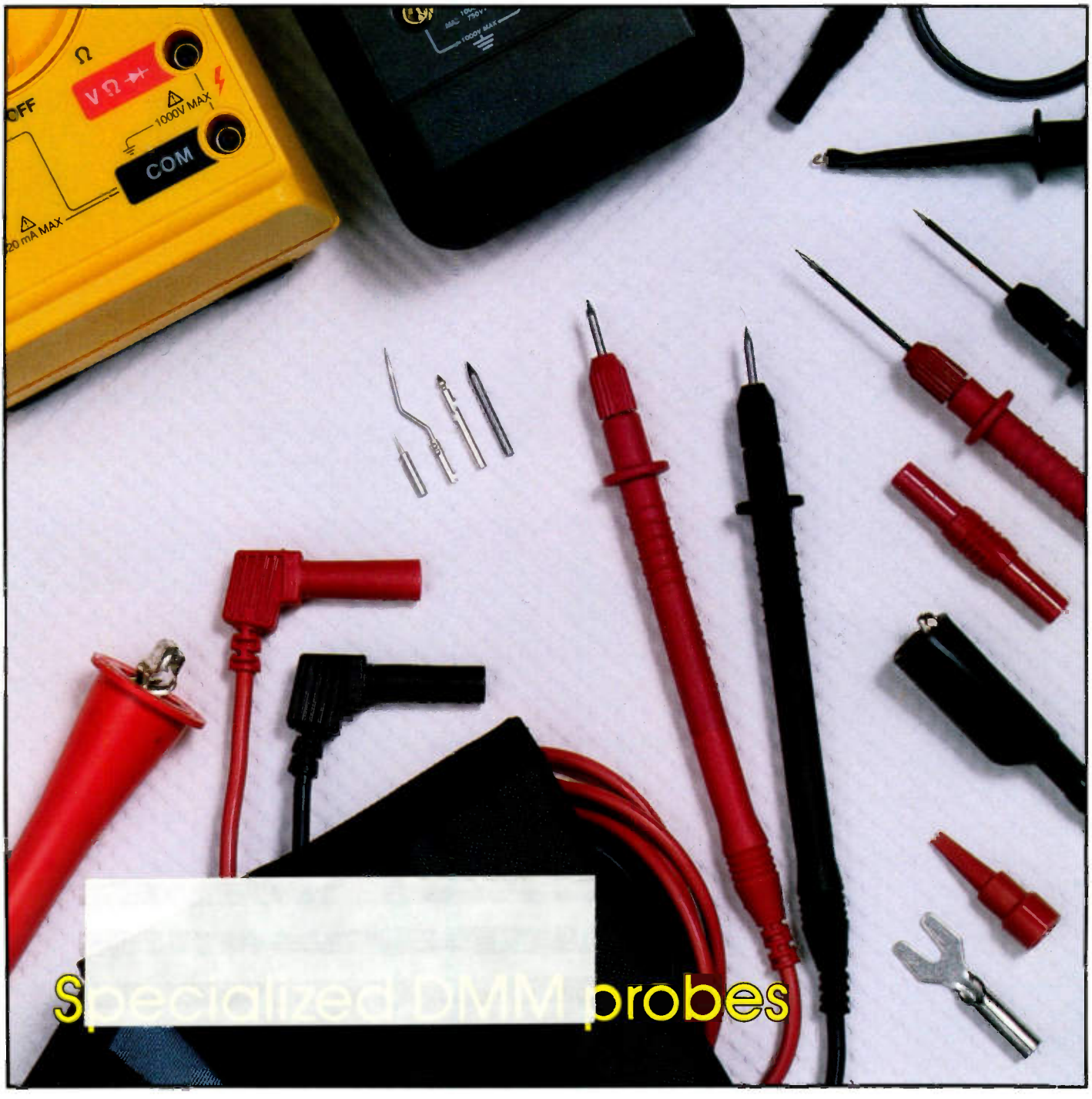
THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC™ Servicing & Technology

OCTOBER 1991/$3.00

CD player servicing

Troubleshooting horizontal circuits in imported TVs



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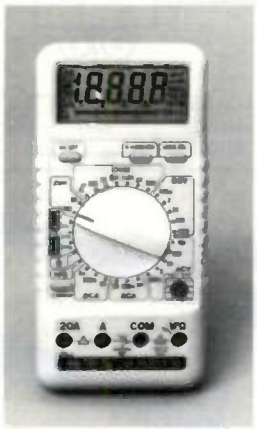


M4650CR

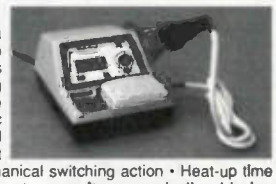
FUNCTION	RANGE	ACCURACY	RESOLUTION
DC VOLTAGE	200mV	±0.05% of rdg+3dgts	10µV
	2V		100µV
	20V		1mV
	200V		10mV
	1000V	±0.1% of rdg+5dgts	100mV
AC VOLTAGE	200mV	±0.5% of rdg+10dgts	10µV
	2V		100µV
	20V		1mV
	200V		10mV
	750V	±0.8% of rdg+10dgts	100mV
DC CURRENT	2mA	±0.3% of rdg+3dgts	100nA
	200mA	±0.5% of rdg+3dgts	10µA
	20A	±0.8% of rdg+5dgts	1mA
AC CURRENT	2mA	±0.8% of rdg+10dgts	100nA
	200mA	±1.0% of rdg+10dgts	10µA
	20A	±1.2% of rdg+15dgts	1mA
RESISTANCE	200Ω	±0.2% of rdg+5dgts	0.01Ω
	2KΩ	±0.15% of rdg+3dgts	0.1Ω
	20KΩ		1Ω
	200KΩ		10Ω
	2MΩ		100Ω
	20MΩ	±0.5% of rdg+5dgts	1KΩ
CAPACITANCE	2000pF	±2.0% of rdg+20dgts	0.1pF
	200nF		10pF
	20µF	±3.0% of rdg+30dgts	1nF
FREQUENCY	20KHz	±2.0% of rdg+10dgts	1Hz
	200KHz		10Hz

GENERAL CHARACTERISTICS:
Max. Display: 19999 counts with automatic polarity indication • **Max. Input Current of AC and DC:** 20A (max. of 15 minutes) • **Overrange Indication:**"OL" and "Bar graph flashing" figure on display • **Max. Common Mode Voltage:** 500VDC/AC RMS • **Reading Rate Time:** Approx. 1-2 readings per sec. • **Temp. for Guaranteed Accuracy:** 23°C ±5°C • **Temperature Ranges:** Operating 0°C to 40°C, 32°F to 104°F, Storage –10°C to 50°C, 14°F to 122°F • **Power Supply:** One 9V battery (Included) • **Size:** 3.4"W x 7.4"D x 1.3"H • **Unit Weight (Excluding carrying case):** 0.8 lbs. • **Accessories:** Operating manual, 9V battery, test leads, spare fuse, and carrying case. RS-232C Cable, Floppy Disk (Optional)

Order #	Price	Description	Weight
M4650CR	109.95	4 1/2 Digit LCD Multitester	1.50 lbs.
RS232C	9.95	RS-232 Interface (Cable and Floppy Disk)	3.5 oz.

SOLDERING STATIONS

Features – 168-3CK
•The AUTOTEMP 168-3CK soldering station offers the ultimate in controlled temperature hand soldering • The soldering tip is grounded through the power unit to ensure less than 0.4mV or 0.03mA leakage • The cartridge element wire is precision wound at the end of the stainless steel shaft to ensure max. temperature as close to the working surface of the tip as possible. This results in both rapid heating and instant recovery• AutoTemp is constructed with a lock-out feature to allow supervisors the ability to set and lock the stations at a specific temperature • Ideal for hobbyists, service technicians or production lines.



Features – XY9-60DK
•SUPERTEMP XY9-60DK solder station offers a unique electronic control circuit that maintains tip temperature to within ±3°C (6°F) of idling. This is accomplished by embedding the thermocouple sensing unit in the top of the heating element shaft so that the tip actually sits against it • Revolutionary electronic "Zero Voltage" thyristor switching protects voltage and current sensitive components (CMOS devices) against transient voltage spikes caused in stations using mechanical switching action • Heat-up time to working temperature approx. 60 seconds • Supertemp units exceed all soldering equipment military specifications regarding electro-static sensitive devices due to zero voltage switching and fully grounded tip.

Order #	Price	Description	Weight
168-3CK	69.95	60 Watt Soldering Station	2.38 lbs.
XY9-60DK	109.95	60 Watt Soldering Station (Digital Readout)	4.68 lbs.

TOOL KITS

E8305

Both units feature: DMM's, pliers, utility knife, screw driver sets, hex key sets, wrenches, soldering iron, solder, desoldering pump, solder stand and much more!

E8900

The best collection of fix-it and put-it-together tools. Ideal for do-it-yourself, handyman and professional craftsman. Designed for most maintenance and repair jobs around the house, workshop, etc. Compact vinyl covered carry-along suitcase with combination lock and sturdy removable pallets. Provides safe storage and keeps all tools clean and organized. Case Size: 17.5" x 12.5" x 3.5"

The most popular tools come packed in this large and complete kit. Use it for building, repairing and general maintenance of most electronic equipment. The heavy duty, molded poly case is built to hold 2 pallets, and has a bottom center partition. The case comes with 2 surface type locks, a durable handle, side buckles and strap. Case Size: 18" x 14" x 7"

Order #	Price	Description	Weight
E8305	119.95	51 Piece Professional Tool Kit	12 lbs.
E8900	199.95	92 Piece Electrician's Tool Kit	17 lbs.

POWER STRIPS

•Economical 6 Outlet Power Strip
•Circuit Breaker Protected

Order #	Price	Description	Weight
E6102	9.95	Power Strip	1.89 lbs.

JUMPER WIRES

FEATURES
•22 Awg wire
•Stripped 0.25"
•14 assorted lengths
(25 pieces each length)

Order #	1-9	10+	Description	Weight
JW350	9.95	8.95	Jumper Wire Kit	8.8 oz.
JW350R	7.95	6.95	Refill Pack	2.3 oz.

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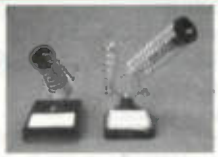
Ever wondered what to do with all those magazines or catalogs you have lying around? Here is the perfect solution. Holds up to 12 issues of most standard monthly magazines or up to 12 catalogs and magazines of various shapes and sizes (8.5" x 11" max.). Space provided on the rib for easy listing of material contained in each binder.

Order #	1-9	10+	Description	Weight
MB12R	4.95	4.45	Binder	1.22 lbs.

SOLDER IRON STANDS



E100L E100M

Order #	1-9	10+	Description	Weight
E100L	3.95	3.75	Economical	8.9 oz.
E100M	4.45	4.25	Multi-Purpose	1.51 lbs.

POWER SOCKET

Order #	1-9	10+	Description	Cond./ Terminals
E3PS	1.09	.89	Power Socket	3

POWER CABLES

Order #	1-9	10+	Description	Cond.
AC34	1.50	1.40	4' Power Cable	3
AC36	2.15	1.95	6' Power Cable	3
AC312	3.95	3.25	12' Power Cable	3

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We reserve the right to substitute manufacturers.
Prices subject to change without notice.

Circle (48) on Reply Card

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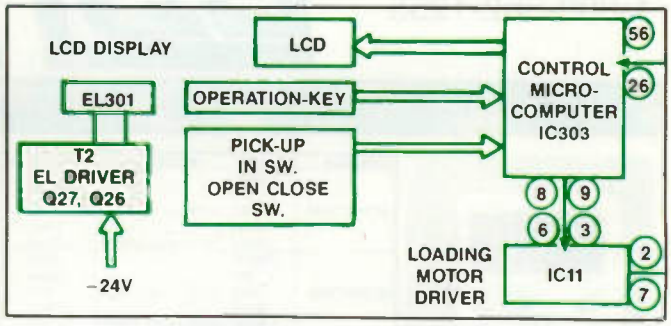
Volume 11, No. 10 October 1991



FEATURES

DEPARTMENTS

ON THE COVER

The complex, and tiny, circuits found in today's consumer electronics products have complicated the once simple task of taking measurements. In many cases, simply getting a test probe on the point to be measured, or finding a way to hook the meter lead on an exposed wire can be a serious challenge. DMM and test probe manufacturers have risen to the challenge by creating test lead/probe kits with every imaginable (almost) kind of tip. *(Photo courtesy ITT Pomona).*

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ON SCREEN PROGRAM,
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15 MHz VIDEO SWEEP,
DOT/CROSSHATCH
MOD STAIRCASE,
CHECKER, SYNC
CHROMINANCE
LUMINANCE,
SMPTE BARS
GENLOCK,
100 PRESE
WINDOW
RASTER
Y/C, B
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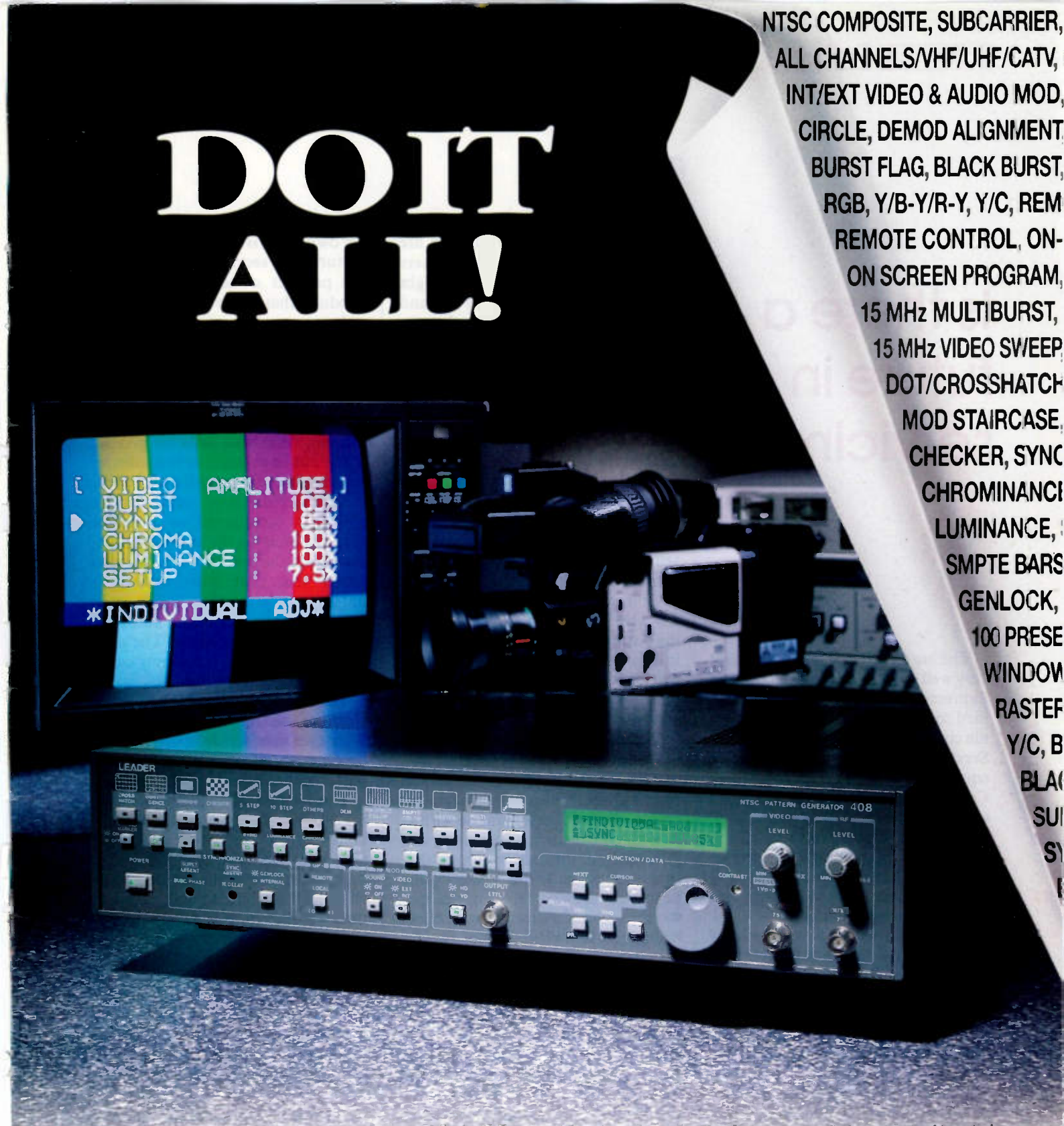
SU
SY



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

The **GENLOCK**able 408 also produces **multiburst** and **video sweep** to 15 MHz, as well as many more **precision test signals.** And **on-screen programming** provides for easy signal creation for wide-ranging test situations. For routine testing, create up to **100 preset** test setups. And there's much more to this uniquely feature-rich generator. There's even a PAL version available.

To get the whole long story of Leader's amazingly versatile Model 408, call toll free: 1 800 645-5104. In NY, call 516 231-6900. See what our new do-it-all can do for you!

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Is there a future in servicing?

The answer to that question might very well depend on the outcome of a Supreme Course case that's scheduled to be heard this fall. A California company named Image Technical Service (ITS), that services office equipment, has sued Eastman Kodak Co. in an attempt to force Kodak to sell replacement parts to them. Back in 1985, ITS became so successful in competing with Kodak's own service organization that Kodak halted sales of replacement parts to independent servicers throughout the U.S.

There's an excellent synopsis of the case in an article in the August 19, 1991 issue of Business Week magazine by Peter Coy entitled "High-tech repairs: Are giants hogging the pie?" There's also a news item in this issue on the subject. According to the Coy article, a lawsuit by ITS and others intended to force Kodak to sell replacement parts to independent servicers was thrown out by a federal judge in San Francisco. Subsequently, an appellate panel ordered it back for trial. The Supreme Court has agreed to hear Kodak's appeal for dismissal. It might grant Kodak's appeal or send the case back for trial without considering its merits.

The article concludes that if " . . . outside maintenance companies are shunted aside, the biggest losers could be their customers, who might end up paying more for service and getting less." In such a case, the other big loser would be the independent service centers that service every kind of product, not just customer electronics products.

If you're not familiar with this case, you should be; it could affect your livelihood.

It's interesting to consider who's rights take precedence in a case such as this. From the point of view of the manufacturer, is it not his right to sell, or not sell, to whomever he chooses? Hmm.

Or how about looking at things from the point of view of the servicing business? In the related news item in this issue, NESDA contends that servicers have a right to remain in business and to make a living from servicing products. Hmm

What if, instead we take a look at the merits of the case from the point of view of the consumer. A person buys a product. Unless he agrees otherwise, the product is his to do with as he will. He can use it, give it away as a gift, sell it, or do anything else with it that he chooses. If the product fails, he can toss it away, repair it, return it to the manufacturer for service, bring it to any other service facility for service.

This scenario makes sense in the case of most low-tech, or no-tech products, and even in the case of high-tech products where the cause of failure of the products is some common part that is available from any of a number of vendors. As products become more sophisticated, however, they ordinarily contain more special parts: parts made especially by or for the manufacturer, and not available from any other source.

In such a case, if the manufacturer will not sell replacements to the owner of the product or to independent servicers, the only recourse the product owner has is to contact the manufacturer for service. In such a case, the product owner must have the product that he owns serviced by only one agency, at whatever price they choose to set, and according to their terms. There is no alternative except to replace the faulty item.

It seems to me that is justice is to be served, the law must require that any manufacturer who sells his product to the public at large, or to a substantial segment of the public, such as the business community, make any replacement component, or subassembly, available to the individual who purchased the product, or to a service center that that individual designates, at a price that is consistent with the pricing of other, common, replacement components. The alternative is a servicing monopoly on the part of the manufacturer.

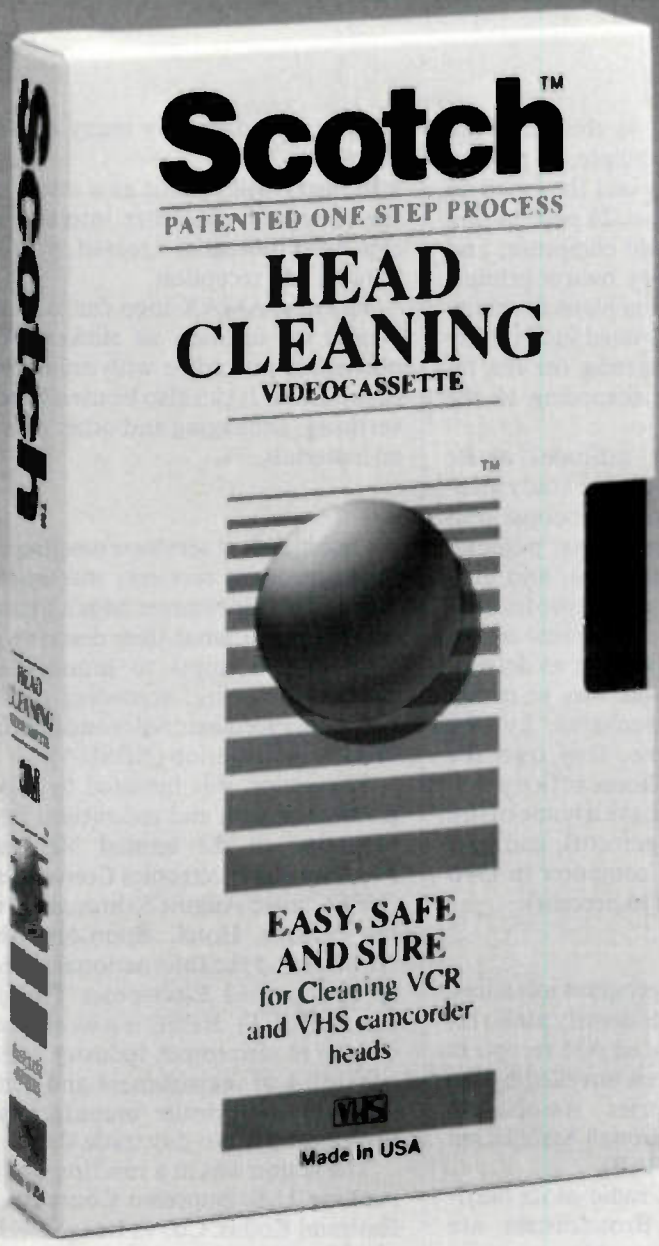
The case is now up to the Supreme Court of the United States to decide. Whatever they decide in this case will become law as regards replacement parts availability.

There may still be time for servicing professionals throughout the United States to offer, if nothing else, their financial and moral support to the servicing professionals who have introduced this case into the legal system. For more information, you may contact either of the two organizations named below:

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

California State Electronics Association (CSEA)
10564 Progress Way, Suite E
Cypress, CA 90630
(714) 827-4986
Fax: 714-827-5630

Nils Conrad Persson



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Don Erwin, CSM, San Diego, CA

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As featured in the Advance Technology Nov./Dec. '87 supplement

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Study points to huge growth in home office products market

A huge growth potential exists for the home office products market, according to a new EIA/CEG study of purchasers of home office equipment released today at the 1991 International Summer Consumer Electronics Show.

"The number of potential purchasers of home office equipment is extremely large," says Gary J. Shapiro, group vice president of the Electronics Industries Association's Consumer Electronics Group (EIA/CEG), the sponsor of the study. "There is a high rate of intent to purchase these products, and, based on statistics revealed in the study, it seems that users are confident they will be satisfied with the home office products they purchase."

In 1990, the penetration levels of fax machines, personal organizers and cellular telephones in United States households doubled. According to the study, 1991 buying plans point to accelerated growth for many of the products included in the study, particularly fax machines, personal computers, computer printers, modems and cellular telephones.

Thirty-six percent of the study respondents said they utilize a home office or workspace in their homes. Fifty-nine percent of recent purchasers of home office products work at home, versus 41 percent who use these products for educational or recreational purposes. Both of these user segments contribute greatly to the potential overall home office market.

The study shows that the 59 percent of recent purchasers of home office products who work at home either:

- Bring overflow work home
- Are self-employed and work at home
- Work part-time or free-lance at home, or
- Work full-time at home for an employer

The EIA/CEG Home Office Information Equipment Study was designed and conducted by Market Facts, Inc., of Washington, D.C.

Penetration rates of many of the products included in the study are substantial. For example, 33 percent of the respondents said they own an electronic typewriter, 28 percent said they own a personal computer, and 23 percent said they own a printer. Respondents' buying plans for many of the products included in the study look particularly strong for the remainder of 1991, according to the study.

Based on their attitudes about home office products, the study identifies four categories of people who buy home office products: pragmatists, dabblers, hobbyists, and professionals. Home office professionals, who make up 16 percent of the total home office market as defined by the study, led the way in nearly every statistic uncovered by the study. For example, they own the largest number of home office products (5.3 percent), have a home office or workspace (88 percent), and purchased a personal computer in 1990 for a home office (36 percent).

AM certification program advances

A new symbol to identify audio receivers with enhanced AM reception capabilities has been unveiled by the Electronic Industries Association (EIA) and the National Association of Broadcasters (NAB).

The idea is AM radio at its *maximum* potential. Broadcasters are working to improve AM programming and music quality, and this certification program will enable receiver manufacturers to advertise and market their products which can deliver this improved quality sound, according to the (EIA) Consumer Electronics Group. The certification program will be a dual-level one, with one logo indicating enhanced AM capability and the other indicating enhanced reception plus AM stereo capability.

The EIA/CEG Board of Directors resolved to participate in the certification program at its spring conference meeting in April. Their decision was based on the benefits that:

- Certification will enhance competition and consumer choice by permitting consumers to select among products produced by many manufacturers.
- Industry will benefit as a result of the increased consumer interst and expanded potential created by enhanced AM reception.

The new AMAX logo can be embossed on or used as stickers for placement on radios with enhanced capabilities. It can also be used in advertising, packaging and other printed materials.

Independent servicers meeting

Independent servicers meeting in Reno, NV this summer began a campaign against what they describe as corporate attempts to monopolize product servicing, according to the National Electronic Sales and Service Dealers Assocaition (NESDA).

The action was initiated by independent dealers and technicians participating in the annual National Professional Electronics Convention (NPEC) held August 5 through 10 at the Nugget Hotel. Sponsored by NESDA and the International Society of Certified Electronics Technicians (ISCET), NPEC is a week-long consumer electronics industry event consisting of management and technical seminars, dealer/manufacturer forums and a two-day trade show.

The action was in a reaction to the pending U.S. Supreme Court case: Eastman Kodak Co. vs Image Technical Servicers, Inc. et al. In 1987, according to NESDA, the office products manufacturer refused to sell parts for printers and copiers to an independent servicer. That servicer rallied the support of others nationwide to challenge Kodak in court. The case is scheduled for the Supreme Court this fall. Joining the suit on behalf of Kodak are a number of computer, automotive and consumer electronics companies.

NESDA members attending NPEC '91 began collecting funds, encouraging independent servicers from local, state and regional associations to make donations in support of independent service and the rights of their profession. By the end of the convention, the drive had already raised several thousand dollars, according to NESDA. ■

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Literature

Electronic test instrument catalog

New from Bel Merit Corp. is a product catalog that details the manufacturer's line of digital and analog multimeters, function generators, frequency counters and power supplies. Accessories and product specifications are covered.

Circle (1) on Reply Card

Computer course introduced

Heath Company introduces five new computer courses in its free Fall 1991 Home Works by Heathkit catalog. According to the manufacturer, these new courses offer the fastest, easiest way to gain a working knowledge of computer applications and include WordPerfect, Windows, Lotus 1-2-3, Word for Windows and AutoCAD. The courses allow learning through easy-to-read text and step-by-step instructions, plus frequent examples, illustrations and tips. The four color 40-page catalog also introduces six new home study video courses which can be used to learn important electronics concepts. The topics include Operational Amplifiers, Linear Power Supplies, Switching Power Supplies, Troubleshooting with the Oscilloscope, Troubleshooting with Electronic Test Equipment and Troubleshooting Microprocessors. A student workbook is included with each video to reinforce learning.

Circle (2) on Reply Card

Technical booklet on optoelectronics

Anritsu announces the availability of "Optoelectronics Technology Today," a free 46-page booklet on optoelectronics detailing the latest advancements in light source technology and applications. The booklet is the sixth in a series Anritsu has published on optoelectronics. The book contains studies on surface emitting lasers and active parallel microoptics, synchrotron radiation and its applications, remote detection of methane using a 1.66 um diode laser, current R&D of X-ray lasers, ultrafast optoelectronics and their application to IC testing, and the present and future of optical technology.

Circle (3) on Reply Card

New product data sheet describes digital multimeters

A new 2-page, 4-color product bulletin is available from Simpson Electric Company. It describes the company's model 487 and 488 digital multimeters. Both feature hand-held convenience, but with bench top specifications. The Model 488 provides true RMS readings for complex, non-sinusoidal wave forms over a broad 20KHz frequency range. The text of the new product bulletin provides descriptive information on auto-ranging which combines the best of both digital and analog displays. Other important operating features described in the text include an audible self-test and audible continuity for fast troubleshooting.

The full-color brochure also includes complete specifications, ordering information and a list of convenient accessories.

Circle (4) on Reply Card

Oscilloscpe probe and test accessory catalog

Test Probes, Inc offers a catalog of test probes, test leads and accessories for oscilloscopes and DMMs. The catalog, "Oscilloscope Probes and Test Accessories, 1991" contains detailed descriptions of the company's full line of leads, probes and accessories. Cable for the leads is made with 720 strands of copper wire, and is low in resistance to facilitate low voltage and resistance measurements. The insulation is made of silicone rubber, which is flexible under extreme cold and is burn resistant to soldering irons, and does not crack due to age hardening. Included in the catalog are descriptions and replacements for popular probes, special purpose and repairable probes, multimeter leads, coax adapter kits, probe accessories, and more.

Circle (5) on Reply Card

CD player servicing

By Victor Meeldijk

Compact disc players, introduced in 1983, have been steadily increasing in sales since their introduction, with almost 7 million sold to dealers in 1989 (according to the EIA). Sales of the CD's themselves have also increased, so much so that they outsold vinyl LP's in the first six months of 1988 (70.4 million CD's to 43.5 million LP's).

Whether the CD players have 20 IC'S, as in the 100,000 units made by Phillips in 1983, or as few as 6 IC'S in some players made in 1987, all CD players operate in basically the same manner.

CD player initial operation and the spindle motor servo

When a CD player is first turned on, the microprocessor (or microcontroller) checks to see that the CD drawer switch is closed, the spindle motor servo causes the turntable to rotate clockwise at a constant speed of about 350 RPM, and the pickup sled (or rotating arm used in some players) goes to the inner track (the microprocessor gets a signal from a limit switch when the pickup gets into the proper position.

Refer to Figure 1A, which is the block diagram of the Sharp DX- 620 (where the microcontroller is IC303, and the servo control is IC10). Figure 1B is the underside of the mechanical portion of the CD player. The laser (generated by a low power aluminum-gallium-arsenide, AlGaAs, semiconductor diode) goes on and the focus servo circuit puts out a focus up/down signal (FUD) which causes the focus actuator to move up and down 2 or 3 times to focus the beam on the disc.

If there is no disc in the player, no focus is obtained and no focus OK (FOK) signal is generated by the focus servo (in Figure 1A the servo is IC4 and the Focus driver is IC5). The player then shuts down, the turntable stops, and the pickup moves to the inner limit.

If there is a disc on the turntable, RF data is detected (via the laser beam reflecting from the pits and flats of the disc and back through the optical system to a photodiode array in the pick-up assembly), and the turntable motor servo goes into an 11T speed mode. The 11T speed mode is based upon 11 clock cycles and relates to the digital data encoding scheme (Figure 2 is the RF eye pattern).

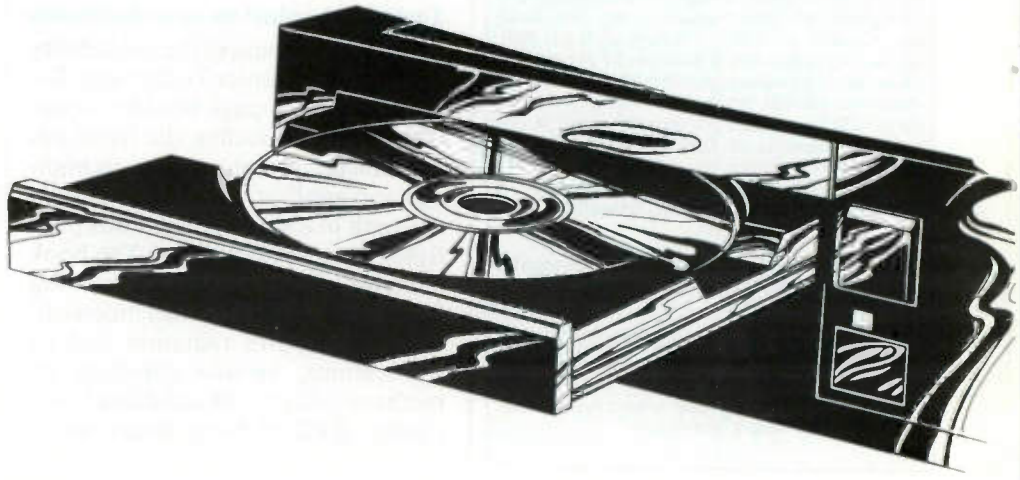
This is part of the EFM or eight to fourteen bit modulation scheme in which 14-bit words are substituted for the eight-bit words to limit the high and low frequency content of the data stream. In this scheme there are no more than 10 zeros between ones and no fewer than 2 zeros between ones. This is called the 2 to 10 rule. This aids in playback tracking by limiting the playback tracking to 720KHZ even though the data rate is 4.3221MHZ.

Once the phase of the playback EFM signal and the crystal clock is aligned, the spindle motor servo goes into the CLV (a Constant Linear Velocity of 1.3 meters per second) mode for playback (the 11T mode is used again for search, skip and pause functions).

The CLV servo action keeps the information coming off the disc at a constant rate by varying the speed of rotation from 480 RPM for the inner tracks to 240 RPM for the outer tracks. The data rate is monitored by the data stored in RAM (in Figure 1A this is IC14).

If the memory fills to more than half of its capacity because the speed of the disc is too fast, an error signal is generated which slows the turntable motor. If the memory does not fill to half capacity the disc speed is too slow and the speed of the turntable motor is increased. Further details on why data is stored in RAM will be found in the section on *Audio Data*, which is discussed below.

During the initial operation, the disc Table of Contents (or TOC), located at the innermost tracks of the disc, is read. The TOC contains the information on track times and the number of tracks on the disc. Without the EFM, RF signals and the reading of the disc TOC, no other playback operations can be performed.



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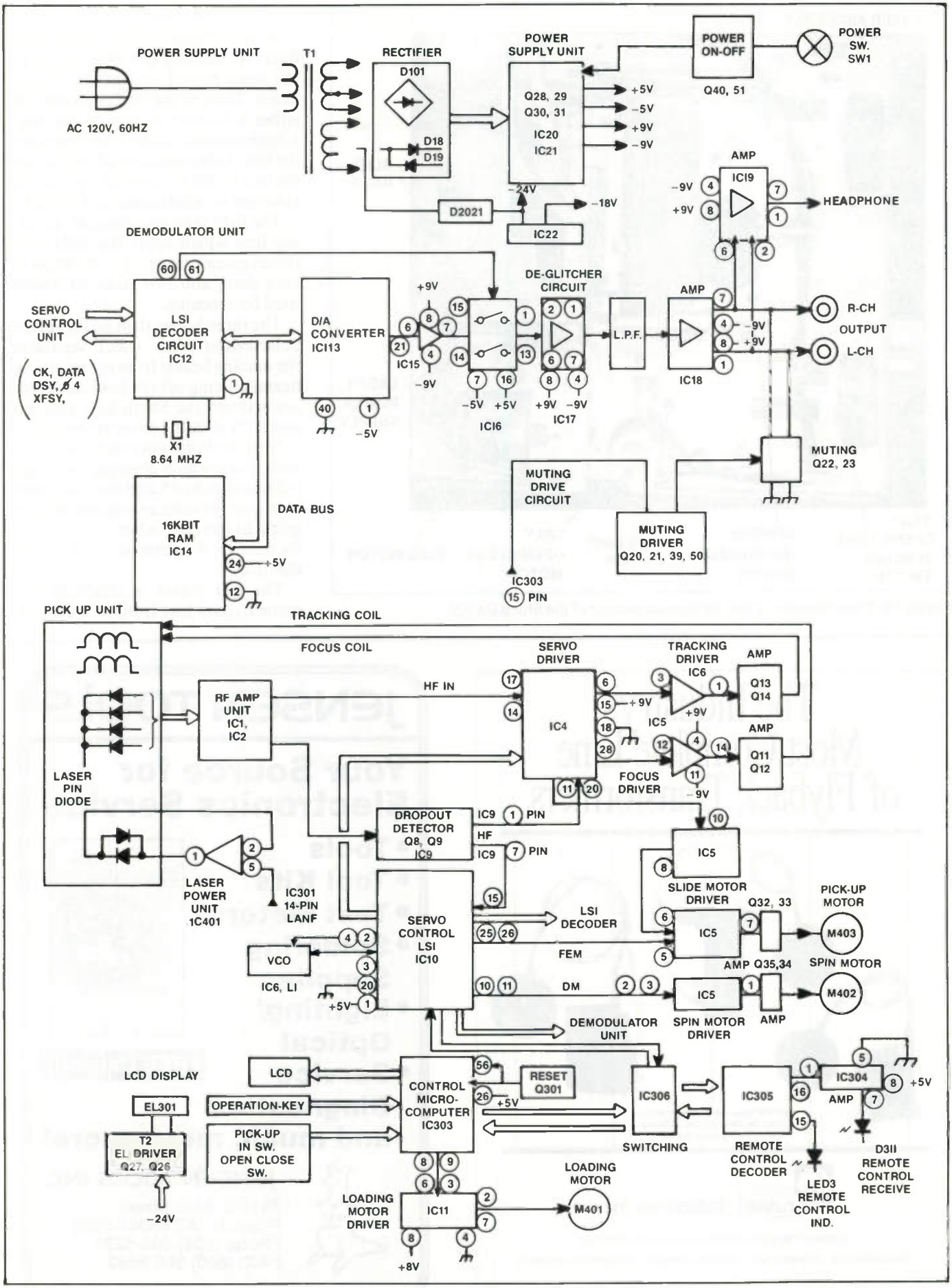


Figure 1A. The Sharp DX-620 block diagram.

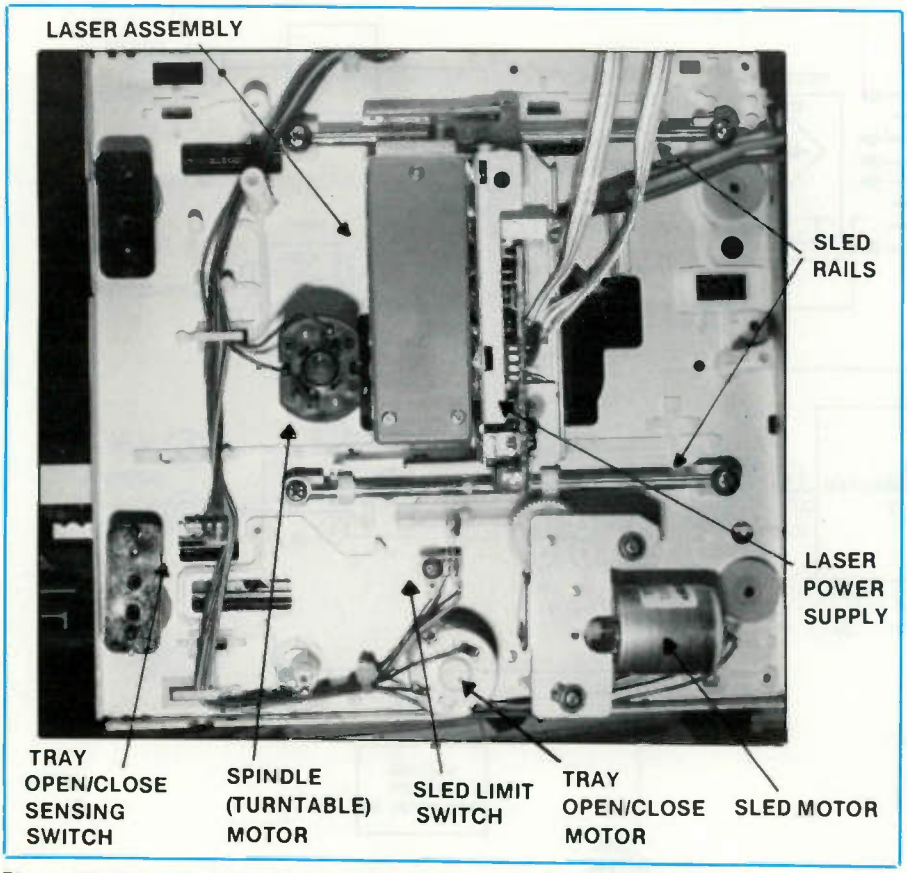


Figure 1B. The underside of the mechanical section of the Sharp DX-620.

The laser beam

A semiconductor laser diode produces a coherent (all light waves in the same phase) IR (infrared) light beam. The CD player design may be either a 3-beam system or the later 1-beam system. In the 3-beam system the laser light goes through a collimator lens which focuses the light into a coherent parallel beam (see Figure 3).

The light then goes through a grating lens which splits the light into three separate beams, a main beam to read data, and two adjacent beams used for tracking.

The three beams then go through a polarization prism which separates the sending beams from the returning beams coming off the laser disc (Figure 4 shows the Sharp laser pick-up assembly with the cover removed).

Next the beam goes through a 1/4-wave plate which changes the beam polarization by 45 degrees. The beam then goes through a focus lens before going to the disc, where it is further focused by a factor of 1000 by the disc itself.

The CD player is relatively immune to data loss from scratches on

the disc because the scratches occur on the surface of the disc, while the laser is focused on the optical surface of the disc, which is below the scratches.

The beam that is reflected from the disc returns through the focus lens and through the 1/4-wave plate. Because the beam travels through the 1/4-wave plate twice, once on its way to the disc and once on its way back, it undergoes a total polarization change of 90 degrees. Next the beam goes through a detector and cylindrical lens and finally to the photodetectors. Two outside photodiodes are used for tracking and four centered photodiodes are used for data and focus error detection.

In the one-beam system, the beam is not split, and therefore the optical system contains fewer components. The complete beam is used for data and tracking, as described below.

The tracking servo

In the 3-beam system, the tracking beam's photodiode output goes to a comparator which produces an error voltage if the tracking needs adjustment. A sawtooth waveform goes to the tracking coil for the CD player to step from track to track (in Figure 1A, IC6 is the tracking driver).

In a one-beam system, the photodetector outputs go to a phase comparator, to determine if the data pit crossing is detected equally by the center diodes. If this is the case, a TOK or tracking OK signal is generated (see Figure 3). If not, an error voltage (TER, or tracking error) is generated by the servo circuitry.

The focus servo

When an in-focus returning laser beam goes through the cylindrical lens it is a round spot when it hits the four photodiodes (see Figure 3). Because all photodiodes receive the same amount of light, their output signals are all equal. If the beam is not in focus the spot will be an ellipse, tilting either to the left (focus too near) or to the right (focus too far). The photodiode outputs will therefore be different because the four diodes receive different amounts of light.

In this case, when the outputs are paired and sent to a comparator circuit a focus error voltage is produced: a positive voltage if focus is

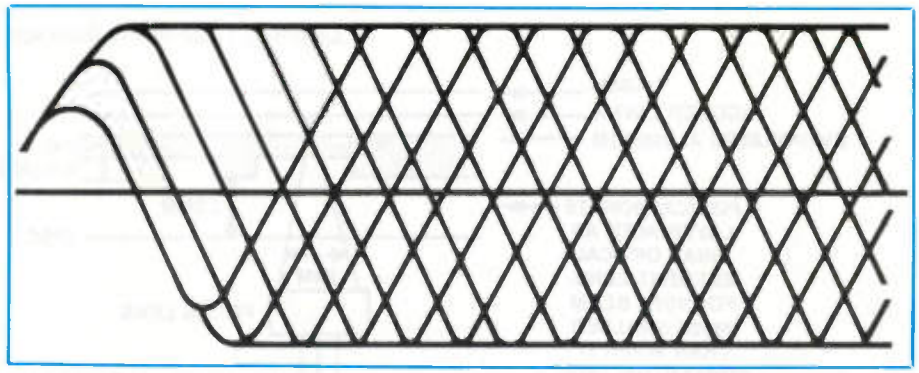


Figure 2. The RF eye pattern (note the distinct diamond shape in the center of the waveform).

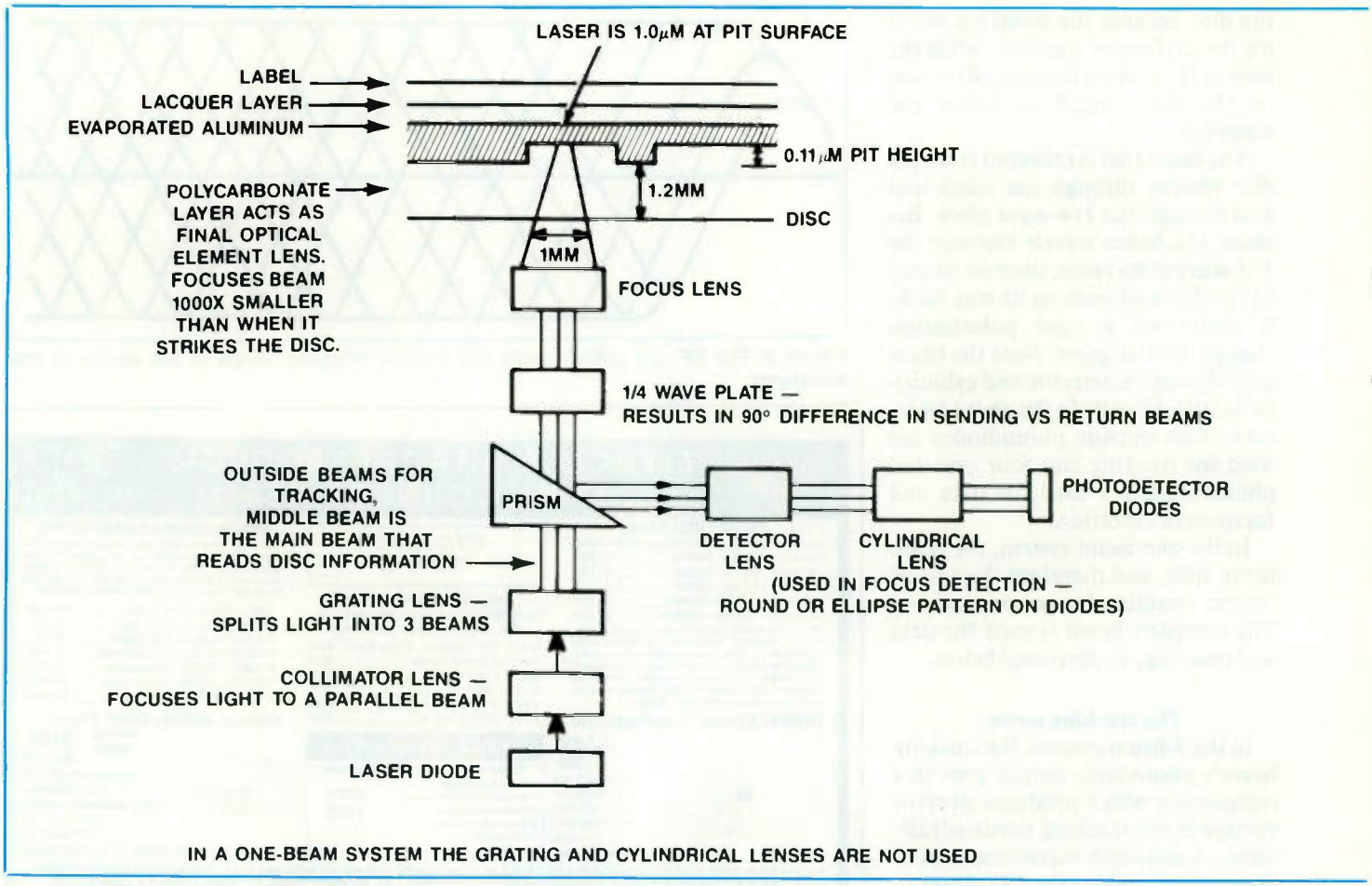


Figure 3. The 3 beam laser system and photodiodes.

too near; a negative voltage if the focus is too far. This output signal is amplified and goes to the focus coil, which behaves like a speaker coil, moving the focus lens up and down to keep the laser beam in focus.

The audio data

The RF signal coming from the photodiodes also goes to a phase locked loop, consisting of a Voltage Controlled Oscillator (VCO) and a phase comparator. This is part of IC12 in Figure 1A). The PLL 8.642 MHZ output is divided in half and compared to a squared-up RF signal. This scheme recovers the data bit clock (PCK) which is used to gate the RF signal and produce the EFM signal.

The EFM signal is then demodulated back into an 8-bit data signal and CIRC (Cross Interleave Reed Solomon Code, a form of error correction) and CRCC (Cyclical Redundancy Check Code, another form of error correction) and interleaving data recovery is then performed.

Interleaving recovery restores data continuity in time, which was fragmented, or interleaved, to prevent a loss of a large portion of continuous data because of a major scratch or imperfection. With this fragmentation of data, enough information can be recovered from undamaged portions of the track to reconstruct the original data.

Restoring the data in its proper order involves temporarily storing portions of it in RAM memory and then retrieving it in the order in which it is needed to restore the original signal. Therefore, this demodulation recovers from a 588 bit signal; which includes parity (error correction), control, EFM modulation and data bits; the original 192 bits of data (all this is done in IC12 in the Sharp player).

The signal then goes to a D/A converter (IC13) and then a deglitcher circuit (IC17), which separates the left and right audio channels from the serial data stream coming out of the D/A converter. The deglitching creates a 44.1kHZ switching noise which is filtered out by a low pass filter (LPF).

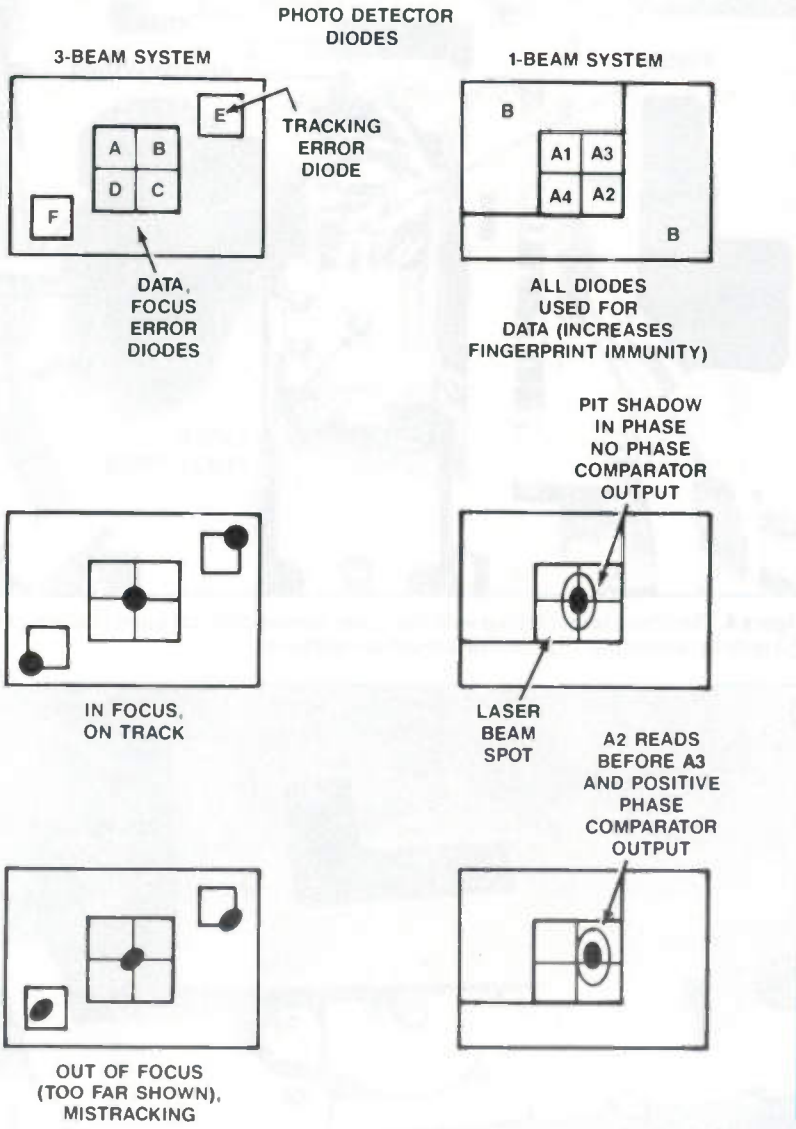
Some CD players follow this by a Phase Shifter which corrects an earlier 11μS phase shift, done because data sampling of both channels is done simultaneously. The output then goes to an output amplifier, the output of which is controlled by a muting circuit (should large data errors be detected the output is muted). This is Q22 and Q23 in the Sharp player block diagram.

Troubleshooting a CD player

There are various sections of the CD player to check should a malfunction occur. Some typical problems and areas to check include the following.

Player does not turn on

When the player fails to turn on, check fuses, power cord, power switch, power supply, power supply turn-on circuit (more about this in the repair case history to follow), closed cover switch (in portable units), and the transit screws (some units may not turn on if they are engaged).



Drawer does not open (close)

If the drawer doesn't open or close, or opens or closes only part way, check for a stuck mechanism (may need lubrication), foreign objects in the drawer, damaged gears or worn belts (Figure 5), front panel open/closed switch, power supply voltages, internal drawer open/closed sensing switch, loading motor, control microprocessor (microcomputer).

Player starts to operate then shuts down

If the spindle (turntable) has not rotated at all, check the drawer closed switch, power supply voltages to spindle motor, spindle motor, spindle motor servo.

In the case where the spindle starts to rotate then stops, check the slide inside limit switch; the pickup may not be in the proper position to read the disc (Figure 6). Check for the presence of RF and EFM signals. If no RF is present check to see if the laser lens is dirty or is fogged by condensation.

WARNING: NEVER look directly at the laser assembly as it can damage your eyes. the laser beam is invisible and you will not be able to see it. When the safety switches/interlocks are defeated and the player is turned on, keep a disc on the turntable at all times (Figure 7).

Check the laser diode either with a laser power meter, or measure the voltage drop across a resistor in the laser power supply. Compute the las-

er current. Typically it is between 40mA and 80mA.

The laser assembly is susceptible to electrostatic discharge damage (ESD), so don't remove it unless you are absolutely sure it is the problem. Make sure, for example, that all mechanical problems have been ruled out. If you do have to remove the laser assembly, you *must* follow proper ESD precautions in order to avoid damage. These precautions include placing of shorting clips on the connections after disconnecting this assembly. Follow all of the manufacturer recommendations.

Also check for proper turntable rotation. Problems here can be caused by the motor drive circuit, or the system microprocessor (microcontroller), or even the signal processing circuits (refer to the discussion on the RAM memory in the "Initial Operation and the Spindle Motor Servo" section above). Other things you should check are turntable height, focus coils and focus servo circuitry.

If the optical pickup does not move to the inner position on power up, check the inside limit switch, check that the slide assembly is not stuck or the gears are worn and check the motor drive circuits, the motor, and the control microprocessor.

To check turntable height (when there is no RF signal present), monitor the RF output test point and, while the turntable is rotating, tap the side of the disc nearest the pickup. If you observe an RF signal momentarily, the turntable is too high. If you tap the opposite side of the disc and observe the RF signal, the disc height is set too low.

To check the focus servo and the focus coils, observe if the focus moves up and down two or three times when the player is turned on. Look carefully at the lens in the pickup from the side of the player. You should have a disc on the turntable when you do this. If it does not move, check the focus coils (resistance is typically 20Ω to 30Ω). When checking the coils with an ohmmeter you may see some slight movement of the focus lens caused by the voltage on the ohmmeter probes. If the resistance is within specification, check for a stuck focus assembly.

Player mistracks or skips

This problem may be related to either tracking or servo focus problems. Check the FOK (Focus OK) signal and trace the TER (Tracking Error) signal. If there is no TER signal, both the radial tracking coil and the pick-up motor have no control signals. The loss of either the FOK or the TER signal can cause tracking problems. Also check tracking balance adjust, RF PLL, radial tracking coil and sled (pick-up) motor and rails for binding or sticking. A low laser diode output can also produce tracking errors and audio dropouts.

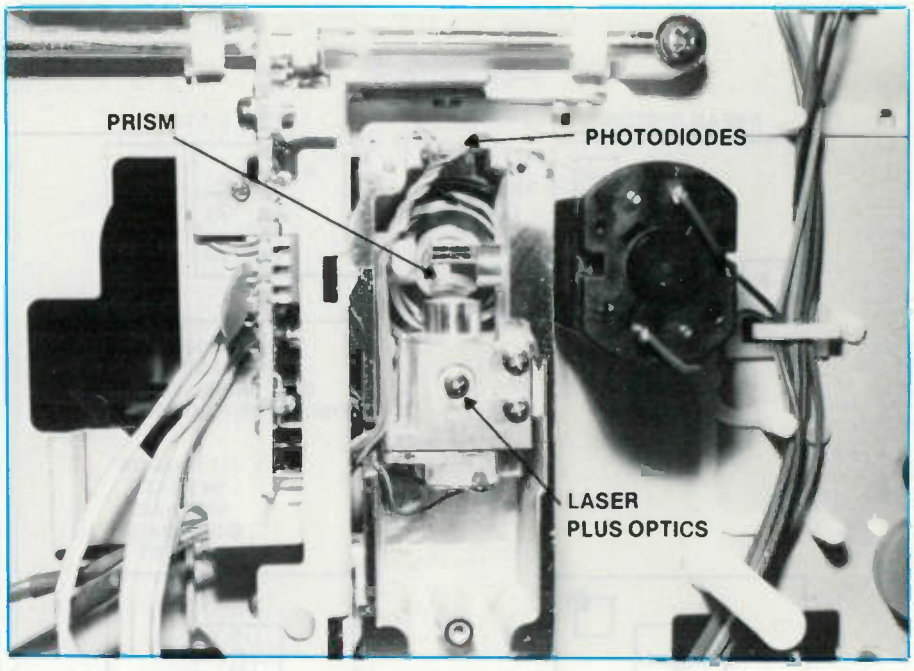


Figure 4. The Sharp laser pick-up with the cover removed (do not open or attempt repairs of the pick-up assembly. if defective it must be replaced).

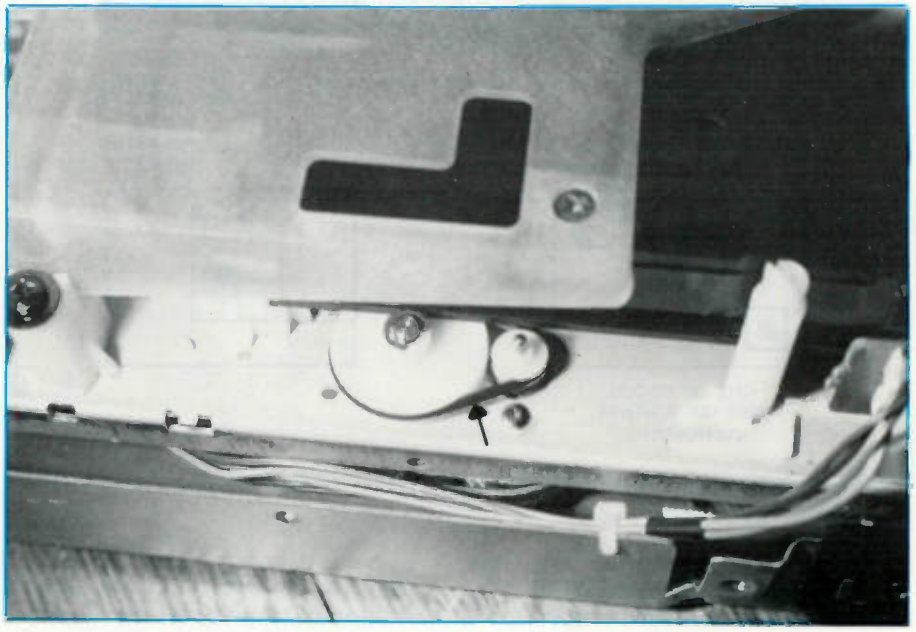


Figure 5. The tray open/close belt.

Player susceptible to bumps or jolts

When the player is unusually susceptible to bumps and jolts, check tracking gain adjust.

Distorted audio

Distorted audio is a sign that most likely the problem is in the audio circuits. Check audio amplifier IC's and transistors and coupling capacitors. The CD player may use a separate amplifier for the headphone jack. If this output is correct you have isolated the problem to some-

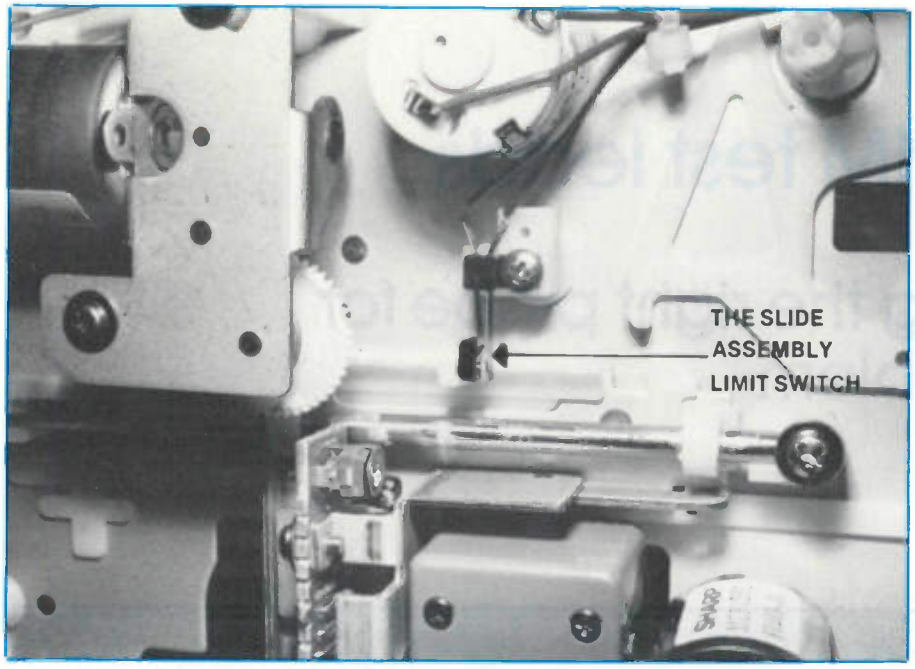


Figure 6. The slide assembly limit switch.

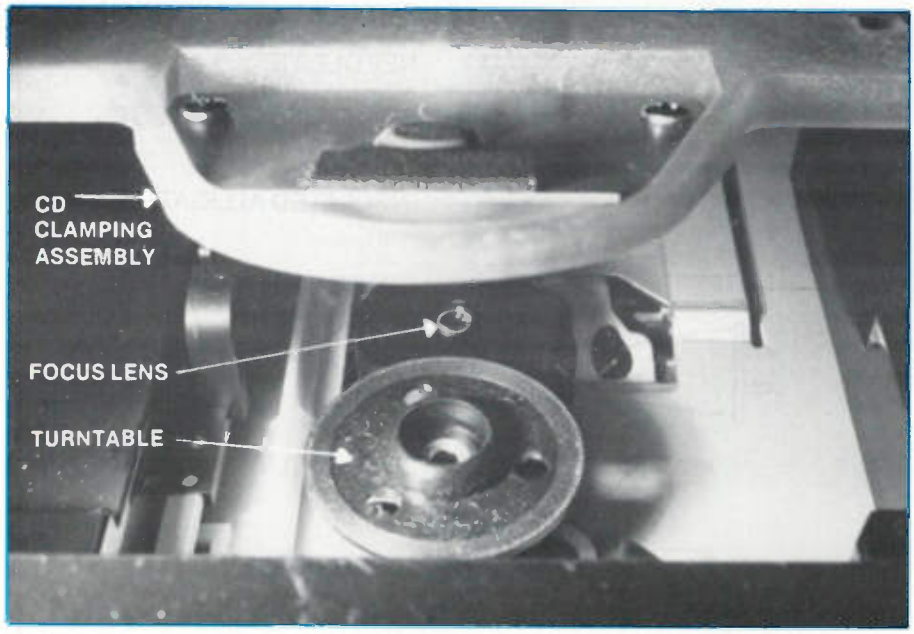


Figure 7. Never look directly at the laser when the unit is on and the interlock switches are defeated.

thing in the area of the main audio amplifier.

Remote control problems

When the CD player doesn't respond to the remote control, start by checking the batteries in the hand held unit, then check for cracked PC cards or damaged parts in the remote control unit (they are often dropped). Check and clean the optical surfaces of both the remote control and the main unit, and check the remote control circuitry.

Front panel control problems

If this symptom is accompanied by a malfunctioning remote, check the system microcontroller. If the remote operates but the front panel controls don't, check the front panel switches, printed circuit card (for cracks caused by excessive force in pressing the front panel switches), wiring harnesses and connectors.

Display problems

When the display doesn't operate properly, check display input power (especially if it's a fluorescent display), check display drivers and look for signs of physical damage or poor connections (especially if one segment is out).

No audio output

If there is no audio output, but the turntable is rotating and there is an RF signal, check the decoding circuits, D/A converter, deglitcher circuit, low pass filter, audio amplifier and muting circuit. Also check connections to the audio output jacks.

Long track search time

Check for dirt and scratches on the disc, power supply output voltages, the RF PLL adjustment, the system microcomputer.

To assist in troubleshooting there are test discs available from manufacturers (such as Sony and the N.A.P. Consumer Electronics Corporation) which evaluate the CD player's ability to play dirty or scratched IC's, and which supply signals that enable the measurement of player performance, amplifier response and speaker performance. ■

All about DMM test leads

Help in choosing the right probe for your testing problem

By Bill Hansen

Connecting test points to a multimeter is an every day experience. Yet, while common, it's usually difficult. It's often at least a three hand job! So having the right kind of test lead, probe and probe tip can be very helpful. Taking a look at what's currently available might help make for a less testing experience.

The basics

The first requirement of a test lead is to make the connection. This means getting through the oxide, dirt, corrosion, insulation or conformal coat to make a good contact with the lead, test point or wire.

The second requirement is to hold the connection - keep a continuous, not intermittent, contact.

The third requirement is dependability. The test connection must be insulated from other devices or equipment. And the connections shouldn't pull loose. All reports indicate this is a particularly frustrating problem. Stopping everything and making re-connections, perhaps several times, is particularly annoying. Having a hot lead swinging loose can also be a danger.

Which leads to point four - safety. Testing can be inherently dangerous. So it's important that the equipment be as inherently safe as possible.

In fact, these four points aren't intended as priorities but as interdependent necessities. A good contact doesn't accomplish anything if you have 1500V flapping against your leg.

Referring to these four basic

Hansen is the engineering supervisor for ITT Pomona

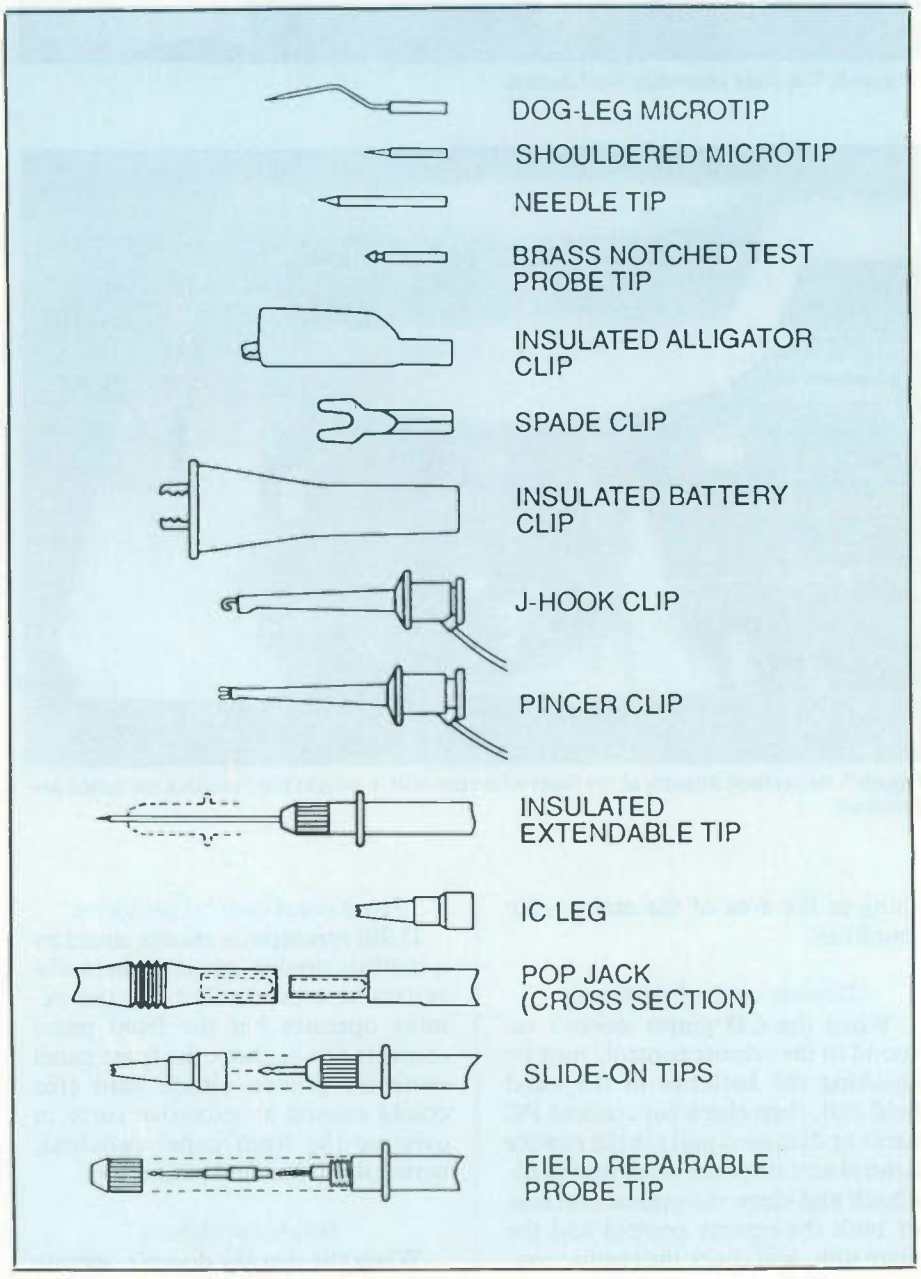


Figure 1. Types of probe tips

needs, we'll look at probe tips, which actually make the test contact, as well as body design and interconnections.

Types of probes

The most common tip is the brass notched test probe tip (see drawing). This is normally a 0.080" diameter brass rod, an inch or less in length, with a conically shaped arrow head on the end.

Brass is a good current conductor with a very low voltage drop across the contact point. It's relatively soft so it can mash into the test point with some friction grab, and not slide away too easily.

Additionally, the notch can lock on to a lead or wire if that's what you're contacting. It's small enough to fit into most spaces, and it can handle most loads you're liable to subject it to.

Sharp needle points offer a lot of advantages, particularly in electronics. They can penetrate oxides or insulation easily, and make a good connection. The sharpness of the point digs in and grabs hold of the test point, tends to stick and not slide off.

Dog leg versions let you dodge around components as well as providing a springiness that lets you move the probe handle slightly without losing your contact point.

Extendible versions let you reach several inches down into a circuit, and perhaps get around a power supply or other object. Because these long, thin tips are insulated, they offer protection against shorts.

Needle tips are so sharp, they can accurately reach minute leads or points. They're stainless steel so they're strong, even springy, easy to handle. The drawback is that steel is not the greatest conductor and the sharp point means you can't drive much current through them or they'll burn up.

The IC leg is a specialty tip, a sharp needle point protected by insulating plastic on each side. As with the needle points, it digs in and holds in place while the insulation protects against shorts. It's excellent for accessing some IC leads.

Alligator clips are also common, perhaps the most common. Nobody likes alligator clips but everyone uses them. They don't fit in close quarters well. The weight of them acts as a lever that tends to work toward pulling themselves loose. Their jaws tend to be out in the open, contributing to inadvertent contact with neighboring objects, although sheathed clips help protect against this. In fact, most clips are now sheathed.

However, alligator clips come in different sizes and we're all used to them, so we use them. And the truth is, you can wiggle them around and force a good contact, and in the right applications they stay locked on and keep the connection. So they have their uses.

J-hooks with a spring loaded insulation sheath can really grab a component lead or wire and hold well. They come in maxi, mini and micro sizes to adapt to different jobs. Gold plated beryllium copper makes an excellent contact (don't accept J-hooks of base metal, the savings aren't worth it).

The spring loaded sheath is a safety factor as well as a mechanical aid for a good hold. Their advantages are obvious. The disadvantage is a slightly higher price than straight tips. In very close quarters, with tightly spaced component leads, J-hooks can also present a size problem.

Pincers were really designed as a J-hook replacement in tighter spaces. The tips, shaped like commas, are gold-plated beryllium copper, heat treated to act as a spring. They reach around and grab on to component leads.

Again, a spring-loaded sheath provides a safety advantage and protects against shorting to adjacent leads. While not expensive, pincers' disadvantage, just as J-hooks, is a higher price than simpler straight tips.

Spade lugs can be screwed down at a binding post, letting you then operate hands-free and turn on your motor, throw your switches and make your measurements. In specific applications they let you hook one or both sides of your multimeter and not worry about making or keeping contact.

A battery clip, not really designed for batteries but the common descriptive name used in industry, lets your grab on to big nuts or bolts and hold on strong.

Probe design

Many of the tips described are available permanently installed in special purpose probes. Some are available as slide on tips, which allow a common probe body to meet a variety of needs. Some are available with pop jack connections to plug-in to a common probe body.

A fixed-tip design offers advantages to anyone who needs to often or repetitively perform the same test step. You just pick up your sturdy probe and do the job.

The disadvantage is a lack of versatility. Either you'll have to try to make do with the wrong probe occasionally, or you'll have to buy a number of different probes to meet each situation. In fact, if you do large amounts of testing, having a collection of probes to meet each situation is a wise decision. A number of kits of probes selected to match various applications are available at good prices.

Slide-on tips give you versatility. You can use a needle sharp tip when you need it, then just slip on a spade lug when you need it. The disadvantage is an outgrowth of the advantage: the slide ons can also slide off. Slide-on tips provide big advantages to anyone who usually works with heavier electrical equipment and only occasionally with electronics; elevators might be an example, operating with high power and controlled by digital electronics. One probe with multiple slide-on tips can meet a number of needs for testing the controls. However, if much of a load is put on the connection, it can pull loose.

The pop-jack connection (see illustration) offers a solution to this problem. It allows you to interchange probe tips but holds them in place tighter. It offers a metal male-female connection with a friction grab, plus the plastic insulating sheaths actually deform and create a seal. The pop-jack connection requires 5 or more pounds pull to dislodge (although if you twist first, it parts easier). It's a little like the Chinese finger puzzle in its holding ability.

Field repairable

Most test probes are insert molded, with the test lead permanently imbedded in the handle. This can present several problems. Most problems occur with the lead wire fraying where it enters the handle. Once this happens, the probe must be discarded and replaced.

There also is a safety hazard. Dur-

ing manufacture, the site of the tip and lead juncture, usually a crimp, can result in a stray wire strand. When molded into a handle, this stray wire can be very close to the surface of the probe and, particularly at high voltages, present serious problems. Most molded probes are 100% hi-pot tested to try to avoid this.

One solution to this problem is to thread the tip-and-lead-wire assembly into a hollow handle and then hold the tip in place with a screw-down chuck. That means that it is inherent in the design to never short through the probe handle.

It also means the probe is actually field repairable. If the lead wire is bent, broken or frayed, you cut it off. You then re-solder the wire to the tip, insert it back into the handle and chuck it in place.

Most probes include finger guards, to keep you away from getting too close to the test points, and matte finishes or ridges to provide a tight grip.

Connections

Connection of the probe to the multimeter is through wire and a standard banana plug.

The wire must have a low enough resistance to let your signals get through and it must be insulated. Probes that use 18-gauge wire, double insulated, more than meet all UL criteria. Some manufacturers use 20 gauge, which is not capable of handling the load in some cases.

Various insulations are available, such as standard PVC and a superior PVC that's more flexible, or silicone, which is both more flexible and much more heat resistant.

There's more to a banana plug than some might think. First is construction, superior banana springs are made of a single piece of heat treated, spring quality, beryllium copper. Any other banana plugs on the market are made of materials with bus spring retention, which may make for less dependable, less reliable connections.

There still are unsheathed banana plugs available for multimeters but the move is away from them. All of the better, newer multimeters accept sheathed plugs. A bare, unsheathed plug swinging loose while hot is just too dangerous to accept. An acceptance of sheathed plugs is urged.

Most users, as they finish a testing task, wrap the leads around the meter and put it away until next time. That means the leads are getting bent at 90°, banged against a drawer or shelf, and eventually tend to break or fray. To counteract this, many leads are molded at 90° from the sheathed plug.

Most applications require some additional connections. And there is nothing more frustrating, or more common, than having connections pull apart right in the middle of a test. It's also dangerous, as mentioned earlier. Look for tight pop-jack connections on lead wires, on probes, and as connectors that let you put together any combination, in varying lengths, to meet your needs. Different companies offer various ways of meeting this problem. Whatever you prefer, it is a problem that must be faced.

Wrap up

Multimeter manufacturers have a bad reputation for test leads. The fact is, your meter probably does not come with the best selection of leads for your specific needs. Typically, you should plan on spending something on additional test leads. The point of this article is to give you some facts that will let you make the most informed decision.

Testing is inherently dangerous, particularly at higher voltages. The closer a user can get to having the correct tool for each task, the safer it will be and the easier it will be to perform the task accurately and quickly. ■

Troubleshooting horizontal circuits in imported TVs

By Homer L. Davidson

Horizontal output circuits in most imported TVs are quite similar to those of domestic manufacturers, except that Japanese sets were the first to include a damper diode built inside the horizontal output transistor (HOT) package. Additionally, the Japanese were ahead of other manufacturers in supplying low scan-derived voltages from the secondary of the horizontal output transformers.

Service the horizontal circuits of sets made in the orient as you would any other TV chassis (see Figure 1).

Davidson is a TV servicing consultant for ES&T.

Shut down problems

Before performing any service on a modern set, connect it to the ac line through a variable isolation transformer. When the symptoms suggest that the problem is in the horizontal circuits, isolate the horizontal output transistor. One way to achieve this isolation is to remove the B + fuse or isolation resistor to the flyback transformer. If a fuse is not handy, then remove the transistor.

Monitor the horizontal waveforms at the driver, the base of the horizontal output transistor, and the flyback transformer. Two different measurements can be made with a dual-trace scope. Clip the HV tester under the diode lead of the picture tube. Measure critical voltages throughout horizontal circuits.

Horizontal output transistor

In the horizontal circuits of the latest imported sets, the damper diode is included in the same case as the output transistor (see Figure 2). The normal PNP output transistor on diode test (DMM) will have a measurement of under 0.5Ω with the red probe at either base or emitter and black lead to collector (metal). When you reverse the leads, you should read infinite resistance.

You should also take resistance readings from base to emitter and

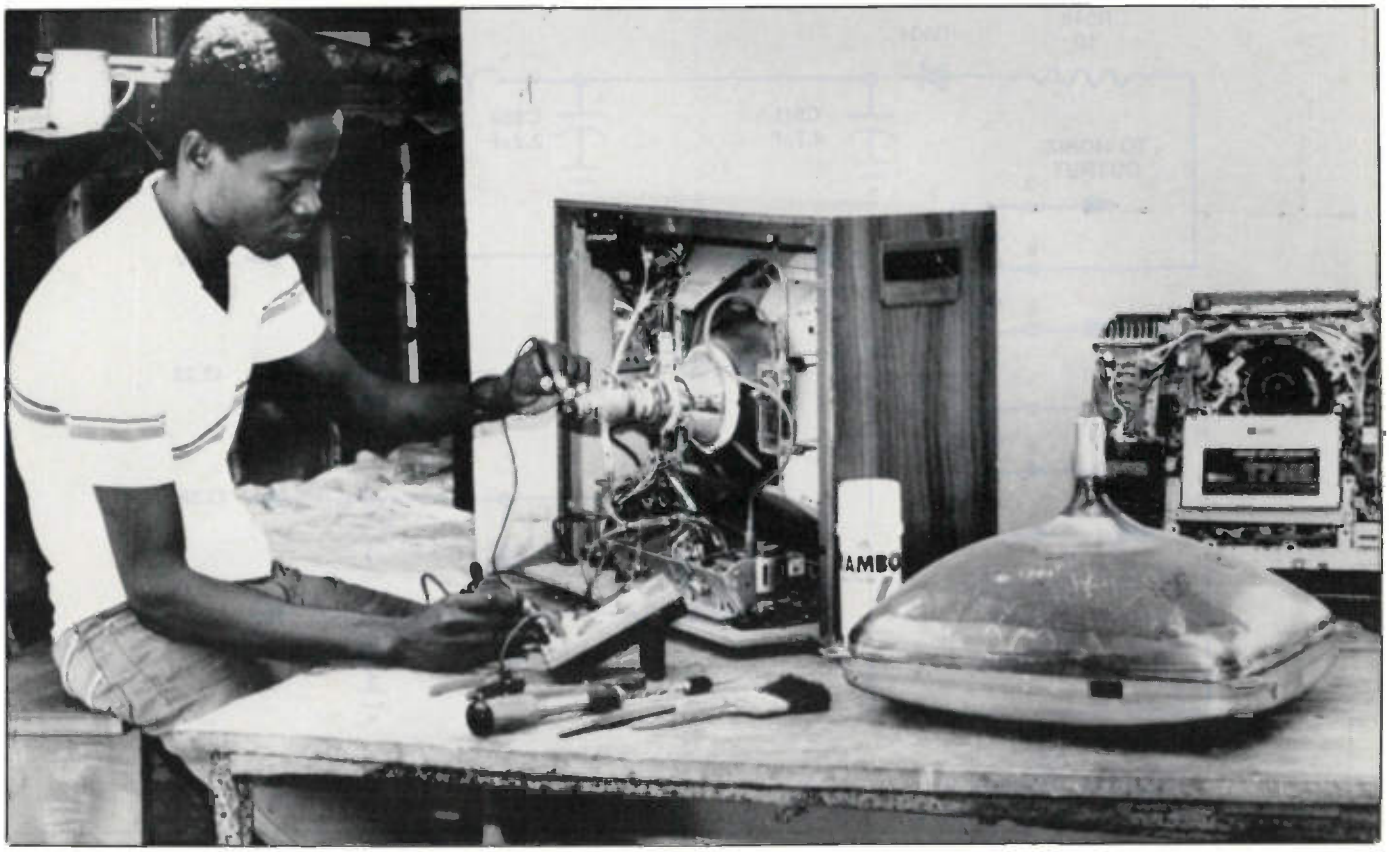


Figure 1. A technician services an imported TV set.

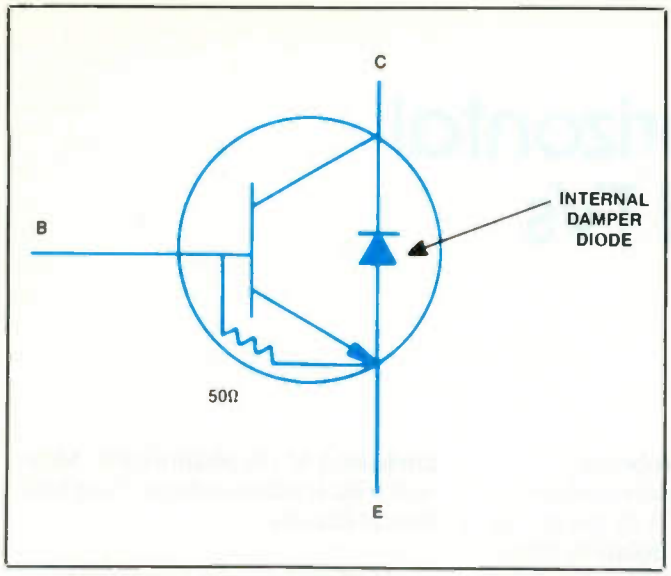


Figure 2. The damper diode is found inside the case of the horizontal output transistor in these TV chassis.

Figure 3. Universal horizontal output transistor replacement chart.

TRANSISTOR NUMBER	RCA	SYLVANIA
2SD869	SK9119	ECG89
2SD898B	SK9119	ECG89
2SD871	SK9119	ECG689
2SC870	SK9119	ECG89
2SD1398	SK9422	
2SD1426	SK9422	
2SD1453	SK9422	
2SD1555	SK9422	
2SD1651	SK9422	

emitter to base of the HOT. A reading of less than 50Ω is normal in both directions. If your DMM has an audible resistance indicator, it will sound at this resistance value.

When a horizontal output transistor shorts or becomes leaky, it usually occurs between emitter and collector. Because the internal damper diode is connected between those two points, it's impossible to tell whether it's the transistor or the diode that has gone bad. Any time you encounter a horizontal output transistor with a low resistance measurement between collector and emitter terminals, replace it.

Do not try to substitute another output transistor in place of this type transistor, unless you add an external damper diode of the correct specifications to the circuit. Universal replacement transistors sold by distributors such as RCA-SK, Philips ECG or NTE may be used to replace horizontal output transistors that include the internal damper diode (see Figure 3).

Scan derived voltages

In a number of present day color TV chassis, several circuits may be powered by low voltages derived from the secondary windings of the flyback transformer. While this is done to improve the efficiency of

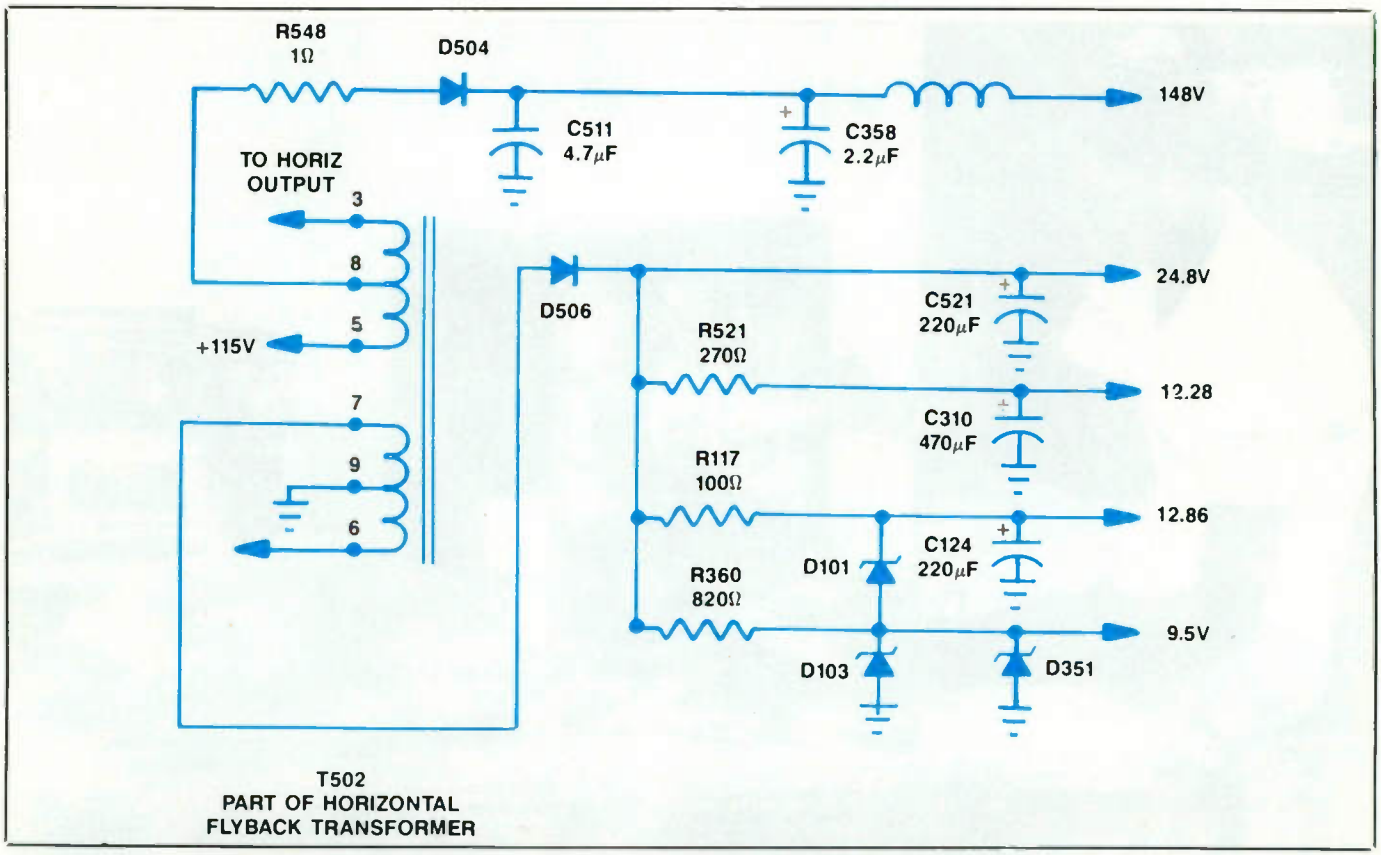


Figure 4. Scan derived low voltage circuits found in the secondary winding of some chassis.

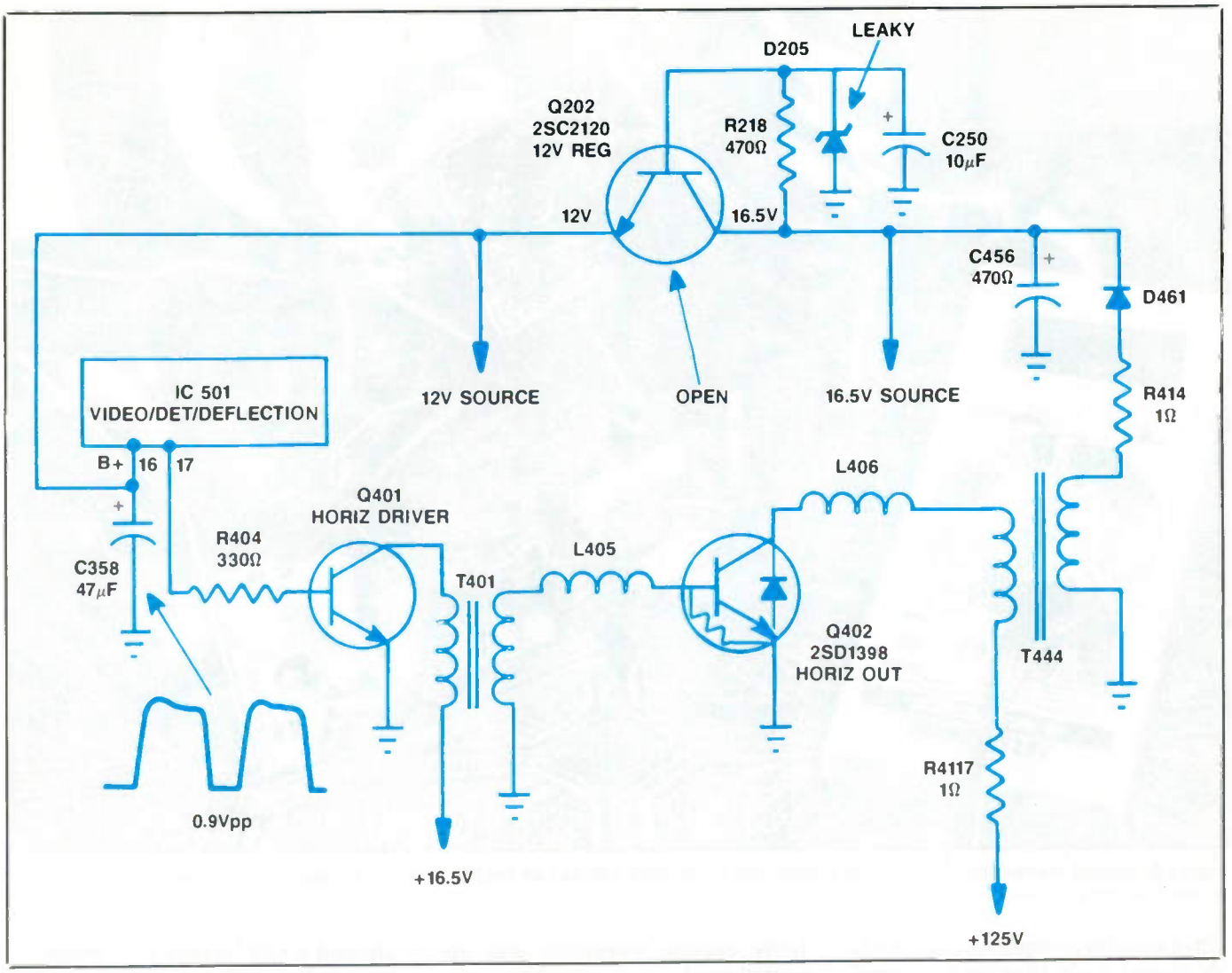


Figure 5. The Samsung K50 chassis shut down was caused by a defective 12V regulator transistor.

manufacturing, with its consequent lowering of costs, a side effect is that these sets are more difficult to service: in a set with scan-derived supplies, the horizontal output stages must be functioning before other circuits will operate (see Figure 4).

If the horizontal oscillator and output circuits also are fed from the scan derived low voltages, it becomes extremely difficult to isolate the defective component. In low voltage circuits in some Japanese sets, the horizontal oscillator IC is fed directly from the low voltage power supply. In the case of these circuits, problems in the horizontal stages can be quickly isolated. If the low voltage feeding the horizontal oscillator or countdown circuits are fed from the flyback power circuits, however, the only way to check the oscillator is through the use of an external power supply.

Scan derived voltage circuits are difficult to service when the chassis is shut down or has HV shut down. The same applies to a no start-up chassis. Isolation and external voltage injections are effective in troubleshooting scan derived low voltage circuits.

The best method to show how to service horizontal circuits in imported sets is to discuss actual trouble symptoms.

Samsung K50 chassis shutdown

A Samsung K50 chassis set was brought into the service center with a symptom that it did not operate at all. The first step in servicing this set was to determine if the symptom was caused by failure of the ac-line power supply, or if the problem was the result of high voltage shut down. To determine this, I monitored the high voltage at the anode of the CRT and the low voltage at the power supply.

I measured about +128 volts at the collector (metal) terminal of the HOT. Because the horizontal output transistors cause most horizontal circuit problems, my first step was to check Q402 resistances. An in-ircuit check showed that Q402 was normal (see Figure 5).

When the switch was turned on, no HV was present at the HV probe. Often, HV shut down occurs after excessive high voltage and takes a few seconds before shutdown. I assumed the symptoms were chassis shutdown.

Naturally, with no output from the horizontal output transistor very little voltage was found at pin 16 of IC501 and collector of Q401, since these voltages are derived from the flyback circuits. D401 and R414 tested normal. The flyback winding of pin 1 and ground indicated low ohm continuity on the ohmmeter.

Since the horizontal drive waveform from IC501 must be present (pin 17) in order for this set to operate, and generation of this horizontal

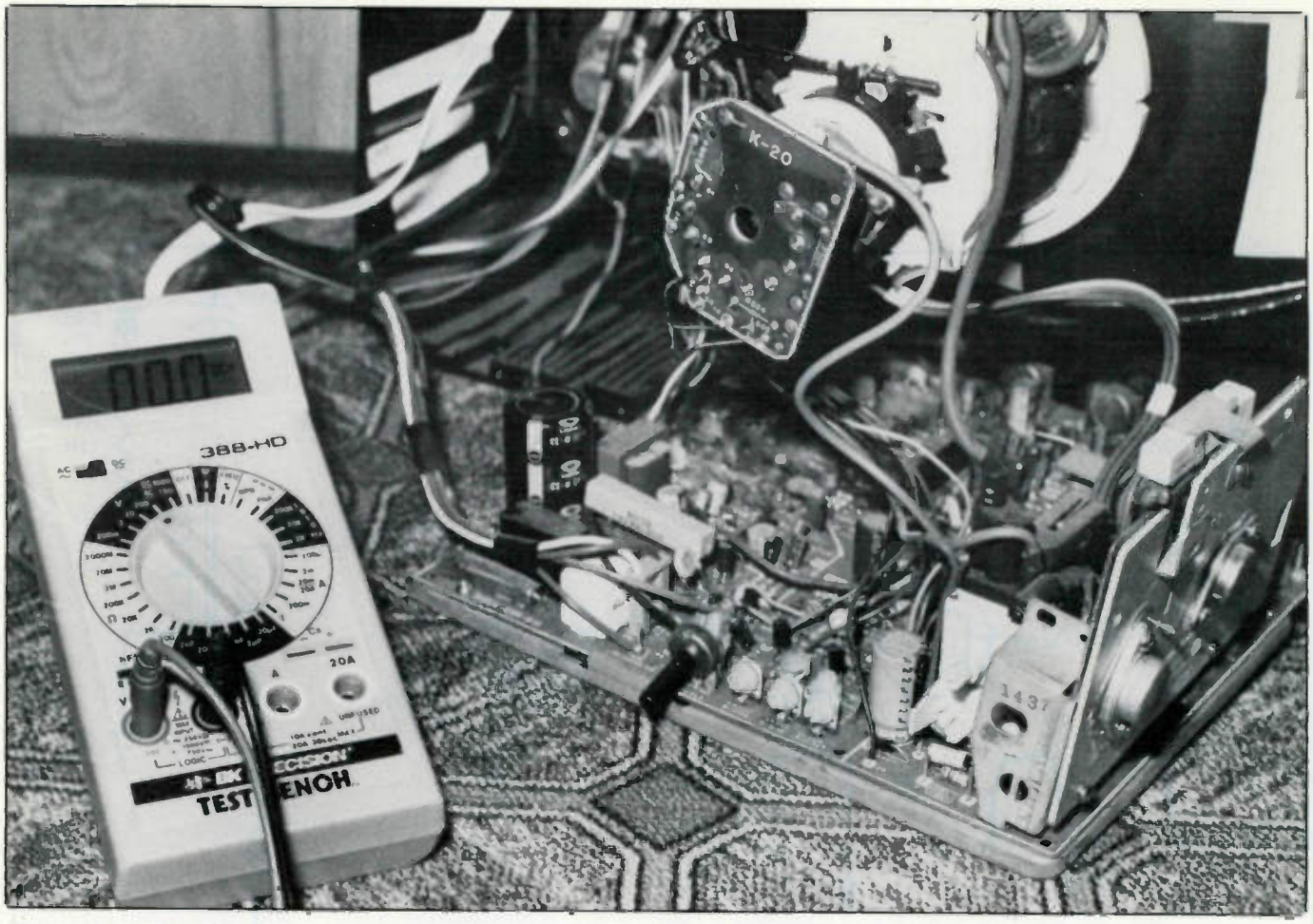


Figure 6. Careful measurement of critical voltage and resistance values can help to locate defective components in the horizontal circuits.

drive waveform requires that there is dc present at pin 16 of the horizontal oscillator IC, I applied a 12.5V external voltage source to pin 16, with ac power disconnected, then monitored pin 17 with the scope to determine if the internal oscillator and horizontal drive were normal. IC501 produced a fairly normal waveform and appeared good.

From the foregoing tests, I assumed that the horizontal driver or flyback circuits were the problem. I came to a different conclusion, however, after checking the 12V regulator circuit in the 16.5V line. Q202 showed a 52Ω leakage path between base and ground. Suspecting a shorted transistor, I removed Q202. Further checks showed, however, that Q202 was open between base and emitter terminals, and that leakage still was present from the base terminal to chassis ground. D205, a zen-

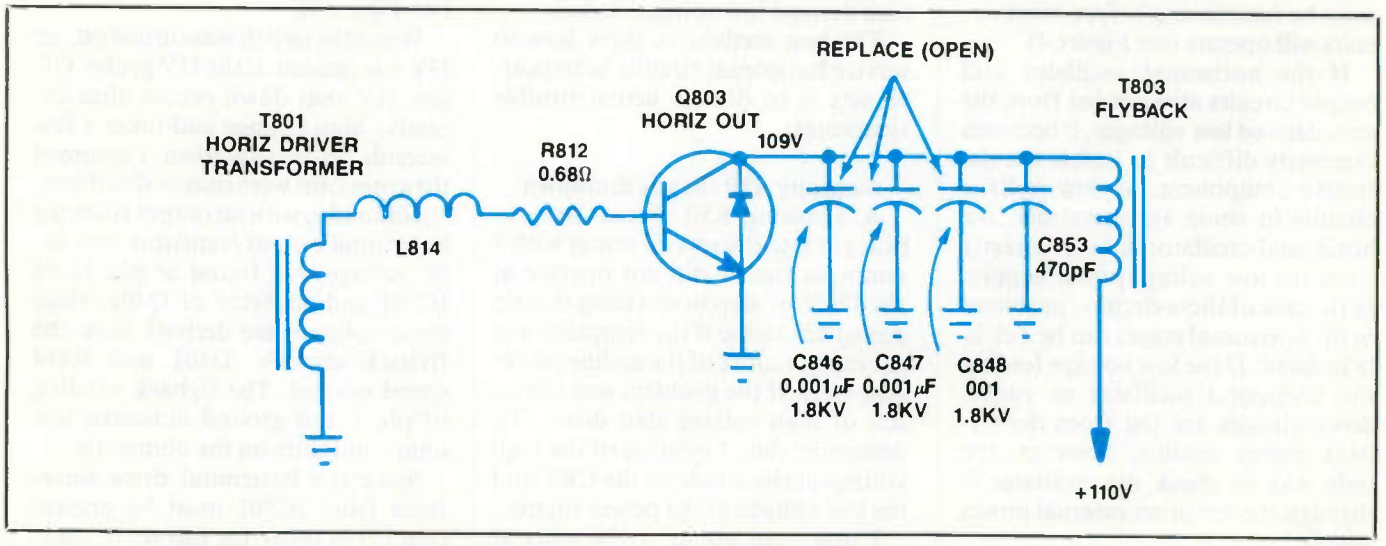


Figure 7. Excessive high voltage in a Sony CVM 1270 model was caused by open safety capacitors.

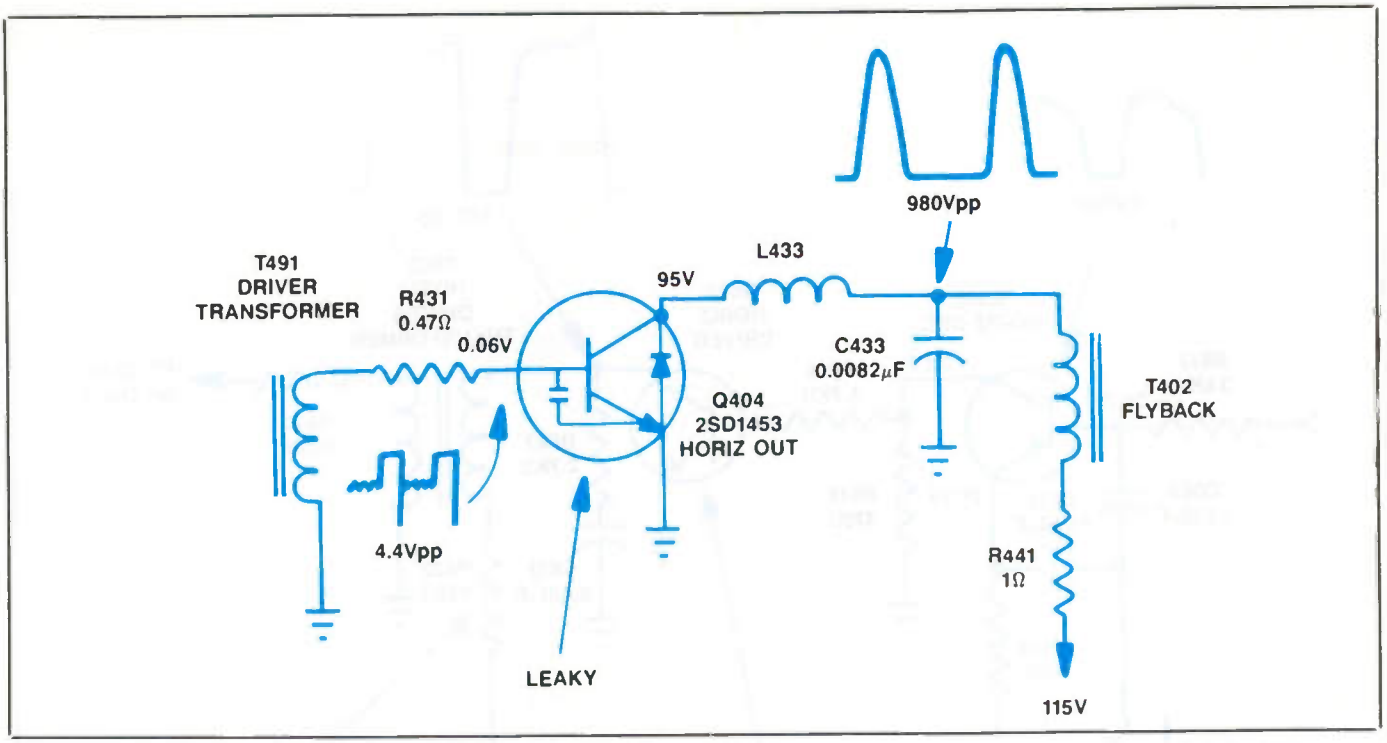


Figure 8. Leaky Q404 blew the fuse repeatedly in a Goldstar NF-OIX chassis.

er diode, was the culprit. I replaced Q202 with an SK3849 universal replacement, and D205 with an appropriate replacement diode.

After replacing Q202 and D205, the horizontal output circuits were normal and produced a raster. Although the shut down trouble may be caused by any of the horizontal, flyback or low voltage stages, the trouble in this case occurred in the 12V source, causing chassis shut down.

Sony CVM 1270 excessive high voltage

In one Sony set, sometimes the chassis would shut down whenever it was turned on during the day, but then operate perfectly through the evening hours. Because the set operated during the evening and shut down in mornings, I suspected line voltage problems. I measured 123 Vac in the afternoon when I went to check out the problem.

When I monitored the low voltage at the collector of Q803 it was 115V. The specs called for 110V. I adjusted the 110V adjustment (RV 601) to +110V at Q802 (see Figure 7). I assumed this adjustment was set too high such that it caused problems during the day when the power line load was light and the voltage was high, and when the load on the line increased during the evening, that the set would operate satisfactorily.

Two days later I returned to pick up the set because it was experiencing the same problem. I noted that when I rotated the 110V adjust, the high voltage became excessive and shut down the chassis. At first the HV shutdown circuits were suspected. Further investigation revealed that when higher voltage was applied to the collector of the horizontal output transistor picture width became excessive.

Usually, when both picture width and HV are excessive, the high voltage increase is the result of a defective safety or hold-down capacitor in the collector circuits. In this set the HV probe indicated excessive high voltage even though the +110V was at the correct value. The symptom clue turned out to be excessive width and poor horizontal linearity.

I left the HV probe to monitor the high voltage while making other tests. Although, C846, C847 and C848 appeared normal, when I pried at C848 with an insulated tool the chassis shut down, accompanied by high voltage arc over. I noticed all three safety capacitors had the same capacitance value (0.001, 1.8kV). No doubt, one or more of these hold down capacitors had become open.

I replaced C848, C847 and C846 with exact replacement part numbers. Because one had failed, I assumed that the others had been damaged. Now, when I adjusted RV601 for 110V operation, the raster width was normal. I again readjusted the low voltage control when I returned the set to the slightly high power line.

Keeps blowing the fuse

While servicing a Goldstar NF-01X chassis, I found both low voltage fuses (F801 and F802) open. I replaced the fuses, but when I plugged the chassis in and turned it on, F802 failed again (see Figure 8). Either the low voltage regulator (IC801) or the horizontal output circuits were leaky.

A quick resistance check of the horizontal output transistor, Q404, indicated a 0.17Ω measurement. The schematic diagram for this set showed that the Q404 package contained the damper diode as well as the HOT. I removed Q404 and checked it out of the circuit. The resistance readings I obtained revealed that either the internal damper diode was shorted or there was high leakage from collector to emitter of Q404. Replacing the 25D1453 power output transistor with an SK9422 universal replacement returned the set to normal operation.

Sampo KR-1306 - No horizontal sweep

A Sampo KR-1306 set that I worked on exhibited the symptom of absence of horizontal sweep. My first

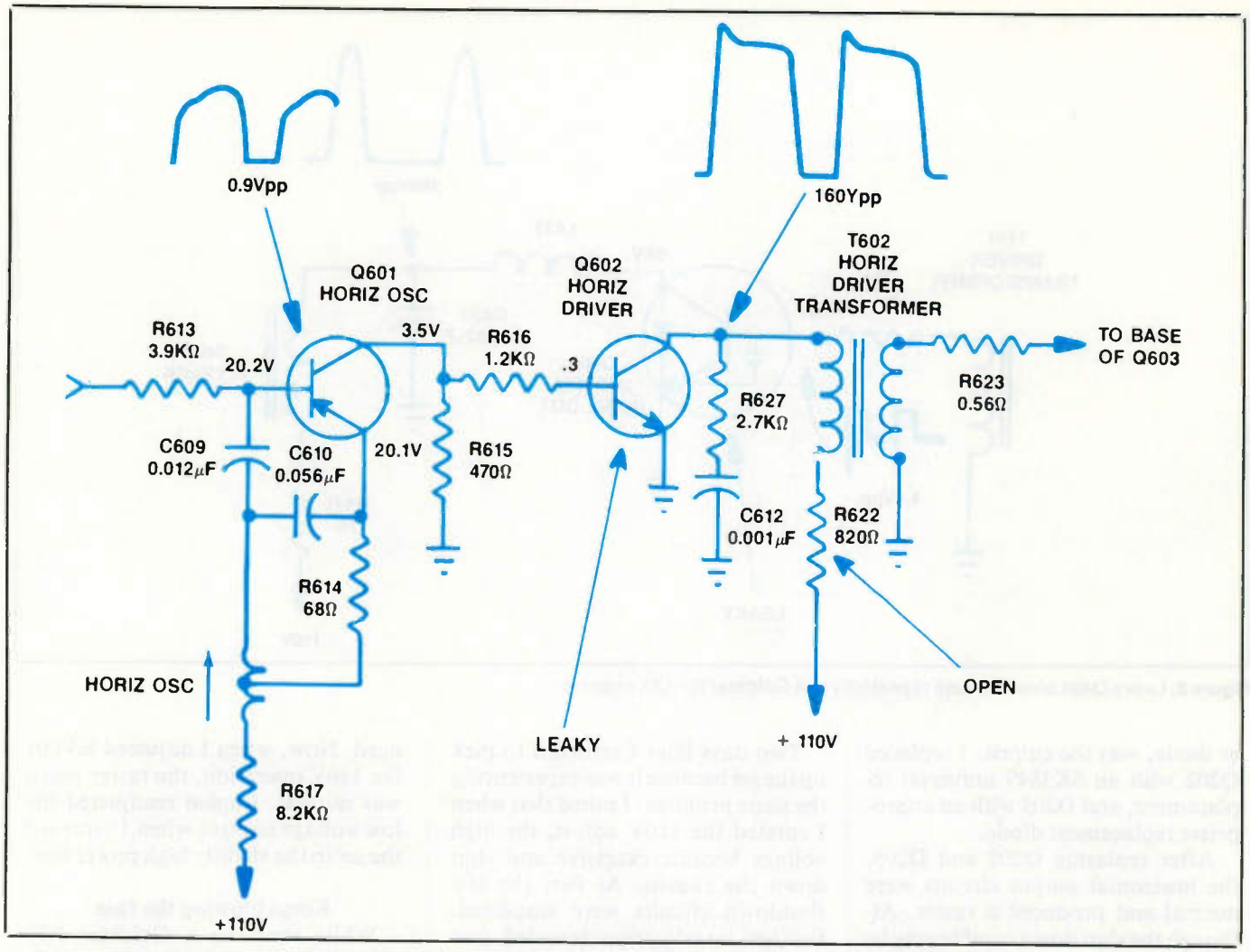


Figure 9. Absence of horizontal sweep in a Sampo KR- 1306 portable resulted from leaky Q602 and open R622.

diagnostic step was to measure the voltage at the collector of Q603 (105V). A quick scope test on the base of Q603 indicated that there was no horizontal signal. There was no waveform at the horizontal driver transistor (see Figure 9). The waveform at the output of the horizontal oscillator transistor (Q601) did not look correct.

The low voltage power supply was fairly normal, so I decided to look elsewhere. The voltage output from this supply also feeds Q601 and Q602 (110V). The voltages on the collector of Q602 and T602 were very low. Resistance measurements revealed that R622 was open and that Q602 was shorted between collector and emitter terminals. I replaced the resistor, and installed a SK9362 universal replacement for the 25C1514 driver.

My experience has shown that sometimes the horizontal driver transformer is the cause of intermittent start-up because of poor soldered terminal leads. The reason for this is that this is a relatively massive component whose leads do not get sufficiently heated during the wave soldering process. I soldered all four terminals at the same time as I was installing R622.

Insufficient width

I was called to service a KTV 13 CNR-C portable that had about one-inch of black on each side of the raster. This indicated some kind of problem in the circuits that control width. The set would sometimes shut down after operating for several hours. Width problems are usually caused by problems in the horizontal output transformer, flyback, yoke or pincushion transformer circuits.

In this set, the voltage measurements on Q404 were fairly normal, and there were adequate drive and output waveforms. I checked C450 and C451 first as most width problems are the result of defective safety capacitors (see Figure 10). They were normal.

Next, I inspected the deflection yoke for overheated or burned marks but there were no visible signs of overheating. I soldered the leads of pincushion transformer T304 because they have a tendency to heat up and break. This did not correct the problem. Although, no resistance values were indicated on the schematic for the primary or secondary winding of T304, the ratio of resistance between windings was 9 to 1, which is fairly normal with pincushion transformers.

Continuity checks upon the yoke windings and resistance measurements of corresponding resistors turned up nothing. Careful inspection of small components around the pincushion transformer revealed only that C318 looked a little unusual. A touch, revealed that the small electrolytic was running warm. Replacing the 33μF capacitor with a 35V

(Continued on page 37)

ES&T Manufacturers' schematics **PROFAX**

OCTOBER 1991

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RCA/GE

CTC 167 Color TV.....3081

FM RADIO SCHEMATIC

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

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

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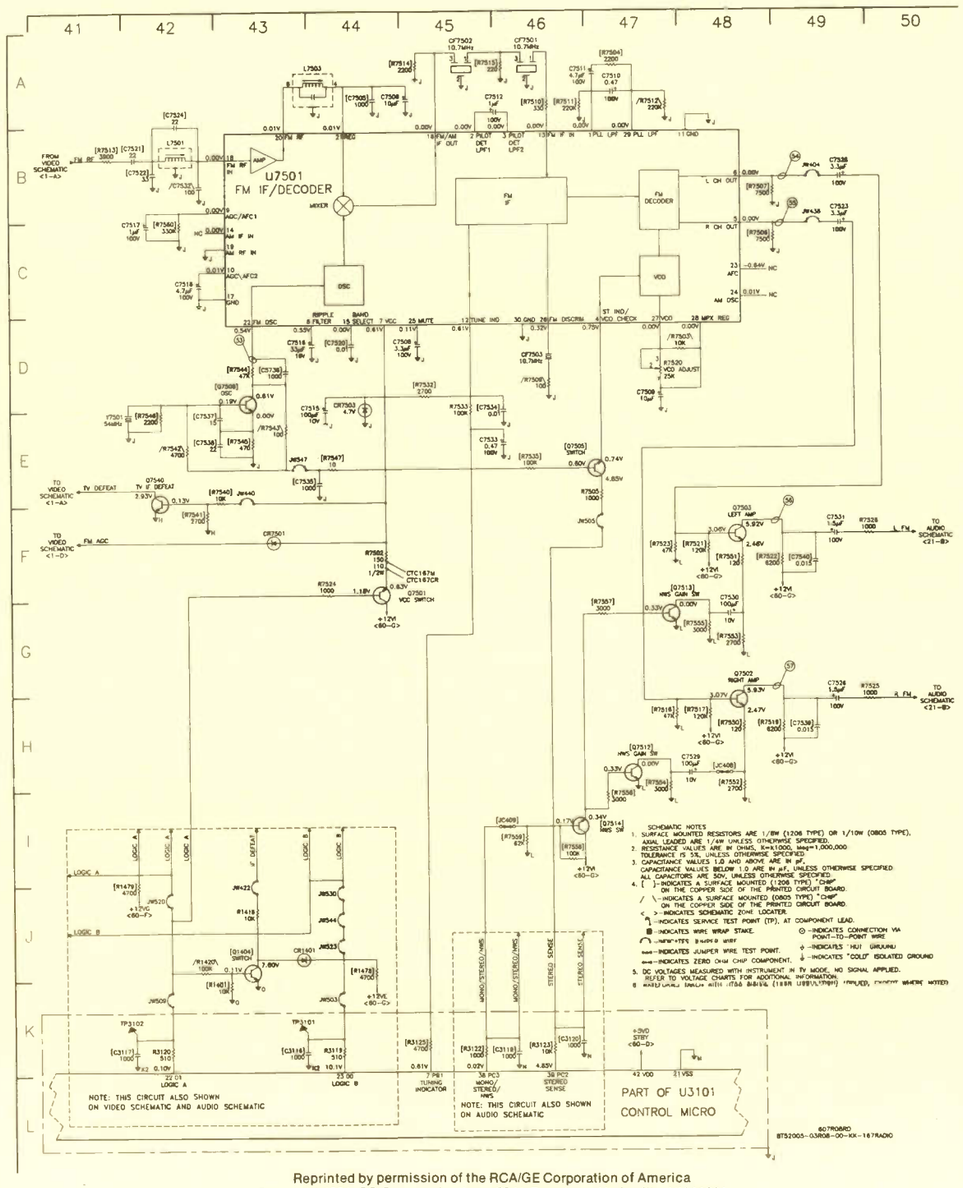
The other portions of this schematic may be found on other Profax pages.



POWER SUPPLY SCHEMATIC

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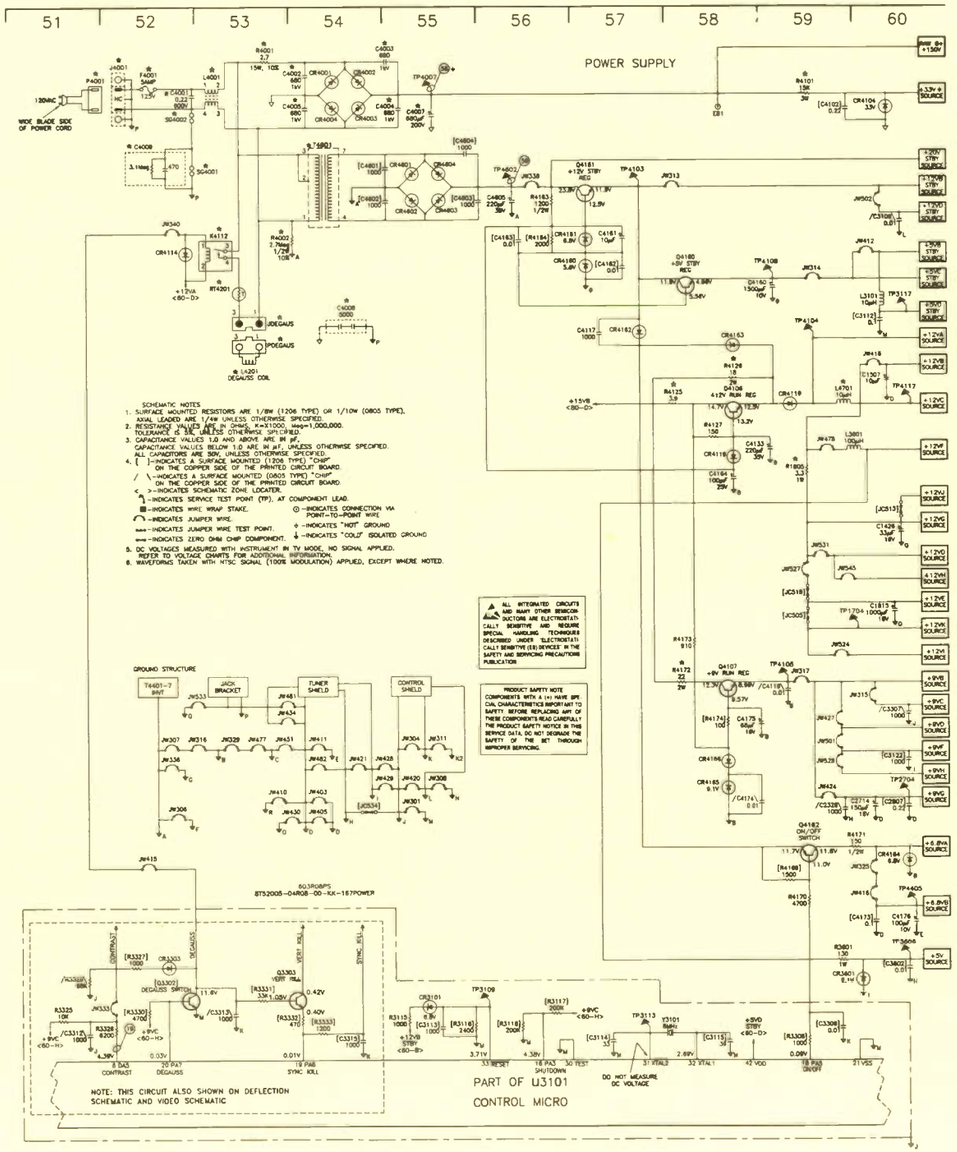

VIDEO SCHEMATIC

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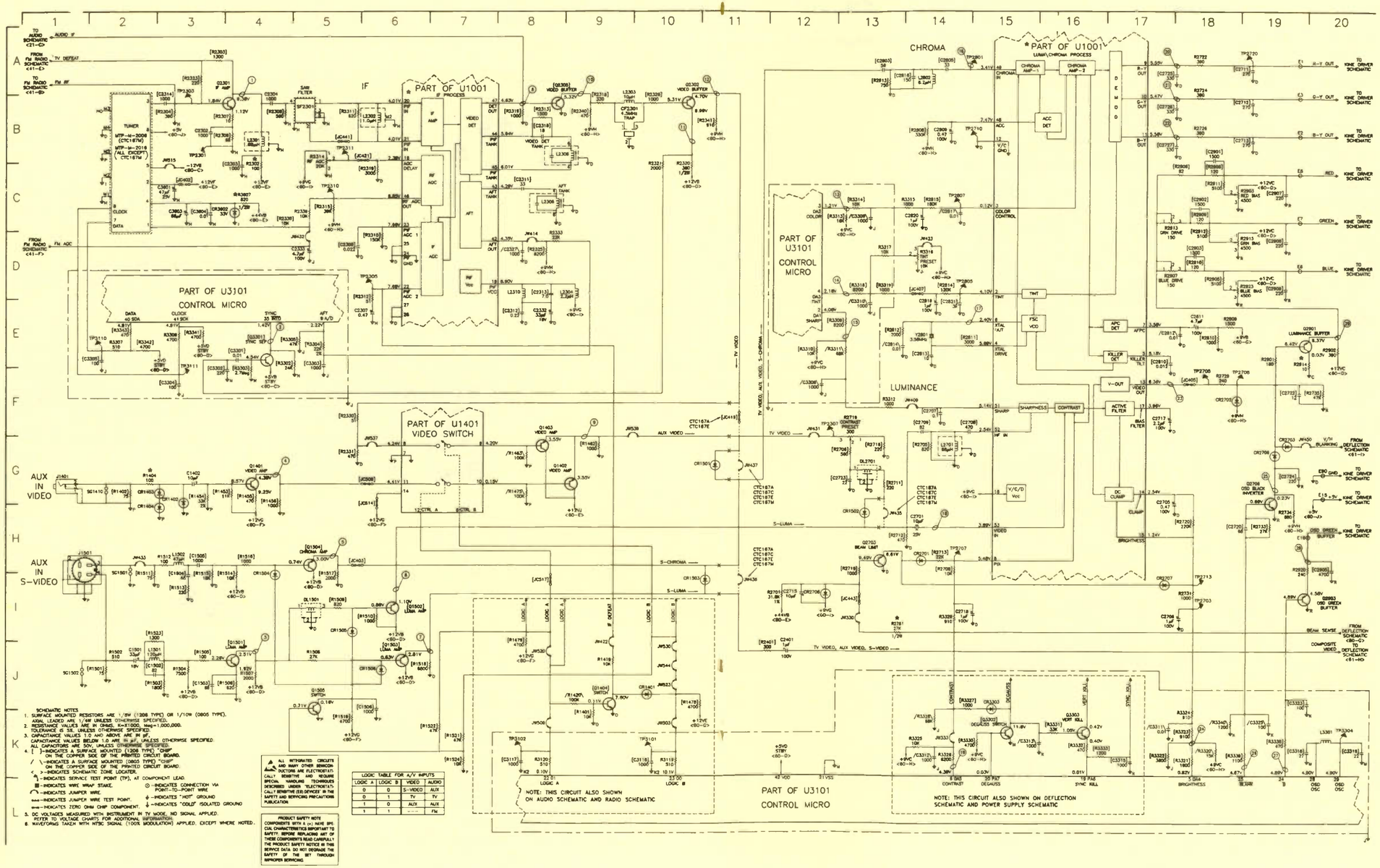

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INTERCONNECT WIRING DIAGRAM

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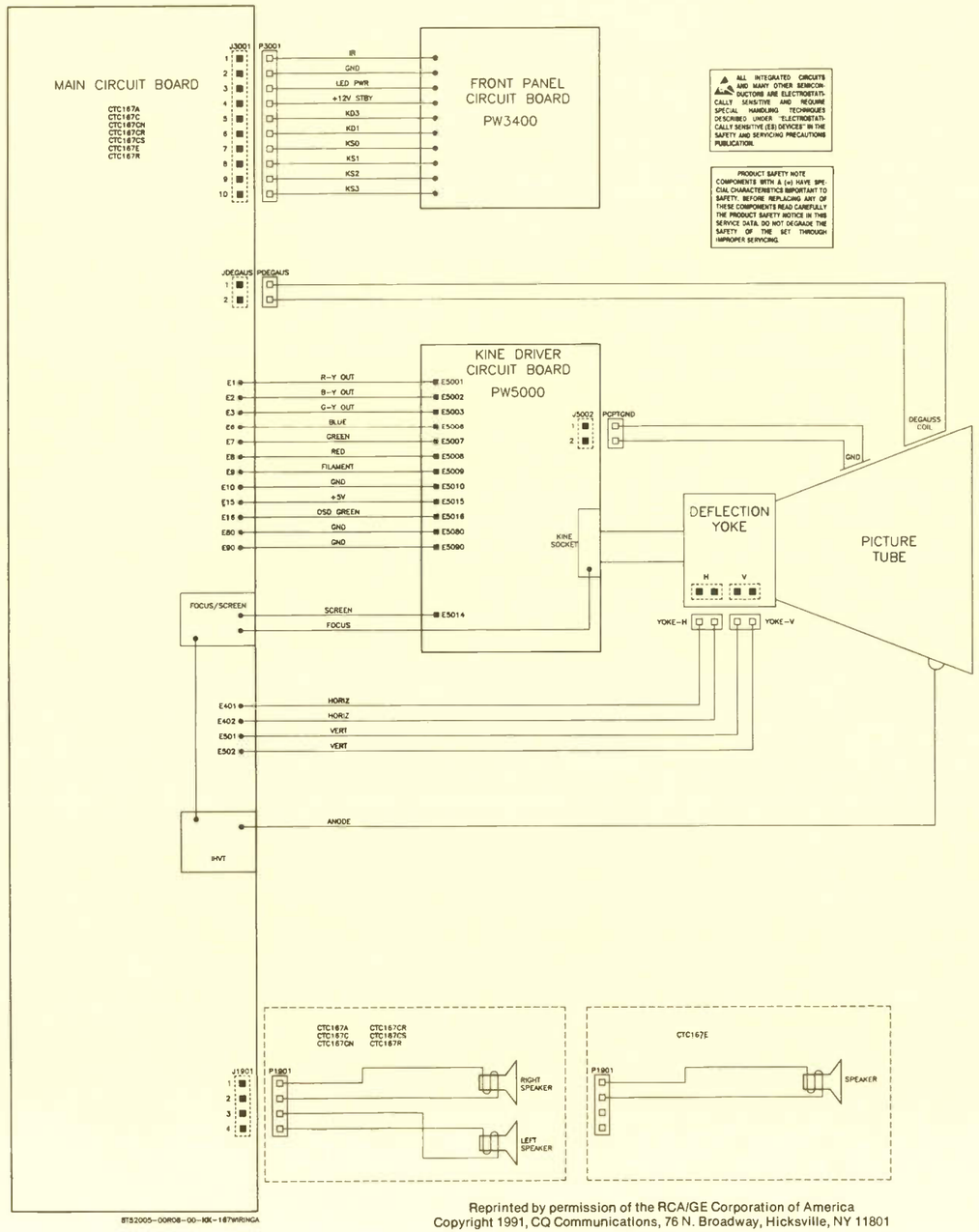

Manufacturers schematics PROFAX 3081

INTERCONNECT WIRING DIAGRAM

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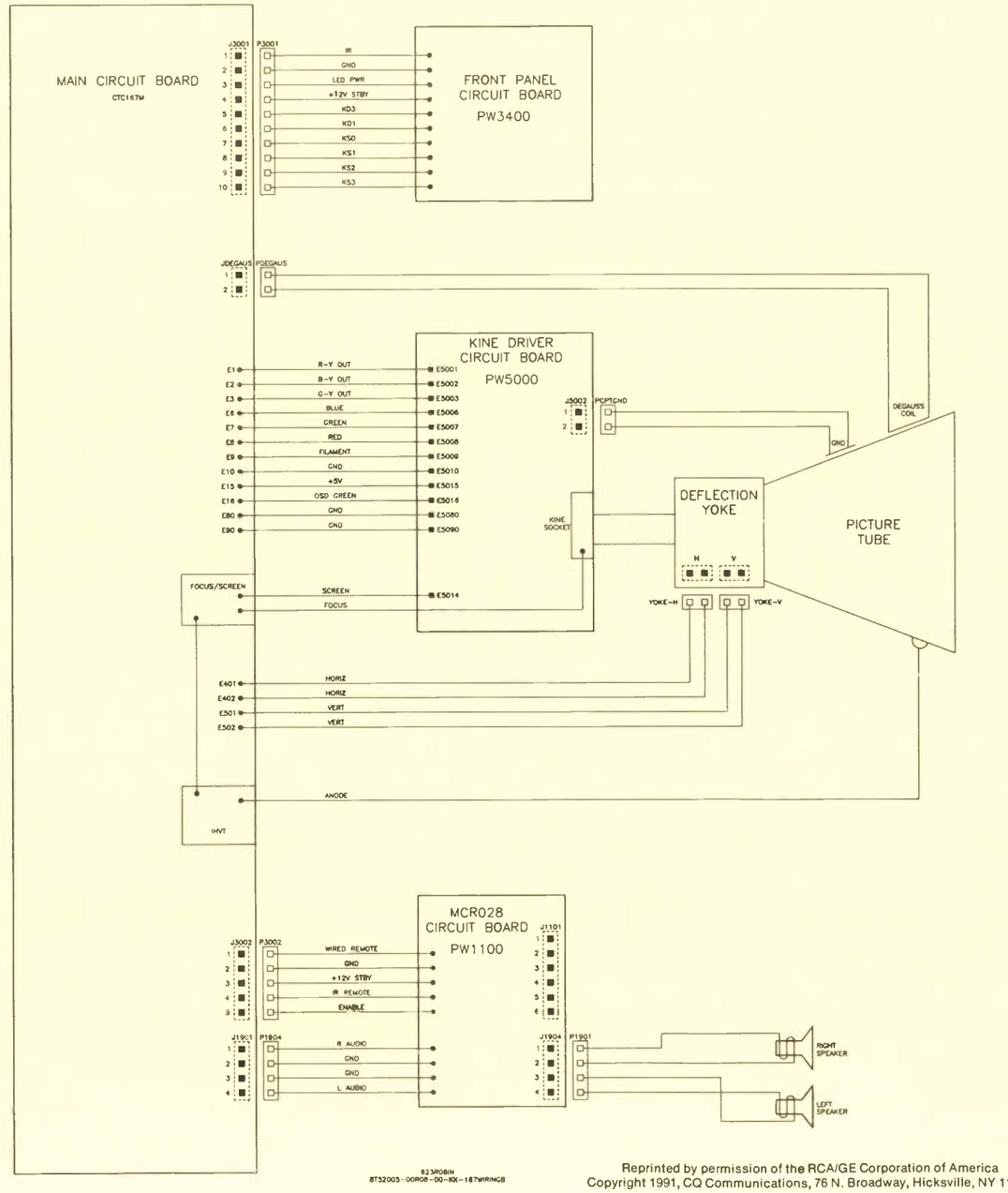

AUDIO SCHEMATIC

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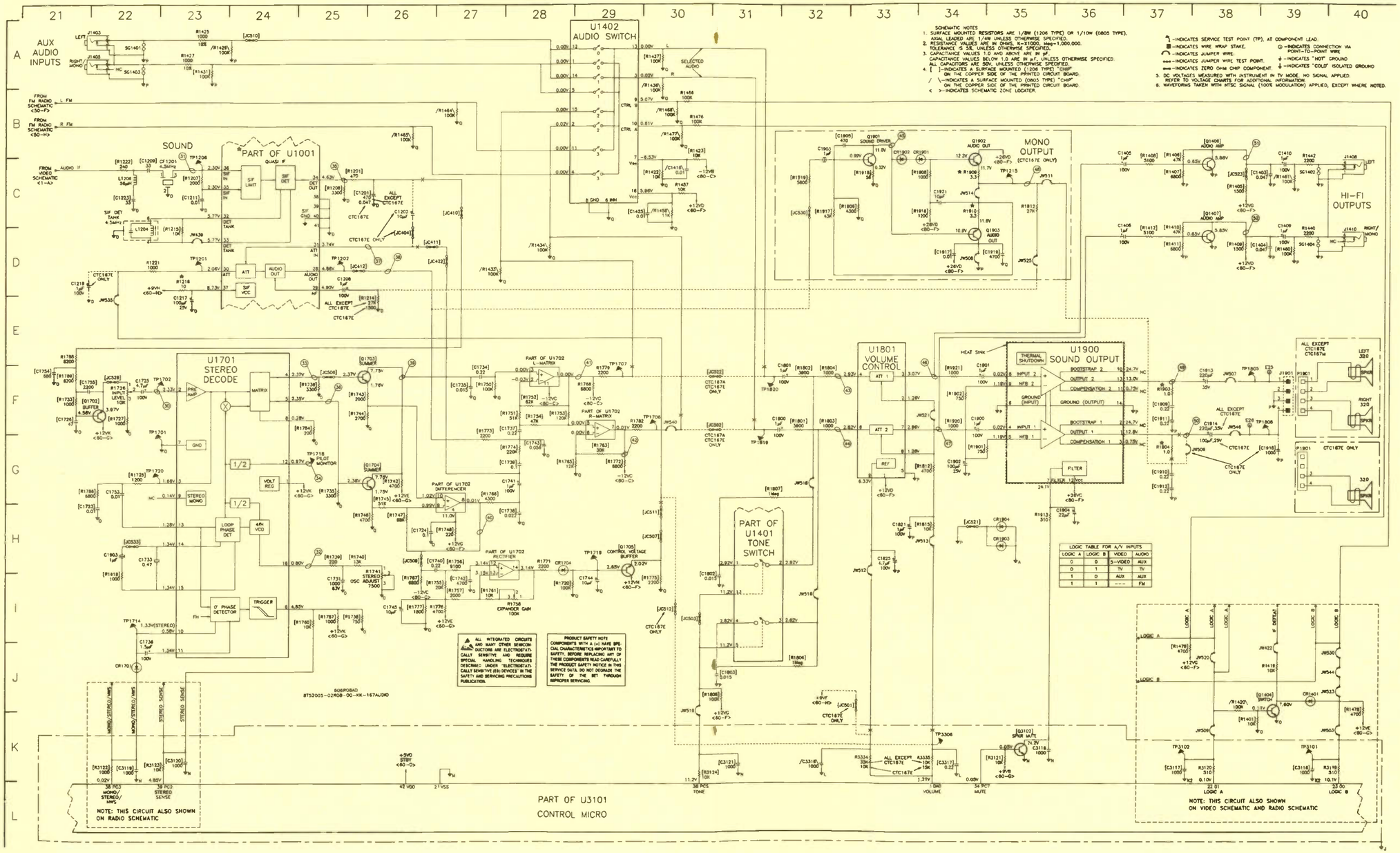
Manufacturers' schematics PROFAX 3081



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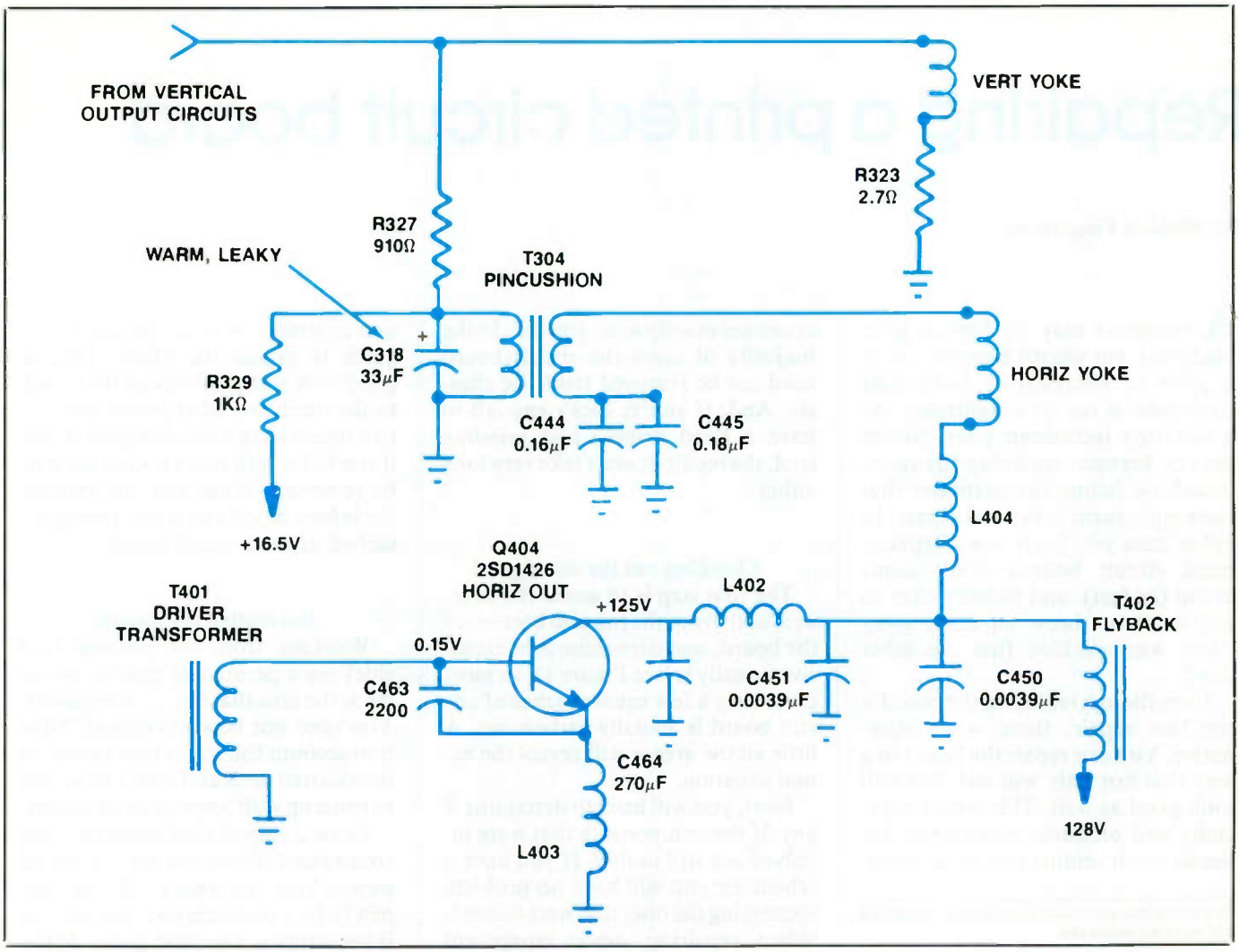


Figure 10. A leaky C318 pincushion electrolytic capacitor produced a narrow raster in a KTV 13 CNR-C portable. I identified this problem when I found that the capacitor was warm to the touch.

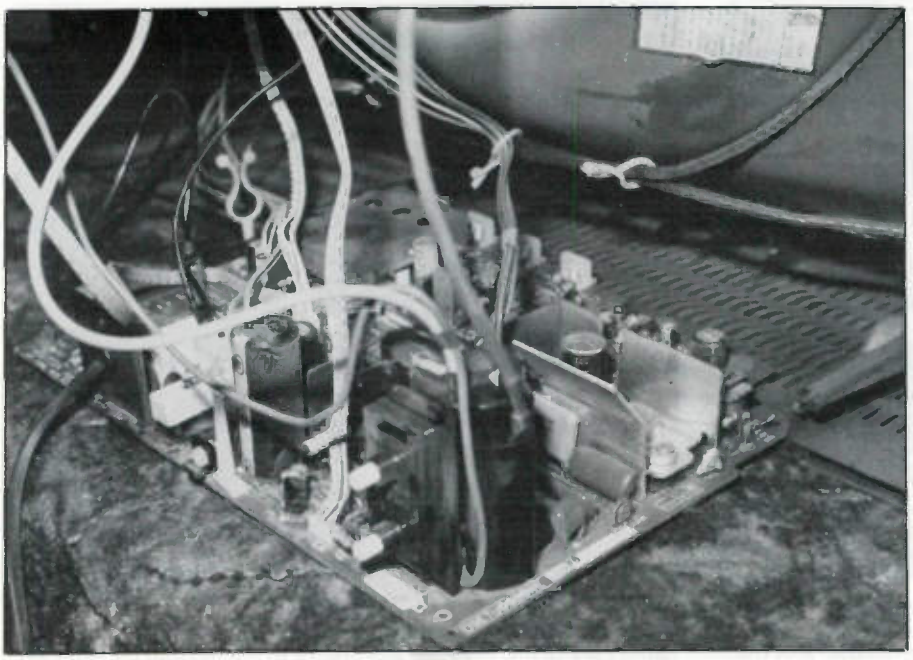


Figure 11. Notice how small the chassis is in this set. In most imported sets, universal replacements are quite adequate for faulty horizontal output transistors.

capacitor solved the width or narrow sweep problem.

Conclusion

While the circuitry of imported sets may be similar to domestic units on the service bench, component part replacement is frequently more of a problem. Most troublesome components are in the horizontal output, flyback, pincushion, driver, deflection IC, low voltage and regulator circuits. Universal replacements are perfectly acceptable for such components as a defective horizontal output transistor (see Figure 11). Critical safety parts, such as driver and pin cushion transformers and flybacks, however, should be replaced with exact replacements.

If critical parts can not be found locally, try the manufacturers depots and parts departments. You may have to order some of those parts from electronic mail order firms. ■

Repairing a printed circuit board

By Sheldon Fingerman

A barbecue may be fine in your backyard, but when it happens inside a piece of electrical or electronics equipment it can be a nightmare. As a servicing technician your choices may be between replacing the entire board, or telling the customer that their equipment is beyond repair. In either case you both lose. Replacement circuit boards don't come cheap (or fast), and nobody likes to pay a lot or throw anything away "that was working fine the other day."

Even though replacing the board is the best repair, there is an alternative. You can repair the board in a way that not only will last, but will look good as well. This works especially well on audio equipment that has so much venting that the customer can see exactly what you did. In the majority of cases the circuit board need not be removed from the chassis. And, if you're lucky enough to have a hand drilling and grinding tool, the repair doesn't take very long either.

Fingerman is an electronics and computer consultant and servicing technician.

Checking out the damage

The first step is to assess the damage, both from the top and bottom of the board, and determine how extensive it really is (see Figure 1). In most cases only a few square inches of circuit board is actually carbonized. A little elbow grease will reveal the actual situation.

Next, you will have to determine if any of the components that were involved are still usable. If you have a schematic you will have no problem identifying the ones that were burned. When repairing stereo equipment one channel can often be used as a guide to repair the other. Take a good look at the foil side of the board to determine to what extent the circuit traces have been damaged. Even if the foil is still there it may have to be removed. What you are looking for is how much foil is still firmly attached to good circuit board.

Recreating the circuit

Working from the bottom (foil side) use a permanent marker to encircle the area that has to be removed. You need not be symmetrical. Take into account foil traces that surround the charred area and don't be afraid to come up with some unusual shapes.

Draw a map of the foil pattern and component placement on a sheet of paper. You can trace it, if you happen to be a perfectionist, but all that is necessary is a general guide. Make

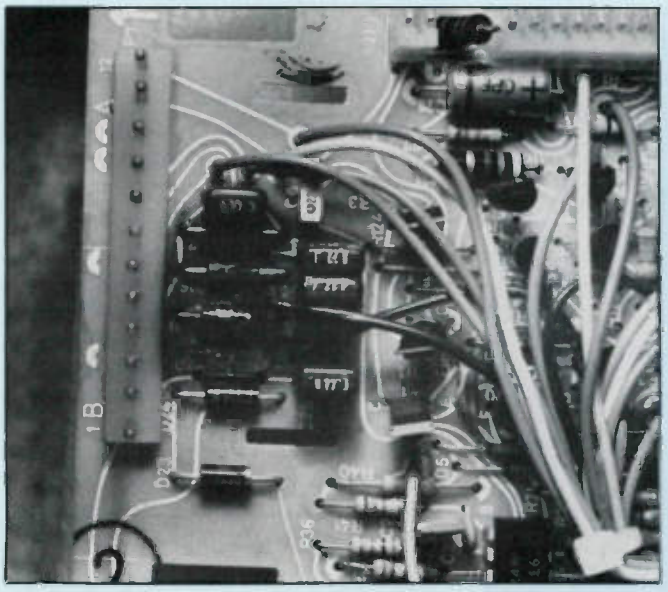


Figure 1. When a PC board gets burned like this as a result of a malfunction, it isn't always necessary to replace the entire board or discard the product. If the damage is not too extensive, and the unit is worth it, or has sentimental or classic/antique value, you may be able to patch the board and restore the unit to operation.

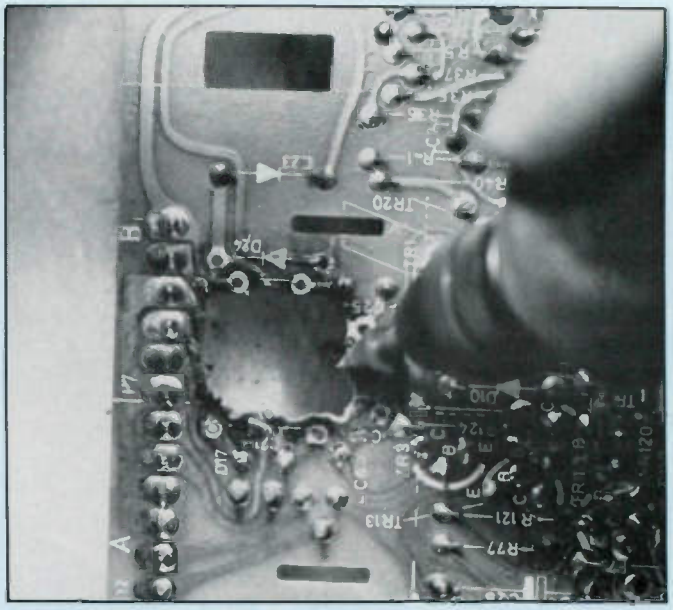


Figure 2. Remove the components from the damaged area, then being careful not to cause any cracks to spread into undamaged parts of the PC board, cut, chip, or grind away the burned parts of the board.

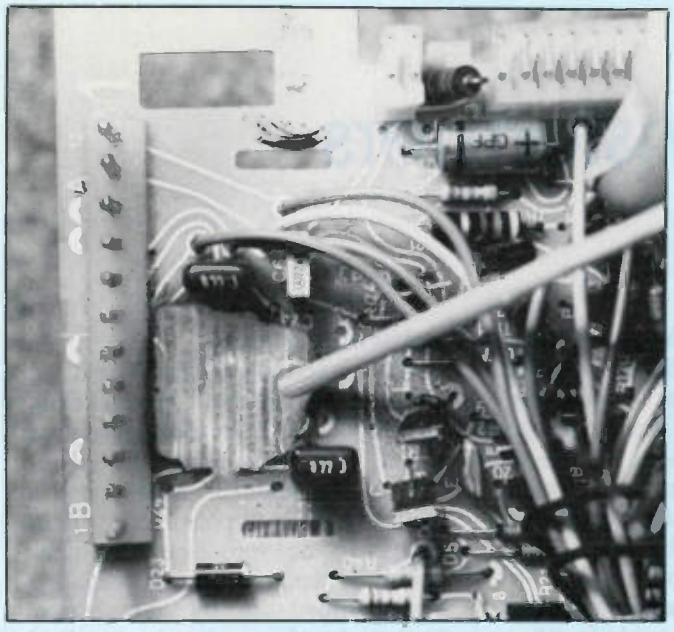


Figure 3. Fill the hole in the board with epoxy, according to the directions given in the article.

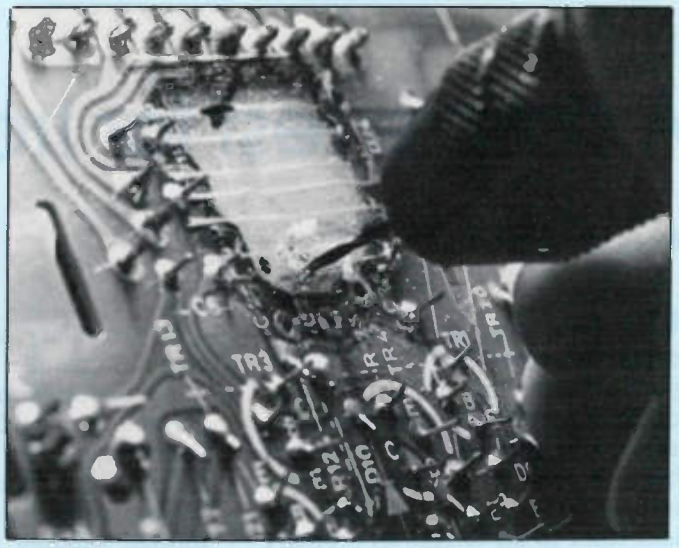


Figure 4. Referring to the drawings you made before starting the repair, and the manufacturer's service literature, drill holes to receive the replacement. Then, after inserting the components and crimping the leads, reconnect them according to the original scheme by soldering with hookup wire.

sure that all semiconductors are positioned and labeled properly. Even if you have a service manual your drawing may be the best guide for reconstruction.

When you are sure that you have mapped out the area to be reconstructed correctly you can begin removing all components that fall within the area that you have marked out. If in doubt, throw it out.

It's now time to remove the affected portion of the circuit board (see Figure 2). A hand grinding tool is perfect for the job, but judicial use of a drill, pliers, cutters, and files will work. Stay within the boundaries you have outlined, and remember to wear some type of safety glasses. Charred circuit boards are quite brittle. You may want to wear a mask as well. I'm no doctor, but I'm sure that breathing all that stuff can't be good for you either.

Take your time. Charred boards usually have cracks in them. Working too quickly could cause a crack to spread into areas of the board that are outside of your work area causing intermittent headaches that will come back to haunt you. Leave the edges of your work a little rough. You want smooth curves in the hole you just created, but the edges should not be polished. As soon as you are satisfied clean up the area looking for pieces that may have lodged around and under other components.

Rebuilding the board

Now it's time to fill the hole. Start by putting filament tape on the bottom (foil side) of the board. Stretch it tight across the board, overlap it, and make sure it completely seals the hole. This tape will be removed later, so don't be stingy. You want to completely cover and seal the hole while being level with the bottom of the circuit board. Turn the board over so that you are now looking at the component side. Tape should be completely covering the hole with no gaps. Now, using any good epoxy (not the five minute type) start filling the hole. You want a smooth surface that rises just above the top of the board. Work on a level surface adding epoxy and spreading it around until it looks right (see Figure 3).

Five minute epoxy may speed up the drying process, but it never seems to hold as well as the "normal" stuff, and it won't give you enough time to work. Even if the job looks a little rough, gravity will usually smooth things out. Put the unit away for the night on a level surface to dry. Clear up any mental or paper sketches you may have made so you don't forget anything.

After the epoxy has set, turn the board over and remove the tape. Some of the filaments in the tape may remain on the board. That won't cause any problems. If all was done correctly you should now have a translucent patch on the original circuit board. You can tap it and push a bit, to make sure it will hold, but it should be fine. Obviously if you push hard enough it will break. Don't push your luck

Installing and connecting the components

Now, using your marking pen, draw in the old foil traces and mark the spots to drill through. Again, a hand drilling and grinding tool is perfect for the job, but any drill will do. Insert the components, bending the leads so that they will not fall out when the board is inverted. Take care to follow the schematic, or your notes, making sure that all semiconductors are positioned properly (see Figure 4).

Working from the bottom, just about any method of connecting the components will work. If you have one of those fancy repair kits you could even replace the original traces, but wire and solder works just fine. Bend the wire to follow the original foil pattern for a neat job.

Double check your work and bring the unit to life carefully, as you would with any repair.

Congratulations. You now not only have a strong reliable repair, but in the case of a vented audio component a work of art you can show off to your customer. ■

A simple test for transformers

By Jud Williams, CET

One of the most perplexing components to troubleshoot is the ordinary power transformer. It is particularly difficult to tell if the windings are shorted, because an ohmmeter is ambiguous below 1Ω. When I first got into the repair of power supplies, the idea came to me to take an ordinary 6.8V filament transformer and buck it against the winding of a transformer that I suspected was bad. By the way, the reason the transformer is called a "filament" transformer is, that it was used back in the vacuum tube days to power vacuum tube heater elements, also known as filaments. These transformers are still widely available from distributors.

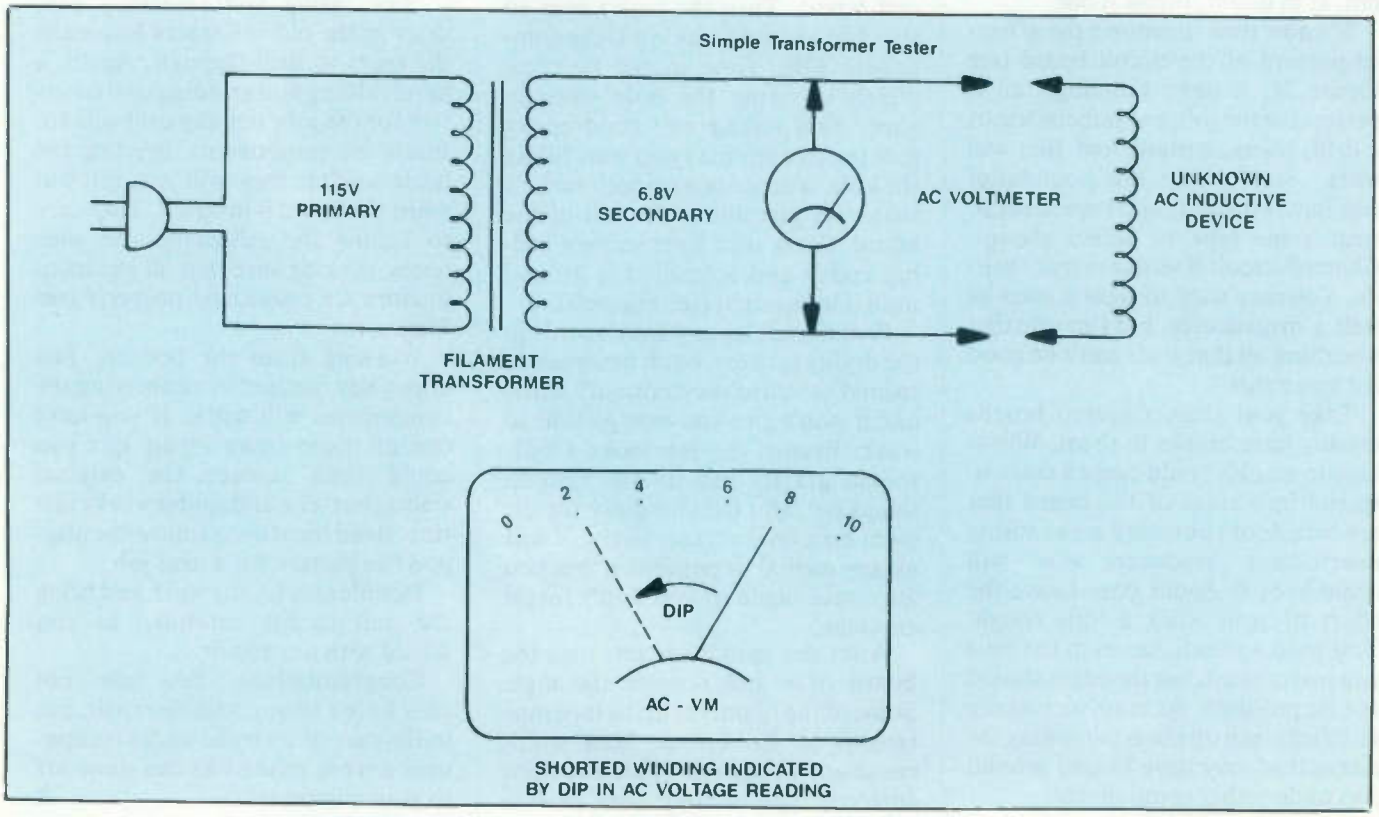
I found that when I connected the 6.8V secondary of the transformer across (in parallel with) the winding of a transformer under test, the output voltage would be practically the same as the open circuit voltage of the unloaded filament transformer. If the suspect transformer had a shorted winding in it, the voltage would drop by 25% to 50% or more. So by merely placing an ac voltmeter across the winding I could identify a defective transformer with no further fuss.

A second check is necessary; a continuity check with an ohmmeter to assure that the winding is not open. When making a continuity test with an ohmmeter, look for a very low resistance, making sure that the meter is set to its lowest range. Transformers may register several ohms, depending on the number of turns in the winding. This, of course, relates to the length of wire in the winding, and its dc resistance.

What is actually taking place is, an ac inductive impedance is paralleling an unknown reactive element such as a coil or winding. Since the secondary of the filament transformer is relatively low in impedance, it will, in most cases, be "looking into" a higher impedance, so it will not be loaded down. Impedance, by the way may be thought of as ac "resistance." If the device has shorted windings, then the impedance will, in most tests, be less than that of the filament transformer, and will result in a lower than normal voltage reading.

This test will work not only for power transformers, it is very useful for testing relay coils, solenoid coils, chokes, ferroresonant transformers, ac adapters, inverter transformers, electric motors and fans, etc. Almost any device containing a winding may be tested in this way. ■

Williams is owner of Performance Technological Products, a company that manufacturers and services products used by the cable TV industry.



Repairing microcomputer keyboards

By Matt J. McCullar

Computer keyboards must accept a huge amount of wear and tear, and do it constantly. A keyboard filled with microswitches, springs, or rubber membranes has to go through hundreds of cycles every hour while under the fingers of even an average typist. A frustrated user may pound out his frustrations on it. But whoever uses a keyboard, one bad key is all it takes to bring work (or play) to a halt. And it's never one of those keys you never use.

Disassembling and checking

What causes keyboards to fail? Before we examine the reasons in detail, let's disassemble a keyboard.

The first thing to watch is the placement of the screws. They may not all be the same length. Note which ones went where. The connector cable from the computer will often be found running through a couple of plastic trenches after entering the case. These provide strain relief for the cable. A ground lead coming from the cable's outer shield may be connected to the internal PC board ground plane with solder, a snap connector, or a screw.

Now that the insides are exposed, use compressed air to blow out as many solid contaminants as possible. These can be eraser crumbs, pieces of food, cigarette ashes, dog or cat hairs, or worse. A good blast will allow an otherwise obscured problem to be seen, like a bad solder joint or a broken trace. Following are several of the more common causes of keyboard failure.

Bad keyswitches

Individual keyswitches can just plain wear out. But as long as replacements are available, either from the manufacturer or the scrap pile, a quick operation under the soldering iron is all it takes to get that key back into operation. Before you jump right into replacing a keyswitch, however, take an ohmeter reading to verify that it actually has failed. The actual problem might be a broken circuit trace.

Some keyswitches are simply single-pole, single-throw pushbuttons, while others contain more complex mechanisms and have more pins. Certain keyswitches are meant to stay down when pushed, such as the Shift-Lock or function keys. Before you replace any keyboard key, make sure that the replacement keyswitch is the same type of switch as the original. Replacing a latched switch with a momentary keyswitch, for example, would be a mistake.

In addition, be careful when disassembling the keyboard. Make sure that any miniature springs around the keyshafts do not fly away in the process of removing the key caps. Take extreme care when desoldering, because the traces are very thin and can't take much heat.

Dirty membranes

A thin rubber sheet provides the springiness for certain keyboards. The keyswitch contacts are not mechanical, but are made up of long metal fingers of printed circuit traces. These traces are not masked but bare, so anything conductive placed across them will short them together.

Ideally, the only time they will be shorted comes when someone presses a key. When this happens, the rubber membrane will come down and a conductive carbon button will be forced onto the metal fingers, and they will conduct. This method is used extensively in remote controls for televisions and VCRs. The only major problem with this is oxide. After long use a thin film of dirt covers the contacts and they won't conduct when they are supposed to. A quick wipe with alcohol cleans off the dirt and the switch is back in operation. While you're at it, clean the carbon button, too.

Liquids

Liquids are probably the most common reason for keyboard failure, such as when someone spills a cup of coffee with lots of sugar, or a cola on the keyboard. Some people insist that it is not economical to clean out keyboards damaged this way, but most can be restored with a little patience.

The first thing to do after disassembly is to rinse out the keyboard thoroughly. And I mean thoroughly. Use a large sink or a garden hose. A stiff, short paint brush will help scrape away the molasses-like substances that technicians sometimes find in a keyboard that has taken a bath. Liquid soap works well, too. Press each and every key a dozen times or so during the process to break loose any hidden obstructions. After this, shake out as much water as you can, blast with compressed air, and allow to dry. If compressed air isn't available, leave the keyboard to dry outside for at least a full day.

Another method I've had good luck with is to wash the keyboard it in the dishwasher. Why not wait until several dunked keyboards arrive and wash them all at once? This cleans motherboards, too. But I wouldn't dry them in the dishwasher; too much heat.

Broken connector cable

Check each wire in the cable for continuity, flexing the cable in the process to reveal intermittent breaks. If the cable plugs into a connector inside the keyboard, check those pins for bad solder joints. If you work on lots of keyboards, it pays off to build

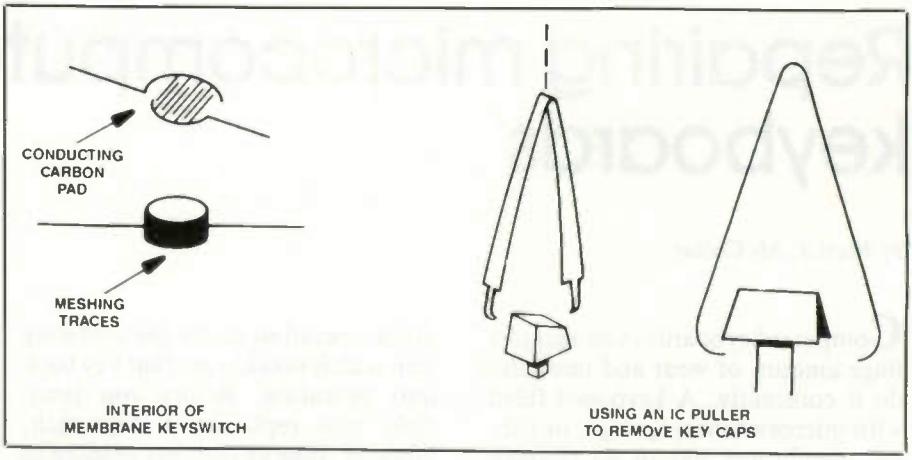
McCullar is an independent computer and electronics consultant and servicing technician.

a little test jig consisting of a socket, test clips, battery, and some LEDs. If all the LEDs light up, the cable is good. If any of them doesn't light up at all, or goes out when you flex the cable, there is a break. Such a quick and dirty continuity tester really speeds up keyboard repair in the long run.

Internal PC board cracked

Occasionally, you'll find that the PC board in the keyboard is cracked. This means either that someone dropped the keyboard; someone dropped something onto it; or someone suffered from what I call the "Control-Fist Syndrome," in which a frustrated user beat the daylights out of it. A broken trace may be difficult to spot depending on the severity of impact. A broken trace is the first thing to look for if the user complains of "certain keys not working."

Because all microcomputer keyboards arrange their keys in a matrix (rows and columns), a single printed-circuit trace can kill off an entire row or column of keys. A minor break can be repaired by soldering a wire from one terminal to another across the break. Don't use a solder bridge; if the circuit board couldn't stand up to what hit it, a solder bridge certainly won't, either. If the break is just too large and affects too many traces, ditch it and give up. Save it for the scrap pile.



Internal electronic failure

Many of today's keyboards contain their own microprocessor. It keeps book on all the letters, numbers, function keys; everything. One or two TTL chips may accompany it. If these chips fail (and they do), the result is a dead keyboard. Nothing will work. Unless you can get a replacement for the microprocessor, it cannot be fixed. The most common cause for this comes from people connecting or disconnecting the keyboard cable while the computer is on. Some computers are more forgiving of this than others, but it's been my experience that PC keyboards just can't take this abuse at all.

User error

All of us technicians have found out that people just don't read instructions. To kill two birds with one stone, many of today's manufacturers build their keyboards to be compatible with both the XT and the AT computers. To be completely compatible, however, a small slide switch on the underside of the keyboard must be in the right position. If it's brand-new and right out of the box, maybe the user didn't read the directions and hasn't put the switch where it's supposed to be.

Removing keycaps

There's a trick to removing key caps, those plastic knobs on the keyswitches. Don't use a screwdriver. Prying with a screwdriver just places undue stress on nearby keys. Instead, reach into your toolbox and pull out a standard, twenty-five cent IC puller. The little tabs reach under key caps perfectly and a slight pull pops them off. (By the way, an IC puller also removes knobs from television sets and stereos very well.) Be sure to note where all the key caps came from before removal.

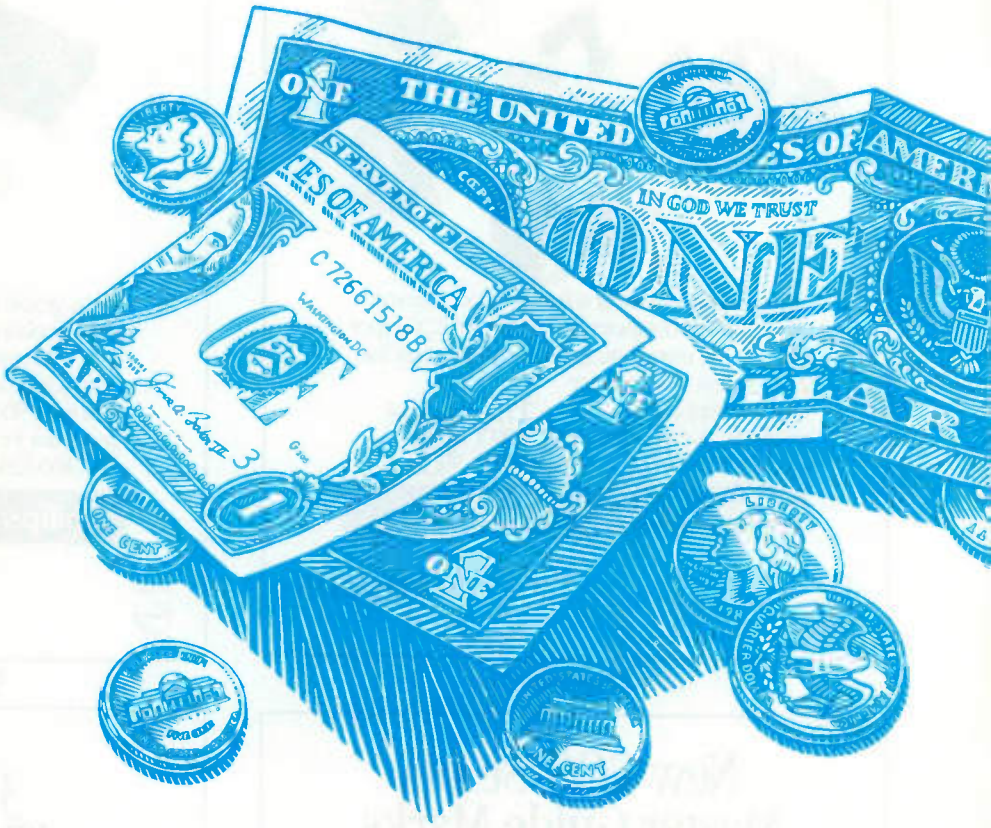
Save extra key caps that you salvage from scrap keyboards. Often keyboards that come in for repair are missing certain key caps, and having replacements already in the drawer saves having to order them from the manufacturer.

It's good public relations to clean the outside of a keyboard before returning it to the user. Cables run across desks and pick up all kinds of gunk, and key caps are subject to anything on fingertips. Window-glass cleaner wipes off the dirt instantly.

You can always tell if there's a pet in the house by the small hairs found in the keyboard. For these folks, suggest they place a towel over the keys when the computer is not in use so dog and cat hairs won't fall into them.

As with everything else in electronics, repairing computer keyboards gets easier with practice. And if you're willing to fix them when others aren't, you're that much ahead.

Should you be selling service contracts?



By William J. Lynott

For many years, I have been a booster of service contract sales by independent electronics servicers. During that time, I've had the opportunity to help launch contract sales programs for scores of dealers around the country, large and small. The reasons for my enthusiasm are still the same. Properly handled, a good service contract program can benefit both the customer and the servicer. The customer benefits from the peace of mind that comes with the elimination of large unexpected repair bills. The servicer benefits from increased sales and profits.

Until a year ago, I was adamantly opposed to the idea of sharing the profits with third parties. After all, a contract sales program is easy to launch, and financial risk is minimal when accounting is set up properly. So why share your sales and profits with someone else?

But recently, the third-party service contract industry seemed to take on a new legitimacy with the establishment of the Service Contract Industry Council (SCIC), a trade association designed to assure servicing dealers of fair treatment and financial stability on the part of third-party contract sellers.

After looking into SCIC and its roster of participating companies, I began recommending the third-party route to my clients who were still reluctant to take on the responsibility of backing their own contract programs. The third-party service contract industry had finally gotten its act together - or so I thought.

I was wrong

Despite the sincere efforts of a lot of people, it's now quite clear that the third-party service contract industry is sick. It has problems that are so serious and so pervasive that it may never fully recover. I've spoken with a number of small servicers who are currently participating in third-party programs. I couldn't find a single one who was truly satisfied. Some of the tales they tell are scary enough for me to suggest that you think carefully before getting involved yourself.

The complaints run along the lines you might guess: slow reimbursements to servicers, unreasonable paper work demands, and unilaterally imposed reimbursement rates that are too low to allow for decent profit margins. Worst of all, at least one third-party firm has filed for reorganization under the bankruptcy laws and has suspended all reimbursements to servicers. Meanwhile, the California State Electronics Association (CSEA) has listed four third-party firms that are now taking 90 days or more to reimburse servicing dealers.

A recent series of meetings between servicing dealers and third-party contractors appears to have contributed little or nothing to the resolution of these problems. In fact, according to reports I've received, some of the meetings have resulted in little else than flaring tempers and heated arguments.

The basic idea behind SCIC is still a good one, and it's entirely possible that this organization will eventually bring order to the present chaos. In the meantime, however, be advised that you should investigate very carefully before you sign up as a participant in a third-party program. One absolute requirement is that you personally speak with at least several servicers who are currently working with the company you are consider-

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

ing. Ask each of them whether they are satisfied with the arrangement and what specific complaints they have.

Does all this mean that you should pass up the many benefits that accrue to servicers who sell contracts? Not at all. Establishing your own program requires some work, but it can be done by almost any established service dealer. No need to agonize over potential problems. If you prepare well and use conservative accounting, you will be exposed to little or no risk. Here are a few other hints that may help you.

"Shop" your local and national competition to obtain all the promotional and pricing literature available. This will provide you with models for the design of your own program. Important: use other firms' pricing only as a model for your initial price lists. It is essential that prices be based on *your* costs as soon as data become available.

Obtain copies of as many of the competition's actual contracts as you can. These can serve as models for the construction of your own; but be sure to have an attorney go over your final drafts.

And be sure to let your employees know how important your service contract program is. Its success will enhance their jobs and improve their security. You need their support, so it is a good idea to let them in on your plans at an early stage. This gives employees the chance to offer suggestions. That, in turn, tends to build pride-of-authorship which further enhances the likelihood of the program's complete success.

Finally, remember that it is essential that you and your employees embrace the program fully. In order to be successful, a contract program must be an all-out effort. A half-hearted sales effort will bring in only those customers who are easy to sell and who are likely to require more than average service.

Service contracts are an important means for the electronics service dealer to enhance sales and profits. A little preparation and determination will allow you to enjoy the benefits of contract sales while retaining full profits and complete control of your own program. ■

The groundwork

By Sam Wilson, CET

As I have said many times - there is nothing wrong with teaching basic concepts by using models. My personal feeling however, is that students should never be left with the idea that models are fundamental truths.

When the models stand in the way of understanding things that are happening in modern technology it is time to abandon them and go to the real truth as we know it at this time.

There are some basic assumptions in this article. The water pipe model is used in part of the discussion, but it has been altered.

When there is a voltage across a piece of wire, as shown in Figure A, there is a flow of electrons. Electron flow is the only type of current under discussion at this time. That, of course, is a model for current flow.

Wilson is the electronics theory consultant for ES&T

One end of the wire in this discussion can be considered to be at zero volts because the system is floating.

If the positive terminal of a voltage source is considered to be zero volts there will be a voltage gradient along the wire. In other words, there will be a constant voltage drop along the wire.

The force exerted on the electrons in the wire is considered to be evenly distributed along the wire, so, there will be a force gradient along the wire.

It will be shown that the force on the electrons and the voltage are not the same thing.

Voltage is not an electromotive force

In fact, voltage is not any kind of force. Figure 1 shows a model that is sometimes used to explain basic terms like voltage, current and resistance.

The faucet is an effective way of representing an opposition, or resistance, to the flow of current. The number of gallons per minute represents electronic current in coulombs per second.

The model does *not* accurately portray the idea of voltage. In the model, the pressure pushing the water through the pipe is said to represent the voltage pushing electrons through a circuit. That gives a totally false idea of voltage. Figure 2 shows a much better model for representing

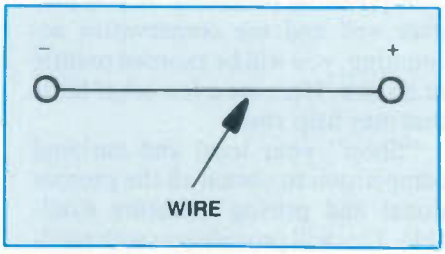


Figure A

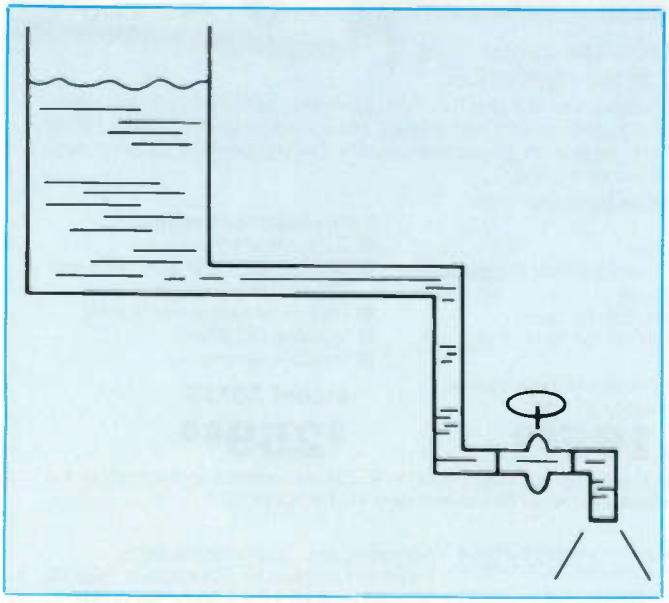


Figure 1

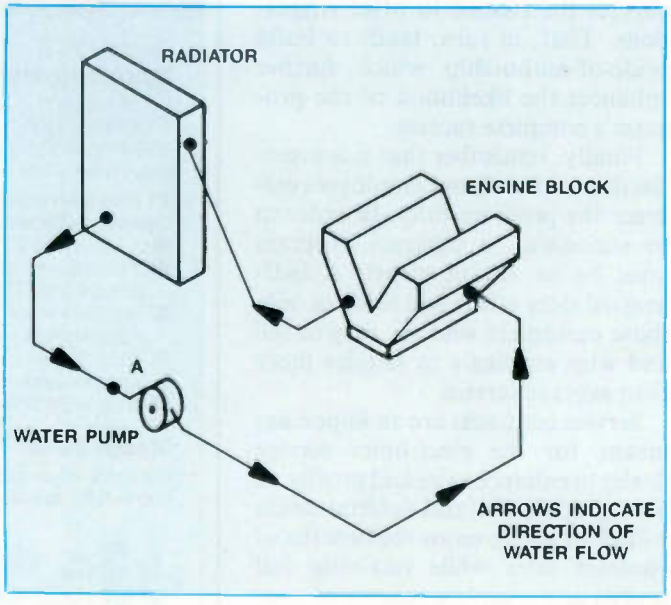


Figure 2

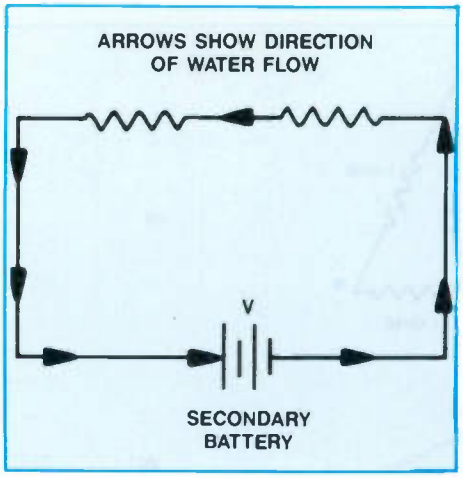


Figure 3

an electric circuit. It does not properly represent the idea of voltage, but it is better for the discussion in this article.

The water pump forces the water through the engine block, through the radiator, and, back to the pump. Now, this is very important: When the water gets back to the pump (at Point A) the force on the water must be zero! If there was any force remaining it would help turn the pump.

If the force was not high enough to get the water back to the pump the water would stop flowing.

To summarize, the force created by the pump must always be exactly the right amount to move the water around the circuit; and, the force created by the water pump must always be the correct amount so that there is zero force at point A.

Figure 3 shows a similar situation. The negative electrode of the battery forces electrons in the conductor away from the battery. The positive electrode attracts the electrons.

So, there is a *force* moving electrons the same way the pump in Figure 2 moves the water. That force occurs because the like charges repel and unlike charges attract.

When the electrons get back to the battery the force must be zero. If the force wasn't zero, electrons would move from the + to − terminals inside the secondary battery. That, in turn, would charge the battery. In other words, the battery would be charged by the current it created!

If the force on electrons was less than zero at the battery positive terminal, the electrons couldn't make it all the way and the current would stop flowing.

In Figure 4 there is a short circuit across a battery. There is a force on electrons causing them to move from the negative to the positive terminal. As before, the force on the electrons must be zero when they get back to the battery. (you cannot charge a battery with a short circuit).

The wire in Figure 4(a) is exactly one foot long. Point X is half way along the wire. Since all of the force is used between the negative and positive terminal of the battery, half of the force must be used between the negative terminal and point X.

The wire in Figure 4(b) is two feet long, so, it takes two feet for the electromotive force to drop to zero between the battery terminals. However, point Y is still half way along the wire. So, the force at point Y is the same as the force at point X.

Four 1-ohm resistors have been added to the two paths. They are connected as shown in Figure 5. The force on electrons at point X is still the same as the force on electrons at point Y.

The situation in Figure 6 is different. The points of interest are now marked M and N. In Figure 6(a) point M is 1/2 foot from the negative terminal; and, point N is two feet from the negative terminal.

The total distance along the wire between the negative and positive terminals of the battery can be determined mathematically by using the Pythagorean Theorem, or by drawing the triangle to scale and measuring the distance.

Regardless of which method you use you will find the total distance to be 1.618 ft. Of course, the graphical solution will not be as accurate, but it will be close enough for this problem.

Point M is a little over 30% of the way between the negative terminal and the positive terminal. That percent value is calculated as follows:

$$0.5/1.618 \times 100 = 30.9\%$$

So, the force on electrons at point M has dropped by 30.9% Remember that it must drop 100% by the time it gets to the positive terminal.

There is a force on the electrons at point M that is 69.1% of the original force. Since the original force was 10 force units, the force at point M is:

$$0.691 \times 10 = 6.91 \text{ force units}$$

Using the same mathematics (or, graphical) solution you will find that the total length of the wire in Figure 6(b) is 4.236 ft. Also, point N is

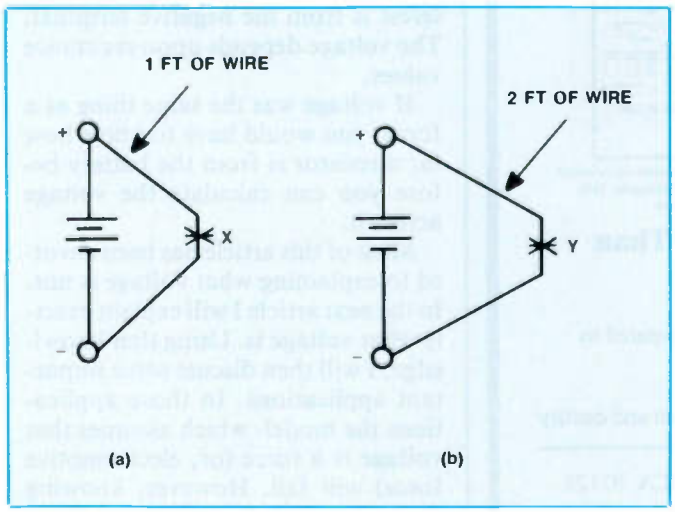


Figure 4

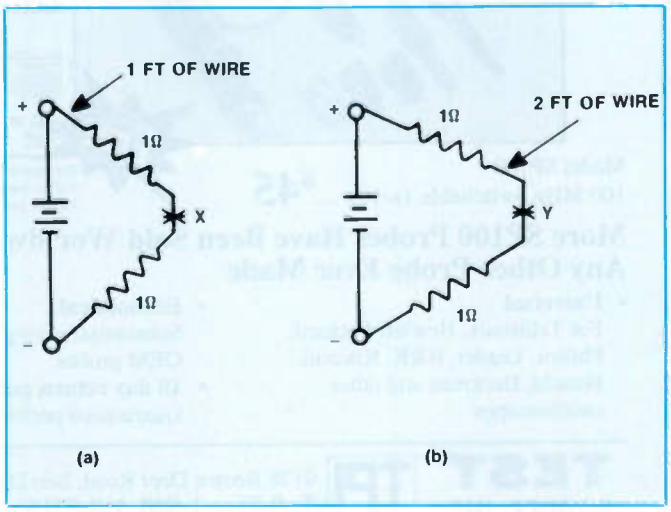


Figure 5

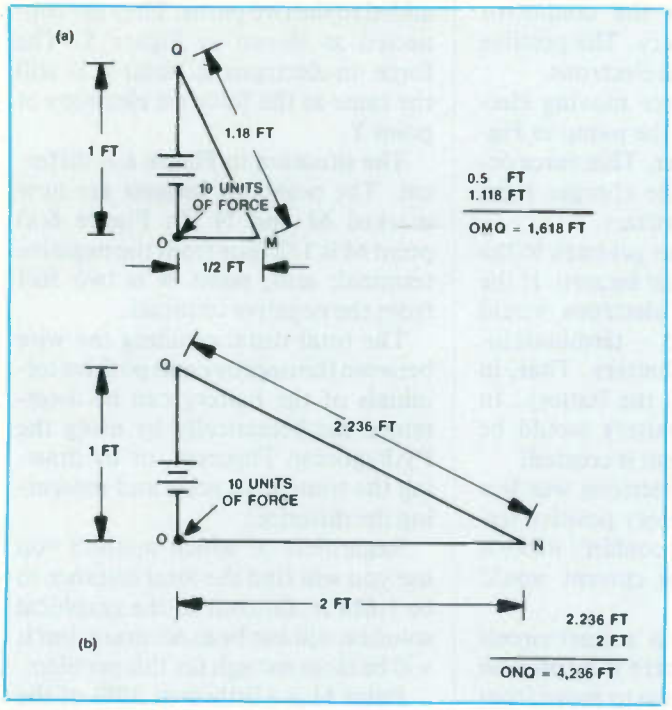


Figure 6

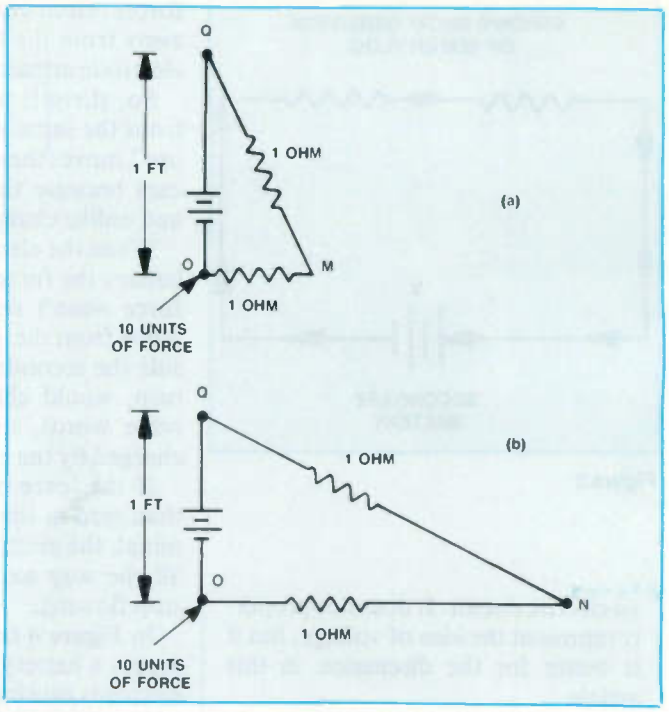


Figure 7

47.2% of the way along the total length, calculated as follows:

$$2/4.236 \times 100 = 47.2\%$$

Since 47.2% of the force has been used, there is 52.8% of the original force on electrons at point N. That means there is a force of 5.28 force units on electrons at point N.

As shown in Figure 7, four identical one-ohm resistors have been added to the circuit. That will *not* change the force on electrons at points M and N.

Your experience tells you that a voltmeter will measure half the applied voltage between the negative terminal and points M or N. So, the voltages at points M and N are equal. However, the above calculations show the force on electrons at points M and N are not equal. Obviously, voltage is *not* a force pushing electrons through the circuit. In fact, voltage is not any kind of force.

In this article it has been shown that voltage is not a force. The amount of force on an electron depends upon how far the point of interest is from the negative terminal. The voltage depends upon resistance values.

If voltage was the same thing as a force, you would have to know how far a resistor is from the battery before you can calculate the voltage across it.

Most of this article has been devoted to explaining what voltage is not. In the next article I will explain exactly what voltage is. Using that knowledge, I will then discuss some important applications. In those applications the model- which assumes that voltage is a force (or, electromotive force) will fail. However, knowing the true meaning of voltage will explain the applications. ■

Test your electronics knowledge

By Sam Wilson, CET

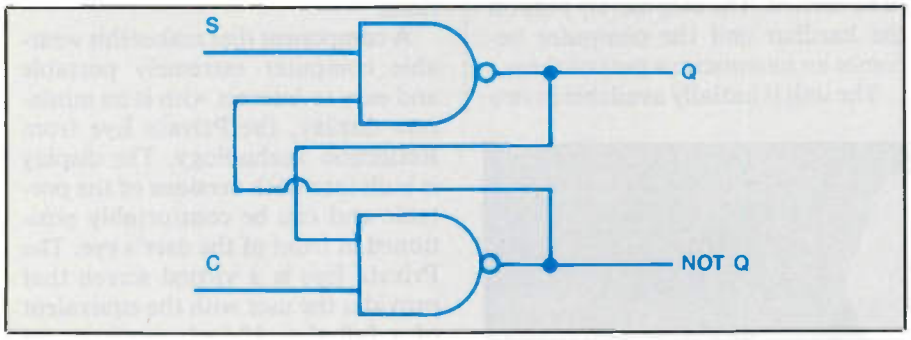


Figure 1

1. Which of the following inputs is not valid for the circuit of Figure 1?

A. 00
B. 01
C. 10
D. 11

2. Is the following statement correct? An advantage of using IEEE/ANSI symbols is that they are easier to draw compared to standard logic symbols.

3. What do the initials ULSI stand for?

4. A pulse stretcher can be made with

A. An INVERTER
B. Two NANDS
C. A bootstrap circuit
D. None of these choices is correct.

5. Which of the following will produce a low output at L in figure 2?

A. A = 0, B = 0
B. A = 0, B = 1
C. A = 1, B = 0
D. A = 1, B = 1

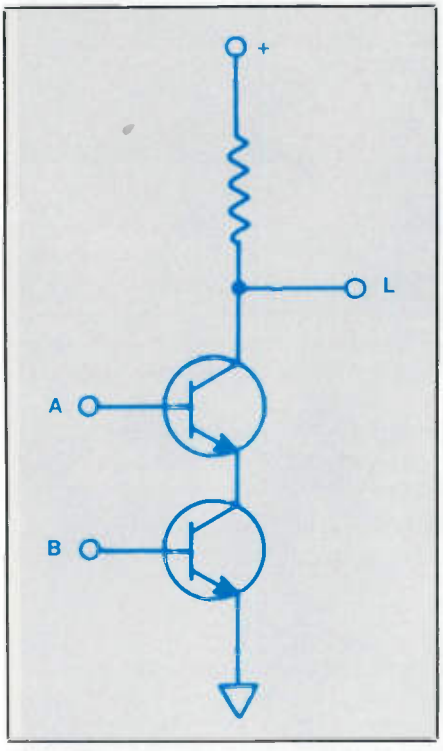


Figure 2

6. Is the following statement correct? Using a MUX, one of several inputs can be delivered to the output terminal.

7. Is the following statement correct? The output of a DAC is at LOGIC 1 when the input is at LOGIC 0.

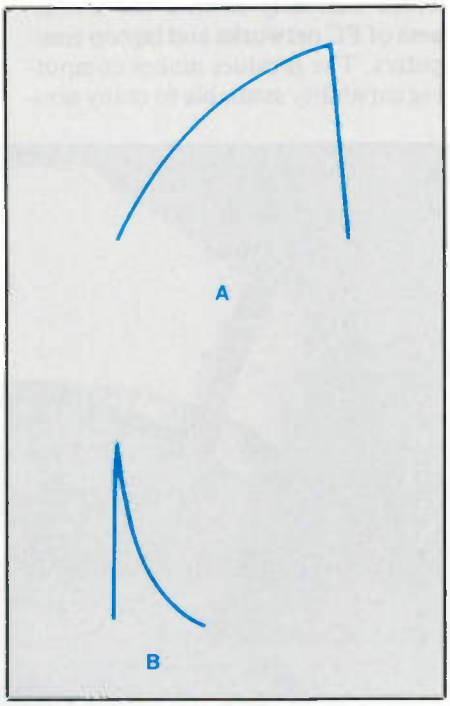


Figure 3

8. The bubble in a bubble memory is best described as a(n)

A. Sphere
B. Cylinder
C. Ellipse
D. Coil

9. Which of the waveforms in Figure 3 is obtained from a UJT?

A. The one marked A
B. The one marked B
C. Both
D. Neither

10. The resistance of a piece of wire depends upon the type of material, cross-sectional area, length of the wire, and, _____. ■

(Answers on page 51)

Wilson is the electronics theory consultant for ES&T.

Wearable computer brings desktop computing power to mobile workers

The first portable computer that is small enough to wear has been announced by Park Engineering. Called CompCap, the new 1 lb. device is designed for mobile environments which currently restrict the usefulness of PC networks and laptop computers. The product makes computing capability available to many non-office workers for the first time.

The new PC-compatible portable offers users the speed and processing power of a 286 or 386 desktop computer, yet can be easily worn as part of a work uniform. Unlike many portables, this computer does not have to be carried. The user merely puts on the hardhat and the computer becomes an unconscious part of them.

The unit is initially available in two versions: a hardhat version in which the electronics are built into the hat, and a softband model which includes a band worn around the head or hat with its electronics built into a belt or vest. Both models can be customized to meet the needs of specific applications.

Figure 1. First portable computer called CompCap.

A component that makes this wearable computer extremely portable and easy to interact with is its miniature display, the Private Eye from Reflection Technology. The display is built into both versions of the portable and can be comfortably positioned in front of the user's eye. The Private Eye is a virtual screen that provides the user with the equivalent of a full size, 12-inch monitor, yet weighs only 2 ounces. Its image, which appears to float a few feet in front of the user, displays 720 x 280 pixels and can be used to show either graphics or text.

Another feature that allows users to interact with this computer more naturally than traditional PCs is its voice data entry system. When coupled with the tiny display screen, voice recognition system allows users to interact with the device in a completely hands-free manner.

The computer cap offers users a "mobile" solution in environments where it was previously necessary to interrupt the work at hand in order to reach a computer terminal. For example, a control room operator can now transmit commands to a computer from any location in the area, rather than running back and forth between a PC and a particular process.

For environments where computers have until now been impractical, such as a construction site, workers can now use a computer built into their hardhats to communicate with a host computer in a van. The product is useful for a range of other applications including industrial maintenance, manufacturing, warehousing, retail, airline ground support, and medicine - or anyone who needs to access information and be mobile at the same time. ■

Test your electronics knowledge

Answers to the quiz

(from page 49)

1. A - if both inputs are at logic 0, both outputs try to go to Q = 1 and NOT Q = 1.

2. Correct - Compare the AND symbols in Figure A.

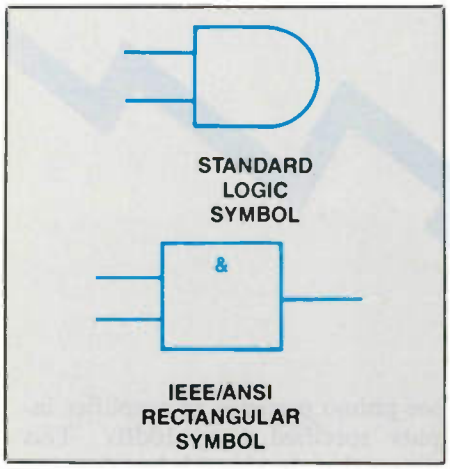


Figure A

3. UltraLarge - Scale Integration

4. D - A one-shot multivibrator is used for a pulse stretcher

5. D - The two logic 1 inputs saturate the two transistors. That, in turn, puts L at common, or, Logic 0.

6. Correct - The MUX is, of course, a multiplexer.

7. NOT correct - The DAC (Digital-to-Analog Converter) does not have a logic output.

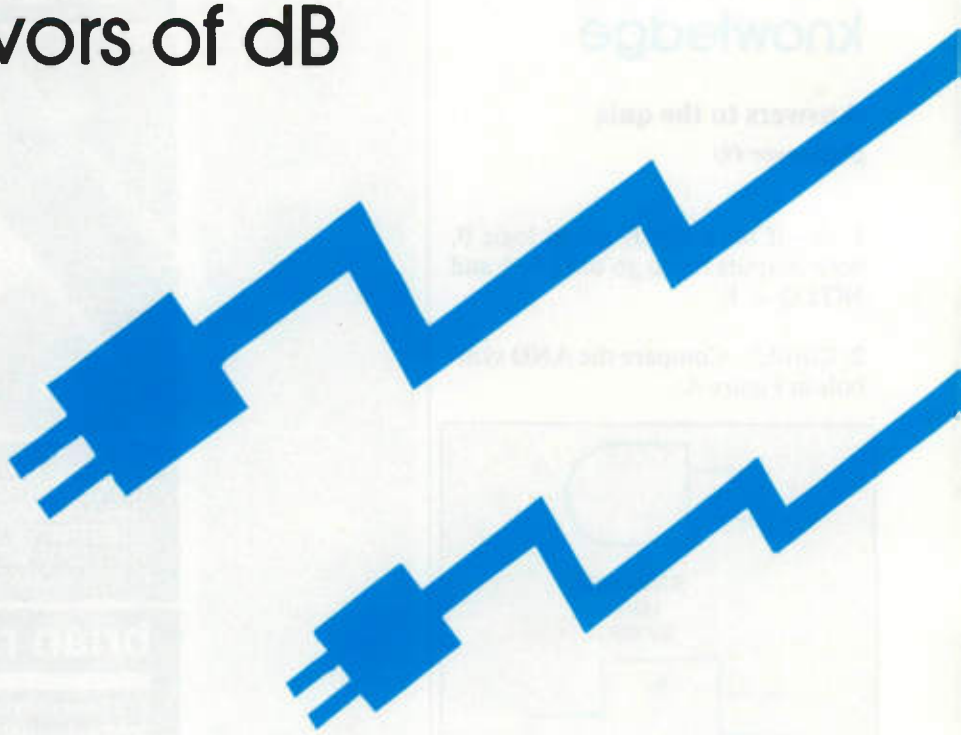
8. B - From the top they look like bubbles when seen through a microscope. But, in reality, the material has thickness and the circle extends all the way through the material and that makes it a cylinder.

9. C - Both waveforms can be obtained from a UJT.

10. Temperature. Although it is a factor in determining wire resistance, temperature is often overlooked. ■

The many flavors of dB

By John Shepler



A term you'll run across again and again in audio servicing is dB. No doubt you already know that this abbreviation stands for "decibel." You're also familiar with the non-linear dB scale on recorder and amplifier meters. But, what exactly does dB mean?

The dB unit is a way to represent signal levels. One common use is to compare a signal with a standard. Audio inputs and outputs are often specified as being −10dBv or +4 dBm. The extra letter means that the signal is referenced to an industry standard of volts or milliwatts.

Another way to use dB is to represent gain or loss through an audio component. For instance, an amplifier might be rated as having 20dB gain. A resistive pad might be said to have a −10dB loss. Positive values represent gains or amplitude increases. Negative values represent losses.

Historically, dB is an audio engineering term. It is based on a unit called the *bel*, named after Alexander Graham Bell. A decibel is one tenth of a bel or a deci-bel. There are two reasons why the decibel is so widely used.

First, representing gains and losses in dB makes figuring out the total gain or loss through an audio system a matter of simple addition. If a microphone preamp has a gain of 30dB, followed by a sound effects module with a loss of −10dB, and this is followed by an amplifier with a gain of 25dB, then the total gain through the system is +45dB. Simply add and subtract the units in series.

Why is it this easy? The dB scale is logarithmic, not linear. That's why a VU (Volume Units) meter scale looks so compressed. The interesting thing about logarithms is that you multiply two numbers by adding their logarithms.

Say you have two voltage amplifiers in series, one with a gain of 178 and the other with a gain of 317. Their combined gain is 56,426. You have to multiply the two gains to get the total. But, stating the two gains as 45dB and 50dB gives a sum of 95dB. You can easily add that in your head. Imagine how much easier it is when there are 10 or 20 series gains to figure.

Another reason for the decibel standard is that sound levels vary over an extremely wide range. The human ear can distinctly hear both the sound of leaves rustling and the scream of a jet engine. That large hearing range is available because the response of the ear is also non-linear.

The logarithmic nature of the decibel provides a close enough approximation to the characteristics of the human ear that it is useful in representing audio levels from the barely audible to the threshold of pain.

Now, let's go back to the standard audio levels you are likely to encounter. The most standard scale is the dBv, pronounced "dee bee vee." The v stands for 1V, the reference level. In this system, 0dBv means an input or output signal of 1V. You'll also see phono preamps or amplifier inputs specified as −10dBv. This means that the signal is less than the standard, 10dB less. The conversion between volts and dB is:

dBv = 20 log (B/A), where A and B are two signals

You can work this out with a calculator that has a LOG button or just know that twice the voltage is 6 dB more and 10 times the voltage is 20 dB more.

The other popular reference is dBm; 1mW across 600Ω, or 0.775V. This is an old telephone company standard that stuck with broadcasters and is still used in professional sound systems. Note than an impedance, 600Ω, is specified for this standard.

A hybrid standard is dBu, or dB unloaded. this system uses the 0.755V of the dBm scale, but without the 600Ω load.

This information may seem a little confusing, but it will come in handy when trying to hook two audio components together. They need compatible signal levels. The dB standards are also handy in relating what you see on your scope to the dB output spec of the gear under test. ■

Shepler is an electronics engineering manager and broadcast consultant. He has more than 20 years experience in all phases of electronics.

Using digital troubleshooting, Third Edition, By Don L. Cannon, Macmillan Books, 286 pages, $24.95.

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

Macmillan Computer Publishing 11711 N. College Ave., Suite 140 Carmel, IN 46032.

Neural Networks and Fuzzy Systems, By Dr. Bart Kosko; Prentice Hall Books; 480 pages, $39.00.

This book is organized into two main sections. Part one explores neural network theory and the second part investigates fuzziness and adaptive fuzzy systems. The book contains neural and fuzzy C software, including source code. The software includes programs that give the user the opportunity to exercise various types of neural network paradigms. Each chapter is followed by a section of references and problems. The book ends with a complete index.

Prentice Hall Books 200 Old Tappan Rd. Old Tappan, NJ 07632.

Op-Amp Circuits and Principles, By Howard M. Berlin, Macmillan Books, 286 pages.

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

Macmillan Computer Publishing 11711 N. College Ave., Suite 140 Carmel, IN 46032.

Using digital troubleshooting, Third Edition, By Don L. Cannon, Macmillan Books, 286 pages, $24.95.

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Macmillan Computer Publishing 11711 N. College Ave., Suite 140 Carmel, IN 46032.

Understanding Solid State Electronics, 5th Edition, By Don L. Cannon; Macmillan Computer Publishing, 307 pages, $24.95.

This 5th edition explores the latest in semiconductor theory and applications. This book makes sure readers

know how semiconductors fit within circuits; how circuits and logic gates make "decisions" and how to properly adapt solid-state devices in circuit design. Readers will discover what electricity does in every electrical system, with details on FET's, thyristors, and optoelectronics and how MOS and larger scale integrated circuits work and how to use them, and the seven transistor specifications most important to successful IC implementation.

Macmillan Computer Publishing 11711 N. College Ave Suite 140, Carmel IN 46032

VCR Troubleshooting and Repair, 2nd Edition, By Gregory R. Capelo and Robert C. Brenner; Macmillan Computer Publishing, 286 pages, $19.95.

VCR Troubleshooting and Repair can help quickly diagnose the problem, find the cure, and prevent further breakdowns. This practical guide to VCR preventive maintenance lays out basic troubleshooting guidelines and gives intelligent ways to preserve memorable and precious videotapes. VCR and recording principles are also explained to give a better understanding of VCR components and recording theory.

Covering the latest in stereo and audio circuits, Super-VHS, and Extended Definition Beta, the books really helps make VCR's operate smoothly, safely, and properly.

Macmillan Computer Publishing 11711 N. College Ave Suite 140, Carmel, IN 46032

Improving TV Signal Reception: Mastering Antennas and Satellite Dishes, By Dick Glass; TAB Books, 202 pages; $19.95.

This books explains in simple, direct terms the three basic reception setups used for transmitting signals to television sets. Also included are technical data and formulas. The test discusses details on the installation of signal booster system, and describes tools and troubleshooting techniques for determining specific problems in current antenna or satellite setups. Other features of the book are advice on solving difficult reception problems as well as important tips on safety. Helpful information includes reference charts on carrier frequencies and satellite station numbers, plus a directory of satellite/antenna installer associations around the country.

TAB Books, Blue Ridge Summit, PA 17294

Improving TV Signal Reception: Mastering Antennas and Satellite Dishes By Dick Glass; TAB Books; 202 pages; $16.95.

This book explains in simple, direct terms the three basic reception setups used for transmitting signals to television sets. Also included are technical data and formulas. The text discusses details on the installation of signal booster system, and describes tools and troubleshooting techniques for determining specific problems in current antenna or satellite setups.

Other features of the book are advice on solving difficult reception problems as well as important tips on safety. Helpful information includes reference charts on carrier frequencies and satellite station numbers, plus a directory of satellite/antenna installer associations around the country.

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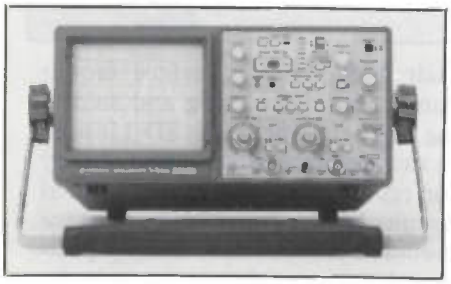
Products

Analog oscilloscope

Hitachi introduces their V-1065 2 channel, 100 MHz and V-665A 2 channel, 60 MHz dual-timebase oscilloscope which features microprocessor control, digital sweep circuitry and automatic measurements to



speed troubleshooting. The unit sets your time range for optimal signal viewing the moment a test point is probed. Some functions include: built in frequency counter, auto triggering and trigger lock, which is used to observe complex pulse trains most often found in microprocessor designs and digital control systems.

Circle (31) on Reply Card

Frequency counter

Optoelectronics Inc. announces a new universal frequency counter timer in the form of a 9-inch drop-in card for personal and laptop computers. It uses Windows 3.0 as a control panel and display window, and it directly tunes radio receivers such as the ICOM-R7000, resulting in a uniquely configured self tuning radio. The

unit is a 10Hz to 2.4GHz radio instrument that captures and analyzes discrete and average frequency readings, pulse width, time interval, period and the ratio between two frequencies. It provides a useful "reciprocal counting" feature for 8-digit resolution of low frequency readings.

Circle (32) on Reply Card

Hi-power degaussing coil

Contact East introduces a hi-power degaussing coil which is useful for color TV and color monitor service. The coil is made to standard industry specifications and eliminates magnetic fields in color TV picture tubes or computer monitors as required prior

to purity adjustments. It is encased in a 13″ diameter molded high-impact plastic housing and operates at 110VAC and comes complete with an 8 foot cord and momentary contact switch that permits de-energizing of the coil without pulling the plug.

Circle (33) on Reply Card

High capacity desoldering station

HMC now has desoldering stations which feature heavy-duty absorption power and quick thermal recovery to permit fast desoldering of multilayer PC boards. There are two units to choose from. Model 470 has

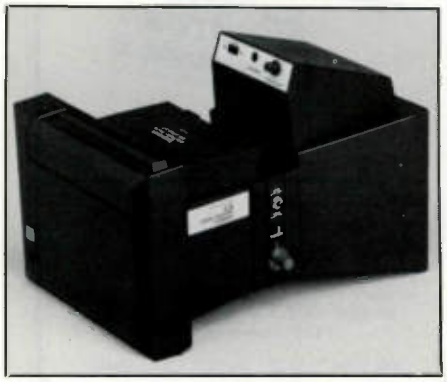
a self-contained, double cylinder type vacuum which generates 23″ Hg of vacuum. The barrel and tip design prevent clogging and a variety of eas-

ily replaceable, long-life tips permit high heat transfer efficiency for any work requirement. Units come with desoldering gun, desoldering tip, and 3-wire cord.

Circle (12) on Reply Card

Screen-mounted scope camera

The new C-9 camera from *Tektronix* features popular Autofilm capabilities, enabling oscilloscope and other measurement-instrument users to take high-resolution photos of screen images, even in clean-room environments. In addition, the camera also offers an optional chamber to hold and protect photos as they are ejected and developed.



Circle (28) on Reply Card

Training schedule for U.S. training centers

Pace Inc. is now offering classes on the development techniques to perform high quality, non-destructive assembly and repair on all types of electronic modules and assemblies. Classes include: universal repair for electronics, multilayer and flexible circuit repair, and surface mount technology and a new Instructor training seminar which is an intense 1-week course designed for personnel involved in solder instruction.

Circle (29) on Reply Card

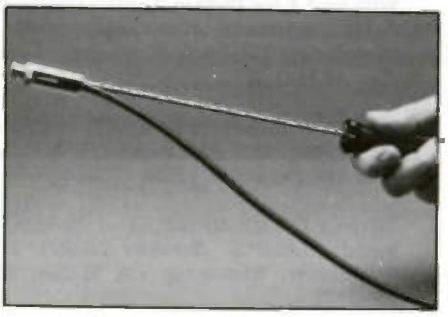
Desoldering tweezers

Wybar now introduces the availability of new, improved elements for their Model SD-1, surface mount component desoldering and soldering tweezers. The model SD-1 is used in the high-tech electronics industry for repair or production of printed circuit boards containing surface mounted components. Simply position the tweezer elements to grip the component to be removed, depress the footswitch to apply heat to the elements and lift the tweezers to remove the component as the solder flows. The separate power unit allows controlled, adjustable element temperatures between 200F and 800F to provide the correct amount of heat for the application.

Circle (30) on Reply Card

Connector removal tool

Jensen now has available an answer to removing BNC connectors in high density or hard-to-reach panels. This tool has a sure-grip plastic handle and comes in the three blade lengths: 4″, 8″ and 12″. The tool is

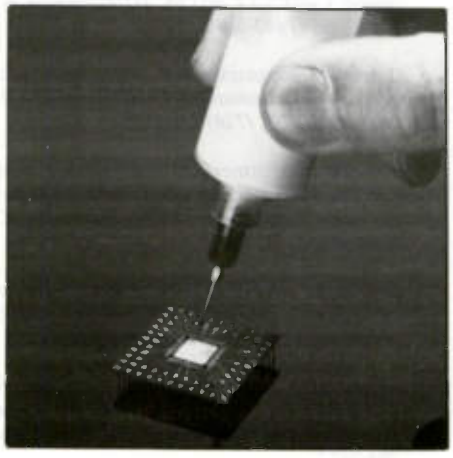


offered in the company's 1991 spring catalog supplement. Many other broadcast maintenance products are also presented, including coaxial cable, cable connector kits, terminal kits, wire strippers, crimpers adapters and more.

Circle (95) on Reply Card

STD 2008 Automatic liquid dispenser

New from *I & J Fisnar Inc.* is the Model STD 2008 dispenser designed for accurate dispensing of all assembly fluids including adhesives,pastes, solvents, lubricants, inks and greases. With timing intervals from 0.1 to 30 seconds the STD 2008 can dispense microdots or be used for potting components. The STD 2008 includes a vacuum system on the fluid line for non-drip application of low viscosity fluids. The unique STD 2008 dispenser features simultaneous liquid dispensing from one or two barrel reservoirs. The STD 2008 includes all



hardware, hoses, fittings and quantities of disposable dispensing components.

Circle (11) on Reply Card

Low cost version of service program

Soft-serve makers of computer programs for the service industry has announced a new product called PC-Service Elite. This MS-DOS program features electronic, computer or appliance work order entry, inventory control with purchase orders, invoice preparation with batch printing of NARDA/NESDA/CEASA/ABCD warranty claim forms. Automatic manufacturer information, labor pricing and service code look-up are also standard features. Reports include technician productivity, work order status, customer postcards and daily sales.

Circle (8) on Reply Card

Readers' Exchange

Reader's Exchange has been reinstated as a free service.

The following restrictions apply to Reader's Exchange:

• Only ondividual readers may Reader's 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 advertisemet, not Reader's Exchange.

• Readers Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Reader's Exchange submissions to:

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

FOR SALE

Sencore SG 165 $800, value LC53Z meter and much more for complete list send SASE.*Fred Ingersoll 6845 Lathers, Garden City, MI 48135, 313-427-0499.*

VCR's, SAMS, test equipment, many more items. Send for free list.*Henry Weymouth 21-1A Cassidy Rd, Budd Lake, NJ. 07826 or call 201-691-4943.*

Sencore VA-48 video analyzer, complete with box, manuals and cables. $495.00. B&K 470 CRT Restorer/analyzer with many adapters. $225.00 both excellent. *L. Harmony 458 S. Main Street, Vermonville, MI 49096 (517) 726-0485 after 5 pm EST.*

A complete shop of new Sencore TV test equipment . Never used.*Cost over $1200 will sell for $7500 cash. For complete information call 903-796-4528*

Zenith U/V tuner module #9-151 $25, vert/chroma module #9-152 $15 both for $35 C.O.D. "Chuck" Kelly 708 623-2597, 3336 Chatham, Waukegan ILL 60087.

B&K model 467 CRT restorer/analyzer with adaptors and manual. Excellent condition $500.00. *Call Jim Toreky 23063 Virginia Ave North Olmsted, Ohio 44070.*

B&K test equipment TV analyst $175 CRT tester $250 747 tube tester $200 or best and shipping (619) 448-1910, AM Pacific time.

Sams photofacts #1516 through #2305 (783 total) $3.00 each. B&K 1077B analyst $50. B&K 467 CRT checker $200. All items plus shipping. Call *Art Diedrich 10426 Abbeville St. Spring FL 34608, 904-688-5782.*

B&K model 2125 20MHz oscilloscope. Like new. Used maybe 5 times. Paid $450.00 will sell $275.00. *Gene McHaughton, 129 McDonald Blvd. Belleville, ILL 62221.*

German Radio (5 speakers table model). *Herbert Lehmann 5901 Melvern Dr. Bethesda, MD 20817 (301) 530-5662 after 6 p.m.*

Text books, diagrams, parts and tubes send large SASE.*M. Seligsohn 1455-55th Street Brooklyn, NY 11219.*

B&K 520B transistor testor $229.00. Leader LAG-5Y audio generator $90.00 B&K 1245 color generator $75.00. *Maurer Radio TV Service 29 South 4th Street Lebanon, PA 17042*

Beltron Picture tube restorer with Dandy adapter leads and set up book, asking $300.00. Call (617) 259-8377.

Shop liquidation, Sencore VA48, TF30 transistor tester, CR161 CRT tester, leader scope, much more! All mint condition $1,100.00 OBO. *Steve K. (701) 663-0607.*

Sencore test equipment. Complete TV/VCR bench. Paid over 8000 will sell 5500. *For more info call 206-568-0228 leave address, will send details.*

Riders radio manuals Vol 1 to 23. Some indexes. Best offer over $300.00 each set. You pay shipping.*Maurer Radio TV Service 29 South 4th Street Lebanon, PA 17042.*

Service manual for stereos 3 year old and on back. Akai thru Yamaha, sell single, by manufacturer or entire lot. Write or call for listing. *Sound Doctor 133 Remington Fort Collins CO. 80524. (303) 484-7530.*

WANTED

Riders radio service volumes 21, 22, 23. Power supply for Kolster model K43 Radio. Clock for Philco model 51 clock radio.*Cosmos TV 5919 15th Ave NW Seattle, WA 98107 206-784-9417.*

General Electric flyback part number EP-77X51 & a Sharp yoke part number H-1167CE both are discontinued parts. *Herb's Servicing, 1792 Finch Ct., Hayward, CA. 94545, 415-785-7783*

Operated manual and schematic for ROBERTS 440 reel-to-reel studio tape recorder. Will pay for copy, or similar arrangement. *Tamas Lassu, 18347 Prairie* #206, Northridge, CA 91325, 818-993-4080.

KNIGHT 83YX137 AF generator and KNIGHT KG-686 RF Generator. Charles T. Huth, 229 Melmore St., Tiffin, Ohio 44883, (419) 448-0007.

VA-48 Mint with AT218, 39G118, etc. Heath IO-104 scope, ID-101 dual trace, low cap probes, IG-5257 W. attenuator.*Chas. Maufin 2124 SW 68 OKC, OK 73159 (405) 685-6768*

Dandy Adaptor with instructions/adaptors, flyback #FB 163 492 (Orion A9. 20B). Source for Solidex Magicool 12V 100W video lamps (wholesale/discount). Placement Chart/Schematic for *Portland (Daewoo) TV. TCB 142OP Chass. C-105A. "Chuck" Kelly, 3336 Chatham Waukegan, IL 708-623-2597*

Wire lead # for Dynaco Audio Transformer A-431 schematic for Zenith VR-550 VCR.*Robert Tinsley 4010 Prospect, Kansas City, MO 64130.*

Power transformer for Sprague TO-6 Capacitor analyzer. *MCLester Brown 1197 No. Garfield Ave, Deland FL 32724.*

Sylvania flyback 50-39287-3 or 50-39287-1, model CL468P.*S. Barnhart HCR*#1 2117 Windflower, Rosamond, CA 93/560, 805-256-0123.

Schematic or service information for Citek model 7383 color television with a chassis number of WG105793.*Jeff Holland 6231 SO. 41 Ave, Omaha, NE 68107, 402-733-6170.*

Schematic diagram for Marantz SR1100 stereo receiver.*Joe Sanfilippo 1935 N. Farming Rd., PO Box 347 Woodruff, WI 54568, 715-356-6004.*

Test equipment needed ISO-V-AC II monitor model WP30 or equivalent ASAP. *(503) 267-0628, or write 892 So. BRoadway, Coos Bay Oregon 97420.*

Supremes TV-1, TV-2, TV-11 and R-17 manuals.*Charles T. Huth, 229 Melmore St., Tiffin, Ohio 44883.*

Service manuals for Kenwood model "KD-3100" turn table and Smith Corona Model "Mark X" typewriter. Will copy and return. *Ted Lietzau 15669 Couzens East Detroit, MI 48021 (313) 777-5661.*

Operations literature for Sencore Yoke and Flyback tester model -YF33.*Guy D'Amico 1770 Ft. St. Lincoln Park, MI 48186, (313) 381-7800.*

Parts, test equipment, SAMS photofacts (-170, -1473) old radio and TV tubes) from a 1960, 70's service shop). Owner recently deceased. *Clark's TV Box 68, Jeffersonville, NY 12478, (914) 482-5030.*

Compute! Magazines will pay a reasonable price. *Jack Grossman 98-17 HOR. HDG.Corona, NY 11368, (718) 271-2775.*

Flyback transformer for "leading edge" monitor DR 1240 part number; TMF 2000 (will pay).*Joe LaGuardia 1521 Flamingo Ct, Homestead, FL 33035.*

Deflection yoke 51-37549-3 for a Magnavox 13" color TV chassis 13C1. *Claudes TV Radio Shack dealer 3rd St. Newport, VT 05885.*

Rider Radio Service Volumes 21-23, Kolster K43 power supply. *Cosmos TV Radio Repair 5919 15th Ave NW Seattle, WA 98107, 206-784-9417.*

Classified

Classified advertising is available by the word or per column inch.

By-the-word: $1.65 per word, per insertion, pre-paid. Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 additional. No agency discounts are allowed for classified advertising by the word. Contact Emily Kreutz at 516-681-2922 to place you classified ad (by-the-word). Or send you order, materials and payment to Emily Kreutz, Electronic Servicing & Technology, 76 North Broadway, Hicksville, NY 11801.

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 contact Jonathan C. Kummer at 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

MISCELLANEOUS

CAMCORDER REPAIR: Don't turn away good profits let our experienced technicians provide your shop with complete camcorder repair service. Also, VCR, "Tough Dogs." Call 1-800-846-4648. Edington VCR/TV, 204 North Kimble Drive, Bloomington, IN 47404. 9-91-6t

FOR SALE

REPAIR MANAGEMENT SOFTWARE: for IBM PC's. Repair tracking, inventory, reports, billing, maillist, more. Demo disk $15. CAHILL ELECTRONICS, PO Box 568, Kingston, NH 03848. 10-91-3t

PHOTOFACTS: Folders under #1400, $5.00. Above #1400, $7.00, sent same day first class postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 516-481-4380. 9-91-4t

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5¼" IBM Compatible disks. 1,000 VCR, Printout $55, Disks $51. 3,500 TV, Printout $95, Disks $91 (Hardrive). Time saver. Add to or quick scan by model, chassis or stage. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903. 8-91-6t

TELEVISION-MONITOR TROUBLESHOOTING: 350 Symptoms/Cures, nothing old listed, $20.00. Older Symptom/Cures, 1978 back, $10.00. 35 Steps to Easier TV Repairs, $20.00. Buy all three $42.00. Refund if not satisfied. Jones Enterprises, Box 702, Niceville, FL 32588. 8-91-2t

TV CASE HISTORIES UPDATED!: Volume 2.0 contains 1,150+ histories. Satisfaction assured, $28. Supplement to Volume 1.0 with 450+ histories, $10. Mike's Repair Service, P.O. Box 217, Aberdeen Proving Ground, MD 21005. 8-91-3t

TROUBLESHOOTING TV dogs - Over 500 symptoms and cures newly updated listing - free bonus - VCR cures. Send $10.95 to Century Electronics, 600 Starkey Road. 607, Largo, FL 34641. 9-91-2t

VCR SYMPTOMS & SOLUTIONS *UPDATED* Over 175 Solutions. Numerous Makes including Emerson, RCA, MAG, Sharp. $10.95 to Johnsons TV, 1905 N. Dixie, Elizabeth, KY 42701. 10-91-1t

VHS-VCR REPAIR SOLUTIONS SETS I,II,III,IV,V,VI. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each all six $59.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 10-91-3t

SENCORE: VA62, NT64, VC63, EX31, HP200, $2,050. ST65, $450. **B&K 467 CRT TESTER RESTORER** with universal socket adapter, $350. 305-964-4465 ask for Bruce. 10-91-1t

SHARP PARTS, ORIGINAL NEW & BOXED 35 Flys, 34 ICS, 23 H. Outs and misc. pieces. $1,500 plus, worth sell all $500 includes shipping and handling. 1-608-244-5767. 10-91-1t

ATTENTION VCR SERVICE CENTERS: 1000 VCR symptoms/cures from experience and manufacturers publications. Computer printout $90. Guaranteed satisfaction. VCR Tuneup Center, 43 James Avenue, Redwood City, CA 94063 or call 1-800-777-7883. Mastercard and Visa accepted. 10-91-1t

SENCORE VA62 for sale. In great condition. With VC63 and NT64. Priced at only $1,900. Call Ray at 813-262-7838. 10-91-1t

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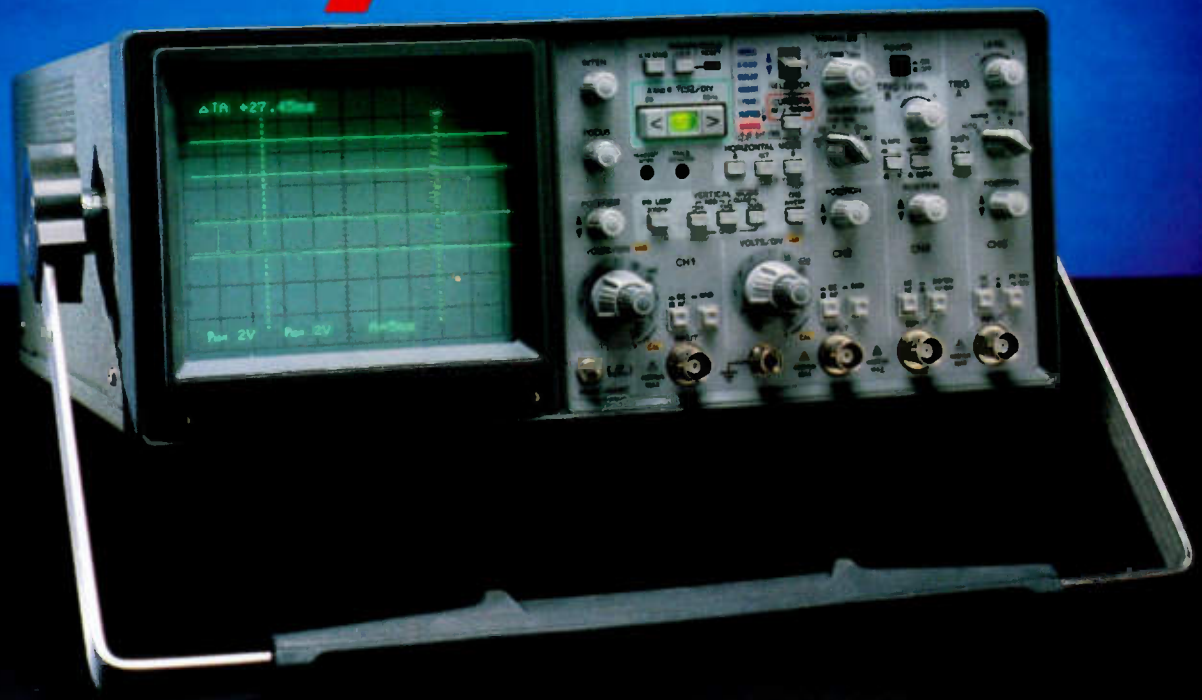

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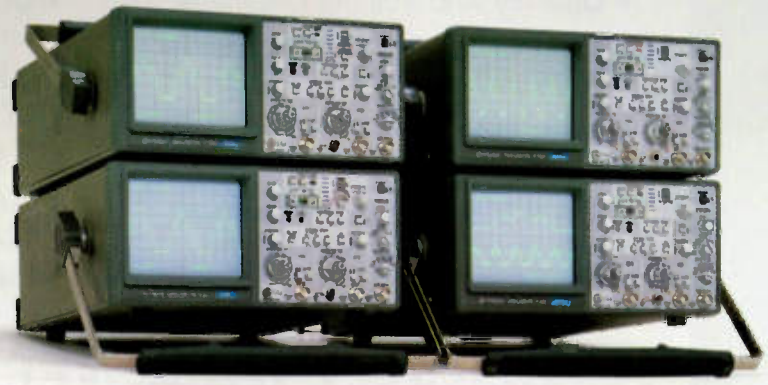

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