THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

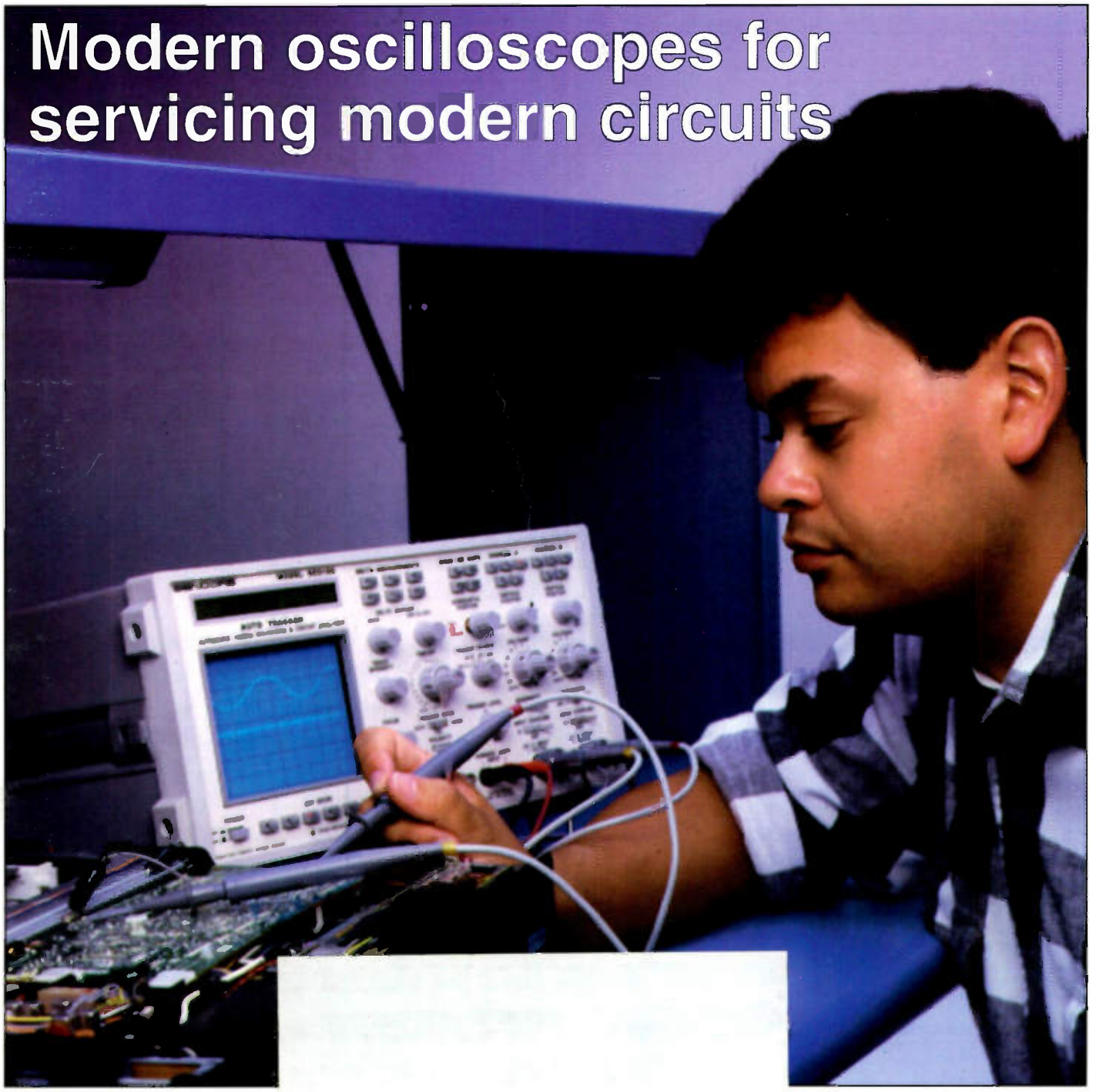
T.M.

APRIL 1993/$3.00

All about transformers

Servicing personal headphone stereos

Modern oscilloscopes for servicing modern circuits



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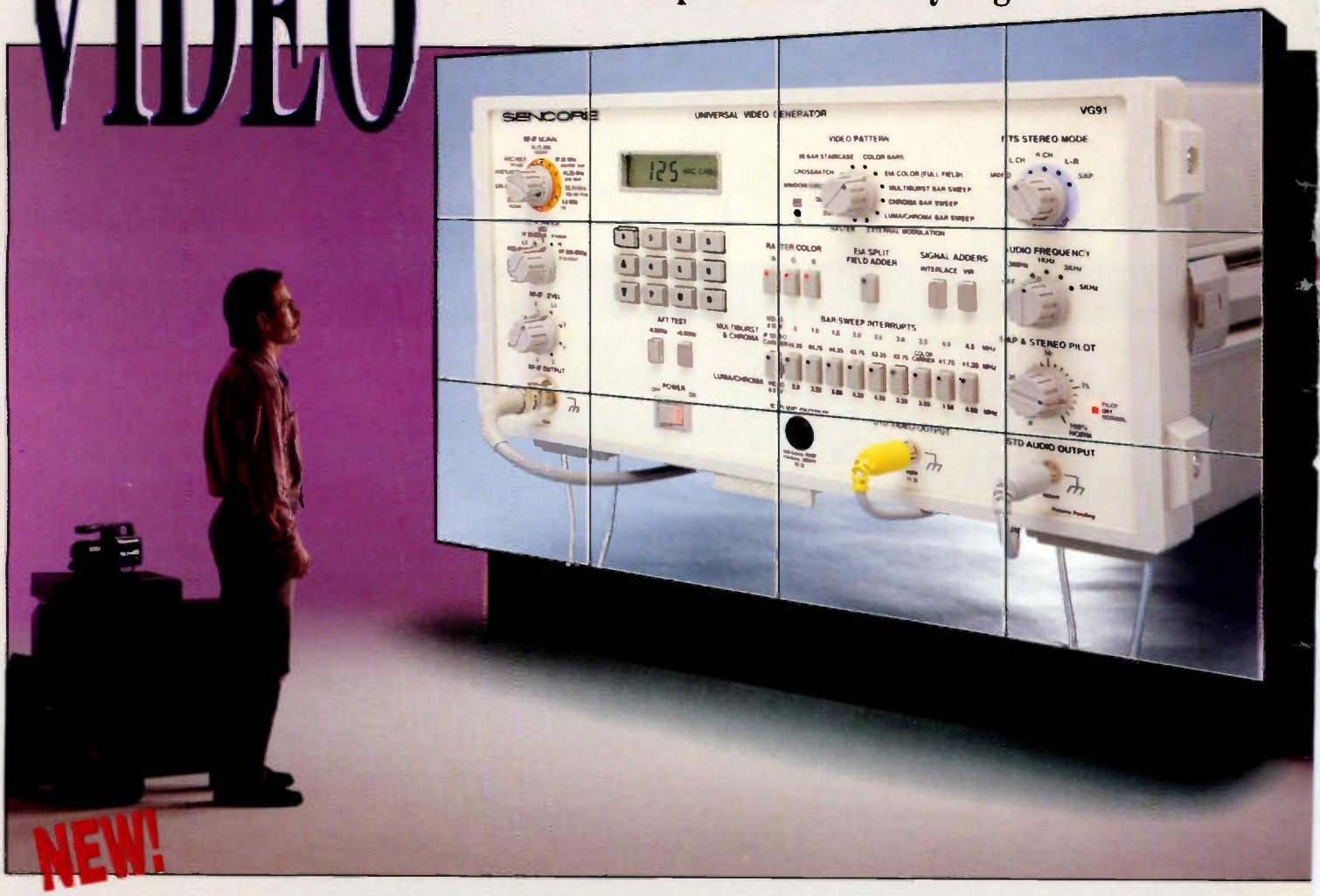

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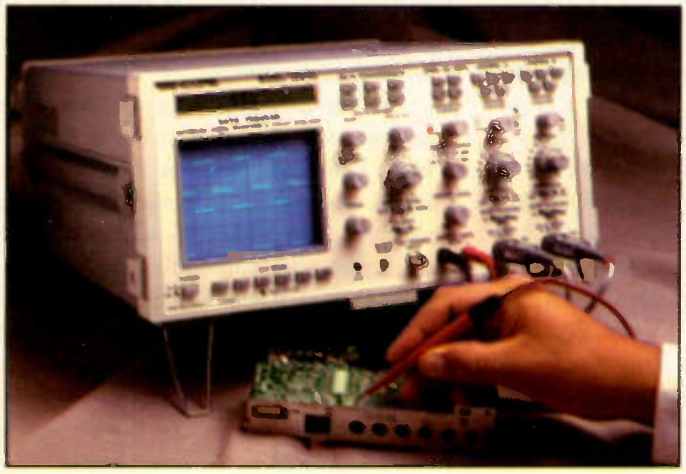

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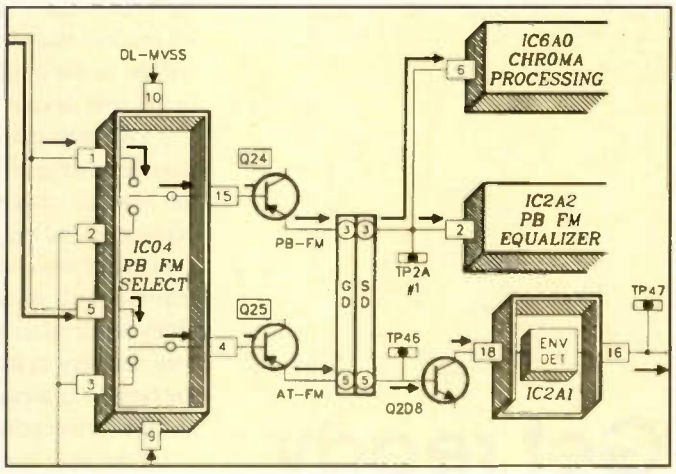

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By Brian Phelps
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By Homer L. Davidson
Transformers are used to perform a variety of functions in consumer electronic products.These transformers come in a variety of sizes, from tiny to large to heavy and are used in TV chassis, radio receivers, CD players, and VCRs. This article looks at the many different kinds of transformers.

18 Servicing personal headphone stereos
By Sheldon Fingerman
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22 Unraveling the parts numbering maze
By Vaughn D. Martin
Nothing is more frustrating than to see a schematic or block diagram with a rectangular block with only a part number inside. This tries the patience and knowledge of all but the most seasoned electronics veterans. It also unfortunately tells you nothing about the IC. Realizing this, let's start to unravel this parts numbering dilemma.

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Buying components, tools, test equipment, or other products from a distributor is much like dealing with any other kind of business. Whether you buy most of your products from a local distributor, or whether you do almost all of your business with a mail order firm, or some combination of the two, it is prudent to choose carefully the distributor (s) with whom you do business. This showcase is designed as an aid to help you, the ES&T reader, decide which distributor is right for your servicing needs.

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ON THE COVER

Every year, consumer electronics products becomes more complex and sophisticated. Today's TVs, for example, boast picture-in-picture, remote control, on-screen displays and more. Similarly, VCRs feature on-screen displays and movable head drives. Such advanced circuitry requires similarly advanced oscilloscopes to service it. *(Cover photo courtesy of Sencore).*

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
ELECTRONIC
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Editorial

Get ready for the next revolution

Are you ready for "smart" TV, or the "telecomputer". This is the new electronics product that the experts are predicting will be in the homes of consumers within the next decade.

This new product (actually, system may be a better term) will combine all of the features currently offered by TV, the computer, and the telephone.

One of the characteristics of the system that will distinguish it from TV of today is interactivity. TV of today is a one-way delivery system. Programs arrive at the home via airwaves, cable or satellite, and the viewer selects a program to watch.

The new communications system envisioned by the experts at such technology centers as MIT's Media Lab would allow viewers to somehow scan availability of programming and call up any desired episode of any given television program at any time. Most of this type of programming will be paid for by the consumer, and it's possible that the consumer will have a choice of whether she wants to watch advertising or not.

Some experts suggest that if the consumer wants to pay the full cost of the program, she may watch it without commercials, or if she wants to have someone else pay part of it, she may elect to watch the show with commercials.

Another technological development that will be part of the same trend is fiber optics. Delivery of the massive amount of programming that is expected to be available in the future, particularly if all of this is to take place in high definition, will require bandwidth, and lots of it.

One medium that can provide the extremely broad bandwidth required in order to transmit all of this information is fiber optics. And while fiber optic technology is still some distance from becoming a medium for delivery of information to consumers, its use as a consumer-oriented medium is coming ever closer.

For example, one problem that plagued fiber optics in the early going, the making of terminations, has been largely overcome. In those early days it took a skilled technician and highly specialized equipment to make fiber optic terminations. Developments over the past few years have made the making of terminations far more routine.

Moreover, as time goes on, the industry is gaining valuable experience that will make application of fiber optics to consumer information delivery far easier when the time comes.

Other indicators suggest that fiber optics are coming ever closer to becoming a consumer medium. For example, home developers in some areas have included fiber optic networks in some of the homes they're building, in anticipation of the day when some distributor of information will bring a fiber optic feed to these homes. This may happen sooner than anyone thinks, as telephone companies are continuing to look to fiber optics as a telecommunications medium.

For example, an article in the *Kansas City Star* on February 28, 1993, reports that Southwestern Bell is proposing to install a fiber optic network in Missouri. While the purpose of this network is not intended for delivery of commercial TV signals, at least not for the present, it's another indication that fiber optics are growing as a communications medium.

Every consumer electronics service center has been vitally affected by developments and changes in technology, prices, consumer attitudes, manufacturer policies and attitudes, legislation and more, over the 50 or so years since TV became a consumer medium.

The changes that will be wrought in the next decade or two by the introduction of smart TVs, programming on demand, fiber optics and more will probably make that period seem like a most orderly and sedate evolution.

All of these advances in consumer electronics products, and in the media being developed to deliver the programming for them will require that people who wish to service these products be intimately familiar with how they operate and how to correct problems that arise.

The revolution to come during the next decade or two will be a challenge for all servicing organizations, but considering the costs of all the elements: the delivery system, the programming and the TV sets, the future would seem to be bright for servicers who are foresighted enough to prepare for it, and to offer the needed services when it arrives.

Nils Conrad Person

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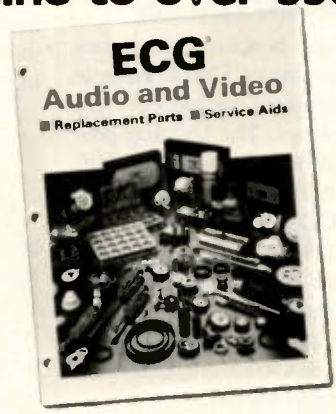

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Literature

IC test accessories catalog

Pomona Electronics has introduced their new 24-page Surface Mount and IC Test Accessory catalog. Highlights include an expanded line of popular FIN (Flexible Interface Network) clips and SMT-PGA converters and adapters. The brochure also introduces the company's newest SSOP and SQFP test clips designed to access chips with lead densities of 0.5mm or less and heights of 1.4mm. To assist designers and users in the selection of the right test clips, a concise SMT/IC product selection guide allows the user to select a standard test clip by identifying the various characteristics of the device (chip). Easy to follow, the table is designed to help the user identify each parameter of the chip (number of leads, pitch, package type, standard, EIAJ or JEDEC, and top-side interface requirements). Over 100 SMT/IC test clips are listed in the new user-friendly guide format. In addition, a carefully selected family of DMM test lead kits, coaxial cable assemblies, test probes and static control devices are presented providing a complete family of test accessories most associated with device testing requirements, including interface solutions between test clip and logic analyzers or other instrumentation. A glossary of terms is included in the back of the brochure to help define common industry terms and standards.

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Catalog for SMT/thru-hole

A new 24-page brochure describes A.P.E.'s complete line of SMT/thru-hole soldering/desoldering equipment for electronic assemblies. The Catalog provides technical information on all A.P.E. systems that are military certified in compliance with DOD-STD-20001B, WS-6536E and MIL-S-45743E. New products featured are the models EX-700 Digital Solder/Desolder station offering electronic temperature control from 450F to 900F and the EX-675 Air Operated Desolder Production Model.

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Parts/belt guide on disk

Projector-Recorder Belt offers their new and expanded 1993 PRB Comprehensive Belt & VCR Parts Cross Reference Guide on a convenient, easy-to-use computer disk. The Guide has a self-driven menu which quickly and accurately provides the information needed to get the replacement part and/or belt wanted in mere seconds.

The manual and PC version of the Guide have been updated to feature the latest comprehensive information on replacement parts and belt for VCRs, camcorders, answering machines, CDs, cassettes, car stereos, plus replacement parts for a wide variety of electronic equipment.

The Guide lists most of the mechanical parts by manufacturer make and model, and is crossed to the company's recommended replacement part.

The Guide is available on either 5 1/4" or 3 1/2"disks. IBM compatible, DOS 3.1 or higher, 512K RAM minimum.

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Semiconductor catalog

NTE Electronics, Inc. has announced the availability of its new 1992-93 Technical Guide and Cross Reference featuring over 250,000 U.S., Japanese and European devices cross-referenced, in a new easier-to-use format, to NTE's 3,500 quality replacement semiconductors. All of NTE's parts are available off-the-shelf. The company also recently introduced 338 U.L. and CSA recognized relays, sockets, I/O modules, and accessories. These have been cross-referenced to over 10,000 industry part numbers from over 110 different manufacturers in a separate catalog that is also available. In addition to the printed catalogs, NTE has electronically listed both of its lines in "QUICKCROSS", an IBM PC-based, high-speed, cross reference database.

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Spectrum analysis seminars

Tektronix is sponsoring a series of spectrum analysis seminars in several locations in 1993. These seminars offer techniques for using your spectrum analyzer more efficiently and obtaining better measurement capabilities whether you are in research, design or production test. Morris Engelson, a leading authority in the spectrum analysis field and published author, will lead the seminars. Mr. Engelson has over 30 years experience in the industry and has published several books, including *Modern Spectrum Analyzer Theory and Applications* and *Modern Spectrum Analyzer Measurements*. A list of dates and locations for the seminars is available.

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THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC Servicing & Technology

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

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Personal communications and computing show (PCC) launched by EIA

The first Personal Communications and Computing Show (PCC) has been announced by the Electronic Industries Association/Consumer Electronics Group (EIA/CEG). It is scheduled for June 3-6, 1993 in Chicago and will be held in conjunction with, and as part of, the 1993 International Summer Consumer Electronics Show (CES).

Exhibitors at the PCC show will exhibit products and services that enable the exchange, manipulation and storage of information in real time. Expected products include notebook, palmtop and pen-based computers, digital cellular, fax and data transmission equipment, as well as other products and technologies relevant to digital communications. Communications services such as cellular carriers and on-line data networks are also expected to participate. More than 75 exhibitors are expected to cover over 25,000 square feet on the 9.5 Level of McCormick North.

In addition to the exhibits, there will be a comprehensive conference program, as well as special evening events designed to help facilitate the exchange of technological and market information.

Attendees will include retailers, specialty retailers, value-added resellers, business technology and telecom managers, wireless technology service providers, industry analysts and executives from the airline, hotel, travel, public safety, healthcare, government, education and transportation industries, and financial institutions. (NOTE: The PCC Show will not be open to consumers.)

As a "show within a show," the PCC Show attendees will reap all the benefits of attending the CES. Also, CES attendees will be able to attend the PCC Show at no charge and see a window on the future.

Futurists offer forecasts for 1993

The coming year promises greater prosperity but rising violence, to judge by two of the ten best forecasts selected by the editors of The Futurist magazine to mark the approach of the New Year.

The forecasts were among those made over the past year by scholars, scientists, and others writing for the magazine, published by the World Future Society, Bethesda, MD. The editors selected the ten forecasts that seemed most thought-provoking, not necessarily those most likely to be realized.

The top forecasts for 1993 are:

—The 1990s will be a prosperous (though not euphoric) decade. The Dow Jones average could reach 5,000 by 1995 and 10,000 before the end of the decade.

—Due to increasing violence, private homes in the future may be designed more for security than for show. Bulletproof siding may become commonplace.

—Environment-friendly jobs will increase in the years ahead. People will be doing things like building bicycle paths and restoring damaged areas.

—Giant pandas will become extinct within the next 30 years unless efforts succeed in improving their low birth rates and saving their habitats from encroachment.

—As the baby boomers grow older, their jobs will go to baby busters. These "twenty-somethings" are said to have a poor work ethic and be unwilling to accept authority.

—"Supertrains" now being planned for heavily traveled routes in the U.S. could take 40 million travelers a year out of crowded airports and gridlocked highways.

—Los Angeles will increasingly resemble cities of the Third World, with a population rapidly becoming poorer and more ethnically diverse.

—Food in the future will be likely to be manufactured in "farmories"—hygienic food factories that will replace traditional agriculture.

—An oft-predicted shortage of teachers will fail to materialize in U.S. public schools. Teachers now have the lowest attrition rate in more than a quarter century, and experienced former teachers are returning to the profession.

—Japan will lose strength in the future due to its aging work force and young people uninterested in working long hours.

The top ten forecasts appear in an eight-page report, Outlook '93. This report, listing 72 selected forecasts made during the past year, is available for $3 from the World Future Society, 7910 Woodmont Avenue, Suite 450, Bethesda, MD 20814.

Zenith, GoldStar develop digital high-definition VCR

Zenith Electronics Corporation and GoldStar Co. Ltd. have jointly developed a digital high-definition video cassette recorder for home use, the companies announced today.

The new digital HD-VCR, developed for the Zenith-AT&T "Digital Spectrum Compatible" HDTV system, is designed to record HDTV signals on standard Super-VHS (S-VHS) videocassettes. The HD-VCR also would be able to record and play back programs in today's TV format using standard VHS tapes.

Unlike other proposed high-definition VCRs for consumers, the Zenith-GoldStar VCR prototype is built around "off-the-shelf" S-VHS head technology, making it very cost effective, according to Wayne C. Luplow, Zenith's division vice president, research and development, advanced television systems.

Zenith and GoldStar expect that the VCR could be sold in the United States for about $1,000 beginning in 1996.

Chai-Woo Lee, managing director of GoldStar's Image and Media Laboratory in Seoul, Korea, said that GoldStar has invested more than $5 million in the 18-month HD-VCR development program with Zenith. About 30 GoldStar engineers in Korea and in the United States have been working on this project.

Luplow said, "The first HDTV sets will be able to receive both standard and high-definition signals, so it's crucial that HD-VCRs be able to play standard tapes and record from either source. In addition to enjoying new HD tapes, consumers would still be able to play conventional VHS tapes from their home video library and corner video store."

He explained that a number of factors make the Zenith-GoldStar HD-VCR approach very cost effective:

- The HD-VCR would record digitally compressed video and audio, allowing use of conventional half-inch home videotape and recording head technology. (This, according to the developers, is a much less expensive design than the wide bandwidth recording approach being developed for consumer HD-VCRs in Japan.)
- To play HD tapes, the HD-VCR would not require video compression decoding, because the HDTV receiver would "decompress" the signal. And, the HD-VCR would not require video encoding and decoding circuitry (like today's VCRs), to record one program while watching another.
- Economical digital signal processing is achieved because circuitry in the HDTV set, not in the HD-VCR, would detect and correct errors in tape playback and in signals received over the air or via cable.

For pay-TV applications, the HD-VCR would record scrambled (encrypted) programming for playback only through an HDTV set equipped to descramble the pay-TV program, Luplow explained.

"This kind of signal security will finally give Hollywood an incentive to release programming for pay TV and home video simultaneously," he said. The HD-VCR also would make it possible—for the first time—to record one encrypted program while watching another without a second decoder box and without compromising signal security.

The HD-VCR would be able to record and playback two hours of high-definition programming on an ST-120 S-VHS cassette (the same time as conventional VHS recording in the Standard Play mode.) A full range of standard VCR features, such as fast forward, reverse, pause and scan would be included in the HD-VCR. It also would feature digital audio with the same high-quality audio found in today's compact disc technology.

Modern scopes for modern circuits

By Brian Phelps

If you are like most technicians, you must make waveform, dc voltage, dc current, peak-to-peak voltage, resistance, and continuity measurements literally hundreds of times each day. So, you need to be able to make these measurements quickly and accurately. Typically, most of these circuit measurements involve the use of an oscilloscope.

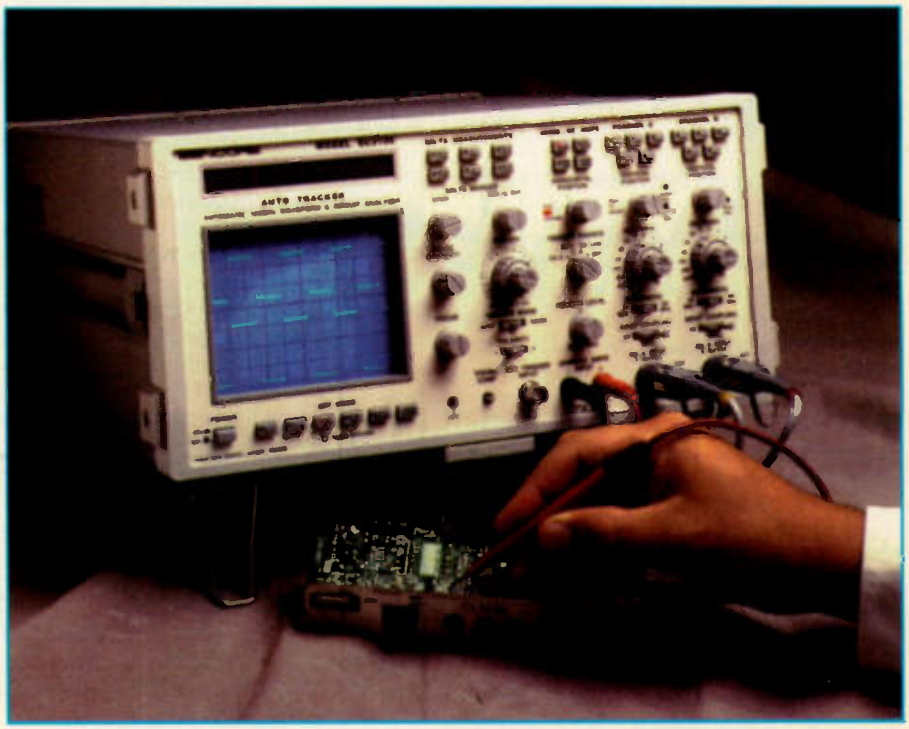

Figure 1. Servicing of circuits in today's consumer electronics products requires equally up to date test equipment. An oscilloscope with digital parameter measurement accuracy ease of use, and a full set of features will help to cover today's troubleshooting demands.

Features of a modern oscilloscope

Because the use of digital circuits has become widespread, many manufacturers are now requiring oscilloscopes with 100MHz bandwidths to make critical timing adjustments in today's faster circuits. Also, an instantaneous voltage measurement referenced to common circuit ground is important in determining trigger points and the proper logic levels of digital circuits.

In addition, technicians need greater sensitivity to troubleshoot and align circuits that have low level signals, such as audio and video record heads. In these applications a narrower bandwidth is required to prevent noise and high frequency interference pickup when viewing these signals.

In fact, many technicians believe that in order to find circuit problems, they need to compare every measurement that they make to the values that are printed on schematics and service literature. This need goes beyond the waveform parameters, and includes resistance and current measurements for full circuit analyzing.

Conventional oscilloscopes

An oscilloscope is an analog device whose CRT display shows a picture of the waveform, but the CRT display doesn't readily provide the user with the numerical values of the parameters needed to compare to the values printed on a schematic. The user makes all of the necessary parameter measurements by counting graticules on the CRT.

Taking into consideration all essential factors, (including the accuracy of the CRT circuits themselves), voltage measurements made using the CRT may be off by as much as 20 percent. Accuracies of time and frequency measurements are similar.

A separate digital voltmeter and frequency counter will provide the numerical values for the waveforms observed on the oscilloscope. A disadvantage of this approach to circuit analysis is that making measurements in this manner would require three sets of test leads to connect to the test point. Besides being awkward, having three leads connected at one time may load the circuit and cause your measurements to be incorrect.

Digital measurements

Many oscilloscopes today offer digital readouts that eliminate the need for multiple test leads for digital measurements. Some provide a digital readout of signal parameters measured by the CRT circuits.

With some digital readout oscilloscopes, first, you select the measurement channel. This is done by first selecting the appropriate menu and then selecting the measurement channel. To make a measurement on the other channel you go back through the menu.

If you want to measure the dc voltage at a test point while you are ac coupled you first set up the scope controls.

An auto-tracking digital readout, in contrast, does not use the oscilloscope's circuitry to obtain its digital readout. Auto-tracking digital tests are independent of the CRT circuits. The digital readings do not require that the variable vernier be set to "CAL"; they are correct no matter where you set the VOLTS/DIV or TIME/DIV controls, or whether the input coupling switch is set to ac or dc.

Resistance and current measurements

Most of your troubleshooting measurements and waveform analysis will be accomplished with the oscilloscope's analog and digital voltage measurement functions, but often you need to make resistance and current measurements in order to determine where the defect is located. These circuit parameters are printed in service literature and are often the key to isolating a circuit problem to a single stage or component.

Some oscilloscopes offer an integrated,

Phelps is Technical Product Marketing Specialist with Sencore Inc.

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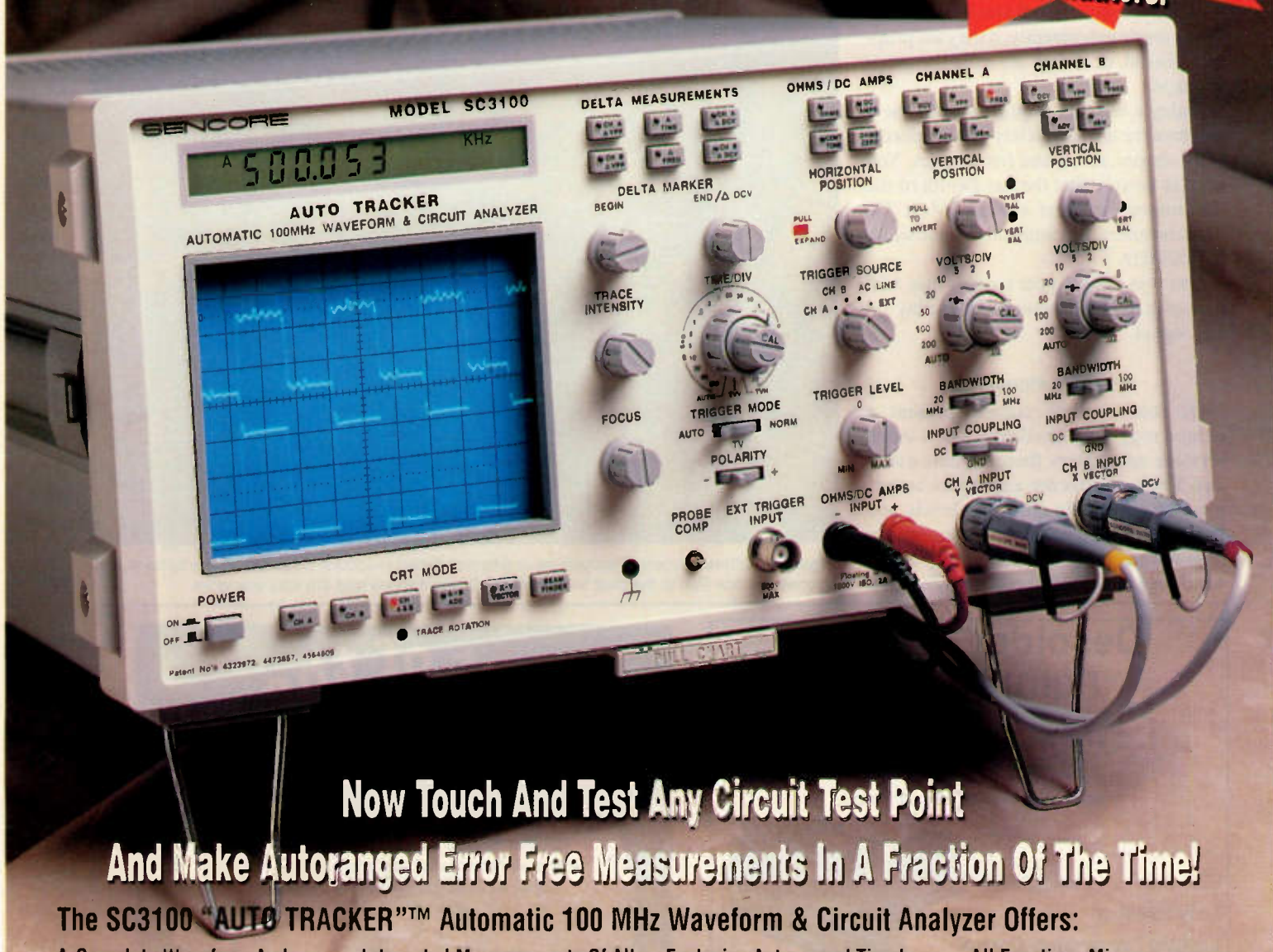

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Digital Delta Measurements To Analyze Every Portion Of Any Waveform
Highlight any part of a waveform with Sencore's exclusive Delta Bar and analyze the amplitude, absolute DC, time, or frequency. No more wasting time on graticule counting or setting cursors.

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The SC3100's analyzing speed will increase your servicing capability. All measurements are based on digital circuits, not the analog CRT, for fast, easy and accurate readings. There are no hidden menus, no multiple function buttons, no complicated setups and no confusing on screen displays. Just push a button and read the results on the LCD display. Eliminates any chance of measurement errors.

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autoranging ohm and current meter to confirm proper circuit operation.

Bandwidth

Sometimes a digital readout of the signal parameters at a test point just isn't enough. There are times when you need to view the waveform. For example, only the CRT display can tell you if two waveforms are timed correctly, if they are properly phased, or if they are even the proper shape.

Today's circuits require you to view and analyze a wide variety of waveforms of all shapes, sizes, and frequencies. You need to be sure that the bandwidth of the oscilloscope is great enough. Most TV manufacturers recommend a bandwidth of 100MHz.

You also need trigger circuits that will give you a stable waveform display on any signal.

Video signals

Of course video signals present a unique triggering challenge, but a video servicer encounters these signals every day. These signals are a complex assortment of constantly changing levels and frequencies. Special sync separators are required and provided in most scopes that are designed for video work, to give you

Figure 2. Different types of scopes have different digital readouts. Evaluate all the options and choose the one that is the best for the products you service and the way you work.

Figure 3. If you service video, make sure the scope on your bench offers complete video triggering and full measurement capabilities allowing you to measure the collector of the horizontal output transistor.

a stable waveform, even on "live video." On some scopes the sync separators are available through a menu.

On other units, video presets allow the user to lock onto a video waveform and automatically view two fields at the vertical rate (TVV) or two lines at the horizontal rate (TVH). Or, you can use TRIGGER MODEs to view TV signals and adjust the timebase control to see the desired detail of the video waveform.

The input circuits of any scope used for video troubleshooting should provide a 0.02 VOLTS/DIV range and provide a 2mV direct input for measuring small signal levels, such as the output of a VCR playback head. Also, it is helpful if it can sense if you're using the direct probe or 10X probe so you can't make a mistake.

If you're measuring higher voltages, such as the collector of the horizontal output transistor, a 200V/DIV range will allow you to measure signals up to a 2,000Vpp.

Autoranging

Autoranging allows the oscilloscope user to automatically set the timebase and vertical attenuators. This provides a locked-in waveform without manipulating the controls.

Autoranging is not the same as the "Auto Setup" feature found on some units. "Auto Setup" helps the technician get a display on the CRT - it does not follow changes in the applied signal, as when you're probing through a circuit.

Autoranging automatically adjusts the attenuator and timebase to display the waveform, then continues to adjust the CRT display to follow the input signal.

Measure a portion of the waveform

There are times when a technician needs to measure a portion of a waveform, such as measuring the amplitude of a sync pulse, time delay between signals, or the absolute dc level of a logic level.

On an oscilloscope without digital delta capability, the technician can measure a portion of a waveform by counting graticule divisions. This is accomplished by expanding the trace to show as much detail as possible, then positioning the trace so the portion to be measured is next to the graticule markings. The measurement is made by estimating the number of graticule makings, and multiplying by the switch settings. The accuracy of this measurement depends on the accuracy of the analog CRT circuits, and the care with which the technician estimates the trace and graticules.

Some digital readout scopes simplify this procedure. They allow the technician to adjust a cursor to mark the portion of the waveform that is to be measured, and digitally display the voltage or time that is marked. This requires care in order to avoid errors that may come about from an incorrect interpretation of cursor position, or parallax errors.

Another approach to this type of measurement is a digital delta test that allows the user to highlight the desired portion of the waveform with a delta bar, and read the results on the digital display. Only the portion of the waveform that is highlighted by the delta bar is measured.

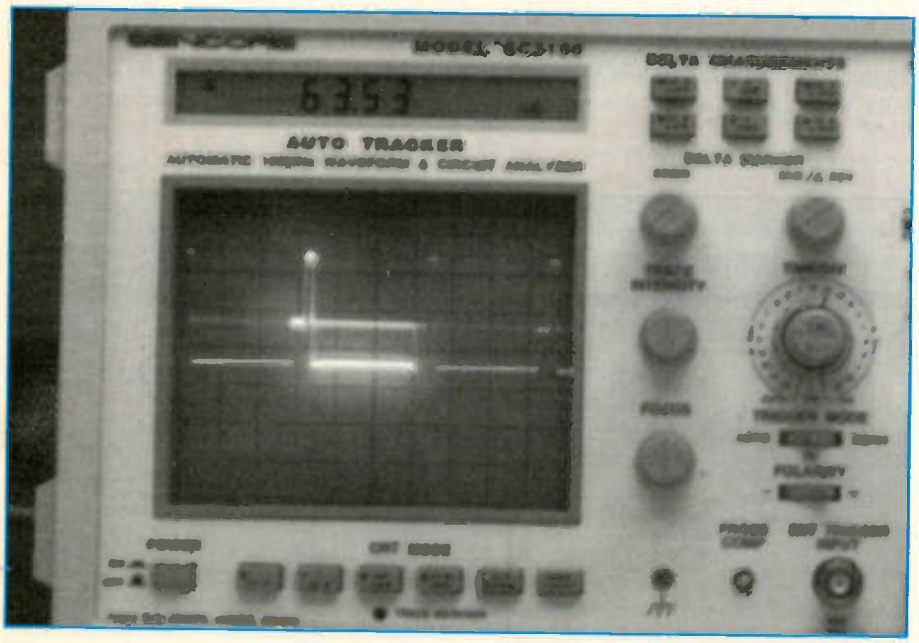

Figure 4. Digital delta measurements allow you to measure any portion of the waveform. This is useful for setting timing, time delays, absolute dc levels of digital signals, and other parts of complex signals.

Research carefully

Consumer electronics products continue to employ ever more complex, sophisticated circuitry, and increasing information density to provide improved sound and picture quality. The technicians who service these high technology products require ever more sophisticated test equipment to locate and correct the malfunction.

Manufacturers are responding with ever newer and useful testing products. In order to select the test equipment that will meet his expanding analysis, the servicing technician must carefully evaluate his testing needs, and the offerings of the manufacturers to find the products that best fit his needs and budget. ■

All about transformers

By Homer L. Davidson

Transformers are used to perform a variety of functions in consumer electronic products. These transformers come in a variety of sizes, from tiny to large and heavy. A transformer is a device that employs electromagnetic induction to transfer electrical energy from one circuit to another, often without any direct connection between them. In many cases, the voltage is increased or decreased from one side of the transformer to the other.

The transformer may consist of separate primary and secondary windings, upon a common core of magnetic material. When ac flows through the primary winding of the transformer, the magnetic flux that it creates in the metal core induces an ac voltage across the secondary winding. Both sets of coils are wound upon a laminated iron core.

Many different kinds of transformers are used in TV chassis, radio receivers, CD players, VCRs, and stereo amps. The step down, step up, coupling, standby, startup, driver, chopper, pincushion and horizontal output transformers may be found in TV chassis. Radio receivers, CD players, VCRs, and stereo amps may employ a step down transformer (Figure 1). Air core, coupling and IF transformers may be found in radio receivers.

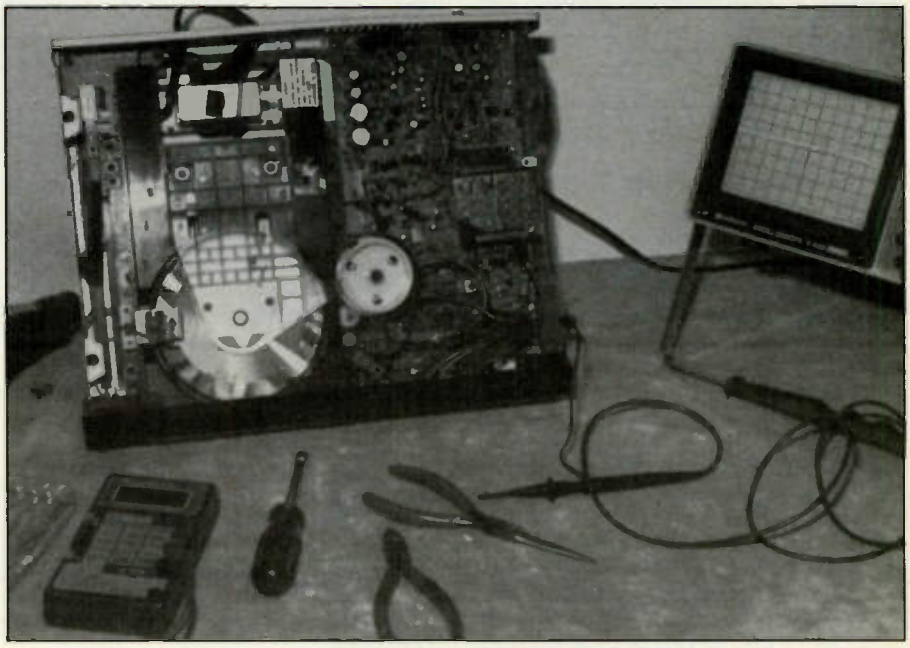

Figure 1. When you service a compact disc player, you may encounter a step-down transformer.

Step down transformers

The step-down transformer has fewer turns of wire on the secondary winding than on the primary winding, which causes the ac voltage of the secondary to be lower than the primary voltage. The secondary voltage created by the transformer in the CD player, radio, VCR and stereo amplifier is typically between 6Vac and 55Vac (Figure 2).

The secondary of a step-down transformer is wound with larger wire than the wire used for the primary winding, because it will carry higher current. Consequently, if there is a leaky silicon diode or electrolytic filter capacitor connected to the secondary, the increased secondary current, which results in increased current in the primary as well, may cause the primary winding to become open.

Although an overloaded circuit outside the power supply may load down the transformer, damage rarely occurs to the transformer. But if the audio output transistors or IC become shorted, and the circuit doesn't have an isolation resistor, the transformer may be damaged. Check the primary winding for open conditions, then replace the transformer if this winding is open.

If you suspect that a transformer is damaged, check both the primary and secondary windings for correct continuity. Typical primary resistance is between 30Ω and 350Ω, while the secondary winding measures less than 1Ω.

If the secondary is open, suspect a poor internal soldered connection. Sometimes the lead wire is poorly soldered or crimped underneath the cover. Remove the outside cover, being careful not to damage the coil winding. Check the lead wires for breaks or for a poor soldered joint. Replace the cover after soldering the lead wires.

In an Olympic Model RTD-40 tape player that I serviced, the primary wind-

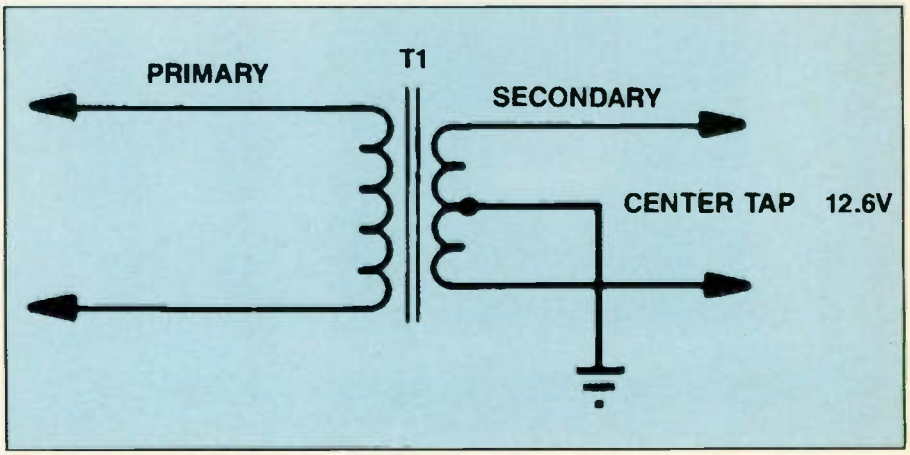

Figure 2. The step-down transformer has fewer windings, but of larger wire, on the secondary than on the primary.

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

ing of the transformer was open. Because the manufacturer was out of business and there were no replacements available for that particular transformer; either the unit had to be junked, or I would have to substitute a different power transformer (Figure 3). The dc motor operated at 13.2Vdc with 6.3Vac pilot lights.

I located a 12.6Vac, 2A transformer to replace the B+ and ac pilot light voltage. I connected one wire to the center tap of the secondary winding and connected the other end of the pilot light to chassis ground. I replaced both silicon diodes with 2.5A diodes.

You may be able to install a fixed voltage regulator for unusual circuits or cassette motors, if the voltage is fairly high. B+ voltage can be lowered with voltage regulators or low ohm 5W resistors. If the defective transformer is non-standard and there is no suitable replacement, it may not be possible to repair the product.

Step up transformers

The step up transformer was common in early tube and hybrid chassis. You may still find a few in high powered stereo amps. Often, the ac power transformer would be shorted internally, caused by a leaky silicon diode and voltage regulator in the secondary. The transformer would appear overheated with shorted turns or high overloading. Smoke with a rancid smell may occur with a shorted winding within the power transformer. Replacement is the only answer.

Power transformer replacement

When you're preparing to replace a transformer, make a note of all color-coded wires to be removed from the transformer circuit. You will usually find that the primary winding has black or white connecting wires. The secondary wires may be red with black or yellow center tap lead. In some equipment no special color arrangement is found. In this case, make a note of where each wire connects. Take continuity measurement of each lead wire.

Remove transformer mounting screws. Two or more metal screws may hold the transformer to PC board or chassis (Figure 4). When you install the replacement transformer, be sure to solder correct wires to marked connections. Check the continuity of each winding of the new transformer with the circuit. If you have been able to find an exact transformer replacement, check to make sure that the color coding of the wires is the same.

While servicing a Sanyo CP660 CD player, I found the primary open in the power transformer. There was no voltage in the secondary circuits. At first I suspected switch S901, but it tested normal.

Before I replaced the transformer and applied power I wanted to make sure that I corrected any problems in the secondary circuit that might have caused the transformer to fail. D601, D602 and Q601 in the +5V power source were found to be leaky (Figure 5). No doubt this was the cause of the transformer failure. After replacing these leaky components, I checked the power line source against the negative 5V source for overloading. Also, C609 and D609, zener diode regulator, was checked and appeared normal.

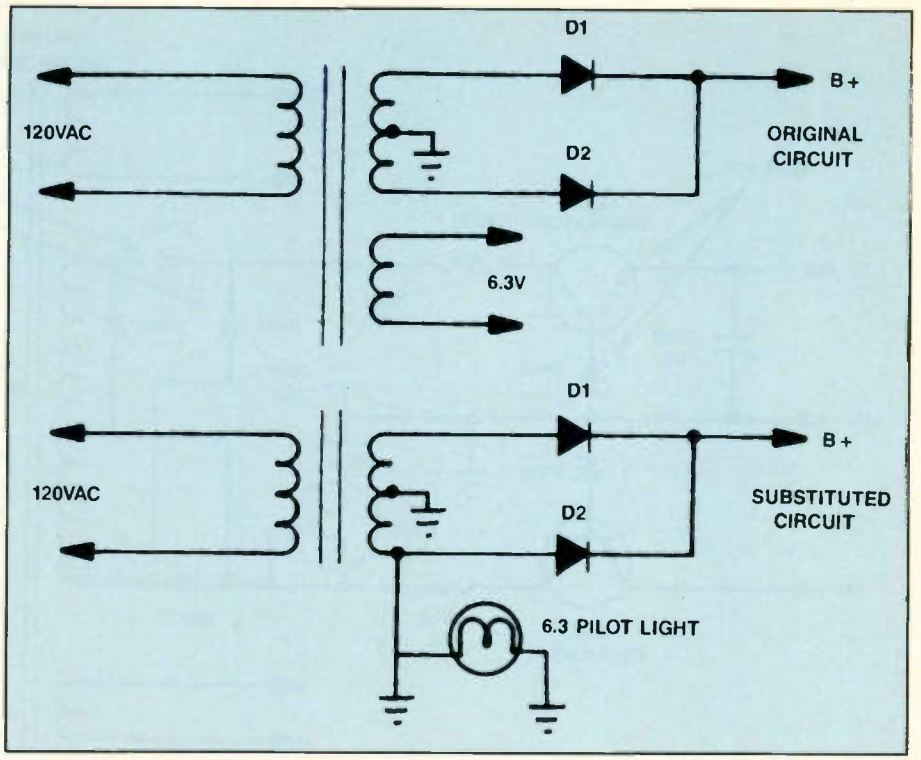

Figure 3. When the correct step-down transformer was not available, rewiring the ac circuits in this Olympic Model RTD-40 tape player returned the player to service.

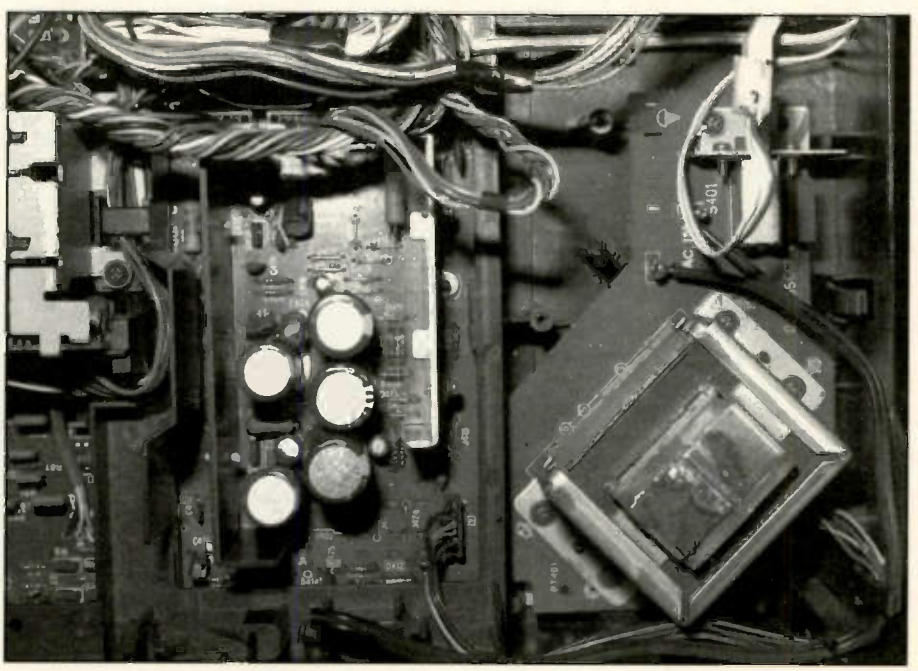

Figure 4. In the Technics RS-M275K amplifier, four mounting screws must be removed before the transformer can be replaced.

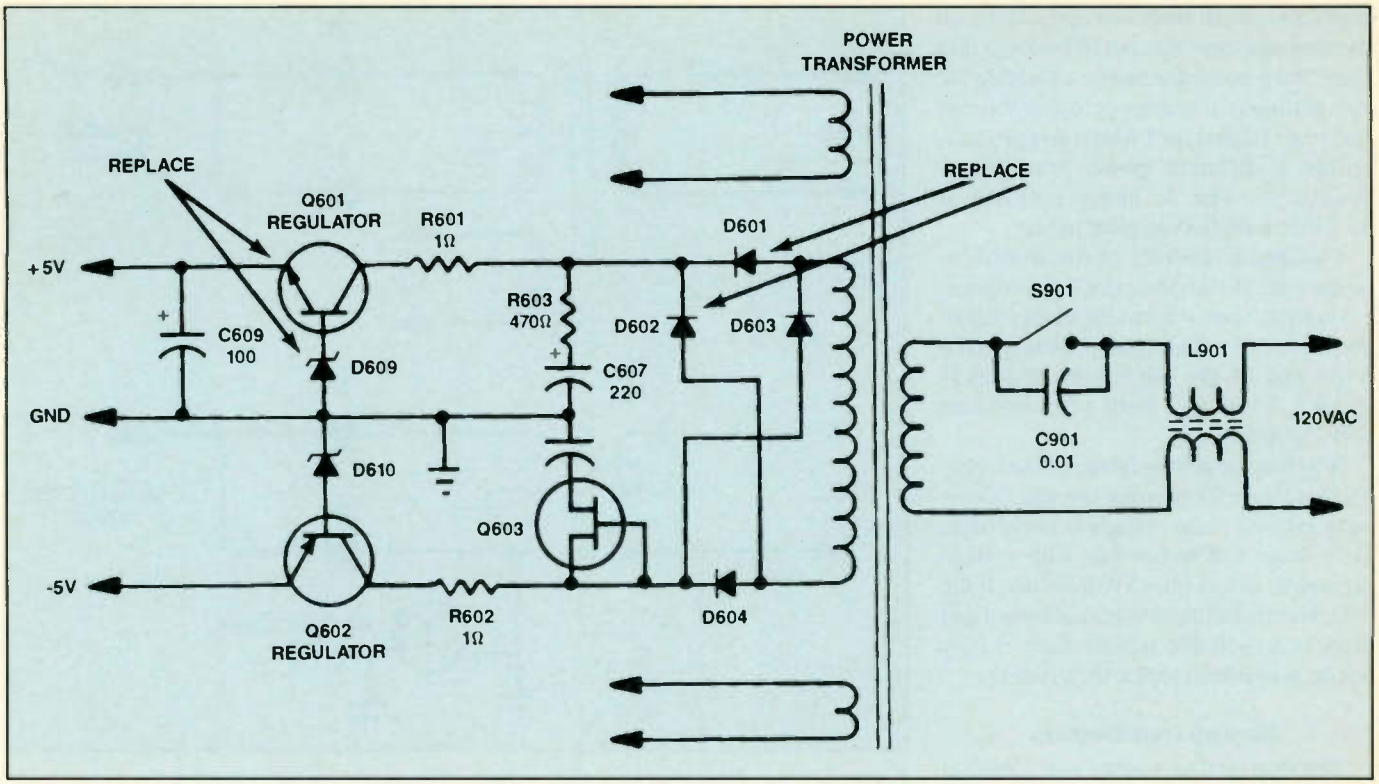

Figure 5. Leaky components within the +5V source opened the primary winding in a Sanyo CP660 CD player.

Replacing the power transformer (PT) solved the dead compact disc player. This transformer must be replaced with the original part number 4-300T-95200.

Air core transformers

The air-core coil or transformer is an inductor without any magnetic core. These air-core coils may be wound side by side, or the primary may be wound over the secondary, or vice versa. RF coils in a radio receiver or TV chassis may be called air-core transformers.

Although the IF transformer may be constructed like an rf coil, the powdered iron core or slug provides tuning or alignment. The intermediate frequency may be 455kHz or 10.7MHz in the AM and FM bands. Most coil problems are caused by broken leads, coils that were wound too tight and have snapped coil connections, and poor soldered terminal connections. Tuned coils should not be touched except with the correct alignment tools and test equipment.

Standby transformers

The standby power supply provides standby voltage with rectification and sometimes voltage regulation. The standby transformer is connected directly to the ac power line and is alive at all times. The standby power supply, with its trans-

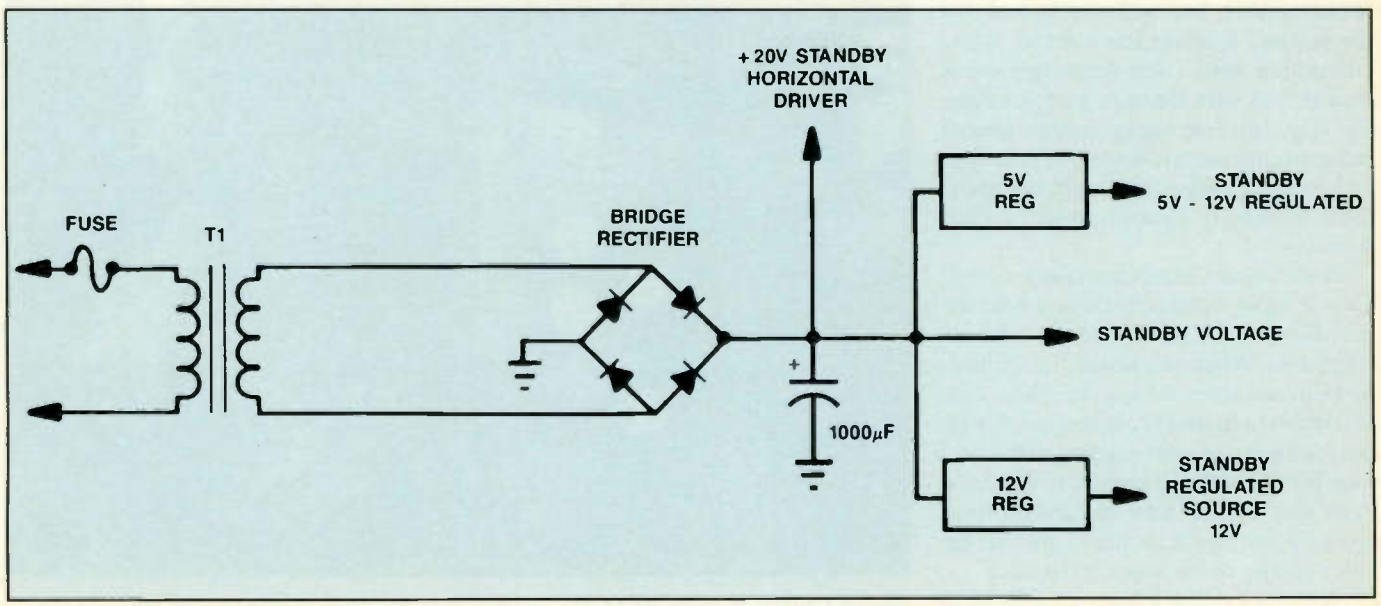

Figure 6. The standby transformer is alive at all times and provides standby voltage to the IR remote receiver and other circuits.

former is found in the remote control TV chassis.

The standby dc voltage is applied to the infrared remote receiver and microprocessor. This voltage may be applied to the horizontal driver transformer during startup, as well as to supply voltage regulation, to the power on/off relay, and a standby voltage source (Figure 6).

When the remote does not function even though the remote transmitter functions normally, suspect a defective standby transformer. Check for continuity at the ac plug to determine if the primary winding is open. Check the small fuse. Measure the ac voltage at the secondary winding terminals or at the silicon diodes. Remember, the standby transformer is a step-down transformer with lower ac voltage at the secondary.

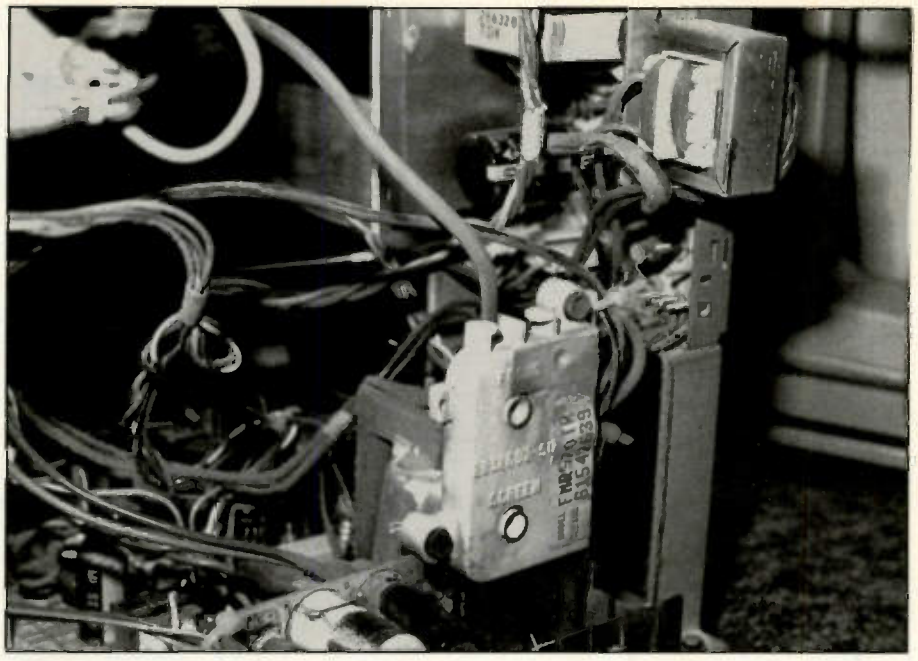

Figure 7. A start-up transformer provides the start-up kick in an RCA FMR570TR portable.

Start up TV transformer

Start-up transformers were common in TV sets manufactured during the 1970s and 1980s, while in other TV chassis a special winding on the flyback may give the circuit a kick to effect start-up. The transformer consists of a secondary and primary winding with silicon diodes. Check the continuity of both windings with the ohmmeter. Very few troubles are found in the latest TV chassis with the start-up transformer. I have had to replace several transformers in earlier RCA chassis, however.

Horizontal driver transformer

Horizontal driver transformers are found in just about every TV chassis manufactured. The transformer couples the horizontal drive pulse or waveform to the input terminal of the horizontal output transistor. The transformer isolates the driver transistor circuits from the output stages. In the early tube circuits, one tube served as driver and two tubes operated in push-pull with a drive or interstage transformer. This is a step-down transformer. This type of winding may be found in the audio output transformer.

The defective driver transformer within the TV chassis may cause the set to fail to start-up, or to be dead or intermittent. Check the transformer connections where winding terminals are soldered to the chassis or PC board. These wires may break off, or they may have poor enameled connections or soldered terminals. If the driver transistor is shorted or leaky, the primary winding of the horizontal driver transformer may be damaged.

No start-up

While servicing a Montgomery Ward GGY-16215A TV set, I found the driver

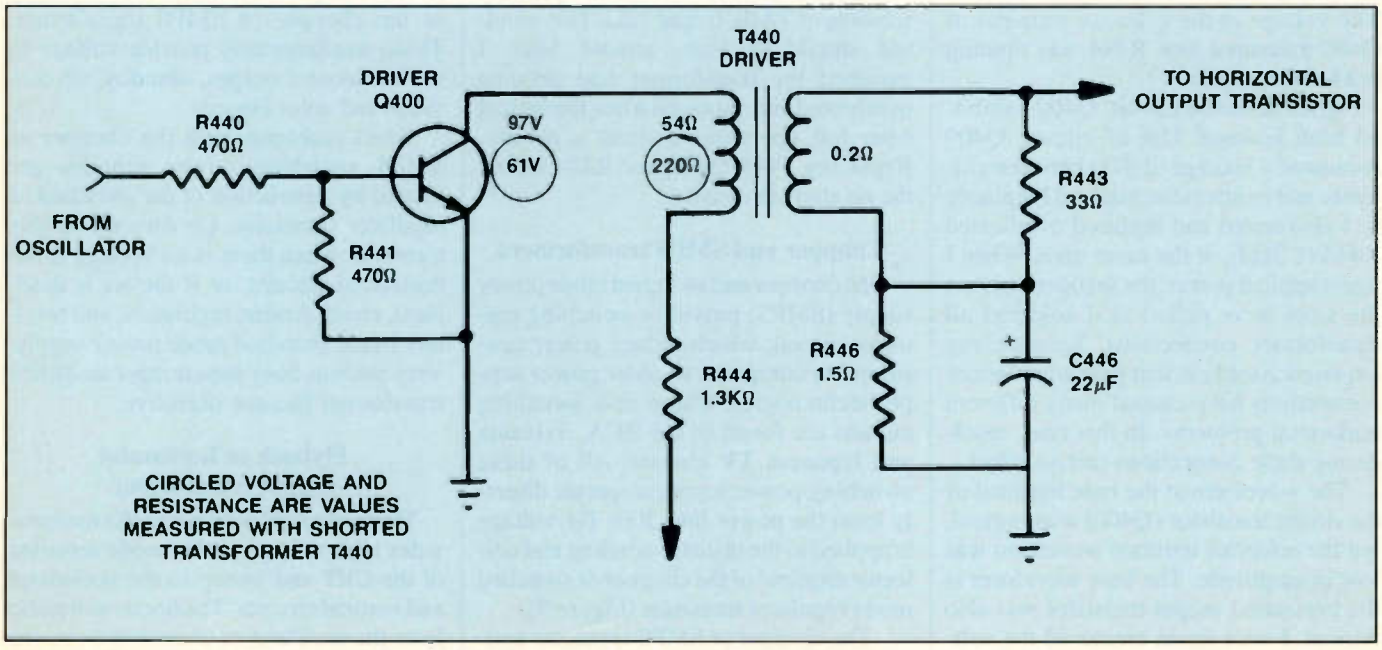

Figure 8. The chassis of a Montgomery Ward GGY-16215A portable was inoperative, and was caused by a defective driver transformer.

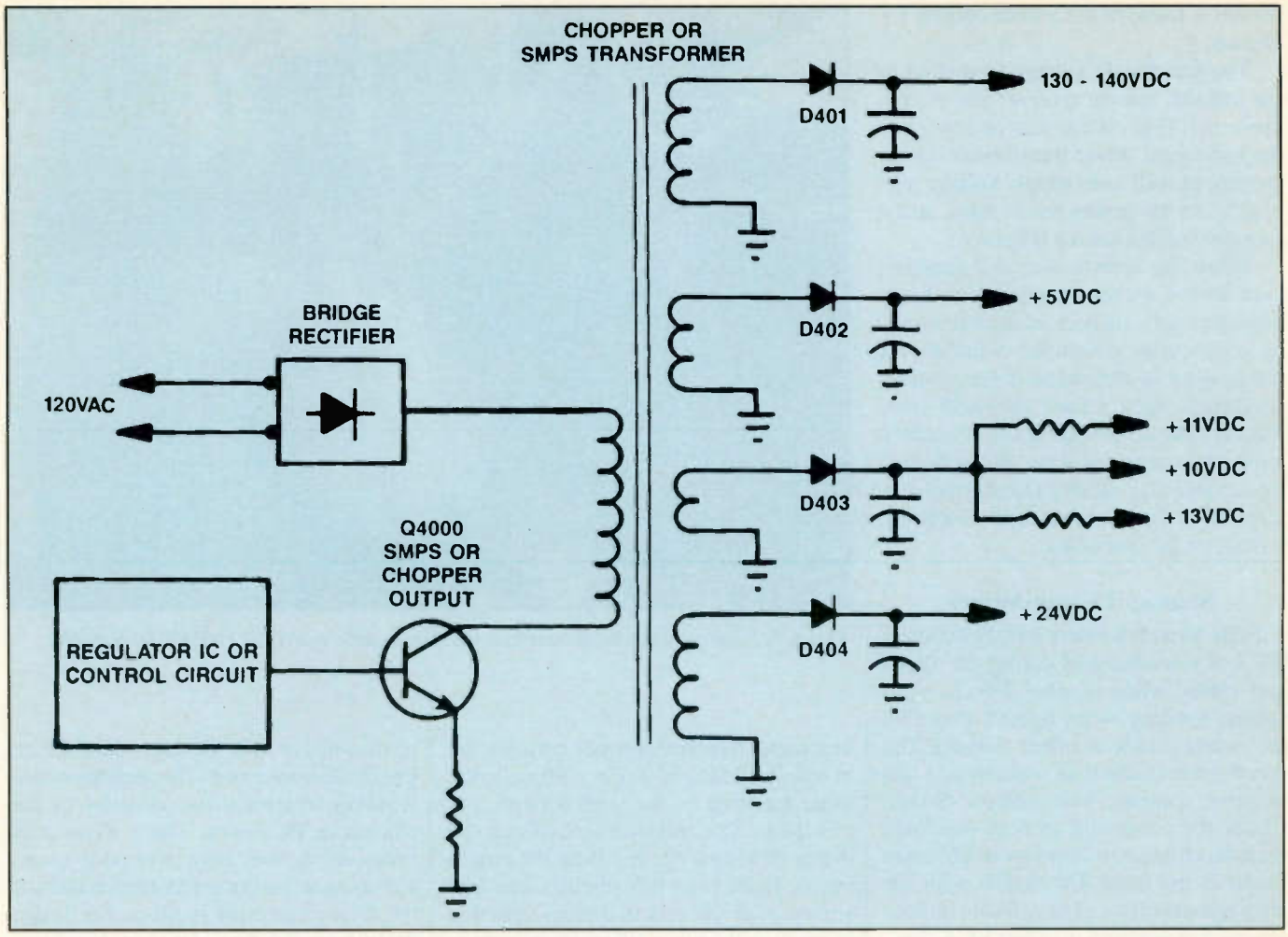

Figure 9. A chopper or SMPS transformer provides several voltage sources.

transistor (Q400) operating quite warm, and there was no high voltage. In this set, the raw B+ voltage is tied to the horizontal output transistor and driver circuits. The voltage at the collector terminal of Q400 measured low. R444 was running red hot (Figure 8).

When tested in circuit, Q400 exhibited high leakage. Out of circuit, Q400 measured a leakage of 87Ω between collector and emitter terminals, so I replaced it. I also tested and replaced overheated R444 (1.3kΩ), at the same time. When I again applied power, the set operated, but the sides were pulled in. I soldered all transformer connections, because my experience told me that poor transformer connections have caused many different horizontal problems. In this case, resoldering these connections had no effect.

The waveform at the base terminal of the driver transistor (Q400) was normal, but the collector terminal waveform was low in amplitude. The base waveform at the horizontal output transistor was also normal. I once again measured the voltage at the collector of Q400 and at R444. The collector voltage was higher than normal (101V).

After shutting down the chassis, I measured the resistance across the primary winding of T440. It read 22Ω. This winding should measure around 54Ω. I assumed the transformer had become overheated and damaged when the set had been left operating without a picture. Replacing T440, Q400, and R444 solved the no start-up chassis.

Chopper and SMPS transformers

The chopper and switched mode power supply (SMPS) provide a switching regulator circuit, which reduce power consumption compared to older power supply technologies. These new switching circuits are found in the RCA, Sylvania and Japanese TV chassis. All of these switching power supplies operate directly from the power line. Raw B+ voltage is applied to the primary winding and collector terminal of the chopper or switched mode regulator transistor (Figure 9).

The chopper or SMPS regulator transistor may be damaged when a defect occurs on the ac side, or when circuits in the secondary voltage source become overloaded. Separate windings with different voltages are found in the secondary of the chopper or SMPS transformer. These windings may provide voltage to the horizontal output, standby, screen, video and color circuits.

Most problems with the chopper or SMPS switching power supplies are caused by destruction of the switched or regulator transistor. Go directly to this transistor when there is no voltage at the horizontal circuits, or if the set is dead. Next, check diodes, regulators, and resistors in the switched mode power supply. Very seldom does the chopper or SMPS transformer become defective.

Flyback or horizontal output transformer

The horizontal output transformer provides high voltage to the anode terminal of the CRT and sweep to the horizontal and vertical circuits. The horizontal pulse from the oscillator or countdown circuits provides a pulse or waveform that is

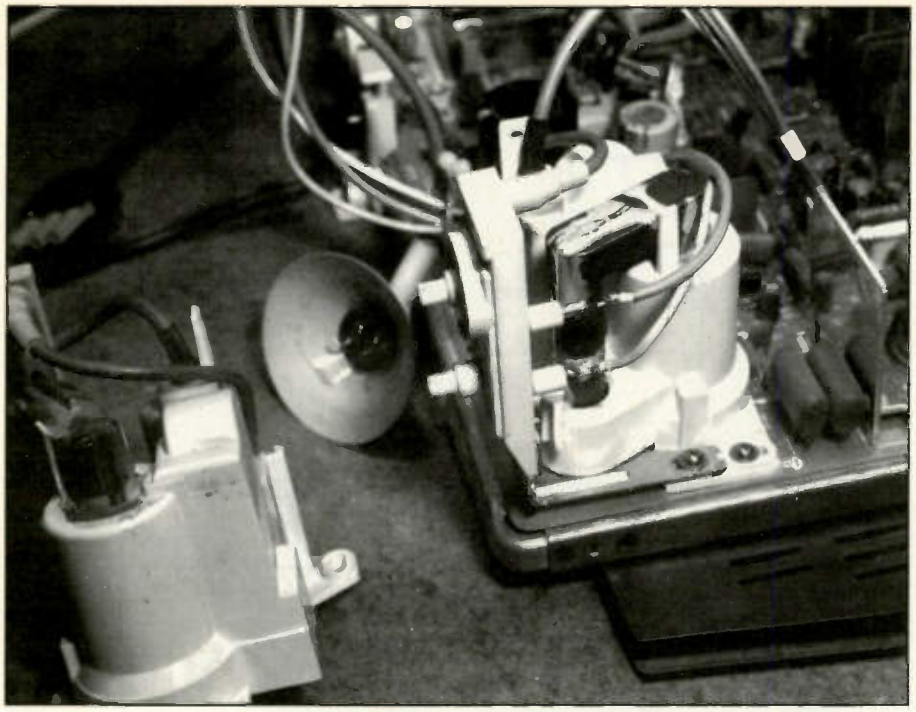

Figure 10. A leaky flyback transformer may cause destruction of horizontal output transistor.

amplified and driven with the driver transistor, transformer coupled to the horizontal output transistor that ends up driving the flyback. This transformer may have additional windings on the secondary to provide many different voltage sources (Figure 10).

Sometimes it is difficult to determine when the horizontal output transformer is defective. This transformer may become open or leaky. If high voltage capacitors molded inside the plastic case become leaky it may cause internal arcing and damage to the transistor. When leaky, the flyback may destroy the horizontal output transistor, voltage isolation resistor, and the ac or dc fuse, or both fuses.

If you suspect that the horizontal output transformer is faulty, you can check it using a 100W light bulb or a variable isolation power line transformer. To perform this check, remove the ac fuse and clip the light bulb across the fuse terminals. If the light bulb is bright, a short exists. If the light is dim, the horizontal output circuits are probably normal. Connect the set to the ac power line through a variable isolation transformer. Slowly raise the ac line voltage to the TV set from 60Vac to 75Vac. Check the waveform at the base of the horizontal output transistor or driver output. A distorted waveform with low dc voltage at the collector terminal and a warm output transistor indicates an overloaded flyback.

If a horizontal pulse and waveform is noted upon the amp IC and driver transistor, suspect a leaky output transformer. When the ac voltage is raised higher, the output transistor may be damaged. But, if the output transistor operates cool and you observe a drive pulse on the scope with the probe placed next to the output transformer, slowly raise the ac voltage to the normal power line voltage (120V) and observe the results.

Remember, improper drive, a leaky output transformer, a leaky SCR regulator or an open damper diode may damage the output transistor. Make sure that the drive voltage is present at the base of the horizontal output transistor. Replace the output transistor and damper diode if they're leaky. In newer sets, the damper diode is frequently mounted inside the same case with the output transistor.

Replacing the flyback should be a last resort measure. Before taking this step, you should disconnect the power sources that are derived from the outputs of this transformer one at a time to see if the problem lies in one of those circuits.

Pincushion transformer

Pincushion distortion occurs when the picture on the TV screen bows inward at the sides or bottom. This kind of distortion is only a problem in sets that are 27 inches or larger. The pincushion correction circuit eliminates or reduces this distortion. When the raster or picture bows inward, at the sides or bottom area, sus-

pect problems in the pincushion correction circuits.

Poor width and horizontal linearity may be caused by an open winding or poor soldered board connections in the pincushion circuits (Figure 11). If you observe this symptom, solder all pincushion board connections. Take continuity measurements of each coil winding.

Another possible cause of poor vertical or horizontal linearity is an open or leaky pincushion transistor.

Comments

Transformers should be replaced with an exact replacement that bears the same part number as the original part when one is available. Two different power transformers may be used to achieve the correct voltages when a transformer with multiple windings must be replaced and no suitable replacement is available. When the symptom is an open winding, don't forget that the cause may be a poor soldered terminal under the heavy wrap.

A future article will cover auto, isolation and variable ac transformers. That article will include instructions on how to build a variable-isolation transformer. ■

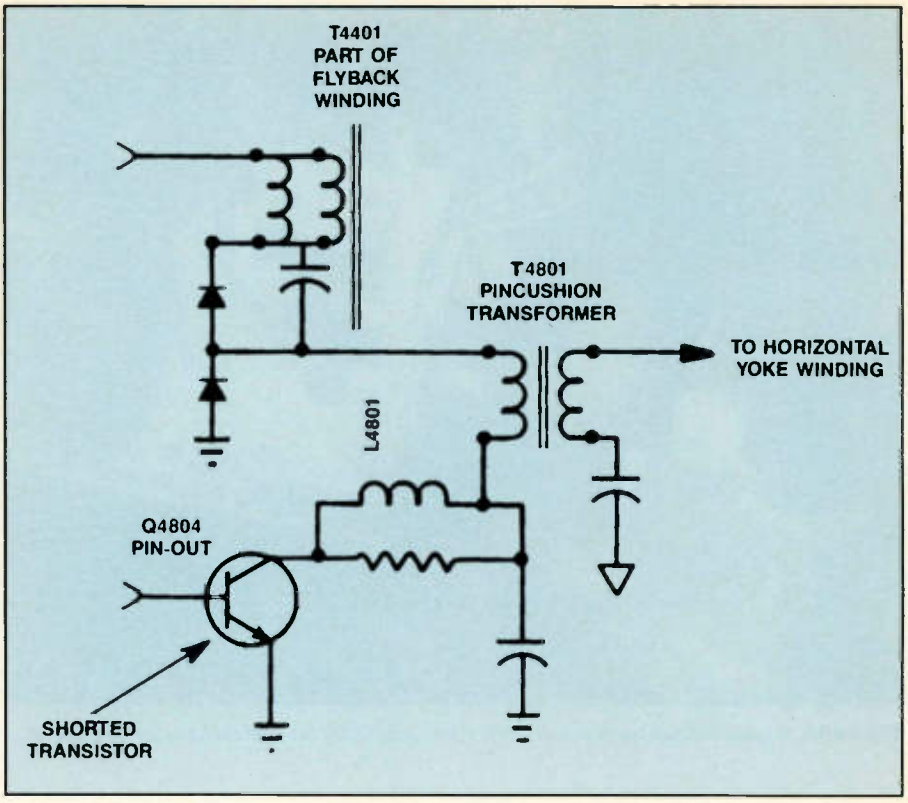

Figure 11. A leaky pin-out transistor (Q4804) in an RCA CTC158 chassis caused the picture to bow in.

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Servicing personal headphone stereos

By Sheldon Fingerman

In today's world of throw-away consumer electronics, servicing personal headphone stereos may seem like a waste of time. On the other hand, servicing these units can be a rewarding break from the routine, and will enable you to offer a service that is difficult to find. This helps to bring in customers. Even most authorized service centers will refer these miniature marvels to the factory.

Once inside a personal stereo, you'll find that there is very little difference between it and any other electromechanical device, except for size. Typical problems you'll find in these units are broken belts, cracked circuit boards, cold solder joints, and worn out parts. Approach problems in personal stereos the same as you would approach problems in any other consumer electronics product. The primary difference you'll find is that things are on a smaller scale.

Also, keep in mind that personal stereos suffer from abuses that in-home stereo productst are not exposed to. When a headphone stereo is turned over to you for service, assume that it has been dropped, that the unit went one way and the headphones went the other, that it has sand in it, and that it may have been under water at some time.

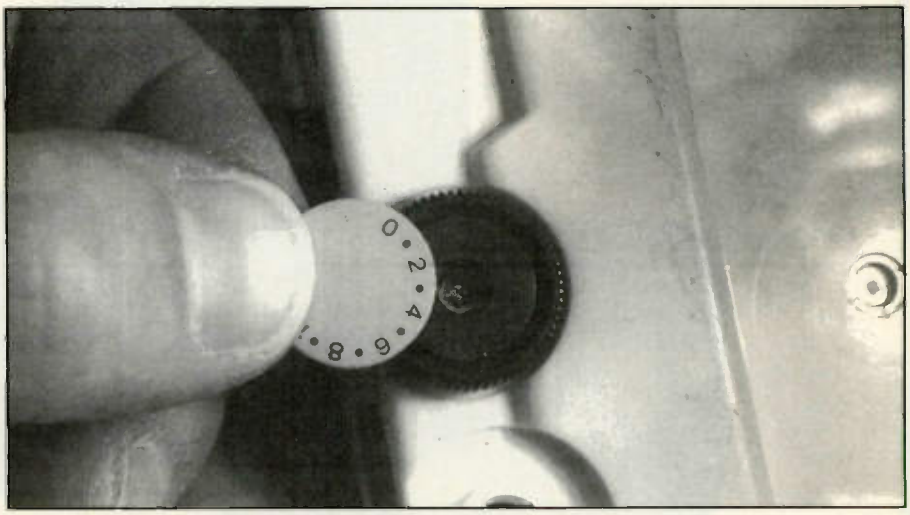

Figure 1. Most screws on water resistant models can be found under adhesive "dots." Note the false hole to the right, and the dot that is still in place at the lower right.

Some common problems

The most common symptoms encountered in servicing of personal headphone stereos are intermittent audio, improper functions, or failure to operate entirely.

Intermittent audio is without a doubt the number one complaint with Walkman type personal stereos. Wiggling the headphone plug will usually make and break the signal. The customer will probably tell you that she has already purchased a new set of headphones but that the problem persists.

The only test equipment required to troubleshoot this problem is a known-good set of headphones. If the unit operates properly with the known-good headphones, you know that the problem is in the headphones. If the unit continues to exhibit the problem, the problem is in the stereo unit, not the headphones.

If the problem is with the headphones, and not the unit, a decision will have to made as to whether to attempt to repair the headphones, or to simply replace them. If the phones are valuable and the problem is one that can be repaired, it may make sense to service the headphones. If the headphones are of the $10 variety, replace them.

In most cases the problem will be in the unit itself, and is usually due to a broken solder joint, a broken foil, or a crack in the circuit board.

If the unit appears to be totally dead, the remedy may be as simple as replac-

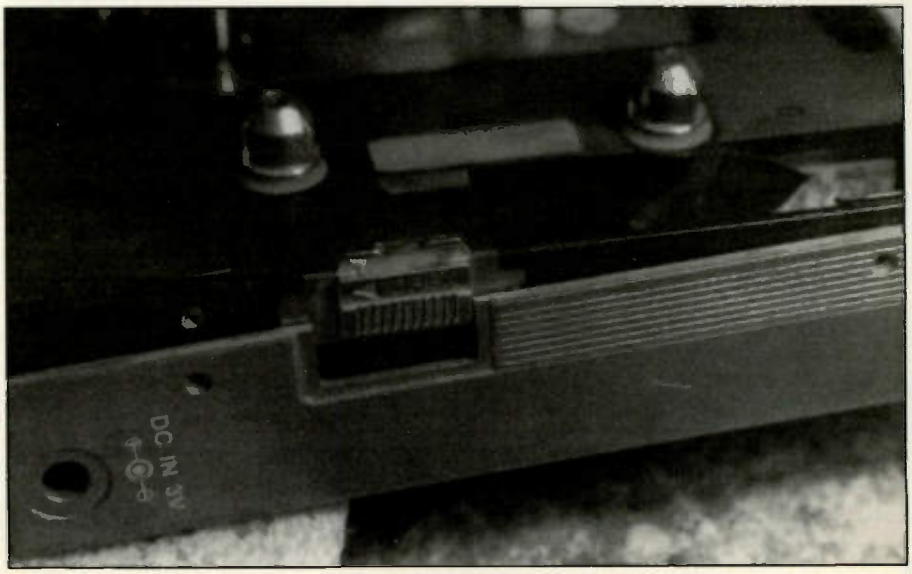

Figure 2. This latch is held in place by the outer cover (which is partially removed). It has a spring behind it, and will pop off if not held in place.

Fingerman is an electronics and computer consultant and servicing technician.

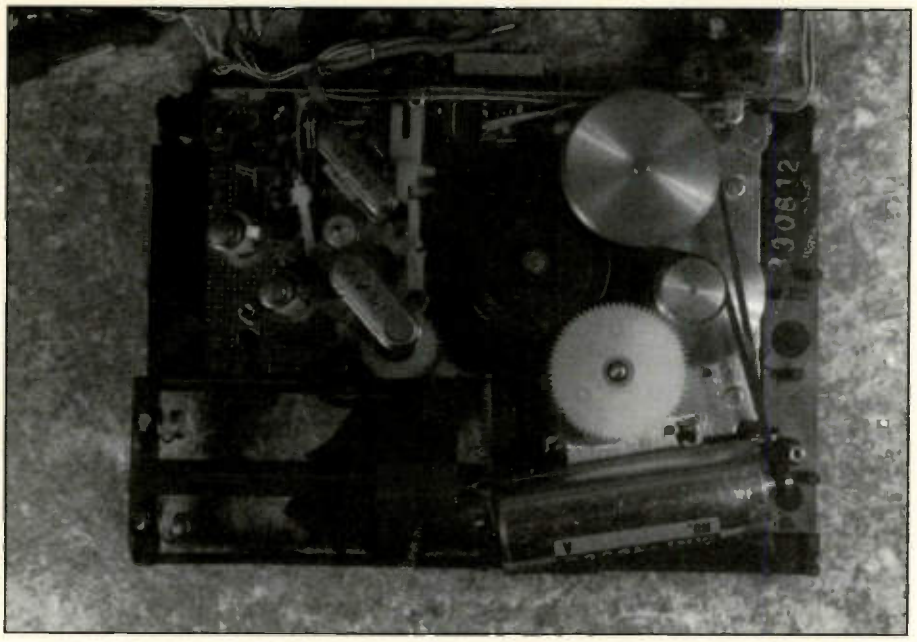

Figure 3. A transport with the circuit board removed. Note that the small cylindrical motor (lower right) is turned 90 degrees to the capstan and flywheel.

ing the batteries. As you are probably aware, just because batteries are new doesn't mean they are good. If the batteries check good, try cleaning the battery contacts. If you can hear the motor spinning when you hold the unit up to your ear the problem may be a broken belt. If you can't hear the motor spinning, the problem may be a dirty or broken leaf switch, or a circuit board problem.

Improper function can include just about anything. One common problem with auto-reverse units is hearing both sides of the tape playing at the same time, one going backwards. This is usually caused by a broken ground on the record/play head. Constant reversing can be caused by a broken belt. Also, look carefully for any broken or unhooked springs around the head, capstan and pinch roller assembly.

Problems caused by small size

The very compact models with metal cases sometimes experience problems because of a bent case. There is very little space between the moving parts and the outer case in these units, so just being packed in a tight suitcase may be enough to bring one of them to a complete halt.

Because many of the functions are driven by very small gears, the mere presence of a grain of sand can cause problems. If the mechanism seems to be jammed, ask if the unit has been taken to the beach recently.

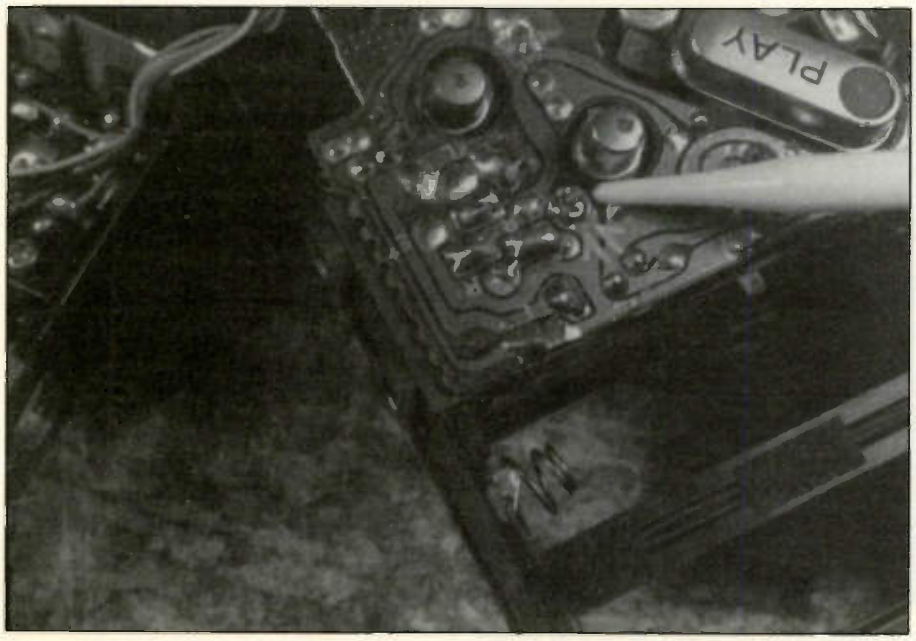

Figure 4. The circuit board around the headphone jack (s). The pointer shows one of the screws holding the board in place. Note the arrow pointing to the screw as well (Sony).

Getting it open

In most cases of problems in headphone stereos, the repair itself may actually be quite simple. The real problem in servicing headphone stereos is getting them apart.

There are two common methods of assembly. In the first method, the case is solid and there are no visible screws; the transport is held in place by screws inside the cassette well. The other is more typical; with external screws holding the outer cases on.

On some of the water resistant models the screws are recessed and covered by small plastic circular "dots" that match the case color. Carefully lifting these dots will reveal the screws. Don't be concerned if you find no screws under some of the dots. Many of the cases are used on more than one model, and these dots may be covering nothing, or some of the holes may be for access to adjustments like speed, etc. Any small, sharp, awl type tool will easily remove these covers. They have adhesive on one side, and I usually stick them to the edge of the container I use to hold the screws.

Be careful when removing screws that you assume are holding covers on. Slowly loosen each screw, and if it doesn't begin to back out right away it may not be a case screw. You don't want to inadvertently unscrew any internal parts, turning a simple repair into a nightmare.

In some cases the cassette door will have to be removed, and the hinge released. The door may be held by two screws, one at each side, and the hinge may be held by a plastic retainer that resembles a tiny washer. These retainers can be removed with a jeweler's screwdriver. Get the flat blade under the retainer and twist, lifting it off. Try to keep a finger or some tape on it when you do this. When they come off they have a tendency to fly across the room and you will never find them. Don't ask how I know

this. If you find that you enjoy doing these repairs, it usually pays to keep some spare retainers on hand.

If you feel you've got all the screws out, but the cover still won't come off, it's probably being held on by small indentations in the plastic, in much the same way as a remote control is held together. Some careful prying, pushing, probing, and pulling may do the trick.

On water resistant types you will probably have to lift the assembly out of the case. Starting with the side opposite the function buttons, pull it up and away from rubber button caps, which will stay with the case. If you are working on the type with case covers, lift the side opposite the headphone jacks, and then pull the cover away from the jacks.

When the cover starts to come off, use caution with regard to all external switches. Some are held in place by the cover, others may stay on the chassis. One type of Sony model has a small spring loaded latch that keeps the cassette door closed. This is held in place by the cover and may fall out, springs flying across the room never to be found. Again, don't ask how I know this.

Some units have battery compartment doors (spring loaded in some cases) inside the cassette compartment. These too may be freed when the transport and case are separated. A little strategically placed tape will keep these parts where they belong until reassembly.

Your goal is to try to disassemble the unit just enough to do the repair. It may mean removing the entire transport and circuit board assembly, or merely removing a cover. Every model is different. A few minutes of thought at each stage of disassembly may save you a lot of time later on.

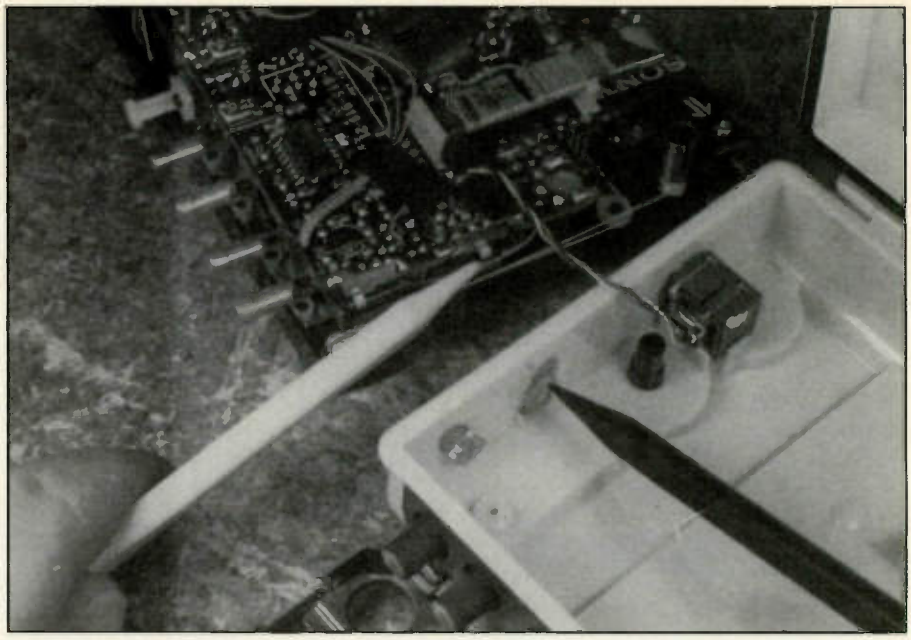

Figure 5. This knob and switch must be lined up on reassembly. Note that headphone jack (in the case with wires attached) is not part of the circuit board on this model.

Visual inspection

Examine the area around the headphone jack for problems, and solder if necessary. Small cracks in the board and foil can be repaired with solder. In some cases you may want to bridge the crack with a piece of bare wire. This is the most common of all personal stereo repairs. If the case cover comes off easily, the circuit board is under the cover, and the foil side is up, you are probably looking at a five minute repair.

The main circuit board is usually under the tape transport, and should only be removed if necessary. It's held in place by screws, and, or, plastic tabs protruding through the board, possibly at the perimeter. You will probably notice lots of tape holding wires in place. It may have to be removed to gain access to screws, and to put a little slack in the wires. Pull the tape off carefully. Most of the wires are tack soldered to the circuit board; if you pull one free you may never figure out where it went.

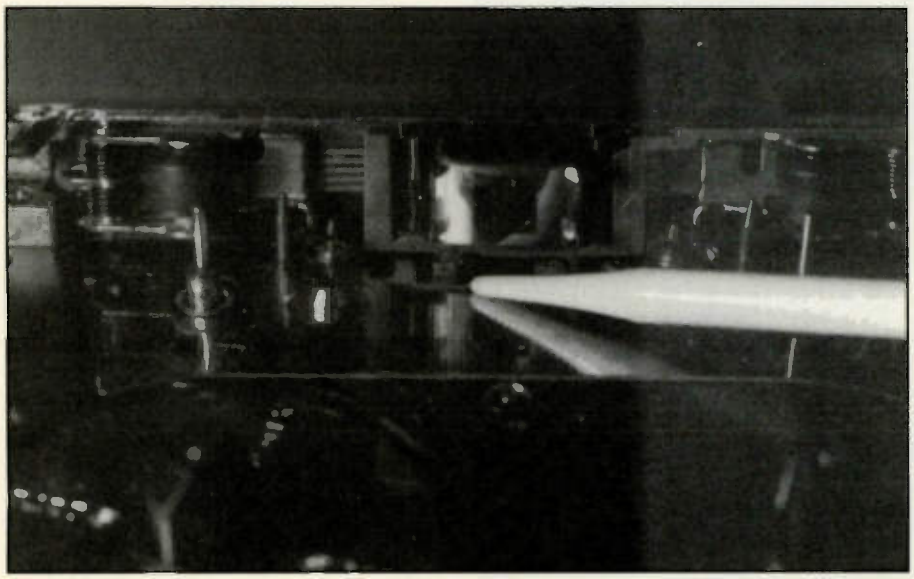

Figure 6. This unit was dropped, causing the head assembly to jump behind the play switch on this autoreverse model. The cover wouldn't open all the way, and when I tried the reels started turning. Prying the switch back in place solved the problem.

Correcting tape transport problems

If the problem is with the tape transport and you have to remove the circuit board to get to the transport, remove all screws (look for arrows on Sony products), and carefully lift the board out of the way. If the board won't budge, look for any components that may be soldered through the board.

If the problem is a broken belt you may have to experiment to get the new belt on correctly. Most modern transports have very small cylindrical motors mounted at an angle of 90 degrees to the flywheels, counterbalancers, and reels. This means you will have to put a half-twist in the belt

to get it on right. Figuring out how to put on a new belt without a service manual can be very time consuming.

Once you've replaced a belt, use the external power jack, clip leads, or even a battery to bring the transport to life and make sure things are turning in the right direction before putting everything back together. If you have to remove any flywheels or capstans, be sure to check for spacers that may have been used and replace them. Space is at a premium in these things, and one spacer, no matter how insignificant it may seem, may make the difference between two parts working in harmony, or agony.

Putting it back together

Assembly is exactly the reverse of disassembly. Take notes as you work that you can refer back to.

Make sure all wires are free of any moving parts, and retape them down if necessary. Some units have leaf switches and record/play switches that must be lined up between the transport and the circuit board. Miss one and you'll have to go back in again.

When replacing the cover, make sure any miniature knobs are lined up with their respective switches. This is an easy one to forget. A bit of tape, and an extra minute or two will save you a lot of grief. Also, be sure that you have not pinched any wires, and that any battery compartment covers are lined up properly.

If the cassette door was removed you have an opportunity to align the heads and clean the capstan(s) and pinch roller(s). If you have to replace the small retainer on the door assembly be careful. Try just pushing it on with your finger, or if that doesn't work use a small screwdriver. Think! If it slips, falls, or flies off where will it go? You certainly don't want to spend an afternoon crawling around looking for it, or worse, having to take the unit apart again because it fell inside.

Once the unit is back together, check all functions, and make sure the indicators on the volume, and if applicable, tuning dial are not turned 180 degrees.

Establishing your policy

Living at a ski resort gives me the opportunity to see more than my share of personal stereos. I charge a flat rate that is less than the factory charges. I also do not offer a warranty beyond the front door. I feel it's better to be up front about these policies than to have the same unit back in the shop every day because the customer keeps dropping it. After a repair they either work or they don't.

Also, working on personal stereos has to be approached as a public service that can bring in a few bucks. Avoid "bizarre" problems, and learn to say "No!," or at least, "I'll get to it when I can." Unless business has been particularly slow, give yourself a maximum amount of time to invest in each repair. If you find that you are having difficulty getting a cover off, give up and cut your losses quickly.

The real money maker is working on high-end microcassette recorders. They experience the same problems as personal stereos, but repairing them is like doing microsurgery. Because they cost around $200 when new, you can usually get your normal hourly fee, and offer a warranty. Be prepared to work with wafer thin circuit boards that contain micro leaf switches and surface mount components.

You may find, as I have, that servicing these items can be enjoyable and profitable, and in addition may generate business in other areas. As with other products you service, the quick jobs will make up for the headaches. ■

Unraveling the parts numbering maze

By Vaughn D. Martin

Nothing is more frustrating than to see a schematic or block diagram with a rectangular block with only a part number inside. This tries the patience and knowledge of all but the most seasoned electronics veterans. It also unfortunately tells you nothing about the IC. Realizing this, let's start to unravel this parts numbering dilemma.

The big three

Three of the largest American semiconductor manufacturers, until RCA's recent merger, were RCA, National Semiconductor, and Texas Instruments, or T.I. Let's concentrate mainly on recognizing ICs from these companies, beginning with RCA. RCA is a company known mostly for linear and digital CMOS ICs.

The part numbers of virtually all linear ICs manufactured by RCA begin with a "C" prefix denoting CMOS. This is followed by either an "A" for analog or a "D" for digital. As an example, a CA3041 is a CMOS quad op amp.

If you know this numbering system, you would know that a CA3041 was a CMOS linear IC, just by glancing at the part number. The fact that it is an op amp is only incidental to the fact that this is an analog or linear IC.

There are suffixes following this two digit alpha prefix and the actual numbers which follow it. These suffixes describe the package type and the type of CMOS with respect to its operating range. As you look through various parts listings, you will note that some manufacturers use prefixes or suffixes that are identical to the prefixes or suffixes used by other manufacturers.

This indicates that one manufacturer is second sourcing components that are proprietary products of other semiconductor manufacturers. Most semiconductor companies do second source other manufacturers' ICs.

Second sourcing means that they make the same identical IC as a form, fit and functional replacement to components manufactured by the original manufacturer. The original manufacturer, which owns the patent and/or other rights, is compensated, usually on a royalty basis.

Table 1

CD4000 SERIES

Order Number	RCA Equivalent Designation	Packages	Temperature Range
• CD40XXCN	CD40XXAE	Molded DIP (N)	-40C to +85C
• CD40XXCJ	CD40XXAY	Cavity DIP (J)	-40C to +85C
• CD40XXMJ	CD40XXAF	Cavity DIP (J)	-55C to +125C
• CD40XXMD	CD40XXAD	Cavity DIP (D)	-55C to +125C
• CD40XXMW	CD40XXAK	Cavity Flat Pack (W)	-55C to +125C
• CD40XXBCN	CD40XXBE	Molded DIP (N)	-40C to +85C
• CD40XXBCJ	CD40XXBY	Cavity DIP (J)	-40C to +85C
• CD40XXBMJ	CD40XXBF	Cavity DIP (J)	-55C to +125C
• CD40XXBMD	CD40XXBD	Cavity DIP (D)	-55C to +125C
• CD40XXBMW	CD40XXBK	Cavity Flat Pack (W)	-55C to +125C
• CD45XXCN	CD45XXBE	Molded DIP (N)	-40C to +85C
• CD45XXCJ	CD45XXBY	Cavity DIP (J)	-40C to +85C
• CD45XXMJ	CD45XXBF	Cavity DIP (J)	-55C to +125C
• CD45XXMD	CD45XXBD	Cavity DIP (D)	-55C to +125C
• CD45XXMW	CD45XXBK	Cavity Flat Pack (W)	-55C to +125C

Table 1. CMOS IC suffixes.

Digital ICs

The prefix CD stands for CMOS digital. Their suffixes though are as outlined in Table 1. Note the "A" suffix describes an older CMOS convention with 3 to 15 volts as the operating range. The "B" suffix (which almost all new CMOS ICs are), operates safely over an operating range of 3Vdc to 20Vdc.

There are some CMOS digital ICs which have a CD54HC or a CD74HC prefix followed by the part number and a suffix of usually two letters. This prefix though means high speed CMOS and they have a CMOS input voltage-level compatibility.

The 54HCT and 74HCT have TTL (Transistor-Transistor Logic) input and output compatibility. This allows you to use these as direct replacements of older TTL parts. Also, the HC series can drive from 18mA to 20mA and this driving is both sinking (receiving) and sourcing (outputting) current.

TTL will only sink 16mA of current and source less than 1mA of current. Bus drivers in this HC series will source or sink 35mA of current.

A TTL IC has a two transistor input and typically on the order of 3.6kΩ input impedance. The logic on these 5V supply devices is about 0.2V to 0.4V for ground and in the 2.6V to 3.2V range for a logic high.

CMOS, in contrast, can have up to a 10MΩ input impedance and logic levels ranging from very nearly ground to only a tenth of a volt from their supply voltage. Before this new type of high speed CMOS, it was understandably slower than TTL merely because the logic levels had to swing further in CMOS and these transitions took time to complete. This new family has the best of both worlds.

A deeper look into TTL

TTL was the dominant logic of the 60's and most of the 70's until it was overtaken by CMOS. CMOS has a greater fanout, that is, it can drive many more (up to 50) other CMOS inputs but barely a single power hungry TTL input. So if a sys-

Table 2						
National	**RCA**	**Harris**	**Teledyne**	**Motorola**	**TI**	**Fairchild**
MM74C00		HD74C00	MM74C00			
MM74C02		HD74C02	MM74C02			
MM74C04	CD4069	HD74C04	MM74C04			
MM74C08		HD74C08				
MM74C10		HD74C10	MM74C10			
MM74C14	CD40106	HD74C14		MC14584		30014
MM74C20		HD74C20	MM74C20			
MM74C30		HD74C30				
MM74C32		HD74C32				
MM74C42		HD74C42	MM74C42			
MM74C48		HD74C48				
MM74C73		HD74C73	MM74C73			
MM74C74		HD74C74	MM74C74			
M74C76		HD74C76	MM74C76			
MM74C83		HD74C83				
MM74C85	HD74C85					
MM74C86	CD4030	HD74C86		MC14507		
MM74C89	CD40708	HD74C89				
MM74C90						
MM74C93						
MM74C95		HD74C95	MM74C95			
MM74C107		HD74C107				
MM74C151		HD74C151	MM74C151			
MM74C154		HD74C154	MM74C154			
MM74C157		HD74C157	MM74C157			
MM74C160		HD74C160	MM74C160	MC14160	TP4360	F340160
MM74C161		HD74C161	MM74C161	MC14161	TP4361	F340161
MM74C162		HD74C162	MM74C162	MC14161	TP4362	F340162
MM74C163		HD74C163	MM74C163	MC14161	TP4363	F340163
MM74C164		HD74C164	MM74C164			
MM74C165		HD74C165				
MM74C173	CD4076	HD74C173	MM74C173	MC14076		
MM74C174		HD74C174		MC14174		F340174
MM74C175		HD74C175		MC14175		F340175
MM74C192	CD40192	HD74C192	MM74C192	MC14192		F340192
MM74C193	CD40193	HD74C193	MM74C193	MC14193		F340193
MM74C195		HD74C195	MM74C195	MC14195		F340195
MM74C200		HD74C200				
MM74C221		HD74C221				
MM74C901		HD74C901				
MM74C902		HD74C902				
MM74C903		HD74C903				
MM74C904		HD74C904				
MM74C905						
MM74C906		HD74C906				
MM74C907		HD74C907				
MM74C908						
MM74C918						
MM80C95		HD80C95				
MM80C97				MC14503	F340097	
MM80C98		HD80C98				F340098
MM80C29						
MM80C30						

Table 2. The 54C/74C family cross referenced.

Table 3

Three basic units of information are contained in the code.

μA741	D	C
Device Type	Package Type	Temperature Range

Device Type

This group of alphanumeric characters defines the data sheet which specifies the device functional and electrical characteristics.

Package Type

One letter represents the basic package style.

D = Dual In-line Package (Hermetic, Ceramic)
F = Flatpack (Hermetic)
H = Metal Can Package
J = Metal Power Package (TO-66 Outline)
K = Metal Power Package (TO-3 Outline)
P = Dual In-line Package (Molded)
R = Mini DIP (Hermetic, Ceramic)
T = Mini DIP (Molded)
U = Power Package (Molded, TO-220 outline)

Temperature Range

Two basic temperature grades are in common use:

C = Commercial/Industrial/Consumer	M = Military
0C to +70/75C	-55C to +125C
-20C to +85C	-55C to +85C
-40C to +60C	
-40C to +85C	

Table 3. An overview of the Fairchild part numbering system.

tem were all CMOS or all TTL everything was usually compatible, but what if you mixed the two families?

If you were inclined to take this potentially disastrous path, you should be prepared to use pull-up resistors and often level translators which would take CMOS' different logic levels and make them compatible with TTL. But assuming you are still looking at this older technology, which is still very much alive, let's see how we can better identify it by part number.

First, the leading manufacturer of TTL used to be T.I. (Texas Instruments) and their TTL ICs began with an SN prefix. This stands for "semiconductor network" and is an atavistic survival of a time when ICs were first being made and were referred to in some circles as merely "semiconductor networks." Following this SN, there will be either a 54 or a 74.

The more common of these two categories, the 74, denotes a commercial temperature range and a narrower supply voltage tolerance of 5V ± 0.25V. The 54 prefix denotes a military or wider temperature range of operation and also a wider supply voltage range of 5V ± 0.5V. The letters that follow can be one of five choices: a blank, L, LS, S, or H.

- A blank in this position means that it is plain TTL with no special features.
- An L stands for low power and means that an ordinary gate which might consume 10mA would consume only about half that much.
- The LS means it is low powered Schottky and has the added feature of a Schottky diode on the input which gives faster switching times and more of a ramp on its risetime and falltime outputs.

Linear IC numbering conventions

The first and second leading manufacturers of linear ICs are National Semiconductor and Motorola. Therefore, it would make sense to address these two companies first.

National Semiconductor's analog, or linear, ICs all start with an "L" for linear and this is followed by either an "M" for monolithic or an "H" for hybrid. The difference between monolithic and hybrid is that the monolithic, as the word means in ordinary English, connotes or implies the IC is fabricated within a single piece of silicon.

Contrast this to one type of hybrid unit in which one monolithic IC chip is used as a small PC board, and other chip components, often thick or thin film in their nature or technology, are applied to this monolith. They are bonded by a process that is not at all like soldering. An extremely fine silk screen mesh deposits a thermally and electrically conductive epoxy "glue" onto the surface which bonds these thin film elements onto the substrate.

As might be expected, due to this more elaborate process you can realize enhanced performance from hybrids, but it is at a cost. The price paid is that they often cost more, the yield in manufacturing is

considerably lower, and the testing in plant, prior to release, is more extensive.

The part number following the LM or LH is a number, usually three digits, and begins with either a 1, 2, or 3.

- A 1 symbolizes a military temperature range and that the device has extended environmental and electrical stressing.
- A 2 indicates the device is an industrial IC or one that would go into harsh industrial environments such as might be found in automobiles.
- A 3 symbolizes a commercial grade component and one that is widely used in high-volume low-cost consumer electronics products such as stereos, VCRs, TVs, and radios, etc.

A different type of CMOS

There is a family or series of CMOS digital ICs originally made in the mid 1970's by National Semiconductor called the 74C family. These are pin-for-pin functional equivalents to the low powered L series TTL ICs.

This concept was obviously originated to compete head on with TTL as replacement devices. Strict design rules were adhered to in the input and output characteristics, such as making all outputs capable of sinking 360mA (two TTL low powered loads) and specifying all ac parameters at 50pF loads. National Semiconductor deemed these devices as their 74C series, and as an example, a MM54L86 Exclusive-OR TTL IC is easily replaced by an MM74C86.

Note the SN which Texas Instruments used as a prefix has been replaced by MM which stands for monolithic and MOS. This is an early attempt to do what has already been done with the 74 and 54 HCT series which drives far more than just two TTL "L" or low powered loads.

RCA, Teledyne, Harris, Motorola, T.I., and Fairchild also made ICs like the National Semiconductor 54 and 74C series. Their part numbering conventions differ slightly from National Semiconductor's, with the exception of Teledyne which used the same numbering system (see Table 2).

Date codes

Below the part number on the IC you will see a date code. This usually assumes the form of a four digit number. The first two digits are the year in which the part was made and the second two digits identify the week in which it was made. So a 9123 date code means that the IC was made in the 23rd week of 1991.

By identifying the IC down to the week, it is possible to isolate a bad production lot. Finding a bad lot is highly unlikely, however, because most ICs are extensively screened and are very reliable. The main cause of failures in ICs is not manufacturing faults but high temperature generated by an external malfunctioning source, or stress and strain on the leads where they enter the body of the IC.

Table 4

SUFFIX Old	SUFFIX New	PACKAGE DESCRIPTION
A,AA	N	14-lead plastic DIL
A	N-14	14-lead plastic DIL (Selected Alalog prods)
B,BA	N	16-lead plastic DIL
DA	DA	2-lead TO-3
DB	DB	3-lead TO-5
DC	DC	4-lead TO-46
DE	DE	4-lead TO-72
F	F	14, 16, 18, 22 and 24-lead ceramic DIL (Cerdip)
I,IK	I	14, 16, 18, 22, 28 and 4-lead ceramic DIL
K	K	10-lead TO-100
L	L	10-lead high-profile TO-100 can
NA, NX	N	24-lead plastic DIL
PN	PHA	12 + 1 GND pin DIL
Q,R	Q	10, 14, 16 and 24-lead ceramic flat
S	S	3-lead TO-92 plastic
SK	SK	Microprocessor kit
T,TA	T	8-lead TO-99
U	U	Plastic power TO-220
V	N	8-lead plastic DIL
W, WJ	W	10, 14, 16 and 24-lead ceramic flat (Cerpac)
XA	N	18-lead plastic DIL
XC	N	20-lead plastic DIL
XC	N	22-lead plastic DIL
XL,	XF	N 28-lead plastic DIL

Table 4. Signetics IC package designators.

Nonconventional parts numbering

A departure from the norm in part numbers of ICs is so common that it itself might be considered the norm. Here's some information about several companies producing ICs with less than easily recognizable part numbers. If you are familiar with their prefixes you will at least be able to recognize what company produces them.

Sprague, Signetics and Fairchild

Sprague makes a whole line of power transistor drivers on an IC in DIP (dual in-line package) form which have no heat sinks, despite being able to dissipate considerably more power than a normal 14-pin or 16-pin plastic DIP package. These have the prefix of ULN.

Fairchild Semiconductor made a lot of ICs in the last ten years with a μ or m prefix followed by an "A" which signified an analog circuit type. They especially made a lot of voltage regulators in TO-202 and TO-220 packages. These are the familiar ceramic and plastic three pin tab packages with a back sometimes made of metal which served as a heatsink.

The "TO" in the package style desig-

Table 5

PREFIX	DEVICE TEMPERATURE RANGE
N	0C to +70C
S	-55C to +125C
NE	0C to +70C
SE	-55C to +125C
SA	-44 to +85C
SU	-25 to +85C

Table 5. Signetics IC temperature ranges.

Table 6	
PREFIX	**DEVICE FAMILY**
CA	Linear Industry Standard
DM	Linear Industry Standard
JB	Mil Rel - JAN Qualified Old Designator
JM	Mil REl - JAN Qualified New Designator
LH	Linear Industry Standard
LM	Linear Industry Standard
M	Mil Rel - JAN Processed
MC	Linear Industry Standard
PA	Linear Industry Standard
SD	Linear DMOS
SP	DTL Series
UA	Linear Industry Standard
ULN	Linear Industry Standard

Table 6. Signetics IC family prefixes.

nator denotes "transistor outline," a holdover from when ICs were not yet in existence. It specifies the outline of the package. In fact, a 14 or 16 pin DIP IC even now has a TO number.

Fairchild has a part number, as shown in Table 3, which consists of three parts. The first part is a µA, with the A for analog. This is followed by the part number, such as a 741 for an op amp. Then there are the package style and the temperature range. The date code is on a separate line below this. It is as previously stated; however, it is preceded by an F then this four digit number.

Fairchild's voltage regulators are so pervasive that you should know that their 78 series are positive fixed voltage three terminal devices. The 79 series are negative fixed voltage three terminal devices.

The exception is if a G follows this 78 or 79, that means it is a four terminal programmable voltage device. If an L or an M follows either a 78 or 79, it means they are only good for 100mA and 500mA respectively, rather than 1A which is what a 78 or 79 number with no letter denotes.

The L and M series voltage regulators from Fairchild, though, are not in the larger TO-202 or TO-220 cases. They are housed in the smaller TO-39 cases, which have less current carrying capability. These usually house small signal transistors.

Signetics makes a number of unique ICs. To make things more confusing, the Dutch company Philips acquired Signetics, so there is a mixture of part numbers. The industry trend is toward acquisition and mergers of companies. As mergers continue, the parts numbering conventions will unfortunately only become more confusing.

Briefly, the following prefixes denote a digital IC: SA, UA, UB, UM. The following are linear ICs: PD, TE, TS, and TD. The third alpha in this sequence can be the letter B, C, D, or an E which stands

Table 7

PART NUMBER	CROSS REF PART NO.	PRODUCT FAMILY	PRODUCT DESCRIPTION
NE535N	MC1741SC	ANA	High Slew Rate OP-AMP
µA741C	LM741CJ	ANA	General Purpose OP-AMP

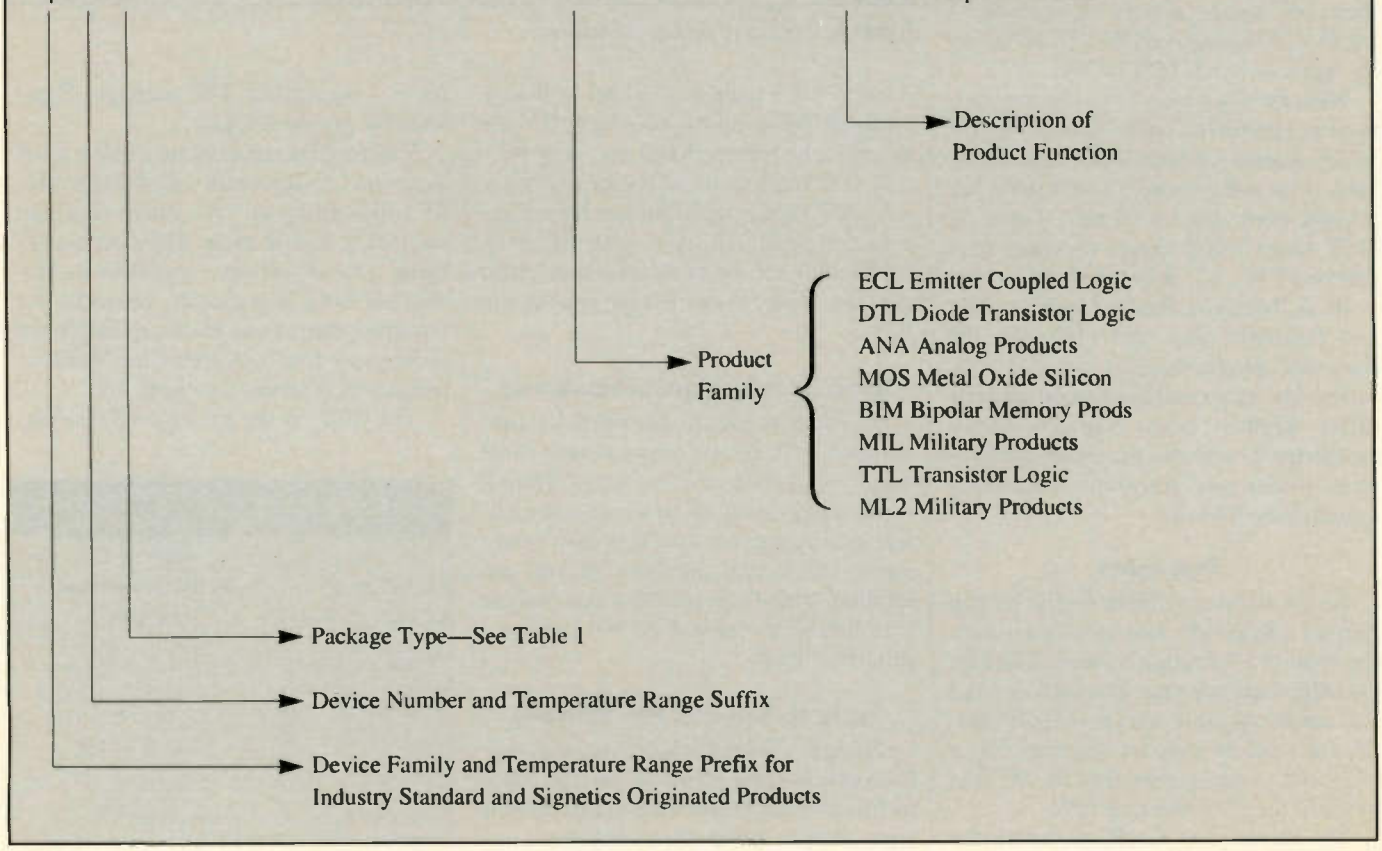

Table 7. An overview of the Signetics IC part numbering convention.

for a commercial, industrial, military and finally an unspecified operating temperature range. The following three prefixes are unique to Philips of Holland: SAA, TDA, and SAB.

Finally, a PC prefix means it is a CMOS IC while a PN prefix means it is an NMOS IC. More standard or popular ICs from Signetics will have prefixes like NE, SE, and SA, which represent parts with a commercial, military and industrial operating temperature range respectively. NE and SE are the two most common prefixes used by Signetics.

Tables 4 through 6 will help unravel Signetics IC part numbers. Table 4 is a description of their IC packages. Table 5 is a list of codes for their temperature ranges and Table 6 is a list of the various family prefixes commonly used. Table 7 is an overview description of the Signetics numbering convention.

Consumer electronics parts

Unlike standards set by the military and more formal commercial market, consumer electronics parts numbering is not so organized. But what has happened is *typing*, or an attempt to establish a system of *types*.

This means similar type part numbers are cross referenced into a common part number. As an example, RCA and the old Sylvania parts were some of the first to do this. Each series represents a particular type component series such as a diode, transistor, or IC. RCA (now Thomson Consumer Electronics, or TCE) has the SK series and Sylvania (now part of North American Philips, or NAP) has the ECG series.

For example, in the ECG series, the 0-600 represents the diode and transistor families. The 700 - 3,000 series represents linear ICs and the 4,000 - 4,900 series from RCA represents the CMOS family. An RCA CA555CE is a CMOS 555 timer/oscillator, and in keeping with this convention, it is an ECG955M in the ECG numbering convention. The method used to derive this part number was by cross indexing the TCE SK part number to the common ECG part number.

More prefixes to remember

Analog Devices, makers of data converters, high quality op amps, sample/hold modules and voltage references uses an AD prefix. Advanced Micro Devices uses an AM prefix, Datel uses an MV, MXD and SHM. Burr-Brown uses BB, DAC, and MPC in many of their ICs. Harris uses HA and HI prefixes, Intersil uses IH and AD, Micro Networks uses MN, and finally, Raytheon uses RC, RM and the old favorite, LM, just as National Semiconductor does.

Looking toward the future

Many of the part numbers covered thus far have to do with old or obsolescent families of logic or analog circuitry. If you do servicing, you may not have had a chance yet to see the new wave of logic which is based on 3-volt logic. Why 3-volt instead of 5- volt logic? The answer is logic operated at this lower voltage consumes only about 45% of the energy as the same technology consumes if operated at 5V.

Why is this important? Increasingly battery operated hand held (palmtop), laptop, notebook, and pen computers all have to be small, light and portable (battery operated). That is why National Semiconductor is introducing its 74LVQ series of logic. None of these ICs draws more than 50mA of current.

The LVQ stands for low-voltage quiet, and that is just what it is. There are just 19 initial ICs at the time of this writing (4th quarter 92), but many more are planned.

Despite being quiet they can be clocked at 33MHz with just a 9ns propagation delay. Despite the use of the familiar 74 prefix, which is mostly associated with TTL, these devices are not power hungry and come in a special compact QSOP (Quarter Sized Outline Package).

Knowing these part numbers isn't an instant cure to the problem of locating replacement components when they're not properly identified on the documentation, but it will at least give the servicing technician a place to start looking. ■

The CD-ROM Primer - Part 1

By Vaughn D. Martin

CD-ROM is short for Compact Disc-Read Only Memory. This new technology for storing and quickly retrieving large masses of data has created a keen interest in the field of personal computers. This is the first of three articles in Computer Corner that will describe this recently developed computer technology.

The disc

The CD-ROM uses the same compact disk as the one used for prerecorded music. It is 4-3/4" in diameter and slightly over 1/20"thick. These one-sided discs consist of three layers. The first layer is made of polycarbonate; a clear tough plastic. This polycarbonate is the same plastic used in bullet-proof glass, which makes the disc less susceptible to scratches. Dust, cigarette smoke, or other airborne pollutants also can't invalidate data, as they can in the case of a floppy disk. Moreover, the disc cannot be erased magnetically.

This first layer contains more than one billion oblong microscopic pits or depressions. The pits are arranged in a spiral pattern emanating from the center of the disc. This series of pits represents data.

A thin layer of aluminum is evaporated over the first, following the contours of the pits. This layer of aluminum reflects laser beam light. The reflected light is converted into a digital electrical signal which is then read by the computer as data.

The third layer is a clear resin, providing further protection for the disc. The label is placed on this layer of the disc.

The areas of the disk where there are no pits are called lands. Pits are of uniform depth; however, both the pit and land length may vary within certain limits. The spiral track formed by the pits and the lands is so narrow and the bands are so closely packed in against one another that if they could be straightened out they would stretch out over three miles.

Drive requirements

To use CD-ROMs, the computer must be equipped with a separate CD-ROM drive. This is a device that plugs into the computer. It contains a laser beam which reads the compact disc and transmits the data generated to the computer. Other than the compact disc drive and the controller, no other changes to the computer are required to operate it with CD-ROM. The computer considers this CD-ROM to be like any other drive.

Martin is Chief Engineer in the Automatic Test system Division at Kelly Air Force Base.

Why all the fuss?

A CD-ROM's main claim to fame is its ability to store large masses of data. Depending on the drive and how much of the disc is used, a CD-ROM can store up to 682 megabytes of data; equivalent to more than 200,000 typewritten pages. A stack of 200,000 pages would be over 20 feet high. This amount of data, contained on a single ROM disk, would be enough to keep a person reading 12 hours a day for nine continuous months. It would take 1,500 floppy discs holding 360 kilobytes each to store the same amount of data.

Well organized

Well organized is the best way to describe how data is indexed on the CD-ROM. This automated procedure allows retrieval of data in a matter of a few seconds. The term ROM, or read-only memory, means that the data is permanent. The computer can't make changes to the data on the disk.

Disc format

The physical layout of the disc is standardized; however, the way the files are located and organized on the disc is not standardized. There is a standard file format proposal, called the High Sierra Group Proposal, which has not yet been universally adopted. In practical terms, this means that a CD-ROM disc can only be used at a work station at which the applications software and file management system is appropriate for that disc.

Reading the disc

The CD-ROM is read by a laser beam focused from the back side of the disc (the side opposite the label) on the reflective layer of aluminum, in much the same way as an audio CD is read. As the light follows the track, the amount of reflected light that enters the lens is measured, and converted into an electrical signal of proportional value. Pits cause the light to be scattered, resulting in weaker reflections. Lands cause less scattering and a stronger signal. The relative strength of the reflected light is interpreted by the computer as either a digital one or a zero.

The laser beam follows the track by moving the laser assembly outward from the center of the disc at the same time that the disc spins. The rotational speed of the disk is carefully coordinated with the position of the lens with respect to the disk so that the linear velocity of the pits past the lens is constant. In other words, as the lens gets closer to the outside of the disc, the disc spins more slowly to compensate for the increased distance per revolution. In contrast, a phonograph record spins at constant speed regardless of the position of the stylus on the record.

Error detection and correction

Because a CD- ROM holds such massive amounts of data, tightly packed, the slightest defect in the disc may cause missing or faulty data.

Before the data and indexes are recorded on the CD-ROM disc, calculations are made based on the data. The results of these calculations are recorded on the disk. When the data is sent from the disc to the computer, the same calculations are performed. If the results of this calculation don't match what was recorded on the disc at the time of recording, the computer knows that an error has occurred.

Once an error has been detected, special codes reconstruct and correct the data. These error correction codes are so efficient that only one error in ten quadrillion (that's 1 with 16 zeros) will go undetected. That translates into one error in every 2,000 CD-ROM discs. Audio discs, in contrast, have more room for error and do not use such a rigid error detection scheme.

Next time

The next installment will describe some of the applications of CD-ROM. ■

ES&T Manufacturers' schematics **PROFAX**

APRIL 1993

Profax Number

SHARP
Color TV Chassis No. 27S1, Model 27SV70 . . . . . **3101**

MAIN-3 CIRCUIT

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

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

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

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

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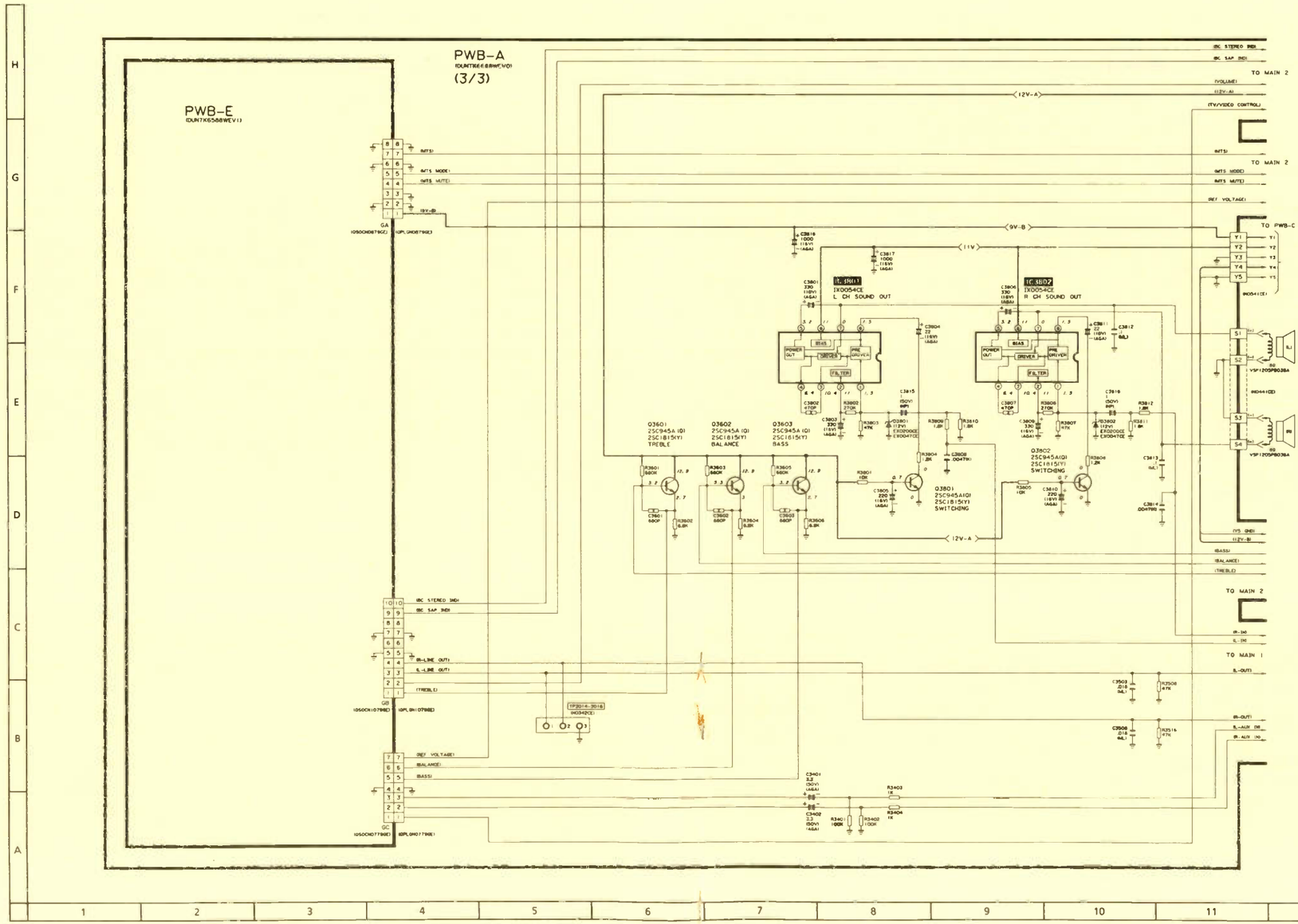
All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



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MAIN-2 CIRCUIT

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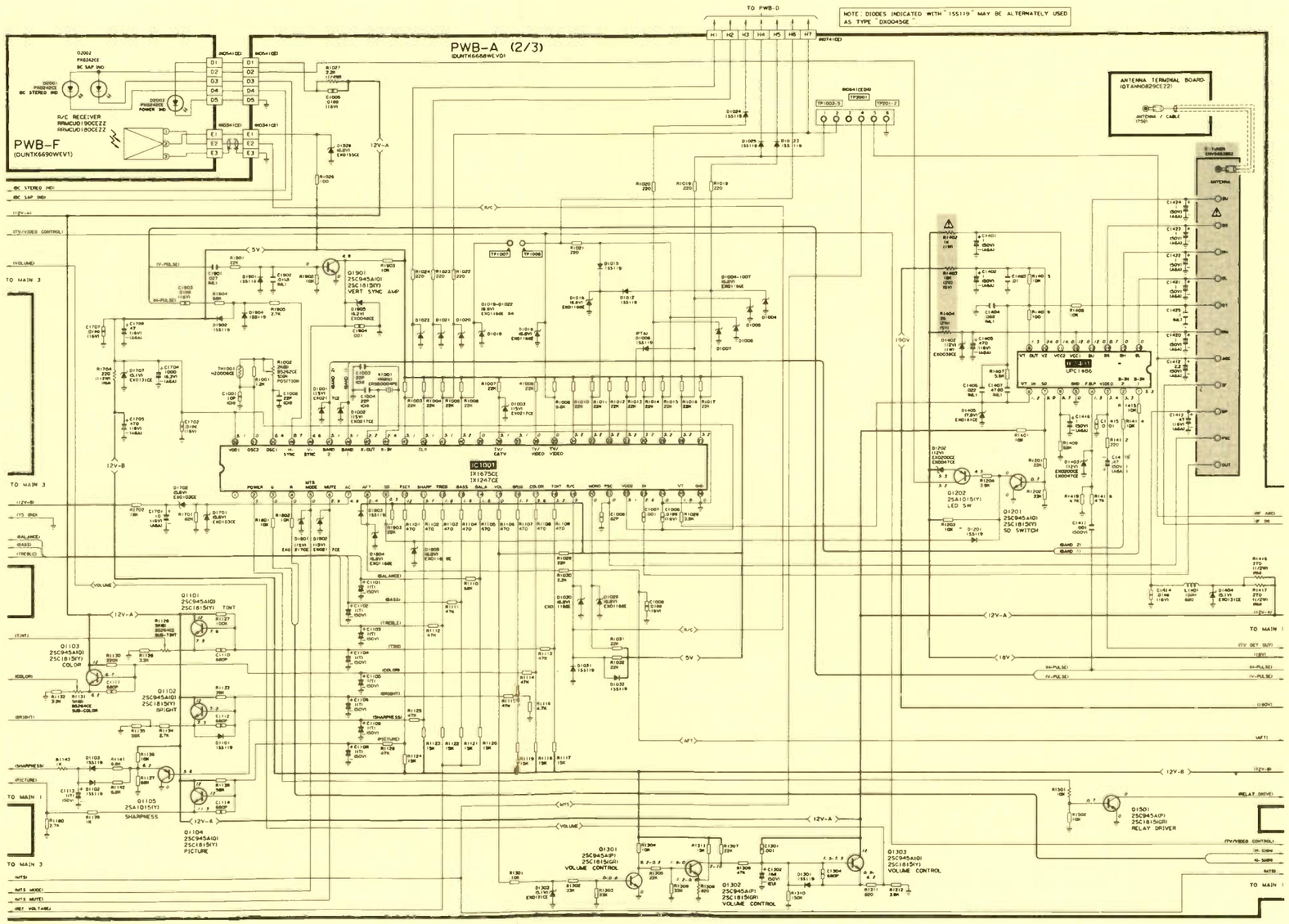
INDICATION OF E-TUNER TERMINAL VOLTAGE

CH No.	V_T	B_1	B_2	B_3	B_4
2~6	3.1V~14V	12V	0V	0V	0V
A-5~13	1.5V~22.3V	0V	12V	0V	0V
J~W+29	1.4V~22.3V	0V	0V	12V	0V
UHF 14~83 CATV W+30~W+98	6.1V~24.4V	0V	0V	0V	12V

INDICATION OF SENSOR IC VOLTAGE (IC1001)

Pin No.	IC1001 Logic or Voltage Levels
2	5V (Power on) 0V (Power off)
3,4	Positive Pulse
5	5V (Sap mode) 0V (Main mode)
6	0V (Mute on) 3V (Mute off)
8	2.1V (on air) 2.9V (no signal)
9	0.6V (on air) 5V (no signal) SD Input
10~18	Active Positive pulse
19	negative pulse
20	5V (mono on) 0V (mono off)
21	Phase Comparison output (pulse)
22	5V (Active High)
23	Local osc. Input (Pulse)
25	Pulse
27~30	Pulse
33	Pulse
35	1.7V (Video mode) 0V (TV mode)
38	5.1V (CATV mode) 0V (TV mode)
40~43	Key Scan output (Active pulse)
44,45	Osc. 4MHz
46,47	5V or 0V
48	V-Sync. Pulse Input
49	H-Sync. Pulse Input
50	Osc. 1 CRT Clock Input
51	Osc. 2 CRT Clock Output
52	5V (Active High)



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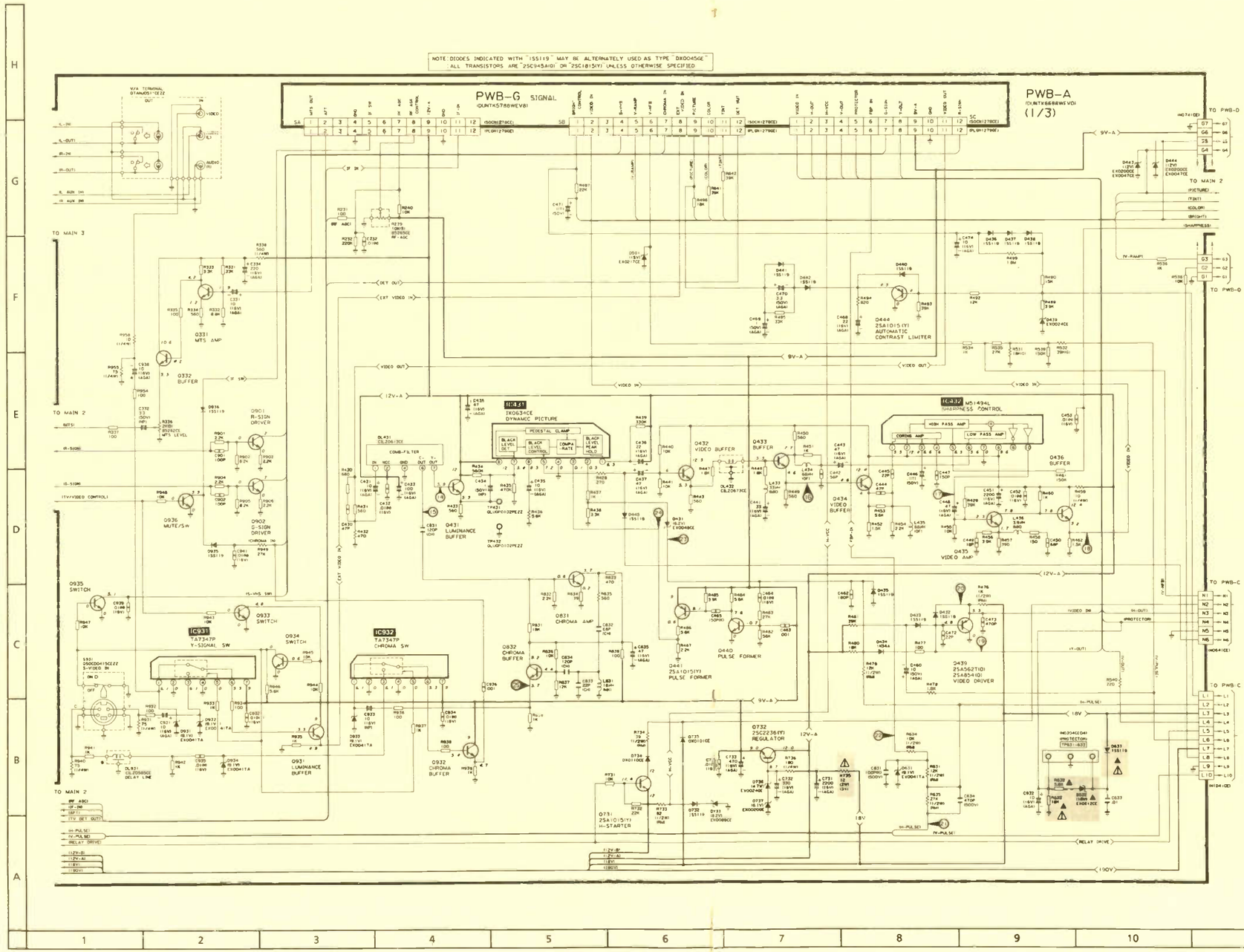

1	2	3	4	5	6	7	8	9	10	11	12

(14) 0.44 Vp-p	Horiz. Rate	(15) 0.54 Vp-p	Horiz. Rate
(16) 0.54 Vp-p	Horiz. Rate	(17) 0.4 Vp-p	Horiz. Rate
(18) 1 Vp-p	Horiz. Rate	(19) 10.8 Vp-p	Horiz. Rate
(20) 9.4 Vp-p	Horiz. Rate	(21) 150 Vp-p	Horiz. Rate
(22) 9.6 Vp-p	Horiz. Rate	(23) 16 Vp-p	Horiz. Rate
(24) 2.4 Vp-p	Horiz. Rate	(25) 50.5 Vp-p	Horiz. Rate

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SHARP
Color Television
Chassis No. 27S1
Model 27SV70

POWER CIRCUIT

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POWER CIRCUIT

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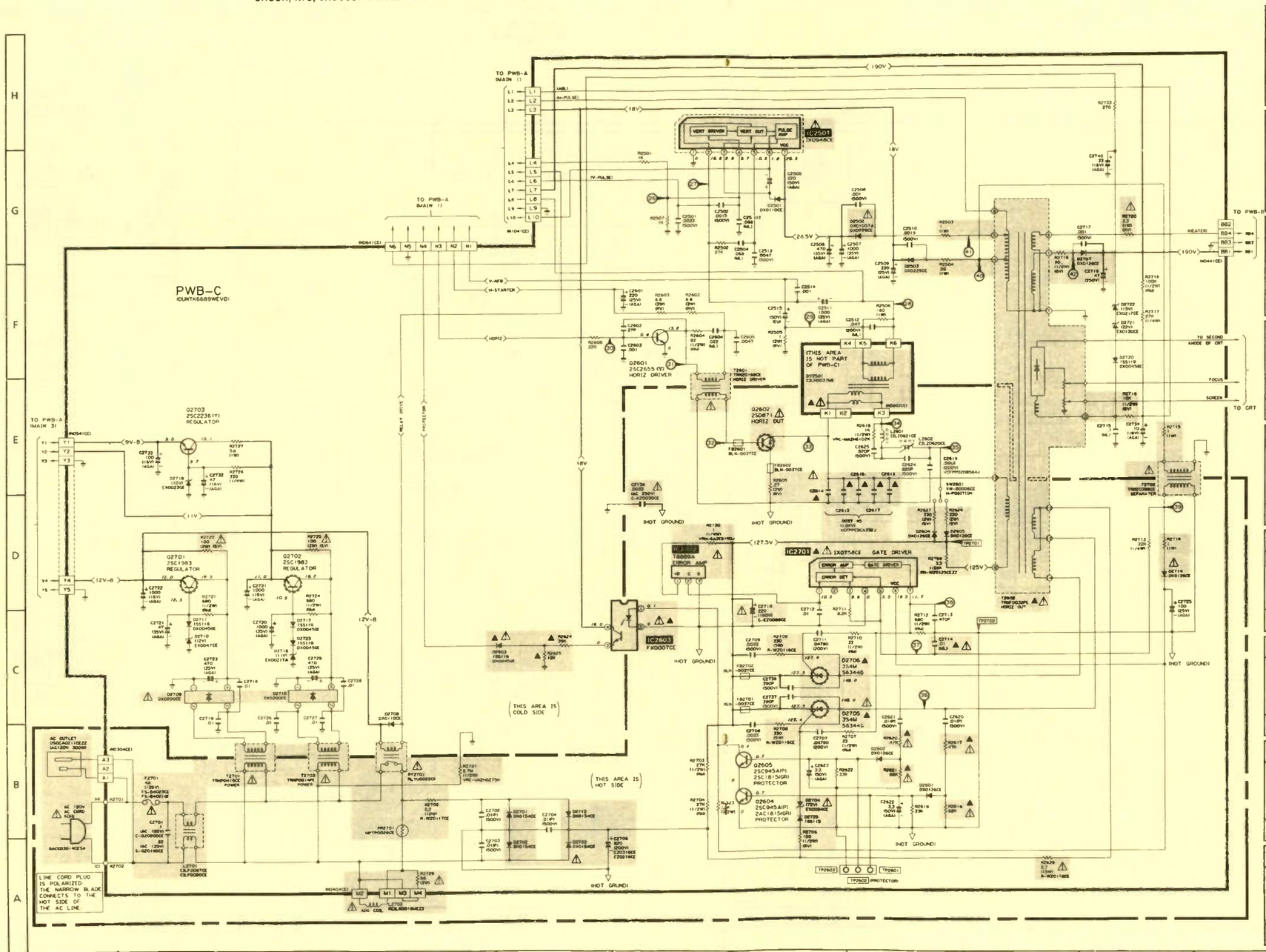
PROFAX Manufacturers' schematics 3101



(26) 0.8 Vp-p — Vert. Rate

(27) 56 Vp-p — Horiz. Rate

(28) 55 Vp-p — Horiz. Rate

(29) 2.2 Vp-p — Vert. Rate

(30) 0.94 Vp-p — Horiz. Rate

(31) 46 Vp-p — Horiz. Rate

(32) 45 Vp-p — Horiz. Rate

(33) 1050 Vp-p — Horiz. Rate

(34) 100 Vp-p — Horiz. Rate

(35) 980 Vp-p — Horiz. Rate

(36) 370 Vp-p — Horiz. Rate

(37) 4 Vp-p — Horiz. Rate

(38) 8.4 Vp-p — Horiz. Rate

(39) 163 Vp-p — Horiz. Rate

(40) 170 Vp-p — Horiz. Rate

(41) 250 Vp-p — Horiz. Rate

(42) 240 Vp-p — Horiz. Rate

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Distributors showcase

Buying components, tools, test equipment, or other products from a distributor is much like dealing with any other kind of business. Whether you buy most of your products from a local distributor, or whether you do almost all of your business with a mail order firm, or some combination of the two, it is prudent to choose carefully the distributor(s) with whom you do business.

Just as with any other kind of selling organization, you'll find many similarities and many differences among distributors. Most distributors are well organized and well stocked, can help you with special requirements, and have a research department to help you find the part you need; some are not.

Some mail-order distributors can accept your orders in a variety of ways including mail, telephone (some with 800 numbers), fax, etc.; some can not. Some distributors charge a reasonable fee for shipping and handling; some will charge you what you will conclude is an exorbitant amount.

Some distributors will send your order right away even before your check clears, some will wait until your check clears, and some will keep your money well beyond the point when they should have shipped your order.

Some variables to consider

Most people are careful shoppers when it comes to buying consumer goods. It pays to shop just as carefully when choosing a distributor.

Here are some of the factors you should consider when settling on a distributor. Some apply only to the local distributor, and some apply only to mail order, but it would be a good idea to keep them in mind any time you're thinking about doing business with a new firm.

These items are not listed in any particular order, for the simple reason that their order of priority or importance depends upon your particular wants and needs. Put them in order of importance for yourself.

- Do the distributor's facilities and/or literature give the impression of competence and order?
- Do prices seem reasonable and in line with what other companies charge?
- Are most items in stock, or does the distributor have to back order many.
- Does the distributor offer a broad line of products, or will you have to find other sources of supply for many of your needs?
- Does the distributor specialize in any particular kinds of products that you typically order?
- What kind of payment options does the distributor offer: Open order account, credit card, COD, check, etc.?
- How soon after receipt of an order does the distributor ship?
- Does the distributor add a shipping surcharge, or a handling charge?
- Does the company list a toll-free number for voice calls? For FAX?
- Are such ordering options as fax, and telex available? How about such computer ordering options as MCI Mail, Compuserve, and EasyLink?
- What is the distributor's policy regarding return of goods?
- Are all of the distributor's policies well documented, or do you have to guess at them? Or do they seem to differ depending on his whim?
- What kind of warranty, if any, does the distributor offer?
- Does the distributor publish a catalog? Is it clear and easy to understand?
- Is there a minimum order amount? If so, is it reasonable?
- What kind of shipping options does the distributor offer: mail, UPS, Federal Express, etc.?
- What kind of special services, such as assembling cables, etc. does he offer?
- What research services does the distributor offer to help you find parts?

These questions can be important

Some of these questions may not seem important, but from what we have learned from some of our readers, they may be very important. For example, we learned from one of our readers that one mail order company that he dealt with made a regular practice of charging unnecessarily high shipping charges.

Another practice that some distributors indulge in is to hold shipment of products for some time after the purchaser's check has cleared. This gives the distributor a nice little interest-free loan between the time the check clears and the time he decides to ship the merchandise. This is not necessary. Some companies ship the product immediately.

One other thing to keep in mind is that some distributors charge a restocking fee even when they were responsible for shipping the incorrect product.

Let the buyer beware

Most replacement parts distributors are hard-working, well-organized, ethical companies, who will make every effort to help you obtain the correct replacement for a faulty component. Some are less ethical in their practices. It's not always easy to locate the good ones and avoid the ones that will give you problems.

When you're considering ordering products from a new distributor, it might be wise to start out with a small order and see what kind of treatment you get. If the service is good, you might gradually increase the size of your order and build a close working relationship.

If the service you receive is not what you'd like, try someone else. It's your business that will suffer if you don't get what you order when you need it, or if you're hit with exorbitant charges that you have to pass along to customers. ■

★ ★ ★ DISTRIBUTORS SHOWCASE ★ ★ ★

East Coast Transistor Parts Inc.

2 Marlborough Road
West Hempstead, NY 11552
Phone: 800-645-3516 Nationwide/Canada
Phone: 800-632-3323 In New York State
FAX: 800-733-5904

East Coast Transistor Parts, Inc. has supplied the electronics industry with quality parts and equipment for over three decades. Our ability to quickly process and fill orders, our expert technical support and our stocking ability make us the best choice for electronics parts.

We are a national parts distributor for Audio Technica, Beckman, Bussmann, Chemtronics, Dantona, Duracell, ECG, Eveready, Hakko, Jabro, Kenwood, Mabuchi, Maxell, Nisshoku, Pickering, Pyle, Russell, Speco, Stanley Weller, Xcelite, and Vaco. We have a tremendous stock of replacement and repair components. In fact, over 200,000 different parts are in stock and ready to ship. We are Kenwood's national authorized parts distributor for Consumer Audio, Amateur Radio and Warranty Stations.

East Coast is a direct importer of Japanese semiconductors. Because we buy direct and eliminate the middleman, these savings are passed on to our customers. We offer large volume discounts and OEM quantities are also available. We're one of the nation's largest sources of semi's and our prices can't be beat.

East Coast is a full service distributor. You won't need to look any further for all your electronic needs; our inventory is updated and expanded regularly. Our sophisticated computerized inventory and distribution system processes and delivers your order quickly and efficiently. All orders are shipped direct from the East Coast warehouse located on the premises. Our new "Quick-Ship" program delivers your orders overnight for only $6.95. Packages can weigh up to five pounds, COD fee additional. Overnight and second day deliveries are available for all orders placed by 3 p.m. While the majority of orders are shipped the same day, you can be assured that all orders are ready to ship within 24-hours from the time they are placed. Customers may establish a Net 30 day account or purchase by credit card or COD.

Our state-of-the-art phone system lets you earn additional *discounts* when you place your order on our order-entry voice mail system. These lines are open 24-hours a day, seven days a week. Or , if you prefer during business hours (9-6 EST Monday - Friday) your call will be answered by a trained sales representative. Every order is given top priority at East Coast. We deliver your purchase quickly and with precision. Our quality control officials oversee the warehouse/shipping departments to ensure you get what you pay for, the first time and every time you order from East Coast. Our toll-free fax lines are at your service anytime, 24-hours a day, to fax your orders 800-733-5904.

While East Coast has grown over the years, we have strived to maintain the personality of the small company we once were. Your business is important to us, and at East Coast we'll go the extra mile to retain that business. You can always access expert technical assistance; it's just a telephone call away. Give us a try, you won't be disappointed. ■

Some More Good Reasons Why You Should Buy Your Parts From East Coast

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- ✓ 24 Hour Toll-Free Fax Line
- ✓ Same Day Shipping
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- ✓ Volume Discounts
- ✓ Discounts on Voice Mail Orders
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East Coast Transistor Parts, Inc. 2 Marlborough Road, West Hempstead, NY 11552 (516) 483-5742 Fax (800) 733-5904

Andrews Electronics

PO Box 914
Santa Clarita, CA 91380
Phone: 805-257-7700
FAX: 805-295-5162

It was 1950 when Andrew Futchik opened a small branch operation for a radio supply distributor. Not long after that the young firm had become quite successful in its surrounding area. Soon "Andy" would move the company to larger facilities, now under its own name: "Andrews."

Although the company earned a solid reputation early on, we have never rested on past accomplishments. Andrews Electronics has maintained and improved upon the basic concepts that Andrew Futchik pioneered many years ago. The success of the company was built on these principles:

- an inventory-control system that insures fast, efficient, accurate merchandise delivery
- specialization in the needs of the professional technician
- specialization in O.E.M. replacement parts
- a constantly updated cross-reference system
- establishment of a good relationship with suppliers by stocking each line broadly as well as in depth.

Andrews Electronics is able to provide a variety of support services as a result of the company's commitment to those basic principles. We can automatically generate backorder reports showing ETAs and send them bi-weekly. We offer easily obtainable factory service literature, usually right from our stock. We are able to perform parts research quickly, because in most cases our computerized referencing system allows us to find what you need instantly. We don't charge extra for our expert handling and packaging. We regularly send out flyers that feature money saving buys, or promotions that anyone can benefit from.

Services such as this that will make it easier for you to obtain and control parts are naturally very important to us, but the one feature that sets us apart from the rest is that we have the parts you need when you need them.

Stocking the right parts is really what Andrews is all about. In fact, we are so committed to having parts in stock that in late 1988 we ran out of warehouse space. That's when we moved into our present location in Santa Clarita, with over an acre of total floor space. And you may be assured that we are not letting any of that space go to waste. Our average fill rate manages to stay steady at over 90.

If you have not given us a try yet, try us. You can call or fax an order 7 days a week, 24 hours a day. If our order personnel are all busy, or if you call during off hours, our sophisticated telephone answering system will make sure that we don't miss your call. Our regular office hours are 8:30 a.m. to 5:00 p.m., Pacific Standard Time. We are closed for lunch between 12:00 and 12:30. ■

Projector-Recorder Belt Corp.

P.O. Box 176
Whitewater, WI 53190-0176
Phone: 1-414-473-2151
FAX: 1-414-473-4727

Projector-Recorder Belt Corp. (PRB) has been the nation's leading wholesale supplier of replacement belts and parts for the electronics industry for over 33 years. To support and enhance the sale of electronic replacement belts and parts, PRB began publishing a *Cross Reference Belt Guide* in 1970. The new and expanded 1993 version of the PRB *Comprehensive Belt & VCR Parts Cross Reference Guide* features detailed information on replacement parts for VCRs, camcorders, cassettes, compact discs, answering machines, car stereos and replacement belts for tape recorders, turntables, audio/visual equipment and office machines. The *Guide* lists a majority of the mechanical parts by manufacturer make and model and is crossed to the recommended PRB line replacement part. This *Guide* features an easy-to-use format and is truly a helpful, necessary tool for everyone who services VCRs as well as a wide range of other electronic equipment. And for the first time, the 1993 *Cross Guide* is also available on a convenient, easy-to-use computer disk, in both 5 1/4" and 3 1/2" sizes. The computer disks are IBM compatible, DOS 3.1 or higher, 512K of RAM minimum.

In our ever-expanding quest for useful service resource material, PRB is pleased to offer *InnerWorks—VCR Mechanical Replacement Booklets*. The *InnerWorks* series covers a wide variety of VCR makes and models. The booklets include easy-to-follow mechanical drawings, as well as a complete listing of all mechanical parts and assemblies.

InnerWorks booklets are arranged and grouped in families so you can:

- economically obtain the information you need. Each booklet provides detailed data for approximately 15 to 20 VCR models of a particular manufacturer,
- easily solve the 80% of all VCR failures that are due to mechanical parts malfunction,
- learn how many different models and manufacturers use the same parts.

Of course, throughout our many years of serving the electronics industry PRB has always put our customers first in everything we do. Satisfying them is our goal. Our in-house staff of professionals all work hard to provide the best possible products and superior service. The PRB line offers the products, the quality, the service, the prices, you can depend on. For complete details just call 1-414-473-2151 ■

C&S Sales

1245 Rosewood Dr.
Deerfield, IL 60015
Phone: 800-292-7711
708-541-0710
FAX: 708-520-0085

C&S Sales is a major distributor of high quality test instruments and electronic educational equipment. The company currently carries such name brands as: Hitachi oscilloscopes, Fluke multimeters, Standard amateur radio equipment, Beckman multimeters, B&K test instruments, Elenco test equipment and educational equipment, MOVIT robotics kits, and many other popular brands.

C&S Sales is a master distributor for Elenco, Hitachi, Standard, B&K Precision and MOVIT. This means that C&S Sales sells to other distributors as well as end users. In this way you are assured that C&S Sales will have the products you need at the lowest possible prices available.

C&S Sales has been servicing the industry since 1984. The friendly and knowledgeable sales staff is committed to offering the highest quality test equipment at the guaranteed lowest prices.

The company publishes a free 52-page catalog listing thousands of items. A 25,000 square foot warehouse assures that these items are available for immediate delivery.

The company prides itself on being the most price competitive distributor in the industry. A huge inventory capability and large sales staff assures the best possible service. Since we are able to buy in volume we are able to pass these savings on to customers. Our motto is "We will not be undersold" and this is true. We guarantee to not only meet, but beat any other authorized distributor's price on any products they sell. Call them and you can see for yourself.

The sales/customer service department has been thoroughly trained to answer all calls promptly and efficiently. These representatives are professionals who can provide immediate information on stock availability and pricing. They are available 8 a.m. to 9 p.m. (CST) Monday through Friday and 9 a.m. to 6 p.m. (CST) Saturday. Orders can also be mailed or faxed to us. Our fax machine operates 24 hours a day, seven days a week. Technical questions about a particular product can be answered by C&S Sales highly trained electronics technicians, who are available to provide the answers customers need. ■

Circle (3) on Reply Card

Electronix Distribution Corporation

313 W. Main St.
Fairborn, OH 45324-5036
Phone: 513-878-1828
Voice order: 800-223-3205
FAX: 800-352-9961

Electronix Distribution Corporation began in business by producing instructional videotapes that describe how to clean and repair VCRs. The company began stocking and selling replacement components and cleaning supplies when people who had ordered the tapes came to us for information on finding the products required to perform those functions.

Electronix Distribution Corporation started in business in 1985, when David Kushner produced the tape "Easy VCR Cleaning." That tape was so successful that we produced the tape "Easy VCR Repair." Other instructional videotapes followed.

When viewers watched the tapes and began to apply the information that was on the tapes, they came to us for information on where to obtain the tools, test equipment, replacement components and chemical supplies needed to perform VCR service and cleaning.

Seeing that there was a significant market for these products, we began to stock and sell the products and materials needed to carry out the procedures described on the tapes.

From that beginning, Electronix has grown to the point where we now offer a complete line of instructional videotapes, consumer electronics servicing replacement components, tools, test equipment and materials throughout the United States, including Puerto Rico, Canada and Mexico.

The product line

Our product lines include replacement components for a variety of consumer electronics products, a general line of replacement semiconductors, tools and test equipment, technical books, maintenance supplies, service center forms, and video accessories.

The replacement component line includes replacements for TVs, VCRs, microwaves and Nintendo and Sega video games.

Our line of tools and test equipment includes all of the standard products that a technician needs to get the job done: standard hand tools, soldering and desoldering tools, oscilloscopes, DMMs, bench power supplies and more.

Our full line of instructional videocassettes includes tapes on servicing of VCRs, camcorders, Nintendo games, microwave ovens and PC computer assembly and configuration. Over 250,000 copies are in circulation. Most cassettes are entry level and designed with the layman or beginning technician in mind. Prices for these tapes are $29.95, $34.95 and $39.95.

Ordering and payment options

Electronix offers toll-free telephone and facsimile ordering, and toll-free customer service. Telephone ordering and customer service are available during the hours of 9:00 a.m. to 6:00 p.m. eastern time. We offer same day shipping for all orders that are received before 4:00 p.m. eastern time.

We accept payment by COD, MasterCard, Visa, Discover, American Express, Diners club and Carte Blanche. Once a customer meets the required approval procedure, we accept Net 30 terms. All orders are shipped via UPS surface. Our minimum order is $20.00.

All parts are guaranteed for 90 days. Video heads and flybacks are both guaranteed for one year.

With over 60,000 parts in stock, we are able to fill most orders from stock.

Let us send you a catalog

For a free catalog, call or fax us at the numbers above, or write to the address above, or circle the Reader Service number. ■

Print Products International

8931 Brookville Rd.
Silver Spring, MD 20910
Phone: 800-638-2020
FAX: 800-545-0058

Print Products International is a premier distributor of equipment, tools and supplies for electronic maintenance and service. Print carries such lines as Pace desoldering, soldering and surface mount systems, Leader, Hitachi, B&K, Kenwood, Simpson, Beckman, Triplett, Global Specialties, and Hameg test equipment, as well as brand name tools for field service and depot repair.

Print lives up to the logo "we make ordering simple." With our staff, toll free phone and fax, huge inventory, and quick processing of orders, it is no wonder that Print has become the "source" for electronic test equipment.

Due to our huge buying power, Print is able to claim that we are the most competitive priced equipment distributor in the country. Print buys in large quantities, and passes these savings on to customers. As our sales staff say "If you didn't buy it at Print, you've paid too much! Because of this buying power, Print sub-distributes equipment to other distributors.

Print accepts VISA, Mastercard, American Express, and COD orders. Open accounts are available to rated firms. Print will ship your order UPS Ground, UPS Blue, UPS Red, Federal Express, or whichever carrier you request. A 10-day trial is available on all equipment.

Remember, when you need test equipment—think Print! "We make ordering simple."

A toll-free phone 800-638-2020 and toll-free fax (800) 545-0058 are available for your convenience. Please contact us for our free catalog. ■

Circle (32) on Reply Card

Circle (33) on Reply Card

Russell Industries, Inc.

3000 Lawson Blvd.
Oceanside, NY 11572
516-536-5000
FAX: 516-764-5747

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

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

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

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

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

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

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

The latest product category to be introduced is Russell's full line of electronic hardware that includes metric and non-metric screws and nuts. Another recent product introduction is a full line of capacitors (electrolytic, mylar, tantalum, etc.). The flyback transformer line continues to grow with an additional 22 models just in the last year.

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

★ ★ ★ DISTRIBUTORS SHOWCASE ★ ★ ★

MCM Electronics

650 Congress Park Dr.
Centerville, OH 45459-4072
Phone: 800-543-4330
FAX: 513-434-6959

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

Because the electronics industry is constantly changing, MCM Electronics continually and thoroughly researches the market to meet its ever changing needs. And MCM is constantly in touch with national and international manufacturers to bring both commonly used and hard-to-find products to its customers. In fact, two full-sized catalogs are mailed each year and the last issue introduced more than 1200 new items. MCM is a full-line distributor for RCA/GE replacement parts. We also carry other brand names including: Chemtronics, Fluke, Panavise, Sams Photofacts, Weller, Xcelite, Hakko, Leader, Hitachi, 3M and many more.

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

The Sales Department has been trained to answer all calls on the toll-free lines promptly and efficiently. These representatives are professionals who can provide immediate information on stock availability and pricing. They are available Monday through Friday, 7:00 a.m. to 8:00 p.m. EST, and Saturday 9:00 a.m. to 6:00 p.m. EST. Orders can be placed after hours with a national toll-free number, ensuring service 24 hours a day, seven days a week. Also, MCM has highly trained electronic technicians available to answer the customers product questions. With a separate toll-free "Tech Line" customers can receive prompt answers to their questions by calling 1-800-824-TECH (8324).

The company's Distribution Center houses an enormous inventory of parts and components. Every order is pulled and double-checked to strive for timely and error-free shipment. Because more than 25,000 of the items in the catalog are stocked and ready for shipment, orders are shipped within 24 hours.

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

For more information and a free catalog, call 1-800-543-4330; in Dayton, OH call 434-0031. ■

Circle (12) on Reply Card

★ ★ ★ DISTRIBUTORS SHOWCASE ★ ★ ★

Herman Electronics

1365 N.W. 23rd St.
Miami, FL 33142
Phone: 800-327-8378
FAX: 305-634-6247

Herman Electronics is a diverse, full-line distributor of everything in electronics. The company, now over 40 years old, has clearly established itself as one of the best in the industry by providing quality products to all phases of the electronics industry.

Herman Electronics' product base varies from transistors to antennas and everything in between including all types of batteries, audio, video and telephone accessories, cable, connectors, semiconductors, test equipment, tools, line conditioners, relays, chemicals, universal remote controls, audio and video tape in all formats, and much more.

The heartbeat of the business lies in the OEM parts department. While servicing the industry for over three decades, Herman Electronics has acquired many of the major OEM parts lines in order to provide more efficient and cost effective service to you. Herman Electronics is a factory authorized original replacement parts and accessory distributor for Sony, Magnavox, GE, Samsung, Panasonic, RCA, Quasar, Sylvania, Casio, Philco, Technics, and Philips. Stocking one of the largest and most comprehensive inventories, we fill over 80% of our orders from our 25,000 stocking items and guarantee two-day service to your door on all in-stock orders placed before 2:00 p.m. (EST).

Herman Electronics is able to provide a variety of customer support services as a result of the company's commitment to maintaining a standard of excellence in serving customers. We have several service representatives to serve your needs from 8:30 a.m. to 5:30 p.m. (EST) Monday through Friday and from 8:30 to 12:30 on Saturday. Whether your request is for pricing, stock availability, or research, the company's toll-free lines and 24-hour fax lines are readily available to fulfill all of your requests. Furthermore, the company guarantees to fill your research requests within three hours and generates computerized backorder reports with ETAs to keep you abreast of your backordered items.

The company prides itself on being flexible and accommodating to its customers' requests. "We realize there are many good distributors throughout the country" says Jeffrey A. Wolf, vice-President and son of one of the company's founders. "It is our job to be better by taking that extra step in giving our customers professional personalized service. Our industry has clearly become service oriented. Therefore, we are dedicated to maintaining a standard of excellence in serving our clientele."

The fringe benefits provided by Herman are several resulting in service and customer satisfaction second to none. All out-of-state orders are shipped UPS 2nd day air at no extra charge. Several methods of payment are available including a net 30 day open account, COD, and Visa and MasterCard. To accommodate the west coast, and after-hours orders and requests, Herman Electronics' has a sophisticated electronic phone ordering system to accommodate you 24 hours a day, seven days a week.

If you have not given Herman Electronics a try, please do so, you will be glad you did. Call now! Herman Electronics—experience, reliability and service excellence. ■

★ ★ ★ DISTRIBUTORS SHOWCASE ★ ★ ★

PTS Corporation

5233 Highway 37 South • PO Box 272
Bloomington, IN 47402-0272
Phone: 800-844-7871
FAX: 800-844-3291

PTS Electronics has been the electronics service dealer's best friend by providing fast dependable service to thousands of service dealers for more than 25 years.

PTS is the nation's largest single source for all major brands of television tuners and TV main boards. Brands such as RCA, Zenith, GE, and NAP are available at substantial savings of up to 60% when compared to OEM direct replacements.

Rebuilding is what we do best

PTS began in 1967 remanufacturing television tuners, and now remanufactures television main boards, satellite receivers, complete chassis, projection set boards, computer monitors and microwave oven panels.

Specialization has made PTS the largest and most efficient independent electronics rebuilder in the world. Maximum use of available resources and skill has made PTS the leader in electronics rebuilding, with the ability to adapt to new technologies and advance into new markets according to customer needs.

PTS specializes in rebuilding/remanufacturing electronic timing devices, modular circuits, and electronic tuners and main boards. PTS currently maintains contracts with major manufacturers in a variety of industries including white goods, television, computer, automotive, medical and various government agencies.

Currently, PTS rebuilds over a million analog and digital products, components and sub-assemblies each year.

Dedicated to customer satisfaction

At PTS, just providing our customers with high quality products and services is not enough. Our goal is total, unconditional customer satisfaction. Since 1967, PTS has been the world's leading independent electronics rebuilder and parts supplier. We provide the electronics industry with quality repair services and parts. We have worked with leading manufacturers to develop service programs for emerging technologies. We've seen a lot of changes over the years, but there's one thing that hasn't changed. That's the value and quality of our products and service programs.

You don't just become an industry leader overnight. It takes several years of experience and dedication to achieve excellence. It also takes a real commitment to training as well as state-of-the-art diagnostic and service equipment. PTS has the commitment.

Our staff are seasoned veterans who put themselves in the customer's shoes. They know how to listen and respond to a customer's needs. Each call is evaluated very carefully, and the response is always supportive and helpful. When you use PTS products and services, you become a part of our family. We'll go that extra mile to make sure you're happy and satisfied. When you call PTS, we really mean it when we say "PTS Electronics, how may we help you?"

PTS maintains a state-of-the-art computer system that allows instant response to your order inquiries. Our staff of customer service representatives are very knowledgeable of our products and services, and can help ensure that you get the part you really need.

PTS carries thousands of different parts for virtually every major manufacturer, and has more than 3 million parts in stock.

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BLOOMINGTON, INDIANA 47401
Customer Service: 1-800-844-7871
Local: 812-824-9331
Fax: 1-800-844-3291

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LONGVIEW, TEXAS 75602
Local: 903-757-6200
1-800-264-5082

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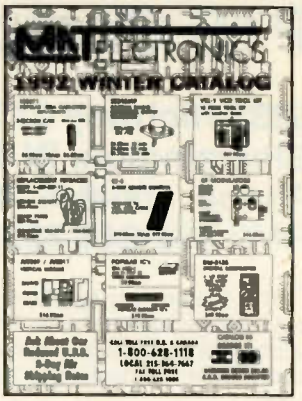
MAT Electronics

975 Jaymor Road
Southampton, PA 18966
Phone: 800-628-1118
FAX: 215-364-8554



MAT Electronics has expanded into a full-line parts distribution center, gearing its inventory to the TV, VCR, computer monitor, and stereo repair industries. The growth of MAT Electronics has been due to the following: quality products, competitive prices and fast reliable shipping. The company's products are used by manufacturers engineers technicians, trade schools and hobbyists.

MAT Electronics stocks an extensive line of flybacks (TV and monitor), Japanese semiconductors, capacitors and MATV accessories. In the past year, MAT Electronics has started to distribute original parts from Hitachi, NEC, Panasonic and Sony at competitve pricing.

The company publishes an easy-to-read 68-page catalog filled with thousands of inventoried items, which can be accessed immediately on a state-of-the-art computer system.

MAT Electronics is always current with market trends in the repair industry-always emphasizing what is new in electronic parts and components—for VCRs, TVs, computer monitors and stereos. MAT Electronics sources its products from around the world as well as domestically to give the best product at a true savings.

MAT Electronics takes great pride in its ability to accommodate the various needs of all its valued customers. The company normally ships orders within 24-hours of receipt of your order, but UPS red and blue lable service is also available to ensure even faster delivery service if necessary.

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

MAT Electronics takes the risk out of ordering from a catalog, offering a 90-day, 100% guarantee on all purchases.

Large volume discounts are available. Orders from foreign countries are no problem. The company's toll-free lines are open weekdays 8:30 a.m. to 7 p.m., and Saturdays from 8:30 to 2:00 p.m., and a toll-free fax number is available 24-hours a day at 1-800-628-1005. ■

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164113 RCA Idler Original	$2.99ea (10 min)
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MDVF33VA3422 Emerson RF Mod	$14.95ea
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FCC1415AL	Samsung	$19.95ea
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F0015	Sharp	$19.95ea
F0016	Sharp	$19.95ea
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FBT-1053	Sampo	$19.95ea
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4.7M/160V	Radial	$.45ea (10 min)
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Dalbani Corporation

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FAX: 213-727-6032
213-888-6032

Dalbani Corporation is a national and international distributor of high quality electronics components and parts servicing the wholesale, retail and manufacturing industry.

Since finding the parts you need should not be a major task, Dalbani Corporation maintains a huge stock of the most popular parts as well as those parts that are hard to find. Our extensive inventory of more than 22,000 different items reflects our commitment to our customers anticipating their needs and offering the lowest prices available for the best quality merchandise.

Dalbani Corporation keeps customers informed of the latest introductions of new items by publishing two full-line catalogs per year including catalog supplements, seasonal brochures, and notifications of sales promotions and specials. The multi-lingual Sales Department coupled with the state-of-the-art computerized order processing, enables Dalbani Corporation to offer prompt and efficient service to benefit the customers: Monday through Friday 7:30 a.m. to 5:00 p.m. and Saturdays 9:00 a.m. to 3:00 p.m. Pacific Time. A toll-free number (1-800-DALBANI/1-800-325-2264) for the U.S.A. and Canada is available, in addition to a 24-hour fax line (213-727-6032/213-888-6032).

Dalbani Corporation offers many shipping options (UPS Red, Blue, Orange & Ground, Fedex, etc.). Orders received by 2:00 p.m. Pacific Time are air freighted the same day, and most other orders are shipped within 24-hours. CODs, company checks and cash, and most major credit cards (Visa, Mastercard, Amex & Discover) are accepted. There is a $20.00 minimum order.

Our Customer Service Department is available to help answer customer's product related questions during normal business hours.

Dalbani Corporation will meet your company's needs: Wholesale, retail and manufacturing. For more information and to receive a free full-line catalog, call toll-free 1-800-325-2264. ■

More about computer memories

By J.A. Sam Wilson, CET

In previous issues we discussed the RAM (random access memory) in detail. Then we put together a circuit that uses a RAM to store such things as phone numbers and words like HELP. In performing that experiment (or, in reading about it) we went through the same process as the microprocessor does. Figure 1 shows the necessary connections between a microprocessor and a RAM.

We have talked about the importance of memory in microprocessor systems. That can be easily summarized: microprocessors will not work without supporting memory. You can think of the microprocessor as being a device that implements memory.

Since the memory is indispensable to the microprocessor, we started our series with an overall view of memory systems. Mass memories were discussed first with the very kind and able support of Lou Frenzel and Ron Weinstein.

After discussing the more common mass memories we turned to the discussions of RAMs and ROMs. We put a RAM on an experiment board and stored a telephone number. Then, the number was retrieved and displayed. In doing that experiment—either physically or mentally—we performed the job of the microprocessor.

The seven-segment decoder that was used for displaying the number is a form of read only memory (ROM). It is programmed during manufacturing to deliver specific outputs to the LED segments when the input is a binary number. Its program cannot be changed or written over as in the case of the RAM.

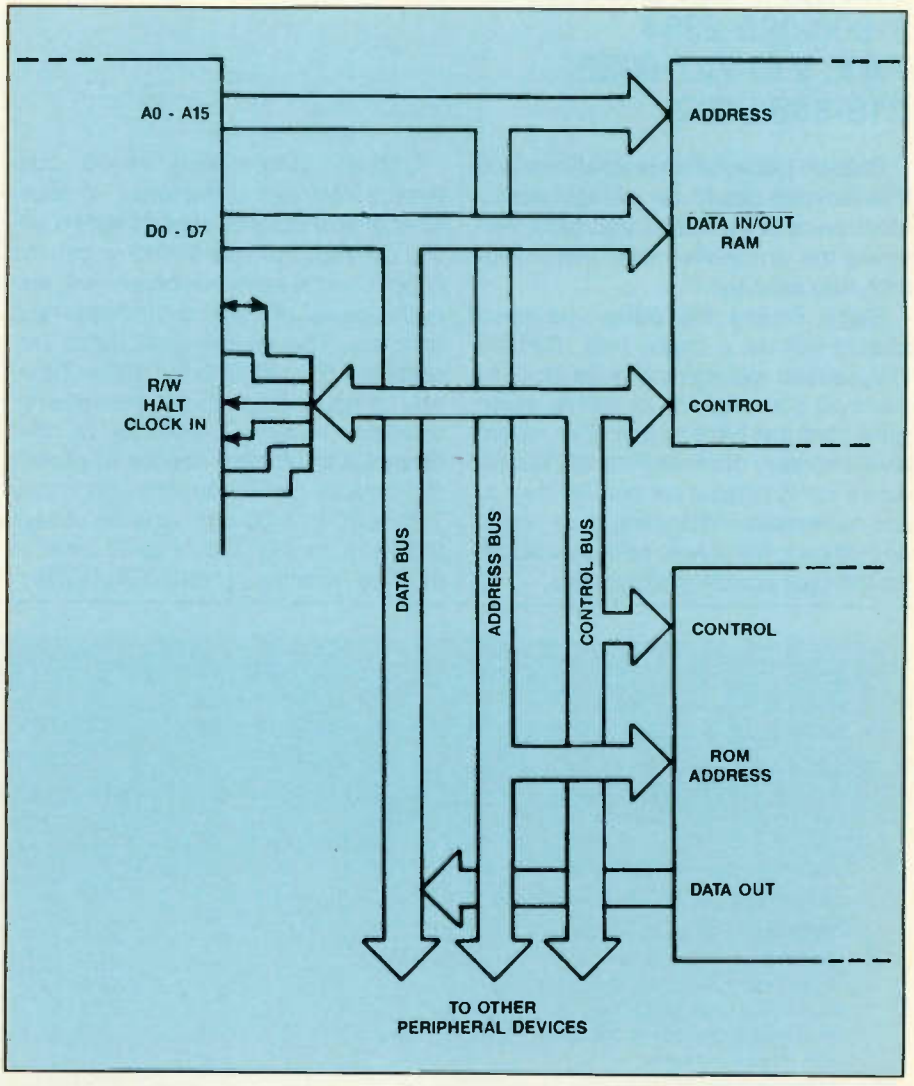


Figure 1

Strobing

It was inconvenient to read the telephone number one digit at a time in the experimental setup. A better arrangement would be to use eleven 7-segment displays and show all of the numbers at the same time.

Actually, the numbers in a display just look as though they are all being displayed at the same time. In reality, the digits are rapidly selected one-at-a-time. This is called strobing. Each selected display gets its data from one word of stored data. That way, there isn't a heavy demand on the power supply as there would be if all digits were actually displayed at the same time.

The decoder in the lab setup isn't absolutely necessary. The output of the memory can be used to light half of the display with each line of memory. That technique involves the use of an electronic switch to connect alternate halves of the segment each time a new line of memory is accessed. (A memory with eight bits per address is better suited for eliminating the decoder. That way, all of the required segments can be selected with each memory line.)

Going further

There are certain letters of the alphabet that can be shown on the seven-segment display when the decoder is eliminated in

Wilson is the electronics theory consultant for ES&T

favor of the direct output from memory. That makes it possible to display words. For example, 7-UP, SHELL, and EIGHT can be shown.

Types of RAMs

The RAM used in the experiment was one of a class called static RAMs. Once loaded, that type holds the data without any further input. If the power supply voltage is removed all of the data is lost.

There are some problems with the static RAMs that should be understood. The circuitry required, such as data flip flops, cannot be made as compact as the engineers would like it to be. You can only squeeze so much stuff onto a chip. A problem with the types that use bipolar transistors for memory cells is that too much power is required for their operation. (A cell is a piece of memory that can store one bit of data.)

Not to be overlooked is the speed problem. Memory speed refers to the time required to access data.

Dynamic RAMs avoid some of the problems that occur with static RAMs, and, at the same time, create new problems of their own. To understand the principle of the dynamic RAM refer to Figure 2. The MOSFET has an insulating material between its gate material and its channel. That construction means it acts as if it has a capacitor connected between the input and output. A dynamic RAM cell is made by allowing the data to charge that capacitor for logic 1 and not charge it for logic 0.

This idea isn't exactly new. There was an RCA television receiver called the RCA 2000 that used a similar technique to hold a selected channel. I'm going to go through about 50 storage boxes full of books and manuals and get that circuitry out for you. It may take a few issues for me to find the right box.

In an actual microprocessor or computer system the data inputs to a dynamic RAM come from the data bus. The address comes from the address bus. The NOT CSF and NOT WE inputs would come from the control bus. Therefore, as far as the microprocessor is concerned there is no difference between a static RAM and a dynamic RAM.

An obvious concern with the capacitor storage method is: What happens when the capacitor becomes discharged? Certainly, some of the charge is going to leak away in a short time. That could mean a loss of data.

Some very clever circuitry has been designed to refresh the charge on the capacitor 500 to 1000 times per second. If the capacitor was charged to store a logic 1 the capacitor is recharged. If a logic 0 was stored there is nothing to do. So, memory loss due to capacitor discharge does not occur in a dynamic RAM.

The refresh circuitry takes care of the problem of capacitor discharge and loss of stored information. However, it creates new problems that need to be reviewed.

While it is true that the memory matrices of a dynamic RAM are more compact than those of static RAMs, you haven't saved a lot of total space when you make room for the refresh circuitry.

It is true that you can get data into and out of a dynamic RAM when you are considering only the access time of the cell matrix. However, you can only access the cells during the time when there is no refresh being done. So, the access time of the complete dynamic RAM (cell and refresh combined) is not as fast as you might expect. Still, it beats the time for static RAMs.

If you were just using charged and uncharged capacitors for storage the dynamic RAM would be much cheaper than the static RAM. But, when you add the cost of refresh circuitry the difference in price is less than desired.

When you get done with the howevers, the dynamic RAM is still faster and cheaper. We will look at the dynamic RAM circuitry again.

Summing up the memories

I once taught a short course in microprocessor technology at a large university. The course required that the teacher have a doctorate degree. I was listed as a student and I taught the course.

There were 19 students and one malcontent who felt it was his duty to challenge everything I said. If he thought he had caught me in a technical error he went straight to the man with the doctorate.

Let me explain the professor's motives. He had a sense of humor almost as unconventional as mine. He loved to hassle me with unusual slants to the field of electronics. In doing so he provided much of the subject matter for my writing.

One day I was talking about the memories associated with microprocessors and noted that memories outside the microprocessor are peripheral memories. Memories inside the microprocessor have been called "on-board memories".

Immediately the malcontent slipped out of class. In about four minutes he and the professor walked into the classroom.

The professor asked me this question: "What memories are there inside a microprocessor?" He didn't wait for an answer,

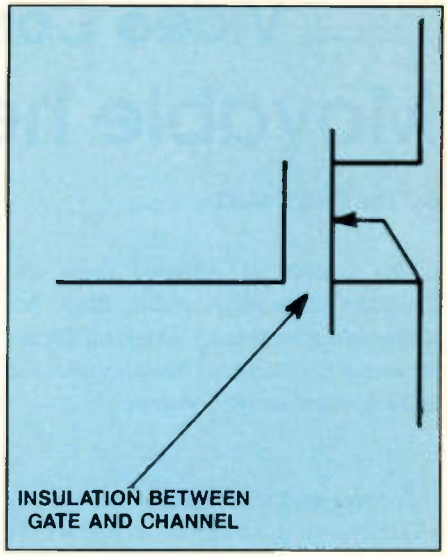


Figure 2

so, I know he was put up to this by you-know-who.

Let's answer the question here and now. First, a memory—to me—is a component or circuit that can hold a binary number for later use. Of course, I'm speaking of an electronic memory.

Two accumulators are used in a Motorola microprocessor to hold numbers for the Arithmetic Logic Unit (ALU). They are memories even though each holds only one number at a time.

The 8080 microprocessor has registers that do the same job that the accumulators do. They are also memories.

A program counter holds memory addresses of a microprocessor program, so, it is a memory.

Throughout the various microprocessors on the market there are many other examples of short-term memories. In our series on the construction of a microprocessor we will build these internal memories and demonstrate their uses.

Over and above the internal memories just mentioned, there are complete RAMs and ROMs in some dedicated microprocessors.

You tell me

I need to discuss an important aspect of this column. I like to discuss basic theory and applications. I believe it is a good idea to review the basics so we don't get led astray with more advanced literature.

My idea of discussing, experimenting, and possibly building the various circuits in a microprocessor system is based on that idea. However, I will abandon the microprocessor series if enough readers say they are not interested. Please let me know. ■

Movable heads drive circuitry

By The ES&T Staff

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

In the speed search mode, the tape in a VCR travels at a much faster speed than it does during the normal play mode, so the video heads describe a path across the tape that is much closer to vertical than diagonal. Therefore, instead of tracing out the recorded stripe of information, the head traverses more than one video track.

The result is noise bars in the picture when the VCR is in the speed search mode. This phenomenon was described in detail in "Video Corner" in the August 1991 issue.

Addition of a set of video heads to the head drum that could move up and down relative to the circular face of the head drum, as the drum rotates and the tape is pulled past the head drum eliminates these noise bars. This article looks at the movable heads drive circuitry in more detail, covering the generation and control of the actual drive signals.

Block diagram analysis

A basic block diagram of the movable heads drive circuitry is illustrated in Figure 1. When a movable head (MV) mode is activated, either speed search or all jog/shuttle modes except high speed search, the channel 1 and channel 2 drive generators output a sawtooth signal to drive the movable heads actuator coils. This is only a rough signal. The amplitude and average dc level must be adjusted to produce a noise free picture.

The control of the drive signals starts at the output of the MV heads. When an MV mode is activated, the head selection circuitry switches the signal source from the normal playback 4 x heads to the MV heads. The output of the MV heads is directed to the video/chroma playback circuitry (not shown in Figure 1) and to signal detection circuitry.

The signal detection circuitry outputs an analog voltage denoting the presence and amplitutde of the FM signal from the heads. If no signal is present the output approaches zero volts. When a signal is present the output goes positive. The value of the positive output is directly proportional to the amplitude of the input FM signal. If there is a slight difference in the output of the individual heads, it is indicated in the output of the signal detection circuitry, as shown in Figure 1. This does not hinder the operation of the circuitry as long as the output of the signal detection circuit indicates FM signal is present.

The signal detection output is applied to the control circuitry of the VCR. This determines the required changes in amplitude and dc level of the drive signals to obtain maximum output from the heads. The control circuitry outputs the control data in a digital format which is applied to the two MV head drive generators altering the drive signals accordingly.

Head selection and signal detection circuitry

A simplified version of the head selection circuitry is shown in Figure 2. IC01

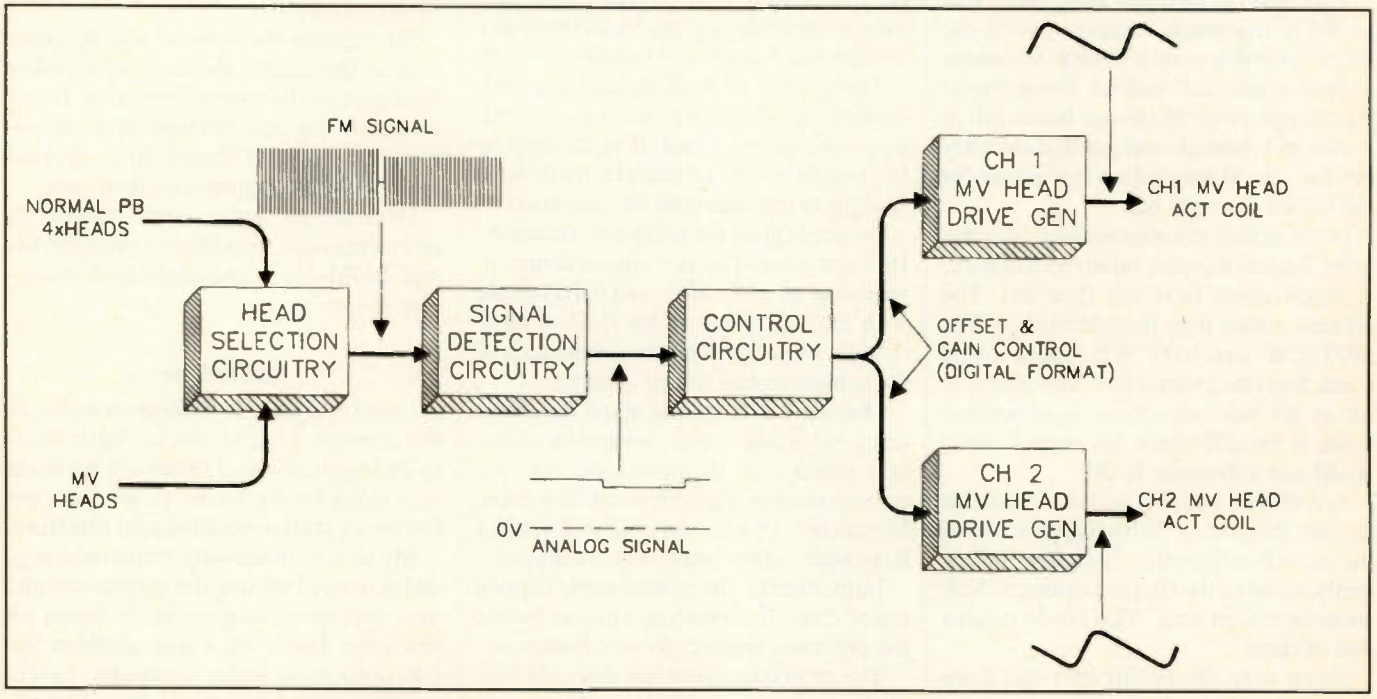


Figure 1. MV head drive circuit block diagram.

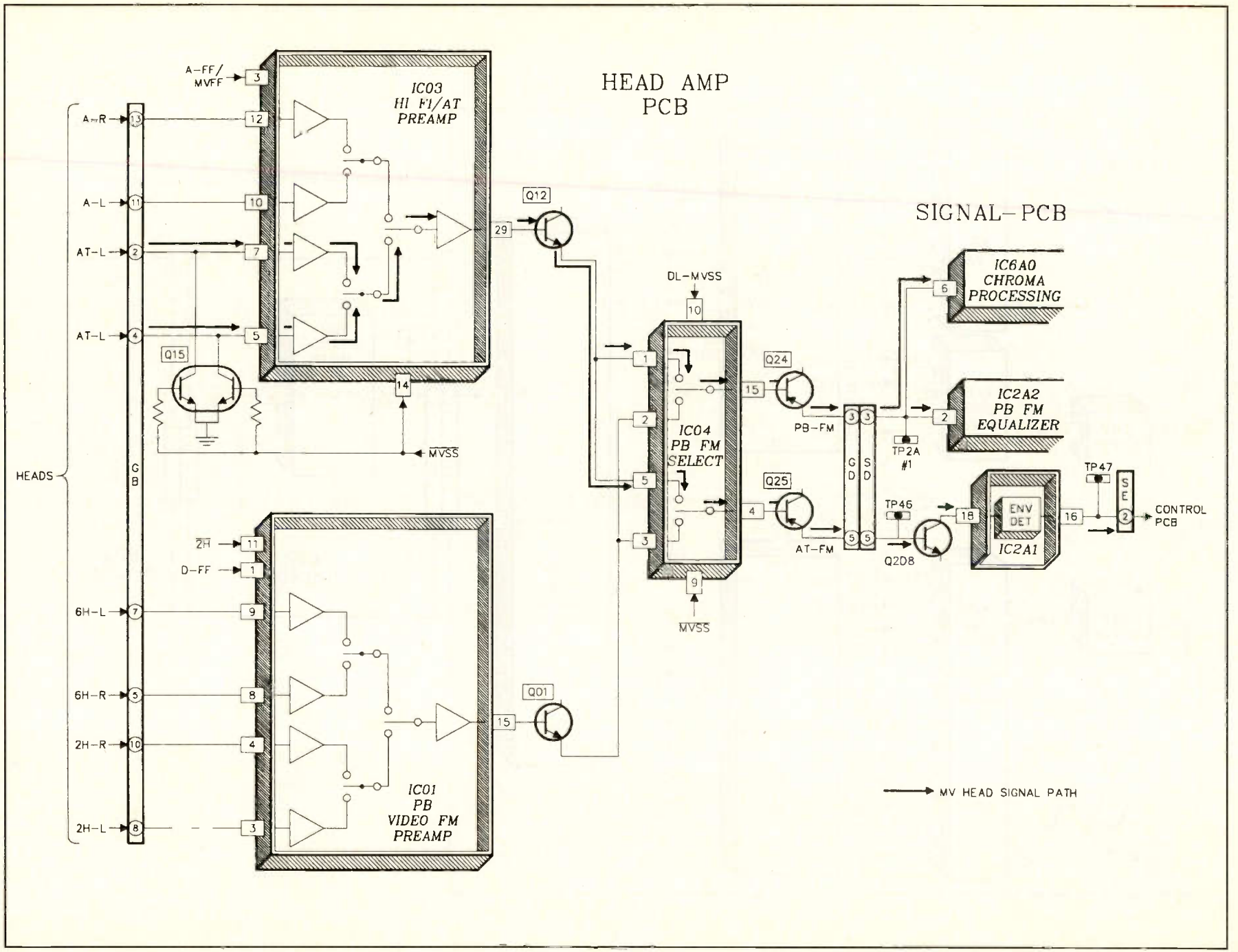


Figure 2. Movable heads selection circuitry.

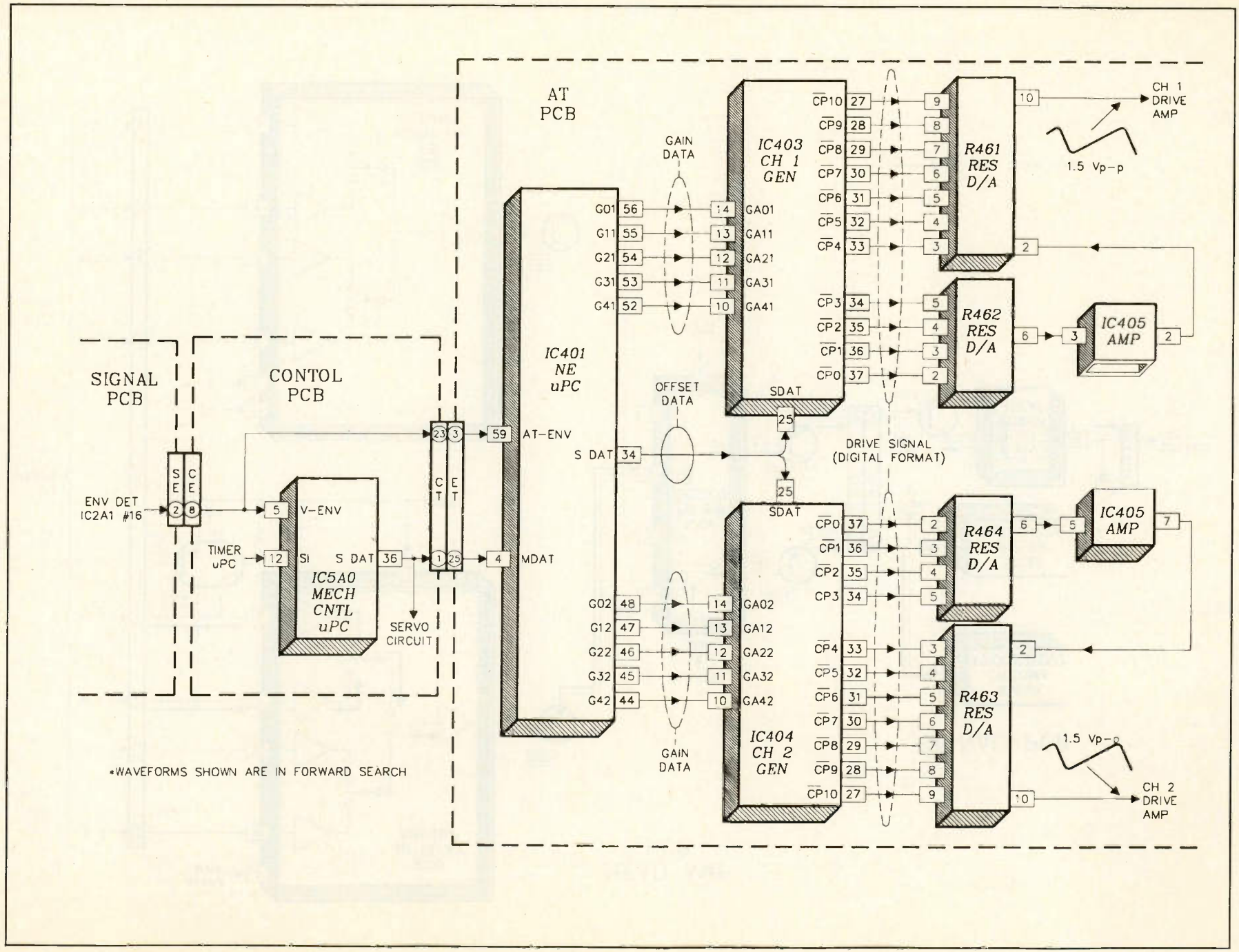


Figure 3. MV head drive generators.

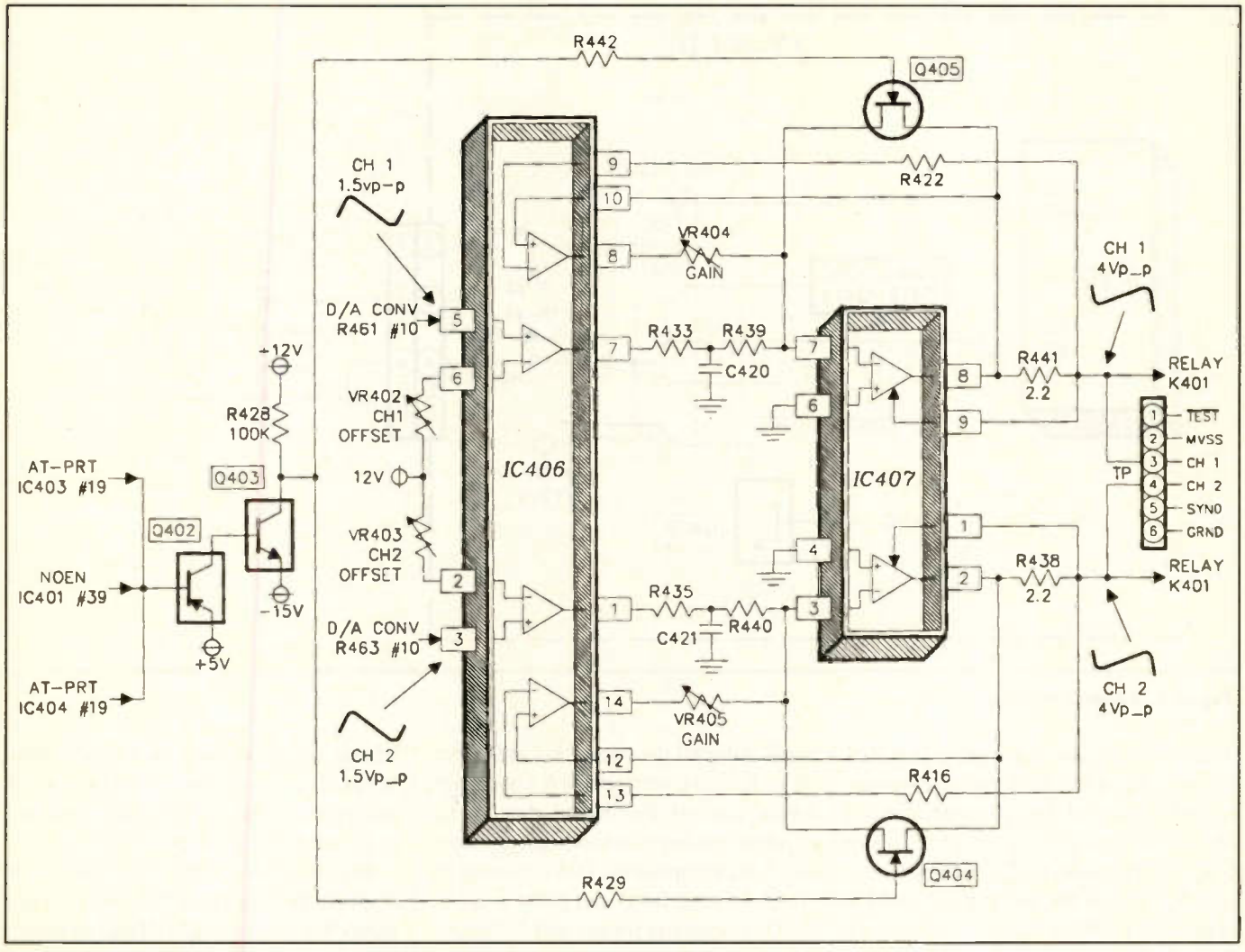


Figure 4. MV actuator drive and protect circuitry.

contains the preamplifiers and head switching circuitry for the 4 x head configuration, and is the signal source in normal playback. The output of IC01 is directed to pins 2 and 3 of analog switch IC04. During normal playback the signal from IC01 is output at pin 15 and 4 of IC04. The signal from pin 15 is directed to the video/chroma circuitry, and from pin 4 to the envelope detector in IC2A1 (signal detection circuit). In playback, the output of the envelope detector controls the auto tracking function of the VCR.

When an MV mode is activated the MVSS control line goes low. The MVSS line controls the lower switch in IC04 and the head selection switch in IC04. IC03 is normally the preamp for the hi fi heads. However, when the MVSS line goes low, the MV heads are selected for the output at pin 29 of the IC. The signal from the movable heads is routed through IC04 to the envelope detector. The resulting MV head output status is directed to the control circuitry, which generates correction data for the two MV drive generators.

Approximately 1 second after the MVSS line goes low, the DL-MVSS line goes high, switching the upper analog switch in IC04 to the MV head output, directing it to the video/chroma circuitry. The slight delay between the change on the MVSS and DL-MVSS lines allows the MV drive signal to be adjusted before the MV heads output is utilized as the signal source. Due to the delay, the first picture displayed when entering an MV head mode, is from the conventional 4 x heads and noise bars are momentarily present. Then it switches to the MV heads and a clean picture is produced.

MV heads drive signal generation

A simplified version of the MV drive generator circuitry is illustrated in Figure 3. Note that the output of the envelope detector takes two paths: to the V-ENV input of IC5A0, the mechanical control μPC; and to the AT-ENV input of IC401, the NE (noise elimination) μPC. During normal playback, IC5A0 utilizes the output of the envelope detector to generate control signals. These are output at pin 36 in a serial format and are directed to the auto tracking circuitry in the servo circuit.

When an MV head mode is activated the two drive generator ICs, IC403 and IC404, generate rough sawtooth drive signals for the MV heads. At the same time the AT-ENV input of IC401 is enabled. Internal to IC401, the signal at the AT-ENV input is analyzed and digital correction signals are generated. Correction signals controlling the average dc devel (offset) of the drive signal are output in a serial format at pin 34 and are

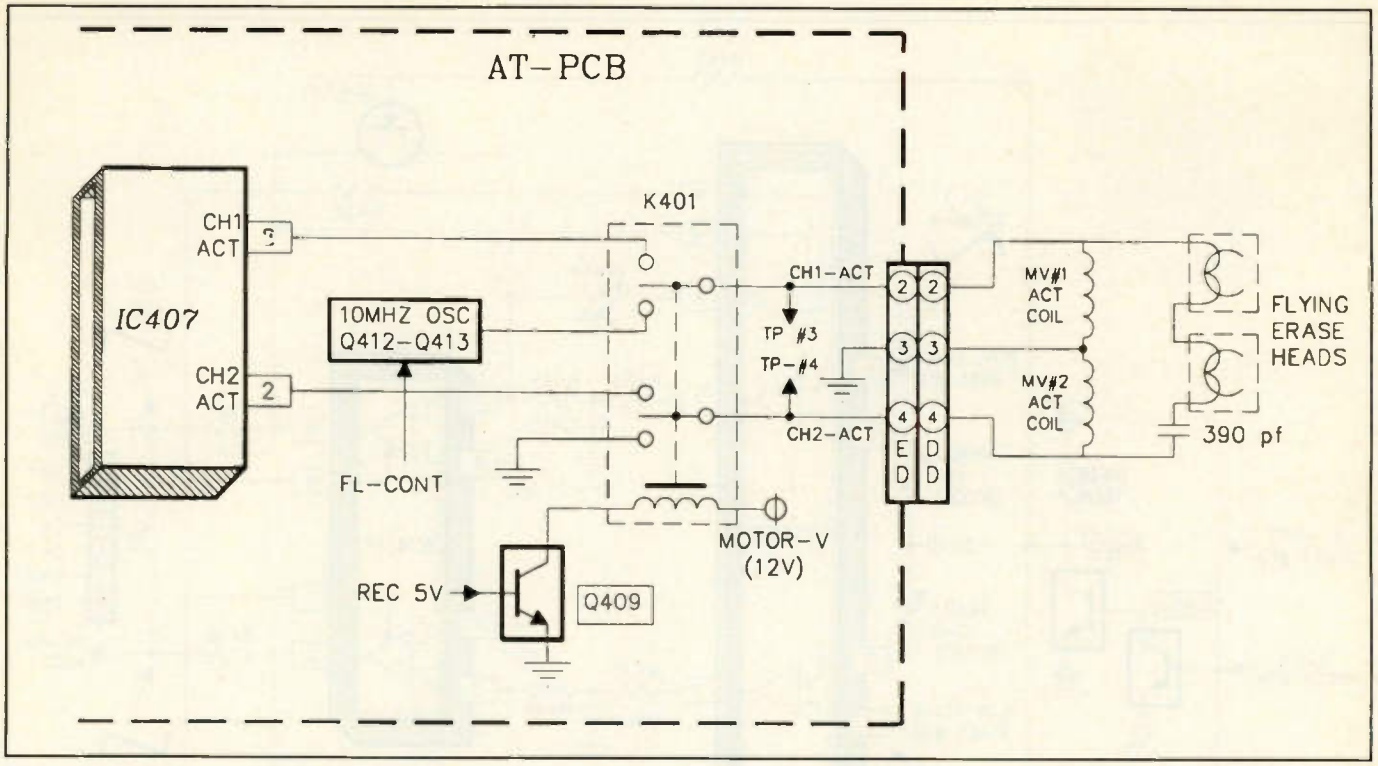


Figure 5. MV/flying erase relay circuit.

directed to the two drive generator ICs. Amplitudes of the drive signals are controlled by parallel data gain control lines directed to each drive generator IC. Gain control for channel 1 (IC403) is output at pins 52 through 56, and gain control for channel 2 (IC404) is output at pins 44 through 48.

The outputs of IC403 and IC404 are 11 parallel digital data lines that are directed to resistive network D/A converters, which convert the digital data to the required analog sawtooth drive. R461 and R462 comprise the D/A converter for channel 1, and R463 and R464 make up the D/A converter for channel 2. The output of the D/A converters are directed to drive amplifiers for further amplification before being applied to the movable heads. The waveforms shown in Figure 3 are typical of the drive signals generated in forward speed search.

Before looking at the drive amplifiers it should be noted that IC401 is not only utilized in developing MV head drive, but is also part of the overall control circuitry. Although it may not be shown in

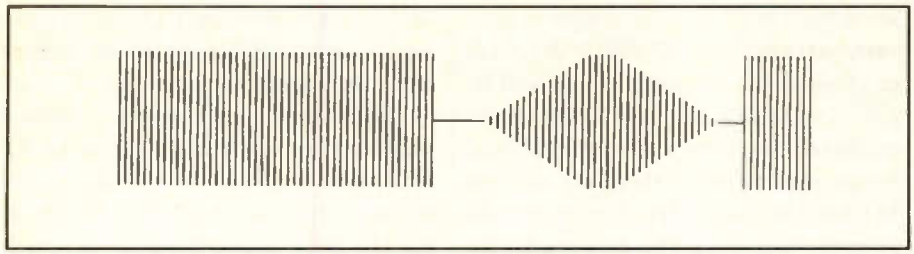


Figure 6. MV heads envelope (one head's movement restricted).

Figure 3, it is also used to generate conventional mode operational commands such as: CT-REV (counter reverse), NOT SS (speed search), EE, STILL (conventional PB still), and SL (slow motion).

MV drive amplifier circuitry

The MV drive amplifier circuitry is shown in Figure 4. Basically the circuitry is relatively straight forward. The drive signals are amplified by amplifiers in IC406 and IC407. VR402 and VR403 set the initial offset (dc level) of their respective channels. VR404 and VR405 determine the gain by adjusting the amount of negative feedback to the input of the amplifiers in IC407. Note the output from IC407 is not applied directly to the MV heads. It is directed to K401, a signal selection relay, which routes the drive signals to the MV heads actuator coils.

The relay is required since the brush contacts on the top of the drum assembly are used for two purposes: to couple the MV drive signals to the upper drum and also to supply the flying erase heads signal at the start of a recording. Figure 5 illustrates the relay circuitry. Normally the relay is de-energized and the contacts are in the upper position, connecting the MV actuator coils to the outputs of IC407. The flying erase heads are basically in parallel with the MV actuator coils. When MV head drive is present, the high impedance of the 390pF capacitor in series with the flying erase heads prevents the 30Hz MV drive signal from affecting the flying erase heads.

When record is activated, the record 5V supply turns on Q409. This energizes the relay and connects the output of the 10MHz oscillator, consisting of Q412 through Q413, to the brush contacts on top of the drum assembly. The FL-CONT line activates the 10MHz oscillator for several seconds at the start of record. This erases any previously recorded signal not erased by the full erase head. When the 10MHz flying erase signal is present, the high impedance of the actuator coils limits any cirrent flow from the erase signal so the movable heads are not affected.

Protect circuitry

The MV heads are protected by protect circuitry, consisting of Q402, Q403 Q404 and Q405. (Refer to Figure 4.) This circuitry is necessary to protect the MV heads actuator coils when not in an MV mode. When not in an MV mode, the output from the A/D converters drops to zero volts. This causes the output for the first drive amplifiers, pin 7 and 1, to go to approximately 4V, due to the positive offset voltage at pins 6 and 2. The -4V is inverted by IC407 and is constantly applied to the MV head actuator coils. If the VCR is allowed to remain in this condition for a prolonged period of time the actuator coils will be damaged by the constant dc current. To prevent this from occurring, the protect circuitry disables the op amplifiers in IC407 when not in an MV head mode.

Three control lines control the protect circuit, an AT-PRT output from both IC403 and IC404, and a NOEN output from the NEμPC IC401. All three control lines are tied together and are connected to the base of Q402. When in an MV head mode all three lines are low, holding Q405 and Q406 OFF, through Q402 and Q403. When not in an MV head mode, all three control lines go HIGH turning on Q405 and Q406. With Q405 and Q406 conducting, the outputs of the OP-AMPS in IC407 are effectively shorted to the inverting inputs, canceling the negative dc voltage from IC406.

Troubleshooting tips

Problems in the MV head drive circuit-

ry only appear when an MV head mode, such as speed search or jog/shuttle is activated. In the jog/shuttle mode the severity of the symptom may vary, depending whether still, slow, playback or speed search are activated. When speed search is activated directly from playback, the symptom is usually only displayed momentarily. The VCR automatically switches back to the normal 4 x head configuration, producing the conventional speed search picture with noise bars.

Although the movable heads are only used during special effects, it must be remembered they are still video heads and are subject to the same problems as conventional heads. If one head is defective or clogged, the resulting picture will be mostly snow with an apparent 30Hz flicker, the same as when a conventional head is damaged or dirty. Therefore, when a MV head mode problem is encountered, clean the heads first. This may resolve the problem and eliminate any circuit troubleshooting time.

If the problem still exists after cleaning the heads, one head may still be defective. It is difficult to check the MV heads output in an MV mode with the unit malfunctioning, since the drive signal to the MV heads is constantly changing looking for an acceptable signal. We suggest using the alignment test mode.

Play a tape and connect a jumper between pins 1 and 6 of the TP on the AT-PCB. This activates the movable heads during normal playback. The output of the MV drive circuit in this mode is only an offset (dc) voltage, not a sawtooth since the head position does not have to be continually varied in playback.

To view the output of the heads, connect an oscilloscope to pin 1 of TPA on the SIGNAL-PCB and trigger the scope from the head switching signal at pin 2 of TP on the AT-PCB. If the output of one or both heads appears to be missing, it may be necessary to perform an alignment procedure. If the offset or gain are misadjusted, it may appear that no output exists from that channel's head.

If satisfactory adjustment cannot be obtained, the problem may be localized further by noting the MV drive signal offset range (channel 1 TP #3 and channel 2 TP #4) as the offset adjustment is rotated from one end to the other. The range of the offset voltage should extend from approximately +3.5V to -3.5V. If the range of the offset voltage is too low the cause is probably in the MV drive generator or MV drive amplifier circuitry. If the offset range is incorrect, it points to a problem in the MV head preamps (IC03) or the MV heads themselves.

On rare occasions the MV drive circuitry may adjust OK when pins 1 and 6 of TP are jumpered, but noise bars still exist in MV modes. Activate forward speed search and monitor the MV heads drive signals with an oscilloscope, channel 1 at pin 3 of TP and channel 2 at pin 4. The two drive signals should be approximately 4Vpp. When there is a marked difference between the two signals it points to problems in the drive generator circuitry.

If the two drive signals appear normal, check the MV head output at pin 1 of TP2A on the SIGNAL-PCB. If the output of a head is OK in the center, but falls off drastically at the start and end of the envelope, as shown in Figure 6, the actuator coil may be damaged or the head's movement mechanically restricted, which would then require an upper drum assembly replacement. ■

Test your electronics knowledge

By J.A. Sam Wilson, CET

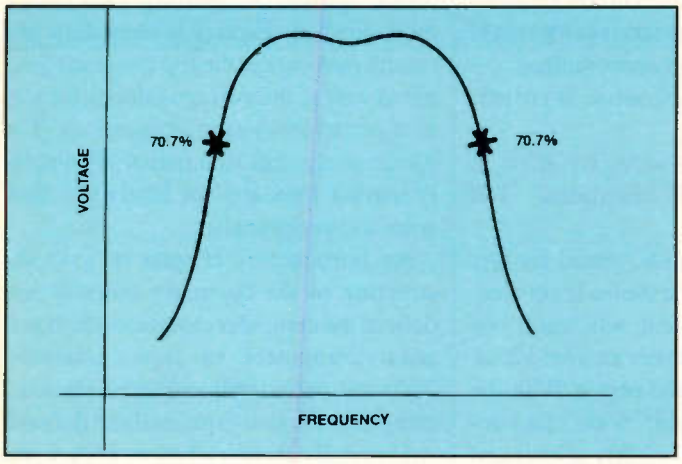


Figure 1

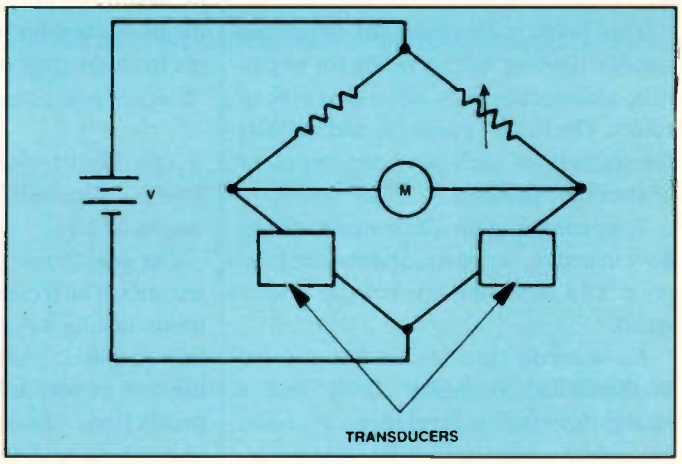


Figure 3

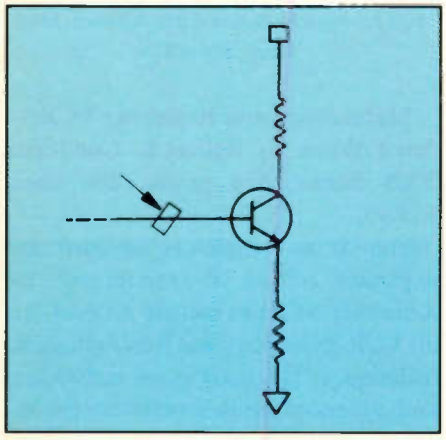


Figure 2

1. The 70.7% points on the curve of Figure 1 are used to mark the

A. maximum-power points.
B. 70.7% power points.
C. bandwidth.
D. gain-bandwidth points.

2. Which of the following is correct?

A. Every op amp must be operated with a positive and negative power supply voltage.
B. There are op amps that can be operated with a single-polarity power supply.

3. What is the decimal value of the following BCD number?

1 0 0 1 0 1 1 1

Wilson is the electronics theory consultant for ES&T.

4. In the circuit of Figure 2 the arrow points to a component that acts like

A. a resistor.
B. an inductor.
C. a capacitor.
D. a diode.

5. A rectangle measures 970.1 inches by 780.2 inches. The area is computed by student Lancelot Ordfug to be 756672.02 square inches. What is wrong with his calculation?

6. Which of the following can be used to protect powered equipment from line surges caused by lightning?

A. MOV
B. LPN
C. NPO
D. LVO

7. The number of output circuits that can be controlled by a relay is called its

_____.

8. How do you express zero in Roman numerals?

_____.

9. A resistive hygrometer can be used for measuring changes in

A. water pressure.
B. humidity.
C. fluid flow in pipes.
D. (None of these choices is correct.)

10. Which of the following is a reason for using two transducers in a bridge circuit as shown in Figure 3?

A. cancel the heating effect of current in the measuring transducer
B. get a greater output voltage (V)

(Answers on page 66)

Books

Telephone Repair Illustrated, By Stephen J. Bigelow, TAB/McGraw-Hill, 240 pages, 169 illus., $17.95, paper, $27.95, hardcover.

This book is intended for telephone troubleshooting and servicing for beginning technicians. It includes coverage of rotary, electronic, cordless, and cellular telephones, as well as many types of answering machines.

Telephone Repair Illustrated explains how to install, maintain, and service telephones in terms the layman can understand.

No esoteric theories or complicated mathematical formulas. It is just a straightforward presentation of basic electronic communications principles, troubleshooting tables, service guidelines, and illustrated repair techniques for non-technicians. Readers are thoroughly introduced to tools and materials, test equipment, components and circuitry, and methods for installing and servicing all popular kinds of residential and small business telephone systems.

In addition to standard rotary and push-button telephones, Bigelow covers the latest cordless and cellular models and variety of answering machines ranging from simple two-tape devices to voice synthesized, digital messaging machines.

TAB/McGraw-Hill, Blue Ridge Summit, PA 17294-0850

Managing High-Tech Start-Ups, By Duncan MacVicar and Darwin Throne, Butterworth/Heinemann, 288 pages, $34.95, hardcover.

Managing High-Tech Start-Ups is for the engineering entrepreneur. It prepares new business owners for both the start-up and growth phases, emphasizing sound and long-term planning. It also details all vital organizational functions, from research and development to manufacturing, marketing and product support. Technically-oriented entrepreneurs will gain a comprehensive understanding of how all personnel perform and interact within a successful company. *Managing High-Tech Start-Ups* addresses the unique challenges and needs of new high technology companies, such as market timing and establishing original equipment manufacturer (OEM) agreements. This book is full of strategies and insights tested and honed at dozens of start-ups in Silicon Valley and other entrepreneurial centers. It candidly analyzes the personal, financial, and professional requirements of a new business and enables readers to assess their own opportunities.

Butterworth/Heinemann, Stoneham, MA 02180

The Multitester Guide, By Alvis J. Evans, Prompt Publications, 160 pages, $14.95.

The Multitester Guide, useful for any technician interested in the basics of electronic testing equipment, will teach you how to make a multitester another versatile tool in your service center. With the instructions provided with easy-to-understand text and clearly illustrated examples, basic electrical measurements become a task easily, correctly, and quickly done.

Contents of the book include: how to use both analog and digital multitesters, dc and ac measurements, measurement of individual components such as resistors and inductors, measurement of in-circuit components, home appliance measurements, lighting and other home system measurements, automotive measurements, tool control circuit measurements, and a complete glossary and index.

Prompt Publications, Howard W. Sams & Company, Indianapolis, IN 46214

The Computer Industry Almanac 1992, By Egil Juliussen Ph.D. and Karen Juliussen, 816 pages, $45.

This is an annual reference book for and about the computer industry. The 1992 and fifth edition is authored by two experienced computer industry observers and computer users and is filled with facts that summarize the whole computer industry. Databases in this *Almanac* include: Over 2,500 entries of computer companies, more than 370 magazines and newspapers, over 440 newsletters and periodicals and more than 200 entries of market research companies. Also included are associations and organizations, high-tech public relations agencies, user groups, computer book publishers, testing companies, a conference directory and a people directory.

The *Almanac* is full of rankings and awards for companies, people and products, which have been excerpted from the business press (i.e., Forbes, Fortune and Inc.) and the computer press (i.e., Electronic Business, Datamation, PC Magazine and Soft•letter). One of the most popular chapters is the salary and wealth rankings of the top computer people as well as the average salaries for various computer-related occupations. The *Almanac* also has summaries of computer market forecasts for hardware, software and peripherals.

An introductory chapter reviews the structure of the computer industry and defines the computer categories from personal computers to supercomputers. Software, peripherals and service product categories are also explained and defined. Additionally, there is a history of the computer, educational statistics, employment data, computer comedy and more.

Egil Juliussen Ph.D. and Karen Juliussen, Lake Tahoe, NY 89451

Maintaining and Repairing VCRs—3rd Edition, By Robert L. Goodman, TAB Books, 576 pages, 480 illus., $19.95.

This is a completely updated and expanded edition of *Maintaining and Repairing VCRs* to include state-of-the-art VCR technology and troubleshooting techniques. The book gives technicians and advanced do-it-yourselfers professional guidance to service and repair VCRs.

Hundreds of helpful pinout diagrams and exploded-view photographs demonstrate how to locate and fix every imaginable malfunction in Betamax and VHS VCRs, from snowy pictures and garbled audio to faulty fast forward/rewind or record/playback functions.

In addition to details on test equipment, this bestselling handbook covers camcorders and special VCR circuits, including high quality (HQ) video and stereo audio circuitry.

All of the book's information has been gathered from the service departments of General Electric, RCA, JVC, Zenith, Panasonic, Sony, and other VCR manufacturers. With actual case studies of popular models that demonstrate how to solve common problems, this book is a thorough guide to VCRs. ■

TAB Books, McGraw-Hill, Inc., Blue Ridge Summit, PA 17294-0894

Products

PLCC socket removal tips

Pace, Incorporated introduces a new family of tips for the IR-70 soldering iron for removing surface mount sockets.

Now available: tips for PLCC-28, -32, -44, -52, -68, and -84 sockets.

Surface mount sockets for PLCC (J-leaded) components are very common in the development and modification of circuit boards. The PLCC can be "plugged into" the socket many times. However, when testing is complete, the sockets may need to be removed for permanent installation of the final PLCC component.

These socket removal tips provide safe, rapid thermal transfer to all of the solder joints simultaneously, without damage to the board or adjacent components. Upon solder reflow, the tip wedges itself inside the socket, allowing easy, one-handed removal from the circuit board.

Circle (60) on Reply Card

AC power line analyzer

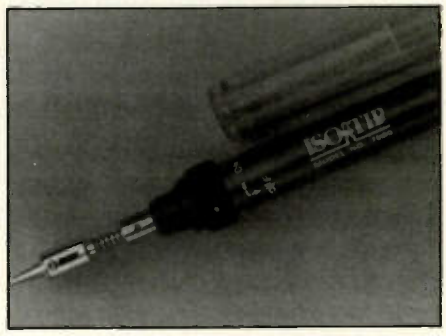
Extech's ac Power Line analyzer is able to diagnose power problems as a stand alone unit or connected to a PC or laptop

to view events in real time. Simply plug the analyzer into a grounded outlet, monitor the power for 24 to 72 hours (storing data in the analyzer's internal RAM memory) and transfer data to a PC by connecting the analyzer to the serial COM port of a PC. Power Audit Software provides complete analysis of spikes, sags and surges, dropouts, power failure, true RMS ac line voltage and frequency, common mode noise, high frequency noise, phase shift, and neutral line voltage. Each power audit chart contains the actual disturbance event data, indicates symptoms that are related to these disturbance types, and recommends a specific solution. Power disturbances are presented on the PC in four easy to understand formats: detailed or summary reports, bar or pie charts, power quality audit, or sine wave graphics. Comes complete with software, RS-232 cable and 6 ft. power cord.

Circle (62) on Reply Card

Butane soldering and torch

Wahl Clipper announces the Iso-Tip butane soldering tool. It is a soldering iron



with adjustable tip temperature up to (1067F); or a torch with adjustable temperatures up to (2372F).

The unit is also available as a kit, which includes a hot blower tip, for heat shrink tubing and heating plastics to a pliable temperature. ■

Circle (63) on Reply Card

UV-A-curable conformal coating

Tech Spray announces UV-A curable epoxy acrylate conformal coating, Fine-L-Kote ER (2107), a new one-part epoxy acrylate conformal coating that cures within 15 to 90 seconds under ultraviolet light.

This clear, non-volatile coating offers the rapid cure of acrylic-based coatings, while providing the superior durability of two-part epoxy systems. The products's toughness and high resistance to solvents make it useful for harsh environments.

Because the coating is 100 percent active and contains no solvents, extremely low amounts of volatile organic emissions (VOCs) are released during curing.

The non-conductive coating can be used to protect printed circuit boards, thick film circuits, electrical components, transformer coils and motor starters and field coils.

Circle (61) on Reply Card

Test your electronics knowledge

Answers to the quiz
(from page 63)

1. C. Bandwidth is the range of frequencies between the half-power points. It is also the range of frequencies between the points where the voltage or current response curve drops to 70.7% of maximum.

2. B. There are now many operational amplifiers that are designed for single-polarity power supplies. Also, a floating single-polarity supply can be used to operate an op amp that requires a positive and negative supply voltage.

3. The answer is 97. Divide the number into groups of four digits like this: 1001 0111. Then, write the decimal equivalent of each group.

4. B. The component is called a ferrite bead. It is donut-shaped and the wire is threaded through the hole.

5. If two measurements are each made to four significant figures their product can only be accurately expressed with four significant figures. As another example, ask a student with a new calculator to find the parallel resistance of a 47-ohm and a 68-ohm resistor. It is not unusual to get an answer like 27.791304 ohms.

6. A. MOVs are connected across the power lines.

7. fan out. (By definition.)

8. You don't. There is no Roman numeral for zero.

9. B. A coating on the resistive element makes the measurement possible.

10. A. There is no voltage gain in a passive bridge circuit. ■

Readers Exchange

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

The following restrictions apply to Reader's Exchange:

- Only individual readers may use 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 messsage is in paid advertisement, 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

WANTED

High voltage rectifier, Quasar PN: 1M 39000A3 type #ECX80085B and video heads for sharp VCR 7864U. Used is OK. *142 Jackson St., Philadelphia, PA 19148, 215-389-1147.*

Samsung CRT or equivalent part # 2701B22-ST-TC04 for Starlite TV Model CTV-10, or info. on above. *403-645-3783 after 6:00 p.m. MST. Ask for Paul.*

Schematic for Diehl Mark V Scanner. *Mike Roberge, 66 Thrush Dr., Milton, VT 05468, 802-893-6765.*

GE Flyback EP77x57 and GE Flyback EP 77x48. *Dave Hlas, 801-259-7576, 1179 Red Sands Rd., Moab, UT, 84532.*

Good used 5" color pix tube 140 BY B22. *Call collect at 316-431-1759. Larry Kuehl, RR2, Box 235, Chanute, KS 66720.*

Oscilloscope 60MHz—100MHz frequency response. Inductance meter, Sencore LC75 or LC101 or any other test equipment for VCR & TV servicing. *Andy Bagatta, 914-236-4773 or PO box 1036, Marlboro, NY 12542.*

Service manual or schemtaic to buy or borrow for Hitachi D980M cassette deck. *Richard Sereda, Canada college A.V., 4200 Farm Hill, Redwood City, CA 94061.*

FCR recorder unit. Half of the Panasonic PV5000 omnivision in good condition, or, non-working recorder unit for parts. *Call Jackson VCR, 205-643-5906.*

A good, used CRT 512OB22 JUG. A schematic for a 25" GE tuner, EM-O chassis. An assist in regard to a Tenma 20MHz oscilloscope 72-320. Print we have shows no voltages, very obscure in detail. *D.J. Aijala, 50 Fir Circle, Babbitt, MN 55706.*

NEC Red CRT #C7M130P22R NEC P/N 95H52231 used in model PJ-4660S(B) projection television and telephone line simulator. Teletone TLS-3 or 4, B&K or Elec. Design Teletester II or III. *LMS Electronics, 11241 Northwest Seventh Street, Coral Springs, FL 33071.*

A schematic, operation manual & cartridge for a Maestro Echoplex, solid state. It was made by Market Electronics. *A.R. Vickery, The Music Shop, 548 Main Street, Torrington, CT, 06790-3796.*

Schematic for Silvertone Model - F- 31778. Audio output Xfmr and speaker for Zephyr model RN-7 radio. *John Phipps, 1412 Navaho Trail. St. Charles, MO, 63304.*

Flyback for Sharp TV, Part No. Z40 27 2105. Also, flyback for Sylvania TV. Chassis No. 31-52. *Write: 4366 Eastport Pl., Bridgeport, MI 48722.*

FOR SALE

We have parted out many TV older chassis; yokes, flys, modules. Many chassis intact, such as Sony, Admiral, Sylvania, RCA, Zenith. Something for most models. All guaranteed, solid state parts. *D.J. Aijala, 50 Fir Cir., Babbitt, MN, 55706.*

Sencore SCR250 and Trace tester accessory. Brand new. Orig. price, $168.00; now selling for $90.00. Also, a SCR70 Beam builder picture tube rejuvenator universal CTR analyzer and restorer. Brand new. Orig. price, $1295.00; now for $950.00. *Floyd Savage, 406-563-5913 (days) or 406-563-3056 (eves.).*

B&K oscilloscope model 1450 modified with sawtooth waveform output for ringing yokes. 165 new electron tubes with substitution handbook. Make offer. *Bing Huie, P.O. Box 2634, Alameda, CA 94501, 510-523-9087.*

Sencore VC-93 VCR analyzer 1 yr. old. Hardly used. *403-645-3783. After 6:00 PM MST. Ask for Paul.*

VA62, VC63, NT64, $2000.00, used only once. Also, an SG165, am/fm analyzer, $750.00 and an SC61 for $2000.00. All excellent cond. *Call John, 201-432-7635.*

Diehl Mark III scanner, make offer. GE HVXFMRS, 1-EP77x44, 1-EP77x55, make offer. *Elmer Wieland, 237 Talbot Dr., Bedford, OH 44146, 216-232-8653.*

SAMs photofacts 1676-2725 complete plus 275 more before 1676; mostly above 1000. Also, SAMs modular Hi Fi series MHF 84-230 complete. Will include 4-4 drawer steel file cabinets with best offer. *Ken Goetsch, 12698 Shorewood Dr., S.W., Seattle, WA, 98146, 206-241-0507.*

Tentel: 4 gauges & stand; Sencore: PR57, LC76, LC53, VA62 plus VC63, SG165, VA48; Tektronix: 2215, 932 scopes; and lots more. Most brand new. *Steve, Somerville, NJ, 908-725-1200.*

Beckman #360 DMM $100.00. BK Precision #1601 dc. pwr. supply. Best offer. *John, 142 Jackson St., Philadelphia, PA 19148, 215-389-1147.*

Riders Vol. 9-16 Sams Photofacts, 1-1079, Auto radio series 19-171. *Write Jay's TV, 15 West Lake St., Chisholm, MN 55719, 1-218-254-4421.*

Three Zenith Z-248 computers w/2Mb, mono, 20Mb HD, 360K FD $1800.00. Novell 2.2 5 user $900.00 & 2.0A 100 user $???. Great Plains accounting software $2000.00. Package $4500.00. *816-665-1390.* ■

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 forclassified advertising by the word. Contact Emily Kreutz at 516-681-2922 to place your classified ad (by-the-word). Mastercard, VISA, American Express are accepted for phone or mail orders. Or send your order, materials and payment to **Emily Kreutz, 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.

FOR SALE

VCR AND TV SERVICERS ** Make those hard repair jobs easy with our up to date symcure information ** 1800 item VCR symcure file and 1200 item TV tough dog symcure file available on IBM compatible disk and print out. VCR disk w/po $85.00 print out only $45.00. TV/dog, disk w/po $85.00 print out only $45.00. VCR Tune Up Center, 2610 Bay Road, Redwood City, CA 94063. MC/VISA accepted on phone orders 1-(800)-777-7883

TELEPHONE LINE SIMULATORS: An absolute must for every repair shop. Two stamps for details. JECTECH, 13962 Olde Post, Pickerington, OH 43147.

VCR 93: made by Sencore all format VCR analyzer, $1,999, all accessories included. 6 months old. Must sell. During day call 603-465-2966, evening 603-880-0174-Nashua, NH.

ZENITH 9-516/517 MODULE CURE: Repair easily yourself and save! For instructions send $15.00. TEK ENTERPRISES, 702 Overland Avenue, Wilmington, Delaware 19804

VHS-VCR Repair Solution Sets I, II, III IV, V, VI, VII. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each, all seven $69.95. Schematics available. Visa/MC. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530.

THE ONLY ANSWER TO REPAIRING ELECTRONICS PROFITABLY (this should have been done years ago) **GET SMART!** Someone somewhere has already repaired your next repair **YOUR TOP TECHNICIAN,** who's training you have paid for **JUST LEFT TODAY! YOU'RE THE BOSS** and now you have to put on your old rusty technician's cap. **TODAY YOUR BANK** sent you three NSF checks your customers so graciously gave you, and you don't have time to chase them down to collect. **THEY LEFT TOWN. IT'S TAKING YOU LONGER** to assess the repairs and your customers are now coming to collect their units. You promised to give them a **FREE** estimate, but you just realized you don't have a schematic or time to do it. **NOW YOU ARE DOING NIGHT REPAIRS** because during store hours the phone rings off the hook with nuisance questions about setting VCR clocks and you have parts to order, bills to pay and service literature to file. **CIRCUIT CITY JUST MOVED IN** and your wife say's there's no money in repairs **FRIEND!! YOU DEFINITELY HAVE AN EMERGENCY!!** Program start up of 10,000 repairs occurring today through out the world with our annual updates of an additional 2,000 tips 1987 thru March 1993. **I CAN ASSURE YOU THESE TECH-TIPS ARE NOT DUSTY OLD REPAIRS YOU'LL NEVER SEE.** Other programs don't even come close to comparing. **CALL NOW (305) 474-2677 FOR A "FREE" DEMONSTRATION DISK OR PAPER FORMAT** or mail request to **TV-MAN SALES & SERVICE, 8614 SR-84 , FT. LAUDERDALE, FL 33324**

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5 1/4" IBM compatible disks, 1,000 VCR, Printout $83, Disks $72. 5,400 TV, Printout $135, Disks $113 (Harddrive). Add to or quick scan by chassis, model and stage. Two solutions pays for it. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903.

LARGEST SELECTION of original TV & VCR IC's and transistors. Lowest Prices. Call or write for free catalog. **PRELCO ELECTRONICS,** 605 Chestnut Street, Union, NJ 07083, 908-851-8600.

REDUCED 85%. Diehl Mark 111 $69, Diehl Mark V Horizontal circuit tester $179. New. Conductive coating for remote control keypads $9.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629, 608-233-9741.

ATTENTION CONSUMER ELECTRONICS TECHNICIANS! "The Dog Catcher" is a new program which gives instant access to the largest repair tips from a network of America's finest technicians. Monthly updates, and your own tips can be added to the database of VCR, Camcorder, TV and Stereo repairs. Take advantage of the Introductory price now! $99.95 DataBasic 1-800-967-5924.

TV-VCR SHOPS: Now fix those tough dogs! A package of over 2800 fixes on disk. ASCII or data for popular data bases. (PFS, QA, etc.) One fix could pay for all. Only $99.95. TECH-DAT, 212 Earth Row, Waynesville, MO 65583. To order call 1-800-280-2100. VISA & Mastercard Accepted.

TV CASE HISTORIES: Booklet with 1,750+ histories. Satisfaction assured. Only $35 (first-class shipping add $1.50). Mike's Repair Service, P.O. Box 217 Aberdeen Proving Ground, MD 21005. Same mailing address 29 years. Send SASE for samples

BUSINESS OPPORTUNITIES

ESTABLISHED SERVICE SHOP, good reputation, great potential. Will sell all or possibly partner with the right person. Central WV 304-269-7850

MOVE TO SUNNY SOUTH FLORIDA: Owner retiring. Fully staffed in largest growth area of Ft. Lauderdale. Established 12 years, no competition. Authorized 15 major brands. 100 percent computerized. Simple to operate business. Owner financing available. Call for details 305-474-3588.

BUILDING and 22 year consumer electronics retail national franchise business in New Mexico near lake. Principals only. Contact Whittington, Box 932, Williamsburg, NM 87932.

WANTED

WANTED: Service manuals for the following EUMIG equipment; FL-1000 cassette deck, T-1000 FM tuner, C-100 preamp, M-1000 power amp. Call Jon Kummer 516-681-2922

Manufacturers Parts and Literature Directory

This monthly section is sponsored by manufacturers to help you find the parts and technical literature needed to service their equipment. Call them for replacement parts or for the name of their nearest distibutor.

Hitachi Home Electronics 401 W. Artesia Blvd. Compton, CA 90220 800-HITACHI	**Mitsubishi Electronics America** 5757 Plaza Drive Cypress, CA 90630 800-553-7278 fax 800-825-6655	**NEC Tehcnologies** 1255 Michael Drive Wood Dale, IL 60191 800-366-3632
Panasonic 50 Meadowlands Parkway Secaucus, NJ 07094 800 545-2672	**Philips ECG** 1025 Westminister Drive Williamsport, PA 17701 800-526-9354 fax 800-346-6621	**Quasar** 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672
Technics 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672	**Thomson Consumer Electronics** 2000 Clements Bridge Road Deptford, NJ 08096 800-257-7946 fax 800-524-1498	**Zenith Electronics Corp.** 1900 N. Austin Avenue Chicago, IL 60634 312-745-2000

Call Jonathan Kummer at 516-681-2922 to reserve space in this special section.

Advertiser's Index

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Dalbani Corporation Of America	53	4	800/325-2264
Den-On Instruments	8	5	800/397-5960
East Coast Transistor Parts	42	6	800/645-3516
Electronix, Inc.	46	7	800/223-3205
Fluke Manufacturing, John	BC	57	800/87FLUKE
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Goldstar Precision	15	9	213/404-0101
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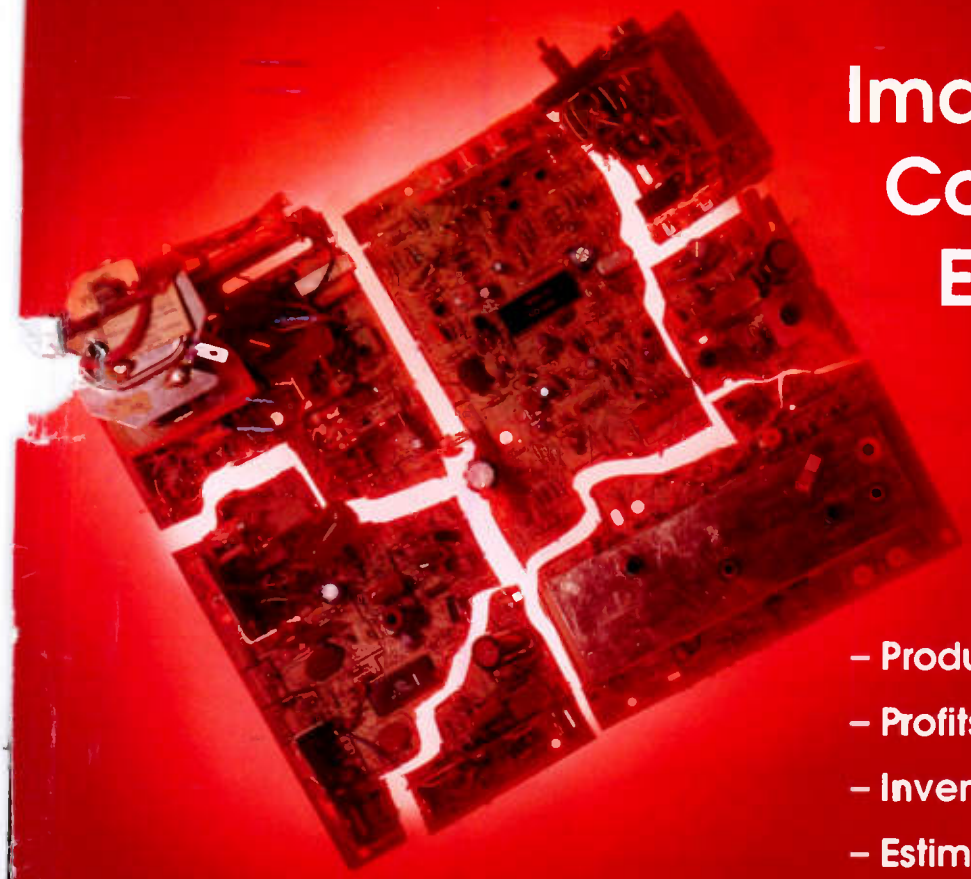
Technics	67		800/545-2672
Tentel	60	31	800/538-6894
Thomson Consumer Electronics	67		800/257-7964
Zenith Electronic Corporation	67		312/745-2000

We'd like to see your company listed here too. Contact Jonathan C. Kummer at 516/681-2922 to work out an advertising program tailored to suit your needs.



Imagine If You Could Divide Every TV Into Its Functional Blocks!

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Physically cutting the TV chassis into the functional blocks isn't practical, but there is a way you can electrically isolate them. There's a way that will help you determine defects by simply watching the CRT. And there's a way to isolate horizontal circuit (startup/shutdown) faults without risking damage to replacement components – or your price.

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If you're looking for the only complete TV Analyzer to help build your TV servicing business – reserve your new TVA92 TV Video Analyzer today. Act now and lock-in special limited introductory pricing. (New video demonstration tape available upon request.)

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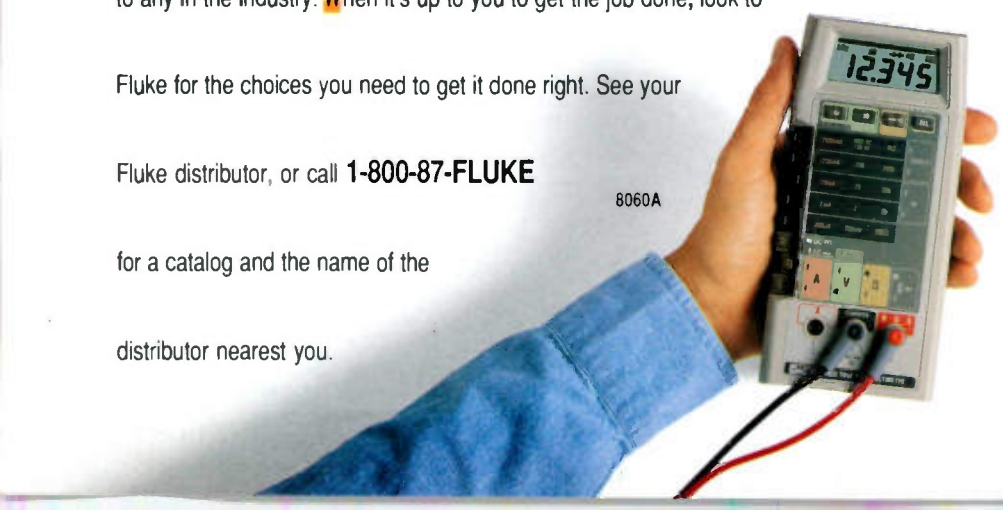

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