THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
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June 1995

Video heads and related circuits

Setting up a test bench

Test equipment update: Clean up and repair that test equipment

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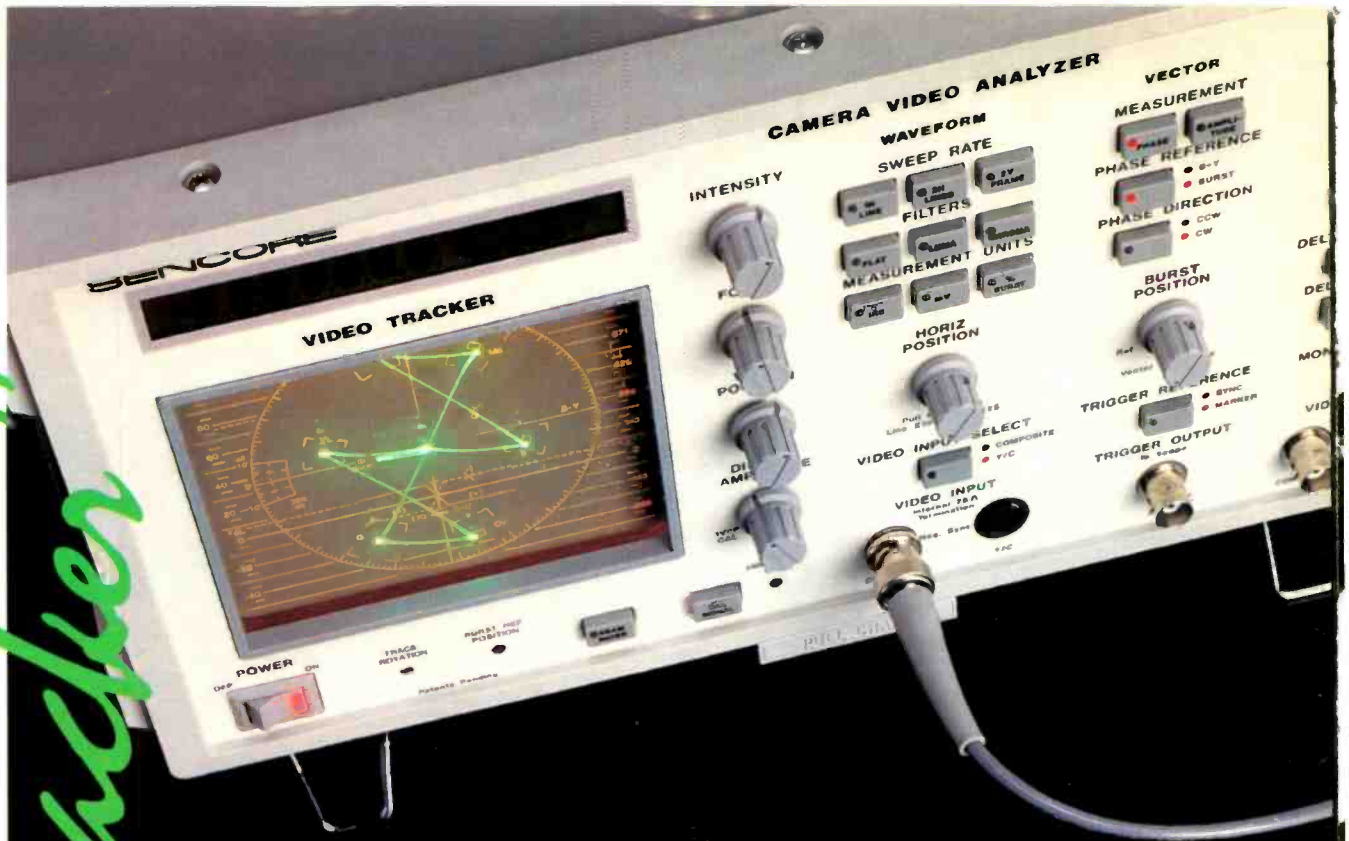

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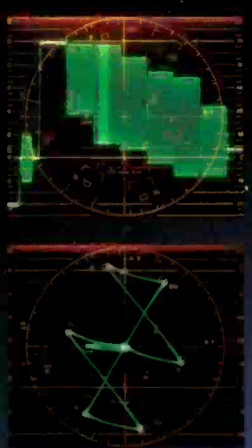

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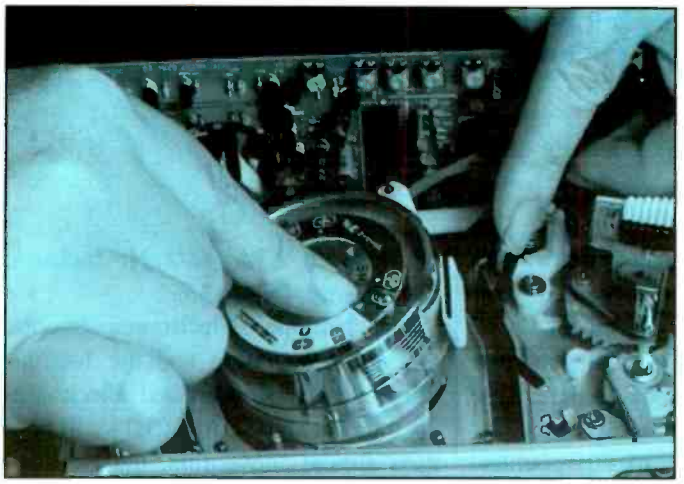

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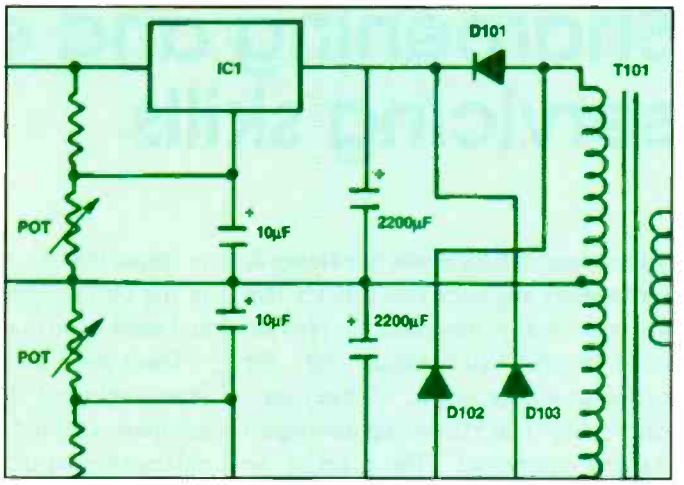

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FEATURES

DEPARTMENTS

ON THE COVER

Test equipment manufacturers provide service technicians with modern sophisticated products to make diagnosing problems in consumer electronics easier, faster and more accurate. But even the best piece of test equipment needs some attention now and again to keep it looking and working like new. (Photo courtesy of Sencore)

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
ELECTRONIC
Servicing & Technology

Sharpening and enhancing servicing skills

This issue of **Electronic Servicing & Technology** includes two articles that are specifically designed to provide some useful information on the test/diagnostic process: "Setting up a test bench," and "Clean up and repair that test equipment." The point of the two articles taken together is that the technician's bench position is the place where the work is done, and it is that work that brings in the money to the service center. Because of this, attention should be paid so that the bench position is efficient, and that valuable test equipment is occasionally treated to some degree of maintenance.

Not discussed in the articles is the importance of the training and skills of the individual who will be making judgments, and taking corrective actions as a result of his interpretation of the readings that the test instruments give him: the technician.

Of course, we all recognize that the best test equipment is useless without a human mind to determine what points in the circuits of the product should be probed, and to interpret the data that the instruments display. But do we sometimes forget that information in that mind can decay over time, just as the circuits in the test instrument. And just as important, advances in the technology in the test equipment calls for advances in the skill of the technician using it.

Honing the skills

Some of the most successful service centers involved in consumer electronics servicing do in fact appreciate the importance of keeping the mind of the technician as sharp as the technology embodied in the latest test equipment, but it's easy to become complacent and to forget that the skills and knowledge of the best technicians were hard won and need to be constantly honed.

There are a number of ways to keep those technical skills up to date. Test equipment manufacturers offer technical training in places across the country. Many of these manufacturers also offer books, pamphlets and video tapes with detailed instructions on understanding and using their test equipment.

Many technical book publishers offer books that describe in detail some of the new technology offered in the latest test equipment and provide instructions and suggestions on getting the most out of them.

Conventions offer skills building opportunities

Some associations also provide training seminars that help service managers and technicians hone their skills. Two groups will be holding meetings at which technical training will be offered to interested parties.

In July, the Electronics Technicians Association, International (ETA) will hold its 1995 conference in Philadelphia July 20, 21 and 22. The location of this event, called "Building America's Concourse - East," is the Philadelphia Wireless Technical School, 1533 Pine Street, in Philadelphia. Headquarters hotel for the event is the Holiday Inn Midtown at 13th and Walnut.

Several classes that will provide college credit to participants are a Satellite, Antenna and MATV (SAM) school, Business Management School (BMS), and Electronics Technician (ET) Classes. Anyone interested may receive more detailed information by calling 317-653-4301, or by faxing an information request to 317- 653-8262, or write to ETA, 602 N. Jackson, Greencastle, IN 46135.

The National Electronics Service Dealers Association and the International Society of Certified Electronics Technicians (NESDA/ISCET) will hold their annual convention, the National Professional Electronics Convention and Trade Show, at the Hyatt Regency, Crystal City, Arlington, VA, from July 31 through August 5, 1995.

The events that will take place in conjunction with this conference are management seminars, technical seminars, dealer/manufacturer meetings, an instructors conference and more.

For further information on NPEC, call 817-921-9061, or fax at 817-921-3741, or write to NPEC, 2708 W. Berry St., Fort Worth, TX 76109.

You will be welcome

Some readers who are not members of one of these groups have expressed the concern that they might not be welcome at one of these meetings. Both of these groups have made it very clear that they welcome anyone associated in any way with electronics servicing to attend these events.

I have personally attended many of the conventions of these organizations and have found the members to be uncommonly friendly, outgoing and welcoming to anyone who cares to associate with them. So if you're looking for a way to sharpen up some of your skills, and you're going to be in the Middle Atlantic region this summer, it would be to your advantage to take in one or both of these events.

Nils Conrad Person

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

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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CQ Publications featured in GEnie electronic magazine.

CQ Communications, Inc. is in the "Vendor Spotlight" in the premiere issue of the GEnie Radio & Electronics Roundtable's online magazine. All of CQ's magazines are featured, including *CQ The Radio Amateur's Journal, Popular Communications, Communications Quarterly, Electronic Servicing & Technology and MicroComputer Journal.*

The online magazine is "downloaded," or copied electronically, from GEnie to the user's home computer and is then viewed on the computer screen. It is not designed to be printed on paper. Features include ham radio news reprinted from the "ARRL Letter" and a text version of "Newsline," plus articles and a monthly "Vendor Spotlight."

Readers accessing the "Vendor Spotlight" in the premiere issue will see the CQ logo and a variety of buttons on their screen. There is one button for each magazine plus one labled "About CQ Communications, Inc." and another titled "Free Offer." Selecting any of the magazine buttons brings up a screen containing a brief description of the publication, along with subscription information. Likewise, "About CQ Communications" provides an overview of the company; and the "Free Offer" button provides details of the automated system by which GEnie users may request sample copies of *CQ* and *Popular Communications.*

Responding to the tremendous growth of online services and their growing popularity among the readers of its magazines, CQ Communications has established feedback areas and other reader services on GEnie and America Online. CQ staffers are also active informally on CompuServe and the Internet.

EIA/CEG endorses legislation ensuring consumer electronic products competition

The Electronic Industries Association/ Consumer Electronics Group's (EIA CEG) Board of Directors endorsed the passage of federal legislation to ensure competitive availability of consumer electronics products. In order to avoid a '90's version of the black phone in every home, steps must be taken now which will let consumers purchase their home equipment from the vendor of their choice. With this goal in mind, Rep. Thomas J Bliley (R-VA and Chairman of the House's Commerce Committee) and Rep Edward J. Markey (D- MA) introduced HR1275 on March 16, 1995, which directs the Federal Communications Commission (FCC) to adopt regulations that assure the competitive availability of converter boxes, interactive communications devices and other consumer premises equipment from manufacturers, retailers and other vendors not affiliated with any telecommunications system operator.

"With proprietary equipment from network and service providers controlling access to telecommunications networks, consumers would not have the options available to them which now can be found in the telecommunications marketplace," said Gary J. Shapiro, group vice president of EIA's Consumer Electronics Group. "Competitive availability of consumer electronics products will allow 'plug and play' by consumers wishing to access the grand array of new communications, information and entertainment services to be delivered over the developing information highway."

"For years, consumers could not choose their own telephones," added Shapiro. "Once the Bell monopoly on telephones was lifted, manufacturers entered the market and gave us higher quality, more feature-rich and more affordable telephones and telephone-related products such as fax machines, answering machines and computer accessories. This same type of monopoly could be propagated in the cable, satellite, fiber optic and other industries which will make up parts of the growing National Information Infrastructure (NII)."

A competitive retail market for access devices will mean new features, better quality and lower prices for consumers. With hardware built into products or available separately in boxes at retail, capital would be freed for the service provider to invest in extending and improving service networks and programming. Once legislative language similar to HR-1275 is adopted, consumer electronics manufacturers will be able to drive technological innovations and spur development of new products and features.

EIA is the 71-year-old trade association representing the electronics industry. EIA's Consumer Electronics Group represents U. S. manufacturers of products such as audio, video, home office and home automation products, mobile electronics, multimedia and accessories.

Public awareness of RBDS increasing

Public awareness of the Radio Broadcast Data System has grown from 10 percent of adult consumers to 16 percent in the last 12 months, according to a survey commissioned by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG). When asked if they would like to own RBDS audio equipment, 20 percent said they were very interested, compared with 18 percent in 1994. Of those expressing interest in owning RBDS, 22 percent said they would like to purchase it as an option on a new car. Twenty percent would like to own it as part of their home systems.

"Clearly, more consumers are becoming aware of RBDS and its benefits," said Gary Shapiro, group vice president of EIA's Consumer Electronics Group. "As awareness increases, interest in RBDS features, and in ownership increases. They remember what they've seen and read, and the result is that RBDS popularity is on the upswing."

Overall consumer interest in specific RBDS features also rose from a previous survey. According to the survey, what the RBDS features respondents want most are station call letters, station format and advertising to be displayed on their equipment. Some RBDS features saw large increases in interest, including station call letter and format display, as well as built-in messaging and paging.

Local stations are first in U.S. to participate in EIA campaign

The Electronic Industries Association's Consumer Electronics Group (EIA/ CEG) announces that Philadelphia stations WUSL, WIOQ, WWDB, WMGK and WXTU have agreed to broadcast RBDS as part of a national campaign to equip 500 FM radio stations with RBDS. All the stations are expected to begin broadcasts by May 15. The addition of these stations using RBDS would bring to 14 the total

number of RBDS stations serving the Philadelphia metro area. In addition, a number of additional Philadelphia FM radio stations are expected to jump on this bandwagon.

"It's important to be announcing these developments the day we publicly kick off the RBDS campaign," said Gary J. Shapiro, group vice president of EIA/CEG. "We're serious about popularizing RBDS and making it available to the public, and this is the best way to prove it."

Of the five stations committed to adding RBDS systems to date, WUSL, on frequency 98.9, plays urban contemporary, and WIOQ, located at 102.1, plays urban contemporary music. WWDB, at 96.5 on the dial, is Philadelphia's most popular talk station and WMGK, 102.9, plays '70s oldies and WXRU, at 92.5, is a country music station. Currently stations WPLY, WFLN, WHYY, WMMR, WRII and WXPN broadcast RBDS.

Combined, the five stations have 23.5 percent marketshare of the Philadelphia radio audience, based on Aribtron figures. These stations, with the six that previously added RBDS, will raise RBDS broadcast market penetration in Philadelphia to 36.3 percent.

"In exchange for the equipment provided by the EIA, the stations will air ads or announcements to educate listeners about RBDS and promote the use of RBDS radios," said Shapiro. The ads will air once the RBDS systems are up and running at the stations. RBDS is an exciting and important new technology not only for consumers but for FM broadcasters as well. RBDS allows for a conventional FM radio broadcast to carry digital data "piggy- back" on an inaudible subcarrier. These computer style bits and bytes of information offer a vast potential of practical benefits for both listeners and broadcasters.

EIA to enter 25 largest markets introducing RBDS technology

After launching a national program in Philadelphia to equip 500 FM radio stations in the nation's 25 largest metropolitan areas with the Radio Broadcast Data System (RBDS), the Electronic Industries Association's Consumer Electronics Group (EIA/CEG) announced that it

(Continued on page 69)

Troubleshooting video head problems

By Jurgen Ewert

All home video recording systems made today function the same way, and the basic signal flow of these systems is very similar. During the recording process, the luminance and the sync signals are converted into an FM signal. It is not practical to record the video signal, with its frequency bandwidth that ranges from 60Hz to 4.2MHz, directly on magnetic tape. The color signal is separated from the video signal, and converted down to a frequency band below the FM signal and then it is superimposed on the FM signal. Figure 1 shows the spectrum of the recording signals in a video recorder.

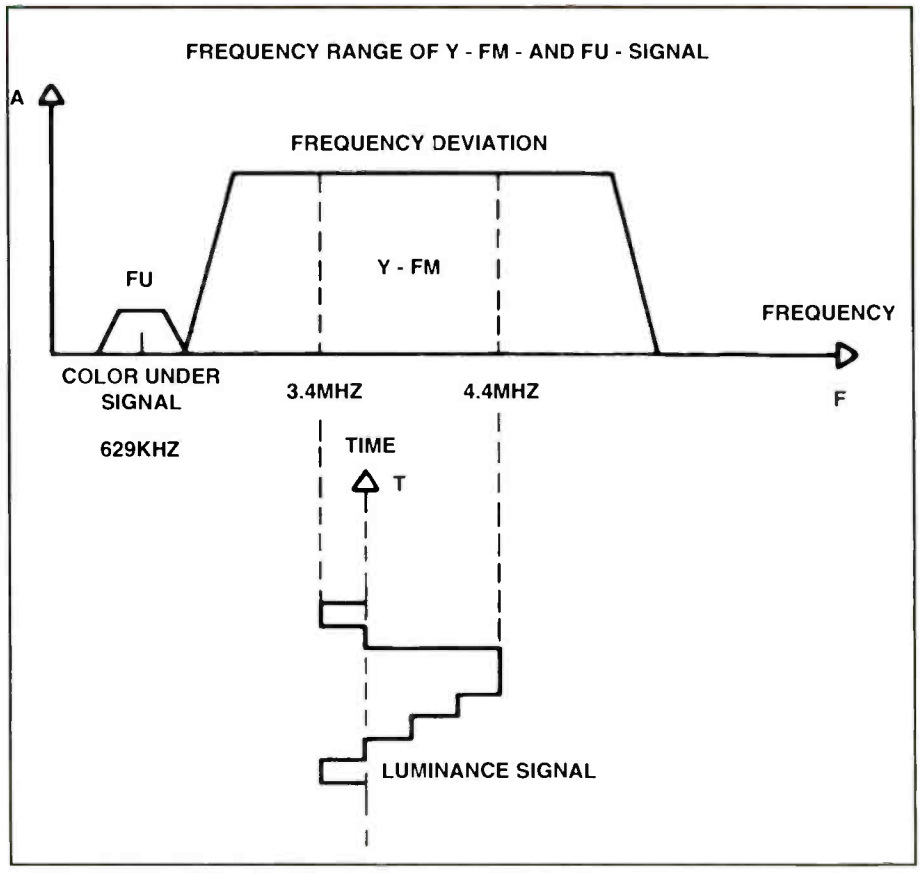


Figure 1. Spectrum of the recording signal

Recording the video signal

A basic block diagram of the video signal flow in a VCR is shown in Figure 2. The video signal is fed into the recording section, where it is split into luminance and chrominance components. To avoid interference between the luminance signal and the FM recording signal, the bandwidth of the luminance signal is limited to about 3MHz and the carrier frequency for the FM is placed above the luminance frequencies. Since the highest frequency of the luminance signal after the low pass filter (Y-LP) is about 3MHz, there is no color signal left in this signal. Then, the luminance signal is put through a pre-emphasis circuit (PEEM) and a white limiter. The pre-emphasis enhances the higher frequencies of the luminance signal to provide a better overall signal-to-noise ratio. The white limiter (WH-L) limits (clips) the amplitude of the luminance signal to avoid overloading of the frequency modulator (FM-M).

The chrominance signal is separated in a bandpass or a comb filter (C-BP) and downconverted (C-C) into the color under signal. A low pass filter (C-LP) removes unwanted frequencies from the converted signal. Both signals are mixed back together and fed through the recording amp, record/playback switch (R/P SW) and the rotating transformer into the video heads.

The FM signal operates for the color under signal the way the bias signal does in magnetic audio recorders. This is beneficial because of the quadrature modulation that is used for the chrominance component. This type of modulation makes it necessary to record the amplitude values of the color signal. To avoid visible interference caused by the color under signal, its frequencies were carefully chosen. The amplitude of the color under component that is added to the FM signal is only about 10% of the total amplitude.

Playback of the video signal

In playback mode, the mixture of the luminance, FM, and color under signals passes from the video heads via the rotating transformer and record/playback switch into the inputs of the head amps. There is one head amp for each head (HA-A and HA-B). The head switch (H-SW) connects the head amp output of the head that is in contact with the tape to the playback circuits. A high pass filter, (L-HP) filters out the luminance FM signal.

Drop outs in the playback signal are replaced by a stored replacement signal in a dropout compensator (DOC) to prevent noise getting into the playback picture. The frequency demodulator (FM-D) demodulates the FM signal. The original luminance signal is present at the output of the de-emphasis circuit.

The color under signal is separated from the FM signal in a low pass filter (CULP). Then it is converted back to the

Ewert is an independent consumer electronics servicing technician.

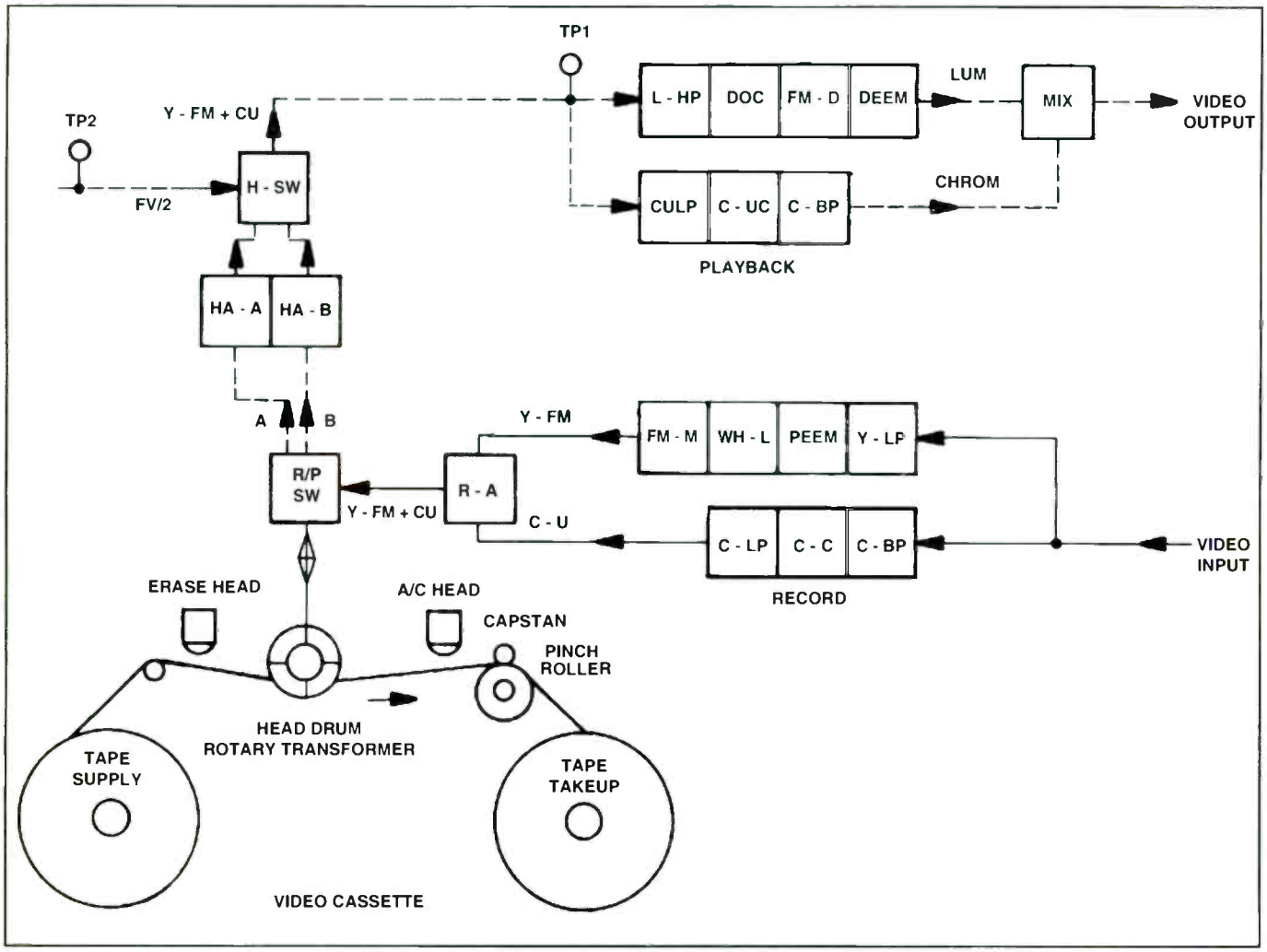


Figure 2. Video block diagram

original frequency band (C-UC). The chrominance signal passes through a band pass filter, (C-BP) into a mixer where it is combined with the luminance signal into a complete color video signal.

Home video recorders use two video heads on a rotating drum to record, and playback the mix of luminance FM and color under signal. The advantage of two head systems is the possibility of simpler tape loading mechanisms. In some VCRs, four video heads are used to provide opti-

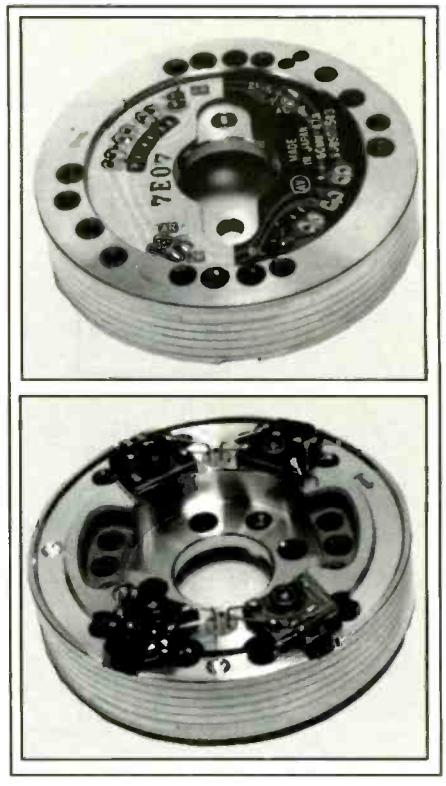


Figure 3. Head drum with four video heads

mal conditions for the different tape speeds. (Figure 3)

Troubleshooting video head related problems

The video heads, and the tape-head system, are the weakest parts of the video signal path. The video heads in a VCR are subject to wear and tear because the relative velocity between tape and heads is quite high.

To get a good transfer of the magnetic field between the tape and the heads, the tape-head contact needs to be very close. The gap of the video heads is accurately designed for the frequencies that are used in the specific video recording system.

The playback signal that is generated by the video heads is in the microvolt range. If the head gap changes greatly because of head wear, the amplitude of the playback signal will be much less. If the amplitude of the playback signal is low, the FM demodulator at the end of the playback circuitry will put out noise.

Video head and tape-head contact related problems always appear in the playback picture as snow; that is the noise produced by the head amplifier and the FM demodulator. So if there is no picture and no noise the problem is not the heads. This does not apply to VCRs with video mute

circuits. These circuits, often found in VCRs with on screen display (OSD), usually place a blue screen on the TV picture tube if the playback signal is missing or noisy.

Clean the heads first

Before checking the playback signal at the output of the head amplifier, it is usually a good approach to clean the video heads. This work should be done carefully because it is easy to break the tip of a video head. The heads are made out of ferrite (a ceramic material) and the tips of the heads are very thin.

It is very important never to move the cleaning tool in a vertical direction. To avoid any vertical movement between cleaning tool and head tip it is best to push and hold a lint-free chamois, dampened with alcohol or a cleaning fluid, to the upper drum assembly. Then, rotate the upper drum by hand so that the heads touch the chamois. I have used a number of different cleaning tools and had very good results with the one shown in Figure 4. After cleaning the heads it is important to clean the capstan, pinch roller, and the other parts of the tape path.

The use of cleaning tapes is often not enough. These tapes are good for a cleaning at the VCR user's home. VCRs with automatic head cleaning provide a similar cleaning action after each stop of the tape. In 90 to 95 percent of all cases, cleaning the heads solves the problem. It does not take much grime to block the flow of the magnetic field to the heads. If the problem is not solved after the first cleaning, perform the head-cleaning procedure again. It happened to me a few times, that the dirt on the heads was so sticky that I needed to clean the heads twice. Sometimes you can see a little improvement in the picture after each cleaning.

VIDEO TRACK WIDTH	58 µm
AZIMUTH	+/- 6 deg
HEAD DRUM DIAMETER	62 mm
RELATIVE HEAD/TAPE VELOCITY	5.8 m/s
TAPE SPEED	
SP	1-5/16ips (33.35 mm/s)
LP	21/32 ips (16.67 mm/s)
EP	7/16 ips (11.12 mm/s)
ROTATION OF HEAD DRUM	30rps
FM DEVIATION	3.4MHz to 4.4 Mhz
COLOR UNDER CARRIER	629kHz

Table 1. Technical data for the VHS system (NTSC)

If cleaning does not solve the problem

If you have carefully cleaned the heads and there is still noise in the picture, then the problem could be caused by the video heads or the tape path. Usually, you can determine whether the cause is the tape path or a head related problem by watching the picture on the screen. If the picture shows horizontal stripes with noise, check the tape path for problems. Horizontal noise stripes occur if the heads cannot scan the whole video track.

Sometimes the heads cross a few tracks or just get out of the track. Check the tracking control first. Some people forget to reset the tracking control after watching a bad rental tape. If the tracking control knob is set to the center position, watch how the tape runs through the machine. Sometimes, the guide posts are loose or the tape slips through pinch roller and capstan. It is very important to try playing several different tapes when troubleshooting these problems.

A bad video cassette can cause these symptoms. If there is something wrong with the heads, the picture shows noise from top to the bottom. In most cases, the picture is still visible but there is a haze of snow (Figure 5). If you see a picture like this, put the probe of the oscilloscope on the output of the head amps (TP1 in Figure 2). You will probably see an image like the one shown in Figure 6.

Connect one channel of the oscilloscope to the 30Hz head-switching signal to synchronize the oscilloscope. This way you will get a steady image on the screen of your oscilloscope. Typically, all the heads in a VCR do not wear out at exactly at the same time. So one of the head signals is mostly still present. It is not possible to check the head signals directly at the heads with the test equipment available in an average service center. There-

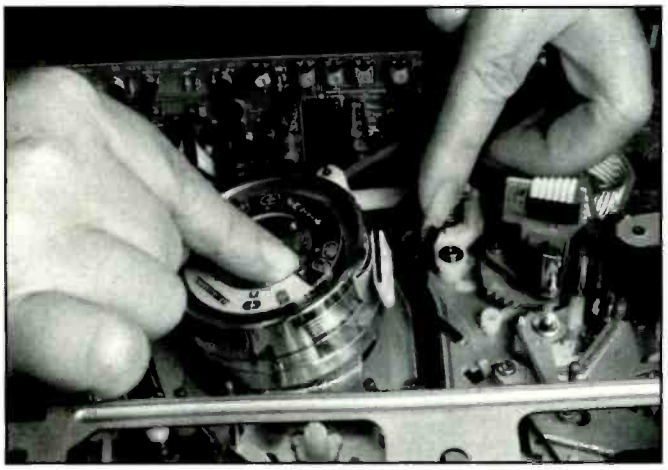


Figure 4. Cleaning the video heads

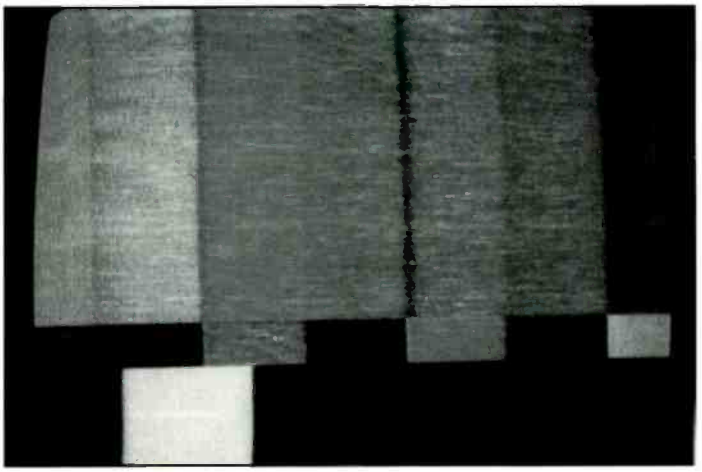


Figure 5. Playback picture with one bad video head

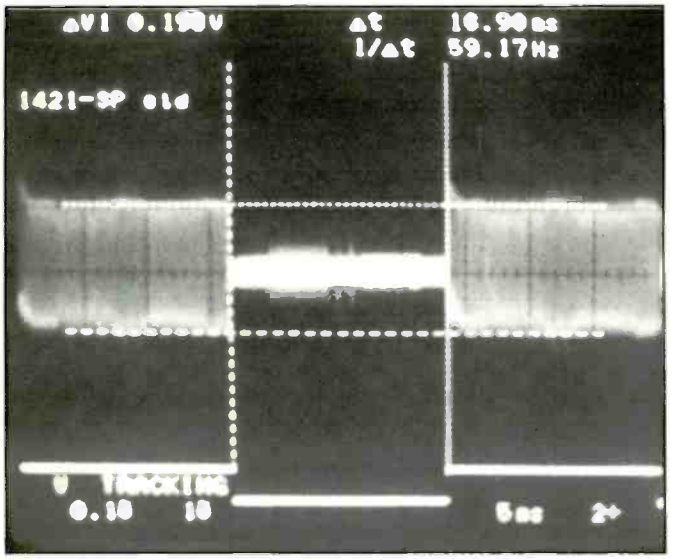


Figure 6a. Head amp output signal in SP (bad head)

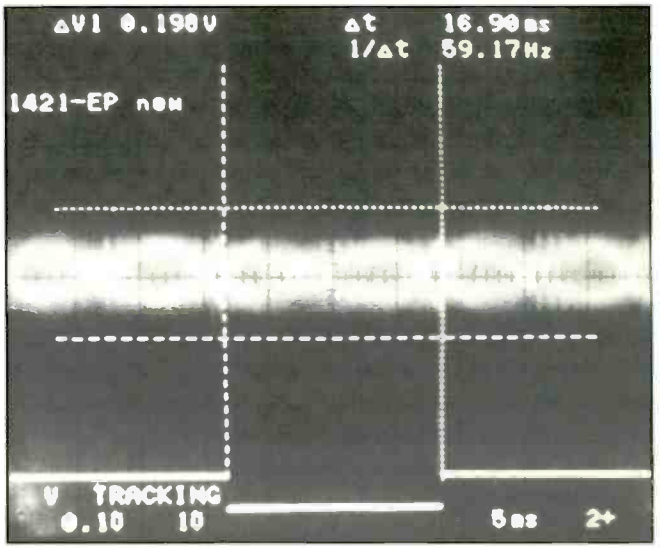


Figure 8a. Head amp output (EP) with new drum-tracking adjustment in center position

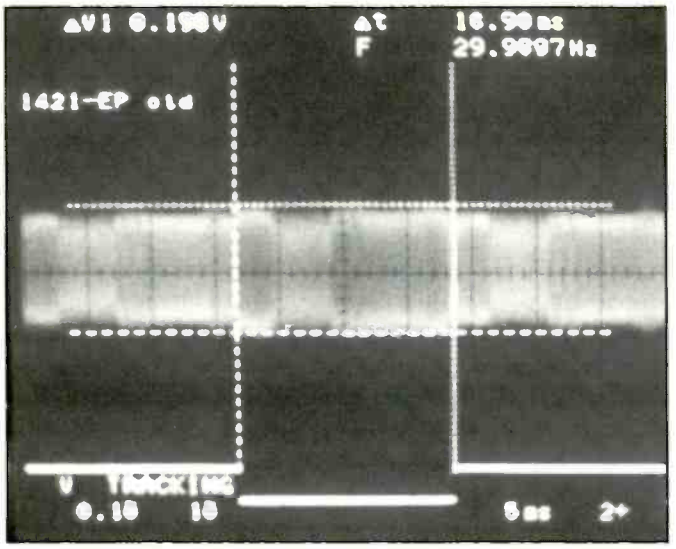


Figure 6b. Head amp signal in EP (both heads good)

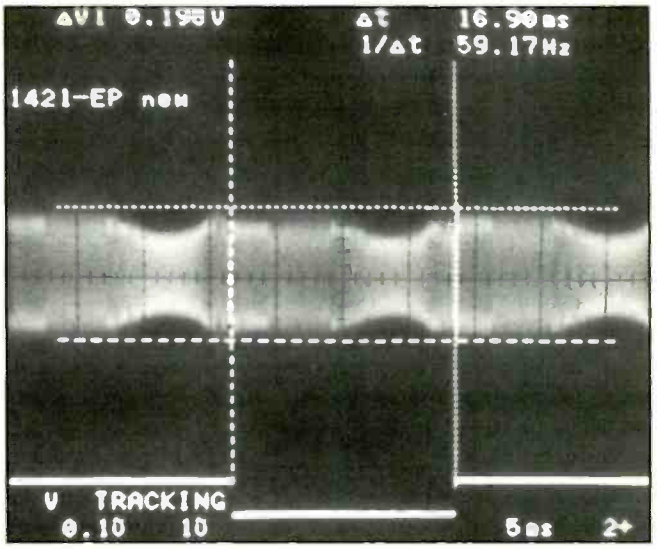


Figure 8b. Head amp output (EP) with new drum-tracking adjusted for best signal

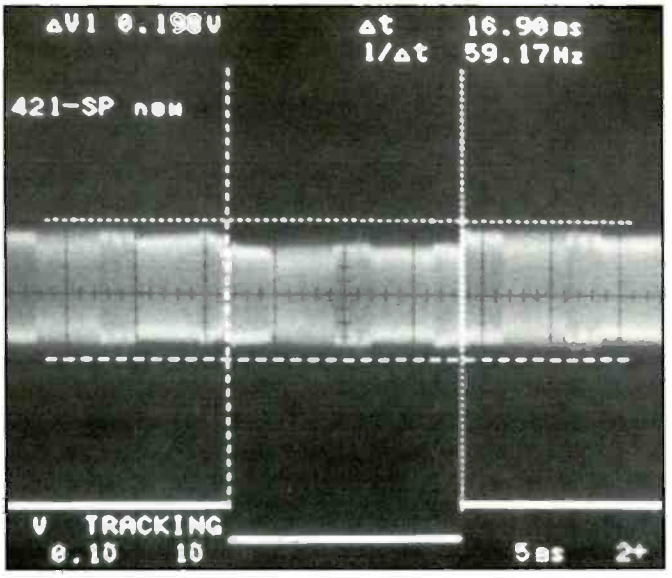


Figure 7. Head amp output (SP) with new drum

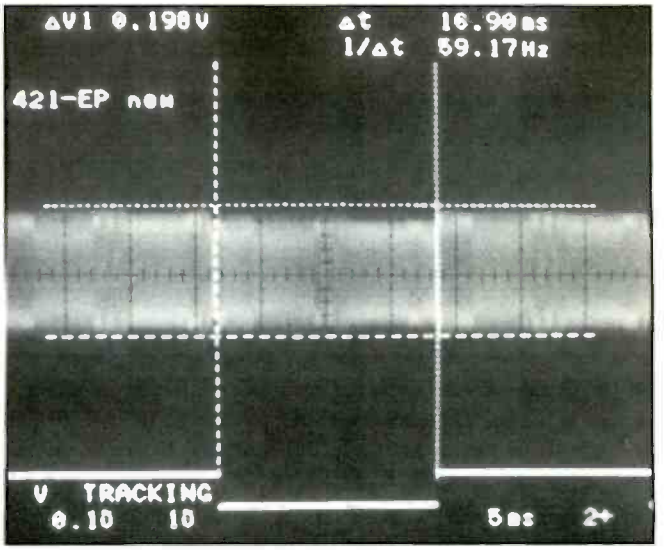


Figure 8c. Head amp output (EP) with new drum - after touchup adjustment of supply and take-up posts

fore, it is not easy to find out if the heads are bad, or if the trouble spot is the rotating transformer, the head amplifier or just a bad connection.

Narrowing down the problem

Before you order a new head drum you can perform a few tests to narrow the problem down.

•Check the inductance of the video heads using an inexpensive head testers. The inductance of a video head decreases if the head wears out, because the head gap gets wider. It is necessary to know the inductance of the good head for this test to be able to tell if the inductance is correct or if it is too low.

•Test the head amplifier by running the VCR in playback mode with no tape (use a test jig), and feed a 3.5MHz, 50µV signal into the inputs. You will see a signal at the output if the head amp is in good working condition.

•Feed a 3.5MHz, 20mV signal into the rotating transformer at the head connections and check the signal at the transformer output (head amp input) with an oscilloscope. The signal at the output of the transformer should be more than at the input. In most cases you will see a step up ratio of about 1:2.

•Use a head protrusion gauge to physically measure the amount of the head actually remaining.

•If available, use special test equipment for testing the heads, head amps and rotating transformer. These test sets provide an FM signal to substitute the head signal and you can inject the signals stage after stage to locate the faulty part of this section in a VCR. If your business is doing well and grows, it might be worth looking at one of these VCR testers to speed up repairs and increase efficiency.

Some real world head problems

My customer complained that his Panasonic VCR, Model PV-4760, showed a noisy playback picture when he tried to play tapes recorded on other VCRs. The tracking adjustment did not make a difference in the picture.

When I checked the VCR I played tapes at different speeds. Playing back a tape in standard play (SP) caused a noisy picture (Figure 5). When I played a tape in extended play (EP) the picture was fine. So my customer obviously recorded all his own tapes at the slowest speed. Rental tapes come only in SP.

This VCR was a four-head machine. Evidently there was something wrong with the SP signal path or the SP heads. I cleaned the video heads carefully but the problem remained.

Because there was noise in the picture, I checked the head amp output with the oscilloscope. The results for playback in SP and EP are shown in Figures 6a and 6b. I suspected one of the SP heads, but to make sure that there was nothing else wrong I checked the rotating transformer and the head amps. Both were good.

I checked the inductance of the heads using an LCR meter. At two heads I measured 3.8µH and 3.7µH but the other pair showed only 2.7µH and 1.9µH. This was a strong indication that one pair of the heads was worn out.

When I received the new head drum, I checked the inductance of all four heads and measured from 3.7µH to 4.0µH on all of them. After replacing the head drum, I checked the signal at the head amp output. In SP mode, the output signal looked perfect (Figure 7). The signal at the slow speed (EP) did not look too good (Figure 8a). It improved after I adjusted the tracking control (Figure 8b).

Something was not right with the tape path. After a little touch up adjustment of the supply and take-up posts the signal looked fine (Figure 8c) and the VCR worked like new.

An unusual video head repair

I encountered a difficult problem on another VCR that had a bad video head. I was unable to remove the upper drum. I tried to pull very hard but it wouldn't come loose. Then I used my Swiss Army knife to try to pry apart the gap between lower and upper drum - nothing moved.

I remembered the old days when I worked on my own car, a real 'Trabant'. If I took the engine apart, it was necessary to heat up some parts to expand the diameter of the part in order to slide it off. It occurred to me that the same principle might apply in this case, so I plugged my two soldering irons in and stuck the solder tips into the holes of the upper drum as shown in Figure 9. After approximately a minute I was able to slide the upper drum off. (Figure 10)

One of the heads on this drum was bad so I ordered a new one. The new drum would not slide onto the rotating trans-

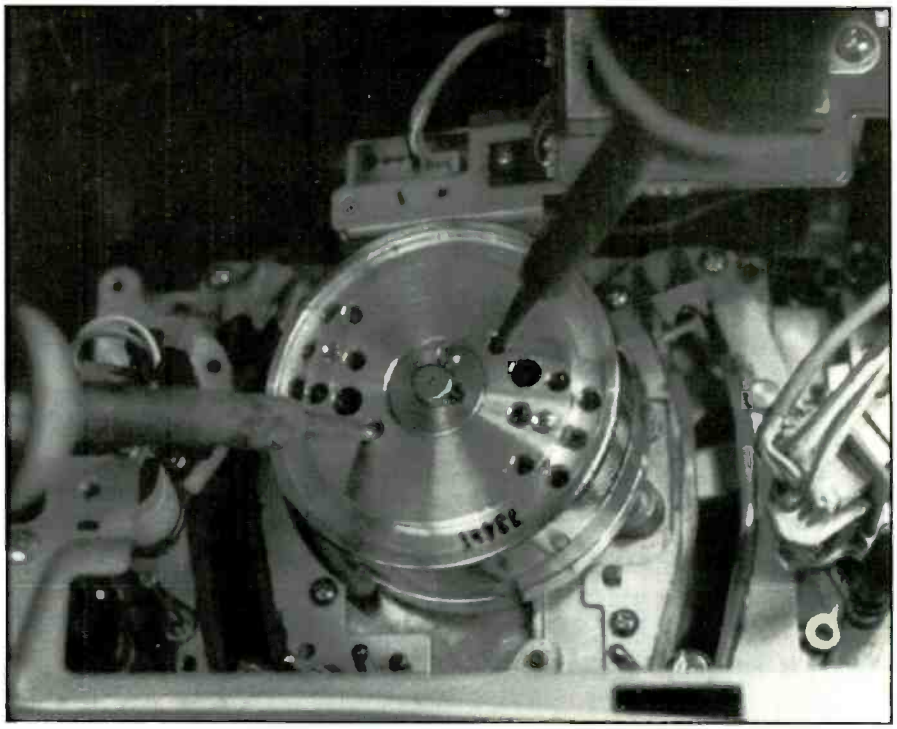


Figure 9. Applying heat to the upper drum with two solder irons

former. I had to heat it up with the solder irons to expand it a little. The manufacturer of this VCR probably had a tolerance problem. After replacing the head drum this VCR worked fine, and the heat did no damage to the machine.

Troubleshooting and replacing video heads is generally a straightforward job, but it is a good idea to check everything around the head drum first in order to avoid the unnecessary replacement of an expensive part. ■

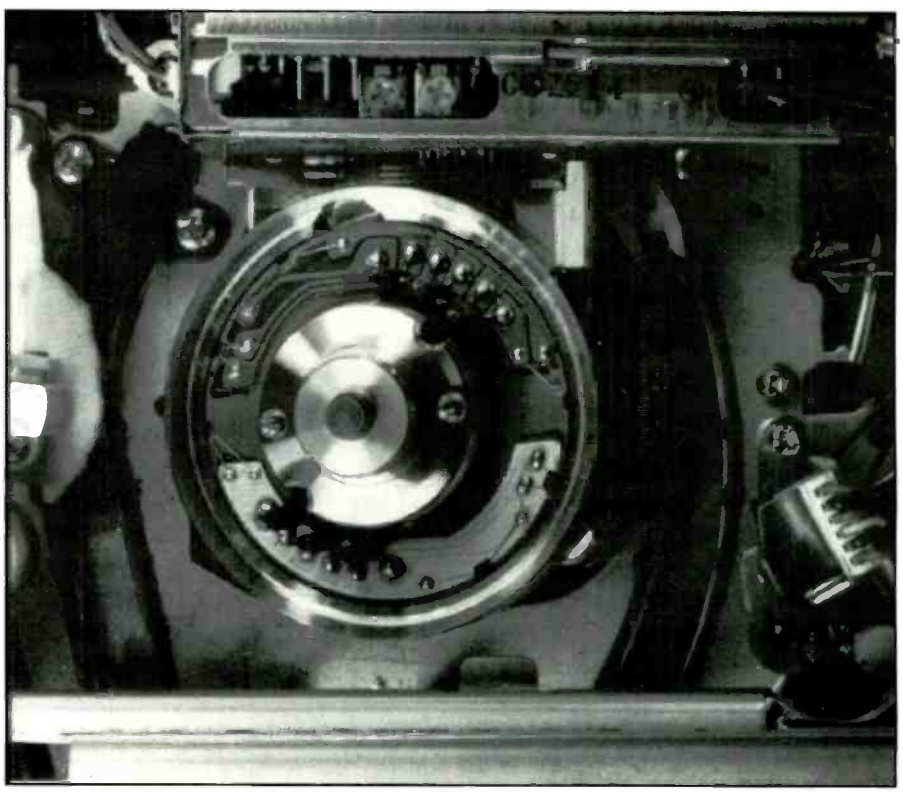


Figure 10. Rotating transformer (upper drum removed)

Test Equipment Update

Clean up and repair that test equipment

By Homer L. Davidson

Test equipment can malfunction, just as TV sets do. As with any electronics equipment that is used day in and out, with constant wear and tear, your favorite test instrument dies a slow death. When that happens, you set it aside and get by another day with a different test instrument that has damaged test leads (Figure 1).

No matter how careful the technician is with critical test equipment, accidents happen; a DMM may get pulled off the bench and land on the floor, suffering damage. During service procedures, the test instrument probe may accidentally touch high voltage circuits, damaging the internal circuits of the test instrument. Some mornings you are not quite awake, you make some tests, carelessly, and the test instrument goes up in smoke.

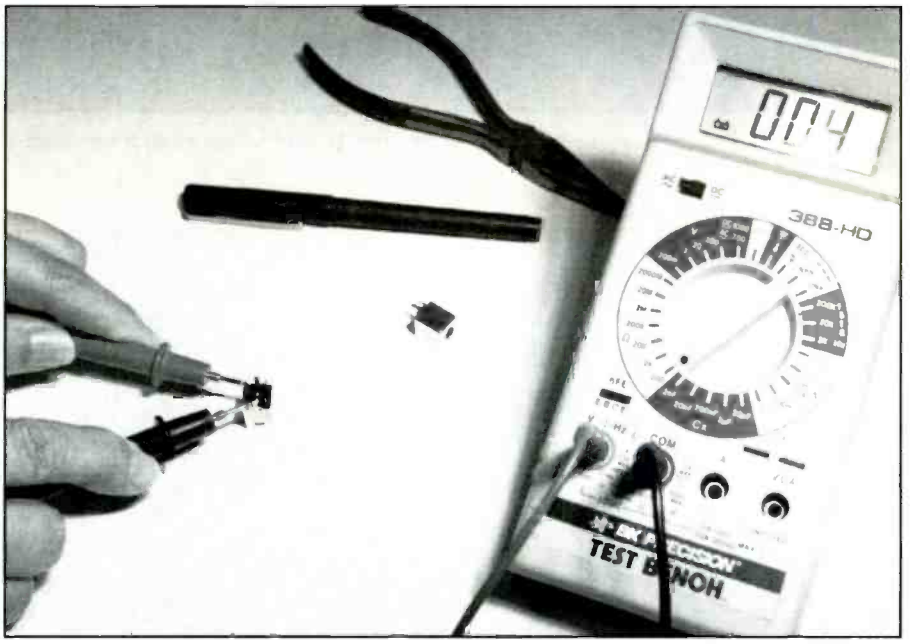


Figure 1. Taking voltage measurements every day adds up to broken, bent or worn multimeter probes and plugs.

Using slow time

The technician must occasionally make test instrument repairs or send them back to the factory for service. Before tearing into a complicated instrument, you should have the correct schematic. Literature and schematic diagrams are included with most test instruments.

All test instrument service manuals should be stored in a separate file, to be used when needed. Besides operational instructions, a schematic, with part lists may be included. Why not place those test instruments back on the job by servicing them yourself? Since you are busy most of the time trying to make a buck to pay the overhead and bills, just take an hour out of each month for test instrument repair. When business slows up on a rainy day, or when you're snowed in, take a few minutes to line up, send in, or repair those crippled tests instruments.

The quick fix

It takes only a few minutes for simple test equipment maintenance. Typical fixes for a test instrument that ceases to operate includes the replacement of weak batteries or fuses. Sometimes the manufacturer will provide a spare fuse within the instrument, near the fuse clip, or as part of the service package.

If you check your own fuse stock, you will find that these small fuses are of different values than those that you typical-

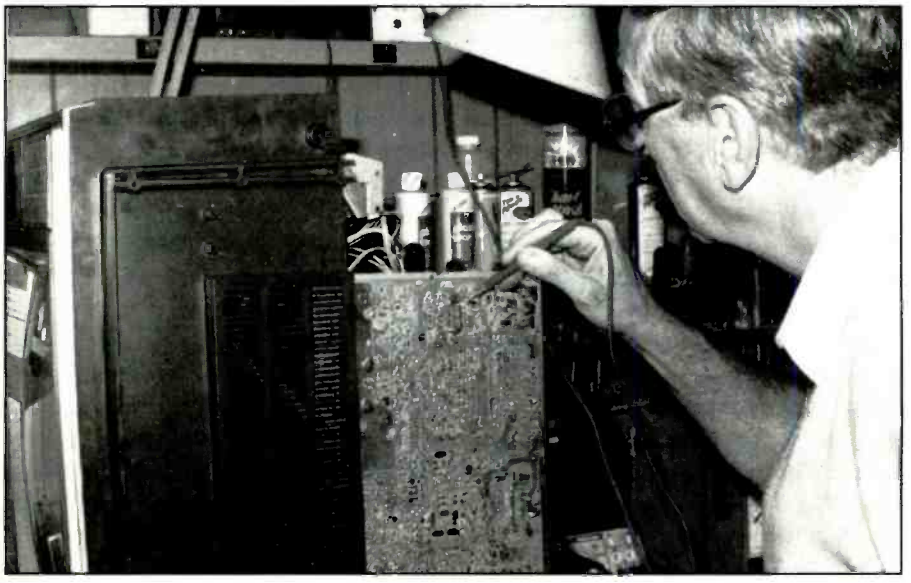


Figure 2. Test probes and plugs can easily be replaced with components found at local electronic dealers.

Davidson is a TV servicing consultant for ES&T

Figure 3. Test instruments can be sent back to the manufacturer or service depot for factory repairs.

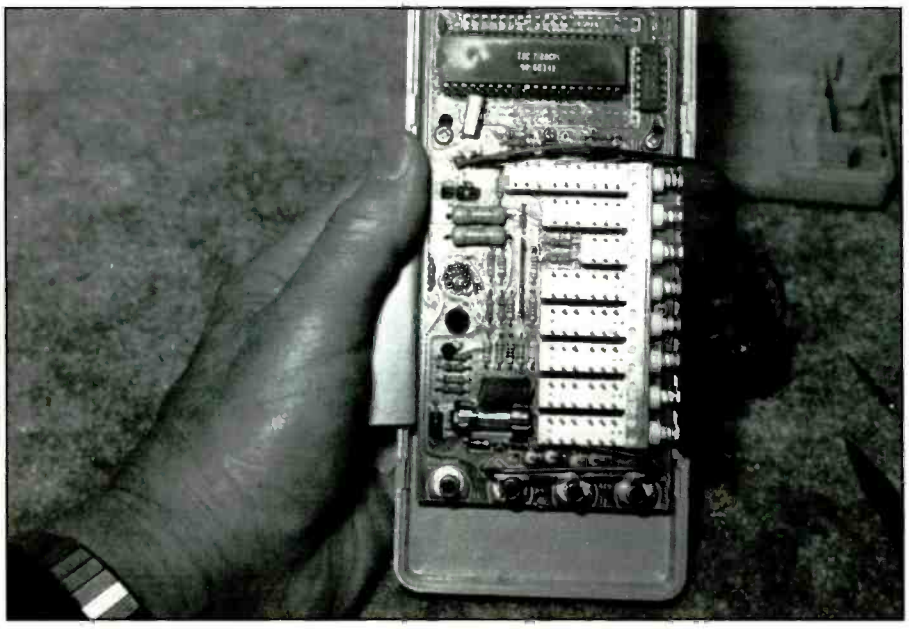


Figure 4. Most resistors, capacitors and diodes in the DMM can be replaced, but make sure that they're of the right type and value. Parts such as meter movements, switches, etc., will have to be ordered from the manufacturer, or an authorized distributor.

ly have on hand. These small fuses may have a rating of 0.5A at 250V, for example. It might be a good idea to obtain an extra fuse and store it with the schematic diagram for the instrument. Now, the next time the fuse blows in that instrument, you can replace it.

Test leads, probes and plugs can be repaired temporarily with parts found at most local electronics wholesalers, or an electronics store (Figure 2). Damaged test leads can be replaced with standard flexible test lead cable. In many cases it's best to replace test instrument leads and probes with replacements from the manufacturer, or with a universal replacement.

In an emergency, you may be able to temporarily replace the probes, tips and plugs locally, until a complete test probe set is obtainable. Make sure that the lead connector fits correctly down inside the meter plug to prevent bare tips and shock hazards. Never use test leads that have frayed or broken insulation.

It's usually no problem to replace batteries in test equipment, as batteries generally found in portable testers are the standard 9V transistor battery, or 1.5V AA types. These batteries are found in almost any store. Some test instruments have a "LOW BATT" indicator, while others have a battery test switch, which makes it easier to know when it's time to replace the battery. More generally, when the numbers on the LCD meter display become dim, replace the batteries.

Warranty repair/replacement

If the test instrument is still in warranty, send or take the defective test instrument back to the dealer, test instrument manufacturer, or factory-authorized service center. Never take the instrument apart during the warranty period. Most manufacturers will not honor the warranty of a new piece of test equipment that has been tampered with. These electronic wholesalers or parts depots generally will replace the defective test instrument in the warranty period.

Critical components

Critical test instrument replacement parts can be obtained from the manufacturer or at factory authorized service centers. Sometimes the names, addresses and toll-free telephone numbers of these service depots are listed in the service literature. Components that have tight tolerances; such as one percent or five percent tolerance trimmer capacitors or crystals, one percent resistors, integrated circuits, and special parts should be obtained from the manufacturer outlets. These same components are stocked by test instruments service depots.

Of course, standard 10 percent and 20 percent capacitors, resistors, and diodes can be taken from the stock room. Filter capacitors and large wattage resistors can be found at local electronic stores. Many test instrument manufacturers have their own equipment repair centers (Figure 3). Check with your local distributor or the distributor where you purchased the test instrument to find out where to send it for factory repairs.

Try to get an estimate, if possible. You may find that the manufacturer has established a fixed price for repairing a certain test instrument. This may be the best road to take in order to get the test instrument back into working condition. In many cases the unit comes back looking like a new instrument. If the test instrument manufacturer is out of the business, try to repair it yourself.

High voltage warnings

Be extremely careful when using a DMM or VOM that has FET (field-effect transistor) circuitry to take voltage measurements in a TV set. Keep in mind that

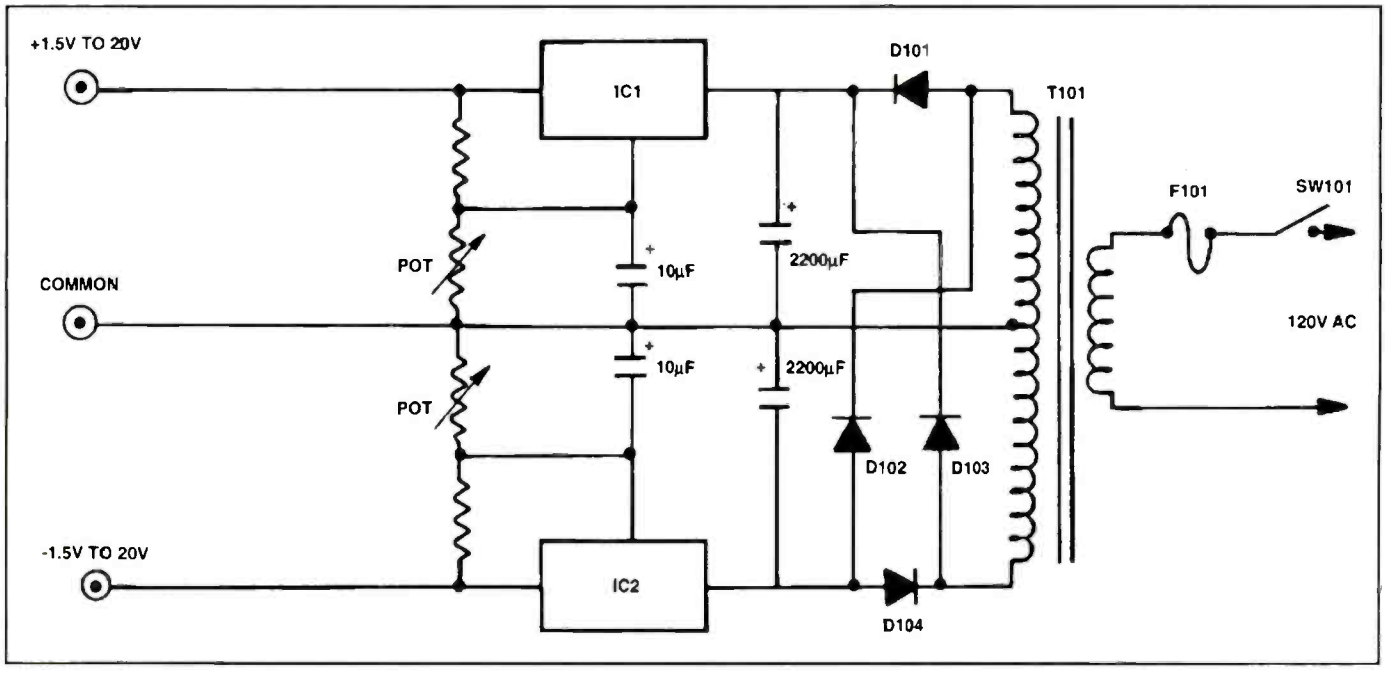


Figure 5. Most simple low-voltage power supplies can be serviced by the technician, without any difficulties.

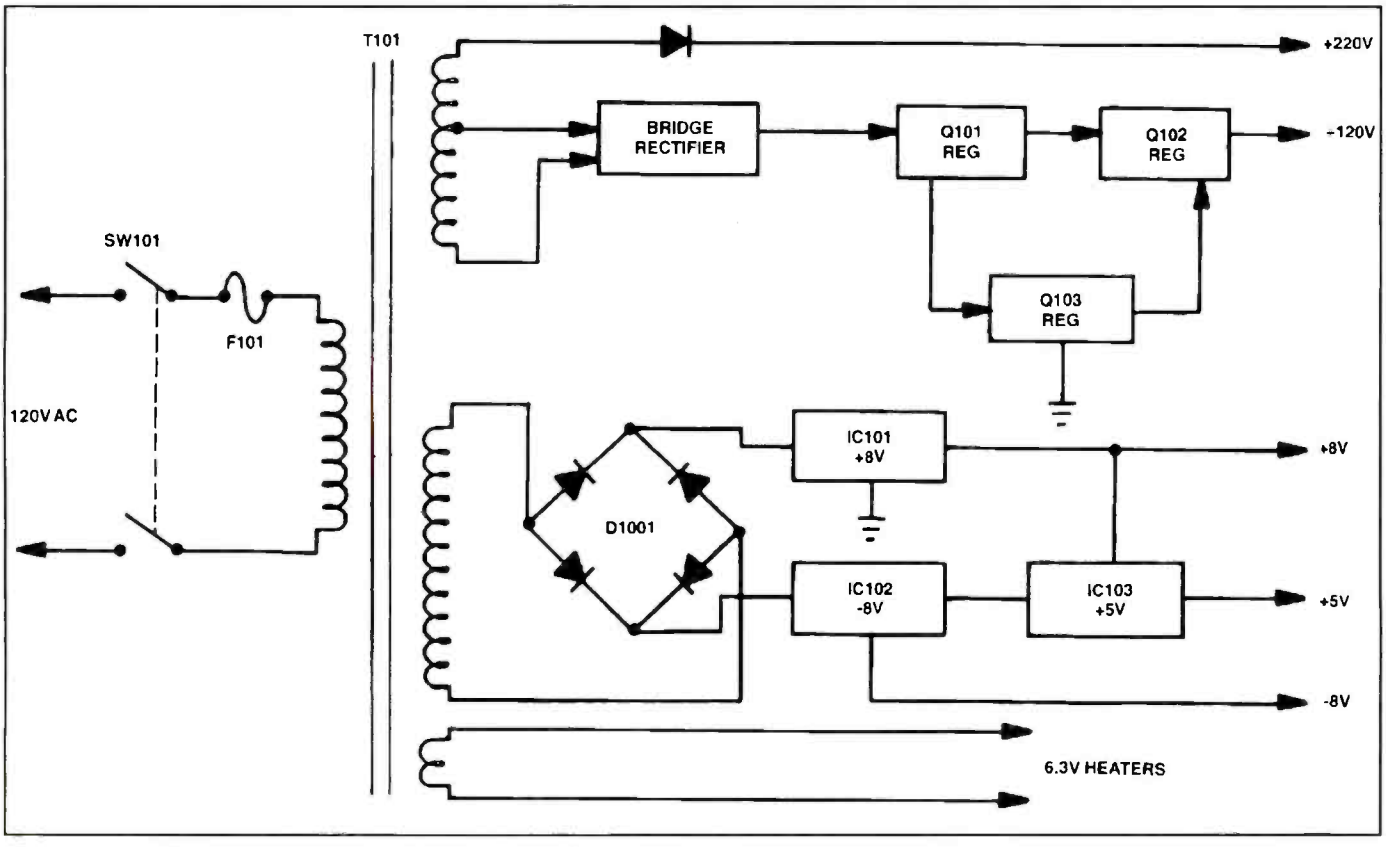


Figure 6. An oscilloscope power supply contains several different voltage sources with transistor, zener diode and IC regulators.

there is always the possibility of dangerous voltage being present in any piece of electrical or electronic equipment.

Meter damage may be caused by carelessness or accidents. Always use extreme caution when making voltage measurements in high voltage circuits. High voltage may appear in unexpected places if the circuit is defective. Think before you probe. Many test instruments are damaged when a clip or probe slips from the point that is being measured and falls down into an area where there is higher voltage than the instrument was designed to measure. If you have to monitor critical voltages or signals in an area where a slip could spell disaster, solder a piece of hookup wire to the PC wiring and clip the test lead to the wire.

Never use a DMM or VOM to measure high voltage in a TV set or a microwave

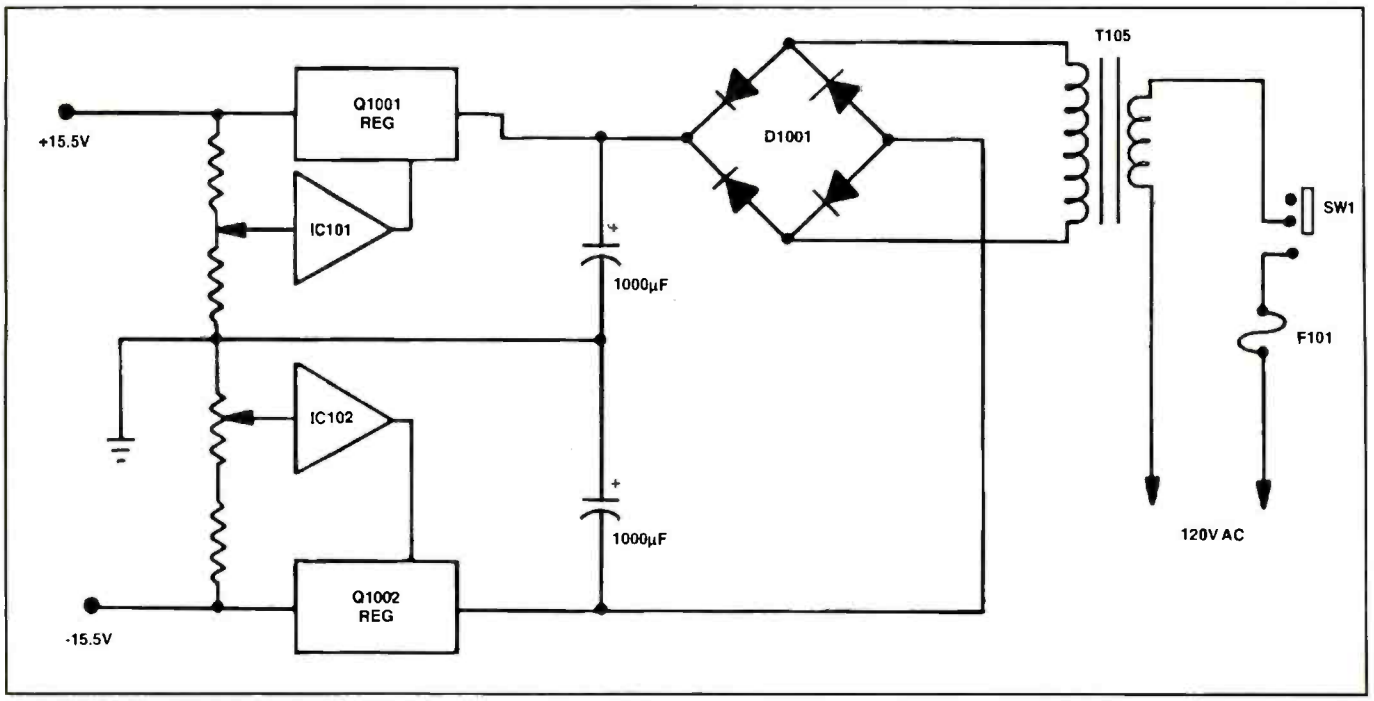


Figure 7. A pre-set low-voltage power supply may contain op-amp and transistor regulation.

oven. Although some meters will measure up to 300V, keep the probe out of high voltage areas. The meter could be destroyed instantaneously. Protect yourself by not standing on damp floors when taking voltage measurements. Keep away from metal work tables, water or gas pipes, metal posts, and electrical conduit. Accidental contact between grounded objects and high voltage can be hazardous to your health.

When taking voltage measurements in a TV set, use only one hand. Keep the other hand and your body away from the TV chassis. Even if you only receive a minor shock, which in itself might not be dangerous, your reflex could cause you to come into contact with a higher voltage, or damage other test equipment or products that may be nearby. Always connect the product being tested to the power line via an isolation transformer.

To repair or not to repair

Critical test instruments, complicated test equipment, and test instruments that may need factory calibration, should be serviced by factory personnel or trained test equipment factory depots. Do not try to repair a frequency counter, multifunction counter, NTSC color generator, or oscilloscope without a schematic. When special components are not available locally, try to obtain them from the manufacturer or service depot technicians. Sometimes it pays to send test equipment in for repair.

VOM and DMM repairs

When the VOM or DMM does not show any measurements, replace the fuse. Likewise, when the DMM or LCD display appears weak and not jet black, replace the battery. If the meter will not respond after replacing the fuse, check for blown or burned resistors. Most of the small resistors found in the voltage and resistance measurement circuits are precision components, and should be replaced with exact replacements. Likewise, replacements for broken switches, dials, meters and LCD display should be obtained from the manufacturer (Figure 4).

Although the meter input circuits are protected by a fuse, an attempt to measure a voltage that exceeds the range setting can cause damage to input resistors, capacitors, diodes, switching and FET transistors, and op amps in an FET analog multimeter. If an analog meter is damaged, it may be more cost effective to replace it rather than to repair it.

Power supply repairs

Test instruments that are connected to the power line have a low voltage power supply to convert the line voltage to the various voltages required by the instrument. Most defective components in the power supplies can be replaced with standard components (Figure 5). Special components that must be obtained from the manufacturer are meter displays, power transformers, and replacements for damaged cabinets. If you wish to improve the appearance of older test equipment while you're repairing it, you can touch up and repair minor cabinet damage with epoxy and spray paint.

In the case of dual-power supplies, you may find both positive and negative voltage sources. The same applies to adjustable or variable power supplies. You may find separate fixed voltage sources with a combination variable source. Usually transistor and IC voltage regulators are found in fixed voltage sources, while IC regulators are located in variable or laboratory power supplies.

The low voltage power supply in an oscilloscope can contain several voltage sources, +220V, +120V, +8V, +5V, -8V, -13V, and - 5V. A 6.3Vac source from a transformer winding supplies heater voltage for the CRT. The +120V source has transistor regulation from a bridge rectifier circuit. A half-wave silicon diode provides unregulated high voltage (+220V) to the CRT circuits (Figure 6).

Just as in TV malfunctions, most test equipment problems are caused by fail-

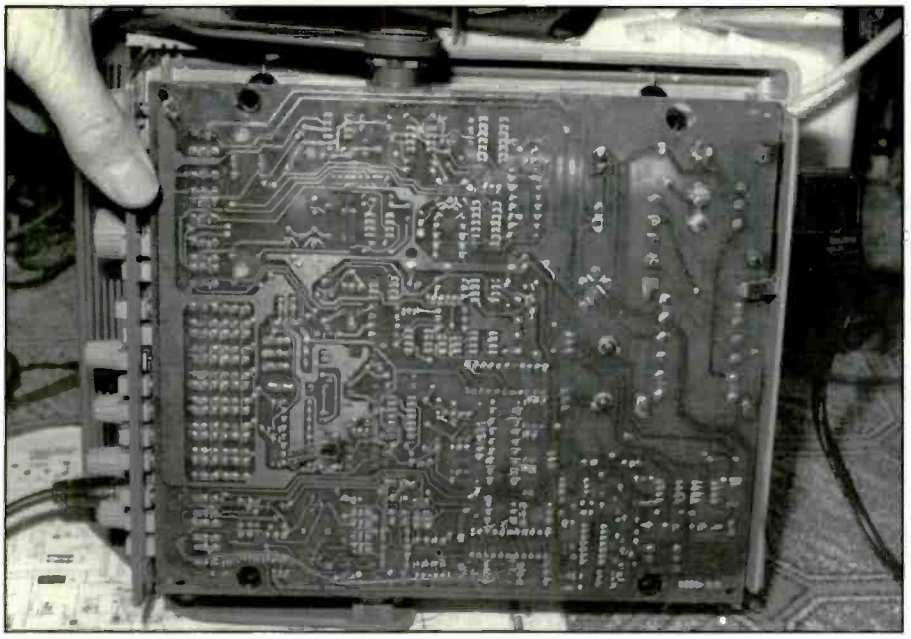


Figure 8. A sweep generator may provide sine, triangle, square, TTY, CMOS, pulse, and ramp waveforms with a sweep time base from 2KHz to 2000KHz.

Figure 9. The dual-triggered scope may be difficult to service since there are many different circuits and components.

ures in silicon diodes, filter capacitors, and transistor voltage regulators. The power supply in a sweep function generator is likely to have outputs of 15.5V, positive and negative, because the sweep circuits usually contain op amps, which require voltages of both polarities.

The bridge rectifier provides +20V and -20V to two different transistor regulators. Op-amp components can be found in both supply sources for a pre- set voltage. Zener and IC voltage regulators may be found in the sweep generator power sources (Figure 7). Regulated power supplies are easily serviced if the correct schematic diagram is available.

Function generator circuits

The sweep function generator provides a number of output waveforms: sine, triangle, square, TTL, CMOS, pulse, ramp, and asymmetrical sine waves. The sweep time may be varied from 2KHz to 20-KHZ. Some generators provide a 10Vpp load output connecting to a 50Ω load. The frequency range can be from 2KHz to 2-

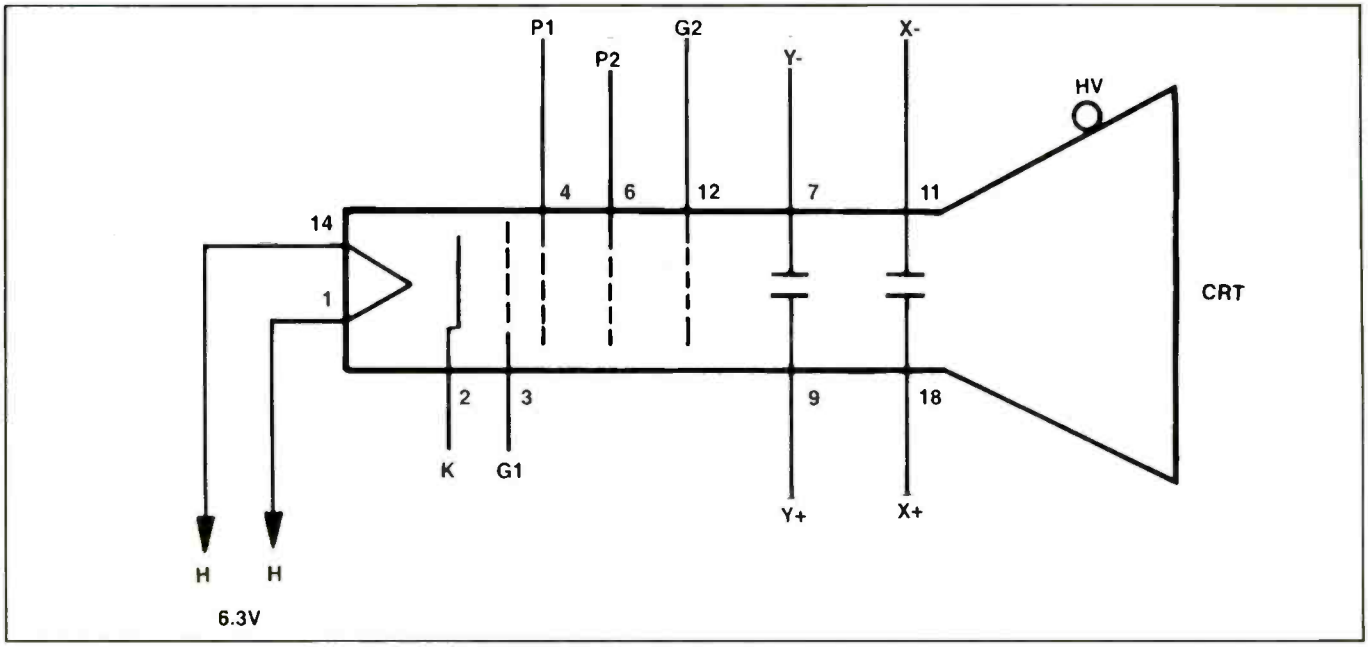


Figure 10. The CRT in the scope has deflection plates instead of a vertical and horizontal yoke assembly.

ES&T Calendar

June 4-5, 1995
Regional Training
CEDIA(CustomElectronicDesign & Installation Assn.)
Idianapolis, IN
1-800-CEDIA30

June 17–19, 1995
CES Specialty Audio & Home Theater Trade Show
EIA/CEG
Chicago, IL
703-907-7600

July 31–August 5, 1995
National Professional Electronics Conference
Arlington, VA
National Electronics Service Dealers Association
817-921-9062

October 10-12, 1995
CES Mexico
Mexico City, Mexico
703-329-1380

October 26–27, 1995
Systems Support Expo
Moscone Center
San Francisco, CA
10:00 am to 5:00 pm daily
Fax: 207-846-0657

MHz in seven different ranges (Figure 8).

Besides the power supply, the sweep circuits consist of many diodes, bridge signal diodes, transistors, and op-amp IC components. You may find quad op-amps in many of the circuits. Defective transistors, diodes and op-amps cause most of the service problems. If you run into a piece of test equipment whose push-type function selection switches operate erratically, spray cleaning fluid into them. If you find that the output waveforms are unstable, it could be the result of bent shields or metal grounding pins, or cracked PC boards, especially if the generator has been accidentally knocked off the bench, or otherwise mistreated.

Signal, audio and function generators can easily be damaged when high voltage comes in contact with the RF or audio cables and probes. Besides blowing the line fuse, damage to the front end or signal output can result in coupling capacitor arcover, or damage to the transistor, FET transistors, or IC's. Erratic operation may be caused by a broken or dirty trimmer pot. Suspect poor filtering in the generator when hum bars are found injected into the product under test.

The oscilloscope

You may find that the scope is a difficult instrument to service. Do not attempt to repair an oscilloscope without a schematic. Today's dual-triggered scope may have such features as channel 1 (X) input to attenuator, input amp, 2nd attenuator, CH1 preamp that feeds into a diode gate. Channel 2 (Y) signal input has attenuator, input amp, 2nd attenuator, CH2 preamp, and feeds into the same diode gate. The diode gate signal feeds into a vertical amp, delay line, vertical output amp, and to the vertical deflection plates of the CRT (Figure 9). The internal trigger input goes to the trigger generator, sweep delay, sweep generator, horizontal display, horizontal amp, and on to the horizontal deflection plates for the CRT.

Besides these signal stages, Z axis amp, square wave calibration, focus and intensity control, CH1 positive offset and offset networks are part of the scope circuits. Auto focus and high voltage circuits provide high voltage to the anode button and the focus grid of the cathode ray tube (Figure 10). Notice that the scope CRT uses electrostatic deflection plates rather then the vertical and horizontal yoke assembly used in TV sets.

Conclusion

Simple repairs to test equipment, such as replacing fuses and batteries, and repairing power supplies, should pose no major problems for a consumer electronics servicing technician. Test instruments with critical circuits and parts should be sent to the factory for repair. Always secure a schematic when attempting to service difficult and complicated circuits. A good clean up, removal of dust and fingerprints, and cigarette burns, may make the test instrument appear new once again.

Setting up a servicing bench

By the ES&T Staff

The service bench is the heart of the service center. It's important, of course, to have a neat, attractive reception area, efficient offices for the management, and an adequate facility in general. But every penny that's brought into the business is generated by the technicians who service the customers' equipment. It's of the utmost importance that those technicians have a comfortable, efficient, well-equipped, well lighted place to work.

The elements of a test bench

At a quick glance, it's not always possible to appreciate what's needed in an efficient service bench. There's usually a lot more there than meets the eye. An inventory of the elements of a test bench can be revealing. Following is a list of the things that make up a test bench. No doubt most technicians and service managers could add to this list.

- Surface area for the product, test equipment, tools, etc.
- Storage: drawers, shelves, bins, etc.
- Tools
- Soldering/desoldering equipment
- Test equipment
- Supplies
- Lighting: general, task and spot
- Power: ac, isolated ac, variable ac/dc power supply
- ESD (electrostatic discharge) protection
- Holder for service literature
- Communications
- Forms/writing implements
- Chemicals
- Computer terminal
- Replacement parts/supplies reception

Everything necessary at hand

In general, the service bench should have everything necessary to get the job done, and nothing that is not necessary to get the job done. In other words, if the technician needs an oscilloscope every day, or almost every day, the oscilloscope should be there and available. But if he needs, say, a function generator once a month, it should be available nearby, but shouldn't be cluttering up the work area.

Many of the elements mentioned above are self explanatory, but let's go into a little more detail about some of the critical elements.

Lighting

This is an area that is frequently neglected. In many service centers the service area has dark walls, ceilings, and floors. In some cases, even the workbench, shelves and back panels are dark. The lighting is provided by a few fluorescent fixtures and an adjustable lamp on the bench.

By any standards, consumer electronics servicing constitutes a difficult seeing task. The components in the product and printed circuit board traces in modern products are so tiny as to be almost invisible. The service literature in many cases has close packed wiring patterns, tiny component symbols and small print that makes it difficult for the technician to read.

Today's service centers should be equipped with comfortable, non-glare general lighting to provide adequate illumination. The bench should have not only at least one good task lamp for close- up illumination, but also some sort of spot light, similar to a flashlight, for seeing into those dark tight places.

Power

Many consumer electronics products these days use a bridge rectifier in the power supply. This means that at least a portion of the circuitry is "hot," and if a line-powered test instrument is used to test the line-powered product, a short circuit will occur, and damage will be done.

It could save a great deal of grief to simply make sure that every bench is supplied with ac from an isolation transformer, and to make it a standard practice to plug products being serviced into the isolated supply.

ESD (electrostatic discharge) protection

Almost every consumer electronics product made today contains large-scale integrated circuits that are susceptible to electrostatic discharge damage. If these devices are handled without the necessary precautions they may be destroyed or damaged.

Every service position should provide as much protection from this type of damage as possible: grounding wrist straps, static dissipative work surfaces, and static protective bags for storage, wherever possible.

Communications

In a small service center, the idea of communication for the service bench may seem obvious; the technician merely has

to call out to someone nearby. But in larger service centers, the technician at the bench may be a long way from the office or the replacement parts/supply area. If a technician needs to check on the availability of service literature, certain parts, or other requirements, it could mean several trips a day, causing productivity to suffer.

Such trips could be minimized by providing intercom communications at every bench. The cost of such a system might be quickly recouped through increases in productivity. Another method of providing this communication would be by placing a computer terminal at every position that would allow the technician to place requests via the keyboard.

Parts/materials

Hand in hand with good communications goes good parts handling. In the average medium to large service center, when a technician has isolated a problem to the component level, he walks to the parts/supplies area and submits a request for what he needs. The supply person may be busy at the time, thus causing delays. A system such as this can cause a great deal of wasted time.

In one service center operated by a major manufacturer, every service position has not only a means of communication, but a pneumatic tube station. Under this system, once the technician has isolated the problem, he can order the parts or supplies he requires via the communications system and have them delivered to him without ever moving from the bench.

Of course, a system such as this requires a considerable up-front investment, but the increased efficiency can more than offset the cost.

Planning is essential

At one time, not so long ago, it was possible to put together a test bench without much planning. The climate of today, in which many products are not only inexpensive and therefore marginally serviceable, but they are also complex and crammed with tiny components connected together by hair-thin traces, and consumers are increasingly demanding, requires that close attention is paid to every detail of the service environment.

Careful planning of the test bench so that everything needed by the technician is where he needs it when he needs it can create the efficiency needed to prosper in these difficult times. ■

Recycling electronic devices

By Dale C. Shackelford

Looking for a specific component in a box of salvaged printed circuit boards is one of the most miserable tasks that an electronics servicing technician can face. If your service center is anything like mine used to be, salvaged boards and components are tangled in a jungle of hook-up wire, where sharp edges and pointed solder connections seem to stalk unsuspecting knuckles and fingers.

Once the proper board is found, usually at the bottom of the pile, the component you had envisioned as the cure for your repair/ modification project is either missing from the board, broken in half, or discolored due to excessive heat. Fortunately, there are cures for this situation, whereby a service center can save considerable time, money and effort when it comes to dealing with salvaged parts.

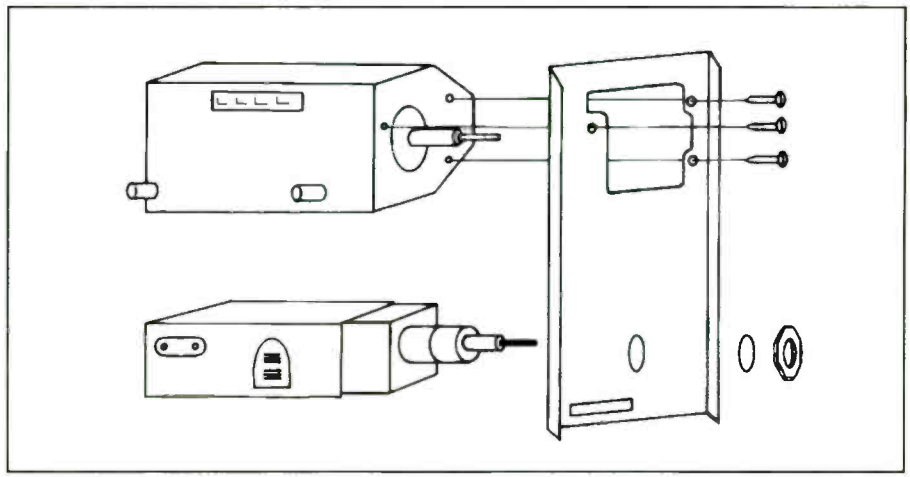


Figure 1. When salvaging a tuner from a scrapped TV set, remove the tuner from the mounting bracket to save storage space.

Orderly recycling

Recycling modern electronic devices requires a little forethought and planning, but the rewards for salvaging these products will far outweigh the minor inconveniences. Many service center owners have found that hiring a part time worker, whose primary responsibility is to strip salvaged appliances, is extremely profitable, because it reduces the time spent searching for used components and removing them from circuit boards later. Doing it this way also saves storage space. If recycling used electronic devices is in your future, here are some tips that will enhance that process.

When parting out a typical television receiver (for example most technicians will remove the chassis, tuners, yoke, speakers and control modules (brightness, color, tint, etc.) as a single unit, leaving all of the subsystems attached to the main circuit board by their wires. If the television was operating properly before it was dismantled, and there is a possibility that the inner workings of the set will be installed in a new cabinet, the entire unit can be placed in a cardboard box, and stored in a cool, dry area.

The box in which the unit is stored should be clearly marked as containing a complete(and operating)unit, and should list the chassis brand and type (i.e.: Magnavox S4 chassis/1992/Electronic tuning). Taping the box closed should prevent hurried (but well intentioned) technicians from snatching parts.

These recycled components should always be identified as such, and used in repairs only with the full knowledge and consent of the customer.

Shackelford is an independent consumer electronics technician

Removing and identifying components

If the inner workings of the salvaged set will be used as components for future repairs rather than being used as a whole, you should begin recycling the set by removing all wires between the main chassis and the subassemblies. For example, cut all wires from the main chassis to the tuner should be cut (or simply disconnect them if harnesses are used), leaving about one inch of the insulation at each connection. This will aid the technician in identifying the proper connection point if the tuner is going to be used in another set.

Clipping wires not equipped with plugs/ harnesses will save considerable time in desoldering the wire connections, and reduce the possibility of heat damage to components. Wires with plugs/harnesses on both ends may be stored for future use. Making sure that all unnecessary wiring has been removed will virtually eliminate the "wire jungle" that is so often found in boxes containing salvaged parts.

Handling tuners

When removing tuners from television cabinets, it is a good idea to remove the tuners themselves from the mounting brackets (Figure 1). This will reduce storage space. Analog UHF tuners can usually be discarded, as they are rarely replaced in modern sets, and the VHF to UHF wiring should be removed. As an aid in future identification, clearly mark tuners with the brand/model of the set from which they were extracted and mark basic connection points (B+, AGC, IF, etc.). If there is any doubt as to the proper connections, the schematic can be used to make the proper determination. For this reason, the marking process works well with all types of subassemblies.

Expensive components

It is almost a given that relatively expensive components such as flyback transformers, microcomputers and microprocessor ICs will be removed from the salvaged unit if they are in good condition. These components should be removed from the board in the same manner as would the same component found in a working set, so observe electrostatic discharge (ESD) precautions and use heat sinks on the conductors between the component and the board. When storing com-

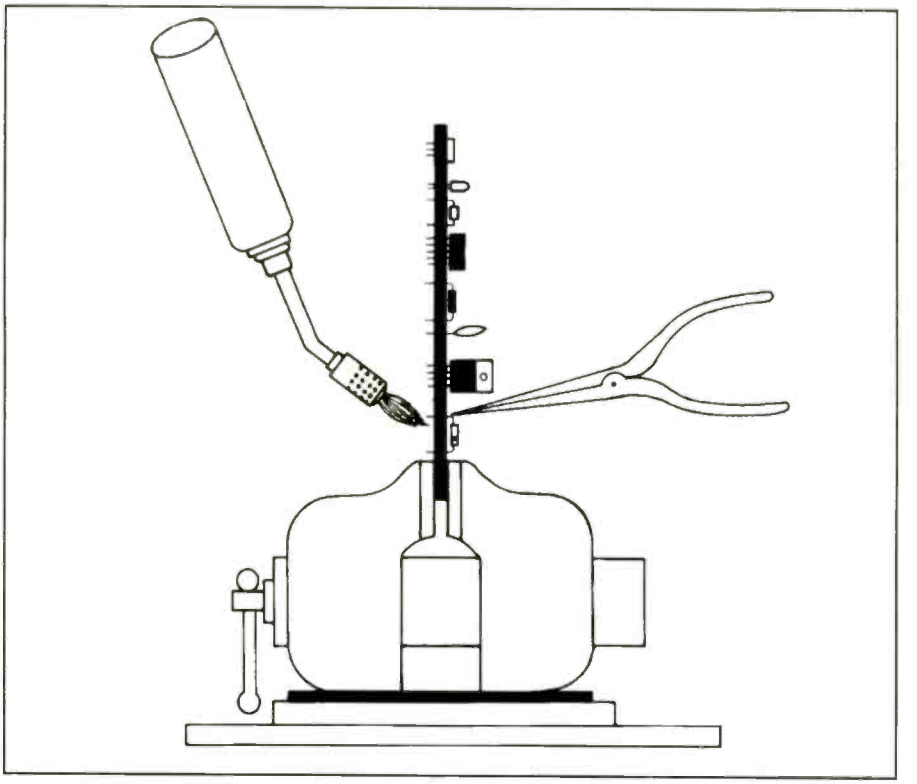


Figure 2. One way to speed up the removal of the components is to heat the solder side of the board with a high wattage soldering gun, or a desoldering torch.

ponents that are susceptible to ESD, use static proof bags, cases or foam, and store ICs such as EPROMs where they will not be exposed to ultraviolet light. All these components should be clearly marked.

Modular circuits

The next phase of the recycling process is to remove all modular circuits on the board. These circuits, which are often self-contained within a shielded housing, are often plugged into the main circuit board in one fashion or another. When removing these modular circuits, mark them clearly as to the module type (picture-in-picture, stereo, etc.) the model number and location (as noted on the schematic), as these modules are indispensable for testing/servicing other sets. When removing modular circuits that are soldered to the main board, be sure to use heat sinks to avoid heat damage.

Marking Components

Because of the relatively high cost of power transistors (such as horizontal outputs, voltage regulators and others, generally connected to heat sinks), these components should be removed and saved for future repairs. In most cases, the transistors themselves will contain factory markings. However, a piece of masking tape on the transistor, indicating the aftermarket cross reference numbers of the aftermarket company typically used in the service center, will save the technician a lot of time later in crossing factory numbers to ECG, SK, NTE or other aftermarket/replacement numbers. Obviously, these transistors should be removed from the heat sinks at once, before being stored in order to save storage space. Heat sinks themselves are rarely replaced in modern sets.

Smaller transformers and relays should be removed next, paying particular attention to their location on the board. Because these components are rarely factory marked, consult the schematic diagram for the particular set, and mark the component(s) with the values (primary & secondary inductance for transformers, voltages for relays, etc.). The amount of time expended in determining these values will save the technician much work during a very busy time in the future, as these components are often used in devices other than the type/brand of device from which they were extracted.

Removing the Small Components

By now, the only components left on

the circuit board will be some common ICs, resistors, capacitors, inductors, and diodes. Smaller transistors and ICs, once removed in the typical manner, can be "crossed", and marked with a small piece of masking tape with the cross number written on it. The transistors can be checked in seconds with a typical transistor checker before being separated and stored with like types.

Removing the remaining components from the circuit board (resistors, caps, diodes, etc.) can be accomplished in a number of ways, though, because time is of the essence in these operations, the service center owner will have to decide which method would be the most efficient. Most service centers will use a traditional vacuum assisted desoldering station to remove solder from component leads. An alternative to this would be to place the circuit board in a vise (Figure 2), and to heat the solder with a high wattage soldering gun, or to make the process faster, a small torch.

Once the solder is heated on the leads of the components (or a small area with the torch), the components can be pulled out of the board with pliers. In either case, be sure to pull only on the leads, never on the components themselves, and apply only the amount of heat necessary to melt the solder. Clamping the pliers tightly on the component leads will also act as a heat sink, reducing destructive heat build-up in the component.

Eliminating the solder

Now that all components have been removed from the circuit board (whether they will be used or not), it is a good idea to remove any remaining solder from the board. This practice is recommended, as the lead in the solder may be considered hazardous waste in your area. Check with a company that manufactures solder to determine the best and safest way to do so.

Recycling makes sense

While the recycling of electronic products may seem at first to consume a great deal of time and effort, it really isn't, especially when done on a volume basis. The service centers that has more used parts than it knows what to do with, may find that it makes sense to donate some of them to local (electronics) technical schools, while some service center have made profits by packaging and selling used parts to other shops throughout the country. Used components also help the environment, as there is less waste, less ground water and soil contamination and less energy used in the production of these components. The metal found in these sets (wire, shields, heat sinks, etc.) can all be easily recycled, as can the wood/plastic cabinets.

In addition to enjoying the benefits described in the recycling of appliances, you may well be leading a young part-time worker down a career path that you and I have found both lucrative and challenging, and providing the basis for a career that will last a lifetime. Separating components, making measurements, "crossing" manufacturer numbers with aftermarket identifications and other such (dreary) tasks will certainly teach the basics of electronics, bring the satisfaction of a job well done, and if properly orchestrated, increase the (environmental and overall) efficiency of your shop. ■

More ways to diversify your business

By Ron Johnson

When it comes right down to it, there are only so many kinds of electronic circuits, they're just applied in different ways. That's especially true of most new electronic equipment where the heart of the system is a microprocessor. For example, the only real difference between a personal computer system and a data acquisition system is the kind of I/O that is employed and the software that runs it.

The topic of this article is simply a specific application of a data acquisition system. If you're currently in the consumer electronics service field and looking to expand your horizons, you might find this interesting. All you have to do is transfer some of the your current expertise into a new area.

The subject at hand is broadly labeled automotive test equipment. These products have a lot in common with both computers and consumer electronics. CRT displays, signal amplifiers, digital circuits, microprocessors, monitors, analog and digital I/O, and printers are just a few of the subsystems that you're probably already familiar with.

Service of automotive test equipment involves routine maintenance and calibration procedures as well as fault troubleshooting, both in the service center and on site. In addition to being interesting from a technical perspective, automotive test equipment can be a lucrative product to service, if you know how. Let's take a broad look at what's involved in automotive test equipment service. First, what kinds of equipment are we talking about?

The products

Automotive service centers use two main kinds of electronic test equipment: engine analyzers, and wheel alignment and balancing equipment. Smaller, handheld test equipment like timing lights, battery load testers, etc. make up a limited, but still profitable side market.

Johnson is a journeyman electronics servicing technician and an instructor of technology at the Northern Alberta Institute of Technology in Edmonton, Alberta, Canada.

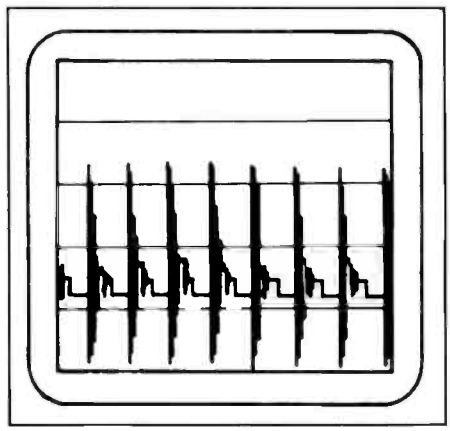


Figure 1a. A sequential display on the readout of an automotive scope shows the firing patterns of each of the spark plugs in the engine allowing comparison of peak values. This is the pattern of a six-cylinder engine.

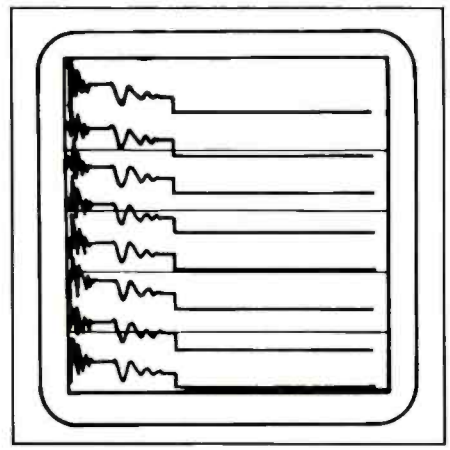


Figure 1b. This automotive scope display, sometimes called a "raster" pattern, displays the cylinder firing patterns on consecutive sweeps, allowing the technician to compare their time related characteristics.

If you're involved in technology for the same reasons as I am, you'll probably find the technical aspects of automotive test equipment interesting. But we all know that the bottom line is the deciding factor, so we'd better look at the business end of things first.

Business considerations

There aren't a lot of service companies doing this kind of work in any given geographical area, mainly because of the limited number of manufacturers of test equipment.

As you probably know, performing third party service without the support of the manufacturer is kind of like slow starvation. To make it in this business you have to be a manufacturer's authorized service center. After you have that authorization, you can do third party service on the competition's equipment (trade-ins, etc.) the same way as you do now. The best way to get in is to keep your eyes open. Find out who, if anyone, is doing service now and keep a eye on them. When changes come, and they inevitably do, be ready to take advantage of the opportunity.

Take a look in your Yellow Pages under Automotive Test Equipment. You'll find three main manufacturers of automotive analyzers: Allen Test products, Bear, and Sun. Snap-On has been making progress with its equipment in the last few years as well. More may have sprung up in the last couple of years, but these are the ones who have been around for a while. Hunter, FMC and Bear (the same company that sells analyzers) make wheel alignment and balancing equipment.

In some cases the manufacturers have set up their own factory service centers, but usually they contract with local ser-

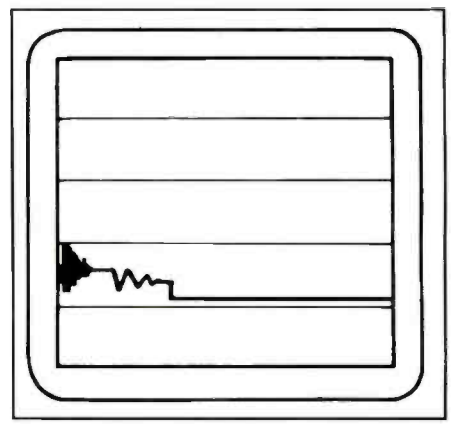


Figure 1c. This scope display superimposes all of the firing patterns over one another, allowing the technician to check for overall uniformity in the patterns.

vice companies to represent them. You might also find yourself working closely with a local sales rep (again, either a company employee or a manufacturer's rep).

Warranty service

The profitability of this kind of arrangement comes in a variety of ways. First, warranty service. As usual, the manufacturer stipulates flat rates for warranty service (usually, shamelessly low). This is where specific training on their equipment becomes necessary. As I mentioned before, you already have some expertise, but there is a difference between servicing and servicing profitably. Time is the key, and with factory training you can speed up the process. The manufacturer should provide you with this training, and pay for it.

If you're not an automotive whiz, don't count yourself out. You don't have to be. With some factory training, after a short period of time you'll be up to speed with as much of the mechanical end of things as you need. You'll also pick up lots of information from working with the automotive technicians.

What you charge for out of warranty service, of course, is up to you, and what the market will bear. You know what kind of hourly rate you need to charge in order to break even. Factor in the learning curve, the significant outlay you will have to put into specialized parts, travel and the overhead of extra space in the service center, just to name a few items to think about when servicing these products.

The good news is that this is a specialized service and the customer probably won't get it from anyone else in the close vicinity. I'm not suggesting that you gouge them, but the customer should pay what your time and expert knowledge is worth. Remember, your customer is in the service business too. He has invested thirty to forty thousand dollars in this equipment and expects to make money with it. You should too.

Replacement parts

Replacement parts for automotive test equipment are obscenely expensive. An oxygen sensor for an exhaust gas analyzer runs the customer between two and three hundred dollars. Some service centers replace several of these a year. A lead set (the cables used to connect an analyzer to the vehicle) can list at five hundred dollars and up. A specification ROM for an aligner is in the neighborhood of eighty dollars. Parts are a definite money maker but you have to keep a reasonable quantity in stock. A set of replacement modules by themselves might run you ten thousand dollars.

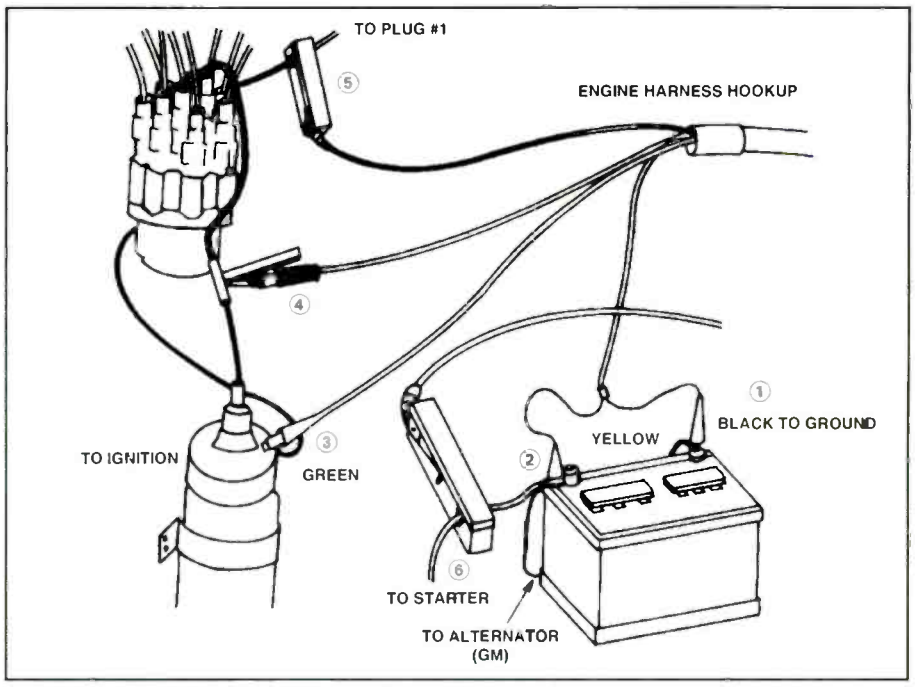


Figure 2. A number of leads are required to connect the engine analyzer to the various points it will be monitoring. These leads are subject to a great deal of abuse, and may require frequent repair or replacement.

But take heart, there are positive aspects to this. Sometimes the factory will consign you modules for warranty use. You can build your own lead sets for a hundred dollars, or you can rebuild the customer's for half that price. And, service centers have been known to reprogram specification ROM's with the latest data. (Don't shoot me. The factory rep told me it was legal.)

Third party service

The other area of potential profit is the third party work that comes along with this. Timing lights, battery chargers, battery load testers, and a variety of other equipment just starts showing up at your door. The local jobbers who supply parts and tools to the automotive shops will often set up a service arrangement with you. Most of it is relatively easy to fix, though you might have to locate a whole new set of parts suppliers. This is the kind of work to keep your junior technician busy with on slow days (when he isn't building lead sets).

There can be a few other unexpected off-shoots in this kind of business. For example, installations and training. Wheel alignment equipment is operated with the vehicle on a special kind of hoist. It may not be the kind of work you expected to do, but the money earned installing a hoist in a automotive shop can be spent just as easily as any other cash earned. After the hoist is in, and the aligner set up, you can train the automotive technician on how to operate it, (demonstrate on your own vehicle and get a free wheel alignment).

Since you're already in the customer's shop you might as well sell him a set of alignment shims (five hundred dollars for a starter set) and the tools to install them while you're there. Next year you'll be back to update his specifications and calibrate the whole system for somewhere around two hundred dollars. You might be surprised to find that the customer will be very satisfied with all of this. He makes good money himself off this equipment.

There are lots of other interesting little idiosyncrasies to this kind of business that I haven't mentioned, but this gives you a fairly good picture of what to look for. Now let's do an overview of the technical side.

Engine analyzers

Modern engine analyzers are computers that are designed to gather data from the vehicle, process it, and print out an

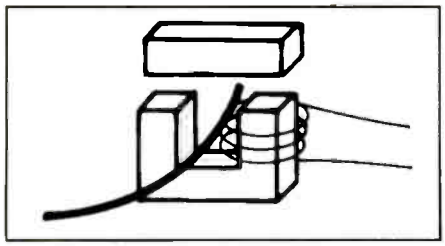


Figure 3. The inductive pickup that generates the signal from number one spark plug consists of a U-shaped ferrite core with a few turns of solid wire wound around it, and another core, the "I-core," which completes the magnetic circuit when clamped to the U-shaped core over the spark plug wire.

analysis of the engine's condition. Most analyzers perform diagnostics and recommend service procedures such as the replacement of spark plugs, the battery, or other parts. Older versions, called automotive scopes, do most of the same measurements, but it is up to the automotive technician to interpret the results. Let's take a look at what, and how these machines measure in order to see what is involved in servicing them.

The central idea of an automotive scope (the older, manual types) is to display, on a CRT, the electrical firing patterns for each cylinder of the engine, from either the primary or the secondary side of the ignition coil. Figure 1 shows the three kinds of displays.

The first is a sequential display where the firing patterns occur one after another, allowing comparison of their peak values (this one is a six cylinder). The second pattern shown is sometimes called a raster pattern. The six cylinder patterns are displayed on consecutive sweeps. This display allows comparison of their time related characteristics. The third display type superimposes all six patterns over one another. This allows the technician to check for overall uniformity in the patterns. Some scopes also provide a higher speed sweep to expand the display for higher resolution.

Obviously these displays are created electronically by controlling the horizontal and vertical deflection waveforms, and synchronizing them with the input signals. The techniques are somewhat similar to the operation of an oscilloscope, (which is a vector display as opposed to the raster display of a television).

The scope performs a number of other functions but, before considering them, we need to know what kinds of inputs are picked up from the vehicle. Most of the repair problems are related to inputs, so this is a good place to start. These inputs are connected to the scope, from the vehicle, through a set of leads, some of them 16 gauge neoprene pairs (like extension cord wire), and some neoprene covered, shielded single-conductor and dual-conductor cables (Figure 2).

They are often connected to the scope through one or more plastic AMP connectors (which break and have to be replaced quite often). The leads break, too, or are sometimes chewed up by the fan belts in the vehicle. If there are more than a few bad spots in a lead set, a trade-in for a rebuilt cable is the customer's best bet. But let's look at what they actually do.

The leads

Let's first look at the positive and negative leads of the battery. The negative (chassis) lead is the ground for the system, the positive lead allows the scope to monitor the battery voltage. A current probe works in conjunction with the battery clips and clamps over the vehicle's positive battery cable. It uses a Hall-effect transducer to indicate the charging or discharging current of the battery.

The voltage and current measurements work together when testing the starting and charging systems. By pushing a button on the scope, the primary side of the ignition coil is shorted out so the engine won't start. The technician then turns on the ignition, and cranks the engine. A comparison of the level of cranking current and the battery voltage drop over time indicates the condition of the starter and battery.

Next, the technician removes the short from the coil primary, and the engine is cranked again and allowed to start. Again, by monitoring the charging current and battery voltage the condition of the alternator and voltage regulator can be determined. The computerized systems do this all automatically, just prompting the technician when to crank the engine.

The analyzer can perform another useful test while cranking the engine by monitoring the instantaneous cranking current during the compression cycle of each cylinder. A cylinder with poor compression will not cause as heavy a current draw from the battery. As we'll see further on, the computer "knows" which cylinder is which and can display the pertinent information later.

As mentioned before, one lead (a shielded, single conductor) connects via an alligator clip, to the primary side of the ignition coil. This is the lead which was shorted to ground inside the scope during the starting/charging systems test. It also provides the primary signal for display on the CRT. Another shielded cable connects to the secondary side of the coil, but, since the secondary is a high voltage, the connection is a capacitive clip that connects around the high voltage lead from the coil to the distributor cap. Since the secondary signal is a complex ac waveform it can be capacitively coupled to the scope.

In order to synchronize the signals and trigger the scope trace, another input connects to the number one spark plug. In this case an inductive pickup is used. Figure 3 shows what's inside the pickup. A few turns of solid wire are wound around a U-shaped ferrite core. Another core, (straight this time, and called an I-core), completes the magnetic circuit when clamped over the number one spark plug wire. The spark plug wire becomes the primary winding of the transformer which sends trigger pulses back to the scope.

A cracked I-core causes a lot of customer complaints about scopes and analyzers, because an intermittent sync pulse messes up many of the tests done by the system. All it takes to crack an I-core is to drop the number one pickup on the shop floor once. I usually gave an extra I-core to good customers and showed them how to detect and replace a bad one. I lost a few service calls but gained good will with this gesture.

I mentioned earlier that the primary side of the coil could be shorted out to ground, which would inhibit the vehicle from starting while testing the battery. With a little digital logic (or the help of the computer in an analyzer) individual cylinder firing pulses can be shorted out on every revolution. A comparison of the RPM of the engine with and without the help of any given cylinder, provides an indication of the condition of that particular cylinder. On the older scopes, each cylinder could be tested by pushing consecutive buttons on the scope. Analyzers perform the test automatically.

Other parameters

Vacuum is another parameter that needs to be checked during a typical engine analysis. The older scopes had built-

in vacuum gauge that the technician connected via a rubber tube and then interpreted himself. Newer engine analyzers use the vacuum signal in their diagnostic engine analysis so the vacuum signal has to be converted to an electrical signal. A small pressure transducer inside the analyzer is used to convert the signal.

Some analyzers also use a temperature sensor. The ones I have seen were a long probe that could be used to replace the oil dipstick in the vehicle. Again, the analyzer used the engine temperature in its analysis.

The final input to the analyzer isn't really a lead at all; it's the exhaust gas sample probe. The exhaust gas analyzer is a system unto itself (which shares information with the analyzer computer). Automotive exhaust gas analyzers usually measure the concentration of four gases: carbon monoxide, carbon dioxide, hydrocarbons and oxygen.

The first three gases are detected and measured by a sophisticated infrared absorption spectrometer. Oxygen is detected by a polarographic oxygen sensor. The gas analyzer is used to determine the efficiency of the emissions control system of the engine. The analyzer takes this data and, with the other information obtained, makes diagnostic decisions about the required service.

If the primary cause of service to scopes and analyzers is damaged lead sets, gas analyzer problems are a close second. Automobile exhaust is pretty dirty stuff and the sample system for the analyzer requires some maintenance. Dirty filters, worn out vacuum pumps, and damaged exhaust probes are just some of the things to consider. And whenever service is performed, a quick check of the calibration is necessary using premixed test gas. Training the automotive technician on how to keep the machine running is another requirement.

Information output

While we're still on the subject of input/output, analyzers use a variety of methods to communicate with the technician. Some have light pens which the technician uses to select targets on the data display. Others have QWERTY style keyboards. Some use pendant switches to allow the technician to key the analyzer to specific events from under the hood.

Some analyzers have both computer monitors and analog CRT's for displaying ignition waveforms. Large analog meters were common, especially on the scopes and older analyzers, so the automotive technician could see the readings from under the hood. Printers supply a hard copy of the data and diagnostics which can be presented to the customer as proof of the analysis.

Automotive analyzers can also communicate with the on-board computers in many vehicles, and display the information on screen. Parameters such as fault codes, coolant temperature, manifold absolute pressure and oxygen sensor output, can be displayed at the same time giving the technician lots of input that he can use for diagnostic purposes.

There's a lot more that could be said about this kind of equipment, and we haven't even touched on some of the other automotive test equipment that's needs service out there: wheel alignment, balancing and handheld test equipment. It might be worth your while to at least explore these areas for yourself. ■

Test Your Electronics Knowledge

A sampler

By Sam Wilson, WA8RMS

1. In an ac circuit the product of rms voltage multiplied by rms current gives
A. rms power.
B. true power.
C. VARS.
D. average power.

2. Two resistors are connected across a constant voltage source. One resistor dissipates 3W and the other dissipates 4W. How much power is dissipated by the circuit? _____

3. Assume the control grid of a working CRT is held constant. The cathode and control grid are both positive with respect to common. Making the cathode of the tube more positive will make the display
A. brighter.
B. less bright.

4. Refer to the CRT described in Question 3. In normal operation the cathode should be
A. more positive than the control grid.
B. less positive than the control grid.

5. The phase angle between the voltage and current in an ac circuit is 38°. What is the power factor of the circuit?

6. Write the conjugate of 5-j8.

7. The equation for impedance compared to turns ratio is:
$\frac{N_P}{N_S} = ?$

8. In an amplifier, what term is used to describe the ratio of the maximum allowable input signal to the minimum discernible signal?

9. Which of the following cannot be an octal number
A. 10101010
B. 12345678

10. A certain 0.0022μF capacitor has a reactance of 3.6Ω. What is the frequency used to determine that reactance?

(Answers to quiz on page 55)

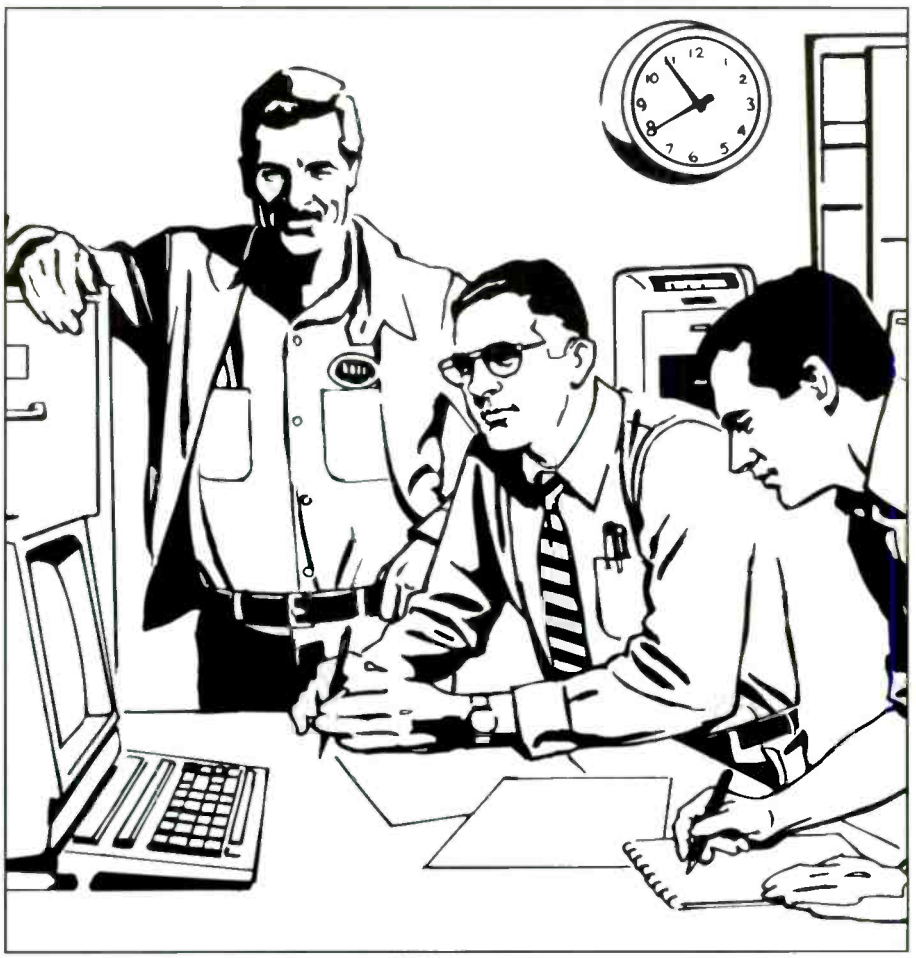
Wilson is the electronics theory consultant for **ES&T**

Computer maintenance and diagnostics using MS-DOS 6.0

By David Presnell

Many computer service calls turn out to be basic file maintenance calls. Many customers will ask you to speed up their systems, back-up their hard disks, or try to recover lost files. You will often find computers with the hard disk disorganized, not maintained, and highly fragmented. Such hard disks often contain bad clusters and corrupted files that need to be repaired.

You may occasionally come across a computer that has been infected with a virus. Problems may arise when TSR (terminate and stay resident) programs are running with the use of certain applications, and hardware conflicts can exist unnoticed for some time before certain programs bring them to life.



Utilities in DOS

Microsoft has included certain utility and diagnostic programs to aid the user in solving these and other problems in MS-DOS version 6.0 and above. In fact, many of these problems could have been prevented if the user had fully understood and applied these DOS 6.0 utilities. So, it is left to the computer service technician to solve these problems.

In many cases, all the technician needs to do is to run a few DOS utilities to solve the problems, and MS-DOS 6.3 should, by now, be on all late model computers. If it's not, then you should, by all means, sell your customers an upgrade. This article will look at some of the more useful utilities and diagnostic programs supplied with MS-DOS 6.0 and above.

Getting started

Maintaining a computer, beyond cleaning it occasionally, involves keeping performance at an optimum level. A computer performs very well when it's new, but in time wear and tear, abuse and poor maintenance take their toll. For example, files are added and removed over and over causing fragmentation of the hard disk. Hard disk drives begin to wear, causing bad clusters and eventually lost data. New hardware and software is added and not properly configured.

The physical abuse some people inflict on their computers is even worse. Coffee or other liquids are spilled, or smoke from cigarettes is sucked into the drives. Then, there are the errors in software management. For example, the new employee adds some garbage to the AUTOEXEC.BAT file thinking it had something to do with an executive's parking spot. A new secretary accidentally deletes last month's invoices from the hard disk because she didn't get a raise. Then there's the disaster just waiting to happen. The college kid who's working part time introduces the latest nasty virus on some application program he lifted from the computer lab at school.

Considering all of these existing and potential problems, it should be obvious that computers must be maintained. In the case of the spilled coffee, get yourself a computer cleaning kit and go to work. In most cases such accidents don't cause permanent damage if handled correctly from the beginning.

Using the DOS utilities

For the rest of the problems mentioned

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earlier, you will need some utility programs specifically designed to fix the problem. A number of vendors offer such utility programs, but in many cases DOS 6.0 can do the job just fine.

For accidentally deleted files try UNDELETE. If your customer is someone who wondered what the FORMAT command does, and decided to satisfy their curiosity, you may have to use the UNFORMAT command. If no files have been saved to the hard disk since the DELETE or FORMAT command was invoked, DOS 6 can often recover the system to its original condition.

File maintenance procedures allow you to *maximize* and *optimize* for *performance*. That is, you make the computer perform better at a faster speed. In some computer circles you will hear this called MOP for short, or mopping up the mess.

Before you MOP the system, perform a complete hard drive back- up. During the MOP process you might inadvertently delete files, or the entire contents of the hard disk, or just generally make the situation worse than it was when you started, by improperly using the utilities discussed in this article. If you have made a complete backup, you can always restore the system to its original condition.

Part of the file maintenance process is talking to the user to determine what files or directories may be unnecessary so that you can erase them from the hard drive. Many hard drives are loaded with files that have never been used and never will be used. Your customer can help you determine which to get rid of. Be sure to remove all related subdirectories from the system. This is a good time to try the DELTREE command, which removes a directory and all its related files and subdirectories at the same time. But don't use DELTREE unless you are absolutely sure of what you're doing.

Checking start-up files

Once you have backed up the hard drive and cleaned out the garbage files, you are ready to take a look at the start-up files. First, you may wish to take a look at the ROM BIOS SET-UP information to be sure the BIOS is set up correctly. You can usually enter this set-up upon start-up by pressing the DEL key before the computer completes the memory check. Now, at the C prompt, type VER and press ENTER to be sure you're using MS-DOS Version 6.0 or above. If not, upgrade before continuing.

After you have checked the ROM BIOS setup and have rebooted the computer, make a backup copy of the start-up files by doing the following: At the C prompt, type COPY AUTOEXEC.BAT AUTOEXEC.OLD and press ENTER. This will make an exact copy of the AUTOEXEC.BAT file and name it AUTOEXEC.OLD. Thus, if something should go wrong, you can always copy the AUTOEXEC.OLD back to make things the way they were before. Now type COPY CONFIG.SYS CONFIG.OLD, and press ENTER. Again CONFIG.SYS will be copied to the file named CONFIG.OLD. It wouldn't hurt to copy these files to a floppy disk as well.

Editing the AUTOEXEC.BAT file

At the C prompt, type EDIT AUTOEXEC.BAT, and press ENTER. This will start the DOS EDITOR program and open the file called AUTOEXEC.BAT. Refer to your DOS manual for help in determining what each line of the file means. You need to determine exactly what each line does, why it's there, and if it needs changing. Be especially curious about lines or statements that are not mentioned in the DOS manual's index.

To temporarily disable a line, type REM at the beginning of the line with the keyboard set to insert (REM is the programmer's shorthand for "remark,") the computer considers any line of code preceded by "REM" to be a remark, and does not execute it. To save the changed AUTOEXEC.BAT file; press the ALT key, the F key, then the X key, and press ENTER, or select YES when asked if you wish to save the file.

You will now have to re-boot the computer to see how your changes affect the system. You can also type AUTOEXEC, and press ENTER to run the batch files. It's usually best, however, just to re-boot. To re-boot, press and hold down the CTRL key, ALT key, and the DEL key at the same time to warm boot the system. This method of using REM to disable lines in the AUTOEXEC.BAT file works great when there is a suspected file conflict between a TSR program started in the AUTOEXEC.BAT and a program you are using. Remember that the AUTOEXEC.BAT is a batch file that executes automatically every time you start the computer. This batch file is used primarily to run programs or menus without user input when the computer is turned on.

Editing the CONFIG.SYS file

When you're satisfied with the AUTOEXEC.BAT file, at the C prompt, type EDIT CONFIG.SYS, and press ENTER. Again using your DOS manual, determine what each line means and why it's there. (It would be difficult to cover all the possible combinations in this article.) CONFIG.SYS does just that - it configures the system to operate with certain drivers and hardware, sets up the use of extended and expanded memory, and so on. To exit the editor, press ALT+F, then X to exit, and ENTER to save changes.

Check for viruses

Next, it would be a good idea to run a check for viruses on the system. In DOS 6.0 with MS-WINDOWS installed, you will need to start WINDOWS and double click on the MICROSOFT TOOLS icon, then select the MS-ANTIVIRUS icon to start the antivirus program. Select drive C: as the drive to check, and then click on the DETECT AND CLEAN button to run the anti-virus program. Follow any on screen instructions while running the program. When done, exit WINDOWS and return to the C prompt.

Microsoft diagnostics

Beginning with version 6, Microsoft has included a utility called MSD. MSD stands for MICROSOFT DIAGNOSTICS. MSD is an excellent program that provides complete information about the computer it's running on. Very little printed documentation exists about MSD, so let's generate some.

To start MSD at the C prompt, type MSD and press ENTER. MSD works great with a mouse, so if one is attached to the computer by all means use it. On start-up MSD reads information about your computer from available set-up information and on chip data, and determines the type of hardware connected to the system. The first screen you will see is the main menu or summary screen. At the top of the screen, you will see a menu bar with FILE, UTILITIES, and HELP. At the bottom you will see a help line as follows: "Press ALT for menu, or press

highlighted letter or F3 to quit MSD".

On the left side of the screen, you will see the following bars with a brief summary just to the left of the bar: COMPUTER, MEMORY, VIDEO, OS VERSION, MOUSE, OTHER ADAPTERS. On the right side, you will see the following bars: DISK DRIVES, LPT PORTS, COM PORTS, IRQ STATUS, TSR PROGRAMS, DEVICE DRIVERS. You can click on any of these bars to see a complete breakdown of the information about that item.

The FILE menu

Under the FILE menu, you will notice a FIND FILE feature. This feature alone makes MSD a great program. Click on FIND FILE, or type the highlighted letter to start. Type the name of the file you want located. If selected, FIND FILE will search the entire hard disk.

Next under the FILE menu you will see PRINT REPORT. If you have a printer connected, select this and MSD will print the available information about the system onto about 10 to 20 pages depending on whether you have Windows installed. Also under the FILE menu, you can view the AUTOEXEC.BAT and CONFIG.SYS files, as well as WINDOWS set-up and operation INI files.

The UTILITIES menu

Under the UTILITIES menu item, you can view MEMORY BLOCKS, or BROWSE the memory in general. The INSERT COMMAND allows you to make changes to your AUTOEXEC.BAT and CONFIG.SYS files. You can also test the printer and switch to a black & white display. MSD itself performs no diagnostics as such, but provides you with the information you need to locate the problem. Locating hardware interrupt conflicts is simple using the MSD IRQ STATUS function. When certain programs lock up for no apparent reason, you may have a conflict between the TSR (Terminate and Stay Resident) program and the application you're trying to run. Such conflicts can usually be located easily using the MSD TSR PROGRAMS function. When installing hardware such as a modem, looking at the COM PORTS function can help make selecting the right port a simple task.

Freeing up more memory

In many cases, your customer will tell you that they need more memory, even though their computer already has eight megabytes or more and is only using 640k. This is a case of improper use of expanded and extended memory drivers. MSD can help you determine the status of all the memory available on your hard drive. MSD also tells you the brand of the computer, CPU, video, and helps you with network problems. With a computer that can't seem to be fixed, try to produce a printout using the MSD PRINT REPORT function, and study the printout carefully. You may find the problem.

Checking the hard disk

To continue the MOP process, you will want to run a utility called SCANDISK. SCANDISK is a modern and efficient replacement for CHKDSK in MS-DOS version 6.0 and above. CHKDSK is still available, but you should use SCANDISK instead. It's much better at its job.

To start SCANDISK, be sure that no TSR programs are running. Be sure that WINDOWS is closed and not running in the background. Now at the C prompt, type SCANDISK and press ENTER to start the SCANDISK utility. SCANDISK first tests the structure of drive C: (you may

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have to select that drive), and displays a message asking you if you want to perform a surface scan, press Y to perform the scan.

The surface scan will take about 10 minutes for a 130MB hard drive. The screen that appears will show the operation taking place and identify any bad clusters found. SCANDISK will attempt to fix the bad clusters by trying to recover the data on them, moving it, and marking the area as bad so future programs won't write data to it. When done, choose MORE INFO to look at the structure of the FAT and COMMAND.COM system files. Save the log and exit SCANDISK when you're finished.

Defragmenting the hard drive

One of the more useful tools of DOS 6.0 is DEFRAG. Here's why DEFRAG is necessary. When a hard drive writes to the disk, the first available space is used in most cases. When a file is erased from the disk, a space is left between two segments of data. If a larger program is then written to the disk, part of it will be used to fill up the available spot and the rest sent wherever there is room available. In time, bits and pieces of a program or file may be scattered all over the hard disk.

As you may know, this process forces the disk heads to move around until all of the data is read, thus, slowing down the system. This phenomenon of scattered files is known as "fragmentation." DEFRAG reorganizes the data on the disk so that programs and files are on the disk in continuous blocks, thus speeding up the system and reducing hard drive wear.

Start DEFRAG at the C prompt by typing DEFRAG and pressing ENTER. If DEFRAG has never been run before, select the configure defrag option from the on screen bars. DEFRAG will show the percent of fragmentation, it will then recommend the best method and configuration depending on the percent of defragmentation found. Press ENTER to start the method chosen by DEFRAG. DEFRAG will take a while to run; about 10 minutes per 5% of defragmentation. You should make it a habit of running DEFRAG monthly. The improvement in performance can be substantial.

Improving your memory

The next procedure in MOP is to run a DOS 6.0 utility called MEMMAKER. MEMMAKER is a utility that checks and configures available memory in such a way as to improve performance, speed, or both. When you run MEMMAKER, be sure there are no TSR programs running. Be sure WINDOWS is closed, and that no other programs are running in the background. I have heard complaints from users about MEMMAKER, but problems are usually caused by TSR programs running while MEMMAKER tries to reconfigure the system.

To start this program, type MEMMAKER at the C prompt and press ENTER. MEMMAKER will automatically set up expanded and extended memory where feasible, and place as many programs as possible in upper memory, thus allowing as much room on the 640k for DOS programs that do not take advantage of upper memory.

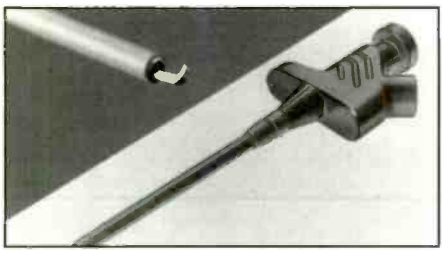
If you choose the custom option, you will be questioned by MEMMAKER about certain functions you desire. Generally, it's best to let MEMMAKER make all the decisions. MEMMAKER will determine a set-up it believes will work with your system. It will then reboot the computer. If something goes wrong, it will ask you, and return to the conservative set-up.

While using MEMMAKER, be sure to take your time and read all of the on-screen information before responding. Once you and MEMMAKER determine that the new memory configuration is correct, then MEMMAKER updates your CONFIG.SYS and AUTOEXEC.BAT files with the necessary information. With care and proper use, MEMMAKER can be another excellent utility provided with DOS 6.0.

Summary

The final MOP procedure includes testing the system by running some applications. Once you're sure everything is running well, make another complete back-up of the system. Add an exterior and floppy drive cleaning, and the entire process outlined in this article can be sold to computer owners as necessary computer maintenance. This maintenance can be performed over several visits or offered as a regular monthly service for a nice hourly fee. Each trip will include a back-up of changed files using the original two sets of back-up disks, and any necessary file maintenance. This can be a very profitable service that your customers will thank you for. ■

Products



Test probe with spring-loaded hook

The new KLEPS 290 test probe with spring-loaded hook is now available from Richard Hirschmann of America, Inc. It connects securely to the test point and allows for safe, reliable testing in research and development labs, workstations, service departments, etc.

The probe features a special, durable hook that extends up to 5.5mm and then retracts around the test point to provide a reliable connection for applications up to 1000V (when used in accordance with VDE 0100, 0105 and VGB4.) The molded, shock-proof handle incorporates a special socket with a safety shroud for connection to fixed or retractable 4mm plugs and/or leads.

Circle (70) on Reply Card

Monitor tester

Computer & Monitor Maintenance Inc. announces the newest member of the Checker family of monitor test equipment, the "Checker JR.," small hand held, low cost, battery operated computer color monitor pattern generator. The unit is

small enough to fit in your pocket or tool kit, yet it can drive virtually any VGA or Multi-sync monitor.

With this tester, a field service technician can quickly isolate display problems without having to open the computer. By simply connecting the monitor to the tester, most problems can be quickly isolated. No more swapping video cards or monitors. In the shop, no longer will you need to search for a computer, keyboard, and software just to test a monitor. It supports VGA monitors in the 640x480 mode. This is a mode that will drive all VGA, Multi-sync, and VGA monitors.

Circle (71) on Reply Card

SMD vacuum pick-up tool

The pen-sized, totally self-contained Pen-Vac is useful for picking, placing, and positioning small, flat-surfaced objects weighing 100 grams or less. The units are lightweight, brushed aluminum construction and provide finger-tip vacuum control.

A storage compartment inside the rear of the unit holds and protects probe tips and cups when not in use. The device comes with pocket clip, one straight probe with medium cup, and three angled probes with cups (small, medium, and large). No batteries are required. The unit is ESD-safe.

Circle (72) on Reply Card

Understanding and optimizing PC memory

By Steven J. Bigelow

No matter how many MB of memory are fitted into your system, every PC ever made relies on the first 1MB for proper DOS operation. More specifically, DOS loads programs and files into the lower 640KB of system RAM. For many serious DOS applications, at least 590KB of that first 640KB must be available, sometimes even more.

When device drivers and TSRs (terminate-and-stay-resident) are loaded into memory during system initialization, they traditionally occupy small portions of conventional memory. However, the proliferation of peripherals (i.e. SCSI adapters, CD-ROMs, sound boards, and so on) over the last 5-8 years has resulted in a dramatic increase in the number (and size) of device drivers that are needed by a PC. Even PC performance enhancers such as DoubleSpace and SmartDrive require a part of this first 640KB.

As you might imagine, it does not take long before a sizable part of the conventional memory is committed to device drivers, and not enough memory remains for applications. This article explains PC memory, and shows you how to configure your system startup files to free up as much conventional memory as possible.

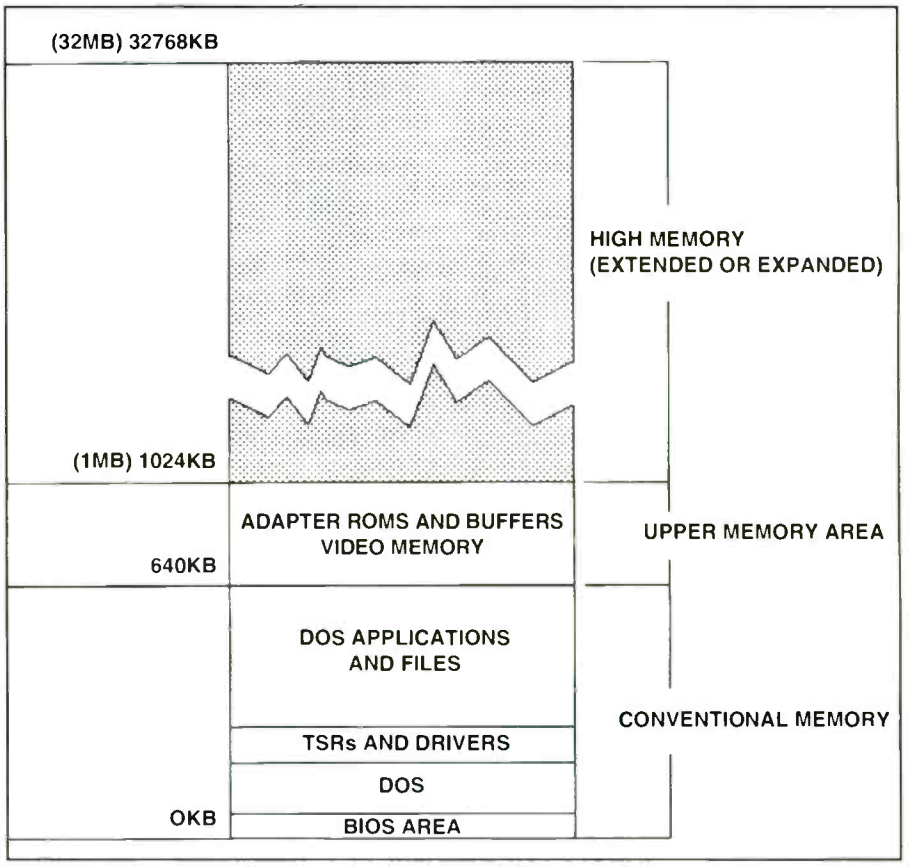


Figure 1. Memory map for a typical IBM compatible personal computer.

Understanding PC memory

Before you can optimize your system memory, you have to understand how memory is organized and categorized in a PC. Figure 1 illustrates a basic memory map for a typical PC. Although the map may appear daunting at first glance, all memory maps are read starting from the bottom. As you look at the memory map, you will notice an emphasis on the first 1MB of system memory. There is an important historical reason for this. When the original PC/XT was designed, it used the Intel 8086 microprocessor. The 8086 could only work with 1MB of RAM, so DOS was designed to work within 1MB as well (technicians refer to this as real-mode addressing).

When Intel's 80286 microprocessor appeared in the PC/XT, the i286 could work with 16MB of RAM, but the 1MB limit remained to ensure backward compatibility with 8086 systems. Working with RAM above the 1MB limit required the microprocessor to change its operating mode (known as protected-mode addressing). Every Intel CPU to follow (the i386, i486, and Pentium), also kept this shortcoming for the sake of backward compatibility.

You might wonder why the PC would only set aside 640KB for applications if 1MB is readily accessible. The answer is, there is much more than applications that have to be handled within the first 1MB. BIOS instructions, DOS itself, TSRs and device drivers, video memory, and expansion ROMs (i.e. for disk drives, video adapters, and so on) all need a part of the available space.

To ensure that video memory and expansion ROMs would "always" have plenty of room, PC designers allocated the upper portion of 1MB (about 384KB from 640KB to 1024KB) exclusively for such support purposes. This became known as the upper memory area (or UMA). The first 640KB (which became known as conventional memory) was left over to load BIOS data, DOS, TSRs and device drivers, and any applications and files.

Moving beyond 1MB

Figure 1 also shows a large portion of

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```
device = c:\dos\himem.sys
device = c:\dos\setver.exe
device = c:\dos\emm386.exe
stacks = 9,256
files = 70
buffers = 20
lastdrive = Z
device = c:\sb16\drv\sbcd.sys /D:mscd001 /P:220
device = c:\rodent\oldmouse.exe
```

Table 1 - A simple but inefficient CONFIG.SYS file

```
device = c:\dos\himem.sys
device = c:\dos\emm386.exe ram
dos = umb,high
stacks = 9,256
files = 50
buffers = 10
lastdrive = K
devicehigh = c:\sb16\drv\sbcd.sys /D:mscd001 /P:220
devicehigh = c:\dos\setver.exe
```

Table 2 - A reasonably optimized CONFIG.SYS file

potential memory space above the 1MB mark—many current PCs are designed to hold up to 32MB of RAM. However, the problem of a 1MB limit still exists. PCs must use memory management software which allows DOS to reach out beyond 1MB. There are two types of high memory: extended and expanded. The physical RAM that is installed beyond 1MB can be used as either extended or expanded memory depending on what memory management software is being used.

Extended memory (XMS), is a simple and straightforward technique which just tacks memory onto the first 1MB. This results in memory addresses that are larger than FFFFFh (which is hexadecimal notation for 1024KB). Windows is designed to work with addresses larger than FFFFFh, so XMS is well suited for Windows.

On the other hand, DOS and DOS applications are not written to work with addresses larger than FFFFFh. As a result, XMS is virtually useless for DOS. An extended memory manager (such as HIMEM.SYS) must be loaded to give your PC access to extended memory. Keep in mind that many people will use the terms high memory and extended memory interchangeably. For the purposes of this article, high memory can be either extended or expanded memory.

Expanded memory (EMS) is a bit more complicated than extended memory. Unlike extended memory which can be accessed directly (by protected-mode software such as Windows), EMS is divided into small segments called pages. Each page is typically 16KB long. Each page can contain program code or data, but none of it can be executed from EMS.

When the program running within the 640KB limit needs code or data held in EMS, the expanded memory manager maps the required page(s) into a reserved area of conventional memory called a page frame. The application can then execute the information contained in the page frame. Using EMS, a real-mode program can cheat the 1MB limit. EMM386.EXE is an extended memory manager that allows XMS to simulate EMS.

Enabling your high memory

The first step in optimizing your system's memory is to enable your high memory area. To do this, you will need to place HIMEM.SYS and EMM386.EXE into your CONFIG.SYS startup file. From the DOS prompt, start a text editor such as DOS EDIT and load your CONFIG.SYS file. One of the first things that CONFIG.SYS should do, is load HIMEM and EMM386 as shown in Table 1 (Table 1 is shown as an example only—your CONFIG.SYS file may be radically different).

Remember that there are a number of command line switches for both HIMEM and EMM386. Depending on the vintage and particular configuration of your PC, you may need to add one or more switches to achieve proper driver operation. Refer to your DOS manual for a description of each switch. If you intend to make use of both high memory and any available UMAs, you should use the RAM switch with EMM386.

Optimizations for CONFIG.SYS

When MEM /C is run with the CONFIG.SYS file shown in Table 1, only 441KB of the total 640KB is available. Large DOS applications may fail to function with so little conventional memory. Now that we know the high memory is active (thanks to HIMEM and EMM386), we can optimize CONFIG.SYS to free as much conventional memory as possible.

Before you begin

The first rule of system configuration is backup, backup, backup. You should always make a copy of your CONFIG.SYS file before attempting to change it. That way, you will always be able to return to where you started, should you run into trouble. You can copy the CONFIG.SYS and AUTOEXEC.BAT files to a floppy disk, or copy the files to unique file names such as; copy config.sys myconfig.old copy autoexec.bat myautoex.old to restore the original file (if necessary), simply reverse the command; copy myconfig.old config.sys copy myautoex.old autoexec.bat You can now begin to modify the CONFIG.SYS file. We will work on the AUTOEXEC.BAT file later.

Eliminate unnecessary entries

The first and simplest step in freeing conventional memory is to remove any entries that are no longer being used. For example, when old peripherals are upgraded, the old device driver should be removed and the new one loaded. Look through the CONFIG.SYS file and erase any obsolete entries.

Suppose for Table 1 that the file oldmouse.exe was an old mouse driver that was no longer needed. You can simply erase the entry. If you are not certain whether the entry is needed or not, you can disable the entry rather than remove it by adding the term REM before the entry. This effectively REMarks-out the entry. If you find that you need the entry after all, you can remove the REM statement later and re-enable the entry without having to type it in again from scratch.

Files and buffers

The FILES entry defines how many files MS-DOS can have open at one time. The BUFFERS entry sets the number of 500 byte buffers that MS-DOS reserves for data transfer to and from disk. Large numbers of FILES and BUFFERS wastes

conventional memory. Make sure that the number of FILES and BUFFERS allocated for your system are sufficient without being excessive.

For example, if you have been using a complex application that required 70 files and 20 buffers, but the application has been removed from your system, you can return the number of FILES and buffers to a lower level (50 FILES and 10 BUFFERS are usually adequate for most Windows-configured systems).

```
set blaster = A220 I5 D1 H5 P330 T6
set sound = c:\sb16
prompt $p$g
loadhigh c:\sb16\sb16set /M:220 /VOC:220 /CD:220 /MIDI:220
/LINE:220 /TREBLE:0
loadhigh c:\sb16\sbconfig.exe /S
loadhigh c:\sb16\drv\mscdex.exe /D:MSCD001 /V /M:15
loadhigh c:\dos\smartdrv.exe
loadhigh c:\mouse\mouse.com
loadhigh c:\dos\share.exe /L:100
```

Table 3 - A typical AUTOEXEC.BAT file using the LOADHIGH command

Tighten the LASTDRIVE entry

DOS allows up to 26 letters to be used as logical drive references. In many cases, the LASTDRIVE function is set to Z (as in Table 1), but the actual last drive to be enabled may be E, H, or K. Each letter requires about 100 bytes. Use a smaller letter that more closely reflects the true last drive. For this example, we will change the LASTDRIVE reference to K.

Setting the stacks

If you are running DOS only, you can usually remove the interrupt stack reference entirely or set it to 0,0. For Windows systems, however, the setting of 9,256 is adequate for most systems.

Relocating DOS

MS-DOS is one of the largest files to occupy conventional memory, so one of your priorities in optimizing conventional memory should be to move DOS to either an available part of the upper memory area, or to the high memory area using the dos=command in CONFIG.SYS. Remember that you will need to load HIMEM in order to load DOS into high memory, and use the RAM switch with EMM386 if you plan to try DOS in the UMA. Make sure the following line is added after the EMM386.EXE entry in CONFIG.SYS; dos=umb,high If you do not wish to try putting DOS in the UMA, you can omit the "umb" portion of the line above. Table 2 shows our refined CONFIG.SYS file beginning to take shape.

Make use of DEVICEHIGH

The DEVICEHIGH function allows you to place most device drivers into the UMA where otherwise they would be loaded into conventional memory. There are only a few rules to keep in mind when using DEVICEHIGH. First, you must add the "umb" reference to the dos= function in order to use DEVICEHIGH at all. Second, you can not use DEVICEHIGH until your memory managers are loaded, so HIMEM and EMM386 must always be loaded in conventional memory with the ordinary DEVICE function as shown in Table 2. Third, if you have any DEVICE references placed before your memory managers (such as the SETVER.EXE reference placed before EMM386.EXE in Table 1), relocate the statement(s) after the memory managers as shown in Table 2.

You can then use the DOS MEM function to check the new amount of free conventional memory. After booting a system using the CONFIG.SYS file of Table 2, free conventional memory reported by MEM (the "Largest executable program size" entry) rose to 555KB. For only a few minutes worth of work, the system picked up over 114KB of conventional memory.

Optimization for AUTOEXEC.BAT

Working with the AUTOEXEC.BAT system startup file is a bit easier than dealing with CONFIG.SYS. AUTOEXEC.BAT is used to set system variables, and to start any non-critical device drivers or TSRs (such as mouse drivers and caching programs) that may be needed to streamline the system.

Before you attempt to work with the AUTOEXEC.BAT file, you should make a protected backup of the original file just in case you get into trouble. If you need guidance making a backup of AUTOEXEC.BAT, see the section above entitled; "Before You Begin". Start a text editor and load the AUTOEXEC.BAT file.

Eliminate unnecessary entries

This is the most common method of streamlining an AUTOEXEC file. As applications come and go on your system, you will likely be left with a number of system variables that are no longer used, as well as very long PATH statements that you probably do not need. You may also find obsolete or unused drivers and TSRs in AUTOEXEC.BAT that can be removed without problems.

If you are not sure whether an entry can be removed safely, place a REM statement in front of the entry. This effectively REMarks-out (disables) the entry without removing it. If you find that you need the entry after all, you can simply remove the REM statement later to re-enable the entry.

Make use of LOADHIGH

The LOADHIGH function is used to load a program into the UMA where otherwise it would be loaded into conventional memory. As with DEVICEHIGH, there are some rules that must be followed in order to use LOADHIGH successfully. The "umb" reference must be added to the dos= statement in CONFIG.SYS, and the LOADHIGH function can not be used until the memory managers are loaded in CONFIG.SYS.

A typical application of LOADHIGH is shown in the sample AUTOEXEC.BAT file of Table 3. It is important to note that DOS does not report whether a LOADHIGH was successful or not. If a file can not be loaded into upper memory, it will be loaded into conventional memory. Keep in mind that you can use the letters "lh" instead of LOADHIGH.

Reviewing your results

DOS offers the MEM function, which provides a comprehensive breakdown of memory in the system and how it is used. You can use the MEM function before and after an optimization to see the results of your work. Table 4 illustrates a typical memory report using the /C switch.

Since this article is primarily concerned

Modules using memory below 1MB:

Name	Total	=	Conventional	+	Upper Memory
MSDOS	17149 (17K)		17149 (17K)		0 (0K)
HIMEM	1168 (1K)		1168 (1K)		0 (0K)
EMM386	4144 (4K)		4144 (4K)		0 (0K)
COMMAND	2912 (2K)		2912 (2K)		0 (0K)
SMARTDRV	28816 (28K)		28816 (28K)		0 (0K)
MOUSE	24560 (24K)		24560 (24K)		0 (0K)
SHARE	7648 (7K)		7648 (7K)		0 (0K)
SBCD	11584 (11K)		0 (0K)		11584 (11K)
SETVER	640 (1K)		0 (0K)		640 (1K)
MSCDEX	46576 (45K)		0 (0K)		46576 (45K)
Free	570432 (557K)		568688 (555K)		1744 (2K)

Memory Summary:

Type of Memory	Total		= Used		+ Free	
Conventional	655360	(640K)	86672	(85K)	568688	(555K)
Upper	60544	(59K)	58800	(57K)	1744	(2K)
Adapter RAM/ROM	393216	(384K)	393216	(84K)	0	(0K)
Extended (XMS)*	15668096	(15310K)	2610048	(2549K)	13058048	(12752K)
Total Memory	16777216	(1638K)	3148736	(3075K)	13628480	(13309K)
Total under 1MB	715904	(699K)	145472	(142K)	570432	(557K)
Total Expanded (EMS)			16056320	(15680K)		
Free Expanded (EMS)*			13303808	(12992K)		

* EMM386 is using XMS memory to simulate EMS memory as needed.
Free EMS memory may change as free XMS memory changes.

Largest executable program size 568592 (555K)
Largest free upper memory block 1296 (1K)
MS-DOS is resident in the high memory area.

Table 4 - A breakdown of memory utilization using the DOS MEM /C function

with freeing as much conventional memory as possible, you should be most concerned with the third line from the bottom; "Largest executable program size". The objective is to make this number as large as possible.

Handling upper memory problems

In an ideal world, you should be able to load DOS, TSRs, and device drivers into the UMA and high memory without any difficulty. But in the practical PC world, there are many situations that can prevent a program from being relocated out of conventional memory.

In many cases, the result is harmless - the program will simply load into conventional memory as it had before. In other cases, however, system operation can be adversely affected when programs are relocated. This part of the article looks at a number of symptoms and solutions related to memory optimization.

Error message from a driver or TSR

One problem you might run into is that you see an error message from a driver or TSR when attempting to relocate it. This is not necessarily a problem. It may simply be that there is not enough memory available in the UMA to handle the program you are trying to relocate. Try rearranging the order in which the drivers or TSRs are loaded.

Also, the available space in the upper memory area will vary depending on how the PC is configured. A PC with a great many expansion boards and expansion BIOS ROMs may not leave enough upper memory to hold more than a couple of programs. There is little else to be done with such a problem.

The system locks up when a program is relocated

Not all software is suitable for operation in the UMA. Check the screen messages carefully as the PC initializes, and attempt to determine the last program to load successfully before a fault occurs. If you can find the fault, it is a simple matter to remove the DEVICEHIGH statement and replace it with the DEVICE statement. This will load the uncooperative program in to the conventional memory. Keep in mind that it may be necessary to boot the system from a backup or alternate boot disk so that you are able to use a text editor to make, and save such a correction.

If you are unable to determine the point

at which the system locks up, start with the last DEVICEHIGH statement in the CONFIG.SYS file and change each one to DEVICE. Reboot the PC after each change is made. The last line to be changed before system operation returns, is the problem. You can then leave that line (to load into conventional memory) and return all subsequent lines to the DEVICEHIGH function.

A device drive fails to load in UMA

You may find that a device driver small enough for the available UMA fails to load there. Some device drivers expand when they are loaded into memory. In most cases, the program will be loaded into conventional memory. You can find the actual amount of space a driver needs by allowing the driver to load into conventional memory, then using the MEM /C command to see the file and its corresponding file size—this will be the true amount of memory needed by the driver. You can then try loading the driver with DEVICEHIGH using its size= switch.

Erratic program operation in UMA

You may encounter a situation in which a program works erratically or improperly when loaded into the UMA. There are some device drivers that simply do not work well (or at all) in the UMA. It could be that the program needs a certain amount of memory above it, or the driver does not recognize addresses in the UMA. In either case, the offending program should be loaded into conventional memory. If the offending program is being loaded from CONFIG.SYS, change its DEVICEHIGH statement to DEVICE. If the problem is occurring in AUTOEXEC.BAT, remove the loadhigh (or lh) statement.

Nothing being loaded into UMA

A situation may occur where nothing is being loaded into the UMA. You can see this by looking at the MEM report. Chances are that you have missed a configuration step which is preventing your system from using the UMA. Check the following items. First, check CONFIG-.SYS to see that the dos=umb or dos=umb,high statement is included after the memory managers are loaded.

Second, check that HIMEM and EMM-386 are loaded using the DEVICE statement rather than the DEVICEHIGH statement. HIMEM should be loaded before EMM386. Also see that the EMM-386 entry is using the noems or ram switch. This configuration should enable use of the UMA. At this point, simply make sure that you are using DEVICE-HIGH statements for any CONFIG.SYS device drivers to be loaded in the UMA, and LOADHIGH statements for any AUTOEXEC.BAT device drivers.

Conclusion

Conventional memory is perhaps the most important and contested area of memory in any PC. The large number of powerful peripherals and utilities now available for PCs is placing an ever-greater burden on the first 640KB of system RAM. By freeing conventional memory, you are able to run larger and more complex programs. This article is intended to explain the concepts of system memory, and show you some practical techniques for streamlining your conventional memory.

Test Your Electronics Knowledge

Answers to the quiz

(from page 30)

1. D (I know, in audio speak it is called "rms power" even though that term doesn't make any sense).

2. 7W (Regardless of whether the resistors are in series, parallel, or series/parallel, the total power is found by adding the individual powers).

3. B (It is the same as making the control grid more negative).

4. A (In other words, the control grid should be negative with respect to the cathode).

5. Power factor equals the cosine of the phase angle.
PF = Cos(38°) = 82.7%, or 0.827

6. 5 + j8 (To write the conjugate of a complex number it is only necessary to change the sign of the j term).

7. This equation is hard to find when you need it:

$$\frac{Np}{Ns} = \frac{Zp^2}{Zs^2}$$

8. Dynamic range (By definition).

9. B (There are eight symbols in the octal counting system: 0 through 7. There is no symbol 8 in the octal system).

10. The equation for capacitive reactance is:

$$X_C = \frac{1}{2\Pi fC}$$

Solve that equation for f and you get:

$$f = \frac{1}{2\Pi_C C}$$

Plug in the values and you get a little over 2000kHz.

Reach out and touch someone

By David F. Norman

Small business owners already know about the telephone. While we cuss it and hate it when it rings at an inconvenient time, we know we simply cannot survive in business without it. The phone allows us to be reached by our customers and it allows us to yell at a supplier thousands of miles away when shipments don't arrive as scheduled.

From ordering a pizza when lunch is going to be eaten with one glove on because you are too busy to stop, to making airline reservations for a trade show, the uses of the phone are simply too numerous to mention. However, lately there is another use for the phone which a lot of businessmen have not considered: putting your computer system "on-line."

Connecting the computer to the phone system

Few computers are sold now without a modem—a coined word which means MOdulator/DEModulator—a device which lets your computer "talk" to other computers over telephone lines. (For the nitpickers, it should be stated that modems are also used for other types of access, but regular telephone lines are the most common types of connection.)

Proprietary software—such as that used by franchised operations—has long used automatic dial-up to update catalogs, ask for orders, and send invoices for orders polled from the system. This process is usually so transparent and takes place at such odd hours that no-one pays it much attention unless it doesn't work. But that is only one of the many possible uses of a computer and a modem.

As we move very quickly into the information age, the number of reasons to get with it and get online continue to grow. Everyone knows about America Online and Compuserve. Everywhere you look in the paper, you hear about the Internet and the Information Superhighway. In fact, we hear about it so often, our eyes sometimes glaze over. But don't let that overexposure turn you off. There are a lot of reasons for all that hoopla, and some of them are good news for you personally and for your business. The next few installments of Computer Corner will deal with going online with a computer. Pardon me if I cover what you already know; the idea is to give you ideas.

Norman is an independent computer consultant.

Local bulletin boards

Local BBS Electronic Bulletin Boards (BBS) are not at all new. As soon as someone learned to connect a computer to a modem and call someone else over the telephone lines, BBS's were born. For many years, BBS services were mostly either hobbies or used for special services such as product support.

Protocols for transferring files over the wires were invented and improved until absolute reliability was a reality. Fiber optics improved the telephone service and speeds of transfers began to take giant leaps ahead. The original modems might transfer files at 50 or 100 baud. This translates out to five to ten characters per second. Some of us can type much faster than that.

Now speeds of 14,400 bps are the norm and 28,800 is rapidly becoming the standard. How fast modems will get is still unknown. With error correction and compression built into current modems, throughput—the actual speed at which data is transferred—can now exceed 40,000 bps or roughly 4000 characters per second. To put that into real world terms, I could send this document in only a couple of seconds or less to another computer with a fast modem and a clean phone line. Just plain beats mailing it.

It costs me just under a buck to mail a small manuscript and a disk anywhere in the U.S. I can transfer the same information for less than thirty cents anywhere in the U.S. and know that it got there in perfect condition. Why waste time faxing a document and have it look nasty when it gets there, when I can send it directly to

a computer where it can be printed out on a laser printer and look perfect? Of course, the fax machine will be around for a long time yet. Sending computer generated documents is one thing, scanning a document into a computer and faxing it that way is something else.

The cost of a bulletin board

Computers and modems can be used to move information very quickly, but there is more. National and local BBS services—not counting America Online and Compuserve and their competitors—are a big business. There are still a lot of free BBS services around, but someone has to pay for the upkeep. If you have multiple phone lines to your place of business, you know that each month there is a big flat fee—even if the phone didn't ring all month.

A medium sized BBS has from 10 to 20 lines plus the upkeep on the equipment to which they are connected. Unless the BBS operator is pretty well off, the bills have to be paid from BBS revenue. Fees from users pay some or all of the cost and other revenue comes from advertisers. This is where several opportunities exist for the electronic servicing dealer.

Working with an existing BBS

For modest fees—usually only a few bucks a month—you can offer your products and services to a technically oriented market. If the BBS provides a lot of service to its users, the users tend to be fiercely loyal—not only to the BBS but to the advertisers who sponsor it and help keep user fees low.

Another reason for supporting a BBS as an advertiser is the support you can provide for your customers. If I have a problem with something in the middle of the night, whenever possible I send the supporting party an E-Mail message. Then the support people can either call me or give me an answer to my question by return E-Mail. It works!

If you check your answering machine in the morning, you can figure on being tied up for an hour or so just chatting on the phone. When the solution you provide to your customer may be as simple as: "Unplug the unit from the wall. Wait for 30 minutes and then plug it in again and reprogram the clock and channel setup. If that doesn't fix it, bring it in and we will put it on the bench." Short, sweet, and to the point. If you had this kind of information available on a BBS, it wouldn't waste time—yours or theirs.

Announcements of sales and special offerings are easy to upload to the BBS and as your online customer base grows, you will probably build an E-Mail list of "hot" prospects for your services and wares.

Talk to a local BBS operator or "sysop" and ask if he has any ideas as to how your business might be improved by his particular operation. You spend lots of money for advertising of all sorts. Electronic advertising is cheap and effective. Some BBS's even take orders for products in their "Electronic Malls."

Setting up a BBS

If your business is directly involved with computer sales or service, your opportunities are even greater. You might even want to consider setting up your own BBS. What do you need to access a BBS? If you have a computer with a modem, you probably already have everything you need. Microsoft Windows comes with a basic communications program called, appropriately, Terminal.

Mustang Software makes a full line of communications software. Wildcat BBS software by Mustang is running on BBS's all over the world. They even offer a shareware version—which has most of the bells and whistles of the full-featured version and you can try it before you buy it. Whether you are running DOS or Windows, Mustang makes a communications package for your operation. You can "test drive" Q-Modem for DOS and even download it from Mustang's BBS (805-873- 2400) and all it costs you is a little phone time. Be warned, however, the files for Q-Modem are big and you need to be running at 9600 bps or higher to download it in any reasonable time.

For the last few months, I have been running Q-Modem for Windows. Whatever you want in a comm package, this one has it. Dozens of terminal emulations —so your computer can properly "talk" to the distant computer, even fancy mainframes—automatic dialers and "scripts" which let you automate your connections. The program's script programming language can get pretty complex, but most of us don't have to do anything other than turn on the "Quicklearn" facility and act just like we are recording a macro for any other program.

The software comes with a "host" script which sets up a mini-BBS on your computer so that someone can call you and upload or download files if you allow them to do so. If you are worried about access to your system, you can set it up as a closed, "callback" BBS.

Before anyone can access your computer when it is set up as a callback system, you have to first enter their login name, their password, and their modem's number. When they ring into your board and login, the system hangs up and then calls their modem back. When they answer—which can be automated by a script—they have to give their password again and only then are they permitted to upload or download files. Simple, but fairly impressive security.

Q-Modem can also use RIPscrip if the remote system supports it. RIPscrip allows you to use a mouse for point and shoot as you navigate through the BBS menus. For those of us addicted to the little rodents, this is a neat idea whose time has come. Last and maybe least, the program has a fax facility. This would be a much bigger deal except that most high-end word-processors do the same thing, better.

Next time on Computer Corner, we will discuss some of the business opportunities offered by increasingly less expensive Internet access, and speaking of E-Mail, my address is:dnorman@gem-.kern.com. ■

Servicing remote control transmitters

By Ricky Hall

One of the more profitable products that I service in my service center is remote control transmitters. That is, considering the amount of time I have to put into servicing a remote unit, the amount I charge for this service, and the success rate, the return I receive is very good.

A typical repair, if it is feasible on a remote, takes about 20 minutes. If it takes much longer than that, it isn't worth it. I find that my success rate on remotes is about the same as for TVs, and much better than for VCRs and stereos. For this I can charge about one-fourth the amount that a customer would have to pay for a new unit, if the customer had to buy a new remote from the original manufacturer.

You might say, that the customer could just buy a universal remote for near what I would charge to service one. That is possibly true. However, most of today's TV and VCR remotes have special functions such as menu, setup, sleep, and tracking. It isn't always possible to find a remote unit that performs all of those special functions. Moreover, the customer is comfortable with the remote and would usually rather spend a reasonable amount to fix their remote than to learn how to operate a universal product.

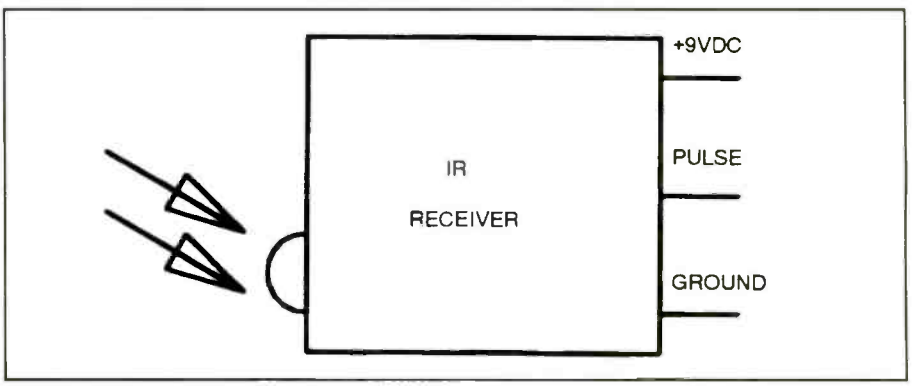


Figure 1. If you have a discarded TV or VCR waiting to be scrapped, you may be able to reclaim the IR receiver. Many of them have connections as shown here. IR receivers are also available inexpensively at stores that sell electronics components.

The remote tester

A remote control unit tester is a must for faster and easier remote servicing, not one of those card indicators that gives off a reddish glow when you hold a remote near it in subdued light. I quit using those cards quite some time ago. They work fine, but they require the use of both hands and I found them hard to see unless the light in the room was dim.

There are some store bought testers on the market. I have seen one in an electronics catalog, for example, that is in the form of a pen. That unit might be OK for testing an IR signal inside a VCR, but I don't use one for remote testing, for the same reason that I don't like the card tester. You have to hold down a button with one hand and the remote in the other.

The best remote tester I have used is one that I built myself, and it didn't cost anything. I used an old IR receiver from a discarded TV set, a box from an old antenna booster power supply, a power supply from an old Atari game, and an LED from an old VCR. I also built a handy compact model using Radio Shack parts (Table 1). An article on those units was published in the March 1993 issue of **Electronic Servicing & Technology.**

The diagrams showing the IR receiver, and the construction of the tester, are reproduced here as Figures 1 and 2 for your convenience. With this tester, you can check output from a remote from clear across the room. You can mount or set the unit on a shelf, plug it into the ac and it will be on and ready whenever you need it, and you don't have to dim the lights or hold the remote transmitter close to the tester in order to get an indication.

You could build another unit, and run it off a 9V battery to take along on calls. My wife works in the service center most evenings while I am out on calls, and she uses the tester when a customer comes in and thinks that his remote needs batteries. The customer can see for himself whether or not the remote works.

Bad solder connections

The most frequent cause of remote failures is bad solder connections, especially on the leads of the crystal, the LED and any other heavy parts on the circuit board. Many times, the broken lead of the crystal will be broken off very short.

I desolder the crystal and scrape around the broken lead with a razor knife to clean off as much of the broken lead as possible. Then I strip an old TV or VCR line cord, take one of those thin strands of copper wire, and wrap it around the broken lead and solder. After reinstalling the crystal in the circuit board, I glue it to the board with some silicone rubber. This will help absorb the shock, and the crystal will not shake loose again. Most manufacturers are now using some kind of adhesive, or sticking the crystal down with two-sided tape so broken crystal leads will probably be less common in the years to come.

Spilled liquids

The next most common problem I encounter in remotes is the spillage of coffee, tea or soft drinks into the unit. In most

Hall is the owner and chief technician at Hall's TV in Prentiss, MS.

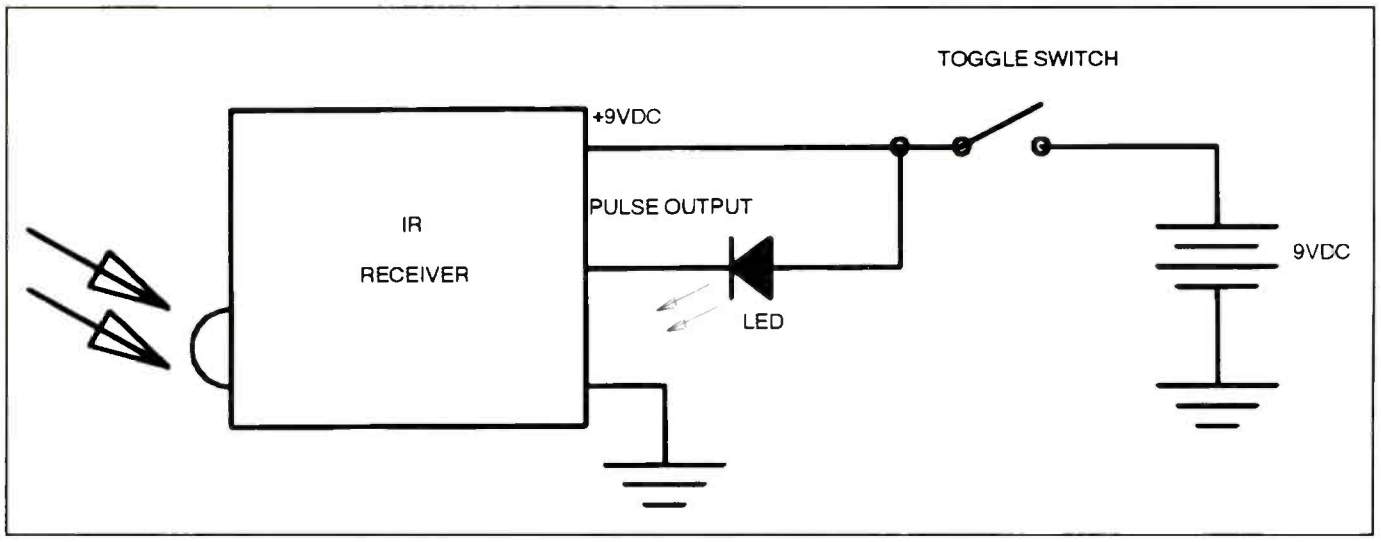


Figure 2. A simple circuit, as shown here, can put an IR receiver to work as an IR remote transmitter tester.

Table 1

IR Receiver	276-137
High Brightness LED	276-066
Case (Box)	270-293
9V Battery Clip	270-325
SPST Toggle Switch	275-624

Table 1. You can build the IR tester circuit in Figure 2 using the bill of materials shown here. The case has a compartment with a door that you remove to insert a 9V battery.

cases, the customer isn't even aware that something has been spilled into the remote. The best way to fix this problem is to take the unit apart and give it a good bath. Don't use an aerosol contact cleaner such as alcohol, Blue Shower, etc., to clean the conductive rubber pads. I ruined several remote-control transmitters trying to do this, and it just doesn't work.

I use a household cleaner called Whistle Cleaner. It is a cleaner/degreaser, and works quite well. I'm sure that any other cleaner of that type, such as 409, Glass Plus, Fantastic, or any of the many similar products would also work. But try any of them on a remote you're not too particular about first, to be sure that they won't damage the unit.

Just spray down the circuit board, the rubber conductive pad, and the top cover of the remote unit. Use a soft toothbrush, and scrub it down well. Be particularly careful to clean the circuit board where the conductive rubber pad meets the board. Usually there will be a buildup of drink and crumbs around the holes in the top cover. Clean this well with a brush so the pushbuttons can move freely.

Next, rinse the unit well and shake off the excess water. The best way I have found to dry the parts before reassembly is to use a vacuum cleaner in the blowing mode. Turn the vacuum on before you start the cleaning and by the time you are ready to dry, the air will be warm.

The air from my vacuum is fairly strong, but not as powerful as the airstream from a compressor hose, which might blow parts around. Also, the air is very dry, and after it has run for about five minutes it is slightly warm. I find that this dries the parts much faster than using a heat gun. Also if you use a heat gun you run the risk of overheating parts.

Other failure modes

Some of the other fixes are broken wires, broken circuit board traces and broken battery terminals. There is an older Zenith IR remote that doesn't use a crystal. This unit is based on a tuned circuit, and has an adjustment on it. When I encounter this unit, I try tuning the unit a little at a time, then try it on a Zenith TV, until it works. I have found that in about ninety percent of the cases, if there is output from the remote transmitter, it will operate the product's remote receiver.

In the case of the Zenith tunable remote control, and one NAP unit, there are occasions when it will not operate the TV set, even though you will see an indication of output on the remote control tester. In the case of the NAP remote, the LED on the tester will flash very slowly. If you see this slow flash, you will know that the lead on the crystal is broken.

Save those old remote control units

It is a good idea to save all your old remote controls from discarded sets, and any remotes left at the service center. It is usually not worth the trouble to order replacement components for remote control units, so things like battery covers, top covers, bottom covers, IR output LEDs, LED lenses, crystals, batteries, terminals and such come in handy.

UHF transmitters can be serviced too

Ninety-nine percent of the remotes that are brought in for service today are the IR type. I have, however, worked on a few of the UHF type that work with satellite systems. The IR tester won't do you any good on those, but a large percentage of those can be serviced, too.

Considering their small size and low cost, it might seem at first glance that remote control units just aren't worth bothering with, and that they should simply be discarded when they fail. But as this article demonstrates, remote control transmitters can be serviced profitably, keeping many of them out of the landfill. ■

What Do You Know About Electronics?
Motor speed control and load lines

By Sam Wilson (WA8RMS)

In a previous issue we reviewed the constant-current supply as it applies to dc motors. Remember that a constant voltage is applied to a dc motor if you want a constant speed. A constant current is applied if you want a constant torque. This installment of WDYKAE? will look at another example of how a constant-current generator is used.

Achieving constant current

Figure 1 shows a traditional differential amplifier with a constant-current diode supplying the two halves of the circuit. We have reviewed the constant-current diode before. It can be made with a JFET having the gate tied to a series source resistor.

There are a number of other ways to get the constant-current input to the differential amplifier. Textbooks tell us that the constant current is necessary so that the sum of the transistor currents will be a constant value. Textbooks also say that the constant current can be obtained by using a high value of resistance. The question is: How can a high resistance give us a constant current? Figure 2 tells the story.

This graph shows the relationship between resistance and current in a circuit that consists of a 0Ω to 600Ω variable resistor in series with a 500Ω resistor. Only five points are used to show the relationship between resistance and current. The steep downward slope indicates that this is not a constant-current relationship. If the current were constant, the current vs voltage curve would be a horizontal line. On the same graph, the current/resistance relationship with the fixed resistance increased to 5000Ωs is shown. As shown by the decreased slope, this circuit is nearer to a constant-current relationship.

Whoa! Wait just a darn minute! The second curve only shows the more constant current/resistance relationship when the circuit has a greatly reduced current.

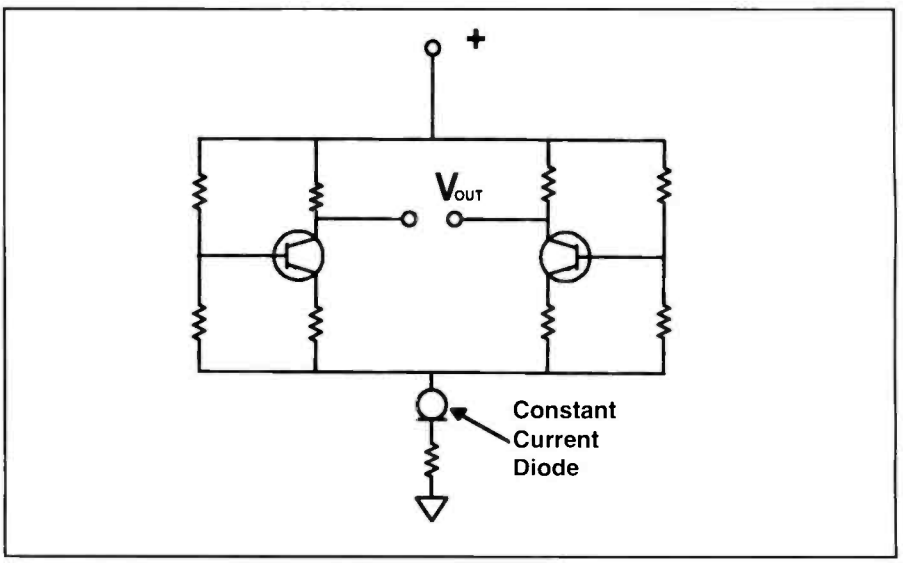


Figure 1. A traditional differential amplifier with a constant-current diode supplying the two halves of the circuit.

What we want to see is a constant current/resistance curve when the current starts at the same point.

Getting higher constant current

Not to worry. Look at the graph in Figure 3. If the applied voltage is raised to 150V, the initial current starts with the same current value as the first graph: 30mA The graph in Figure 3 shows a more-nearly constant current relationship. However, it was obtained by increasing the applied voltage.

Actually, the second graph in Figure 2 is closer to what we are looking for. It accomplishes a better constant-current relationship with the lower voltage. That is the better choice if the amplifiers can operate at the reduced current.

BIFET works better

We established at the outset that the circuit in Figure 1 is a traditional differential amplifier. We're talking about the earliest 741 op amp input circuit. That circuit works much better if you trade in the bipolar transistors for "BIFET" (bipolar field-effect transistor) amplifiers. (Figure 1 inset.) You will also see the newer version referred to as BICMOS. Other favorite terminology is also used.

The point is this: by using a FET to control the base current of the bipolar transistors you get a high-impedance input to the circuit, and to the op amp. The high input impedance translates to the fact that the circuit delivering a signal to the input doesn't have to supply signal power. Read "signal power" to mean signal current. So, you get the advantage of the high (input) impedance FET and the higher-current controlled amplifier.

Picking more nit out of theory

When you mention Newton's Law of Gravity out loud in some circles, you're inviting the statement: "Einstein's Law of Gravity has replaced Newton's Gravity Law". Let's take a look at the difference.

Newton's law of gravity is written in equation form as follows:

$$F = m_1 m_2 / d^2$$

where F is the force of attraction between bodies with masses M1, and M2, and d is the distance between the masses. A constant of proportionality is usually

Wilson is the electronics theory consultant for ES&T.

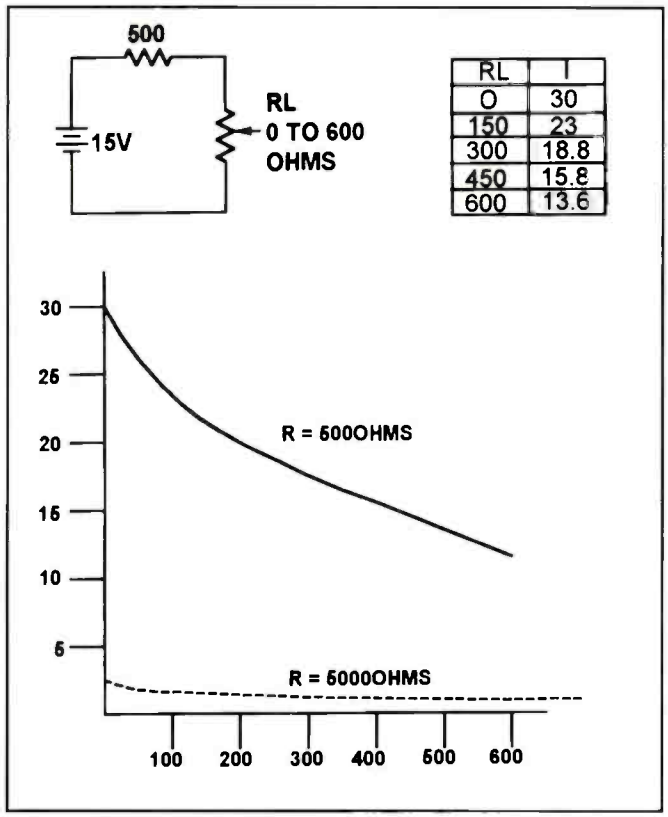


Figure 2. The upper curve on this graph shows the relationship between resistance and current in a circuit that consists of a 0Ω to 600Ω variable resistor in series with a 500Ω resistor. The lower curve shows the current/resistance relationship with the fixed resistance increased to 500Ωs. As shown by the decreased slope, this circuit is nearer to a constant-current relationship.

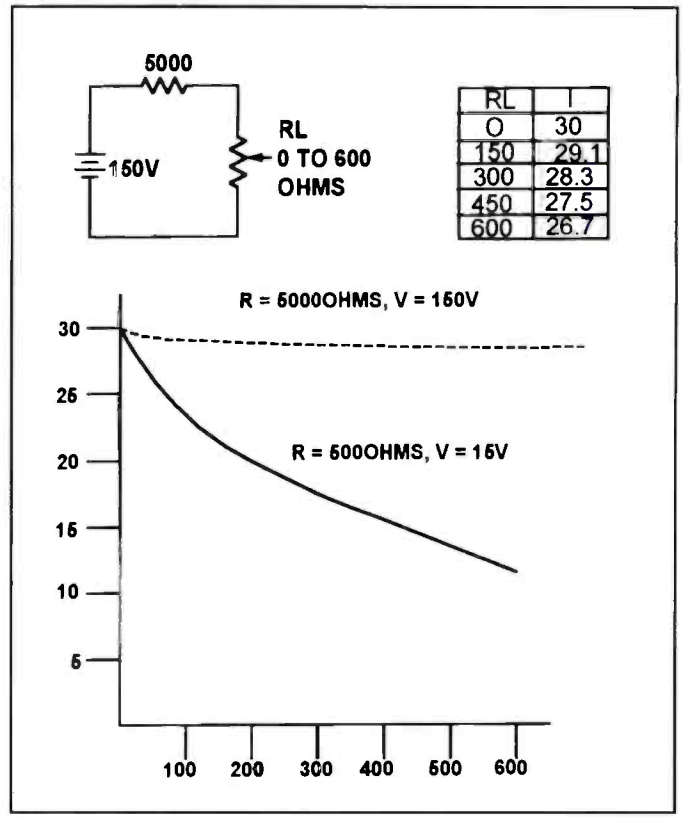


Figure 3. If the voltage applied to the circuit of Figure 2 is raised to 150V, the initial current starts with the same current value as the first graph: 30mA. This graph shows a more-nearly constant current relationship. However, it was obtained by increasing the applied voltage.

included to take care of different mediums between the masses.

Grinding in the effect of relativity, Einstein's Law of Gravity is:

$$F = m_1 m_2 / d^{2.00000016}$$

If you are dealing with heavy objects at a great distance—like planets—Einstein has it. However, if you are working with two Nerf balls separated by a distance of one centimeter, defer to Newton's Law. Einstein's Law did not replace Newton's Law, it increased the accuracy of Newton's Law when dealing with large values of mass and distance.

That infrared thing

It was student Joe Feusner of Wichita, KS who asked about the Radio Shack infrared detector. The question is, "How does it work?" His instructor, David T. Ronan, in Norcross, GA, passed that question on to me. I, in turn, asked the readers of this column how it works.

Many thanks to the readers who sent circuits for IR detectors. But, so far not one reader was able to explain the Radio Shack device that changes color when exposed to infrared light. I managed to go through chemistry in college without taking the lab. I had to get special permission from a doctor to duck out of that lab. I passed the course with a B, but I can't say I know much about the subject. However, I don't feel too bad about it. None of my readers have explained how it works. Neither did the guy who makes keys at Ace Hardware.

So, let me ask one more time—Does anyone know how the Radio Shack IR detector works? Send me an explanation and I'll send you a gift.

Leak detectors

Question: How do they use electronics to detect very small leaks in pneumatic systems?

Answer: They use ultrasonic detectors. Those detectors can pick up the very low volume of ultrasonic sound the leaking gas makes.

If you are thinking of taking the CET test and you want the Industrial Electronics option, ISCET is using the Howard Sams book titled "Industrial Electronics for Technicians" by J.A. Sam Wilson and Joseph Risse. Howard Sams sells the book under the publisher name "Prompt". You can get the book from: ISCET, 2708 West Berry Street, Ft. Worth, TX 76109-2356. Be sure they send you the correction sheet!

A different load line problem

We have reviewed load lines in previous issues. Let's start this discussion with a typical load line problem that will serve as a review. We will then review a different kind of problem. Figure 4 shows a transistor connected across a Thevenin equivalent generator. It is presumed that the generator represents a more complicated circuit where the transistor is actually connected. The applied voltage is 10V and the current is known to be 5mA. The base current has been adjusted to equal 60μA.

The problem is: what is the voltage across the transistor and what is the cur-

rent through the transistor? To solve this problem, start by locating two points on the graph: the open-circuit voltage of 10V and the short-circuit current equal to 10V/2KΩ = 5mA. Draw the load line between those two points. At the point where the load line crosses the 60µA base current curve, draw a vertical broken line down to the voltage axis, and horizontal broken line over to the current axis. The current is 3.8mA, and the voltage across the transistor is 2.45V

Solving for base bias current

Now let's try a different type of problem. Refer to Figure 5. Again, a transistor is connected across an equivalent Thevenin generator. The short-circuit current is 7.5V/1250Ωs = 6mA. The open circuit voltage is 7.5V. The load line is drawn using those values.

The problem shows that there is 5V across the transistor. The question is: What is the base bias current? To solve the problem, project a line up from the 5V point to the point where it strikes the load line. That point is on the 40µA curve, so the base current must be 40µA in order for the voltage across the transistor to be 5V. ■

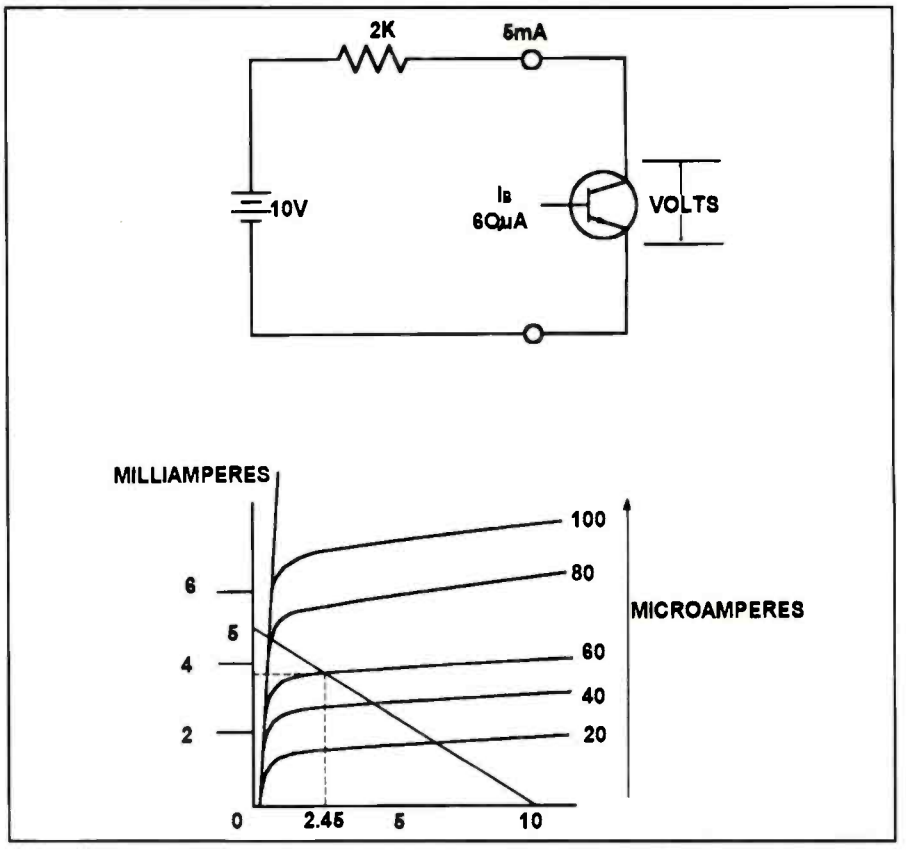


Figure 4. The transistor is connected across a Thevenin equivalent generator. The applied voltage is 10V and the current is known to be 5mA. The base current has been adjusted to equal 60µA. You can use a load-line technique to determine the voltage across the transistor and the current through the transistor.

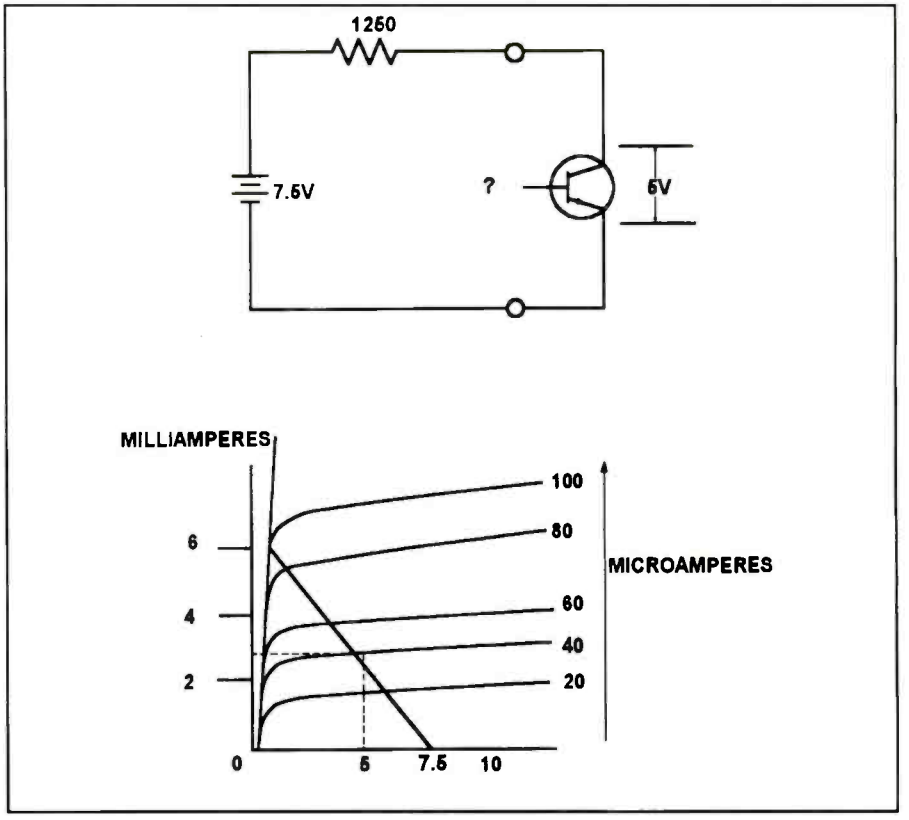
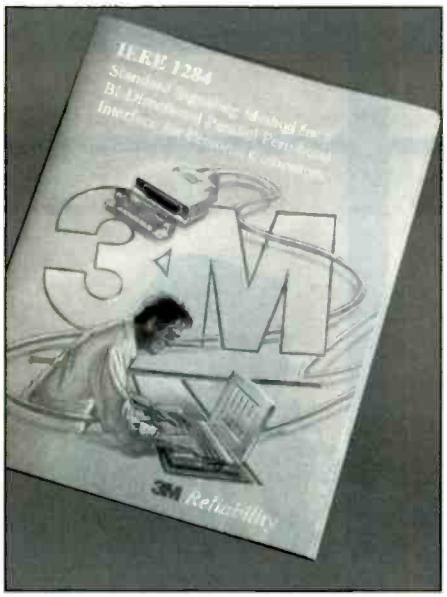


Figure 5. Here's an example of using a load line to solve for base bias current. To solve this problem, project a line up from the 5V point to the point where it strikes the load line. That point is on the 40µA curve. So the base current must be 40µA in order for the voltage across the transistor to be 5V.

Literature

IEEE 1284

A new color brochure is available from 3M Electronic Products Division describing their line of IEEE 1284 compliant products. The newly adopted IEEE1284 standard for high-speed peripheral-to-host communications defines a new bi-directional signaling method and establishes standards for the cable and connectors needed to attach peripherals to a host Personal Computer.



The 42-page brochure provides product features, color photographs and technical drawings of the company's IEEE 1284 boardmount and wiremount connectors, 1284 cables, compliant assemblies, adapters, and accessory hardware. The brochure also details the physical, electrical, and environmental characteristics of the compliant products.

Circle (55) on Reply Card

Solvent guide update

An all-new solvent guide update is now available from Dynaloy, Inc., a manufacturer of specialty chemicals and solvents serving such industries as telecommunications, computers, electronics, plastics processing/molding, automotive, avionics/aerospace, medical, audio/video, converting and laminating.

The one-page flyer is an update to the main Solvent Selection Guide, and describes a new line of safety solvents for solving industries' concerns of health, safety, disposal, and the environment.

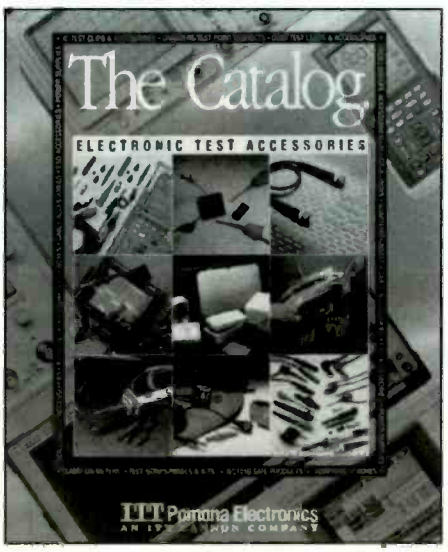
Applications for these solvents include general cleaning and degreasing ; cleaning of urethane and isocyanate residues from equipment and molds; the removal of mold release residue from plastic molded parts; cleaning of silicone oils and uncured silicone polymers from molds and equipment; and the cleaning and defluxing of printed circuit boards.

Circle (56) on Reply Card

Test accessories catalog

ITT Pomona's 1995 Electronic Test Accessories Catalog contains 172 pages of more than 3,800 specialized products arranged in an easy-to-read format including helpful selection guides. All of these accessories are designed to optimize the performance of test equipment and to guarantee consistently reliable test results, according to the company.

Useful as a resource, companion piece to equipment from Hewlett-Packard, Tektronix, Fluke and other leading manufacturers, the catalog includes short tutorial sections such as, "Selecting the Right Scope Probe" and "Extending Your DMM'S Capability."



Featured products include: a new series of 30-450 MHz oscilloscope probes which integrate an all-new surface mount device (SMD) circuit, developed for use in testing today's highest-performance ICs; new IC test clips including a 240-pin version for MC68360 devices; sealed polycarbonate and die-cast aluminum enclosures; a pocket-sized logic scope probe; ultra-thin micrograbbers for testing fine-pitch (0.25 mil) ICs; a programmable IC/socket test switch test adapter; high-voltage and plug-on specialty probes, and a new line of ESD accessories and test/service kits.

Circle (57) on Reply Card

Electronics product catalog

Galco Industrial Electronics has released an updated, easy-to-use, product catalog containing over 300,000 items in over 1,300 pages. These items are easily located through the use of either a comprehensive product or manufacturer index and each section features an individual index for quick referencing.

The greatest enhancement to the company's newly revised Full Line Product Catalog is an all-new complete alphanumeric listing of semiconductor part numbers and their location within the semiconductor section. Modifications have also been made to many of the product lines in the semiconductor section including additional detailed technical specifications and data, 157 pages of new semiconductor products, a fully revised, user-friendly section index, and more.

Many new product lines have been added during 1994. Some of the new lines include, Autocon/Dynapath, BEI, Bourns, Control Techniques Dart Controls, Electromatic, Mallory and Thor Electronics. These new product line pages are located at the beginning of the appropriate catalog section and are highlighted at the top of the corresponding section index. The new products are also featured in the product and manufacturer index located in the back of the catalog. All "New Product Pages" have been tabbed for quick and easy reference.

Circle (58) on Reply Card

Technical supplies catalog

New from HMC is a detailed, fully-illustrated buying guide of electronic tools, test equipment and technical supplies for the assembly, testing and repairing of electronic products. This catalog contains a large selection of brand-name items including precision hand tools, test instruments, datacom/telecom equipment, tool kits, soldering/desoldering systems, lamps and magnifiers, static control products, industrial chemicals and adhesives, measurement and inspection instruments, and work stations.

Circle (59) on Reply Card

Leadership: A rare and valuable commodity

Part Four — Political Leadership

By John A. Ross

This magazine may seem like an unusual forum for a discussion about political leadership. With the exception of our membership in various organizations and our concerns about legislative moves, most of us have very little to do with political aspirations. Furthermore, most of us view political behavior, and thus, political leadership as an undesirable but unavoidable part of organizational life.

Political leadership is everywhere

However, the notion of political leadership surrounds us and affects our actions in a variety of ways. When we consider the leadership spectrum described in previous articles, political leadership becomes difficult to place.

Certainly, transactions occur in the political leadership arena. Just as political leadership tugs at and nudges the concept of ethical leadership. In organizations, political behavior becomes evident when considering the allocation of scarce resources, when evaluating personnel, during the setting of organizational goals, and during the making of decisions.

It becomes obvious, then, that individuals will manipulate organizational politics to acquire, enhance, or to use power and other resources in order to obtain a desired outcome in a given situation. Usually, the situation will involve some type of disagreement or uncertainty. Considering the allocation of scarce resources, astute political behavior by one manager may garner more resources for his section while robbing resources from another section of the organization.

In terms of evaluation, the first manager may win a higher evaluation from his superior. The other manager may receive a message about his perceived lack of performance in the form of a lower evaluation. As mentioned, political behavior also comes into play during the goal-setting and decision-making processes. Individuals may shape organizational goals and decisions, so that not only the organization benefits, but the individual benefits as well. A manager or employee may adamantly push for a new organizational direction, knowing that he will gain personal rewards during implementation.

Ross is a technical writer and microcomputer consultant for Ft. Hays State University, Hays, KS.

Methods of obtaining power

Some methods to obtain power include:

- Controlling information—providing only parts of critical reports for organizational review, omitting certain key or damaging facts, and lies.
- Controlling lines of communication—controlling access to individuals.
- Using outside experts—justifying a position or decision through the claims made by friendly, outside experts.
- Controlling the agenda—keeping a decision off the agenda, extending discussions so that everyone tires, or raising technicalities about a proposal.
- Game playing—being absent when crucial, potentially disruptive decisions are being made, pretending not to be in the decision-making or leadership loop, leaking sensitive information, and showing favoritism to some, ignoring others.
- Image building—maneuvering by individuals so that they participate in only the successful projects, taking credit for the work of others, exaggerating personal accomplishments.
- Building coalitions—urging others to join ranks before a controversial decision has to be made.

• Controlling decision parameters—defining the criteria or specifications by which a decision is made. In this way, the individual may seem unbiased since he can maintain some distance from the actual decision-making process.

Each one of the behaviors listed threatens the stability of the organization and undermines the ability of the leader. Unfortunately, none of us can simply eliminate these behaviors, but, we can take specific actions that will negate the effects behind these behaviors.

Countering political behavior

Countering political behavior in the organization calls for the recognition of political behaviors. Indeed, recognizing these behaviors, and the opportunity for these behaviors to surface can allow the political leader to anticipate certain actions. With anticipation as a weapon, leaders may opt to enlarge and open communications to the entire organization, or productively move to eliminate uncertainty. Instead of allowing rumors to grow, the political leader may make announcements as decisions are made.

In the end, political leadership requires an awareness that leaders and followers play given roles, and an awareness that those roles change often. The exchange of roles may occur over time and with different political settings.

According to James McGregor Burns, leaders have a special role where they become activators, initiators, and mobilizers. The personal influence of a leader flows in multiple directions, and both vertically and horizontally. True leaders will attempt to sort personal motivations from the decisions that affect the direction of the organization.

Moreover, true leaders will maintain contact with ethical values while performing the transactions that are a necessary part of their daily activities. In this way, these leaders create followers who have the ability to become leaders. Instead of maintaining a tight grip on political power, true leaders spread the power, keep organizational communications honest and open, and anticipate personal and organizational needs. All of this allows the leader to negate the effects of political behavior. ■

***Simplifying Power Supply Technology*, PROMPT Publications $16.95 paperback.**

Simplifying Power Supply Technology offers an entry point for people interested in the field of power supplies.

Power supply technology has come a long way in recent years. Many researchers have dedicated their careers to advancing the field of power electronics and a good amount of effort is put into making contributions to the field. One can easily appreciate this field by understanding the basic concepts involved.

This book simplifies the concepts of power supply technology and gives the reader the background and knowledge to confidently enter the power supply field. It is also useful to experienced technicians as a reference guide to the basic concepts of various topologies. Topics covered include: input, regulators, converters, control, specifications, and more.

The book was written for readers from various backgrounds. Students, hobbyists, professional technicians, engineering assistants, and marketing and sales people will find this a useful and informative companion volume in the power supply industry.

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

***Basic Principles of Semiconductors*, By Irving M. Gottlieb, PROMPT Publications, 161 pages, $14.95 paperback.**

In *Basic Principles of Semiconductors*, from an exploration of atomic physics right through a detailed summary of semiconductor structure and theory, established author Irving M. Gottlieb takes readers on a step-by-step journey through the world of semiconductors.

Despite their ever-growing prominence in the electronics industry, semiconductors are still plagued by a stigma which defines them merely as poor conductors. This view fails to take into account the fact that semiconductors are truly unique alloys whose conductivity is enhanced tenfold by the addition of even the smallest amount of light, voltage, heat, or certain substances.

As the book illustrates, this inherent characteristic alone has led to semiconductors eclipsing the vacuum tube as the foundation for electronic technology. Multidiscipline investigations involving physics, chemistry, materials science, and electronic-engineering have been required to optimize the unique conductivity properties of semiconductors for practical use, but their success and conclusions have led to benefits we are just now starting to reap. Some of the subjects covered include: electrical conduction, transistor structure and materials, semiconductor injection lasers, power MOSFETs, Gunn diodes, and more.

With its simplified explanations and thorough discussions, *Basic Principles of Semiconductors*, provides everyone from the hobbyist and student right up to the technician and professional electrician with an introduction and reference into the principles of semiconductors.

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

***Handbook defines electronics acronyms*, Rothschild & Associates, $9.75 a copy.**

A new 28-page handbook takes the mystery out of the bewildering number of acronyms used in electronics. Titled *HOTCAKE-Handbook of a Thousand Common Acronyms to Know in Electronics*, this booklet defines hardware and software acronyms used in communications, IC design, computer architecture, RF and microwave, video graphics and networking (including Internet). It also includes acronyms for worldwide standards, organizations, societies, consortiums, and government agencies and programs. Definitions of general terms used in electronic engineering and business are included as well.

The publisher, the electronics consulting firm Rothschild & Associates, plans to issue new expanded versions of *HOTCAKE* twice a year to keep up with the proliferation of new acronyms.

Rothschild & Associates, 175 Knibloe Hill Road, Sharon, CT 06069

***Troubleshooting and Repairing Compact Disc Players, 2nd Edition*, By Homer L. Davidson, TAB Books, 544 pages, 500 illus., $24.95 paperback, $44.95 hardcover.**

In this second edition of his guide *Troubleshooting and Repairing Compact Disc Players*, Homer L. Davidson gives practicing electronics technicians and students at all levels the hands-on service information they need to correct problems in the latest CD player.

Starting with clear explanations of the basic principles common to all CD players, Davidson then moves on to cover in illustrated detail every circuit found in these remarkable, but often problem-prone machines. Readers learn how to remove and replace defective laser heads; troubleshoot and replace low-voltage power supply circuits; repair servo systems; build an infrared tester; use an oscilloscope to service signal circuits; locate and replace defective slide, load, and disc motors; and more.

TAB Books McGraw-Hill, Inc., Blue Ridge Summit, PA 17294-0850

***The Beginner's Handbook of Amateur Radio; 3rd Edition*, By Clay Laster, TAB Books, 416 pages, 210 illus.,$21.95 paperback.**

This new edition of *The Beginner's Handbook of Amateur Radio* provides information on how to get started in the exciting hobby of ham radio operation. Author Clay Laster gives readers the low-down on equipment and everything else necessary to "get on the air."

This edition shows how to build a fully equipped amateur radio station, and covers the latest amateur radio equipment, FCC rules and regulation, and operating and frequency/band privileges for all license classes. It even explores the theory of electricity and electronics and radio wave propagation.

TAB Books, McGraw-Hill, Inc., Blue Ridge Summit, PA 17294-0850

***Advanced Electronic Projects for Your Home and Automobile*, By Stephen Kamichik, PROMPT Publications, 160 pages, illus., $18.95 paperback.**

You will gain valuable experience in the field of advanced electronics by learning how to build the interesting and useful projects featured in *Advanced Electronic Projects for Your Home and Automobile*. You can build the projects covered in this book whether you are an experienced electronic hobbyist or an electronic engineer.

The book shows you how construct the following: active filters, stereo preamplifier, surround sound system, speaker systems, infrared remote control, electronic scorekeeper, brain wave monitor, car anti-theft system, and more.

Everything in this book has been thoroughly tested by the author, and a detailed explanation of each circuit is given to help you understand its operation. Each project is designed to give you years of enjoyment and reliable service.

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

***Surface-Mount Technology for PC Boards*, By James K. Holloman, Jr., PROMPT Publications, 520 pages, illus., $26.95 paperback.**

Surface-Mount Technology for PC Boards details the evolution, application, and benefits of surface-mount technology, or SMT. As author James K. Holloman, Jr., points out, SMT holds great promise for manufacturing technology and the race to adopt it has been described as the latest revolution in electronics. This book will give everyone from the engineer to the interested layman the inside track on this pace-setting technology.

Since its introduction, the largest roadblock for the complete acceptance and efficiency of SMT has been a lack of communication. The how-to knowledge of SMT comes from the factory floor, but the exchange of ideas and demands between the electronics designers and manufacturing personnel has been either nonexistent or, at best, ineffective.

Surface-Mount Technology for PC Boards provides a two-way street for communication between the manufacturing technology and the layout considerations for surface mount technology.

The subjects covered include: benefits and limitations of SMT, surface-mount components, manufacturing methods, practical applications and standards, glossary and more.

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

***Easy Laser Printer Maintenance and Repair*, By Stephen J. Bigelow, 224 pages, 200 illus., $18.95 paperback, $28.95 hardcover.**

Laser and LED printers have become indispensable fixtures in most of today's offices and, like other office equipment that usually performs reliably, are taken for granted-until they break down. Then, an office can be thrown into chaos while waiting for a professional technician to arrive, never mind the expense of service calls. For readers who want to save money and keep their printers in top operating condition, *Easy Laser Printer Maintenance and Repair* is the perfect all-in-one manual.

Written especially for those with modest technical skills, this easy-to-use guide will have readers handling common problems such as poor image quality, and paperjams and misfeeds with ease. Step-by-step instructions and illustrations aid in solving more complex problems too. And, just as important, this book teaches how to extend a printer's life by performing adjustments, cleaning, and other routine maintenance-all without having to call on a professional.

Chapters are included on: components, power supplies, image formation systems, soldering and test instruments, service guidelines and precautions, mechanical systems, electronic controls, and service guidelines.

The book also includes an index of printer manufacturers and supply sources and a "quick reference" index of troubleshooting procedures.

Professional Book Group, McGraw-Hill, Inc. Blue Ridge Summit, PA 17294-0850

***Troubleshooting and Repairing Consumer Electronics Without a Schematic*, By Homer L. Davidson, TAB Books, 320 pages, 250 illus., $22.95 paperback, $34.95 hardcover.**

Working on electronic equipment without the help of detailed schematic diagrams is one of the most common and time-consuming dilemmas faced by technicians, students, and advanced hobbyists. That's where *Troubleshooting and Repairing Consumer Electronics Without a Schematic* comes in.

In this heavily illustrated, highly practical guide, Davidson reveals a virtual gold mine of trade secrets he learned during his many years as the owner of a profitable radio and TV repair business. Davidson explains how to successfully pinpoint, test, and repair faulty components in everything from compact disc players, VCRs, and cassette decks to car radios, audio amplifiers, and color and black and white TV chassis.

A handy list of common mechanical symptoms, a time-saving troubleshooting chart that tells readers where to look for specific problems, and actual case histories that explain how various repairs were made are included for each type of unit covered in the book.

Davidson is one of the best-known authors of electronics troubleshooting and repair books. He is the TV Servicing Consultant for **Electronic Servicing & Technology** magazine and author of *Troubleshooting and Repairing Solid-State TVs, 2nd Edition* and *Troubleshooting and Repairing Audio Equipment, 2nd Edition*

TAB Books, McGraw-Hill Inc.,
Blue Ridge Summit, PA 17294-0850

***Mechanical Devices for the Electronic Experimenter*, By Britt Rorabaugh, 240 pages, 250 illus., $18.95 paperback, $29.95 hardcover.**

Electronics enthusiasts often find that experiments, especially those in the field of robotics, have significant mechanical elements in addition to their electronics content. But most electronics books don't delve into the particulars of how to build the mechanics or adapt other parts. In *Mechanical Devices for the Electronics Experimenter*, amateur robot builders and electronics and computer hobbyists will at long last, find the nuts-and-bolts instructions needed to design and build mechanical devices for motion and positioning in robotic application, among other uses.

Using an abundance of high-quality illustrations, this guide describes in detail how to design robot propulsion systems, fabricate homemade components for pneumatic systems, design simple hydraulic systems and motor controller circuits, design and fabricate solenoids, design gear trains and cams and design and fabricate vacuum actuators.

Author Britt Rorabaugh includes plenty of useful practical and theoretical information, such as concise explanations of the measuring units used by engineers and an explanation of electromechanical forces and how to harness them. A tinkerer's gold mine, according to the publisher, this book also includes thorough explanations of how to adapt automotive and other types of parts for use in electronics experiments.

Professional Book Group, McGraw-Hill Inc.,
Blue Ridge Summit, PA 17294-0850

Coming Next Month

Servicing a computer with floppy drive, printer and mouse problems

In this article, the author, Jurgen Ewert describes using a diagnostic program under difficult circumstances to correct a multiple-symptom controller problem.

Servicing RF distribution problems

Many hotels, hospitals, convention centers, schools and other large buildings have their own RF distribution system to distribute the signal from a satellite receiver throughout the building. In this article, the author, Arthur Flavell, describes a typical RF distribution system and provides tips on troubleshooting problems in such a system.

Electronics servicing chemicals

The banning of Freon has led chemical companies to create a new arsenal of chemicals that is more friendly to the environment and no less effective in getting the job done. It is important, however, that the technician select a chemical that is effective but will not damage any of the materials it is used on. This article by the ES&T staff lists and discusses some of the chemicals that are useful to the technician in performing servicing.

would approach stations in San Francisco, Chicago, Los Angeles, and New York about using RBDS. In each city, the EIA will also conduct educational programs to raise public awareness about the technology and its uses.

"This is the fastest way to bring RBDS to the largest number of stations serving the largest radio audience," said Gary Shapiro, group vice president of EIA's Consumer Electronics Group. "Having some of the largest cities on board with RBDS should then make it easier for stations in the other 20 major cities to start using the technology. While this is being accomplished, manufacturers will be able to commit more marketing efforts to sell RBDS radios in the U. S. "

EIA's plans call for approaching the following cities: Philadelphia, San Francisco/Oakland, Chicago, Los Angeles, New York, Dallas/Ft. Worth, Houston/Galveston, Washington, D.C., Baltimore, Boston, Long Island (N.Y.), Miami, Tampa, Atlanta, Detroit, Cleveland, Pittsburgh, Cincinnati, Minneapolis, Seattle, Anaheim, San Diego, Phoenix, Denver, St. Louis.

A timetable for each city has not yet been set, although the EIA says it will shortly begin to work in San Francisco and work to finish each city as quickly as possible. Plans call for reaching the 25 markets within the next 12 months.

EIA believes that stations in smaller markets will eventually add RBDS because they clearly see the benefits it offers. EIA has pledged $500,000 in matching grant funds to equip stations with RBDS technology. To date, Delco Electronics Corporation, Denon Electronics and Pioneer Electronics (U.S.A) have committed matching funds and or product(s) for this project.

NSCA offers the first in a series of new video training tapes

A new video training tape on Basic Microphone Construction is now available from NSCA, as part of its ongoing program to provide members with high quality educational programs and services. Produced by the NSCA and Foto-Comm Corporation, the new training tape describes the various types and operating principles of microphones, and shows the viewer how to compare microphones according to manufacturers' published specifications. It also provides valuable tips on selection and applications for various microphone types.

According to David Read, Director of Education for NSCA, the Basic Microphone Construction tape is the first in a series of new NSCA video training tapes. Future tapes will cover mixers, signal processing, amplification and loudspeakers. The NSCA also has a library of educational programs on video tape that are currently available for use by its members.

For more information on purchasing the Basic Microphone Construction video, or any of NSCA's video training tapes, contact David Read at NSCA Headquarters 1-800-446-NSCA.

EIA/CEG announces 1995 resident workshop program

The Electronic Industries Association/Consumer Electronics Group (EIA/CEG) is offering color television servicing workshops throughout the remainder of the year at two locations. These workshops are open to consumer electronics technicians and educators. While covering basic principles and practical troubleshooting on modern equipment, the courses are particularly suited for technicians who wish to be updated on their basic theory and troubleshooting abilities.

Considering the high quality and timeliness of these programs, and the materials the attendees retain, EIA believes that the practical nature of these workshops will give the attendees new skills of immediate benefit.

These courses have an estimated value of $500.00, but EIA/CEG offers them at a cost of only $50.00. The dates and locations of the courses are as follows: Triton Community College, River Grove, IL, July 12 through 14, October 11 through 13 and the Tampa Technical Institute, Tampa, FL, July 5 through 7, October 3 through 5.

For more information, call EIA/CEG at 703-907-7670. To register, send a letter on company or institution letterhead, along with a check or money order for $50.00 to: EIA/CEG Product Services Department 287 Washington, DC 20055, or you may fax your registration request, along with credit card information to EIA/CEG at 703-841-0030. ■

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RCA CTV Chassis CTC4A part number in manual 100409, number on the flyback 274515 need flyback transformer. *Contact: John Albion 604-382-8430 (call collect) or fax 604-920-3517.*

JVC Model HR-D151U VHS recorder, Eldorado Model 1608 frequency counter. Need service manuals or schematics. *Contact: Don Setliff, 149 Barton Chapel Road, Pliny, WV 25158, fax (304) 696-4343.*

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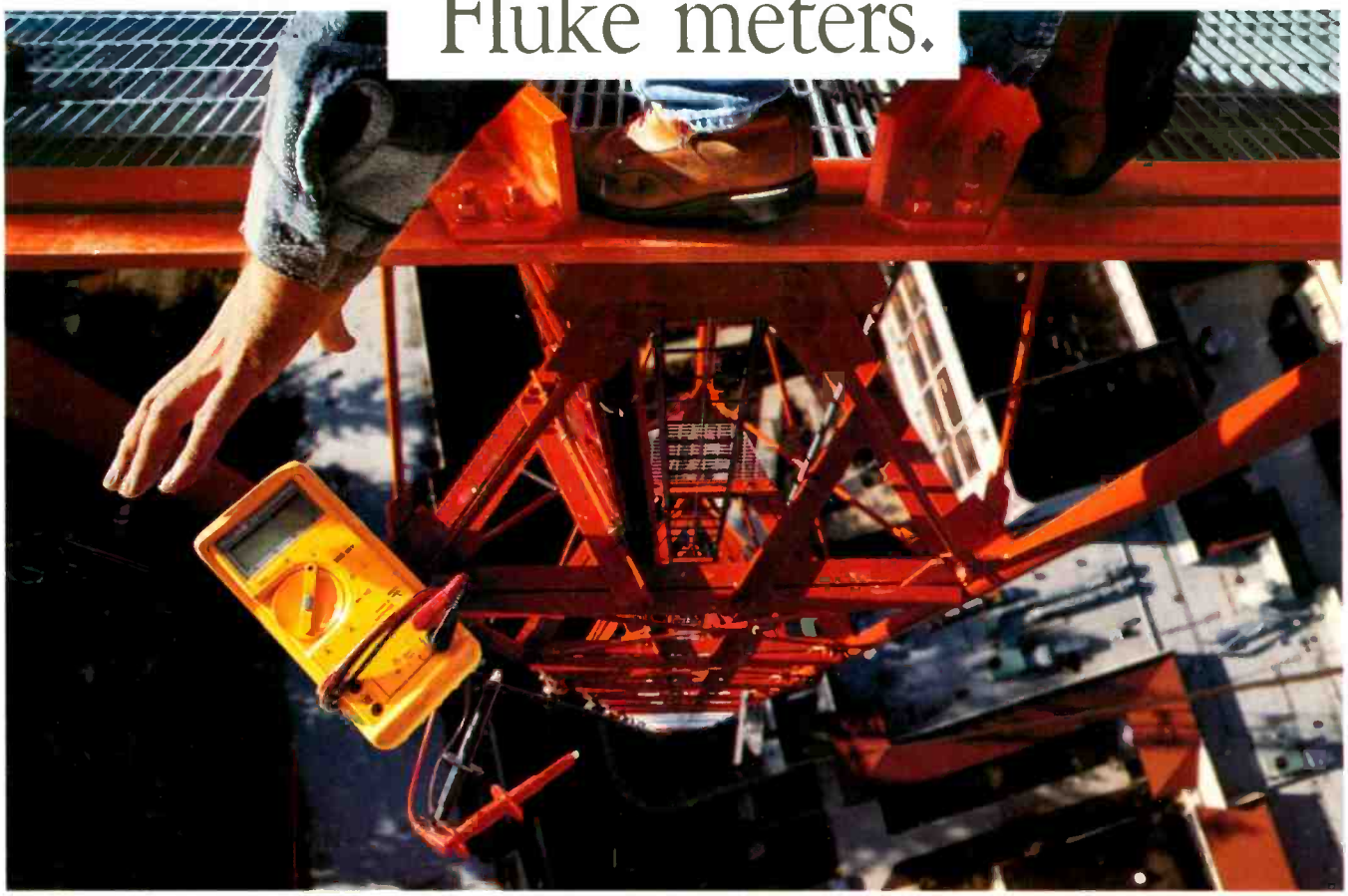

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