34) on Reply Card

The Peak Technologies Group
9200 Berger Rd
Columbia MD 21046-1602
410-312-7660
Printers
Circle (35) on Reply Card

Peripheral Computer Support
Division of Cerplex
2219 Oakland Road
San Jose CA 95131
408-428-6420
Disk Drives
Circle (36) on Reply Card

Princeton Computer Support
5 Crescent Avenue
PO Box 787
Rocky Hill NJ 08553
609-921-8889
Fax: 609-921-7693
Computers
Circle (37) on Reply Card

PTS Corporation
5233 South Highway 37
PO Box 272
Bloomington IN 47402
812-824-9331
Fax: 812-824-2848
General
Circle (38) on Reply Card

Reset, Inc.
49 Strathearn Place
Simi Valley CA 93065
805-584-4900
Fax: 805-583-2900
Computer
Circle (39) on Reply Card

Service Electronics Inc.
682 Passaic Avenue
Nutley NJ 07110
201-284-1200
Fax: 201-284-1550
Computers
Circle (40) on Reply Card

SMH Electronics Co., Inc.
21 Pattersons Brook Rd.
West Wareham MA 02576
508-291-7447
Fax: 508-291-7449
Computers, Peripherals
Circle (41) on Reply Card

TEKSERV
127 Riverneck Road
Chelmsford MA 01824
508-459-9480
Fax: 508-453-6336
Test Equipment Repair
Circle (42) on Reply Card

Trilogy Magnetics Inc.
424 N. Mill Creek Rd.
Quincy CA 95971
916-283-3736
Fax: 916-283-3122
Computers, Electromechanical
Circle (43) on Reply Card

Unicomp, Inc.
800-359-5092
Printers
Circle (44) on Reply Card

Uptime Service Association
14450 NE29th Place #116
Bellevue WA 98007
206-869-6668
Fax: 206-869-6229
Computers
Circle (45) on Reply Card

Valtron Technologies
28309 Avenue Crocker
Valencia CA 91355
805-257-0333
Fax: 805-257-0114
Disk Drives
Circle (46) on Reply Card

Voltura Enterprises, Inc.
Matrix Components
744 Main St. #1
Winchester MA 01890-2713
617-721-4920
Fax: 617-721-7316
Drives, LCD, Monitors, PCBs
Circle (47) on Reply Card

Whitaker Repair Corp
1106 Commercial Street
Athens TX 75751
214-675-3552
Refurbishment
Circle (48) on Reply Card

customer brings in a monitor, you'll service it and this time make a profit.

It's a common way of doing business

Some service centers seem to be reluctant to contract out some of the work, but it does make sense in many cases, and it is standard practice in other businesses. For example, if you bring your car in to the auto service shop for some work, and the work includes damage to the body that will require some straightening, filling, sanding and painting, the chances are very great that the service center will perform the mechanical work to fix whatever is wrong with your engine, transmission or whatever, but will send the car out to a body shop with whom they have an arrangement and get the body work done there. It just doesn't make sense for them to maintain the skills, specialized equipment and supplies for body work when they don't do much of it.

A list of depots

For the convenience of our readers, included is a partial list of depots that provide service for consumer electronics products and for personal computers and computer peripherals. ■

Servicing the deadly TV chassis

By Homer L. Davidson

If a TV chassis catches fire, the fire can spread, destroying furniture or the home, or even causing loss of life. High voltage arcing within the flyback or yoke assembly can eventually start a fire. Shorted components in the low voltage circuits can smolder under dust and dirt (Figure 1). Overheated power resistors may ignite cords, cables or wires that are left on top of them. Arcing within the on/off switch, mounted over the VHF tuner has caused fires in the past.

High wattage resistors that are mounted directly on the PC wiring may slowly cause a smoldering area to burn. Liquid spilled down into the chassis may later cause lines of firing, burning a small area of the PC board. Poor insertion of the cheater cord has caused arcing of contacts. In extreme lightning or power outage, conditions which are accompanied by surges and spikes can destroy the TV chassis with fire damage.

Because of the potential for a TV set to cause a fire, it's important to always make sure to follow manufacturers' safety recommendations in performing service and in selecting any safety-critical components.

This article is presented to remind servicers everywhere that safety is of paramount importance in servicing. Moreover, the process of detective work in determining the cause of the fire described here is very similar to the detective work in diagnosing problems and performing service on a TV set.

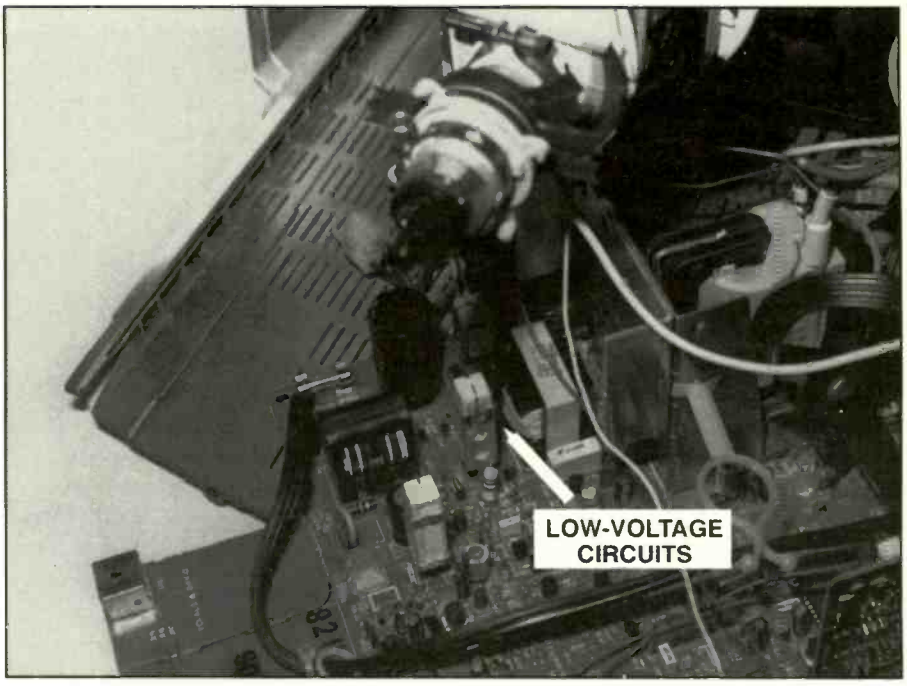


Figure 1. Shorted power line components in the low voltage power supply can cause a fire.

The melted TV chassis

One day I was called by a lawyer to come and inspect a TV set to determine if it might have been the cause of a fire that destroyed a home. Two electrical engineers had already inspected the chassis and had come up with several theories as to how the chassis might have been the cause of the fire damage. No doubt, they were fire examiners from the state fire association. A representative from the insurance company, the owners of the burned property, and the lawyer were to be present at this meeting.

When I arrived, the two engineers were examining several copies of the TV schematics. Color photos, 215 in all, had been taken, documented and numbered. The burned TV chassis was packed in a cardboard box under the table.

I bided my time while the participants of this meeting went through the prelim-

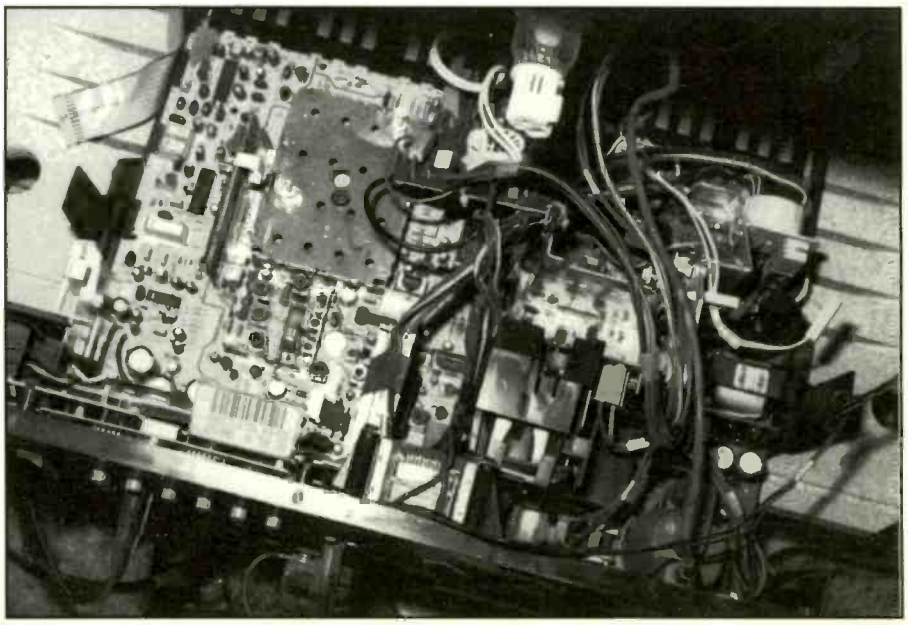


Figure 2. I checked the top of the chassis for burned spots, signs of arcing and burned components and other fire damage.

Davidson is a TV servicing consultant for ES&T.

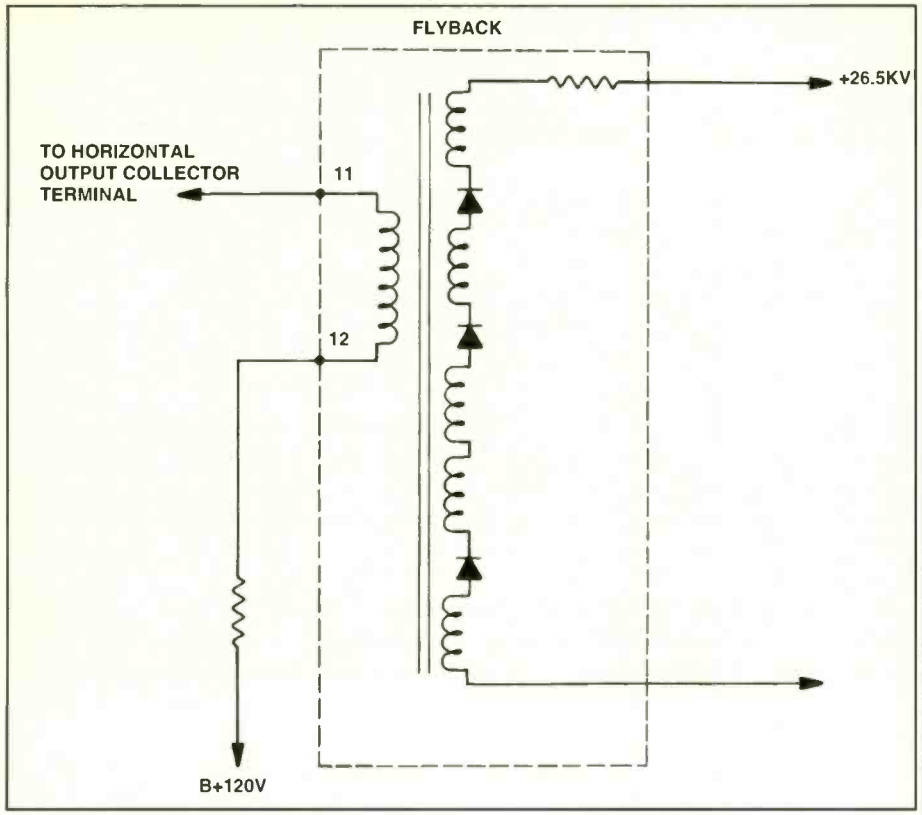


Figure 3. The secondary or high voltage winding of the horizontal output transformer will not show continuity on the highest range of meter.

inary phase, then the box was opened and the set was placed on the table and I was invited to examine it. In all the 40 years I have spent as an electronic technician and dealer, I have never seen a TV chassis as badly damaged as this one (Figure 2). The plastic cabinet had melted down on various parts of the chassis and the picture tube had exploded. Only the HV cable was bonded to a piece of glass.

The eyes of all those present followed my every move. It felt as though a hundred eyes were staring right at me. I asked the other experts not to discuss any details of the fire with me until I was finished with my inspection and had formulated a hypothesis as to the cause of the fire. I did not want any statements made that might influence my thinking as to what had caused the fire damage.

Look me over

I was initially quite surprised at what I found. The top of the chassis was fairly clean on the top side. There were no burn marks on it. The flyback transformer had been removed by the engineers. I carefully inspected the top side of the chassis for burned components before turning the chassis over. On the bottom there were a few burned looking areas with white ring marks on the PC wiring.

The two engineers asked me what I thought had caused the black area and white marks. I stated that I assumed that the black material was soot caused by the fire that occurred outside of the chassis. The engineers said that they suspected that the marks were caused by a fire that occurred within the set, caused by defective components. The black area was right under the flyback transformer and the horizontal output transistor.

To support my theory, I scraped off some of the black area with my thumb nail. The soft black material scraped away cleanly. The PC board beneath the material that I had scraped away did not show any evidence of burning.

The black material that I had scraped away was on top of wax that had been melted by the heat of the fire. I surmised that it was a combination of dust and soot which had collected, possibly as a result of the extensive fire in the home.

The younger engineer, call him Bill Smith, asked about the white lines on the PC wiring. I explained to him that in my opinion they were water marks. When water or liquid is spilled on the PC board,

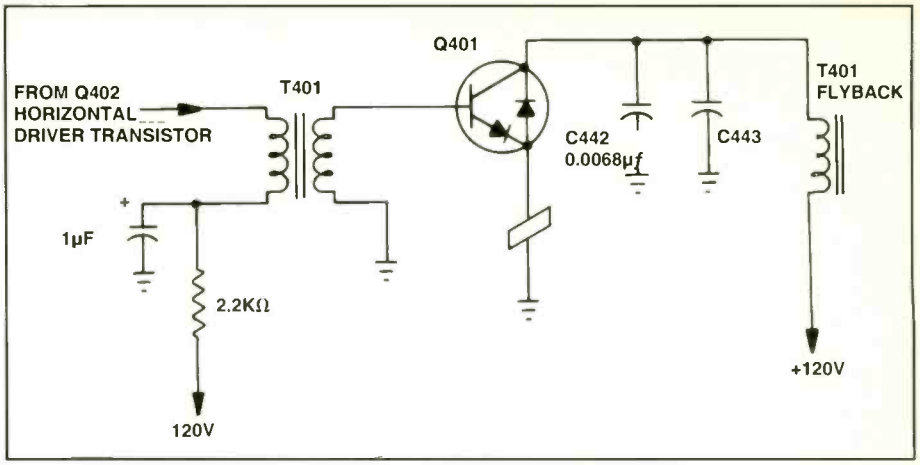


Figure 4. The normal horizontal output transistor with an integral damper diode will show a low resistance on the diode-transistor test using the digital multimeter and infinite resistance with reversed test leads.

white rings are left on the wiring area. The water marks could have been caused by water used to put the fire out.

To illustrate my point I scraped a few white marks off with the screwdriver blade. The older engineer, Joe Jones, was quite convinced, but Smith was not.

The horizontal problem?

Jones explained that they had thought the flyback and high voltage circuits had caused the fire because the black and white marks were directly beneath the chassis. Smith thought that the fire had been caused by the flyback, which he surmised was defective because the secondary winding was open. On the surface, this was a reasonable line of thinking, since defective flybacks have been the cause of fires in some sets.

"Was the secondary fuse blown?" I asked. Jones said no, that only the line fuse was open. I explained the flyback showed no signs of arcing or overheating.

Smith grabbed the flyback, attached a portable DMM to the flyback winding and tried to prove to me that the secondary winding was open. The primary winding showed continuity, but he said the secondary winding was open.

I tried to explain to him, with the aid of the schematic, that the secondary winding could not be measured with any test instrument found in their lab or on my service bench (Figure 3).

Another reason that Smith felt the flyback was at fault, was that one terminal was not even soldered. After inspecting the transformer soldered connections, terminal 3 showed no signs of solder on the flyback terminal or the PC board. Of course, the schematic diagram showed that terminal 3 was not even connected to the flyback winding. It took several minutes to explain why the manufacturer never soldered terminal 3.

Well, Smith just knew that the flyback was defective and the horizontal circuits caused the fire. What about the output transistor? I tried to explain that if the output transistor was shorted or leaky the secondary fuse would open up. I checked the continuity of the fuse and it was okay.

Smith asked me to check the horizontal output transistor. I noted that the DMM they were using had a diode test function and I proceeded to test the output transistor in the circuit.

Naturally, the transistor tested normal, but Smith did not understand the tests between emitter and collector terminals (Figure 4). Again we checked the schematic and I tried to explain to him the damper diode inside the output transistor. To prove a point, he removed the transistor with a low temperature soldering iron, so as not to melt down any connections inside the transistor. After testing the transistor out of the circuit, I think he was convinced the transistor was normal.

The open line fuse

Smith then asked what caused the line fuse to open. I located the low voltage components on the chassis and the line fuse was definitely open. Since the secondary fuse (1.5A) was good, perhaps a silicon diode had become leaky within the low voltage power supply.

A quick diode test across each diode

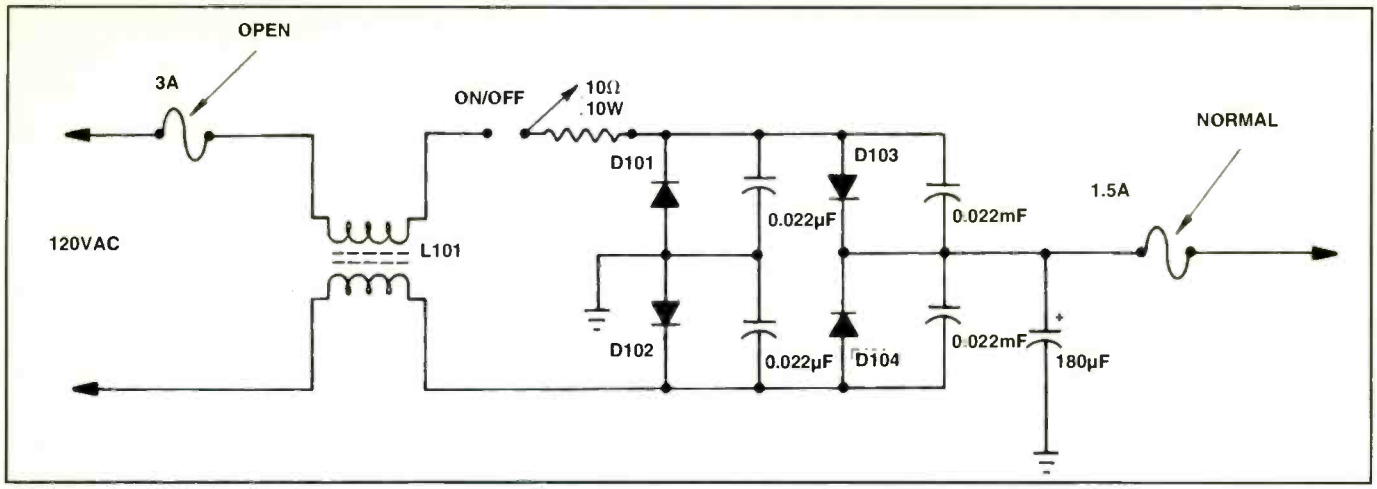


Figure 5. No leakage was found across the silicon diodes and filter capacitor in the low voltage power supply.

indicated they were normal (Figure 5). When I connected the DMM probes to the large filter capacitor, the meter reading gradually increased from zero, indicating that the capacitor was good.

Something had caused the line fuse to open. I asked if there had been any thunderstorms that day? How about a power outage? The owner of the TV set indicated the sun was shining and that there had been no storms that day.

According to Jones, power line fuses and small fuses have been known to open up as a result of extreme heat. According to the fire chief, the temperature at the ceilings in the burned house had reached around 700 degrees.

Check the transformer

Continuity tests of the switching transformer and transistor were normal. The deflection yoke winding was good and clean. Of course, some melted plastic was found on the cover. None of the lead wires from the yoke to the chassis showed any signs of overheating.

Jones checked the power cord for possible arcing or breaks. Only two feet of line cord remained. He found no small beads of copper, which would have indicated arcover. The ac line choke coils were intact and there were no signs of burning, which eliminated any possibili-

ty that there had been large power line voltage spikes caused by lightning or a power outage.

What caused the fuse to open?

Again, the question of what possibly opened the line fuse came up in the examination and discussion. Smith asked how many TV sets I had seen that were burned and caught on fire.

In 40 years of radio and TV repair, I could only remember five such cases. All of these fires were contained inside the cabinet, except one. In this case, fire had burned through the back of the wooden cabinet and caught the window curtains on fire. That fire was extinguished before any greater damage was done.

What components in the TV chassis, he asked, may cause a fire if there's a short circuit? Again, I mentioned the power transformer, flyback, yoke, cables and wires, and a shorted degaussing coil (Figure 6). The only component that I mentioned that had not been checked was the degaussing coil. When we examined the degaussing coil, we found that the plastic cover was burned off leaving only strands of wire. The insulation or enamel was burned off of each wire and some of the wires had white streaks on them.

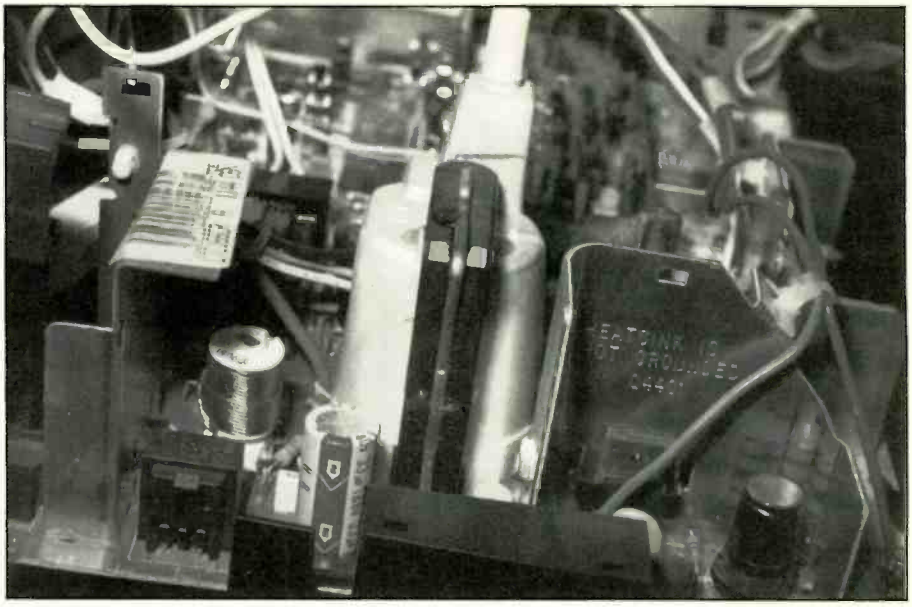


Figure 6. The yoke, transformer, high wattage resistors, degaussing coil, and flyback can arc over and burn.

I had seen in the past, cases in which the degaussing coil may be pinched with the metal picture tube shield or against the metal band around the CRT. In these cases only the line fuse was blown. Jones carefully examined each wire and picked up the picture tube metal band from another box. He found no signs of arcing against the metal band or beads of copper.

What caused the degaussing coil to burn?

Again, Smith asked what would cause the fuse to blow and the degaussing coil to become charred. Jones had ruled out a

ES&T Calendar

Eighth Annual Digital Audio & Video Workshop
October 1-4, 1996
Philadelphia, PA
703-907-7674

EIA/CEMA
1996 Technical Workshop
Color TV Technology & Servicing
October 2-4, 1996
Tampa, FL
703-907-7656

EIA/CEMA
1996 Technical Workshop
Color TV TEchnology & Servicing
October 8-10, 1996
Arlington, VA
703-907-7656

Business to Business Expo
VFW Hall, Memorial Building
October 9, 1996
Franklin Square, NY
516-221-6043

EIA/CEMA
1996 Technical Workshop
Color TV Technology & Servicing
October 14-16, 1996
River Grove, IL
703-907-7656

EIA/CEMA
1996 Technical Workshop
Computer Monitor Servicing
November 6-8, 1996
Arlington, VA
703-907-7656

EIA/CEMA
1996 Technical Workshop
Color TV Technology & Servicing
November 12-14, 1996
Walnut, CA
703-907-7656

International Winter Consumer Electronics Show
January 9-12, 1997
Las Vegas, NV
703-907-7674

CES Mobile Electronics - The 12-Volt Educational Forum
April 4-6, 1997
Atlanta, GA
703-907-7674

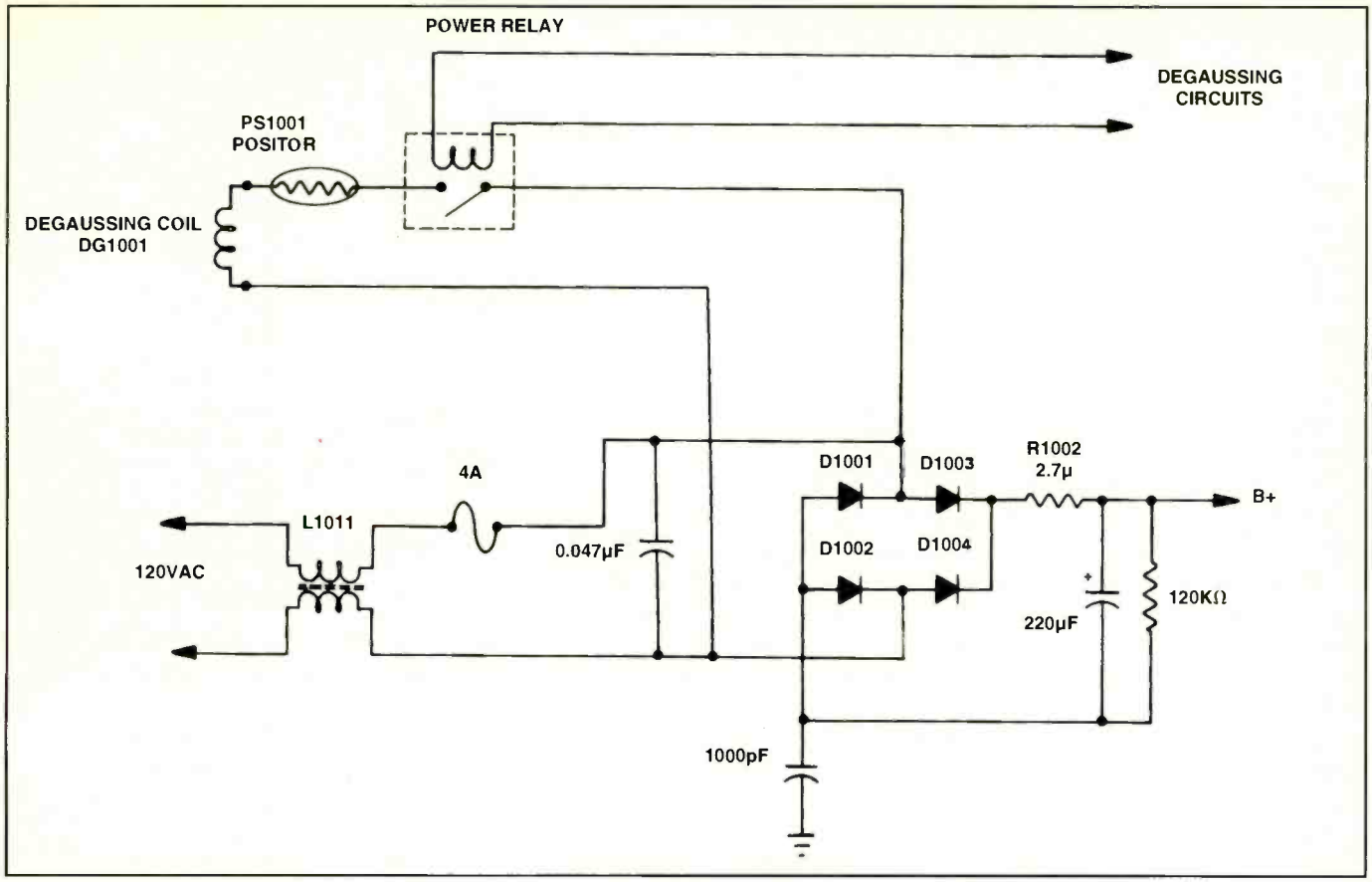


Figure 7. A power relay controlled by transistors or microprocessor closes the degaussing coil circuits to degauss the set.

short between the degaussing coil and the picture tube band. The only other possible component was the power relay that energizes the degaussing coil circuit. After we took another look at the schematic diagram and checked the schematic and chassis, we located a small enclosed relay on the chassis (Figure 7).

Smith immediately grabbed the DMM and started to take continuity measurements and loudly indicated the relay was shorted. I suggested that he remove the suspected relay and test it out of the circuit. He picked up the low-wattage soldering iron and slowly removed the relay contacts. He did not want to melt down any connections inside the relay. Of course, when removed and tested, the relay was good. Was it possible the relay came on, then hung up, or the transistor control circuit caused the TV to come on without anyone operating the TV chassis? Some TV sets have been known to come on without a person in the room.

Relay control

In some of the larger TV chassis, I explained, a microprocessor or transistor circuit controls the degaussing relay. Here a lonely transistor was checked and tested good. Did the degaussing coil cause the fire as a result of a defective relay circuit? I guess we will never know.

I asked if the TV set had been turned on for several hours on the day of the fire, and the owner said it was not. Several pictures showed smoky smudges on the wall behind the TV set. Could any other consumer electronics products have caused the fire? The owner explained that a VCR unit was mounted in the shelf below, but he had not had the time to hook it up. All curtains were burned up in every room. In the bedroom, the window was at least three feet away from the TV set.

This fire did have tragic consequences. The daughter of the family that owned the home was home at the time of the fire. According to the mother, who spoke to her in the hospital before she died said that she had taken a bath and fixed her hair right after school. When she opened the bath room door, the flames burst in and engulfed the room. When her mother asked if she had turned the TV set on she responded no.

The verdict

The lawyer asked each one of us if the TV had caused the fire. Jones said there was not enough evidence to come to any conclusion. Smith nodded in agreement. I mentioned, that the degaussing coil could have caused the fire, but did it turn itself on? The family lawyer decided that in the absence of any conclusive evidence it would not make sense to bring suit against the technician who might have worked on the TV last, the dealer or the manufacturer.

As I drove home, I wondered what might have happened if we had found evidence that a poor soldering job was done replacing the flyback or repairing the TV chassis. What if carbon resistors had been replaced for flame proof resistors? What if some safety marked parts were replaced with common replacement components and the technician was to blame? This burned degaussing coil still haunts me.

Be careful out there. ■

Switching power supplies

By The ES&T Staff

Every consumer electronics product requires at least one, but usually several, sources of dc voltage in order to operate. Because of the nature of electronic circuits, it is necessary that those voltages be relatively stable, regardless of variations in the voltage provided by the power company, adjustments of the product by the user, or other changes that may vary the load on the power supply.

In a TV set, some of the power supply voltages are derived directly from the power line. Other power supply voltages are derived from other circuits in the set; for example, scan-derived voltages, which are derived from extra windings on the horizontal output transformer. This article will not discuss any of these internally derived voltage supplies, but will be limited to supply voltages derived from the ac line.

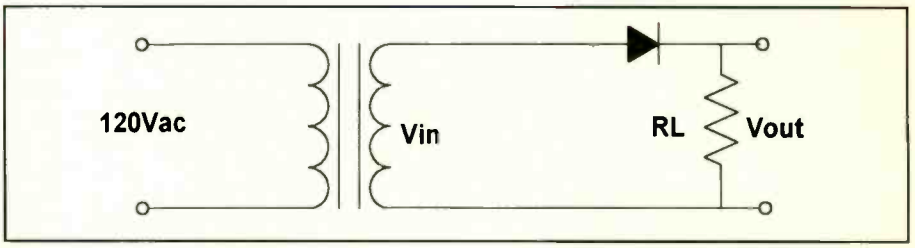


Figure 1. The simplest power supply is the half-wave rectifier. This supply uses a transformer to reduce the voltage to the desired value, a diode to rectify the ac voltage to pulsating dc, and a capacitor to smooth the dc.

The linear power supply

The simplest power supply is the half-wave rectifier (Figure 1). This supply uses a transformer to reduce the voltage to the desired value, a diode to rectify the ac voltage to pulsating dc, and a capacitor to smooth the dc.

There are some problems with this power supply. For starters, it is inefficient because it only rectifies half of the incoming ac waveform, discarding the other half. Moreover, this supply is not regulated. Any change in the input voltage or load will result in an unwanted change in the voltage output of the supply.

Regulation

By adding other components to the power supply, it is possible to regulate the voltage output, thus keeping it relatively constant in spite of variations in the line voltage or the load. A simple way to add regulation to a power supply is to place a Zener diode in the circuit.

When a Zener diode is reverse biased, the voltage across it remains relatively constant over a wide range of conditions. By connecting a Zener diode as shown in Figure 2, the output voltage of the power supply can be kept relatively constant.

The Zener is not, however, the total answer to regulation. If the load resistance is too low, the diode may not provide the required regulation. If the input voltage becomes too high, the diode may carry too much reverse current and be damaged or destroyed.

The pass transistor

A transistor in the circuit (Figure 3), called a pass transistor because the current passes through it, improves the operation of the basic regulated linear power supply. There are, of course, many variations of this simple regulated power supply, and other ways to achieve a regulated power supply, but this simple model provides an understanding of how a linear power supply works.

Switching power supplies

Switching power supplies operate on a different principle. Actually, there are a number of ways to achieve switching regulation. Figure 4 shows one generalized type of switching regulator.

One of the greatest advantages of a switching power supply over a linear supply is that a switching power supply is supplied from a rectifier that operates at line voltage, instead of a step-down transformer. Those step-down transformers use a lot of costly copper wire in both primary and secondary, which along with the laminated core add a lot of weight.

The switching power supply can operate at a much higher frequency than the 60Hz line frequency by switching the dc input voltage on and off, and so the amount of wire required to provide voltage transformation, and the weight of the transformer, is considerably less.

The switching regulator of Figure 4 operates in this manner. The pulse generator provides pulses to the base of the pass transistor. Each pulse turns the transistor on for the duration of the pulse. When the

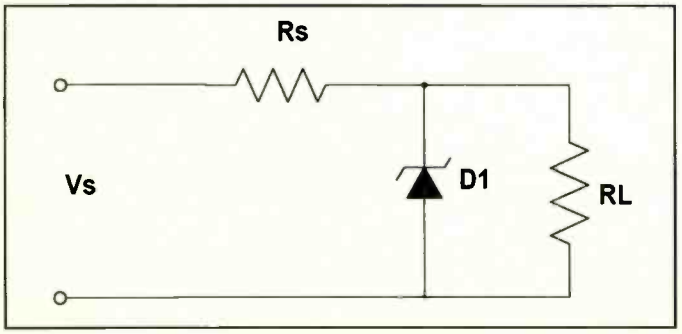


Figure 2. By connecting a Zener diode as shown here, the output voltage of the power supply can be kept relatively constant.

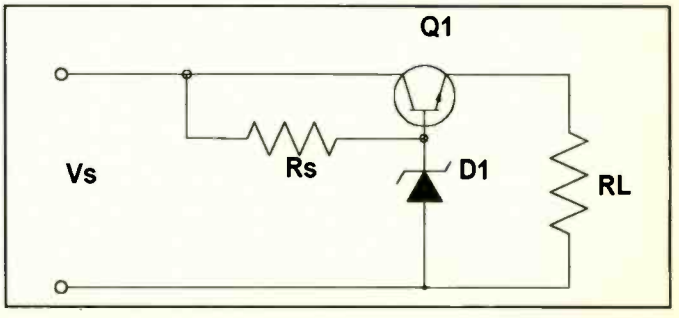


Figure 3. A transistor in the circuit, called a pass transistor because the current passes through it, improves the operation of the basic regulated linear power supply.

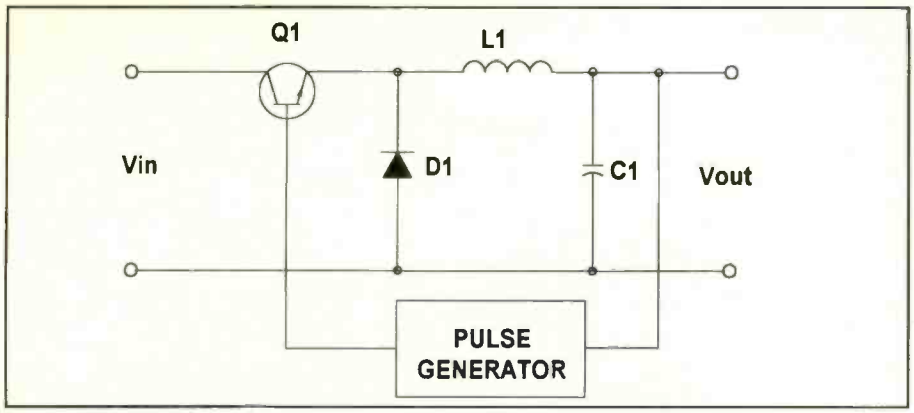


Figure 4. A switching power supply senses the output voltage, using it to vary the the duty cycle of a pulse generator that determines the on time of the transistor that provides energy to the output, thus keeping the output voltage relatively constant.

transistor is on, the rectified input voltage, Vin, is connected to the output via the LC filter.

The frequency of the pulse generator is generally in the range of 20kHz. If the input voltage decreases, or if the load increases, causing the output voltage to decrease, the pulse generator, which monitors the output voltage, will increase the duty cycle of the pulse train (increase the length of the on time of the pulse) applied to the base of the transistor, causing the transistor to stay on longer, and thus causing the output voltage to increase.

If the input voltage increases, or if the load decreases, causing the output voltage to increase, the increased voltage sensed by the pulse generator circuit will cause the duty cycle of the pulse train applied to the base of the transistor to decrease (decrease the on time of the pulse), thus reducing the output voltage back toward its specified value.

The purpose of the diode in this circuit is to provide a path for inductor current when the transistor is off.

Troubleshooting switching power supplies

Because switching power supplies are generally more complex than their linear counterparts they are frequently more difficult to troubleshoot. It may be almost impossible to determine what's going on in a switching power supply without service literature for the product.

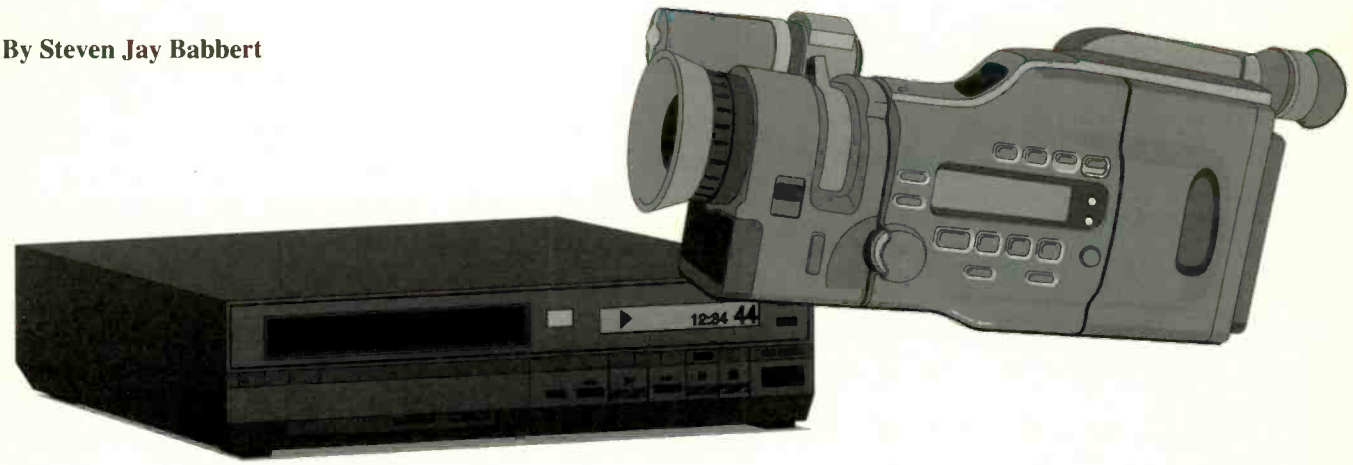
Some general steps in troubleshooting are fairly obvious. Check the fuse. Check to see if ac is reaching the input to the rectifier. Is there dc of approximately the right value at the output of the rectifier? Can you observe the pulse train at the output of the pulse generator? Is the duty cycle varying?

One important step in troubleshooting a switching power supply is to spend a few moments studying the schematic to try to determine the functions of each portion of the circuit .

Switching power supplies provide a difficult troubleshooting challenge, but with the right information available, they can be conquered. ■

Where do I begin?: Analyzing VCR and camcorder problems

By Steven Jay Babbert



When preparing to service a VCR, my most valuable service information often comes from the customer. Typical questions I ask are: "What is it doing—or not doing?" "Did the problem appear suddenly or gradually?" "Was the unit handled improperly or abused in any way?" Answers to these questions can be helpful in localizing the problem even before the cover is removed.

A fairly common complaint is that the VCR starts to play but then stops and possibly ejects the tape or shuts down. A symptom such as this could be caused by a variety of problems ranging from a worn belt or idler wheel to a defective syscon (system control microprocessor). Information provided by the owner could be helpful in this case.

If the owner tells me that the unit has had a fast-forward or rewind problem that has been getting progressively worse, I'll focus my attention on parts of the drive section that are common to the play, FF and rewind modes. The idler wheel is subject to progressive wear and may not cause play-mode problems until it becomes seriously worn.

If the unit has had no prior problems the drive system could still be at fault particularly in the case where a belt has broken or fallen off, but now there is an increasing likelihood that a non-mechanical problem exists. In this case visual inspection will be helpful while trying to cycle the unit through various modes. This should be done while using a clear or cutaway test jig.

Babbert is an independent consumer electronics servicing technician.

The test jig

The cassette test jig is a valuable troubleshooting aid, particularly for tape transport problems. Not only does it prevent possible damage to expensive test tapes, it allows you to see moving parts which would otherwise be blocked. More than one test jig can be useful since different models allow access to different areas. Be sure that the jig is designed for the chassis you are servicing. For example, "G" function chassis requires a "G" function jig. These jigs will also work on most other models.

Test jigs perform two main functions; they activate the respective "tape-in" leaf switches, informing the syscon that a tape has been installed, and they prevent light from the IR LED from reaching the tape-end sensors. Some older models use miniature incandescent lamps instead of LEDs.

In normal operation, clear tape leaders allow light to pass, signaling the syscon that the tape has come to an end. The syscon responds by stopping the drive motor and applying the brakes to prevent damage to the videotape.

In some VCRs, ambient light will activate the photo sensors when a test jig is used with the cover removed, causing the machine to stop. Usually this can be remedied by blocking light from specific areas using cards or by using lower light levels.

As a last resort you can cover the photodetector openings with black plastic tape. These will be located near the cassette door hinge on either side of the tape stage while in the fully-loaded position. If you must cover the photo sensors be sure to remove the tape after servicing.

Generally when using a test jig in any mode, the VCR will stop after a few seconds. This is because the feed reel won't be turning without an actual tape. This condition is sensed as a fault by the syscon which initiates shutdown. Turning the reel by hand will prevent this problem. It doesn't usually matter how fast or in which direction.

Reel motion sensor

Reel motion is typically sensed by an IR LED/photo detector assembly located beneath the reel table. If the LED and detector are housed in the same package it will most likely have four wires. The underside of the reel tables have a series of mirrors that alternately reflect or block reflection between the LED and detector as the reel rotates. The resulting pulsed signal generated by the turning reel is applied to the syscon.

In some units the tape counter is incremented by the reel motion sensor pulse and may be used to indicate the presence of pulses. This does not apply to VCRs that have "real-time" counters.

(Continued on page 39)

Analyzing VCR & Camcorder

(from page 26)

The take-up reel should be turning once the machine has settled into the play mode. With practice you will be able to make a judgement as to the general condition of the drive system by grasping the reel with your fingers and feeling for torque. Use a torque gauge if you're in doubt. Bear in mind that if you inhibit the reel motion for very long the machine will stop. I usually allow the reel to turn at a reduced speed while trying to feel for any loss of power.

If the take-up reel torque is low or intermittent the test jig should allow you to see where the power is being lost. In most cases the idler tire will be the culprit. It might appear cracked or glazed. In some instances cleaning may be all that's necessary to remedy the problem but usually this is only a temporary fix.

In most designs the idler wheel is driven indirectly by the capstan motor. Other parts of the idler assembly can break down causing loss of torque. The reel tables themselves contain a slip-clutch mechanism consisting of felt pads, springs and pressure plates. These can be rebuilt if they appear to be worn. Be sure to replace any bushings after reinstalling a reel table as height is critical.

Watch the take-up reel

Another method of checking the tape transport system if you suspect it is causing a shutdown problem, is to focus your attention on the take-up reel while playing a standard tape. If the take-up reel is turning smoothly but the VCR still stops or shuts down consistently after a few seconds, then the problem must not be related to the idler assembly or other parts of the drive section. In this case I would check the reel motion sensors and associated circuitry.

If the take-up reel turns intermittently or freezes up just before shutdown, then the transport system must be at fault. In addition to a slipping idler wheel, this type of problem could be caused by binding at some point in the tape path or binding of the feed reel. The feed reel has brakes and a brake band to provide quick stopping, and drag to create the proper tape tension.

If you suspect excessive tape tension you might need to use a tape tension gauge. However, in many cases visual inspection may help you to determine that a brake isn't being released due to a mechanical failure. Insufficient tape tension can lead to loss of video, tracking or sound due to improper contact between the heads and the tape.

Idler replacement

In the event that the idler wheel has been found to be worn, there are two choices: you can replace the entire idler assembly or you can replace just the idler tire. Some techs routinely replace the entire assembly. In this case a higher bench charge can usually be justified. I rarely replace more than the tires, which I can usually find in a universal tire kit. This policy saves my customers money and in turn they become my best advertisers. The decision whether to relace just the tire or the entire assembly, should, however, be made on the basis of the condition of the idler assembly as a whole.

The pinch-roller and capstan regulates the speed of the tape being drawn past the various heads and guides. In most cases the speed of the capstan will remain correct even when problems develop in the idler/take-up system. In fact, this is one cause of tape "eating."

The take-up reel may lose torque and fail to pull in the tape fast enough and yet continue turning just enough to avoid system shutdown. Since the capstan is still pulling tape at a constant speed the excess will spill into the machine.

Another tape eating problem occurs during unloading with a worn idler. During loading the tape is pulled from the cassette by guide posts on sliding tracks. During unloading the guide posts retract but the take-up or feed reels must pull in the tape slack. An idler problem can prevent this from happening and when the cassette is ejected a tape loop will be caught in the machine or at least be left hanging out of the cassette.

Pinch roller problems

If the pinch-roller becomes glazed it may lose its grip on the tape. The take-up reel tries to turn faster than necessary to maintain tape tension while the slip-clutch keeps the tension in check. In this situation the tape may move faster than normal as it slips past the pinch-roller or it might stop moving depending on the combination of torque and drag in a given machine. Replacement of the pinch-roller is the best solution in this case though I have resur-

faced hard-to-find pinch-rollers with a hobby grinding tool and a fine sanding bit.

System control problems

Like most mechanical functions, loading is coordinated by the syscon. A leaf switch is closed when a tape is inserted into the VCR which instructs the syscon to begin the load sequence. Loading problems can result from an electronic malfunction but most of the time the problems are mechanical.

In addition to the tape-in switch which initiates loading, a multi-position "mode" switch allows the syscon to monitor various mechanical movements so that it can activate or deactivate motors and other components at the appropriate time. This switch is mechanically linked to the tape "stage" (the tape holding compartment) and other moving parts. A problem with this switch or its synchronization can prevent loading or playing after loading.

A common loading problem results from foreign objects in the machine. When a tape is inserted, the loading sequence will begin only to be halted when contact is made with the object. In most cases the tape will be ejected after a few seconds because the syscon hasn't received verification from the mode switch that loading has been completed. Without this safely feature the load motor would burn out eventually by continually trying to load the tape.

The tape-in switch can easily be checked with a DMM. In most cases you will be able to see if either of the leaves has become misshapen preventing proper closure. The mode switch on the other hand isn't so easy to test because there are so many configurations. They typically have about five connections. Service literature will usually include a table showing where you should expect to find continuity in each position.

If you suspect that a mode switch is faulty, particularly in a case of intermittent operation, try applying pressure to various parts of the switch assembly while cycling the VCR through the mode in question. In some cases the position of the mode switch or part of the actuating linkage is adjustable and might have shifted out of position.

Occasionally you might service a unit in which the loading gears have been forced out of sync by someone trying to force loose a tape which had become lodged. The tape hang-up might have been the result of a problem within the cassette itself which prevented ejection and caused the machine to shut down. In these cases minor problems have been turned into major ones. If you don't have service literature a known good unit of the same design can be used for comparison.

When the unit blows fuses

Blown fuses often indicate a serious overload caused by a shorted or leaky component. The problem could be in the power supply or in one of the circuits it supplies. In some VCRs the power supply is located on a separate subchassis. In some models a plug-in harness can be disconnected to help isolate the problem. Service literature might be required for this type of problem but searching for low resistance readings to ground may lead you to the defective component.

Fuse blowing symptoms aren't necessarily confined to electronic problems. In one VCR the fuse would blow only when the unit was placed into play, FF or rewind. At first I suspected a shorted motor or motor driver IC. To my surprise I found that a stretched belt had become lodged between the capstan motor flywheel and the board, seizing the capstan motor. When power was applied to the motor it began drawing excessive current because it had an excessive load. Apparently this was enough to blow the fuse.

Another place objects become lodged is in one of the tracks used by the loading posts that pull the tape around the head drum. If these posts aren't firmly seated against the "V-stops" at the end of their tracks, part or all of the picture may be missing. In some cases the lodged objects will be from the VCR itself. Screws and retainers that have worked loose have a habit of finding their way into this area.

Motor control circuits

The motor control or "servo" circuits in VCRs are very complex. These circuits maintain the correct speed and phase of both the head drum and capstan motors. Some servo problems will cause symptoms similar to those of defects in other circuits. No video with only snow (some models go to a blue screen under these conditions) may look like a head problem when in fact the heads aren't tracking due to a servo problem. Past issues of this magazine have featured articles devoted to solving servo problems so they won't be covered in depth here.

If the sound or video is playing at the wrong speed, particularly if the speed is erratic, there is a good chance that the capstan servo circuits are faulty. In some cases it will appear that the servos are hunting for the correct speed as the capstan motor alternately speeds up and slows down. In most cases this type of symptom is not due to motor problems.

Problems with the head drum speed or phase servo won't affect sound recorded on the linear sound track which is picked up by the stationary audio head. Video might drift in and out, noise bars might be present or video might be completely absent. Bad bearings in the drum motor can also cause some of these symptoms. Sometimes turning the head drum by hand and feeling for play or catching will help reveal this type of problem.

One way to differentiate between servo problems and problems in the motor or motor driver circuit is to use voltage substitution. This works because the servo circuits use a dc voltage to control the motor speed. However, the dc voltage is applied to the motor driver circuit and not the motor itself. These motors are usually three-phase and cannot be directly tested like the loading motor with dc voltage.

Mechanical alignment

It is usually necessary to follow the manufacturer's recommendations when doing mechanical alignments. Most adjustments require special tools which can be purchased in sets. Fortunately alignments are rarely needed except during replacement of parts in the tape path.

Gross misalignment can be spotted by watching how the tape rides against the guide posts. If the tape rides too high or too low it will "bow" or even ride outside of its track. This will affect the way that the tape meets the video heads and can cause problems in part or all of the picture.

Misalignment of the audio/control head assembly can cause problems ranging from poor sound to servo system failure. Since the servo system requires feedback from the control head it is essential that it be tracking properly. The audio/control head assembly generally has at least two adjustments.

If you suspect an alignment problem but have no success using the recommended procedure, consider the possibility that one of the reel tables is at the improper height. If a reel was removed during repair and a bushing was lost, the height could be improper. Reel height gauges are available but specific models need specific gauges.

The alignment of the "V-stops" is very critical and requires a special test jig only available from the manufacturer. These rarely need adjustment even if guide posts have been replaced. Don't overlook the possibility that they might have shifted particularly if untrained personnel have been involved.

The rf modulator

The main function of the rf modulator is to convert the baseband audio and video signals into an rf channel which is switch selectable to channel 3 or 4. This signal is available at the output F-con when the VCR/TV mode is set to VCR. The modulator housing also holds the input F-con that brings the input signal into the VCR's tuner. This input signal is also passed to the output F-con when the TV mode is selected.

A simple test for the rf modulator is to check for baseband audio and video at the line-level A/V output jacks. These signals can be scoped or fed to the A/V input of another VCR or a monitor. If they are present during tape playback, or when a channel is selected on the tuner, it is likely that the rf modulator is defective or not getting power. These are usually not difficult to obtain or replace.

RF modulators can develop other problems besides complete failure. They can develop reduced power level causing a weak picture or they can introduce noise or cause the picture to become grainy. Whatever the symptom, if it is present during both tape playback and while using the VCR's tuner then the problem is probably in the modulator.

Detached F-con

Occasionally you will come across an RF modulator in which one of the F-cons has been torn loose. Usually this is the result of a dropped cable converter etc. In most cases I've found that the modulator can be repaired. Sometimes the original F-con can even be reinstalled.

After desoldering and removing the modulator, remove the rear shield (consider the F-con side as the front). If the entire F-con was pulled out you will see a hole usually with a metal grommet in the circuit board where the center conductor was soldered in place. If the center conductor is still in place you might be able to desolder it and pull it through from the rear, otherwise you might need to further disassemble the modulator.

Since the original F-con was probably pressed into the front housing, the housing might be slightly deformed. Flatten the deformed area if necessary. It won't affect the performance of the modulator, but in some cases the modulators can't be reinstalled properly unless the face is flat.

The new F-con will have to be soldered to the housing. This might require a hotter iron since the heat tends to dissipate through the housing. If you're using a temperature controlled iron you might be okay since they tend to hold the tip temperature well.

First install the F-con and solder the center conductor into place. Next solder the F-con to the housing one point at a time. It is a good idea to follow this step by cooling the F-con with circuit coolant. If the plastic insulator in the F-con reach-

Test Your Electronics Knowledge

By Sam Wilson

Sam Wilson is currently busy with other urgent projects, and was therefore unable to prepare What Do You Know About Electronics/Test Your Electronics Knowledge for this issue. This is a reprise of articles that appeared in a previous issue.

This test deals with measurements and parameters. It has a high level of difficulty. A grade of 50 percent is to be considered good.

1. What is the unit of measurement for the reciprocal of the period of a sine wave signal?

2. What do you get when you divide the center frequency by the bandwidth? (It is more commonly called Q.)

3. In what unit is the time rate of doing work or expending energy measured?

4. Two components of the power triangle are of true power and apparent power. What is the third?

5. The number of amps per volt is called the conductance. In what units is it measured?

6. In the United States, it is called decibels and it is based on log10. In other countries, it is based on log(e) or log. What is it called?

7. This 3-terminal thyristor will not conduct until its emitter is a certain decimal part of the power supply voltage. What is that decimal part called?

8. In what temperature scale does all motion of atoms stop at 0°?

9. What kind of interrupt is impossible to ignore for a microprocessor?

10. What is reciprocal for reactance?

(Answers on page 53)

es its melting point it will quickly deform and be ruined.

Since most of the work involved has to do with removing and reinstalling the RF modulator, I have found that the bench charge is about the same as when replacing the modulator completely. I have, however, saved my customer the cost of a new modulator. I find that in most cases they are very pleased by this which is more important to me than what little extra profit I could have made through mark-up of a new modulator.

The vacuum fluorescent dislay

Most VCRs use a vacuum fluorescent display which requires a supply voltage somewhat higher than the typical voltages used by other circuits and devices. In some models these voltages are generated by the power supply. Other models use a dc to dc converter module which builds the higher voltage from a lower one. If a "dead" display is found in an otherwise working unit, check the converter first. If the input voltage is good but the output voltage is low or missing it is probably defective.

Remote control problems

Remote control problems are relatively uncommon but they do occur. When a VCR responds to front panel controls but won't respond to the remote control, the first thing to do is isolate the problem to the sending or receiving unit. The sending unit can be tested with an IR sensitive strip or card that converts the IR to visible light. These are available through many parts houses. Just point the remote control at the strip and press any button. You will be able to see a flashing red light on the sensitized area. These can also be used to check the IR LED which is used for the tape end sensor.

If the problem isn't in the sending unit it could be anywhere between the VCR's IR detector and the syscon. In many VCRs the receive unit is self-contained having an IR detector, amplifier and waveshaping circuits. The output is coupled to the syscon which decodes the information and gives the appropriate response. Scoping the line between the IR module's output and the syscon's remote input may help to further isolate the problem. Models not using a self-contained module will have an IC between the detector and syscon.

Syscon

If a system control (syscon)problem is suspected it may be necessary to obtain a schematic to identify the various pins. In order to operate, the syscon needs a supply voltage (typically 5V), a clock signal and a reset pulse to initiate the internal program when the VCR is powered up. The clock is usually part of the syscon and only an external crystal is required to set the frequency.

If the supply voltage, reset pulse and clock signal are present then the syscon should be running. Logic-level high or low transitions at the various input pins from sensors or switches should be followed by transitions at the appropriate output pins. If not the IC must be suspected. Since these are usually static-sensitive CMOS devices, be sure to observe proper handling precautions.

Cleaning and lubrication

Cleaning and lubrication is often all that's needed to restore a VCR to proper operation. The proper materials and common sense are all that's required. Be especially careful when cleaning the fragile video heads. Use a gentle side-to-side motion with chamois swabs and always use fluid designed for the job.

Regular lintless swabs are suitable for audio/control and full-erase heads. Whenever possible I try to clean the idlers and belts while the machine is running with a cassette test jig by holding the swab against the moving plastic or rubber. Be sure to clean all guides that come into contact with the tape. Use a dry swab to remove fluid with dissolved contaminants.

I generally lubricate any unit that hasn't been serviced for a year. As a rule-of-thumb, oil things that turn, and grease things that slide or mesh. Use only the recommended lubricants and be careful how you apply them! Oil on belts, tires or felt pads can cause a call-back.

Summary

VCR repairs aren't too difficult once you develop a basic understanding of the system as a whole. Diagnosing problems might be challenging at first but confidence will grow with each successful repair. In time you will familiarize yourself with "trouble spots" in specific models and learn to track down problems by using symptom analysis. ■

Audio power amplifier repair practice

By Jurgen Ewert

In some cases, it is possible to repair audio power amplifiers without the schematic diagram, because of the similarity of circuits that are used and the common problems that occur. To service an amplifier without a diagram, start by locating the power transistors or the output pins of the power IC and you can start troubleshooting the power stage.

Ask your customer if he changed the wiring to the speakers before the stereo amp quit working. Very often the unprotected speaker outputs get shorted. Make sure to test the amplifier with your own speakers to eliminate the speakers as the source for trouble. If there is no sound and no noise when the amp is connected to known good speakers, there is a good pos-

Ewert is an independent consumer electronics servicing technician.

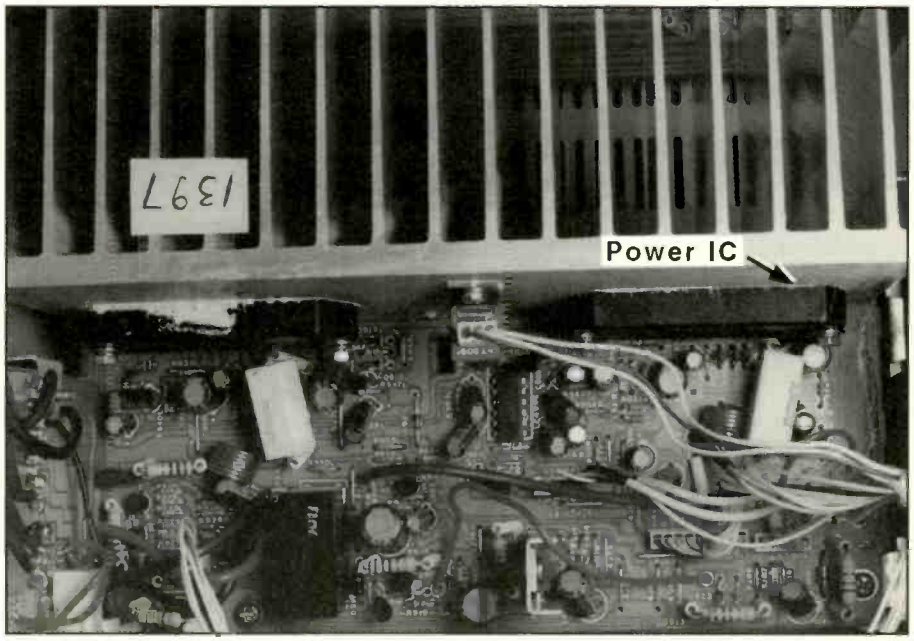


Figure 1. The power amplifier in the Sherwood S-2770RCP receiver is based on the STK4040 IC.

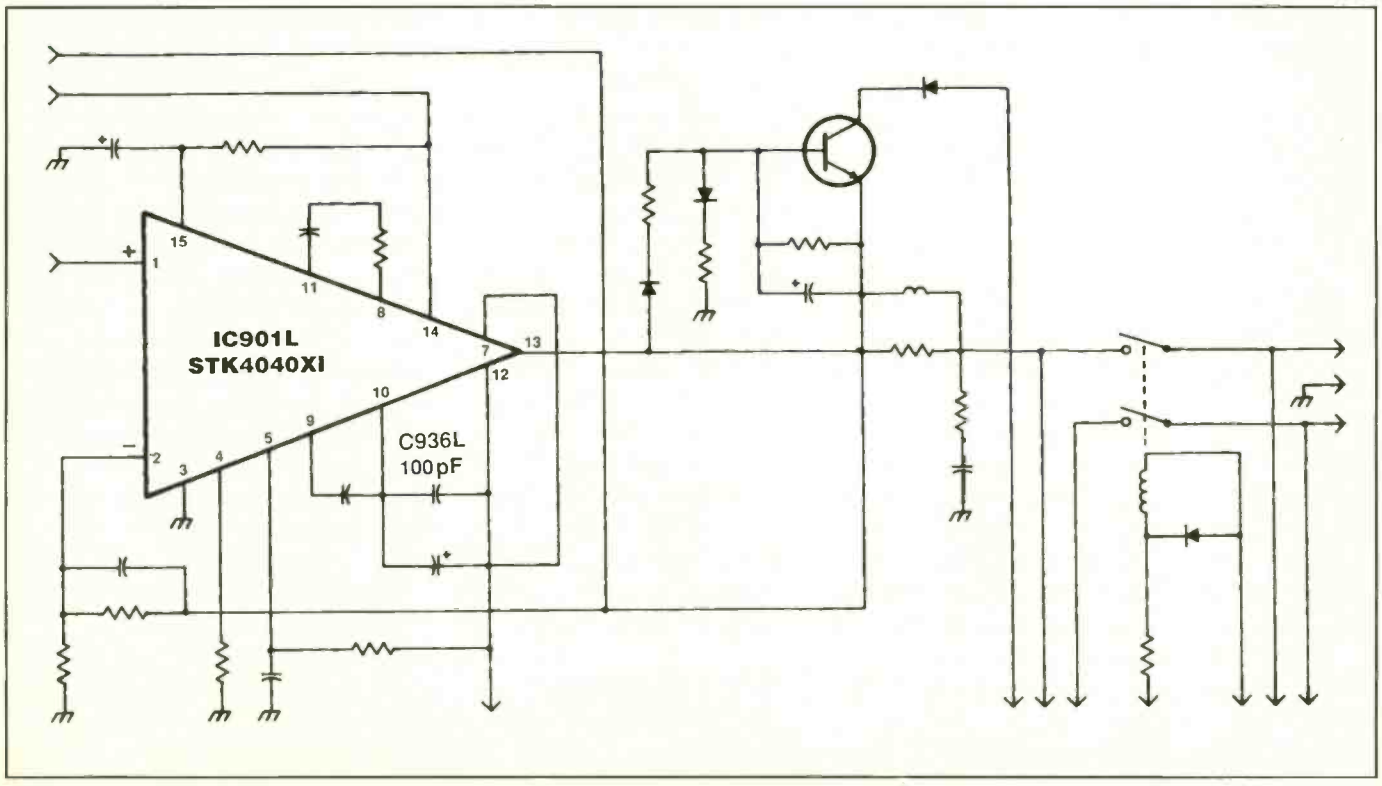


Figure 2. This is the portion of the Sherwood S-2770RCP receiver that is of interest for this service procedure. I started troubleshooting at the output (pin 13) of the STK4040.

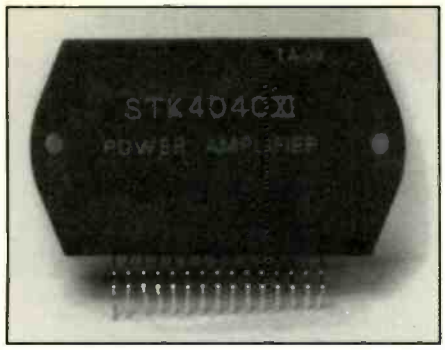


Figure 3. The problem in the Sherwood S-2770RCP receiver was a shorted audio power IC, STK4040.

sibility that the power stage is bad. Noise or a distorted signal at the speaker output might be caused by a problem in the preamplifier or driver.

Power amp repair without a schematic

One of my customers brought two identical Yamaha receivers, model CR-600, into my service center and wanted at least one of them back in operating condition. These beautiful 1960s style receivers had different problems. One of them did not work at all. I traced the problem to a bad component in the power supply. It worked after I fixed the problem in the power supply.

The other amplifer put out very scratchy sound and not much power at the left speaker. My first bet was a bad power stage. Of course I did not have a schematic for these units and I did not bother to try to get one because of the age of the receivers.

Checking the dc voltages at the power transistors, I found that the voltage at the center node was almost 0V. With an ohmmeter I checked the collector-emitter resistance of the power transistors, 2SD-371, in circuit and found that one had a C-E short. The 2SD371 was not available anymore, so I replaced both power transistors in the left channel with 2SD555s.

After I replaced the transistors I checked the isolation to the heat sink. Sometimes it happens that the isolation pad is not aligned properly, causing a short between collector and ground. I also made sure that the heat sink compound was thoroughly distributed to assure a low thermal resistance between transistor and heat sink.

Before powering the repaired unit up I checked the resistances from the transistor connections to ground comparing the values to the good channel. Although these resistance values do not mean much, you will detect differences between L and R channel, and depending on the readings you can decide if you want to power it up or not. The values looked close enough, so I powered the unit up slowly, connecting it through my variable power transformer.

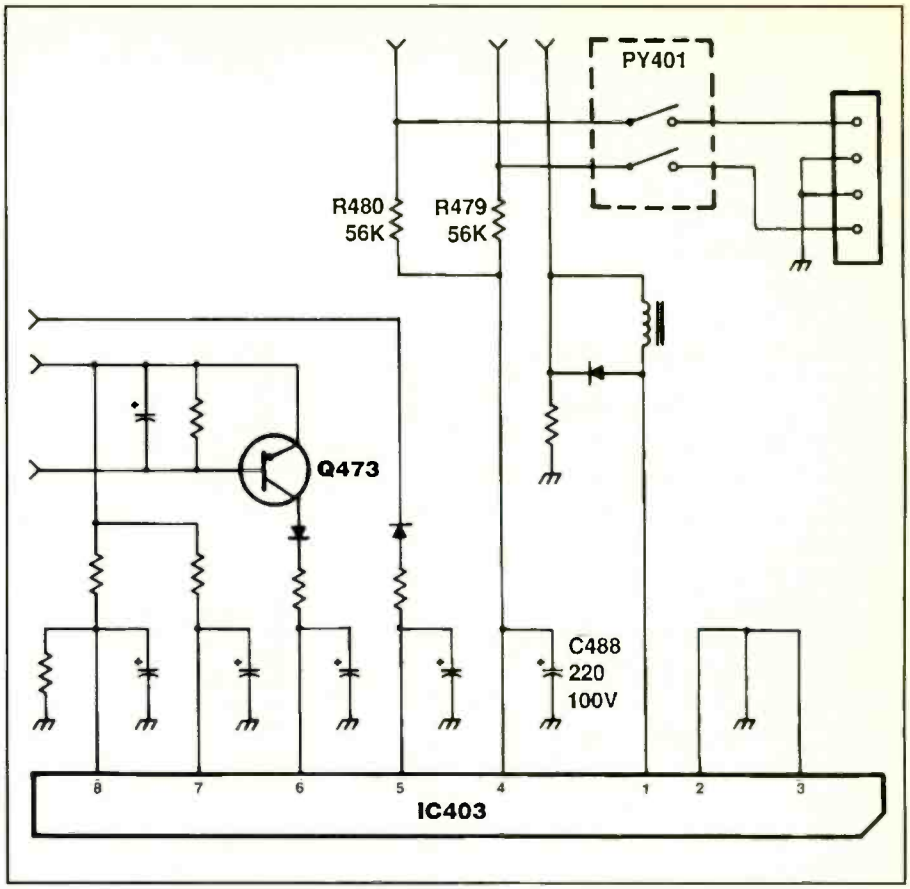


Figure 4. The Fisher RS-280 has an advanced protection circuit built in (IC403). If there is something wrong in the power amps the receiver shuts down through relay PY401.

The amplifier worked fine and the dc voltages at the left channel were the same as the values that I read at the right channel. Finally I checked the quiescent current, the current the power stage draws when no signal is applied. If this current is too high the power transistors could overheat. If the quiescent current is too low the THD value at low power output will be high. The value of 40mA that I read in this case was acceptable. This repair was a typical example for a number of audio power amps which I have seen.

A repair of an integrated power amplifier

A Sherwood receiver S-2770RCP was completely dead. The fuse in the power supply was blown. Replacing the fuse did not cure the problem. When I powered the unit up slowly using the variable line transformer, the line current went up very quickly. I disconnected the power amps from the power supply. When I applied power again, the power supply operated correctly (Figure 1).

To determine if one or both of the channels of the power amp had problems, I connected one channel at a time to the power supply. The amplifer operated properly with the right channel connected, but after I connected the left channel and applied power to the current was excessive at very low line voltage.

Fortunately, I had a schematic for this unit. The portion of interest for this service procedure is shown in Figure 2. The power stage of this amplifier is based on the STK4040 power IC.

To find out where the trouble was located I started at the output (pin 13) of the STK4040, measuring the resistance between pin 13 and the power voltages (pins 5 and 3) in circuit. These pins were shorted. After testing a few surrounding components I removed the IC to find out if the short was located in the STK4040 IC, or

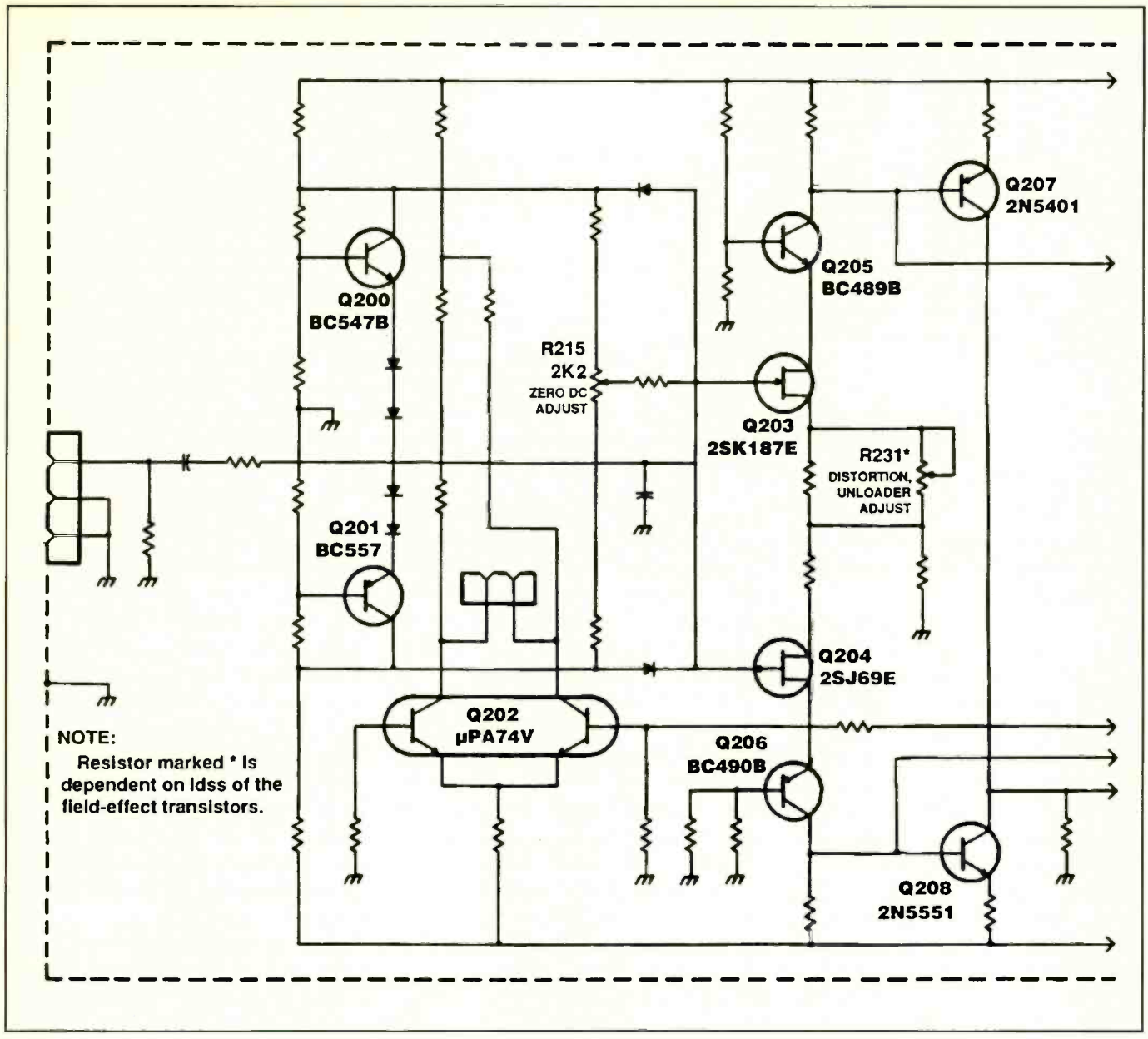


Figure 5. The problem in a Tandberg TPA3006A was caused by faulty transistors Q203 and Q204 in the input section.

in the surrounding circuitry. The short was in the IC (Figure 3).

Power ICs for audio amplifiers are usually expensive compared to discrete power transistors. To estimate the cost of the repair I called for the price of the IC. The first supplier quoted me a price of almost $25.00; too high for a profitable repair. I called around to see if I could find this IC at a better price and found another supplier who sold it for a little more than half of that, so I ordered one from him.

Replacing an IC in this amplifier is a little tricky because the pins do not want to line up. I found out that it is easier to insert the IC temporarily on the solder side to straighten out the pins first. That makes the job of inserting the new IC a lot easier. The receiver worked after I replaced the IC.

Because it was not clear why the IC had gone bad I checked the dc voltages comparing left and right channels. There were no differences. Finally I tested the amplifier with a sine wave input signal to watch the output signal on the oscilloscope screen.

As I watched the output signal, occasionally I saw erratic high frequency oscillations. These oscillations can cause overheating of the power stage. To prevent these oscillations, circuit designers use small capacitors in feedback paths (e.g. C936 in Figure 2). Replacement of these capacitors solved the problem.

Power amp shuts off at low power output

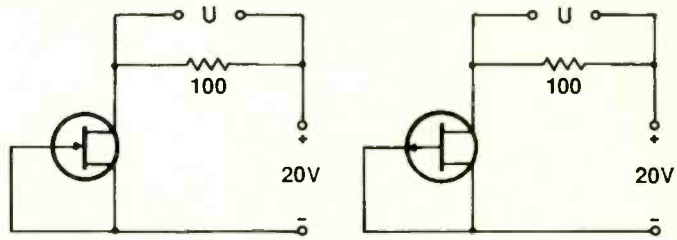
A Fisher receiver model RS-280 shut off at very low output power. My first thought was "Another bad power amplifier IC." Unfortunately, the solution was not that simple. For this receiver I did not have the schematic.

The power amplifiers of the RS-280 are ICs, STK0100 II. First I checked the power ICs for overheating but they were cool to the touch. Comparing the dc volt-

	2N5458 2N5459	2N5461 2N5462	
Idss (mA)	**R10**	**R9**	**R8**
6-7	120	220	1K
7-8	180	470	1K
8-9	270	680	1K
9-10	330	1K	1K
10-11	390	1K2	1K
11-12	470	1K	2K2

When Q103, 104, 203, 204 have to be replaced, the following must be done. Use the table above to find the combination of the transistors' Idss groups and source resistors.

How to measure Idss:



NOTE:

$$Idss\ (mA) = \frac{U\ (volt)}{0.1\ (K\Omega)}$$

Both FET's must be within the same Idss-group.

Figure 6. The characteristics of Q203 and Q204 in the Tandberg TPA3006A are critical. Replacements for these transistors must be carefully chosen.

ages at the IC pins I was not able to find any differences between left and right channels. To proceed I had to order the schematic (Figure 4).

This receiver has an advanced protection circuit built in (IC403). If there is something wrong in the power amps the receiver shuts down through relay PY401. Watching the voltages at the pins of IC403 I found that the voltage at pin 8 decreased from 5V to about 1V when I increased the volume. This pin seems to monitor the dc voltage at both power outputs through R479 and R480.

C488 (220uF/10V) is a smoothing capacitor to block audio frequencies from pin 4 of IC403. Testing C488, I found out that its capacitance was only 1.5µF instead of 220µF. After I replaced C488 with a capacitor of the correct value, the receiver put out a lot more power without shutting down. With a big load resistor on the output I tested the amplifier for the maximum power output. It continued to operate with no further problem.

An intermittent shutdown problem

A Tandberg power amplifier Model TPA3006A began shutting down intermittently. Over a period of time the problem got worse. By the time the unit was brought to me, it did not turn on at all.

This amplifier is completely dc coupled. A watchdog circuit protects the speakers from dc voltages in case the power stage is out of balance.

After I removed the power amplifier board at the right channel, the left channel turned on. In the input section of each channel is a potentiometer (R215) to set the output to 0Vdc. Because of the history of this case I assumed that the amplifier became unstable and a dc voltage at the output was causing the shutdown.

My first approach was to vary the potentiometer, R215. The amplifier did turn on for a moment but there was a hissing noise in the right speaker. To make the amplifier stay on permanently I had to adjust potentiometer R231. With potentiometer R231 it is possible to adjust distortion to a minimum.

Because of the hiss, and the fact that adjusting R231 stabilized the amplifier, I suspected that the problem was caused by a component close to the input. A simple way to find a noisy transistor is spraying it with cooling spray. The noise changed when I sprayed transistors Q203 and Q204, which identified them as the cause of the problem.

It was a little tricky to replace these FETs because the manufacturer of the amplifier specifies certain Idss (drain current) groups for Q203 and Q204. I found a matching pair of FETs. I replaced Q203 (2N5458, R227=680Ω) with a 2N5459, Idss=6.4mA, R227=200Ω and Q204 (2N5461, R224=270Ω) with a 2N5462, Idss=6.3mA, R224=100Ω. After I adjusted zero dc and distortion the amplifier worked to its specifications.

By following similar logic, you may be able to solve the next problem with audiophile equipment that comes your way to be serviced. ■

Coming next month

Advanced technology in consumer electronics has forced many changes in the way in which they are used, and serviced. The November issue will address many of these changes.

Soldering and Desoldering Update

Tiny, heat-sensitive, components, microfine printed circuit board traces, and multi-leaded ICs have made it necessary for technicians who service consumer electronics products to change the way they desolder and solder components. This article will address some of the new soldering equipment and techniques available.

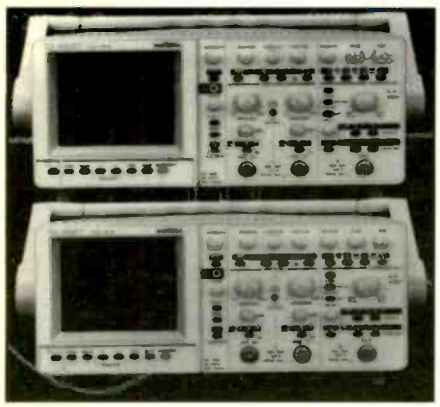
Circuit Board and Parts Handling

Because of the nature of modern consumer electronics products, holding printed circuit boards for removing and replacing faulty components, and handling of those components has become more difficult. This article will provide suggestions and ideas for handling those items during servicing.

Power Protection

Surges due to lightning strikes and other power line anomalies can cause damage to today's voltage sensitive ICs and components in consumer electronics products. This article will discuss the technologies available to prevent damage due to power line problems.

PRODUCTS



Analog/digital scope

The OX86 Series of oscilloscopes from *Metrix Instruments* provides both analog and digital functions.

When the user prefers an analog, real-time approach to avert possible misinterpretation by under sampling, the 100MHz OX86 series displays real-time, accurate, fast rising, square wave forms.

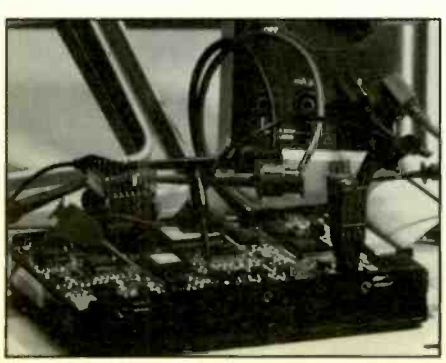
Digitally, the new oscilloscopes offer a sampling 40MS/s rate, enabling slow sweep speeds and non-volatile storage capability. One model, the OX8627, also features glitch capture for recording short-duration signals, usually undetectable using a digital approach.

The are two-channel, dual-timebase instruments which can capture and record up to four waveforms, each of 8,000 points. As well as the normal refresh mode, they offer pre-trigger display, single-shot capture, roll mode for phenomena as slow as 200 seconds per division, and envelope display of signal variations.

Circle (86) on Reply Card

Double-ended ultra-thin test clip

The model 6091 Ultra-Thin Micrograbber is the newest member of *ITT Pomona*'s Grabber series test clips, designed for secure, reliable connection between individual leads on today's closely packed circuits. The 6091 can be used as a "jumper" between two ICs, enabling modification without the risk or expense associated with soldering wires to device leads. The double-ended lead clip comes in black or red with flexible, silicone-insulated connecting wire in 10 inch, 20 inch or 30 inch lengths.



Like the single-ended Micrograbbers the double-ended 6091 provides contact pincers which open to 0.6mm/0.024 inch to securely grip the device leads, and which also rotate, for further positioning accessibility. The clips have an extremely narrow overall body design, measuring just 3mm/0.12 inch. The ultra-thin body contour, combined with a 1.2mm/0.5 inch shaft maximizes the users' ability to stack the clips tightly onto closely spaced leads as fine as 0.8mm/0.08 inch pitch. Serrated surfaces on the plunger and finger tabs further ease handling and contribute greatly to efficient testing. Electrical specifications include 2A current, internal resistance levels of ≤15mΩ and a temperature range of -20° to 80°C.

Circle (87) on Reply Card

Alternate source directory on floppy disk

Hearst Business Publishing/UTP Division announces the 1996 IC Master Alternate Source Directory (ICMASD) on floppy disk. This electronic version of the Alternate Source Directory section from the IC Master catalog allows engineers to customize the cross-reference database for their particular application.

The ICMASD is an industry-wide cross-reference listing of over 120,000 equivalents for current and discontinued integrated circuits, including the complete list of more than 8,500 NTE parts.

The customization feature enables the user to add comments of up to 19 characters to any device in the database. Comments can be technical notes, project notes, price and availability, or any important information required by the user. In addition, the user can add new devices, delete unwanted devices, and mark devices as discontinued. The device category, such as Linear-Telecommunications, or Memory-EPROM is shown for current devices. The disk also contains complete vendor contact information.

To review complete device specifications and data sheets, the user can refer to the IC Master catalog or the IC Master CD-ROM PLUS. Specifications and data sheets do not appear on the ICMASD disk.

ICMASD is menu driven and very easy to use. It is delivered on a 3.5 inch HD floppy disk with documentation that is brief and to the point.

Circle (88) on Reply Card

Thermally conductive adhesives

Dymax offers Multi-Cure product 991, a thermally conductive adhesive that is useful for bonding heat sinks or heat sensitive components to PC boards or for use in any application where it is desirable to increase thermal conductivity between assembled parts.

The adhesive may be dispensed with a variety of automatic bench-top syringe applicators and can be cured by any one or a combination of different cure methods including UV/visible light, heat or activator. Curing of gaps between heat sink or component and PCB of up to 0.015 inch can be accomplished with UV light, heat curing, and activator curing by applying the company's Activator 501-E to one or both surfaces, adhesive to one surface and assembling parts.

Circle (89) on Reply Card

Graphical analysis of capacitor characteristics

By Sam Wilson

Sam Wilson is currently busy with other urgent projects, and was therefore unable to prepare What Do You Know About Electronics/Test Your Electronics Knowledge for this issue. This is a reprise of articles that appeared in a previous issue.

In order to prove a point, in the past I have discussed capacitor characteristics at length using mathematical analysis. I have told you the true meaning of capacitor ESR, and I have explained parallel-tuned circuits.

I sent, to anyone who asked, mathematical proofs of the statements. I never said that the math was absolutely necessary to prove those things. The fact is you can do it with a compass, ruler and protractor. (You also need paper and pencil).

If I had given you this very simple approach at the start you would have said "Wilson is afraid of math!" But my heart is pure and my strength is as the strength of ten. I fear no math!

I just happen to think the math solution is the long way around for technicians who are trying to analyze capacitance. The graphical approach shown here provides an adequate analysis of capacitor characteristics. In this analysis, two kinds of phasor diagrams will be discussed: current/voltage and impedance.

Wilson is the electronics theory consultant for ES&T.

Definitions

Here are a few basic definitions: A *phasor* is a line that represents a magnitude (which means an amount) at an angle. Figure 1 shows a phasor marked *phasor V*. It represents five volts at 45°. This is often expressed as 5V/45°.

The horizontal phasor, marked *phasor I*, is in the standard zero position. Angles are often measured with respect to this standard zero position.

The conventional direction assigned to rotation for phasors in the United States in counterclockwise.

As shown in Figure 1, phasor V is ahead of a phasor I. Another way of saying that is phasor I is lagging behind phasor V. Phasors like this are used to represent the voltage and current is a series RL circuit.

With this information, we can build a very simple graphic solution for the ESR and for the parallel resonant circuit. You need a protractor and ruler. If you are familiar with geometric constructions, a compass will be useful. Also, paper and a sharp pencil are needed.

Simple circuits

Figure 2 shows a series RC circuit. Shown beside it is a phasor diagram that represents the circuit resistance and capacitive reactance.

Figure 3 shows another type of phasor diagram for the series circuit of Figure 2. Current is the same in all parts of a series circuit, so it is usually used as a reference in series circuits. Note that the phasor representing the circuit RMS current (I) is in

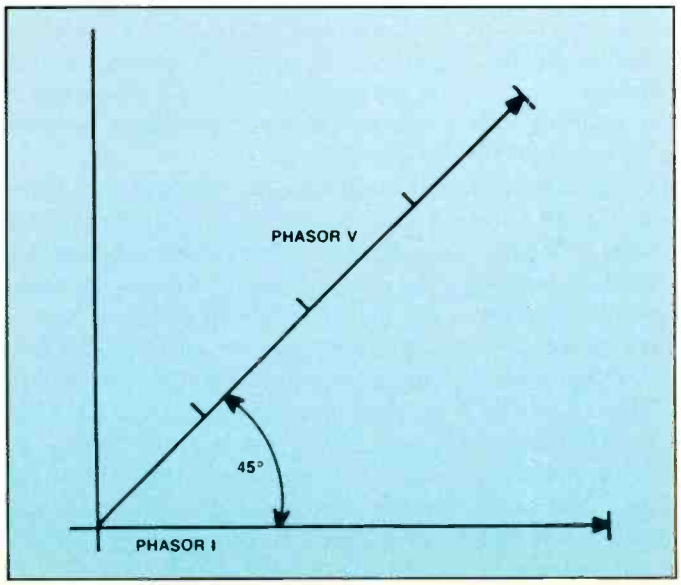
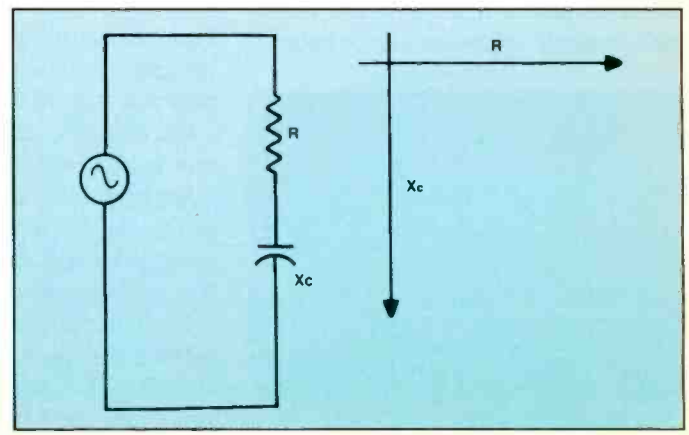


Figure 1. In this drawing, phasor V is ahead of phasor I, that is, phasor V is leading phasor I. Another way of saying the same thing is that phasor I is lagging phasor V.

Figure 2. The phasor diagram in this drawing represents the resistance and capacitive reactance in the circuit.



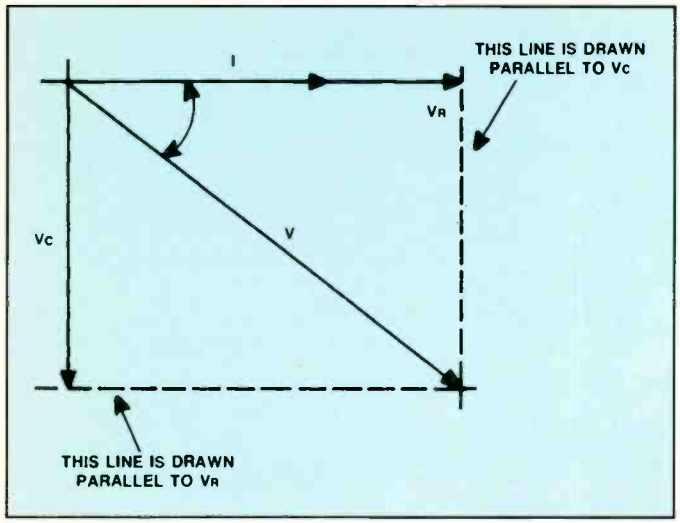


Figure 3. This is a different way of representing the circuit of Figure 2. Because current is the same throughout a series circuit, I is used as a reference in this phasor diagram.

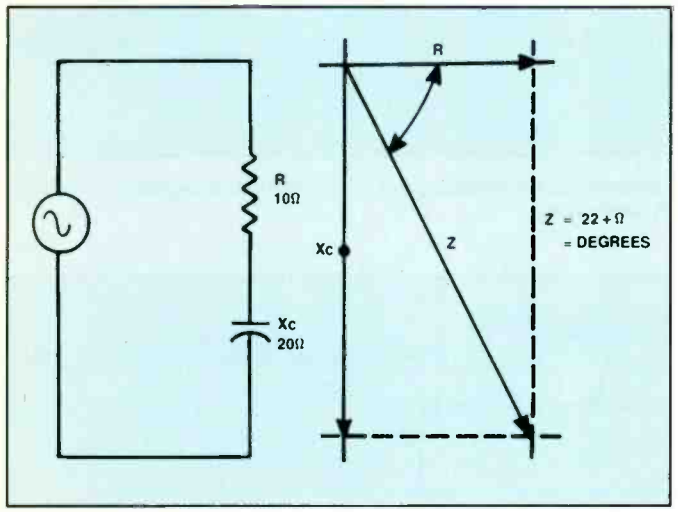


Figure 4. To determine the impedance of this circuit graphically, draw phasors that represent the resistance and the capacitive reactance of the components at right angles, draw the resultant impedance, and measure the length of the resultant.

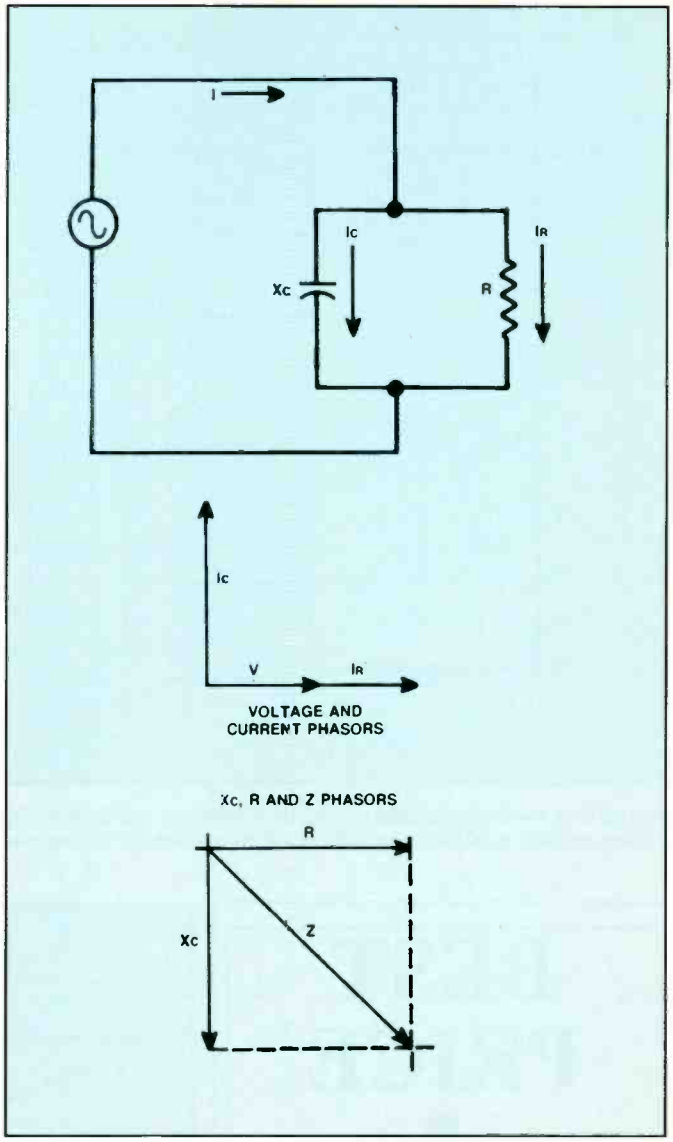


Figure 5. In a parallel circuit, the procedure for finding the total circuit impedance is the same as it is for the series circuit.

the conventional zero position. All other phasors in this diagram are referenced to that current phasor.

The voltage across the resistor, V_R, is in phase with the current, and the voltage across the capacitor, V_C, is 90° behind the current. The two voltages, V_R and V_C, are added by the "parallelogram method." To do that, the broken lines are added to the ends of phasors V_R and V_C. Those broken lines are parallel to the phasors. The resultant is V. It is the vector or phasor sum of V_R and V_C shown by arrow V in the rectangle. It shows that the voltage across the circuit lags the circuit current. A very close approximation to the exact value of the voltage could be determined if the phasors were drawn to scale. Moreover, the phase angle between the voltage and current can be measured by a protractor.

Try this problem

Take a look at Figure 4. What is the impedance of this RC circuit? To solve it, draw phasors that represent X_C and R. Draw the parallelogram and measure the length of the impedance phasor.

Using the same scale as used for X_C and R, you can find Z in ohms. Using a protractor you can measure the phase angle. The solution is shown in Figure 4.

Figure 5 shows a capacitor in parallel with a resistor. The current and voltage phasor diagram is shown in this circuit. Note that the phasor for I_C is drawn in the direction opposite to the one in Figure 3. The reason for this change is that the voltage is now the reference. The current phasors represent the ac currents through the capacitor and resistor.

The phasors for X_C and R are also shown in Figure 5. The procedure for finding the parallel impedance is the same as for finding the series impedance.

Now consider the series-parallel circuit of Figure 6. This is a simplified equivalent circuit of a capacitor. Draw the impedance phasor diagram for the R_C parallel circuit. This was shown in Figure 5. The impedance phasor for the parallel circuit is Z'. Next, combine the resultant (Z') phasor with the phasor for the series resistance R_S. Find the resultant by the parallelogram method as shown. This is the

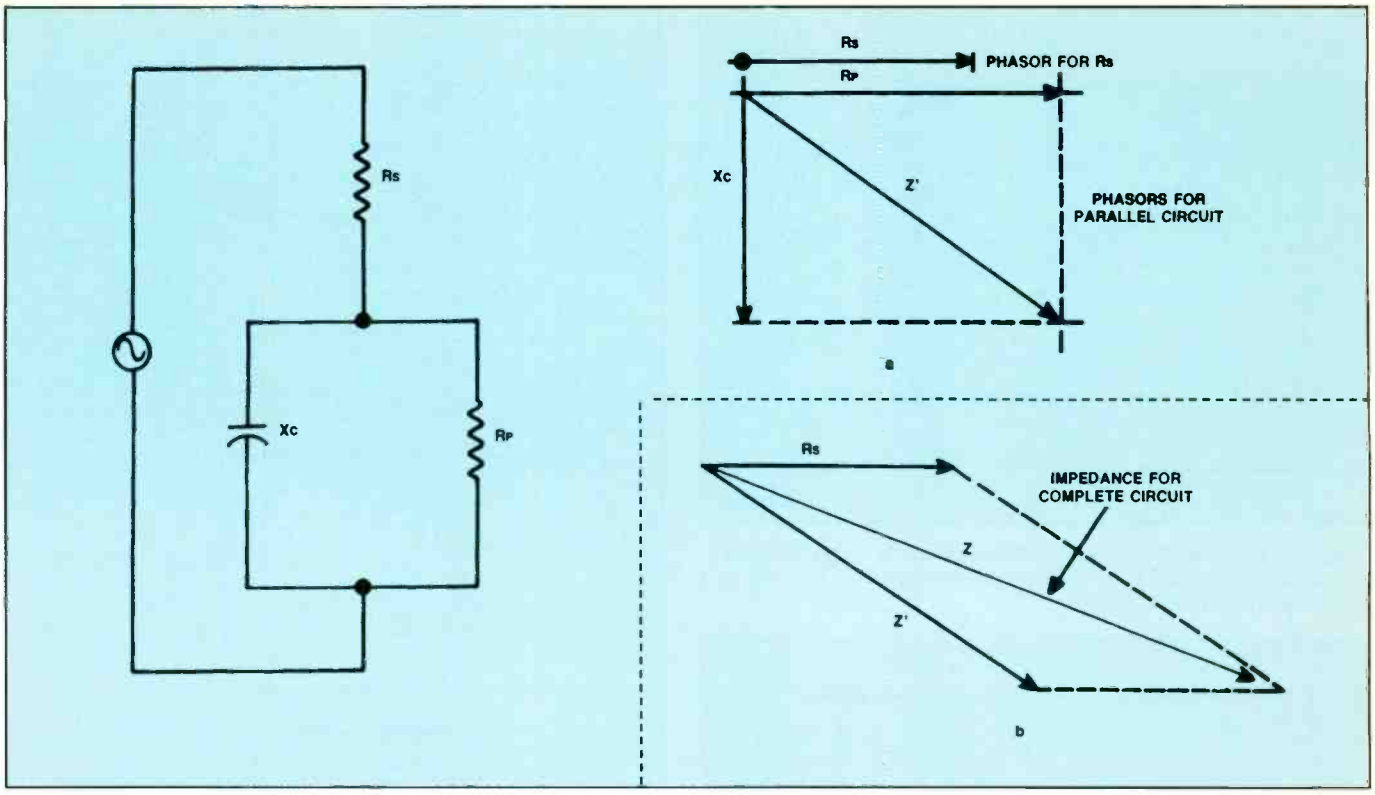


Figure 6. In this series-parallel circuit, the impedance can be found by first determining the impedance of the parallel circuit segment graphically, then graphically combining that calculated impedance with the resistance in series with it.

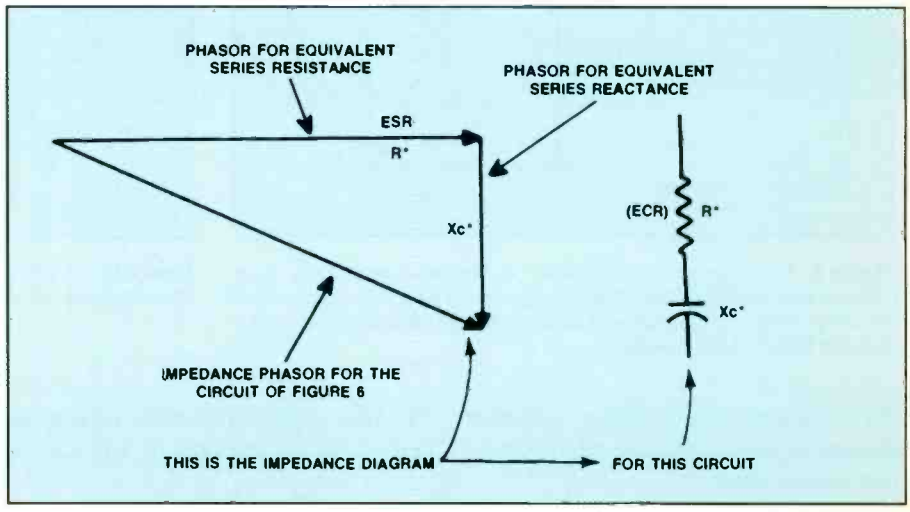


Figure 7. The equivalent series resistance (ESR) of a capacitor can be determined graphically, as shown here, by using the opposite of finding the resultant of two phasors. In this case, we resolve a resultant impedance into its capacitive reactance and its resistance. That resistance is the ESR of the capacitor.

resultant phasor (Z) that represents the impedance of the complete circuit.

The circuit resultant phasor is shown again in Figure 7. Now grab onto your hat!!! You can make a single RC circuit that has that same resultant phasor. All you have to do is connect the correct capacitance (C*). (The * means that the value is the equivalent resistance or capacitance). The graphical procedure for determining the values of R* and C* is called *resolving* a phasor into its component parts (see Figure 7).

It doesn't matter how complicated an RLC circuit, you can always replace it with a single resistor in series with an inductor or capacitor that gives the same impedance. When you do that, the generator voltage and current will be unchanged.

PHOTOFACTS

CROSLEY
CT1924C221 3710
CV1340AT01 ..... (sim to) VCR-280
19X603 3710

GE
TX825QB 3717
09GP106F23 3717

MAGNAVOX
PS1943C121 3707
PS1953C121 3713
PS1953C122 3713
VR9243AT01 ..... VCR-280
XS1953C121 3713
XS1953C122 3713
19PS52C221 3713
19PS52C222 3713
19X611-00AA 3707
19X613-00AA 3713
19X614 3713
19X615 3713
19X616 3713

PANASONIC
AEDP248 3719
AEDP260 3716
AEDP269 3706
ALEDP248 3719
AMEDP269 3714
CT-F29L7LT 3719
CT-F29L7T 3719
CT-F29L7VT 3719
CT-Z2151U 3714
CT-20G11CU 3714
CT-20G11U 3714
CT-20G21CU 3706
CT-20G21U 3706
CT-20S16U 3706
CT-27SF12T 3719
CT-27SF12T1 3719
CT-35G30T 3716
CT-35G30UT 3716
CT-2742SFT 3719
CT-2742SFT1 3719

PHILCO
VT2541AT01 ..... (sim to) VCR-280

QUASAR
ANEDC262 3718
SP2718CU 3718
SP2718U 3718
SP2718UU 3718

RCA
CTC175L2 3708
F19218WTTX2 3708
F19220BKTX1 3708
F19220BKTX2 3708
F19221BCTX1 3708

SYLVANIA
SSC1956421 3711
VC4540AT01 ..... (sim to) VCR-280
19Y402 3711

SYMPHONIC
ST191E 3715

TOSHIBA
CX27E60 3712
CX32E60 3712
TAC9530 3712
TAC9531 3712

ZENITH
SR2773DT 3709
SR2773DTM 3709

Test Your Electronics Knowledge

Answers to the quiz

(from page 42)

1. Hertz—The period (T) is the time required for one cycle. The period is measured in seconds. Frequently (f) is the reciprocal of the period (f = 1/T), and it is measured in hertz.

2. Quality factor—At one time, the sharpest tuning obtainable was considered to be best for tuned circuits. Today, we know that is not always true, but the Q—quality factor—is still used as a measure of tuning sharpness.

3. Watts—The rate of doing work or expending energy is called power.

4. VARS—The letters mean reactive volt amperes. If the component, inductor or capacitor, could dissipate power, that amount of power would be equal to the number of VARS.

5. Siemens—Conductance is the reciprocal of resistance (which is volts per ampere). Older books call the unit of measurement MHOS, which is ohm spelled backwards. I have always thought it was a better unit of measure than siemens. However, electronics is not a matter of opinion.

6. Nepers—It is equivalent of our decibels, but nepers and decibels are not numerically equal.

7. ISR, or, intrinsic standoff ratio - it is defined by the question.

8. Kelvin—The temperature scale based on absolute zero is called the Kelvin scale.

9. NMI, or non-maskable interrupt—This type of interrupt would result from an impending power failure.

10. Susceptance—The reciprocal of resistance is conductance. The reciprocal of impedance is admittance. The reciprocal of reactance is susceptance. ■

Now hear this

By John S. Hanson

Are you tired of ho-hum repairs and need something profitable to perk up business? Read on. Many of the new large-screen direct-view and projection TV sets have decent audio systems that you can customize to improve the sound of your customers' home entertainment systems and make some money in the process.

To determine if any given TV set has a controllable audio output, look in the back and see if it has a Jack Pack. The Jack Pack is a TV sales feature that makes the TV think it's a monitor. Simply put, it's a way of getting audio and video into and out of a TV set. The feature is seldom used and most owners of these sets are not aware of the feature unless a sales person calls it to their attention. This is where you enter the scene.

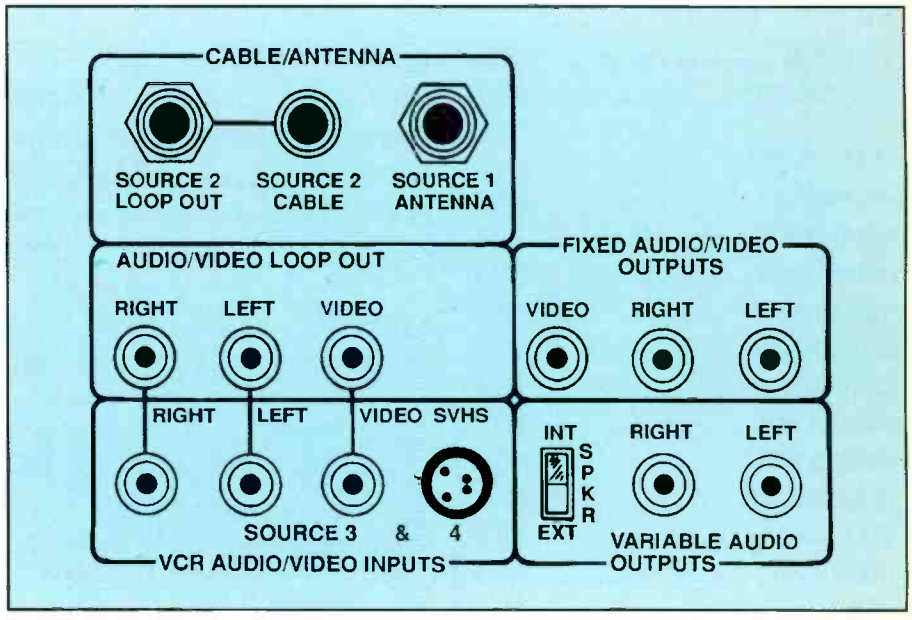


Figure 1. This jack pack has two pairs of jacks that provide audio output. The pair labeled "fixed audio," has line level audio suitable for input to an external stereo amplifier.

Improving the audio experience

Zenith, for one, offers several options on their Jack Packs that can actually expand the customer's sound and video experience. I will not dwell on the benefits of surround sound, but will confine my dissertation to what's available beyond the TV's internal speaker system. While the quality of sound that those speakers can produce is amazing, the sound can be even better.

Zenith's Jack Pack has two pairs of jacks that provide audio output (Figure 1). One pair, labeled "fixed audio," has line level audio suitable for input to an external stereo amplifier. In this mode, the remote volume function is inoperative, and the stereo amplifier's controls take over.

If you change the audio setup of any TV installation, be careful about the placement of the amplifier's speakers. It's possible that the TV sound may appear to be out of sync with the video. This can happen if the speakers are too far away from the TV screen. As a matter of reference, movie theater main channel speakers are always located directly behind the porous movie screen.

Hanson is an independent servicing technicain and a retired service engineer from a major consumer electronics manufacturer.

A sound idea

As with many other individuals who are "out of warranty", I am beginning to miss some words and say "what?" a lot. Many people with this problem are still in the denial stage and haven't considered hearing aids. Enhanced TV audio can be a boon to people with this affliction.

On my big screen Zenith, I noted that the external audio jacks on the Jack Pack were marked "Variable Audio." I assumed that this output would be under full control of the remote. Checking the schematic (Figure 2), I noted the internal/external speaker switch and the isolation and impedance matching network, understandable as the source is the full output of the audio amplifier.

Curious, I connected two four-inch 8ohm car stereo speakers to the jacks and flipped the speaker switch. With the remote I ran up the TV volume level to see if there was enough audio for what I had in mind. Now comes the good part.

Wiring the chair for sound

I have had a recliner chair for years. The kids call it grandpa's rocker. The remotes are in the arm rests. From the chair I command a kingdom of consumer electronics products.

Pacing off about 20 feet from the TV, I cut 30 feet from a roll of wire (#18 bell wire) and fished the wire under the carpet from the TV to the chair. I positioned the speakers on the right and left top wings of the chair. Connecting the leads, I made certain the right speaker went to the right channel. The common ground went to both speakers. I phased both speakers using the old flashlight battery trick. When both speaker cones moved in the same direction with the same polarity I knew that they were in phase. With everything properly set up, I powered up

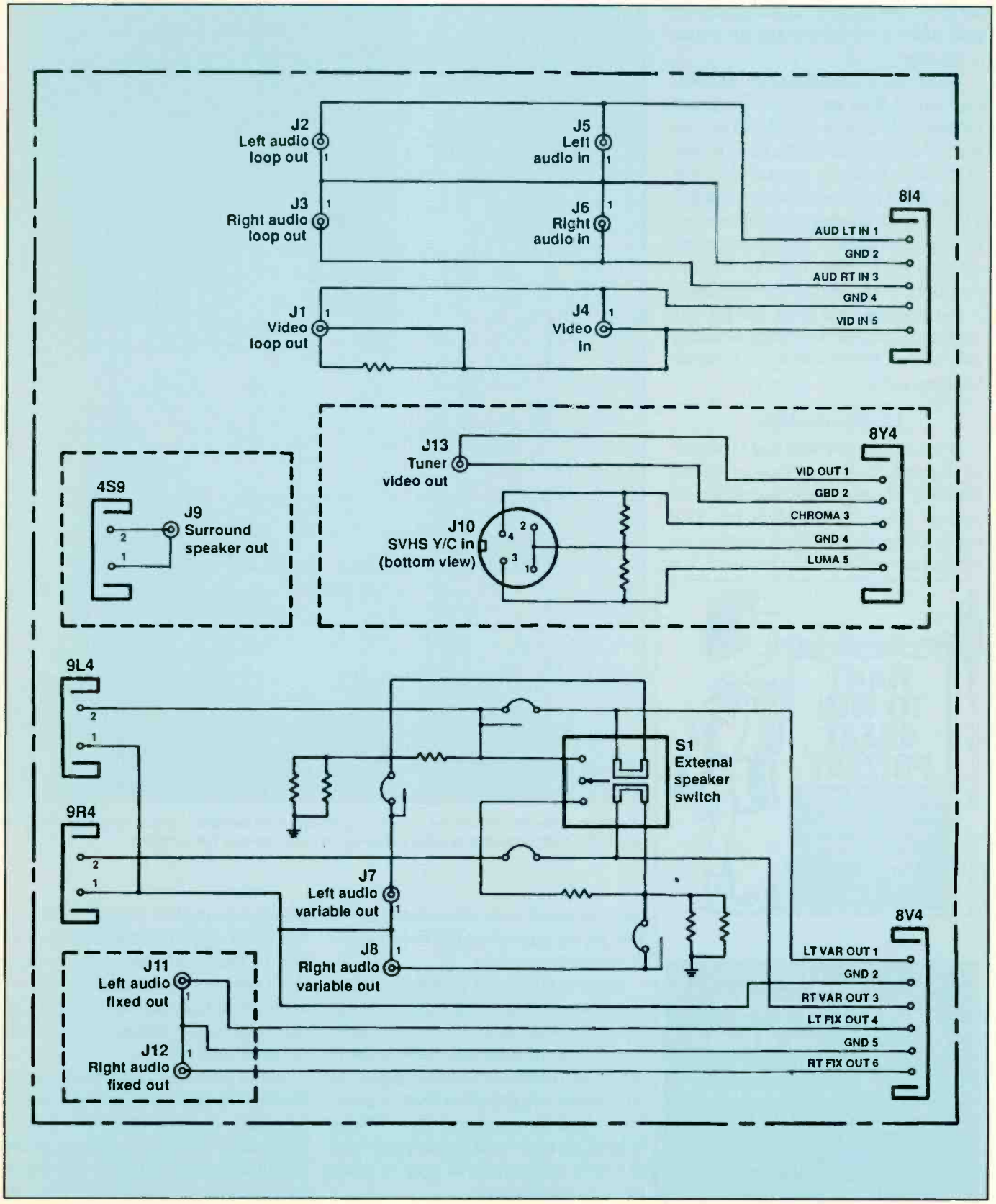


Figure 2. By connecting the speakers to the "Variable Audio" jacks, I can control the speakers volume at my chair using the TV remote control.

the television, but not before I grabbed a glass of my favorite beverage and settled in the chair.

Forget about surround sound. This was even better. With my remote, I adjusted volume, balance and tone. I had no idea that TV stereo could be this good. I knew MTS stereo had only one-half the separation of FM radio, video disk or satellite TV, and much of what was there was lost in the small-screen TVs because the speakers are so close together. But this was great. What's nice about the "chair" is you have the same effect you get with earphones, plus the convenience of being able to hear the telephone or someone speaking to you.

Hearing disability

A recent survey reveals that 11 percent of all people have some form of hearing disability. The percentage increases to 50 percent among people over 65. That equals a large market. Chair speakers are the perfect solution to this problem. You might be able to make some money by offering a service such as this to customers or potential customers.

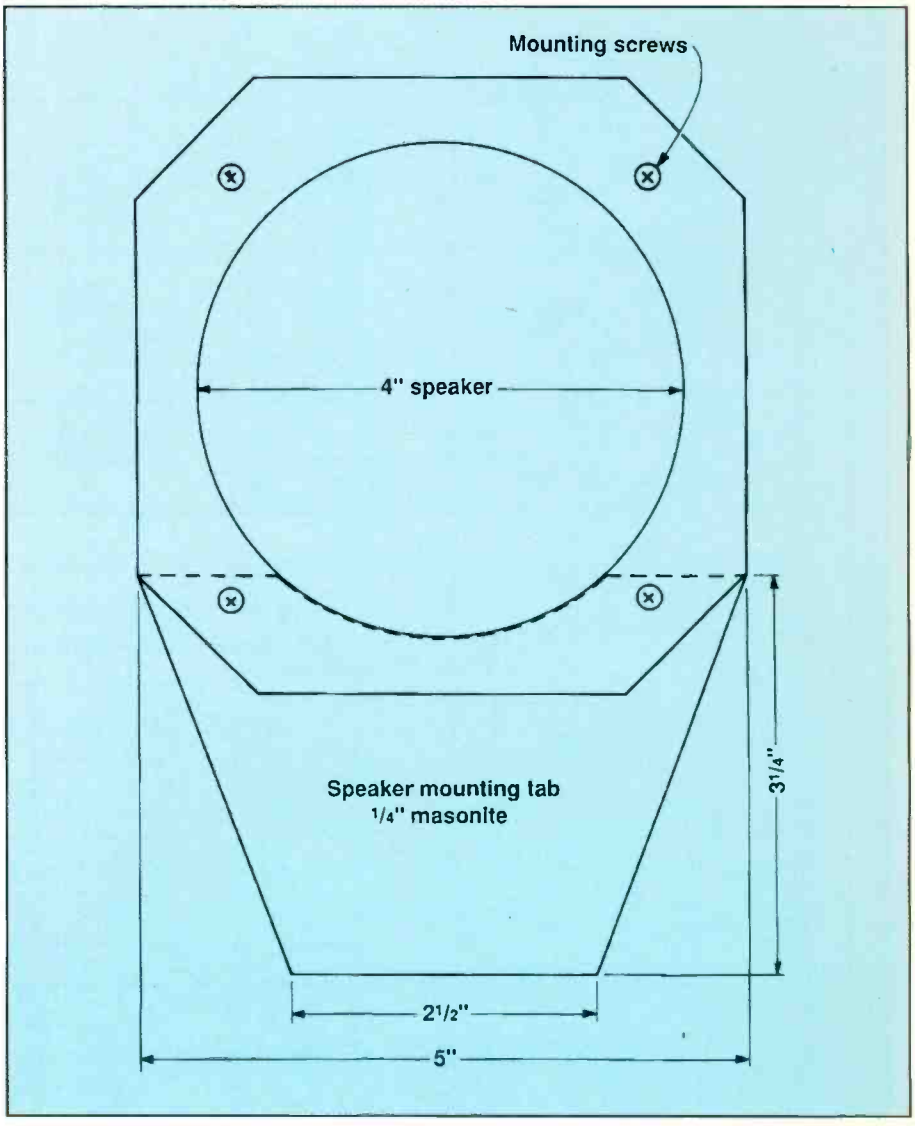


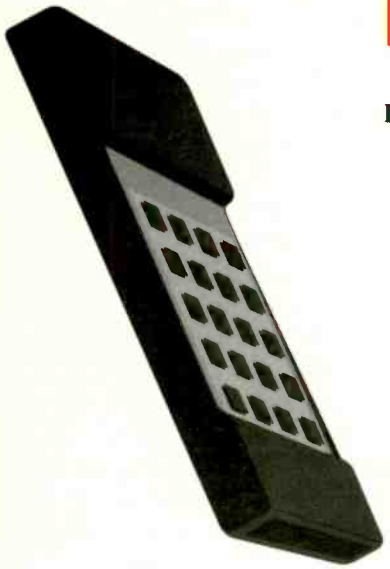
Figure 3. I attached tabs to the speakers as shown. With the tabs in place, mounting the speakers to the chair consisted of simply slipping the tabs between the cushions.

Start by contacting potential customers. If any are interested, check to see if any of the chairs in the home are suitable for this type of treatment. Look to see if the set has controllable audio outputs. If all systems are go, quote them a price. With a high quote and your deposit check in hand, go back to the service center and assemble everything you need to make home installation easy.

I mounted tabs on my speakers that pass between the chair cushions to hold the speakers in place (Figure 3). The customer can adjust the exact speaker position to their preference. The speakers don't need to be in an enclosure for this application. The connecting wires will be out of sight as they are easily passed under the chair cushions.

With a good survey and most of the assembly done in the service center, you can be in and out of the customer's home in less than an hour. If you want to upgrade the installation, add a circuit-closing stereo headphone jack for private listening. The output is a reasonable match for Walkman earphones. ■

Remote chance



By John S. Hanson

New TV models are reliable and affordable. Some require no chassis service throughout the life of the CRT. This life was once arbitrarily stated as being 10,000 hours, predicated on the thickness of the cathode material in the CRT guns. When picture quality is no longer acceptable, customers generally opt to step up to a large screen replacement TV rather than replace the CRT.

This trend has not been good for servicers who clearly miss the income from cleaning tuner contacts and replacing flybacks and CRT's. They do, however, applaud the advanced design in varactor tuners and microprocessor-based channel selection. The fact remains, service income is down. Today's TV viewers rarely approach the TV, preferring instead to use the remote and surf over the 150-plus channels available to them.

Remote works hard

The remote then becomes the hardest-working component in the system. Infrared remotes combine a microprocessor memory selection with the generation of a light beam modulated by the data, and aimed at the TV front panel sensor. Data is sent in the manufacturer's unique serial code to instruct the TV's on-board microprocessor to perform the function requested. The IR beam can command the TV from a distance of up to 25 feet.

If this modern day miracle is so busy, certainly it must be prone to service problems other than being chewed by the dog or drenched by a drink. This makes the servicing of remote control hand units a service opportunity. Remotes can be repaired easily, quickly and profitably (you'll notice that I didn't mention replacing the remote with a manufacturer's exact replacement unit. Check prices of replacement remotes from manufacturers and you'll see why).

"Why bother?" you say; "just sell the customer a universal remote." Universal remotes have their place, and they have come a long way. In fact, one vendor offers double your money back if their remote doesn't work with your TV set or VCR. The problem is that in many cases some of the functions available on the original remote are not available on a universal replacement. Moreover, people become familiar with the product they use frequently, and purchasing a universal remote means they'll have to get used to a new operating procedure.

A common example of a function that is not available on universal remotes is the menu function. Customers are better off with a working dedicated remote. You can sell a universal remote as a backup, but repairing the original is definitely in order in many cases. Follow the six steps below in order to profit from such repairs.

Remote control service procedure

If a remote control has not been subjected to damage from dropping or other trauma, but just doesn't seem to work as well as it once did, or has just quit working, there is a good chance that it can be restored to proper operation. Follow these steps to breathe new life into a remote control unit.

1. Clean and adjust tension on the battery contacts. Replace batteries observing polarity. Clean ruby plastic IR light filter on both the hand-held unit and at the television sensor.

2. Remove batteries and open the case. Remove any screws that may be under the back label. Use a thin knife blade to carefully pry open the case. Be very careful when taking the unit apart, as some have tiny operating buttons that are held in place only by the top cover. When the unit is open they could fall out and get lost.

3. Notice the primary parts of the remote unit: a plastic case, a rubber membrane containing the contact pads, and the PC board with the microprocessor, printed function contacts, an LED driver and the LED diode behind the ruby lens.

4. Begin by cleaning the PC board contacts using a pencil eraser, and polishing

Some remote history

Today's infrared remote controls are very different from the first practical remote control invented by Bob Adler in 1957. Zenith patented the system as Space Command and enjoyed good sales. Expensive for its time, this remote was available only on the step-up models. The genius in Adler's design was the simplicity of the remote unit itself. Four aluminum rods cut at different lengths were struck by individual spring-loaded miniature hammers to produce an ultrasonic tone. The different tones were picked up by the TV front panel microphone, differentiated and amplified to operate relays which performed the on/off, channel up/ down and mute functions.

Clever for its time, this remote worked quite well, with the exception of an occasional customer complaint of a phantom function caused by some unknown ultrasonic interference, such as someone jingling the coins in his pocket or dropping a set of keys.

Hanson is an independent servicing technician and a retired service engineer from a major consumer electronics manufacturer.

Accessories sales start off 1996 on the upswing

Totaling $193 million, sales of video, audio, camcorder and telephone accessories showed a slight rise in the first quarter of 1996 over the same period in 1995, according to the Consumer Electronics Manufacturers Association (CEMA). Audio accessories posted the best numbers, climbing seven percent to nearly $70 million, followed by a rejuvenated camcorder accessories market which gained two percent over first quarter 1995. In a separate CEMA report, blank media also hit the ground running with an increase of seven percent in unit sales from the first quarter of 1995, totaling 197.2 million units sold so far in 1996.

"Accessories are natural add-on sales items that provide full value to retailers and their customers," Steve Trice, CEO of Jasco Products Co., Inc. "Our industry is in a constant process of developing new accessories products that can better enhance, expand the use of and prolong the life of consumer electronic products. Retailers should expect a number of new products and market opportunities to become available throughout 1996."

One of the biggest winners in the audio accessories category was speaker wire. Sales of speaker wire products jumped 26 percent in the quarter with sales of more than $4 million. Stereo headphones (not including earbuds) were also up sharply in the first three months of the year on sales of $25 million, a gain of 21 percent.

Camcorder accessories rebounded from 1995 sales with a two percent increase in the first quarter, bringing in sales of $9.5 million. Carrying case sales were down slightly to $2.55 million.

Sales of video accessories dropped four percent in the first quarter. Most of the decline came from a three percent drop in sales of universal remotes. Sales of indoor TV antennas rose seven percent, capitalizing on the growth of Digital Satellite System (DSS) services and equipment.

Telephone accessories (excluding cellular), fell two percent in the first quarter. Most of the decline came from slower sales of replacement/extension line cords. Sales of cords were down 12 percent to $8 million. Offsetting the decline was an 11 percent gain in sales of telephone plugs and adapters.

with a lint-free cloth wetted with contact cleaner. Clean the conductive pads on the rubber membrane. It is possible that the pads are worn to the degree that they are resistive. There are a number of chemicals that you can use to rebuild the conductive surface. One that comes to mind is called "Conductive Solutions." First try just cleaning.

5. If you suspect that the remote has had an unwelcome drink, clean the PC board using a PC board cleaner chemical, or, alternatively, use dishwashing detergent and water and a toothbrush. If you use water and detergent, rinse and dry thoroughly before reassembling the unit.

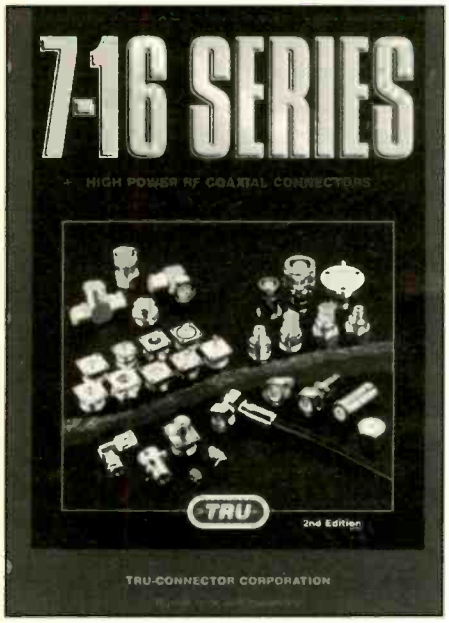
6. Reassemble the remote, install batteries and test all functions. Odds are that the remote will work perfectly, and with the case clean it will pass for new. In the event it does not work, either go back and plate the contact pads, or scrap the unit and sell the customer a universal remote. Replacing components is not advised.

A remote possibility

Occasionally, a remote control unit will not function, even when the product is brand new. In such cases, assuming that the remote is operating correctly. The problem may be that the TV is in a room that is lighted by a new high-efficiency fluorescent light fixture. These units do not have a ballast transformer. Instead, current to the lamp is chopped at approximately the frequency of the TV remote carrier (25kHz). The chopped light effectively blocks the remote carrier beam negating any transmission of a command to the TV sensor.

The solution to this problem is so simple I wish I had thought of it. Cut a one-inch square of electrician's plastic tape and punch a tiny hole in the center. Locate the exact position of the TV sensor on the TV front panel and center the tape over the sensor. The operating range of the remote control will be reduced to about 10 feet, but it will work. The remote must be pointed directly at the hole in the tape. The black tape limits the amount of light striking the sensor, and because the remote control signal is received directly, its signal will dominate. ■

LITERATURE



Coaxial connectors catalog

A new catalog featuring an expanded line of standard 7-16 RF coaxial connectors that are available in straight, right angle, in-series, and between series configurations is being offered by Tru-Connector Corporation.

The 7-16 Series High Power RF Coaxial Connectors Catalog features a broad line of standard straight, right angle, in-series, and between series connectors that fit most cables from 0.141" to 0.875". New products include 7-16 panel receptacles with an "N" connector footprint to facilitate system upgrades and save space, and a wide range of connector and popular cable combinations.

Featuring plugs, jacks, panel receptacles, and a wide variety of combination heads, adapters, and cable options, the 12-page catalog provides product photographs and dimensional drawings, performance specifications, materials of construction, and complete ordering information. These European-type connectors are manufactured in the USA.

Circle (74) on Reply Card

Static control products catalog

A new catalog featuring 3M brand static control products and services is now available from the 3M Electrical Specialties Division. The 72-page catalog provides product data on the company's complete line of static control products, such as bags, films, foam, mats, wrist straps, ionizers and test equipment.

The literature features detailed product descriptions and dimensions. Ordering information is included for all static control products and services.

Circle (75) on Reply Card

Catalog of electrolytic capacitors

ELNA America, Inc. has released a 180-page catalog and design guide which details the company's capacitors.

This new catalog includes the entire family of capacitor products, from miniature chip SMT units to large cans, in both aluminum and tantalum. In addition, it features the broad line of DynaCap double layer electric capacitors.

Included is the wide selection of high performance audio capacitors developed by the company for the audio/video market and end users. In addition, it includes miniature to large can configurations. Many models are available in tubes or tape-and-reel configurations for automated insertion.

Circle (76) on Reply Card

Electronic tools, test equipment catalog

Jensen's new 1996/97 Master Catalog presents 264 pages of tools and test instruments for installation, service and support of electronic products and systems. Included are inch and metric tools, ergonomic and insulated tools, scopes, probes, meters, and analyzers. Also included are LAN products including cable assemblies, scanners and testers; soldering/desoldering, static control workbenches and accessories, cases, shipping containers, technical manuals and more.

Circle (77) on Reply Card

Guide to lead-tinning fluxes for semiconductors and other components

A color brochure of fluxes for lead-tinning of semiconductors and other electronic components is now available from The Superior Flux & Mfg. Co.

The new brochure discusses numerous lead-tinning topics, including base metals, intermediate metallic coatings, precleaning of leads, automatic solder-dipping machines, and steam-aging/solderability testing.

The flux guide also explains how the new environmental laws banning chlorinated solvent-based cleaners will influence flux selection. In particular, current no-clean fluxes are usually not sufficiently active for lead tinning applications; in response, the company has developed a special line of water soluble lead tinning fluxes.

Lead-tinning is done on electronic components, including semiconductors, lead frames, piezoelectric parts, wire, connectors, diodes, transistors, and many other components.

Circle (78) on Reply Card

BOOKS

1996 Electronic Market Data Books, Electronic Industries Association, $195.00 (non-member), $95 (member)

U.S. exports of electronics jumped 23 percent in 1995, as the U.S. electronics industry continued its string of annual record growth. Overall, U.S. factory sales of electronics jumped 17 percent to $374 billion, marking 25 consecutive years of industry gains. U.S. exports reached $125 billion, accounting for over one-third of industry sales. "Just 5 years ago, exports accounted for barely a quarter of industry sales" says Peter F. McCloskey, president of the Electronic Industries Association. "The steady growth in international trade demonstrates the preeminence of U.S. electronics manufacturing in its competitiveness, productivity and technological advantage."

To assist electronics professionals and investors in analyzing the industry, the EIA has just released its *1996 Electronic Market Data Book*. This statistical yearbook guides users to growing markets and emerging trends by providing extensive market coverage of: consumer electronics, electronic components, industrial electronics, electromedical electronics, government electronics, international electronics, computers and peripherals, telecommunications equipment, and defense-related communications.

With over 40 years of experience in data collection and analysis, EIA's Electronic Data Book is the most trusted source of information on the electronic industries. With detailed data tables, charts, and analysis from industry experts, the book offers key information that helps electronics professionals in their business decisions.

Electronic Industries Association, 2500 Wilson Boulevard, Arlington, VA 22201-3834

1996 EIA Trade Directory & Membership List, Electronic Industries Association, $200.00

The Electronic Industries Association (EIA) released the 1996 edition of its annual Trade Directory & Membership List today. The listing of more than 1,250 member companies represents the full spectrum of the $410 billion U.S. electronics manufacturing industry. This useful publication lists EIA members' corporate and division locations, telephone numbers, executive level personnel, trade names, number of employees, as well as specific company products and services.

The EIA 1996 Trade Directory & Membership List includes a valuable section on company facilities by geographical location, a convenient "cross-reference" of companies by product category and now also includes company logos. The 1996 EIA Trade Directory also features a section on the Association's Board of Governors, Group, Division and Departmental Officers, Committees, Councils and Panels with a description of their activities, as well as an EIA staff listing with phone numbers.

In announcing the release of the 1996 edition of the publication, EIA Public Affairs Vice President Mark V. Rosenker said, "The Directory continues to be a necessity for anyone interested in the growing U.S. electronics industry and is one of EIA's most popular publications. It is a virtual "Who's-Who" for this important manufacturing sector. We are particularly pleased to offer a new feature which provides both corporate e-mail and web addresses."

The publication's cover price is $200 per copy to non-EIA members, with special pricing for members and multiple copy orders. For further information or to place an order, contact Carol Brenda at 703-907-7791.

Electronic Industries Association, 2500 Wilson Boulevard, Arlington, VA 22201-3834

Practical Electronic Fault-Finding and Troubleshooting, By Robin Pain, Butterworth-Heinemann, 240 pages, paperback $32.95

New from Butterworth-Heinemann is *Practical Electronic Fault-Finding and Troubleshooting*, by Robin Pain. Simple circuit examples are used to illustrate principles and concepts fundamental to the process of fault-finding. This is not a book of theory, but a book of practical tips, hints, and rules of thumb.

Seasoned professional designers have that peculiar knowledge of their own work and specialized knowledge of its components which allows them to analyze and remove faults quickly on the spot (design errors take a little longer!). Fault-finders can never have this depth of specialization because commercial pressures demand a minimum-knowledge-to-do-the-job approach.

Practical Electronic Fault-finding and Troubleshooting describes the fundamental principles of analog and digital fault-finding (there is no such thing as a 'digital fault'—all faults are by nature analog). This book is written entirely for a fault-finder using only the basic fault-finding equipment: a digital multimeter and an oscilloscope. The treatment is non-mathematical (apart from Ohm's Law) and all jargon is strictly avoided.

Robin Pain was originally trained to service color TVs, and has worked as an industrial fault-finder for manufacturers of mobile radio, audio equipment, microcomputers and medical equipment. He has lectured at home and abroad on microcomputer fault-finding.

Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626

Power Supply Projects, By Maplin Projects Series, Butterworth-Heinemann, 208 pages, paperback $19.95

Butterworth-Heinemann is pleased to announce the publication of *Power Supply Projects*. This latest title in the Maplin Projects Series is a variety of power supply projects, the necessary components for which are readily available and affordable. Projects include laboratory power supply projects (for which there are a wide range of applications for the hobbyist) from servicing portable audio and video equipment to charging batteries; and miscellaneous projects such as a split charge unit for use in cars or similar vehicles when an auxiliary battery is used to power 12V accessories in a trailer.

Using circuit diagrams, PCB layouts, parts lists and clear construction and installation details, Power Supply Projects provides everything someone with a basic knowledge of electronics needs to know to put that knowledge into practice.

Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626

ES&T Book Shop

Industrial Electronics for Technicians

By J.A. Sam Wilson and Joseph Risse

Industrial Electronics for Technicians provides an overview of the topics covered in the Industrial Electronics for Technicians CET test, and is also a valuable reference on industrial electronics in general.

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Introduction to Microprocessor Theory and Operation

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Tube Substitution Guide

Complete Guide to Replacements for Vacuum Tubes and Picture Tubes

By William Smith and Barry Buchanan

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Digital Electronics

By Stephen Kamichik

Digital Electronics is designed to supplement an introductory course, teach the electronics hobbyist about digital electronics and serve as a review for practicing technicians and engineers. With the proper equipment, you can also build the circuits described. Building and testing a circuit is the best way to fully understand its operation.

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The IC Cross Reference Book, compiled from manufacturers data and from the analysis of consumer electronics devices for Photofact service data, will help you find replacements or substitutions for more than 35,000 ICs or modules. **Order# 61049 • • • • • $19.95.**

Advanced speaker Designs

By Ray Alden

This book shows the electronics hobbyist and the experienced technician how to create high-quality speaker systems for the home, office or auditorium.

You can build speaker systems from the parts lists and instructions provided or you can actually learn to calculate design parameters, system responses and component values with scientific calculators or PC software. **Order# 61070 • • • • • $16.95.**

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From the makers of Photofact service documentation, the Semiconductor Cross Reference Book is the most comprehensive guide to replacement data for all major types of semiconductors. This volume contains over 475,000 part numbers and other identifying numbers.

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Per column Inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-Inch or larger ads.) For more Information regarding classified display advertising please call 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

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TEST EQUIPMENT BOUGHT & SOLD: OSCILLOSCOPES, ETC. 1-408-738-4206. FAX 1-408-736-6946.

SERVICE DATA & HARD TO FIND PARTS previously-owned SAMs, manufacturers data, books, FREE catalog. **AG Tannenbaum**, Box 386, Ambler, PA 19002, 215- 540-8055, fax 215- 540-8327.

FURTHER PRICE REDUCTION. Diehl Mark III $49, Diehl Mark V Horizontal circuit tester $169. New. Conductive coating for remote control keypads $9.99 ppd. **WEEC**, 2411 Nob Hill Road, Madison, WI 53713. 608-238-4629, 608-273-8585.

SENCORE, TEKTRONICS, HEWLETT PACKARD (all models). We **BUY, SELL, & TRADE** . Please call **"CHOICE ELECTRONICS"** for all of your test equipment needs. Complete financing options available. Call 1-800-609-0677, ask for Lance Tople.

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TV CASE HISTORIES: Booklet with 2,440+ histories. Satisfaction assured. Only $49 (plus $3.00 for priority mail). **Mike's Repair Service**, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 32 years. Send SASE for samples. 410-272-4984,1-800-2-FIX TVS 11am-9pm.

***********************FREE ZENITH CURES***************************
Earn $$$ Repair Zenith **TV** modules found in over 1,000 models, 1983-1993. Symcure manual shows you how. $89.95 or send SASE for **FREE** samples. **ZMEX,** 807 Queen Palm Lane, Sarasota, FL 34243

Monitor Service Information. Techtips Repair Program on Disk, FCC ID Cross Program on Disk, and **Monitor Schematics.** From $39.95. Visa/MC **MI Technologies** 513-335-4560.

FOR SALE

CRT ADAPTER KIT - Hooks your CRT tester to ALL picture tubes. Win the "socket war". Obsolete proof! $59.00 **DANDY,** 2323 Gibson, Muskogee, OK 74403. 918-68-2-4286.

Sencore VC93 all format VCR analyzer. Great for VCR repair. Excellent condition. $1800.00 or best offer. Contact Eugene at 410-730-1460.

Steps to Troubleshooting Electronic Problems in Circuits, send $25.00. Steps to Setting Up Your Own TV Repair Store, send $100.00. Money order or certified checks only. Arnold Burns, 425 East 51st Street, Brooklyn, NY 11203.

((30,000)) CURRENT TECH-TIPS - LIGHTNING FAST REPAIRS AT FINGER TIPS and Growing faster than ever. Since APRIL 1992 TV-MAN TECH-TIPS has, without waver, CONSTANTLY PROVIDED to our members the only ON-GOING HISTORICAL SUPPORT PROGRAM which adds a MINIMUM OF 2,000 NEW REPAIRS at each semi-annual update. **DON'T LET WHAT YOU CANNOT DO INTERFERE WITH WHAT YOU CAN DO! START WITH THE BEST!!** Our quality, and constant improvements have always increased for each member's benefit. The proof is in our product **- HANDS DOWN -** We are **THE FIRST AND ONLY COMPANY** in the USA to offer our type of program in **CD and 3.5HD FORMAT** for **DOS** and a full blown **TRUE WINDOWS** program for **Windows 3.1, 3.11 & WIN 95,** in which you may Enter, Edit or TAG any repair or Press one key to printout all the repairs on a particular Model or Chassis. For the majority of our industry not computerized, we continue to provide the **ONLY** published **PAPER MANUAL** format of Tech-Tips. ***************(Proven to pay for itself within a few repairs)************ **FEATURES INCLUDE: "FREE" FCC-ID MANUAL with 13,656 VCR and 685 Microwave** cross references. **"FREE"** Product Processing Forms. **Our One-Time Membership Fee** Provides you **30,000 Repairs, 1977 thru July 1996,** TV, VCR, CD, LD, Projection, Monitor, Stereo, Camcorder, Amplifier, Combo Units, Fax Machine, Satellite, etc., **"FREE" 48 page SEMI-ANNUAL NEWSLETTER magazine** with **Step-By-Step Repairs WRITTEN BY OUR TECHNICIANS,** using today's techniques and technology. **NEW** Product Information, **Industry News and Service Center Assistance. Membership "PAYS" Our members received 10,000 NEW TECH-TIPS "FREE" in 1995 and now 4,000** in addition to the standard **2,000** in **1996.** Our program covers complex repairs & part number information for **219 BRANDS, ALL IN ONE CONVENIENT PROGRAM.** Repairs are collected daily at four major service centers and sent weekly to our Data Center where each Tech-Tip is gone over completely, additional Lookup and Cross Reference Information is added. This process is how we constantly **IMPROVE** and **INCREASE** the program **FOR YOUR BENEFIT** at each update. **SAVE TIME** diagnosing, **ORDERING** service manuals and **RESEARCHING** part numbers you may not need! Phone for a **"FREE"** demonstration or **simply order. GET TO THE BOTTOM LINE "PROFITABLY".** Call and speak to a **Service Center Owner** and **Technician** Ed Erickson, **NESDA** Member and Past **President** of **(THE PROFESSIONAL ELECTRONICS ASSOCIATION OF SOUTH FLORIDA) YOU'LL BE GLAD YOU DID! (800) 474-3588 (954) 349-2455 .**

IN-CIRCUIT CAPACITOR ESR CHECKER - Find bad caps FAST and RELIABLY with the new Capacitor Wizard in-circuit ESR Tester! Great for **monitors**, switching power supplies, TVs, etc. Only $179.95. MC/VISA **Independence Electronics Inc., 800-833-1094**.

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RCA Test JIG10J106A with 10J4000 Impedance Matching FVS3950 Focus Supply Many Cables and Adaptors, $400.00. Sencore VA48 Video Analyzer, $500.00. B&K 1653 ac Tower Supply, $200.00. All excellent condition. **Call Dennis, 703-754-8790.**

WANTED

VA62A Sencore Universal Video Generator. LC75 or Newer, Auto Z Meter. PR57 ac Power Supply - Can Be Working or Not. Must Be Reasonable. **Please call Dennis 703-754-8790.**

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Readers' Exchange is a free service.

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• 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).

• All submissions must be typed or printed clearly!

Send your Readers' Exchange submissions to:

Readers' Exchange, Electronic Servicing & Technology
76 N. Broadway, Hicksville, NY 11801 Ph: 516-681-2922 FAX 516-681-2926

FOR SALE

B&K model 470 CRT checker with 12 adapters, $150.00. B&K model 1249A NTSC signal generator $150.00. B&K model 2125 scope $100.00. All good working order with manuals, test leads, original boxes. *Contact: Steve Mack, 1335 Avenue F., Billings, MT 59102. 406-245-0799.*

Sencore VC93 VCR analyzer. Like new. All cables, manuals, videos and original box included. Paid $2600.00. Must Sell. Make an offer. *Contact: 410-532-8215.*

Sencore VA62, NT64, TVA92, VC93, $3200.00. All cables, books, boxes. All in excellent condition. *Contact: Tom, 206-334-4732, 6-9 PM, Pacific time.*

Sencore SC61, SC165, PR57, TF166, SS105. B&K 1077, 415. Zenith 852-241, Triplett 630-PL. All like new. All manuals and cables included. $3995.00 for everything. *Contact: Christopher Marquette. 860-449-8607.*

Sams Photofact 3-1952, 389 folders, $200.00. RCA Volthomyst WV-77E and three other VTVMs. All for $60.00. *Contact: Paul's TV, 260 Main Cross Street, Charlestown, IN 47111. 812-256-3119.*

B&K semiconductor tracer 501, $60.00. HP5004A Signature analyzer, $70.00. Both work and have manuals. *Contact: Sidney, 510-357-3788.*

Sencore SC61 waveform analyzer. Will negotiate. *Contact: 410-644-6047.*

Sencore (2) SC61, excellent condition, $1195.00 each. Sencore VA62A, $995.00. Sencore VA62A/VC93, $1100.00. *Contact: Jerry, 504-693-7000.*

Hickok color bar generator, $246.00. Hickok signal generator, $615.00. Sams Photofacts, tubes. *Contact: Ann Bichanich (Jay's), 15 1/2 W Lake Street, Chisholm, MN 55719, 218-254-4421.*

B&K isolation ac power supply, no. 1653. Sencore LC101 Z meter. Both like new. *Contact: 612-869-4963.*

WANTED

Sony TC142 portable cassette. Need cassette lid/door (new or used). Sony part no. X-3538-807-0 nla. *Contact: Liberman Sound, 510-444-5547.*

New or used chips and flybacks wanted for 1970s and early 1980s TVs. Will pay up to $20.00 for certain items. Ask for complete want list. *Contact: W. Worley, 305 Hickory Bend Road, Enterprise, AL 36330, 334-347-5281.*

Tentel video head protrusion gauge in good condition including brackets. *Contact: Walt, 616-599-3220.*

Need schematic for Conn organ model caper. *Contact: Electronic Technical Service, 139 Lock Street, Apt B. Phoenix, NY 13135-9723.*

Search Master metal detector, GTO dual, circuit board no. 2149. *Contact: Bud Eskey, 805-498-8040.*

Canon camcorder VM-EZ battery charger. 6V CA-EZ, or equivalent. Schematic for Funai T-20M, 20" TV. *Contact: Charlie, 360-825-6097.*

Electronic technician magazines from January 1952 through December 1958 complete with circuit digest schematics 1-465. *Contact: Paul Williams, 2364 Blauk Valley Pike, New Providence, PA 17560-9622. 717-786-3803.*

Sencore LC102 cap tester, TF46 transistor tester, PR57 ISO transformer. *Contact: Tim Stark, 414-568-0791 (phone/fax)*

Hickok TV-2, TV-7, TV-10, 539C, Triplett 3444A, Precise 11M tube tester. Old tubes and amplifiers. Tektronix 570 curvetracer oscilloscope. Sencore PR570, PR57. *Contact: 612-869-4963 (phone), 612-798-4169 (fax).*

High voltage PCB part 935BO9002, for Mitsubishi projection TV model VF-360R. *Contact: Chris, Anchor TV & Repair, 4044 Shasta Way, Klamath Falls, OR 97603. phone/fax 541-884-5985.*

Innovations Inc. (out of business) schematic or service manual. Will pay $10.00 for schematic,; more for manual (copy OK). Owner's manual for IBM graphics printer model no. 5152. Will pay $10.00 for book or copy. *Contact: John Augustine, 3129 Earl Street, Laureldale, PA 19605-2719.*

Super VGA monitor KLHMN275-1 from Sanyo TV model PC-367WS, flyback no. FD122, fisher no. FDO122 flyback. New or used. *Contact: Gene Heard, 2290 Spring Creek Road, Bainbridge, GA 31717. 912-246-2986, Fax 912-246-0644.*

ADVERTISERS' INDEX

We'd like to see your company listed here too. Call Diane Klusner at 516/681-2922 or E-Mail her at dianekest@aol.com to work out an advertising program tailored to suit your needs.

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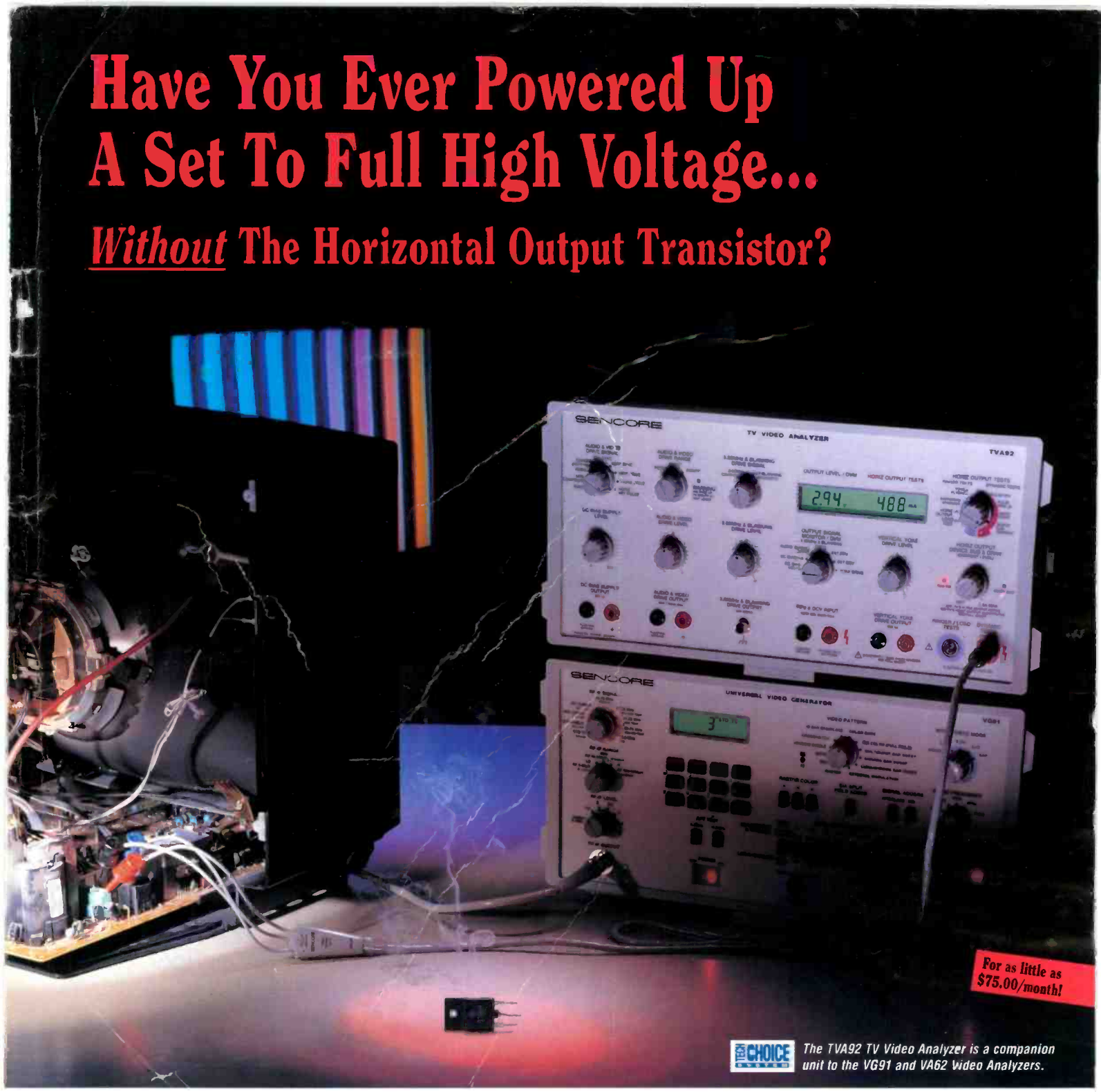

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and ask about our new course on TV horizontal troubleshooting.

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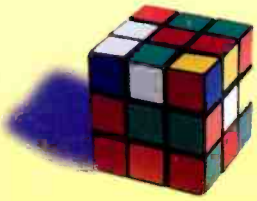

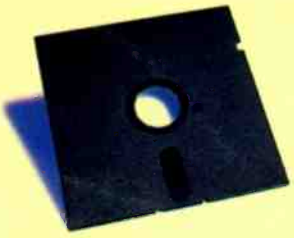

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