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ELECTRONIC

Servicing & Technology

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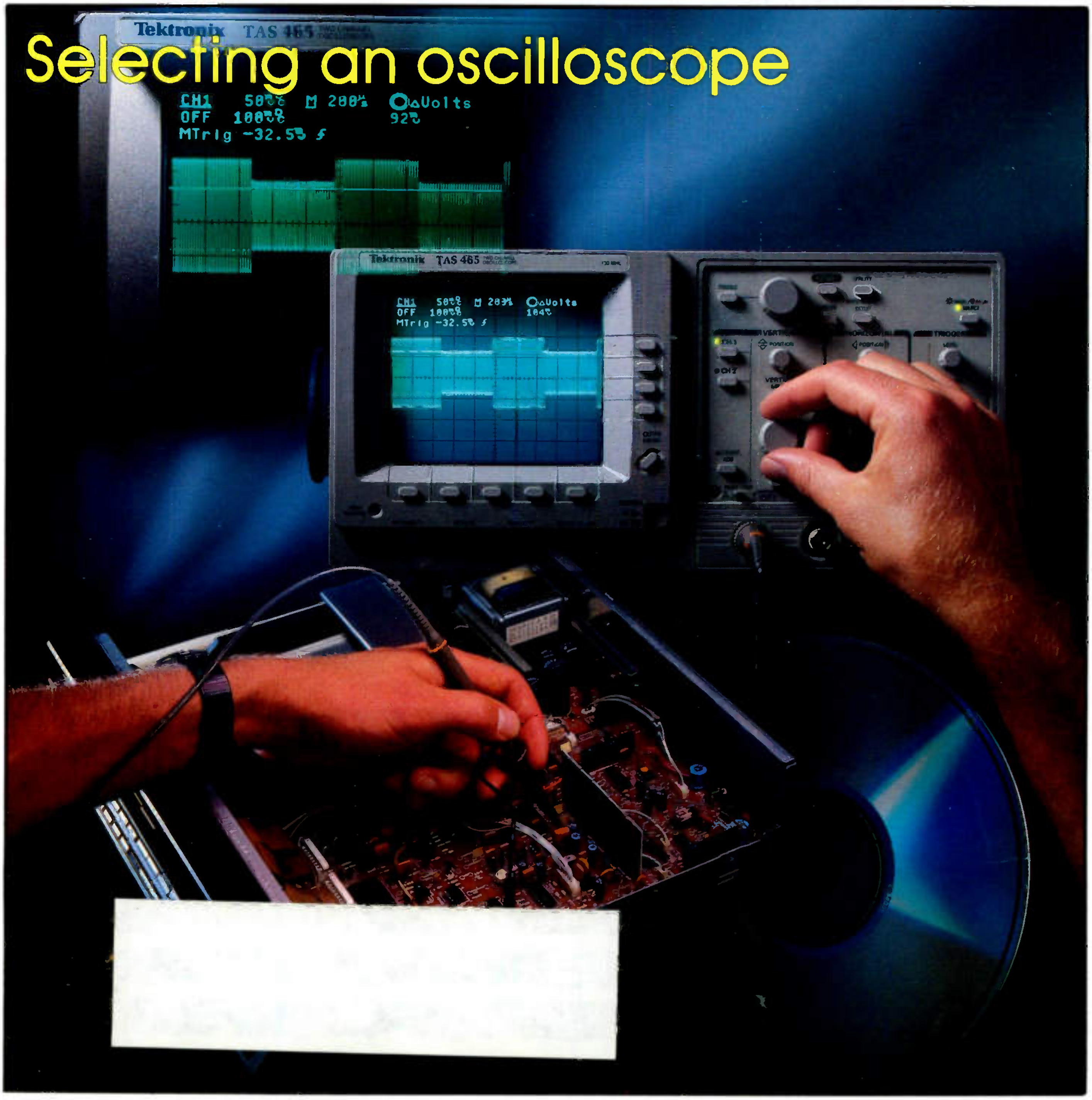
Diagnosing TV problems in the Sharp Model 19D82A

Compact Disc Interactive - Part 3



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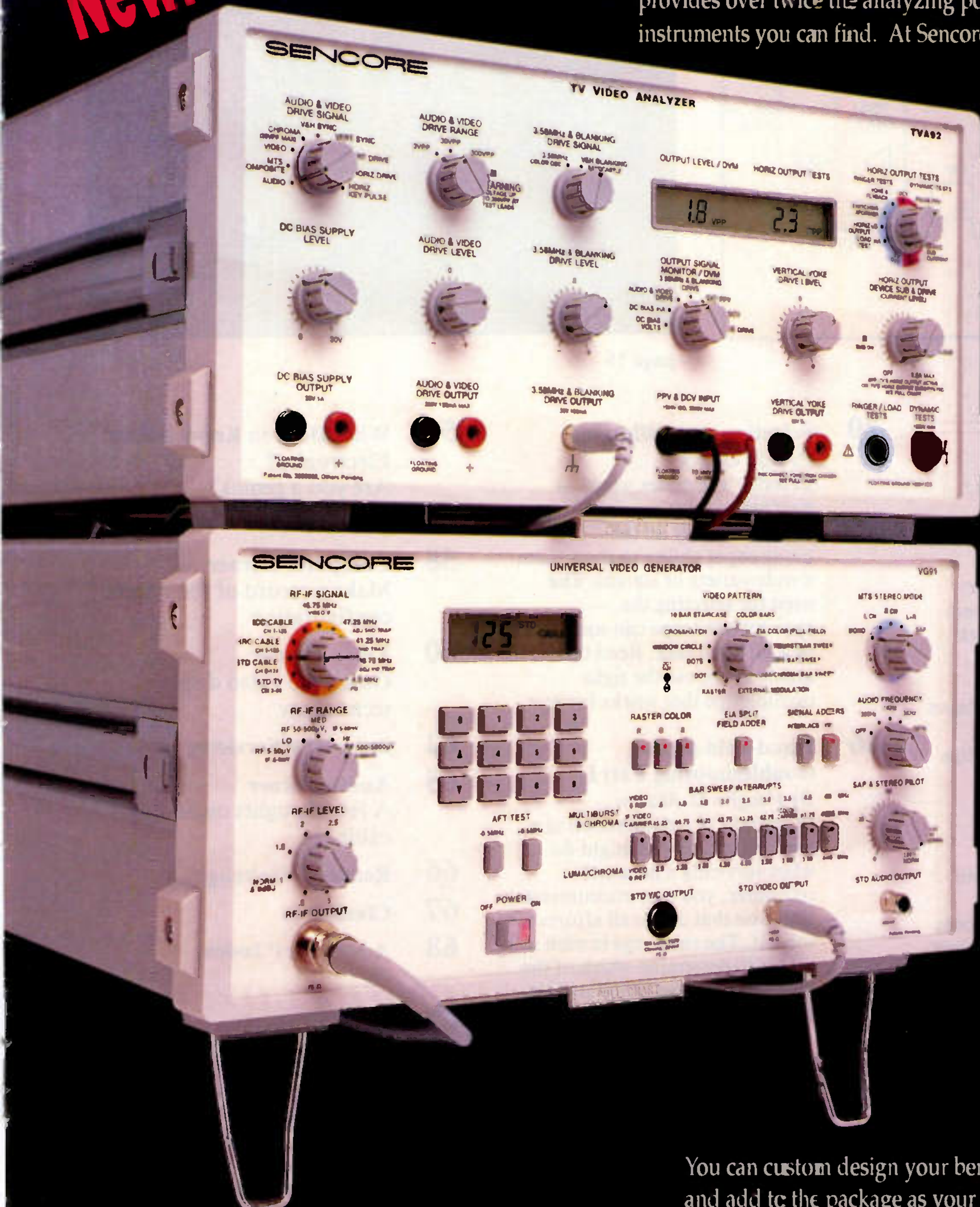

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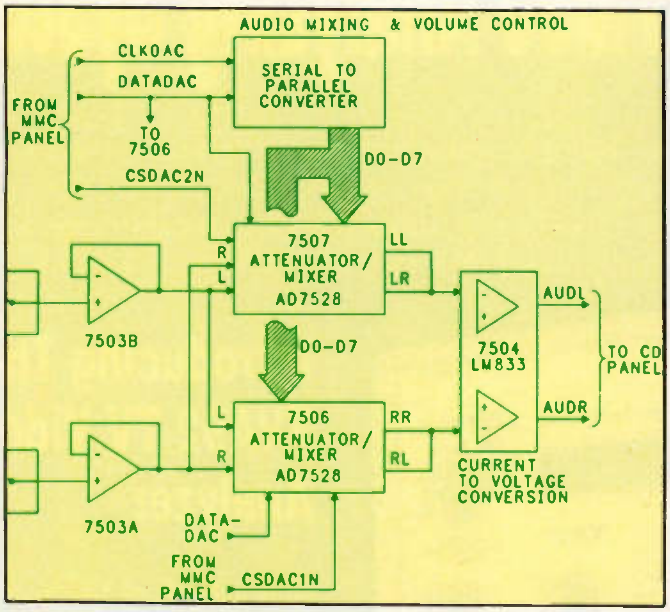

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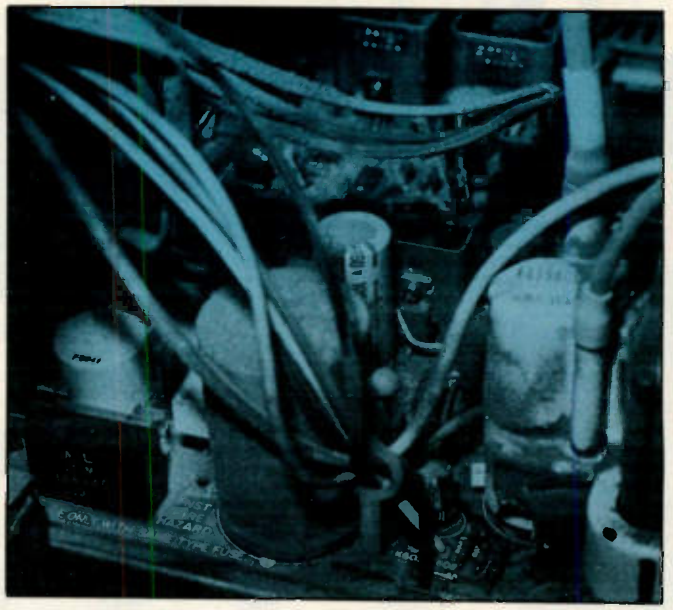

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ON THE COVER

The oscilloscope is without a doubt the most versatile piece of test equipment available to the service technician. Traditionally, oscilloscopes have been strictly analog instruments, but today, digital storage oscilloscopes offer a different kind of functionality. (*Photo courtesy of Tektronix, Inc.)*

The article "Equipment and methods for PC board servicing, by Bob Kral, which appeared in the September 1992 issue of ES&T, was actually the work of two people. Somehow in the rush of preparing the article for publication, the editors lost track of the other name. We would like to set the record straight. Michael McCown is the co-author of that article.

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

The importance of keeping records

Every consumer electronics service technician faces those malfunctions in a product that just don't yield to the standard diagnostic techniques. You know the kind of problem. The symptoms point to a shorted transistor, so you replace the transistor. The unit still doesn't work properly, so you continue troubleshooting.

Then it looks as though replacement of that IC will take care of the problem, so you order a new IC and install it. Still the unit doesn't work properly.

Finally, after spending far more time than the product's even worth, you track down the source of the problem, replace the offending component and restore the product to normal operation.

In a case such as this in which the solution to the problem is so elusive, sometimes the actual cause of the problem masqueraded as a different problem, so that the first attempted fix, or even the first several attempted fixes really didn't accomplish anything except to tell the technician that the suspected component wasn't actually the cause of the problem.

In other such cases, the symptom or symptoms were actually caused by a combination of problems: a shorted transistor, an open IC connection and a cold solder joint, so that all of the problems had to be corrected before the unit would operate correctly.

Of course, tracking down a problem such as this and returning the set to operation does give the technician a strong sense of satisfaction, and the owner of the unit is grateful to have the unit back, but if every job were like this one, the service center would soon be out of business.

Because troubleshooting of problems such as this one presents such a challenge to technicians, and because they can be so time consuming, it makes sense once a problem like this is solved to make a record of the entire procedure for future reference.

Some of the most successful consumer electronic service centers are those that have learned the importance of keeping good records. For example, take a look at the article by Homer Davidson in this issue: Diagnosing TV problems in the Sharp model 19D82A. According to Homer, "The only way to be able to recall the case histories of every TV chassis that you have worked on in the last ten years is to write them down as they occur and file them in some organized way. Some technicians have a card file system, notebook, or other means to refer to the various TV problems that occur within the chassis. I have always marked the various defective components, symptoms and voltage measurements right on the schematic."

"Making a written record of your diagnostic/repair procedures will help you troubleshoot that symptom if you encounter it again. The case histories presented here were taken from my carefully kept notes."

But when you make notes concerning a diagnostic procedure, don't forget to take them extremely carefully. The problem with hastily written notes is that they are often about as worthless as no notes at all. The reason is simple: when you're making notes after diagnosing a tough problem, the procedure is fresh in your mind, and you feel sure that no matter what, you couldn't possibly forget the details of the procedure you went through on this one.

But then you see another ten, or twenty, or one hundred sets, and they all seem to begin to merge into one another, until the procedure you followed on that day a year ago is completely erased from your mind.

However, if you've taken good notes, and put them somewhere logical, filed with the schematic of that set, for example, then if another set of the same type comes in with the same or a similar problem, you've got the record of the entire procedure right there in front of you.

Another benefit of this kind of note taking, is that if you're working in a service center with many technicians and a similar set is brought in with similar symptoms, and the set is assigned to another technician to service, he will be able to benefit from your experience, even if you're taking vacation that week.

And of course, by the same token, if all technicians in a service center add their notes, the collective experience of all the techs is there, from which everyone may benefit.

Nils Conrad Persson

NPEC '92: Success through association

Electronics servicers at NPEC '92 keyed their current and future success to the power of association. A definite upbeat mood was in evidence among the 650-plus attendees at the National Professional Electronics Convention (NPEC), which included over 100 first time participants. A two-day trade show and technical and management seminars made NPEC a valuable experience.

Although participants continue to refer to themselves as "independent" servicers, dialogue focused on their "inter-dependent" relationships with manufacturers, consumers and themselves. Citing the successes of the last year, the call was made for a continued and increased national presence through the National Electronics Service Dealers Association (NESDA) and the International Society of Certified Electronics Technicians (ISCET). NPEC is the official convention of NESDA and ISCET.

Education is always a primary concern at NPEC as servicers must keep themselves informed in an industry with constantly emerging new products and technologies. This year's offering included 11 technical seminars, some of which spanned several days to allow for in-depth, hands-on training. The nine management sessions, covering business planning, marketing, administration, customer relations and profitability, experienced overflow attendance.

Servicers met with top level manufacturer executives in 22 meetings discussing service related problems and concerns. The many opportunities for servicers to interact with their peers and representatives from other industry sectors were supported by 15 corporate food, beverage and entertainment functions. According to hundreds of positive comments, the convention programs met or exceeded all expectations.

Annual meetings resulted in the reelection of NESDA President Connie Bell and ISCET Chairman Ernie Curtis CET. The NESDA Board of Directors voted to reverse a 1983 decision that added the word "sales" to its name. ISCET announced the full implementation of the Certified Appliance Technician (CAT) testing program and also decided that CATs are eligible for membership in ISCET.

By the close of the convention, 229 people had taken advantage of preregistration discounts for NPEC '93, to be held Aug 2-7, 1993, at the Galt House in Louisville KY. Early convention registration through Jan 31, 1993, is $170 for the first adult and $150 for each additional one from the same family or business. To register, contact NESDA/ISCET at 2708 W. Berry St, Ft. Worth TX 76109; 817-921-9061.

Curtis Mathes emerging from bankruptcy

Curtis Mathes Corporation of Athens, TX is emerging from bankruptcy after receiving a vote of approval from its creditors. Gary Whitaker, Chief Executive Officer of the company, announced that more than 95% of all claimants voted in favor of the companies plan of Reorganization. The plan was confirmed by the Federal Bankruptcy Court in Beaumont, TX on August 27, after an uncontested hearing.

Whitaker is also president and CEO and WRC, Inc. The new principal owner of Curtis Mathes WRC, Inc. is a technical services company located in Athens, TX. That firm serves as a national electronic repair center for Curtis Mathes as well as providing services for other major consumer electronic lines.

Whitaker said "We are grateful to the hundreds of Curtis Mathes dealers who have been actively supporting us." He also expresses his appreciation for the support of ITT-Commercial Finance, which is currently providing inventory financing for the company, as well as floorplan lines of credit for most Curtis Mathes dealers.

The company began business as a furniture manufacturer is 1899, and is now a nationwide distributor of Curtis Mathes consumer electronic prod-

(continued on page 52)

Fall catalog supplement

This 48 page supplement to Contact East's catalog features hundreds of new test instruments and tools for engineers, managers, technicians, and hobbyists. Featured are quality products from brand-name manufacturers for testing, repairing, and assembling electronic equipment. Product highlights include new: DMMs, EPROM programmers, power supplies, adhesives, tool kits and portable digital scopes. Also included are popular lines of DMMs, communication test equipment, soldering/desoldering systems, static protection products, ozone safe cleaners, magnifiers, inspection equipment, workbenches, precision hand tools, tool kits, cases and more.

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Catalog of static control products

The "Static Control Products" catalog is now available from Graseby Plastic Systems, Inc. It is a useful guide for individuals in the electronics, business products, chemical, medical and other markets where electrostatic discharge (ESD) is a concern. The catalog introduces several new products including the Statproof Zinc-Free Floor Finish, a heel grounder with a new D-ring fastening system, antistatic hand lotion and a lightweight smock.

In addition, the catalog features instruction on applications such as work stations, mobile personnel, test and measurement, material handling, clean room and office products. Each section includes full product descriptions, specifications, photographs, and pricing and ordering information.

Circle (91) on Reply Card

Test equipment catalog

Print Products Intl., just released their new 1992/93 discount test equipment catalog, filled with 68 pages of test and measurement equipment. Products featured in the catalog include: Kenwood, B&K, Avcom, Phillips, Costar, Vectro Viz/Vid, Hitachi, Leader and more. In addition the catalog includes new lines of closed circuit TV systems for security or observation.

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Catalog of personal computing tools

Personal Computing Tools Inc. announced this week the release of the 68-page, July-September 1992 edition of The Catalog of Personal Computing Tools for Scientists, Engineers, and Technical Professionals.

The catalog gives customers a 90-day, money-back guarantee, as well as a full 2-year product warranty. A 48-hour delivery guarantee is offered on most products. Products are shipped FedEx Economy Two-day Service at low-cost. Expert technical support from experienced applications engineers is always free and unlimited.

Here's a sampling of the new products. Create a full imaging system to fit your needs with over 2 pages of imaging products to choose from. Add an extra monitor, keyboard and mouse up to 250 ft. from your computer with companion plus select from a line of affordable positioning tables and put your project in motion. Organize, easily access, and manage your extensive assortment of AutoCAD drawings with Drawing Librarian Professional.

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High-speed CMOS ICs semiconductor replacement line

The 74HC and 74HCT device families are part of the ECG Replacement Semiconductors product line, which comprises over 4000 distinct solid state devices. Among the logic functions provided by ICs, are gates, flip flops, multivibrators, multiplexers, shift and storage registers, counters, drivers and others.

HCMOS ICs feature the low-power consumption, high-noise immunity and wide operating temperature range of earlier silicon gate CMOS circuits together with the high speed and drive capability of bipolar, low-power Schottky LSTTL. They are also immune to latch up, compatible with the operating frequencies used in many microprocessor applications and provide broad power supply range and fan out capabilities. ECG HCMOS are provided in dual in-line packages, many having the same pinout as comparable 74LSTTL and 4000 series devices. ■

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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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Should you offer free estimates?

By the ES&T Staff

Different consumer electronics service centers do things differently. Some offer in-home service, some are strictly carry in. Some include a flat fee for materials such as cleaners and lubes in the invoice, some do not. Some service centers clean and restore every serviced product to like-new condition and shrink wrap them before returning them to the customer, and some leave the dust that was on the product when it was brought in.

One of the biggest differences among service centers, however, is in the matter of giving "free estimates." Some service centers enthusiastically offer free estimates, and other service centers absolutely refuse to give estimates without charging for it.

Who's right?

Should a service center provide customers and potential customers with estimates without charging a fee? The argument advanced by those who advocate free estimates is that the words "free estimates" on the company's sign, front window, or business literature brings customers in. The reasoning goes that today's consumer electronics products are generally so inexpensive to buy, that the owners of these products that fail are reluctant to have them serviced, so the offer of a free estimate gets the owner into the service center, and he may spend the money to have the product serviced.

One argument advanced by the service centers that refuse to offer free estimates is that a proper estimate of the labor and replacement components to correct a problem in a modern, sophisticated consumer electronics product takes time and skill, and should be paid for.

What is an estimate?

The argument boils down to one main question: what is an estimate? To some service centers, an estimate is little more than a wild guess. The customer comes in with a TV set or a VCR that is completely dead. The technician gives a little thought to what might be the problem: the low-voltage power supply, the flyback transformer, the shutdown circuits, the startup circuits, etc., then gives a wide range of possible costs to correct the problem.

The other idea of an estimate is a thorough evaluation of the problem, including opening up the product and probing with DMM and oscilloscope to determine which of the possible areas might actually be at fault and pinning the estimate of the cost to repair to the anticipated amount of labor to correct that problem.

The first kind of estimate can probably be given for free, but the customer really only has a wide range of dollars on which to make a decision, and really doesn't know a lot more than she did when she walked in. The second kind of estimate gives the customer a better basis on which to make a decision.

The problem with free estimates

One problem with free estimates is that it may set up an expectation in the customer that the service that he will receive will be at low cost. After all, if it doesn't cost anything for an estimate, shouldn't the service be inexpensive?

Another problem with free estimates is that it tends to bring in customers with lower cost products that probably can't be serviced economically, but it takes some time just to acknowledge the customer, and provide the estimate, and diverts the attention of the person who performs the estimate from the work that he should be doing.

Still another problem with the free estimate, especially on a low cost older product is that the customer may give the go ahead to service the product, and then later, because he has no financial stake in having the product serviced, change his mind and not come back and pick it up once it's ready. This leaves the service center with a relatively worthless product with the cost of their labor and components in it.

Handling estimates

In the first place, the word "estimate" is not a very good word when it comes to giving a consumer electronics service customer an idea of what it will cost to service a product. According to my dictionary, the College Edition of Webster's New World Dictionary of the American Language, an estimate is "a rough calculation of size, value, etc.; especially an approximate computation of the probable cost of a piece of work, made by a person undertaking to do the work." Given the complexity of today's consumer electronics products, there's no way to perform such a computation without first spending some time and effort to determine just what the work will consist of.

Most of the successful service centers that I have spoken to charge up front, when they take in a product, for the cost to perform a "technical evaluation," not an "estimate." This does several things. First, the time required by the technician to determine the nature of the problem is paid for. Second, the customer recognizes that he's dealing with a professional, whose time must be paid for - just like a doctor or lawyer, and won't be unpleasantly surprised when he finds that it isn't cheap. Third, the customer is far less likely to abandon the product if he has already paid some money to have the product checked out.

(continued on page 64)

How to make a precision extension tube for spray cans

By Sheldon Fingerman

How many times have you wished those extension tubes that come with spray cans were narrower? They seem to work just fine for lubricating motorcycle chains, but for working on electronics they leave a bit to be desired.

I've seen a lot of ways to modify these tubes, but none have worked as well for me as my own method. The secret to this new extension tube is to use the metal tube from one of those "long reach" precision oilers. The problem is connecting it to a spray can.

Since virtually all those plastic extension tubes have the same outside diameter, this is the obvious place to start. Using a razor blade, or razor knife, cut off a piece of tubing about 1/2 inch long. If the knife is dull, or you try using a pair of cutters, you will only succeed in closing or pinching off the hole in the tube. (You may want to work with the full length tube and cut it later.)

Now for the hard part. How to attach the metal extension to the plastic tube. There are several ways to try this. Even though the outside diameter of the plastic tubes are universal, the inside diameters are not. You may be extremely lucky and have a perfect "press" fit. If the hole is just a tad too small try heating the plastic. Push the metal tube into the softened plastic and hold it there until it cools. If it works you will have completed the job the "easy way."

Sometimes the hole is just a bit too big. If this is the case try heating the

Fingerman is an electronics and computer consultant and servicing technician.

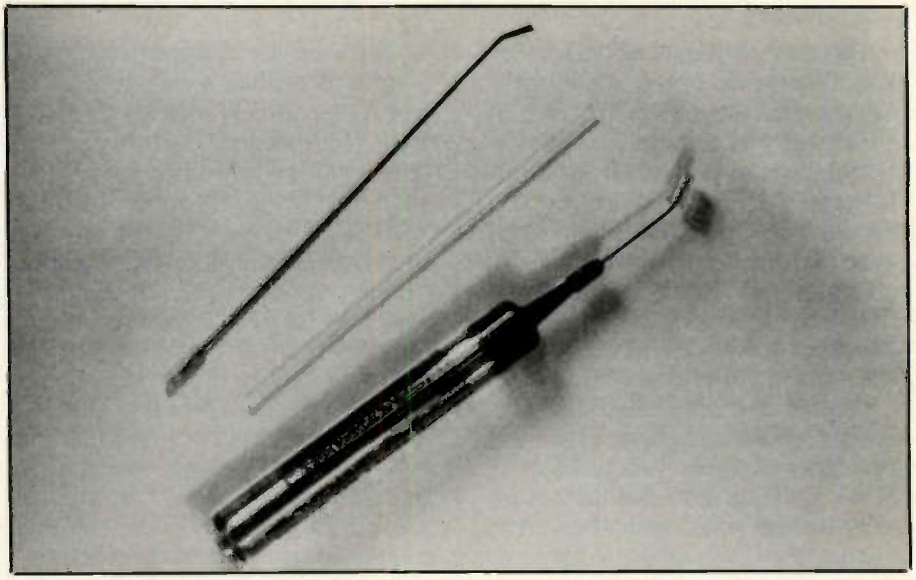

Figure 1. Parts needed

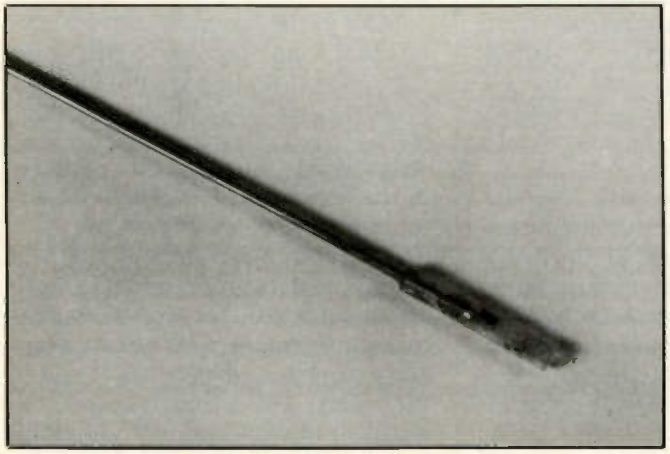

Figure 2. Completed assembly

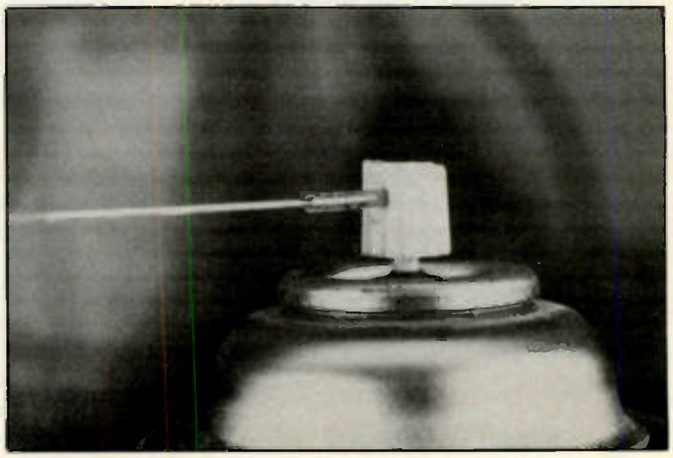

Figure 3. Tube on can

plastic tube while you hold the two tubes in place. You may succeed in shrinking the plastic around the metal tube, again giving you a tight fit without much fuss.

Unfortunately what usually happens is that the plastic tube ID is just a bit too small for the first method to work. When this is the case there is a third method that will work every time. Drill out the plastic tube and glue the metal tube in place.

Using a small bit, drill out the inside diameter of the plastic tube to accept the metal extension. Make sure to drill all the way through. If you try to drill only to the depth required you will probably find that you only clog the tube. The hole should be big enough for a snug fit. A bit larger is OK, but the fit should not be sloppy.

Apply a bit of gel type super glue around the base of the metal tube about 1/8 of an inch from the end. The last thing you want to do is clog the tube. When you insert the metal extension into the plastic tube, the gel will be moved away from the end of the tube, creating a good seal without the risk of clogging the assembly. If the plastic you are using is clear or translucent, you will be able to tell immediately if you have a good seal. You might want to apply a bit more glue around the outside of the joint.

A few things to remember are to be very careful not to clog the metal extension. You will probably have to get a new precision oiler to get your hands on one of these again. On the other hand, since you probably have more plastic extensions floating around then you know what to do with, don't be shy about experimenting with these.

If you use an open flame to heat the plastic tube BE SURE THERE ARE NO FLAMMABLE LIQUIDS STILL IN THE TUBE. You can put the tube on a good can of tuner wash to clean it out. Just make sure to let it dry thoroughly.

When the glue has dried test the assembly by putting it on a can of tuner wash. Check for leaks and, just in case, be careful where you aim it.

Once completed you'll wonder how you ever got along without it. You can now get those wonderful "foaming" tuner cleaners into places you never dreamed of, including those tiny holes they put in pushbutton switches. Just remember that the tube is metal so use caution around live circuits. ■

Compact Disc Interactive - Part 3

By Marcel R. Rialland

Serviceability is an important aspect of the development of any product. This is especially important in the case of a high tech product such as Compact Disc Interactive. The Philips CDI910 player includes some features specifically designed with service in mind.

To begin with, the CD-I player is based on the Compact Disc. Therefore, the basic skills for troubleshooting and repairing a compact disc player may be applied to the CD-I player. For example, the CD Servo system must initiate a start-up procedure. The disc can not be read and decoded if there is a failure in the start-up mode. Also, a problem in either the focus or radial servo circuits can cause an error in reading a disc. The Service Shell is very useful in finding problems in the start-up and servo circuits.

The service shell

CD-I players have a diagnostic software system built in that allows the technician to perform certain tests with no external test equipment. This software system, along with the information on the screen that allows the technician to gain access to it is called the service shell.

If the player's operating system is working, the software will allow implementation of the service shell. The service shell performs tests of the player's compact disc motor (CDM), servo, video, and audio circuits.

The service shell is implemented by turning power on after placing a jumper across pins 2 and 3 of Port 1 (mouse port). The test mode can also be implemented by using the Philips Service Shell Jumper Plug, part number 4835 310 57148. Only a compact disc digital audio (CD-DA) disc should be used when testing the CDM, servo and audio circuitry in the service shell. No disc is needed for the video test.

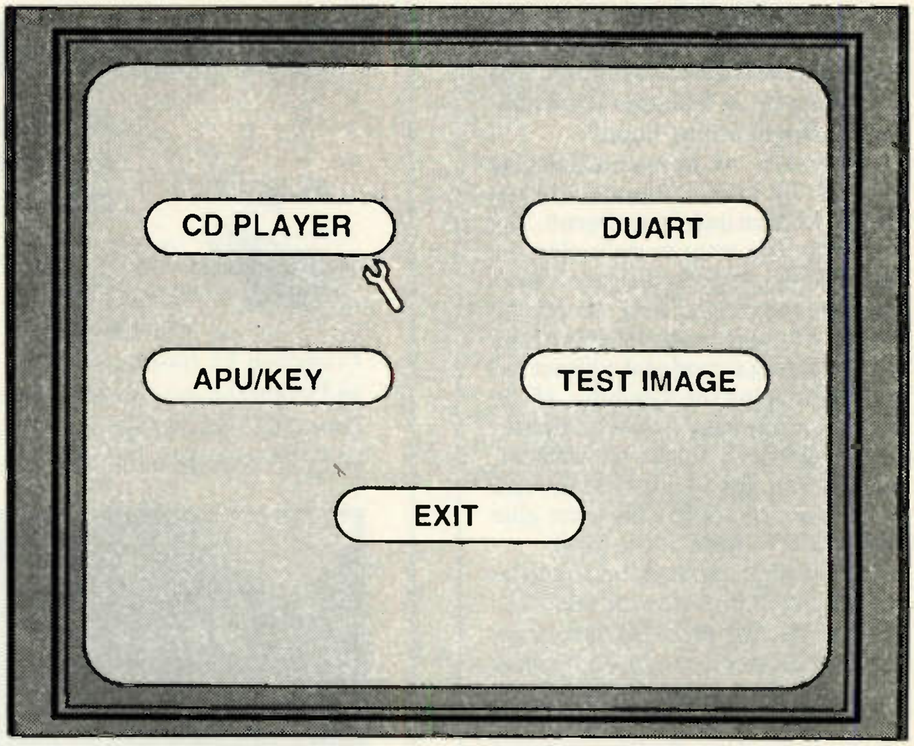

Figure 1. This screen is displayed when the service shell is started. From this shell all of the service shell tests can be performed, as long as an icon is highlighted. The cursor, which is in the shape of a wrench, is used to make service selections via the remote control.

The screen shown in Figure 1 is displayed when the service shell is started. From this shell all of the service shell tests can be performed, as long as an icon is highlighted. The cursor, which is in the shape of a wrench, is used to make service selections via the remote control.

Activating the Test Image icon displays color bars to test the video circuits. Selecting the CD Player Icon opens the sub menu shown in Figure 2. When this menu is selected, the communication channel with the Drive Microprocessor is checked. A message is displayed giving the result of this check (either OK or NO RESPONSE).

In addition to the servo test modes, such as those found on CD players, this menu includes test modes for the communication buses. An error message is displayed if there is a failure in any of the tests. One of the keys around the joystick of the remote transmitter must be keyed to remove the error message.

In some cases, further tests are disabled if an error occurs. For example,

Rialland is a Senior Training Specialist with Philips Consumer Electronics Company, Service Company

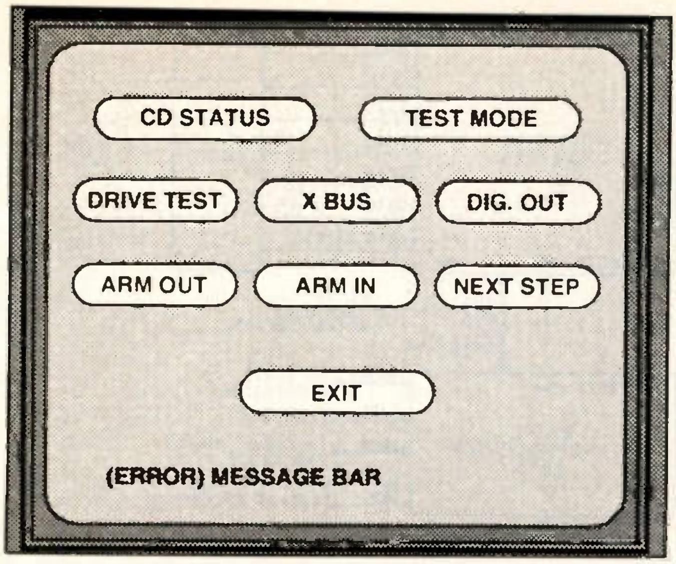

Figure 2. Selecting the CD Player Icon opens this sub menu. When this menu is selected, the communication channel with the Drive Microprocessor is checked. A message is displayed giving the result of this check (either OK or NO RESPONSE).

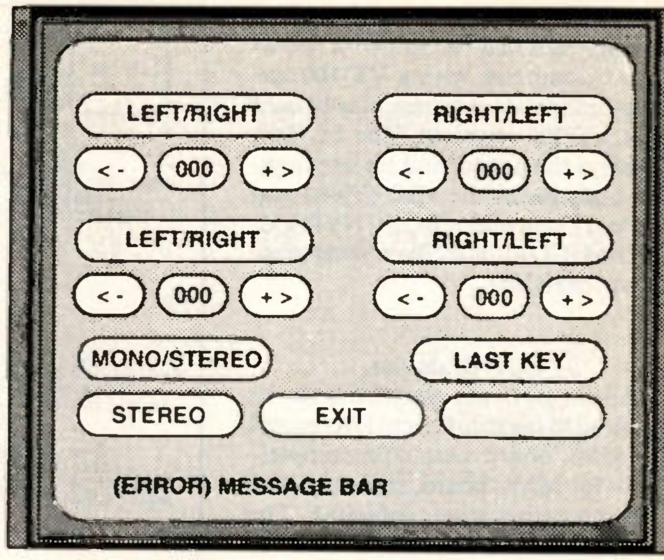

Figure 3. This is the way the screen appears when the APU/Key test is implemented. This is a combined menu. The attenuation can be changed via this menu and the remote control and player keys can be tested.

if the focus test fails, the turntable servo test can not be started. This menu allows all of the Start-up and CDM functions to be tested. The CDM should also be observed during these tests.

The X bus test checks the communication channel between the compact disc interface circuit (CDIC) and the CD Unit's Drive Microprocessor. The DIG OUT test checks whether or not the CDIC receives a Digital Output signal.

The most extensive test in this menu is the CD DRIVE TEST. A disc (CD-DA) is needed for this test. The X BUS and DIG OUT tests are not active when the CD Drive Test is initiated. Selecting the EXIT button returns the player to the CD menu.

The DRIVE TEST consists of the following steps:

- Mode 0: The software release number of the Drive Microprocessor is displayed in the box at the top left of the screen (CD STATUS button). Mode 0 is displayed in the box at the top right of the screen (Mode button). During the CD DRIVE TEST, this icon displays the current Mode. In Mode 0, the ARM IN and ARM OUT tests are active. Selecting NEXT STEP initiates Mode 1.
- Mode 1: In Mode 1 the Drive Microprocessor performs the focus start-up. If focus is achieved (a disc must be present), the message IN FOCUS appears in the status button. Otherwise, the message NO FOCUS appears after 16 focus attempts. In that case (no focus found), the test returns to Mode 0. When focus is achieved, selecting NEXT STEP initiates Mode 2.
- Mode 2: The turntable motor rotates and is controlled by the rough HF (high frequency) (turntable motor servo lock). Moving the CDM arm (by hand) outwardly slows the disc down. If an error occurs, the test returns to Mode 0. Selecting NEXT STEP in Mode 2 brings the player to Mode 3.
- Mode 3: Mode 3 allows the control of the radial arm. If the radial arm servo is operating, you can select ARM IN and ARM OUT to radially move the CDM arm toward the inside or outside of the disc in small jumps. If an error occurs, the test returns to Mode 0. NEXT STEP in Mode 3 puts the player in the normal playing Mode (the test jumper must be removed).

The APU/Key test

Another sub-menu started from the Main Menu is the APU/KEY TEST. The screen appears as shown in Figure 3 when the APU/Key test is implemented. This is a combined menu. The attenuation can be changed via this menu and the remote control and player keys can be tested.

There are three buttons for every attenuation path on the screen. Two of them can be selected (to increment/decrement) and one is used to display the current attenuation value for the path. There is also a MONO/STEREO button on the screen. In STEREO, two attenuation paths are disabled (left to right and right to left). In MONO all attenuation paths are enabled. Maximum attenuation is reached at value 47.

A CD audio disc is needed for the attenuation test. The test routine starts playing the disc when entered. The Key test is used to check the Remote Control and Front Panel Keys. When a key is pressed, text appears on the Key Button on the right side of the screen, identifying the button pressed. The text disappears when the key is released.

Low level test

Another diagnostic tool included in the design of the CDI910 player is the Low Level (LL) Test. This test is used to check major functions of the multi media controller (MMC) board. The MMC board is replaced as a module when defective. The LL Test should be performed if the player shell or service can not be accessed. If the Low Level MMC test indicates a fault, the MMC Unit should be replaced. If the Low Level Test cannot be initiated, check the power sources to the MMC board. If all supplies are present, replace the MMC Unit.

The LL Test is implemented in the boot software of CD-RTOS. It does not need a lot of hardware to run. The test can be performed using a VT-100 terminal or the Low Level Test PCB (Philips part number ST1479). A Personal Computer with a VT-100 terminal emulation program may be used as a VT-100 terminal. The LL Test displays the header and release number and checks the VSC (Video and System Controller), ROM, NVRAM, DRAM, CDIC, and Slave Microprocessor (68HC05).

CDI910 service

All circuit board assemblies can be serviced to the component level except the MMC board. Due to the complexity of the MMC board, replacement is recommended when defective. The CDM-9 CD Mechanism is also replaced as an assembly. Disassembly instructions and exploded views are provided in the service manual.

Audio section troubleshooting

A problem in the CD-I player can be isolated to a particular circuit by carefully observing the symptoms. For example, if there is no audio, but a picture from a CD-I disc is displayed, it is obvious that the CD servo and decoding circuits are functional. Therefore the fault can be isolated to the audio decoding circuits only.

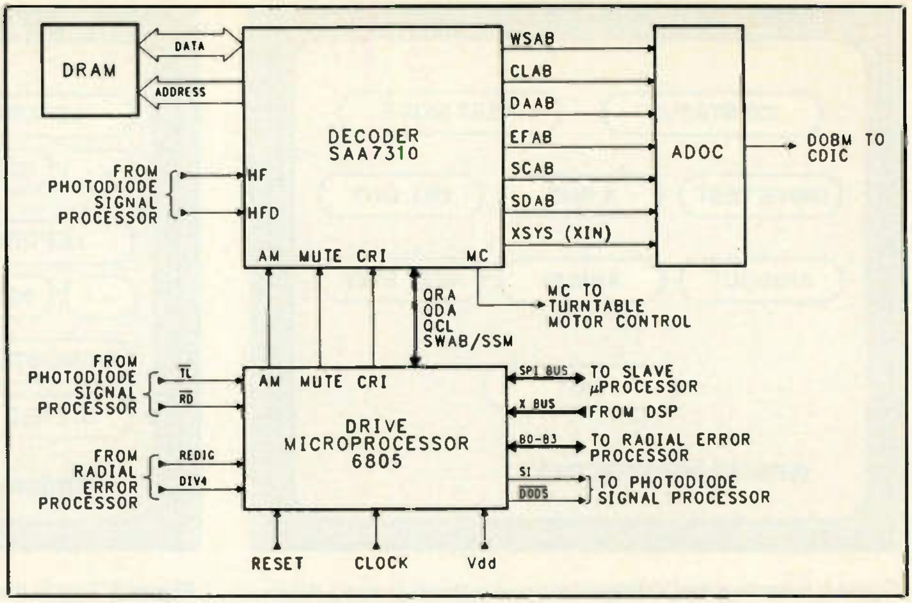

Figure 4. When there is a symptom indicating a fault in the CD Drive circuitry, troubleshooting techniques used in CD players can be followed since the CD Unit portion of the CD-I player is basically a CD player, as shown here.

Or the symptom may be just the opposite: the audio circuits may be working, but not the video. Again, the servo circuits are functioning. Troubleshooting of the video decoding should then be followed.

When there is a symptom indicating a fault in the CD Drive circuitry, troubleshooting techniques used in CD players can be followed since the CD Unit portion of the CD-I player is basically a CD player, as shown in Figure 4.

If the CDM does not start, check for Vdd, clock, and reset on the CD Drive Microprocessor. If these signals are

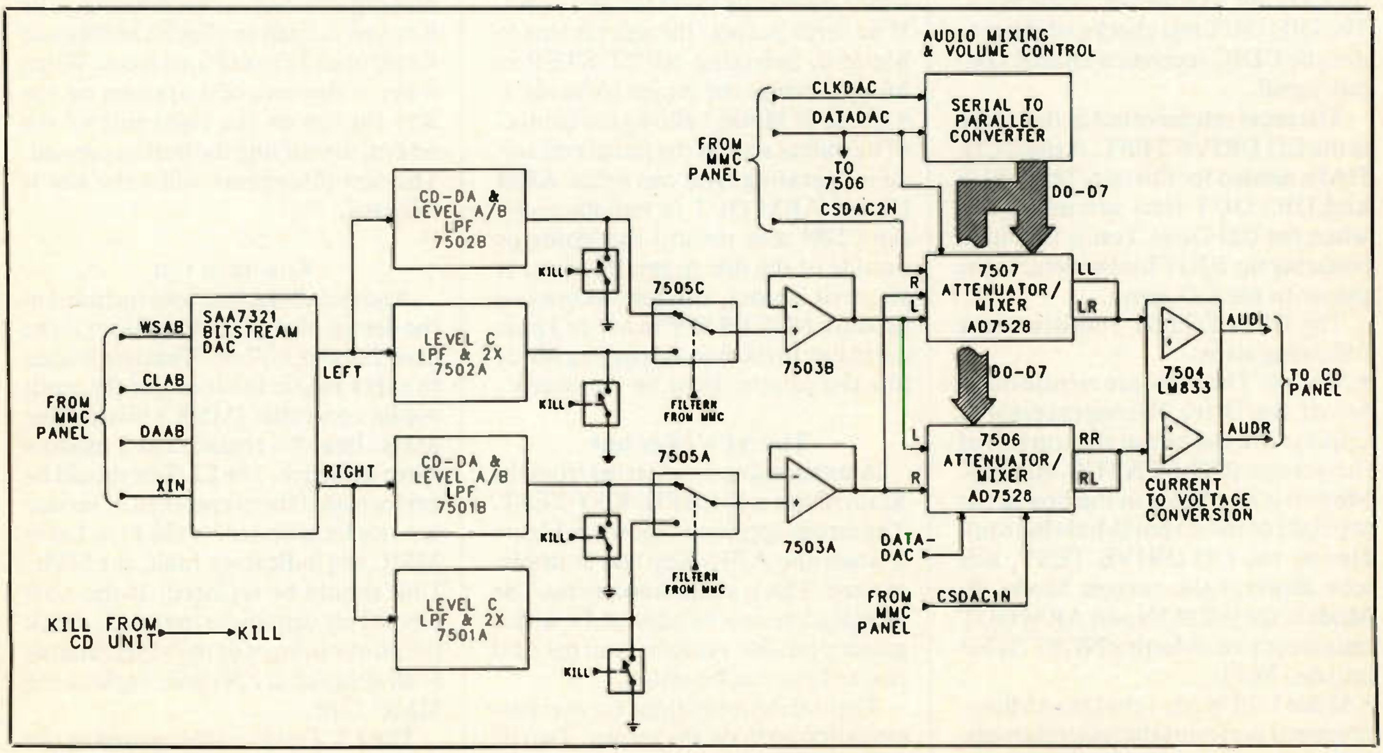

Figure 5. If there is no audio, but the servo and decoder circuits are functioning properly, there may be a problem in the Audio Processing Unit.

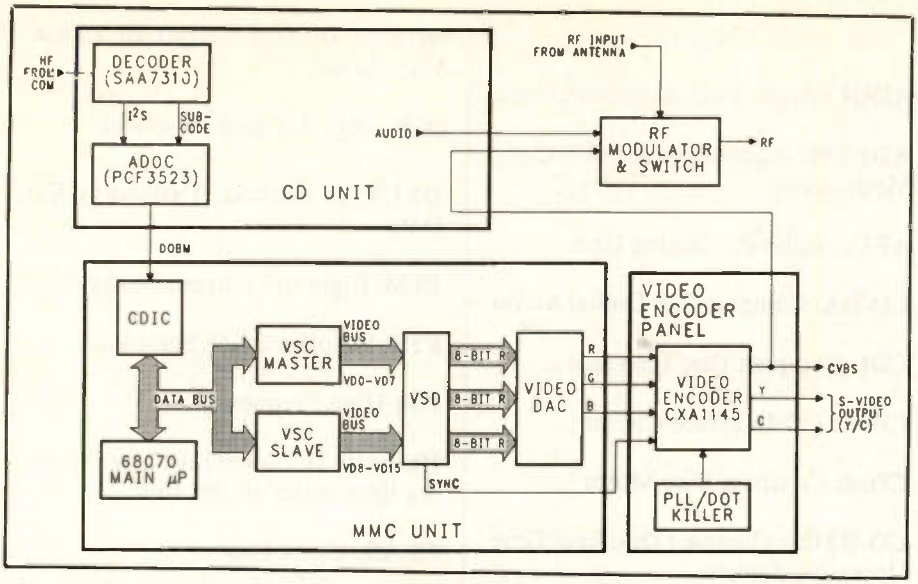

Figure 6. Familiarity with the video processing block diagram shown here may aid a service technician in diagnosing CD-I video problems.

present, perform the X-bus test in the Service Shell. Also check for activity on the X-bus and SPI-bus. If there is a communication failure, proceed with the MMC Low Level Test to determine if there is a failure in the system control circuitry. If the communication buses are functional, check the CD servo circuits using the Service Shell test modes. If there is a failure in the servo test modes, further checks with a DVM should reveal the fault.

If the servo circuits are functioning, check the decoder circuits. Activity should be seen on the I²S (DAAB, CLAB, and WSAB) and subcode (SCAB and SDAB) lines from the SAA7310 Decoder IC. If there is no activity, check the supply (Vdd) and input signals (HF, XIN). If there is activity on each line, check the ADOC circuitry.

When the servo and decoder circuits are functioning properly, there may be a problem in the Audio Processing Unit (see Figure 5). The APU Panel plugs in to the CD Unit circuit board. Inputs and outputs can be checked at the connectors on both the bottom and the top of the board. Extension connectors (part number 4822 321 22268; requires 2 for service) are available to gain access to the bottom connectors.

Video section troubleshooting

The symptoms displayed can help the technician isolate the problem to a particular circuit. The following examples illustrate how a fault can be isolated (see Figure 6).

Player shell displayed but no video

If this condition exists, the Video Encoder Panel and video analog circuits are functioning. Since the player shell is displayed, the video synthesizer circuit is functioning. However, there must be a fault on the MMC Panel, since this is where the video decoding takes place. Thus the problem is isolated to the video decoding section on the MMC Panel.

No video

This symptom may be caused by either the Video Encoder Panel or by the MMC Panel. A few voltage and signal measurements can quickly isolate the problem. Hint, also check all the video outputs: S-video, RF, and CVBS. If video is not present from any output, check the RGB, composite sync, and power source inputs from the CD Unit to the Video Encoder Panel. If these signals are present, the MMC Panel's decoder circuits are functional.

Final checks

Make sure to check all player functions after completing a repair on a product such as the CDI player. Also perform any safety checks outlined in the service manual before returning it to the customer.

Glossary

ADOC: Audio Digital Output Circuit

ADPCM: Audio Digital Pulse Code Modulation

APU: Audio Processing Unit

CD-DA: Compact Disc Digital Audio

CDI: Compact Disc Interface

CDIC: CD Interface Circuit

CDM: Compact Disc Motor

CD-RTOS: Compact Disc Real Time Operating System

CLUT: A method of encoding CD data

CSD: Configuration Status Description

CVBS: Composite Video

DAC: Digital to Analog Converter

DOBM: Digital output Bi-Phase Mark Code

DSP: Digital Signal Processor

DYUV: A method of encoding CD Data

EFM: Eight to Fourteen Modulation

FTS: Favorite Track Selection

HF: High Frequency

IIS: Inter-IC Signal Bus. The following lines make up this bus:

CLAB: Clock Line

DAAB: Data Line

EFAB: Error Flag Line

SCAB: Subcode Clock Line

SDAB: Subcode Data Lines

WSAB: Word Select Line

XSYS: System Clock Line

S2S: Same as IIS

MMC: Multi Media Controller

OPU: Optical Pickup Unit

Photo-CD: A CD system that provides for storage and retrieval of photographs on CD

RGB: Red, Green, Blue Video Signals

SPI Bus: Serial Peripheral Interface

TOC: Table of Contents. The list of the disc's contents which is digitally encoded on the disc. Includes information on which kind of disc this is so that the system can handle it properly.

User Shell: Information that is displayed on the screen of a monitor or TV that provides the user with information about the software that is operating at the moment, and allows the user to select some function of that software.

VSC: Video and System Controller

VSD: Video Synthesizer ■

Diagnosing TV problems in the Sharp model 19D82A

By Homer Davidson

The only way to be able to recall the case histories of every TV chassis that you have worked on in the last ten years is to write them down as they occur and file them in some organized way. Some technicians have a card file system, notebook, or other means to refer to the various TV problems that occur within the chassis. I have always marked the various defective components, symptoms and voltage measurements right on the schematic.

Although consumer electronics products will experience different problems at different times, it's not unusual for the same problem to occur repeatedly in sets of similar makes and models. And sometimes the same component will be a frequent cause of problems in completely different products. Making a written record of your diagnostic/repair procedures will help you troubleshoot that symptom if you encounter it again. The case histories presented here were taken from my carefully kept notes.

Davidson is the TV servicing consultant for ES&T.

Keeps blowing fuses

The customer complained that the TV set had shut down several times, but each time, when the set was turned on again everything was normal. The last time the set shut down, however, it remained dead with no sound or picture. This Sharp 19D82A was dropped off for service.

The 4A fuse was blown, so I replaced it. When I turned the set on, the replacement fuse opened at once. No doubt there was a dead short in the low voltage power supply or in the horizontal output circuits.

A quick continuity check of the horizontal output transistor (Q602) indicated high leakage between collector and emitter terminals (0.15Ω). The apparent leakage might have been the forward resistance of the damper diode, which is connected between emitter and collector of the output transistor, built right in the same metal case.

When I reversed the leads, however, I measured the same resistance between the two elements. I removed Q602 from the heat sink, and again measured the resistance in both directions. These measurements confirmed that Q602 was leaky (Figure 1).

Before replacing the 2SD870 output transistor with a TCE SK9919 universal replacement, I checked the condition of the 0.27Ω emitter resistor. Sometimes when the horizontal output transistor has a dead short this resistor may open up. If you don't correct this situation, you'll face another service problem.

After installing another replacement fuse and a replacement output transistor, I again turned the set on. The result was another blown fuse. I had neglected to check the diodes in the low voltage power supply.

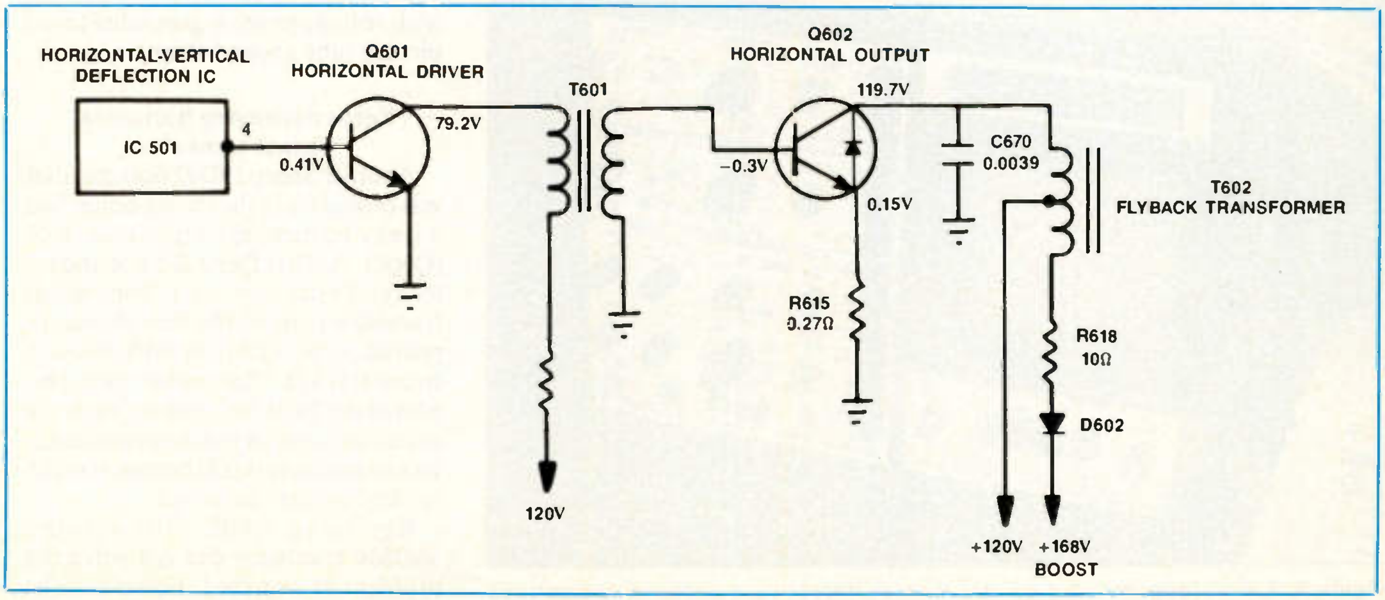

Figure 1. Replacing the horizontal output transistor (Q602) did not solve all the problems within the horizontal and low voltage circuits.

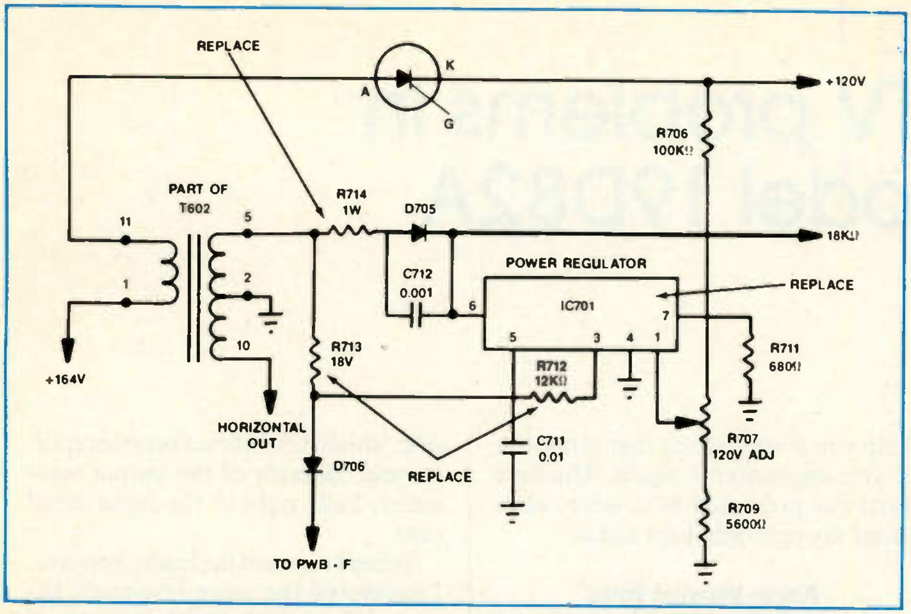

Figure 2. Component parts R712, R713 and R714 were replaced in addition to a leaky power regulator (IC701) in the low voltage power supply before the fuse problem was solved.

Blowing out the excessive dust uncovered the components in the area I wanted to inspect. The diodes were finally located alongside the white ceramic resistor (R702) at the rear of the chassis. I replaced diodes D702 and D704 with 2.5A units. R702 was normal. I applied power to the set expecting it to respond by operating normally, but there was still no picture or sound.

I measured the voltage at the collector terminal of Q602, and at the flyback transformer (the same point, electrically) and read 0V. I checked for the presence of a 120V source at the cathode terminal of SCR701. High dc voltage was found at the anode terminal, and at filter capacitor C706 (172V). This indicated that the low voltage power supply and the primary winding of the flyback (pins 1 and 11) were normal. SCR701 tested normal within the circuit (Figure 2).

When I rotated the 120V adjust control (R707), no voltage change was noted at the metal case of Q602. After locating the power regulator IC, IC701, I measured the voltages at each terminal. All of these voltages were near zero.

A closer look at the schematic suggested that these low voltages might be caused by an open R714, a 1Ω resistor. A resistance check confirmed that R714 was open. While in the power regulator circuits, I inspected and checked all resistors and diodes. R713 and R712 showed signs of overheating. Diodes D705 and D706 were normal.

Although IC701 looked normal, resistance measurements at all terminals indicated a low leakage between pins 3 and 7 and chassis ground. Pin 7 had a resistance measurement of around 700Ω to ground. This could be normal with R701 (680Ω) in the circuit.

After I replaced R714, R713, and R712 and applied power to the set, the 1Ω resistor became hot and opened at once. This confirmed that IC701 (RH-DX0038CEZZ) was leaky.

After replacing IC701, I again applied power to the set. The raster came up with sound in the speaker. Before any other adjustments were made, I set the B+ adjustment control (R707) at 120V dc on TP701 with the brightness control turned to its extreme clockwise position. When you adjust this 120Vdc source, be sure that voltage applied to the set's line cord is at 120V.

Double check the high voltage with the high voltage probe attached to the picture tube anode socket. The 120V adjustment should place the anode voltage somewhere between 20KV and 22KV. Be careful when taking high voltage measurements. Make sure the high voltage probe is grounded to the picture tube ground strap.

Figure 3. A waveform analyzer quickly locates defective waveforms and voltage measurements within the TV chassis.

Keeps destroying horizontal output transistor

Another Sharp 19D82 portable that was brought into the service center had a leaky horizontal output transistor (Q602). At first Q602 did not appear leaky. Resistance tests from metal transistor body to the heat shield appeared to be within specification. I found R615 (0.27Ω) resistor open. I removed the 2SD870 transistor from the circuit to check its junction resistance. I measured only 0.03Ω between collector and emitter terminals.

Replacing Q602 with another 2SD870 transistor did not solve the problem as expected, however. The 4A fuse opened and the replacement horizontal output transistor became leaky.

It then occurred to me, too late, that I should have powered the set at reduced voltage from a variable power line transformer. The cause of this problem was most likely improper drive voltage, higher voltage than normal at the collector terminal, a leaky flyback or components loading the flyback circuits.

After installing another horizontal output transistor, I slowly raised the power line voltage, and measured the voltage applied to the collector of the output transistor with a voltmeter at TP701. The scope was attached to the base of Q602 to measure the drive waveform. A waveform analyzer that provides both an oscilloscope screen and a digital voltage display simplifies waveform and critical voltage measurements (Figure 3).

With only 55Vac applied to the chassis, Q602 became warm, indicating an overload. The scope waveform at the base terminal was not of sufficient amplitude for a good waveform measurement. The chassis was shut down and the scope probe was moved to pin 4 of deflection processor IC501.

Again the ac voltage was raised slowly to 55V. There was no indication of a drive waveform at pin 4 of IC501. At first I suspected that IC501 was leaky. But before ordering a replacement for IC501, I took resistance measurements at each terminal. All resistance readings were fairly normal without any voltage tests. The flyback circuits and horizontal output circuits must function before a voltage source (12.3V) can be found at pin 11 of IC501.

In order to check out IC501 independent of the rest of the circuits in the rest of the set, I applied 12Vdc from an external source at pin 11 of IC501. Scope waveforms at both horizontal and vertical outputs appeared fairly normal.

The horizontal pulse was traced up to the base of the horizontal driver transistor (Q601). Of course the 120V source must be present before a drive waveform can be found at the collector terminal of Q601 or base of Q602. I assumed IC501 was normal because it produced a drive waveform with external voltage applied.

The power line voltage should not be left on too long with Q602 running warm to the touch. Either the flyback, yoke or overloaded circuits in the flyback circuits must be loading down Q601. Before replacing the flyback transformer, other circuits should be checked. Flybacks are difficult to replace, too much time is involved, and you never seem to have the correct one in stock.

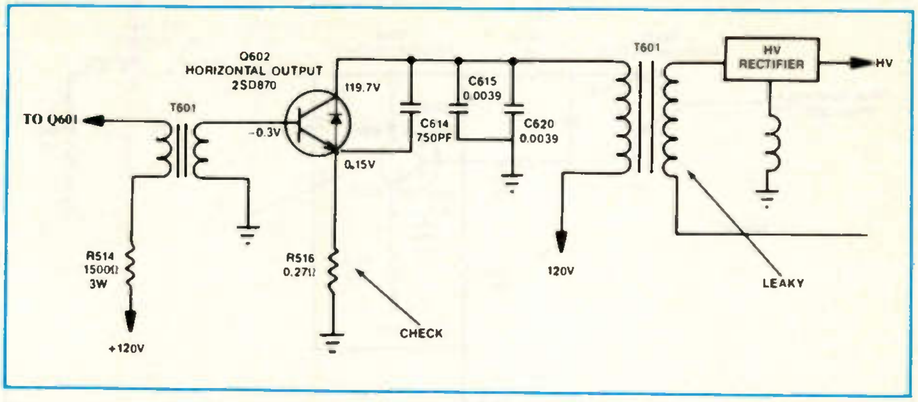

Figure 4. A leaky flyback transformer (T602) solved the loading down and destroying the horizontal output transistor (Q602).

To eliminate the overloading of the flyback derived circuits, one end of diode D507 and D503 must be disconnected from these flyback circuits. These diodes provide dc voltage to the low voltage regulator circuits (18V, 12.3V A&B, 11.97V and 40.7V). The deflection yoke circuits can be checked by removing the red yoke lead from the horizontal circuits (Figure 4).

After removing the yoke lead, I again raised the power line voltage gradually. Q602 again became warm. This eliminated the yoke circuits from suspicion. I disconnected D503 and D507 from the circuit and again applied power. The results were the same. The only possibility remaining was that the flyback (T602) was loading down the horizontal output transistor circuits. Replacement of this component with an exact replacement (RTRNF1172CEZZ) corrected the problem.

No vertical sweep

Another Sharp 19 inch portable was brought in, this one with a symptom of no vertical sweep. A quick voltage test upon each metal output terminal of each transistor indicated the presence of voltages that were higher than those shown upon the schematic. Common symptoms of defective vertical output transistors are improper vertical sweep, a horizontal white line,

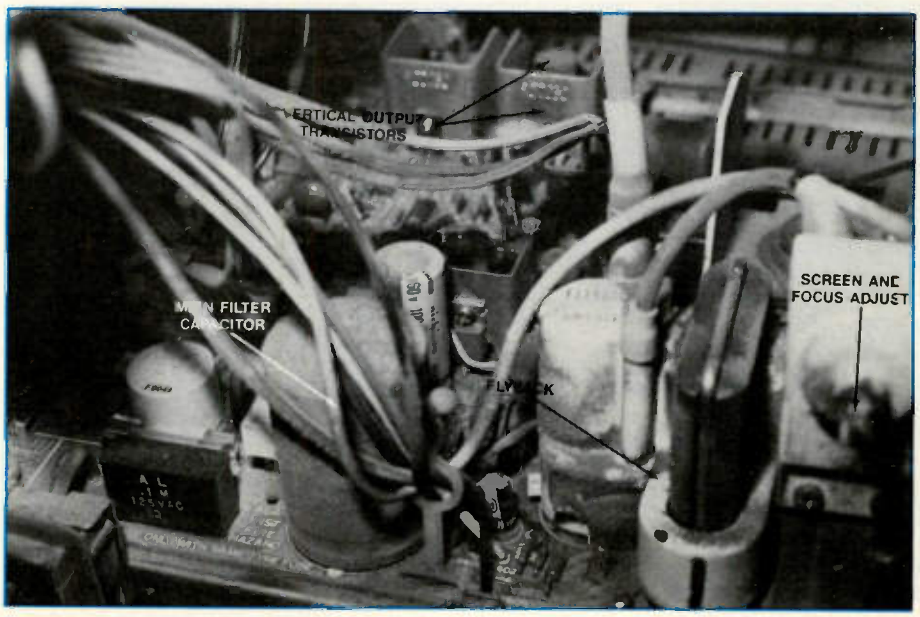

Figure 5. Both vertical output transistors are located on separate heat sinks underneath the picture tube assembly.

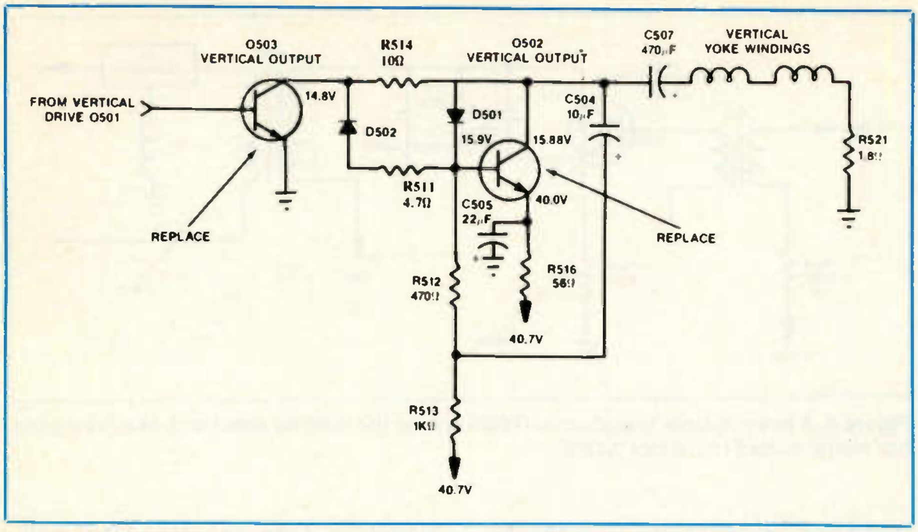

Figure 6. Both Q501 and Q502 were replaced with SK9041 universal replacements in the vertical circuits.

or only a few inches of vertical sweep (Figure 5).

To make sure the deflection IC501 was producing a vertical drive pulse, I checked the scope waveform at pin 7. I found a normal vertical waveform here, and traced it up to the vertical drive transistor Q501. This led me to believe that the vertical sweep problem was in the output circuits.

Because the two vertical output transistors were mounted under the picture tube and difficult to get to to test, I disconnected the set to perform in circuit junction tests on transistors Q502 and Q501. Q502 appeared open and Q501 was leaky. I then removed both transistors from the circuit and tested their junctions again. Q501 had a 0.21Ω leakage, and Q502 tested open out of the circuit (Figure 6).

In previous experience when dealing with leaky output transistors, it is common to find burned or open bias resistors accompanying them. Although D502 tested good at the moment, I replaced it with a GE-514 replacement in case it had been overstressed.

Because both Q502 and Q503 were identical transistors I replaced them both with SK9041 universal replacements. Replacement of D502, R511, R512, R513, Q502 and Q503 solved the vertical sweep symptom.

No color, poor video

The video/chroma processor (IC801) is a very critical multipurpose component. A defective IC801 may cause any of a number of symptoms: no-picture, no-raster with good sound, colors in the raster missing, no color, weak color, no color sync, no green, red or blue, poor tint (Figure 7).

IC801 has been noted to cause intermittent video or intermittent color, or both at the same time. I have had to replace several of these ICs (RH-1X0093CEZZ) in the past. At present there are no universal replacements, so the components must be ordered directly from the manufacturer's parts outlet. You may note that only X0093EE numbers and letters are actually found upon the body of the IC component. When ordering, use the entire part number.

Before replacing IC801 it is best to make sure that it is in fact defective. In many cases these ICs have been replaced without curing the symptom. When the replacement comes in, check to be sure that it is functioning before you install it in the set. If you have been shipped a faulty IC you are entitled to get a replacement.

Once you're sure that the replacement is good, be careful not to apply too much heat to the IC terminals as you solder it in, or you'll damage the new IC.

Careful voltage and resistance measurements may uncover a defective IC. A resistance chart in Howard Sams Photofact 2011 provides a list of the correct resistance measurements at the pins of the various ICs and transistors within the 19D82 models. Although the resistances that you measure may vary by a few ohms from those specified in the case of a good IC, gross differences may help to locate a defective IC (Figure 8).

Usually I go directly to the voltage supply pin (Vcc) of the suspected IC. In this case, although the voltage was around 11.2V with a resistance measurement of 4125Ω compared to the specified value of 4350Ω, the IC was not ruled defective as yet.

When voltage measurements upon pins 12, 13, 14, 15, 16 and 17 were also way off compared to the schematic, IC801 was suspected of leakage. The resistances at pins 12 through 14 were

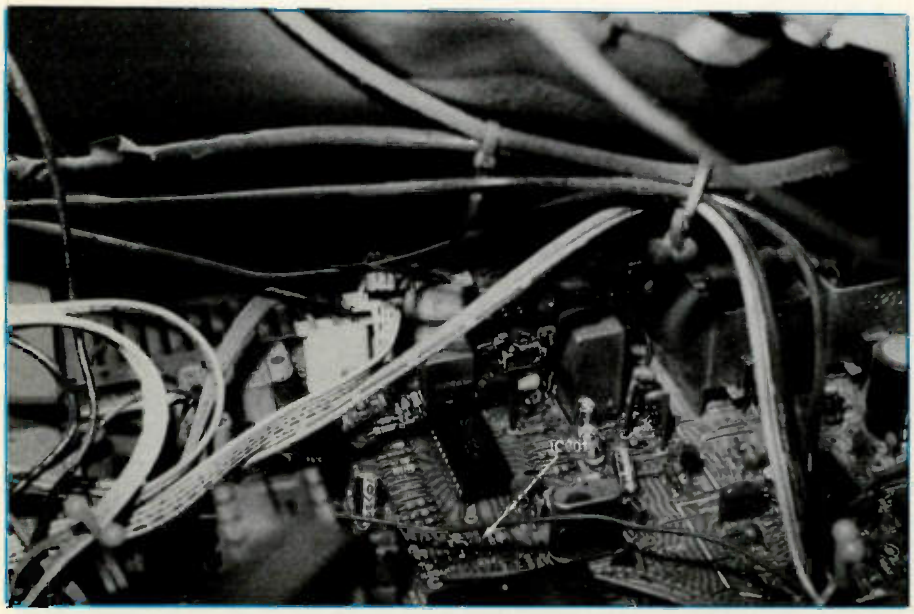

Figure 7. IC801 may cause many different color and video problems within the Sharp 18D82 portable TV.

PIN 1 4350Ω	PIN 15 INFINITE
PIN 2 5980Ω	PIN 16 INFINITE
PIN 3 11KΩ	PIN 17 8170Ω
PIN 4 330KΩ	PIN 18 INFINITE
PIN 5 23KΩ	PIN 19 2.2MΩ
PIN 6 100KΩ	PIN 20 3370Ω
PIN 7 18KΩ	PIN 21 4890Ω
PIN 8 3560Ω	PIN 22 390KΩ
PIN 9 3350Ω	PIN 23 3040Ω
PIN 10 3570Ω	PIN 24 1200Ω
PIN 11 329Ω	PIN 25 INFINITE
PIN 12 2700Ω	PIN 26 1762Ω
PIN 13 2700Ω	PIN 27 INFINITE
PIN 14 2700Ω	PIN 28 Command:

Figure 8. Actual resistance measurements on the suspected IC may be compared to those found in Sams Photofact folder 2011.

under 2450Ω, and should be around 2700Ω according to the chart. Pin 17 had a resistance to chassis ground under 1150Ω (8.2KΩ).

I removed pin 17 from the pc board by sucking up excess solder around the pin and took another measurement. Although pin 17 had a resistance above the 1150Ω measurement, I assumed the IC was leaky. Replacing IC801 with a factory replacement cured the no color, poor video problem.

Comments

Don't hesitate to make careful resistance measurements to common ground when you suspect an IC. Although this same IC has caused many different symptoms when defective, always take critical resistance and voltage measurements before removing from the circuit. Inspect the IC body for signs of overheating or running warm. At other times you may find the IC voltages and resistance measurements are fairly normal and replacing the IC is the only answer.

Remember a leaky or defective flyback may keep destroying the horizontal output transistors. To avoid unnecessary work and frustration, always check all surrounding parts before replacing a flyback transformer.

Selecting an oscilloscope

By Bob Oblack

In the complex world of electronics, most service technicians rely on the oscilloscope's ability to show them a wide variety of signals. Although the need for a scope may be obvious, selecting the appropriate scope for an application can be a bewildering exercise.

The technician's first, and most fundamental choice is between an analog or digital scope. To make a sound decision, he must have a good grasp of the basic strengths and differences between analog and digital scopes. Once the technician decides on the type of scope, he then must sift through the wide selection available for either kind of scope.

Why analog and digital scopes?

The service industry relies on both analog and digital scopes for measurements, because each offers unique capabilities. For instance, analog scopes reveal signal information as it happens and have the ability to display subtle distinctions - such as a signal's relative speed and rate of occurrence. But unfortunately, most analog scopes cannot store the displayed information.

Digital scopes, on the other hand, store signal activity as a matter of course. Because digital scopes sample the input signal, store it and then display it, they typically can perform sophisticated measurements and digital signal processing. And technicians rely on waveform storage for capturing signals when servicing on site.

But the very process that makes storage possible also limits the digital scope's ability to display waveforms. Unlike analog scopes, digital scopes do not display signal information as it happens. Processing and storing signal information results in a definite delay from input to display. Digital scopes also have limited horizontal and vertical resolution based on their memory length and the precision of their digitizers.

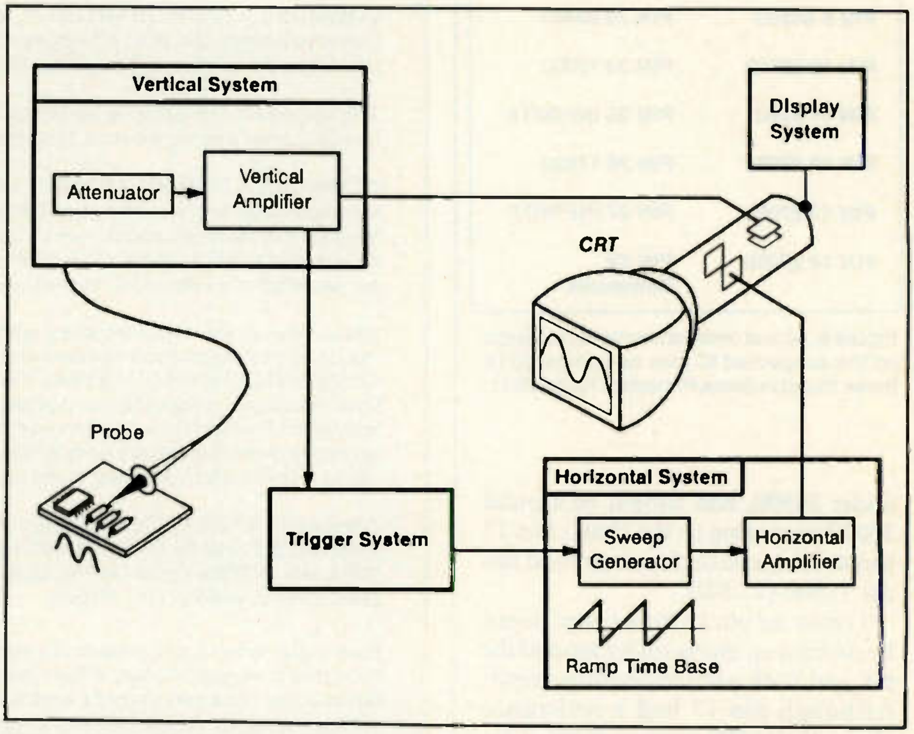

Figure 1. An analog scope takes an electrical input signal and either amplifies it or makes it smaller so it will fit on the display.

Analog scope operation

An analog scope takes an electrical input signal and either amplifies it or makes it smaller so it will fit on the display (Figure 1). The scope controls an electron writing beam that moves across the inside of the display drawing the waveform. The beam's speed depends on two influences - the frequency of the waveform and the user-selectable time base setting of the scope.

With minimal circuitry between the input signal and the display, the analog scope delivers exceptional signal fidelity. The beam can draw a waveform on the display up to 500,000 times a second. And once the beam has moved across the screen, it only takes microseconds to return to its starting point to draw again. Called the *writing rate* and *holdoff period* respectively, these capabilities enable the analog scope to monitor and display waveform activity as it happens in real time.

Besides the ability to react quickly to the input signal, the analog scope can reconstruct signal details with almost infinite resolution. Remarkably responsive to subtle variations in the input signal, the electron beam moves faster when displaying higher frequencies compared to other parts of the waveform. The faster the beam moves, the fainter that part of the displayed signal looks next to the rest of the waveform.

For example, when a signal makes

Bob has been with Tektronix for the last 20 years in sales and marketing roles. The majority of his experience has been with analog and digital oscilloscope technology.

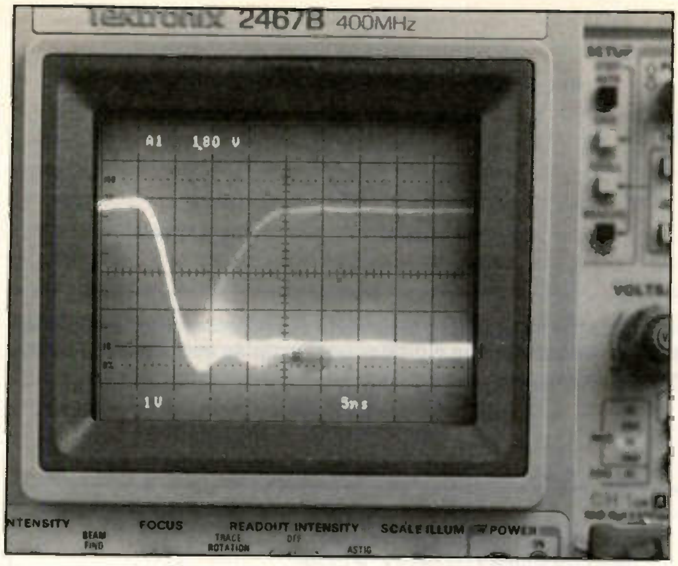

Figure 2. The faster the electron beam of an oscilloscope moves, the fainter that part o of the displayed signal looks next to the rest of the waveform. An experienced service technician can easily extract valuable information from these subtle distinctions.

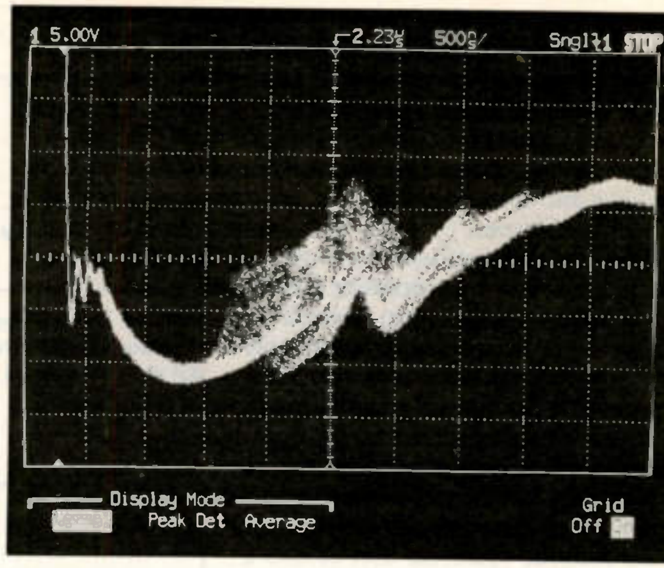

Figure 3. When vjewing mixed or modulated signals, the analog scope's resolution will show all the waveform's activity. Here a switching motor's startup current displays a wide range of speeds clearly when acquired and displayed with an analog scope.

a transition from a low logic state to a high one, the edge of the pulse contains much higher frequency components than the steady state portions. When displayed on an analog scope as shown in Figure 2, the edge will appear fainter than the rest of the waveform, indicating it is faster than the rest of the waveform. A service technician experienced with analog scopes can easily extract valuable information from these subtle distinctions in waveform shading.

Applications suitable for analog scopes

A variety of troubleshooting scenarios demand the capabilities of the analog scope. When viewing mixed or modulated signals, the analog scope's resolution will show all the waveform's activity. In Figure 3, a switching motor's startup current displays a wide range of speeds clearly when acquired and displayed with an analog scope.

Technicians also require the superior writing rate and resolution found in analog scopes to accurately display fast signals or high speed edges at slow sweep speeds. Regardless of the timebase setting, the analog scope will accurately display the input signal up to the bandwidth of the scope. For example, an analog scope will clearly display high frequency glitches riding on a 60Hz ac signal.

Perhaps the most important role technicians use an analog scope for is tracking down undefined anomalies. Because of the analog scope's outstanding ability to display signals in real time, they can expose virtually all of a signal's activity including any anomalous behavior. It's not uncommon for a service technician, when troubleshooting, to monitor a waveform with an analog scope for several minutes in the hope of spotting some aberrant behavior riding on the signal.

Digital scope functionality

A digital scope converts the input analog signal into digital information and stores it for display or further signal processing. The digital scope samples and digitizes the input signals' voltage at regular intervals (see Figure 4). It then stores the voltage value along with the corresponding time information in a waveform record in internal memories.

The digital scope stores information until it fills up the portion of internal memory dedicated to that input channel. Compared to an analog scope, the digital scope processes, stores and displays a section of the input signal whereas the analog scope continuously displays waveform activity.

The holdoff period is much more substantial for a digital scope than for an analog scope. Because the digital scope must convert and store the information, the time required to initialize the scope between acquisitions can be in the tens of milliseconds. During this large holdoff, a digital scope can easily miss important signal information. Figure 5 demonstrates how a digital scope can overlook anomalous behavior whereas an analog scope will find it much faster.

To compensate for its long holdoff period, most digital scopes include advanced triggering modes and longer memories. Longer memories allow the scope to acquire more before pausing for holdoff. And advance triggering modes, such as ones that search for runts or glitches, help the technician to focus scope acquisition around the signal activity of interest.

For instance, the TDS 500 digital scopes offer logic, pulse, runt and glitch triggering. With this type of triggering capability, a technician can efficiently track down and display aberrant waveform behavior.

Advantages of waveform storage

Technicians rely heavily on digital scopes when servicing on-site, because of their ability to store waveforms for later analysis. The service technician can quickly gather information at the customer site and then examine the waveforms back at the depot. This minimizes the down time needed for analysis and gives the technician the time he needs to identify the source of a problem.

Waveform storage also allows digital scopes to perform a wide variety of measurements including mathematical analysis. Using the digital information, the scope can easily measure and display a wide range of automatic measurements for a waveform or between waveforms, including a mixture of live and stored signals.

Digital scopes, by virtue of waveform storage, can perform sophisticated digital signal processing (DSP), translating raw data into finished information. What makes DSP possible is the fact that most digital scopes sample at a such a high rate that they cannot possibly store all the information.

For example, if a scope has a 10kbyte record or memory length and samples at a fixed rate of 100Msamples/second, when the user selects a 1msec period the scope will create ten samples for each slot in memory.

Most digital scopes give the user a variety of options, called acquisition modes, for processing extra sample points. In the above example, the scope can simply discard nine of the samples and store one value (sample mode). It can average the 10 and store the average value. Or the digital scope could look for the highest or lowest value and store that (peak detect mode).

Although most acquisition modes work equally well on repetitive or single-shot waveforms, a few require repetitive signals. For example, the envelope mode reveals the maximum variations in a repetitive signal across time, whereas the average mode calculates the average value for each point in a waveform over many repetitions. Figure 6 gives a brief description of some popular acquisition modes.

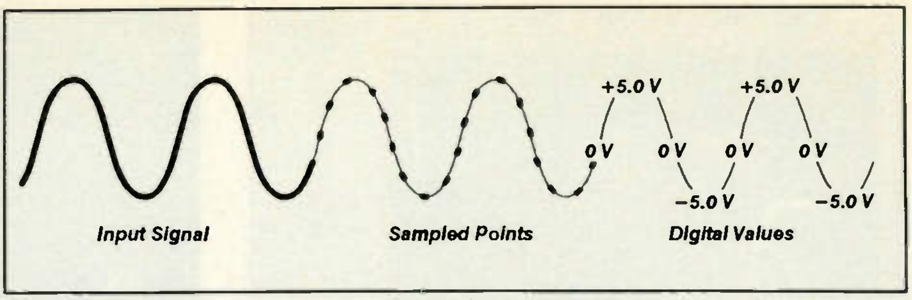

Figure 4. A digital scope converts the input analog signal into digital information and stores it for display or further signal processing. The digital scope samples and digitizes the input signal's voltage at regular intervals.

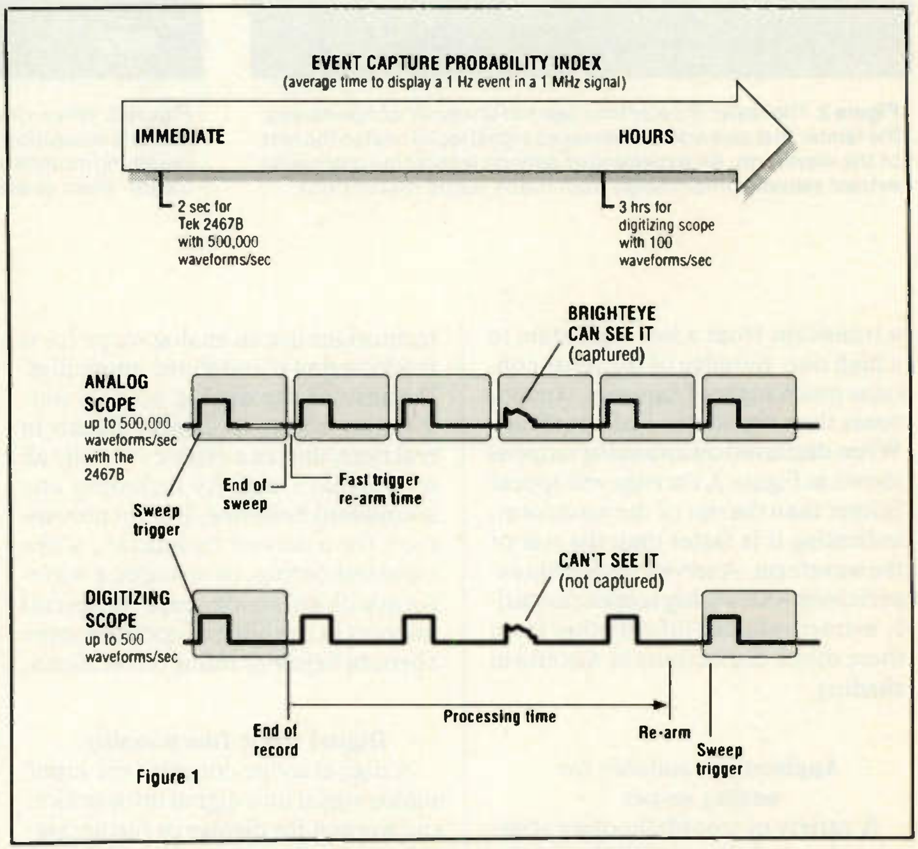

Figure 5. A digital scope can overlook anomalous behavior whereas an analog scope will find it much faster.

Digital applications

Service situations that require digital scopes abound. When troubleshooting demands precise measurements, a digital scope will give the service person the numbers they need. Able to quickly and accurately quantify a waveform, a technician can easily characterize irregular waveforms.

Of course, on-site servicing demands waveform storage capabilities. The digital scope gets the technician in and out of the customer site with the minimum of fuss. Also, storage allows the technician to store a template waveform to compare with signals acquired at a customer site.

Advanced triggering options can efficiently lead a service technician to asynchronous signal behavior such as runts and glitches. In contrast, with an analog scope this type of spurious signal activity might go by so quickly that the technician might never even notice it.

The same is true for single-shot waveforms. The digital scope can acquire and clearly display a one-time event, whereas the same waveform will come and go quickly on an analog scope limiting the technician's viewing time to just a few seconds.

Selection criteria for analog or digital scopes

When choosing a scope, whether it be analog or digital, the technician needs to consider some basic scope functionality. The first, and by far the most important, is bandwidth. To determine how much bandwidth an application requires, identify the highest frequency signal to be acquired and multiply that by five.

So if a technician wants to view a 100MHz signal, he needs a scope with a bandwidth of 500MHz. If the service person wants to examine digital pulses and doesn't know the bandwidth of the signal's edges, he can easily calculate it using this simple formula: Bandwidth = 0.35/Tr

Where Tr represents the risetime for the signal's edge.

The number of channels represents another important consideration in scope selection. Every scope has at least two input channels and higher cost scopes usually offer four. With two channels, the technician can make basic measurements for power, voltage and current. Four channels allows the service person to compare several waveforms simultaneously.

Another issue when selecting either analog or digital scopes deals with ease of use. In the past, many scope interfaces intimidated the casual user. They either bristled with rows and rows of buttons and knobs or had elaborate menu structures that quickly lost the user in a maze of selections. Manufacturers have begun to develop user interfaces to eliminate these problems.

Last but certainly not least, any scope a service technician chooses must meet stringent requirements for reliability and portability. Because a technician must service in a wide range of environments, his scope must meet strict military specs, withstand rough handling and endure the stress of changing environments. For the same reasons, a scope needs to be portable. More and more customers demand on-site servicing, so a service person literally needs to grab and go with his scope.

Analog scope considerations

If a technician decides to use an analog scope, he then must select the type of analog scope based on its ability to meet the application's needs.

One of the most critical parameters in selecting an analog scope, deals with the analog scope's writing speed. The faster the electron beam can move, the more details it will display (see Figure 7). However, with the traditional analog scope display, the electron beam can move so fast that the trace on the screen becomes difficult to see. An answer to this problem is the microchannel plate (MCP) display which enhances an analog scope's display so that even the faintest traces are easy to see. Figure 8 illustrates how the MCP works.

The update rate represents another important specification for analog scopes. A function of the holdoff period, the update rate quantifies how quickly the scope can display new information after drawing a waveform. The shorter the holdoff period, the faster the electron beam can accept new information and display it. A high update rate coupled with a large bandwidth, ensures the technician will see any high-speed anomalies riding on a signal.

If the technician's work includes servicing TV equipment or video monitoring, he'll want to monitor live video signals with an analog scope. To do this, the scope will need video triggering capabilities that must include triggering on lines, non- interlaced fields or interlaced fields and cover all the major video standards such as NTSC, PAL or SECAM.

Digital scope requirements

Sample rate represents the most fundamental criterion when selecting a digital scope. How fast a digital scope can sample and store a signal establishes the timing resolution of the scope. To create an accurate representation of a waveform, a digital scope needs to gather at least two samples per cycle of the highest frequency component in the input signal. So if the input signal contains frequencies up to 200MHz, the digital scope must have a sample rate of at least 400M-samples/sec. Of course the bandwidth of the scope's path must also exceed 200MHz to ensure that the input circuitry does not distort the signal.

Sometimes a digital scope may have a sample rate much lower than the bandwidth of the scope. In this case, if a technician wants to acquire a signal with one acquisition (in real time), the accuracy of the scope is limited by its sample rate. However, if the technician is examining a repetitive signal, then the digital scope can gradually build up a representation of the waveform over many acquisitions. Using this technique, a digital scope rate can create a display of a signal up to bandwidth of the scope.

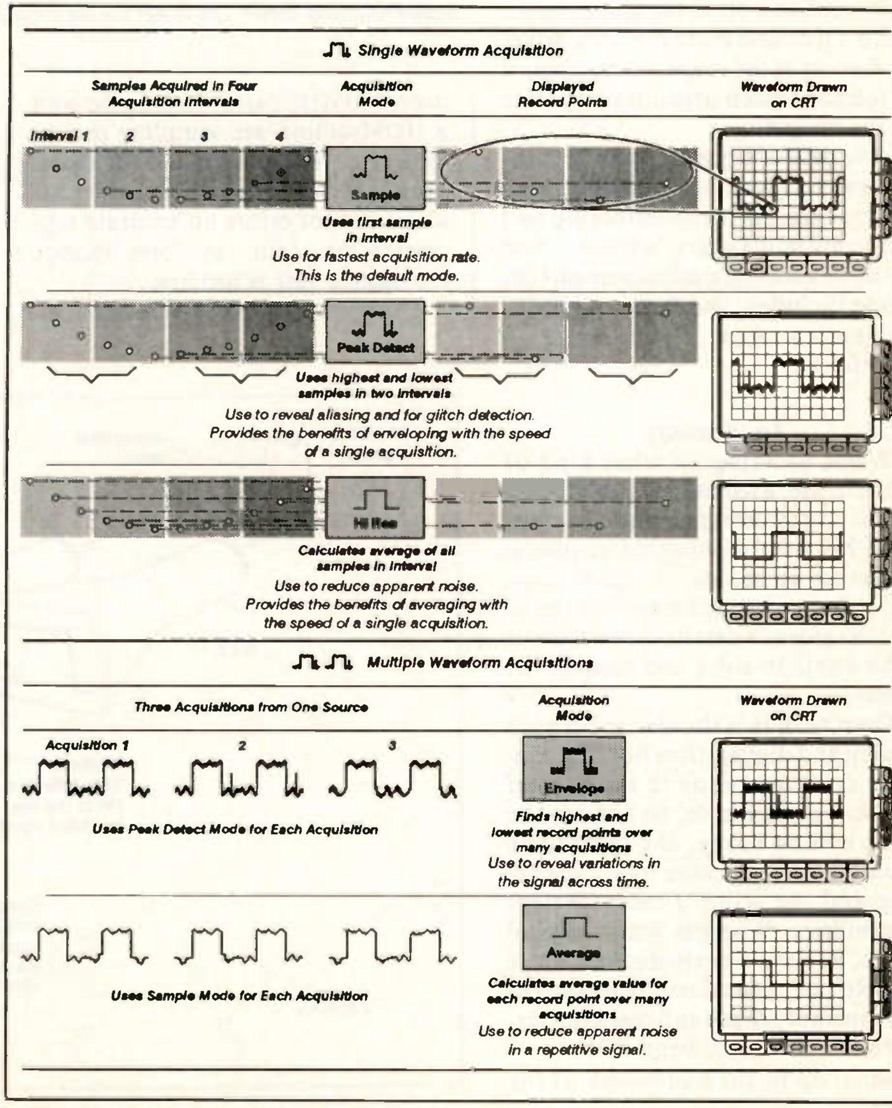

Figure 6 Some popular acquisition modes.

Just as the sample rate determines the timing resolution of a digital scope, so too a digital scope's bits of resolution limits the display's vertical resolution. Most digital scopes offer 8 bits of vertical resolution or 256 (28) levels of resolution per division. More resolution increases the cost of the scope dramatically, whereas less resolution results in poor display quality.

However, certain display modes on an 8-bit digital scope can actually increase the bits of resolution. If a technician uses the averaging mode on a repetitive signal, he can boost his vertical resolution markedly. And an oscilloscope that offers a high-resolution mode can increase the actual bits of resolution up to 15 for single-shot waveforms at lower sweep speeds.

Other important considerations when choosing a digital scope include memory depth, range of triggering and acquisition modes and the scope's automatic measurement capabilities. The deeper the memory, the more information and detail the scope can acquire. Of course more memory drives up the cost of the scope, so the amount of memory often depends on the size of the budget.

A variety of triggering and acquisition modes gives the technician more approaches for troubleshooting and analyzing faulty signal behavior. And the more automatic measurements the scope includes, the faster a service technician can characterize a waveform.

In summary

When deciding on what kind of scope to use, a technician should keep a clear idea of the type of signal acquisition his troubleshooting requires. Choosing an analog or digital scope depends on whether he needs to see all the waveform's details in real time or if he wants to store and analyze the signal.

Once he makes the choice between analog and digital, then he must consider criteria unique to the type of scope. For example, to choose the right analog scope, the technician should consider writing speed, update rate and the scope's measurement capabilities. Whereas with a digital scope, he should evaluate the scope's sample rate, effective bits of resolution, memory depth and real-time versus equivalent time bandwidth.

a signal up to the bandwidth of the scope.

For example, a technician wants to use a 500MHz bandwidth scope with a 100Msample/sec sampling rate to look at a 250MHz signal. If the signal only occurs aperiodically, then his scope cannot create an accurate representation of the waveform because the sample rate is too low.

However, if the 250 MHz signal repeats, then the technician can put his digital scope into equivalent-time sample mode and easily acquire a faithful depiction of the input waveform. But keep in mind, even when the sample rate is too low the scope will display a waveform but it will be a distortion of the actual input signal. ■

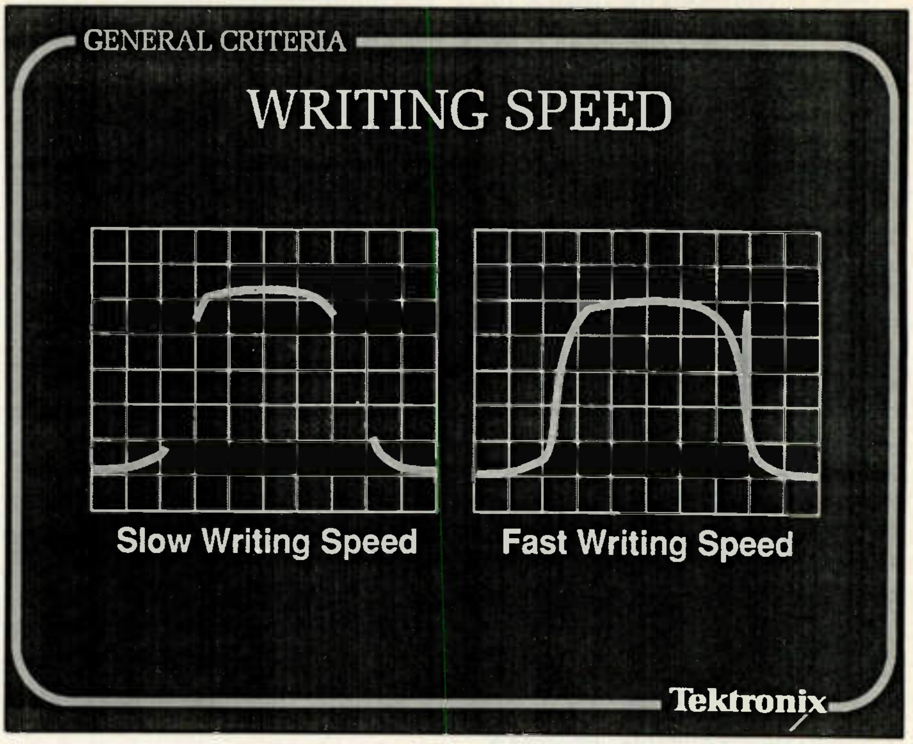

Figure 7. One of the most critical parameters in selecting an analog scope, is the analog scope's writing speed. The faster the electron beam can move, the more details it will display.

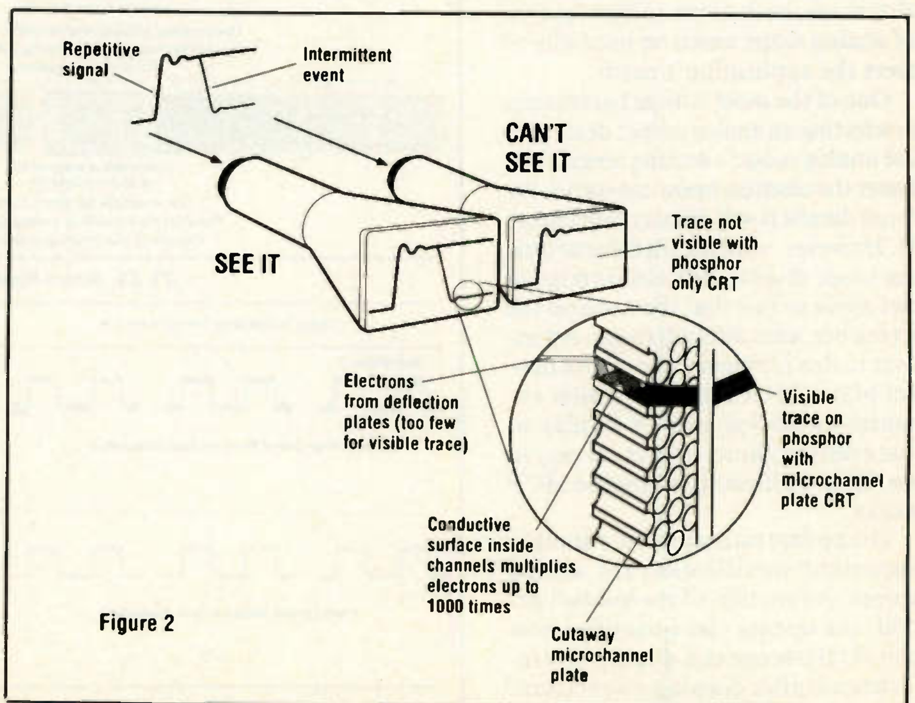

Figure 8. The microchannel plate (MCP) display enhances an analog scope's display so that even the faintest traces are easy to see.

ES&T Manufacturers' schematics **PROFAX**

November 1992

Profax Number

Model 27C-S200 - Schematic Diagram - Main 1

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

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

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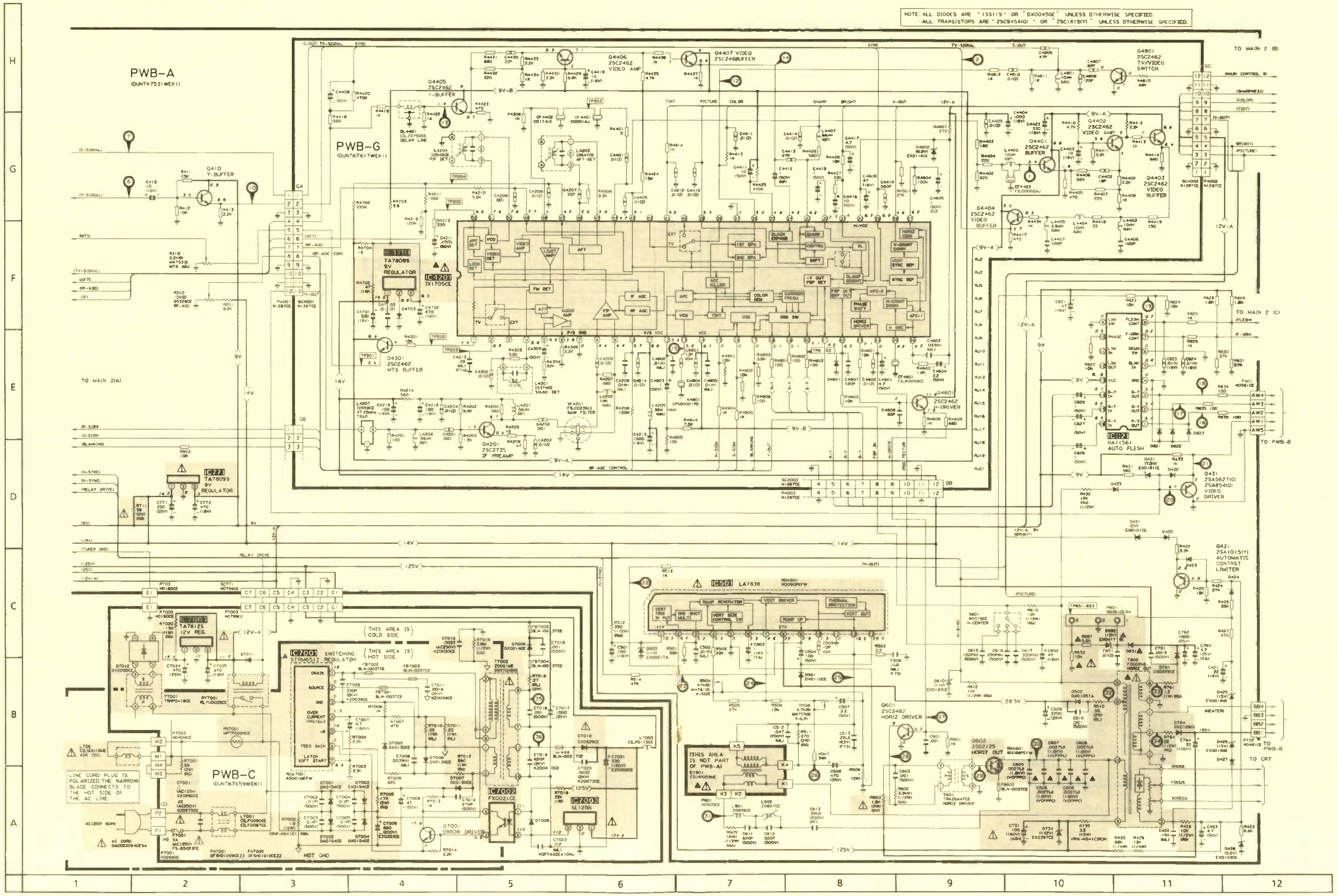

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Models 27C-S300, 27C-S3900 - Schematic Diagram - Main 2

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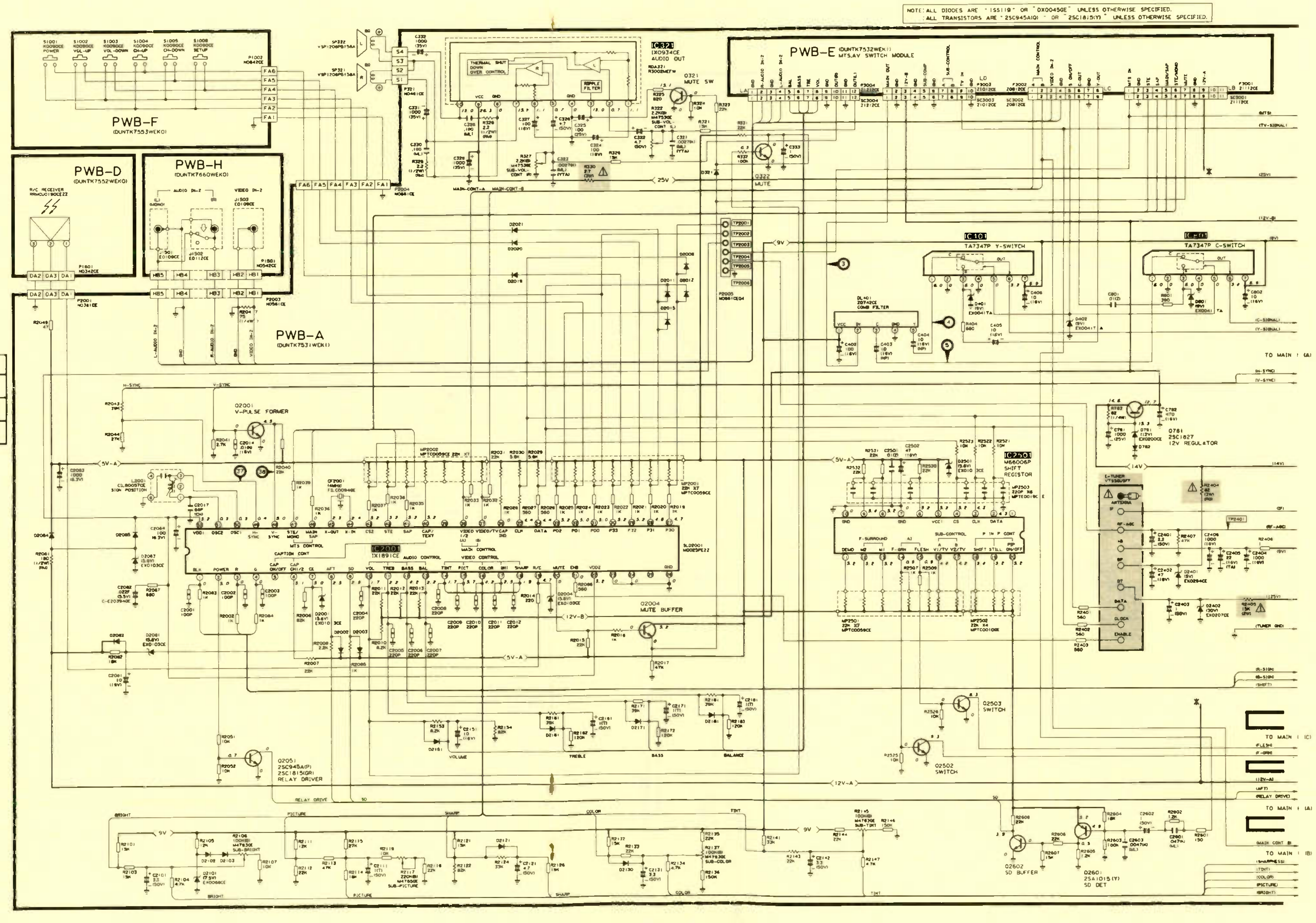
INDICATION OF E-TUNER TERMINAL VOLTAGE(VTSS6USFF)

CH No.	V_T	B_L	B_H	B_U
2~B	1.7V~22V	12V	0V	0V
C~W+11	1.4V~25V	0V	12V	0V
W+12~69	1.5V~27V	0V	0V	12V

INDICATION OF SENSOR IC VOLTAGE (IC1001)

Pin No.	IC2001 Logic or Voltage Levels
1	Positive Pulse
2	H(Power on) L(Power off)
3, 4	Positive Pulse
8	2.5V (On Air)
9	Pulse
10~17	Positive Pulse
18	Negative Pulse (Active)
19	Negative Pulse
20	Positive Pulse
21	Chip Enable
27~30	Key Scan Input (Negative Pulse)
31~35	Key Scan Output (Negative Pulse)
37	H (TV) L (VIOEO)
38	H (VIOEO-1) L (VIOEO-2)
41	Negative Pulse (Sap In)
42	Negative Pulse (Stereo In)
43	Pulse
44	Clock Input
45	Clock Output
46	H (SAP) L(MAIN)
47	H (MONO) L(STEREO)
48	V-Sync Pulse Input
49	H-Sync Pulse Input
50	OSC1, CRT Clock Input
51	OSC2, CRT Clock Output



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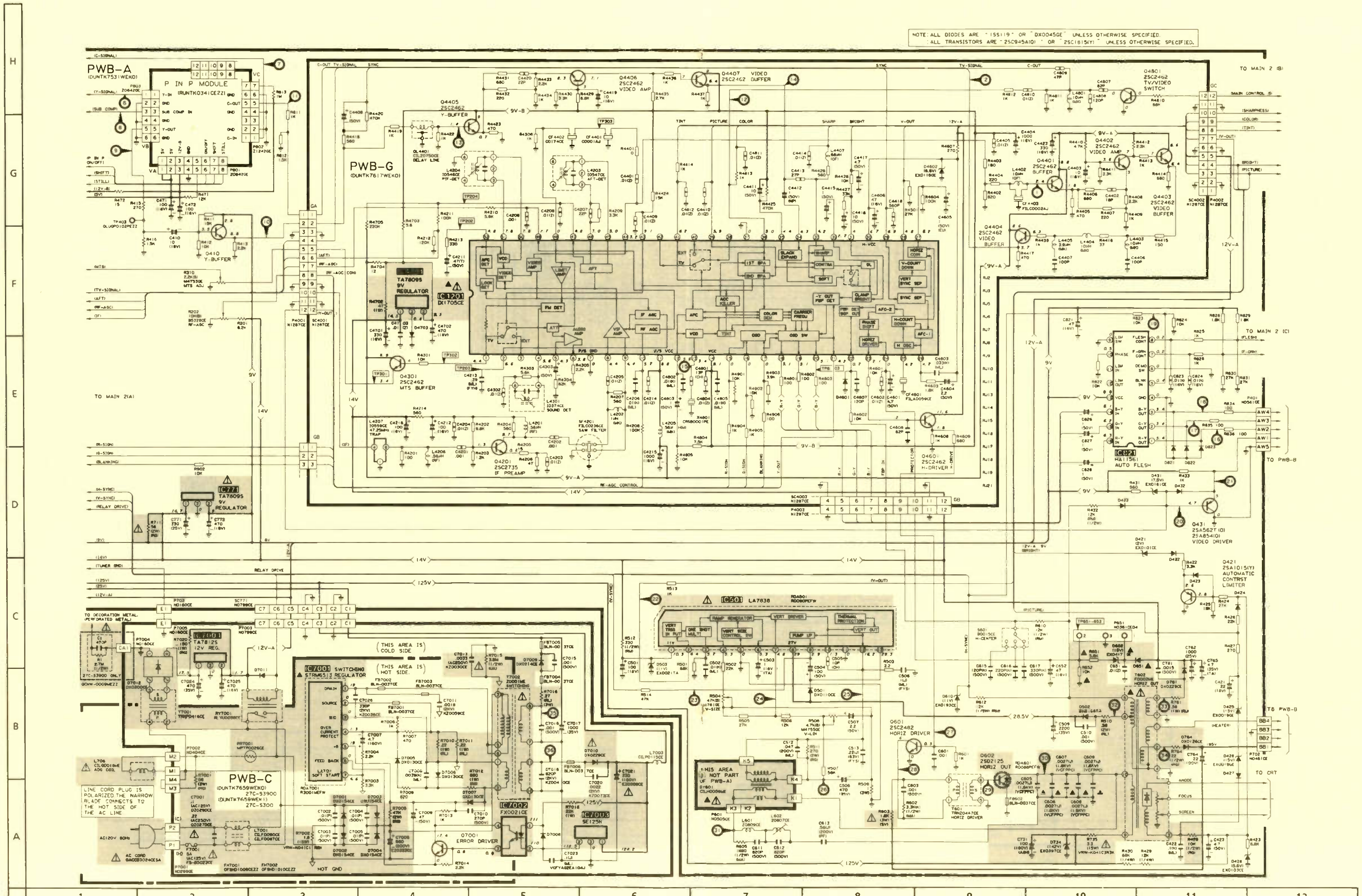

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Manufacturers' schematics

SHARP COLOR TELEVISION SIGMA 9700 CHASSIS MODEL 27C-S200

November 1992

Model 27C-S200 · Schematic Diagram · Main 2

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Manufacturers' schematics PROFAX 3094

Model 27C-S200 · Schematic Diagram · Main 2

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27~30	Key Scan Input (Negative Pulse)
31~35	Key Scan Output (Negative Pulse)
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38	H (VIDEO-1) L (VIDEO-2)
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43	Pulse
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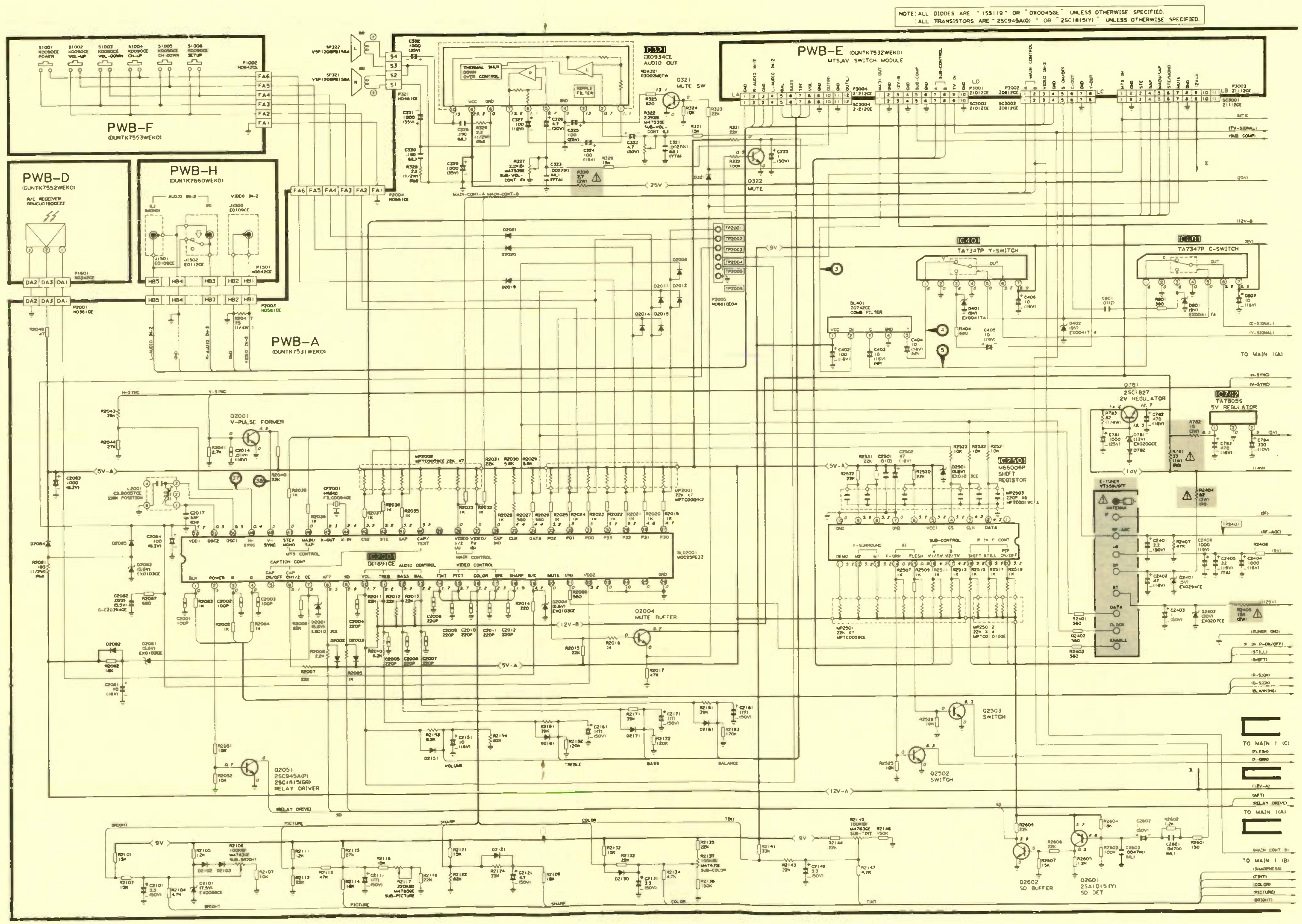

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Profax Number

Sharp

Color Television Sigma 9600 Chassis Chassis No. A20 Model 25A-M050 3095

BLOCK DIAGRAM

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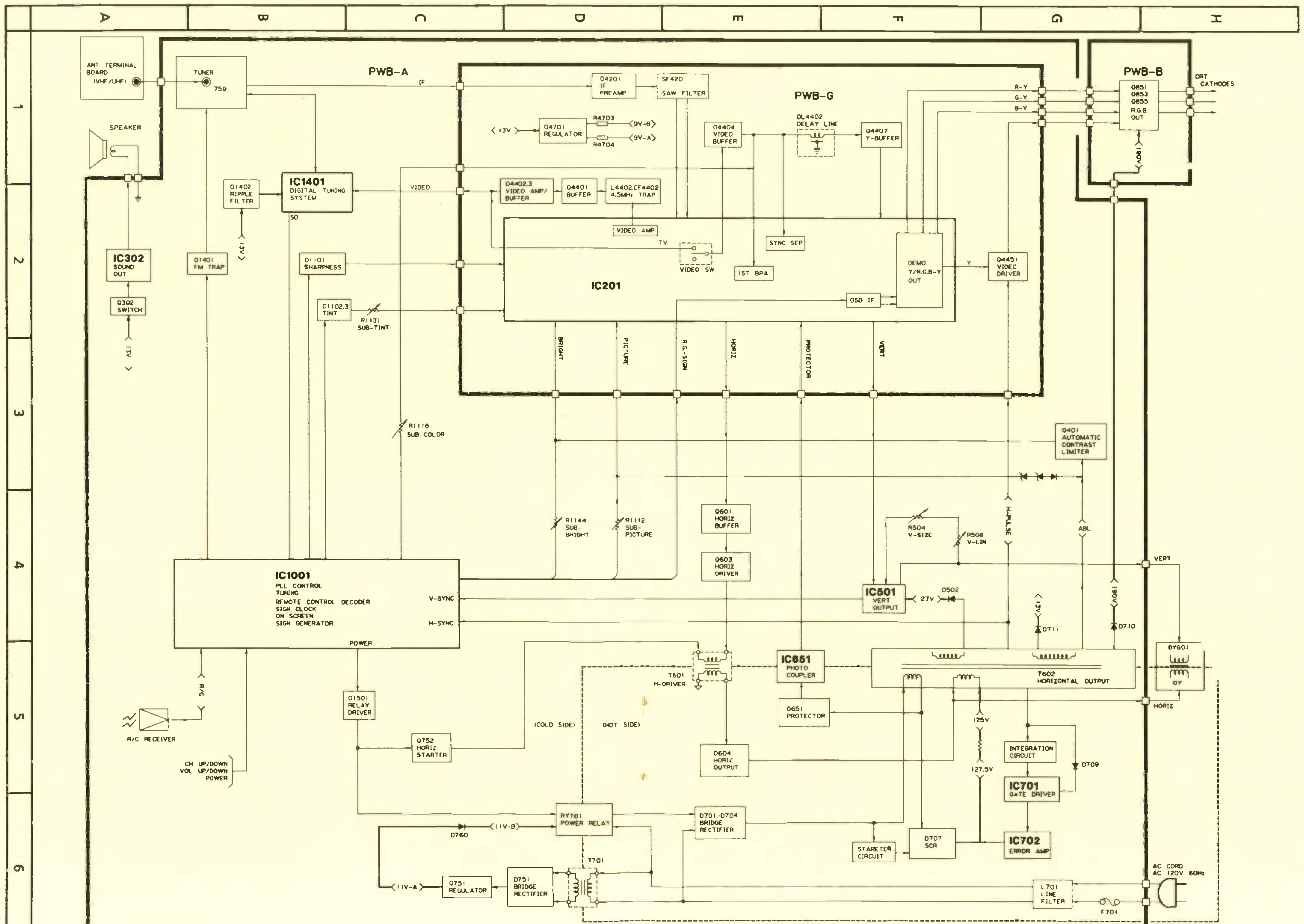

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SCHEMATIC DIAGRAM—SIGNAL MODULE

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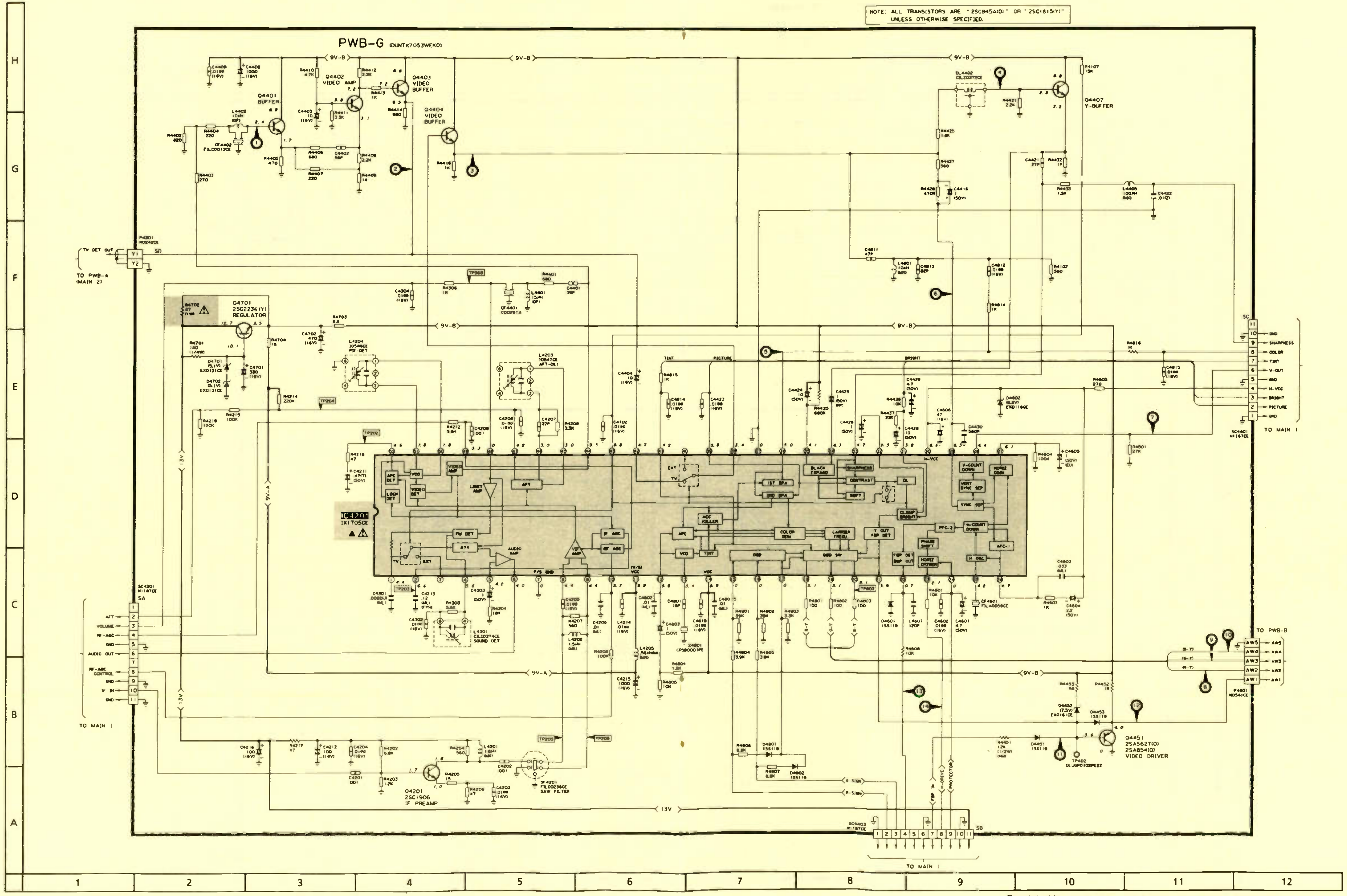

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SCHEMATIC DIAGRAM—MAIN 2

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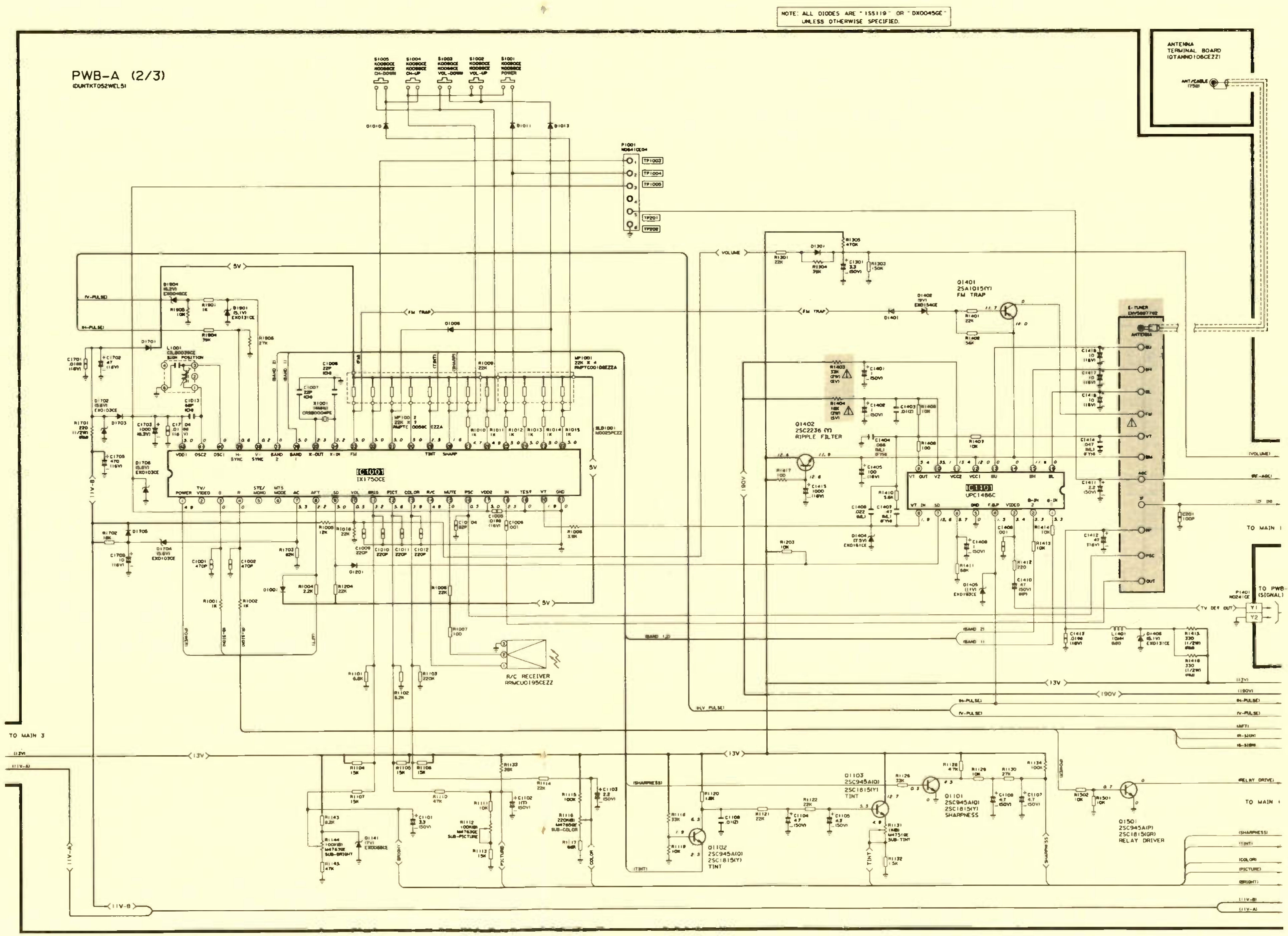

INDICATION OF E-TUNER TERMINAL VOLTAGE(ENV56877G2)

CH No.	V_T	BL	BH	BU
2~8	1V~22V	12V	0V	0V
C~KK	1V~26V	0V	12V	0V
LL~69	1V~24V	0V	0V	12V

INDICATION OF SENSOR IC VOLTAGE (IC1001)

Pin No.	IC1001 Logic or Voltage Levels
1	H(Power on) L(Power off)
3, 4	Active High (Pulse)
7	4.8V (Active High)
8	2.0V~3.5V
9	5V or 0V
10~13	Pulse
14	Active Low (Pulse)
15	5V or 0V
16, 18	Pulse
20	Pulse
22~27, 32, 33	Key Input Active Low (Pulse)
28, 29	Pulse
34, 35	Osc. 4MHz
36, 37	5V or 0V
38	V-Sync. Pulse Input
39	H-Sync. Pulse Input
40	OSC 1 During ON SCREEN operation: Osc. On
41	OSC 2 During ON SCREEN Inoperative: Osc. Off

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SHARP
COLOR TELEVISION
SIGMA 9600 CHASSIS
CHASSIS NO. A20
MODEL 25A-M050

November 1992

SCHEMATIC DIAGRAM—MAIN 1

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SCHEMATIC DIAGRAM—MAIN 1

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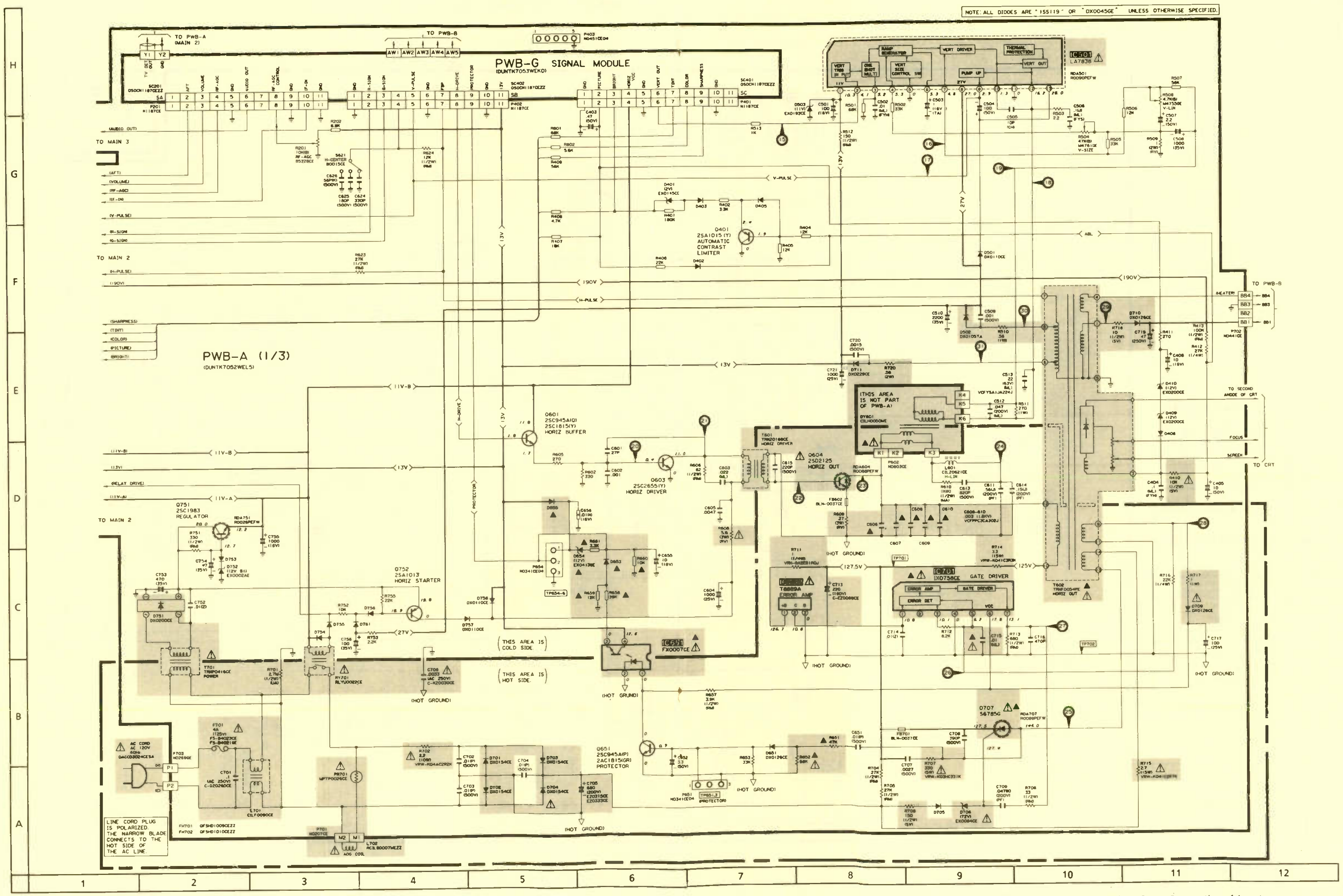

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Test your electronics knowledge

By Sam Wilson, CET

1. A higher output voltage is obtained from a full-wave rectifier supply that has a
A. choke input filter
B. capacitor input filter

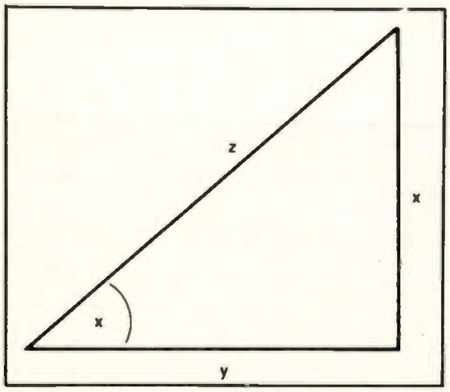


Figure A.

2. In the right triangle of Figure A the cosecant of angle X is

A. y/x

B. z/y

C. z/x

3. A VOM is rated at 20,000 ohms per volt. That means:

A. it offers a resistance of 20,000 ohms for each volt measured. For example, when measuring 2 volts its resistance is 40,000 ohms.

B. a current of only 0.00005 ampere, will cause the pointer to move to full scale.

4. Is the following statement correct? "The technically accurate definition of a transducer is: a device that converts energy from one form to another."

5. Crossover distortion is prevented in bipolar transistor amplifiers by

A. forward biasing the emitter-base junction when there is no input signal.

B. reverse biasing the emitter-base junction when there is no input signal.

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

6. Power transformers have laminated iron cores in order to

A. reduce hysteresis loss
B. reduce power loss due to the resistance of the iron
C. reduce eddy current losses.

7. From the standpoint of an efficient use of power

A. the power factor should be 1.0
B. the power factor should be zero

8. You can measure the RMS value of the voltage waveform in Figure B using an analog VOM such as the Simpson 260. To do that, you must know the ________________.

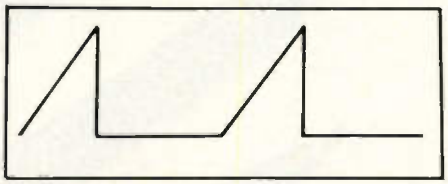


Figure B.

9. Which of the circuits in Figure C represents a higher load?

A. The one marked (a).
B. The one marked (b).

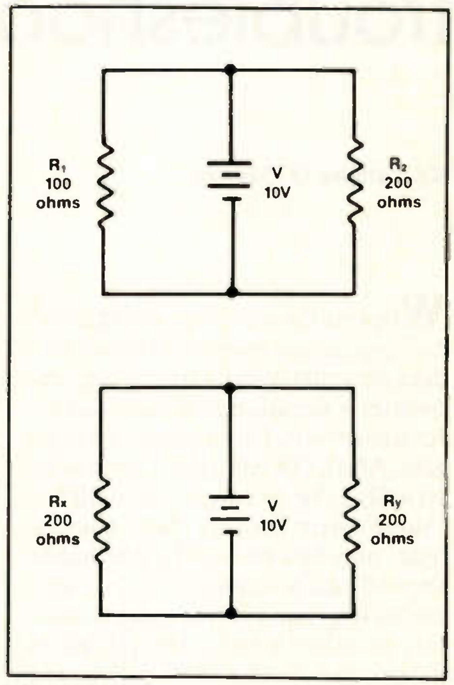


Figure C.

10. Which of the following diodes is best for sensing the presence of infrared light?

A. Schottky
B. PIN
C. Varactor
D. Four-layer

(Answers on page 65)

Hand-held digital troubleshooting devices - Part I

By Vaughn D. Martin

When you're troubleshooting a logic circuit, as you might do when servicing a personal computer, you may encounter a situation that defies all efforts to solve it. For example, if a logic gate (AND, OR, etc.) short circuits internally, the circuit trace (called a "node" here because many components may be tied to it) to which that shorted gate is connected will be connected to ground via the short circuit. Or, in other words, the circuit is "stuck low." The challenge to the technician in such a case is to determine which of the many devices tied to the node is actually faulty.

This two-part article addresses hand-held digital troubleshooters, a class of device that may help you find the cause of the problem described here. These are a group of simple digital test and measurement instruments. They are intended to be used at the node and gate level to precisely locate some very hard to find faults such as V_{CC}-to-ground shorts, solder bridges and stuck buses.

These tools are often used to further verify faults that have already been identified by other electronic test equipment. These hand held troubleshooting instruments allow you to non- destructively repair your circuit quickly and easily. They are also used as test sets by field service technicians on-site.

These testers are also found on the production line, and especially around PC board testers as accessories.

Many manufacturers make varying versions of these devices; however, because Hewlett-Packard makes a full range of these products and they are popular, this article concentrates on that company's products.

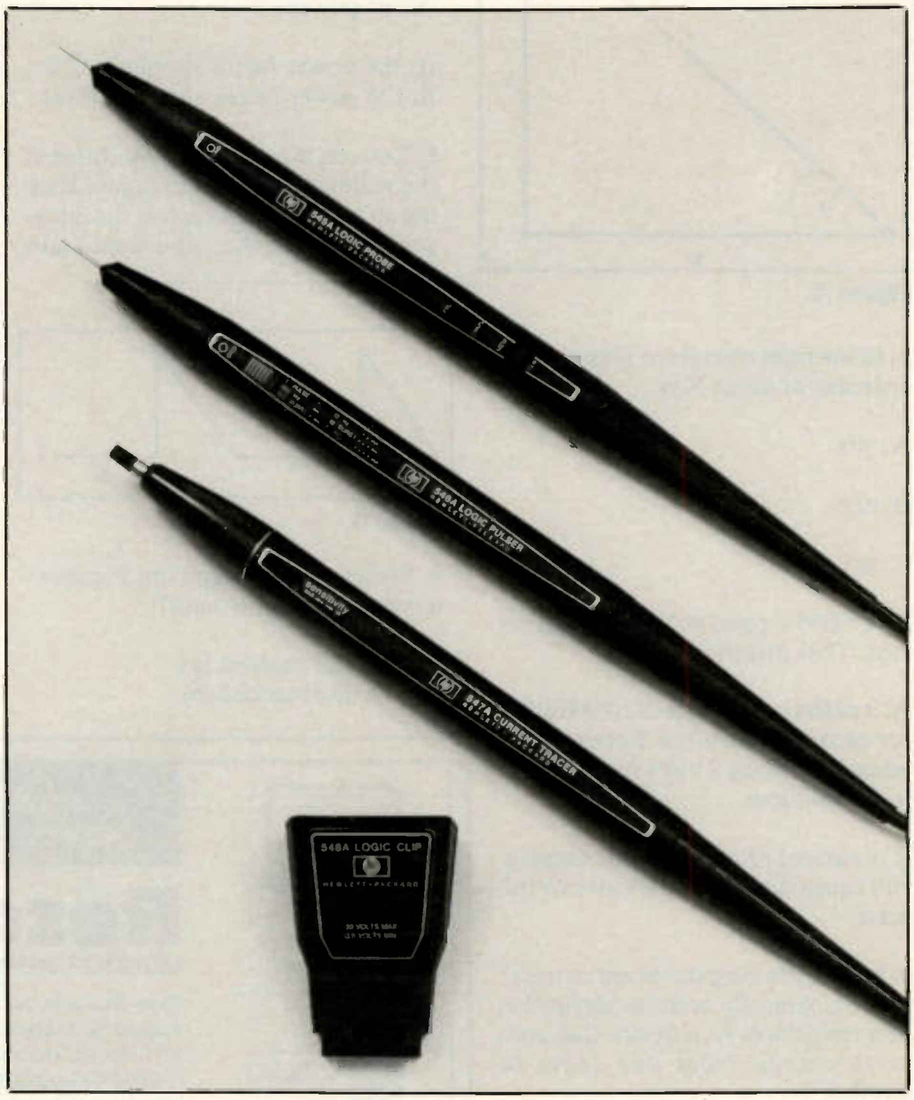


Figure 1. The current tracer, shown here, can be used to isolate a fault in a logic circuit by sensing pulsing current.

It takes circuit knowledge and skill to use simple tools like these IC troubleshooters in digital troubleshooting. This article will enhance your ability to use probes, pulsers, current tracers, logic clips and logic comparators.

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

The current tracer: getting an edge on digital faults

The more familiar you are with a

failed circuit, the more likely you can repair it quickly. There are many occasions, however, where a faulty circuit node is identified as "stuck", and you are stuck too. These are typically when you find many elements common to the node and there are too few ways to isolate the one bad component.

Current tracing can solve this problem cheaply, quickly and non- destructively. For example, when you're performing current tracing, it isn't necessary to lift IC pins, cut traces, or supply large amounts of dc current down a path to locate (burn up) the short.

You can eliminate these destructive measures by using a hand- held probe with a one-lamp indicator that glows when its tip is held over a pulsing current path (see Figure 1). This means you can detect whether current is flowing at all (sometimes it isn't, as when a node driver is dead), or, most important, where the current is flowing.

If a node is stuck LOW and the reason is a shorted input on one of the components connected to the node, a very strong current flow exists between the node driver and the faulty component. If this current is to be detected, the current has to be pulsing rather than dc. In a logic circuit, in most cases the currents will be pulsing. In cases when the current isn't pulsing, pulsing the faulty node with a logic pulser solves the problem.

Obviously, there are steps necessary to avoid "crosstalk", to help troubleshoot multilayer boards. Moreover, the point at which a circuit is pulsed can be important.

Using the tracer

Usually the current tracer is the final test instrument employed to pinpoint a fault on a node. In general, the technician using a tracer pinpoints faults by following current flow after he has used voltage or logic-state sensing devices to narrow the faulty area to a bus line, node, or PC board trace.

Because the area under test is probably stuck at a fixed voltage potential, only the use of current tracing will indicate an activity path that can be investigated. A node "stuck" in one state may be trying very hard to change states, and will therefore be carrying a great deal of current.

Sensitivity

The tracer's sensitivity can be varied over a great range of current values: from (1mA to 1A). It is critical to troubleshooting success to set the sensitivity correctly using the following steps (refer to Figure 2):

1. Select the bad node, gate, or signal path to be traced.
2. Place the tracer's tip at the node driver output.
3. Align the tip (to be covered shortly).
4. Set the Sensitivity Control for half-brilliance on the indicator lamp.
5. Leave the sensitivity control at the same setting until the fault is located or until test conditions change (for example, if it becomes necessary to use a logic pulser to stimulate the node to raise the current level).

Digital IC failure modes and current tracing

When ICs fail, in three out of four cases the failure is caused by opening up at either the input or the output.

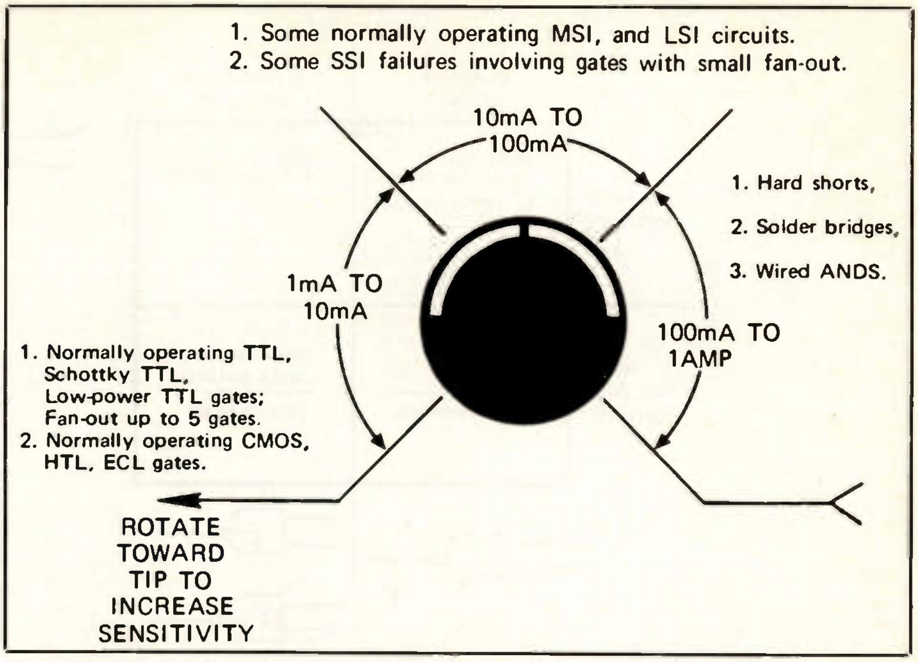


Figure 2. When a current tracer is used to isolate faults, its sensitivity must first be adjusted.

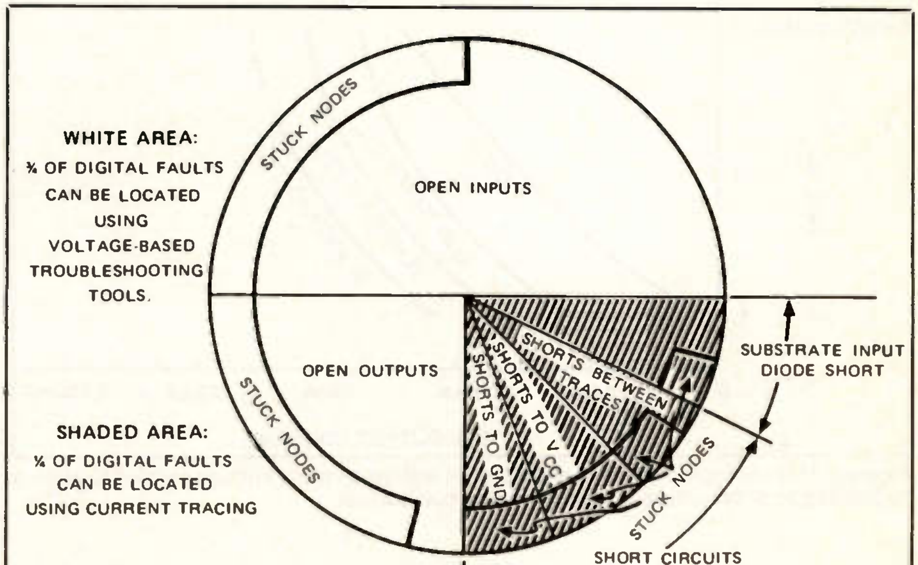


Figure 3. Three out of four digital IC faults are caused by open inputs or open outputs. These faults can be isolated using voltage-based troubleshooting tools.

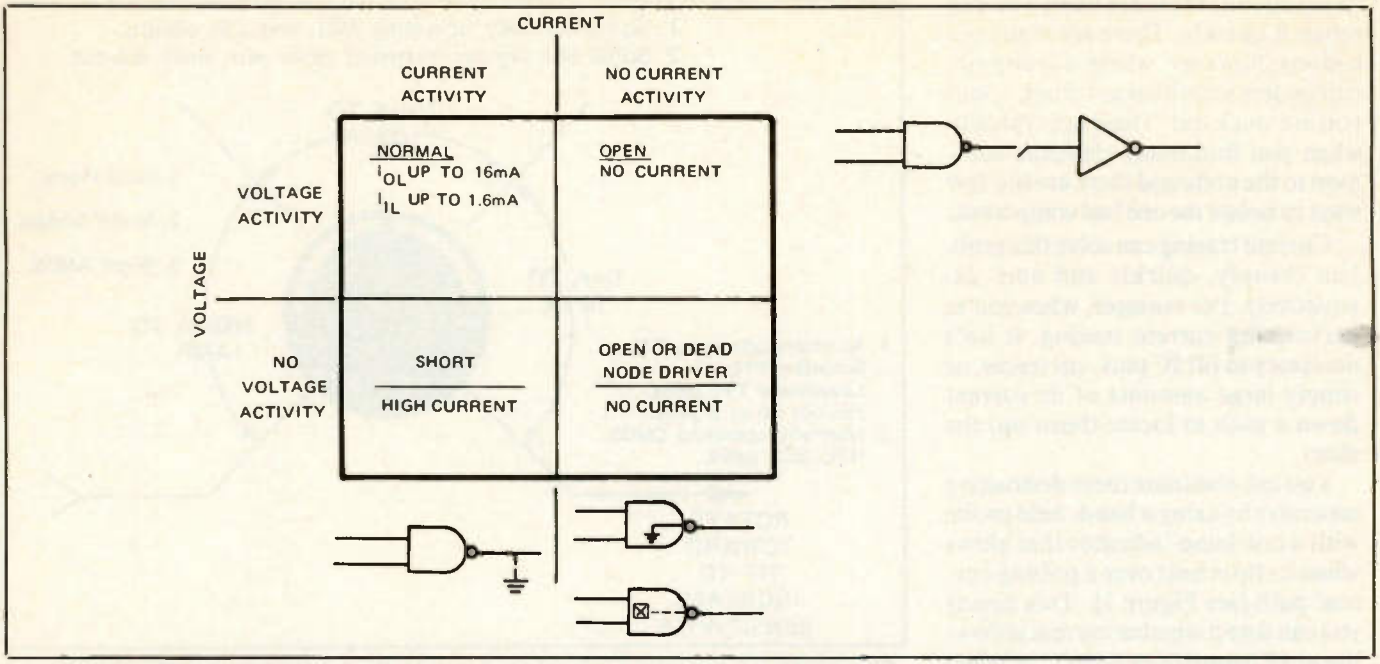


Figure 4. Logic device failures can be classified on the basis of their voltage and current activity.

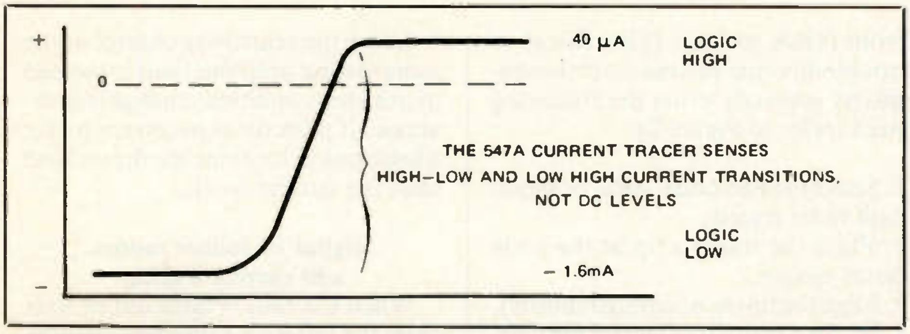


Figure 5. A current tracer senses current transitions, not dc levels.

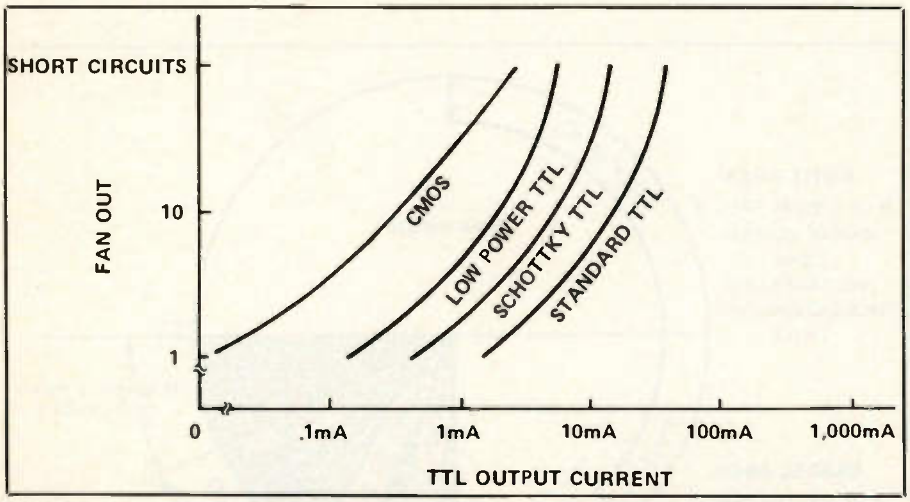


Figure 6. In most logic circuits, a short circuit will cause great enough current to allow a technician to differentiate it from normal circuit current.

Failures of this kind can often be found using voltage-based methods such as probes, pulsers and clips (see Figure 3).

Repairs to the other failures are helped greatly by using current tracers.

Remember, as previously stated, the current tracer is generally the last tool used after a fault has been located down to a specific node or set of nodes. Further, the current tracer is most useful where the fault produces excessive current flow on the node, as in the case of a short to V_{CC} or ground; or in a case where two nodes are solder-bridged together.

If there is little or no current flowing on the node, it is likely that the cause is a dead driver (open output bond), or absence of pulse activity in the circuit. In cases like this, use the probe and pulser to narrow down the symptoms of the fault, then use the pulser and tracer to investigate current flow on the node in question. There are occasions when a circuit appears faulty but isn't because (a) the wrong node is under investigation, or (b) the circuit schematic contains errors.

Current and voltage in failed ICs

Another way of classifying failure is illustrated in Figure 4. Note that in the upper left-hand corner there is both voltage and current activity present on a TTL circuit node, which indicates that the circuit is likely to be operating normally. In the lower right-hand corner there is neither voltage nor current, indicating that the driver is either open, or dead.

When troubleshooting, the symptoms are seldom as clear as these are, and simple faults can often create perplexing symptoms. Nevertheless, a basic understanding of voltage and current provides the tools for troubleshooters to debug complex board faults.

Current tracers sense ac current

The current tracer is an ac device. It detects and displays current pulses or current transitions and then stretches and displays them on its lamp. When a TTL output goes from Logic Low to Logic High, for example, the total current change is about 1.6mA (see Figure 5). The tracer senses the current density in a conductor associated with this change and then displays the result. The tracer is not voltage-sensitive, and so responds only to current changes.

CMOS current tracing

At first glance, it may seem the tracer would not be capable of sensing CMOS current flow. The tracer, however, easily "sees" CMOS current for the following reasons:

1. CMOS inputs charge up like capacitors.
2. The charging current is greater than the threshold sensitivity of the tracer.
3. CMOS IC manufacturers specify the dc current drawn by their devices, not the input charging current mentioned above.
4. The current tracer sensitivity exceeds the 1mA specified.
5. Above all, the current tracer is used to look at faults where the current is a great deal higher than normal.
6. Lastly, use of a logic pulser effectively raises the in- circuit current to a much higher level to allow easy-to-follow tracing. Therefore, whether the circuit is TTL or CMOS, the tracer can sense ac current in it. The diagram of Figure 6 further supports this, and also shows the range of currents usually present in both these IC families.

Current magnitude in TTL and CMOS circuits

There is generally sufficiently high current for the tracer to easily differentiate fault paths from circuits containing "normal" current. See Figure 6. A faulty circuit will usually carry at least an order of magnitude more current than one operating as the circuit designer intended. This is as true for CMOS circuits as it is for TTL. Faulty CMOS circuits carry almost as much current as the low power Schottky TTL example just shown.

Tracer troubleshooting considerations

The current tracer provides a useful tool for logic circuit diagnosis. The

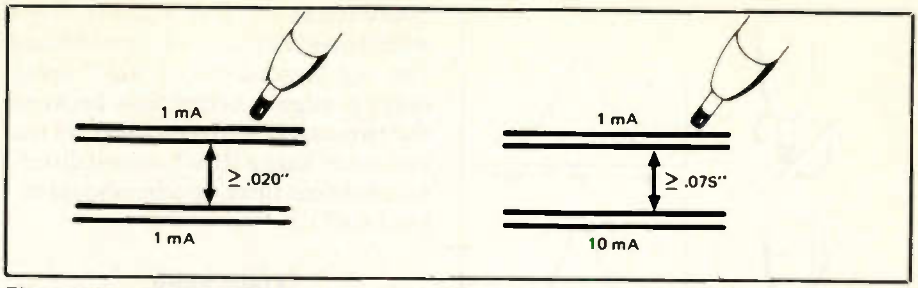


Figure 7. Don't be fooled by the large size of the plastic case of the current tracer. The current sensing coil is only 0.010" in diameter, so it can be used even when the printed circuit wiring is closely spaced.

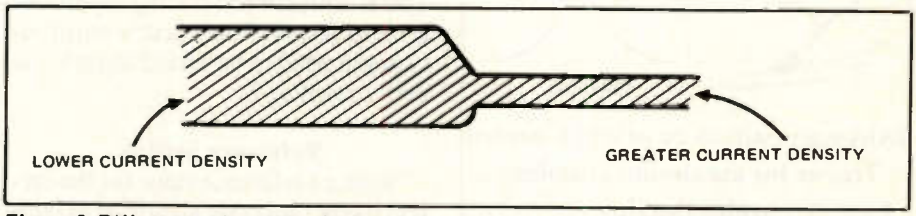
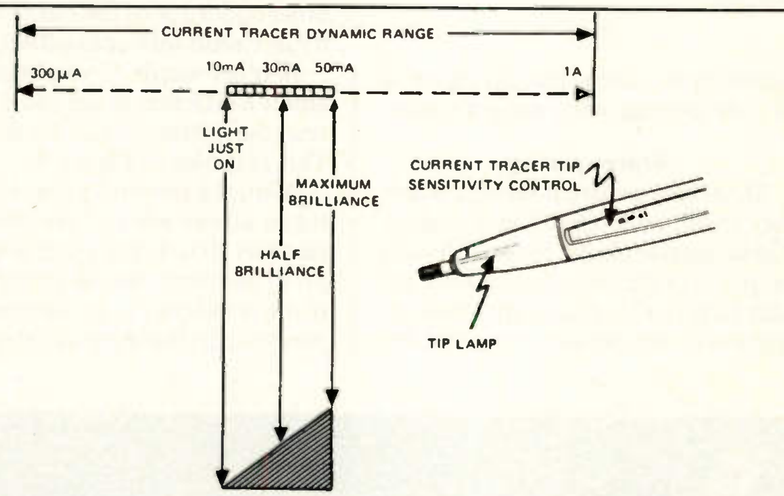


Figure 8. Differences in width of printed circuit traces result in differences in current density. This phenomenon must be kept in mind when a current tracer is being used.



Current needed for barely lit lamp	Current when lamp set for half-brilliance	Current that will produce a fully bright lamp
300 µA	1 mA	≥3 mA
1 mA	3 mA	≥5 mA
3 mA	5 mA	≥10 mA
5 mA	10 mA	≥30 mA
10 mA	30 mA	≥50 mA
30 mA	50 mA	≥100 mA
50 mA	100 mA	≥500 mA
300 mA	500 mA	≥1 mA

When a 10 mA current transition occurs, and SENSITIVITY is set for half-brilliance of the tip lamp, the dynamic range of the current tracer is as follows:

Dim lamp .... 5 mA
Half-bright lamp .... 10 mA
Fully lit lamp .... ≥30 mA

The table above shows several examples of dynamic range for the full range of possible sensitivity control settings available.

Figure 9. For a given sensitivity setting, the current tracer will sense a broad range of current values from a barely lit lamp to full brilliance.

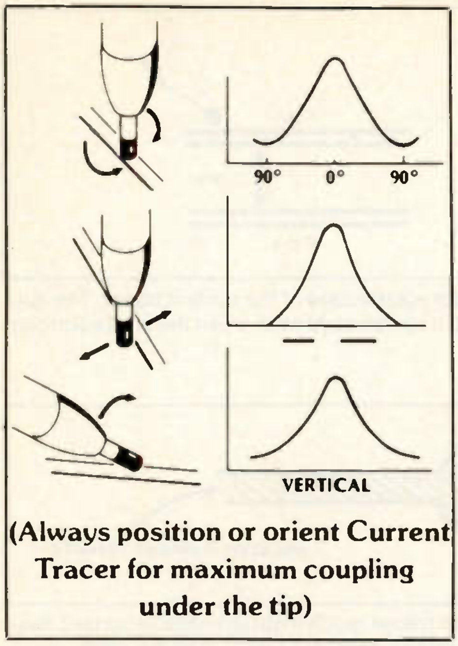


Figure 10. Careful tip orientation provides optimum current sensing with minimum crosstalk.

following are some considerations to be kept in mind when using a tracer.

Trace spacing

The tracer's current sensing coil is very small, only 0.010" in diameter. The protective plastic cover, shown in the photo of Figure 7, just makes it appear larger. This means that the current tracer may be used even when PC board traces are close together. Even when two traces carrying identical current are located only 0.020" apart (edge to edge), current flow between the two can be differentiated. If the two traces have a 10 to 1 current difference between them, spacing should exceed 0.075".

Trace width

Traces that vary greatly in width cause flux density changes under the tracer's tip, as illustrated in Figure 8. This is critical when tracing supply-to-ground shorts. The tracer's sensitivity might need to be varied slightly for better results.

Reference Setting

Setting a reference value for the current tracer on a node identified as faulty is central to the current tracing process, but the setting for that particular node has little, if any relevance for other nodes due to fan-out or variability in circuit interconnections.

In other words, if you begin to examine a different node, you'll have to reset the reference value for that node. This is shown in Figure 9.

Also, the sensitivity control on the tracer allows you to "see"current as small as 300μA, but there is virtually no upper limit. As the figure shows, if the sensitivity is set so that 10mA barely lights the tracer display, 30mA will produce half-brilliance, and 50mA is the point where the lamp reaches full brilliance. Current in excess of 50mA also produces full brilliance.

Crosstalk

One of the challenges in the design of the tracer was the need for sensitivity versus the danger of "crosstalk", i.e. seeing strong current flow in PC traces adjacent to the area under test.

There are several reasons crosstalk isn't as serious a problem as it may seem. Where crosstalk is a problem there are techniques to alleviate its effects. One of these techniques is described below.

Tip alignment

The tracer tip is directional; that is, current in paths oriented 90 degrees out of phase with the pickup coil tend to null out (see Figure 10). Proper tip orientation helps eliminate crosstalk from traces on different layers or at different angles.

Tip shielding

The grounded metal case surrounding the tip along with an internal ferrite core allows signals directly under it to be coupled into the pickup coil, but signals not directly under the tip's open end are attenuated.

Sensitivity and fault current

Once a failed node has been identified (and, as you'll recall, these tend to have higher than normal current), you set the sensitivity to half-brilliance on the tracer lamp. This reference is maintained for troubleshooting on that particular node. The sensitivity setting is only relevant for the node under investigation and should be changed only with foresight and caution.

Pin-to-pin tracing

In areas where a PC board has many traces side by side carrying substantial current (LED drivers are an example of parallel lines that carry relatively high current), the user can move away from these areas to trace current between components by setting a reference current level right on the node driver output pin. Then, simply go from pin-to-pin on the circuit's ICs instead of attempting to follow along the PC traces.

Use the pulser

The faster the rise time of current pulses in the circuit, the easier it is for

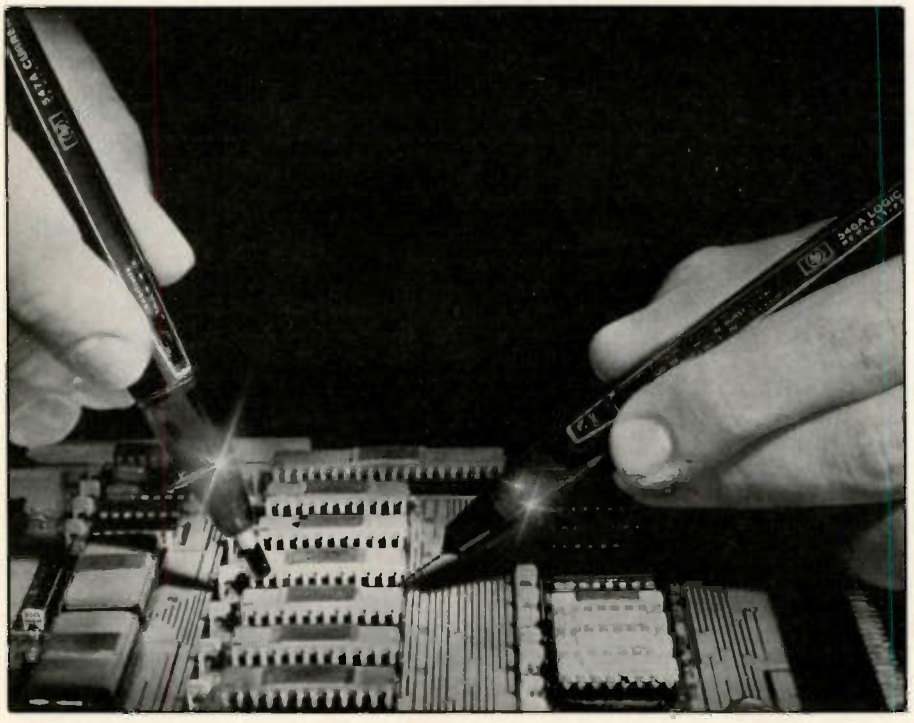


Figure 11. If crosstalk is a problem, the current tracer can be used in conjunction with a current pulser.

LOGIC FAMILY	INPUT CAPACITANCE	STRAY CAPACITANCE	RISE TIME	AC CURRENT +	DC CURRENT CHANGE =	TOTAL CURRENT CHANGE
TTL	5 pF	5 pF	10 ns	5 mA + I = 10 pF · 5V / 10 ns	2 mA	7 mA
CMOS	5 pF	5 pF	50 ns	1 mA + I = 10 pF · 5V / 50 ns	40 pA	≥1 mA

Figure 12. Values of current and amount of current change will be different for different logic families.

the tracer to display current. So, if crosstalk persists, use the logic pulser, as shown in Figure 11, to effectively "boost" viewable current in the circuit (reset current tracer sensitivity when using the Pulser to allow for the higher current flow). Refer to Figure 12 for an illustration of this.

Avoid power supply traces

V_{CC} and ground lines tend to be very "noisy" with respect to current spikes in digital circuits. These traces more often than not provide the highest level of "ac" current on a circuit board, so avoid them if possible or, again, use the pulser to avoid current on the node under test.

"Seeing" through multi-layers

One of the real advantages available using the tracer is the ability to "see" through multi-layers. This makes it possible to follow current paths through several layers to find otherwise undetectable faults. The techniques used are similar to non- multilayer situations.

That is, set a reference at the node driver output, keep proper tip orientation, and avoid crosstalk. The main task here is to increase sensitivity just enough to see the trace through the board, and to avoid "losing" the trace due to crosstalk, direction changes, etc.

OPERATION:

PRESS AND RELEASE CODE BUTTON o

PRESS AND LATCH CODE BUTTON o_

OUTPUT MODES:	
o	SINGLE PULSE
o_	100 Hz STREAM
oo_	100 Hz BURST
ooo_	10 Hz STREAM
oooo_	10 Hz BURST
ooooo_	1 Hz STREAM

TO OUTPUT EXACTLY 432 PULSES:		
1. 100 Hz BURST	oo_	98[1]
		100
		100
		100[2]
		400
2. 10 Hz BURST	oooo_	6[1]
		10
		10[2]
		430
3. SINGLE PULSE	o	1
SINGLE PULSE	o	1
		432

Figure 13. The logic pulser can be operated in a variety of modes to accommodate different logic families.

Logic pulsers: automatic output and programmability

The pulser has the following operating features that make it very helpful in a digital troubleshooting environment:

1. Automatic polarity output.
2. Automatic pulse width.
3. Automatic pulse amplitude.
4. Six push-button programmable output modes.

The 546A pulser uses a complex custom integrated circuit containing 2,000 transistors including those used in an up/down counter, a ROM, a clock, and output sensors. This enables the pulser to pulse TTL gates in single steps, to drive CMOS at 100Hz, or load a counter with a precise number of pulses. It also means the pulser provides versatile stimulus-response

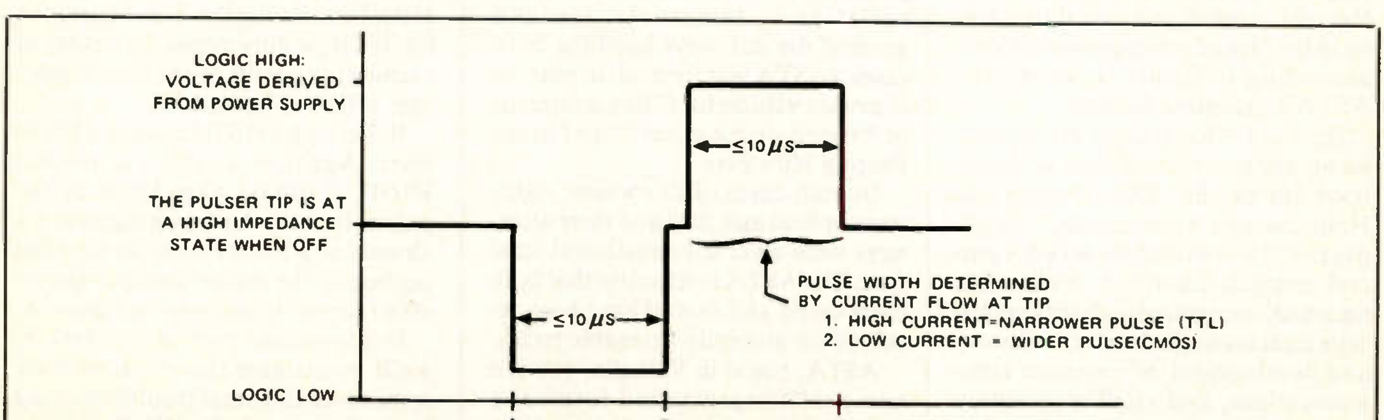


Figure 14. When the logic pulser is operated into an open circuit, the signal it generates looks like this.

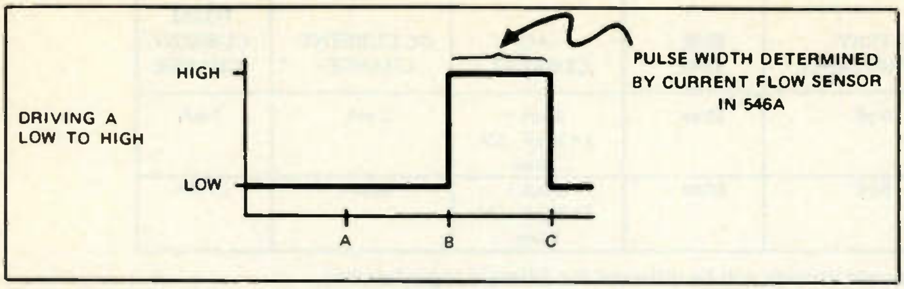


Figure 15. Driving a low node to a high state.

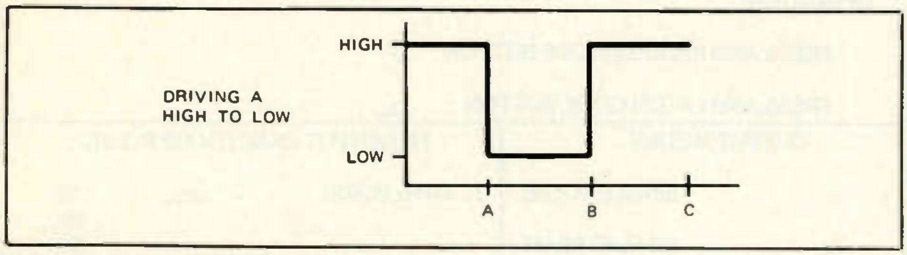


Figure 16. Driving a high node to a low state.

testing capability in both voltage and current applications for virtually any positive voltage logic family (Figure 13).

1. The first pulse burst is produced after subtracting the pulses produced when programming the output.
2. Release the pulse button during the final burst. The pulser will complete the burst, then shut off.

Pulsing into an open circuit

When the HP logic pulser's push button is pressed, the pulser immediately outputs a single dual-polarity pulse. First it goes LOW, then it pauses and goes HIGH. When the tip is pulsed into an open circuit the pulse appears as shown in Figure 14. Automatic pulse width, height, polarity.

In Figure 14, The output pulse is shown with the maximum width it attains. When pulsing into a circuit, the current flow through the pulser's tip is sensed by an output sensing circuit that shuts the pulser off.

The circuit turns the pulser off faster for TTL than for CMOS. This keeps total energy low so as to eliminate any damage to the circuit being pulsed.

Pulse height or amplitude is derived from the power supply the pulser is connected to. For this reason, the pulser should always be powered from the circuit under test, or a power supply of the same voltage.

Pulsing into a load

A. Driving a LOW node to a HIGH state: Since the node is already LOW, the pulser has no effect until it takes the circuit HIGH. When the pulser goes HIGH, it has sufficient output drive to take any normal circuit or bus HIGH momentarily. Total energy is limited (low duty cycle), however, to exclude the possibility of circuit damage, refer to Figure 15.

B. Driving a HIGH node to a LOW state: Again, if a circuit is already HIGH, it can be taken LOW by the pulser. It cannot be driven higher if it's already at a HIGH state, so the high portion of the Pulser's output has no effect on the circuit, refer to Figure 16.

In the second part of this article, we'll investigate these instruments some more and other troubleshooting instruments available. We'll also observe actual case histories illustrating a variety of their uses. ■

News *(from page 52)*

ucts. It files for Chapter 11 protection on January 27, 1992.

ASTA announces covenant restriction information package

The "rules are rules" approach used by homeowners' associations to enforce covenant restrictions against satellite dishes has become increasingly vulnerable to legal defenses by dish owners, according to a legal brief by the American Satellite Television Alliance (ASTA).

The brief is part of a legal information package ASTA has introduced to help dish owners and counsel defend the right to install and use a dish antenna in the face of covenant restrictions, according to Court Newton, Jr., ASTA's executive director.

Entitled "Restricted Neighborhoods and unrestricted skies - A handbook for Satellite Dish Owners and Homeowner's Associations," the 27-page brief was written by ASTA's general counsel, Lauritz S. Helland, a nationally-recognized authority on satellite legal issues. It reviews the history and development of covenant communications, and satellite reception technology (a subject often misunderstood by homeowner's associations).

It then discusses the history and purpose of restrictive covenants, limitations on enforcement, equitable limitations, the "reasonableness" requirement which courts impose on covenant restrictions, and constitutional limitations to their enforcement. In a section entitled, "Dish Owners vs. Homeowners' Association," it discusses situations which typically result in confrontations over dish installations.

The brief analyzes two cases in which the courts firmly rejected the "rules are rules" rationale historically used by homeowners' associations: Seascape Colony Association v. Gruga and Portola Hills Community Association v. James. Mr. Helland assisted the attorneys handling both cases. (ASTA was formed, in part, to provide a vehicle for filling an amicus or "friend-of-the-court" brief in the Portola Hills case.)

In both cases, dish owners' rights were upheld and they and their attorneys were awarded substantial legal fees. The ASTA brief states that both cases could and should have been resolved on mutually agreeable terms.

ASTA, based in Valhalla, NY is a non-profit organization formed to combat zoning and covenant restrictions that impede the right to use satellite TV systems. ■

Weak Fuses

By Matt J. McCullar

Fuses, like other electronic components, age. After years of use a fuse can open up all by itself from normal wear and tear, which might lead a technician to hunt elsewhere for a short circuit that doesn't exist. One might think it's an intermittent failure.

A few years ago I used a DMM that had a continuity tester with a buzzer. Whenever a short occurred across the test probes, the buzzer went off. This feature came in handy for checking fuses because a loud sound informed me whether a suspect fuse was open or not, and looking at the meter's display was not necessary.

These preceding items collided head-on one day when I was working on an arcade video game. The problem was absence of video on the screen. The high voltage was working and the oscilloscope confirmed that a good video signal was reaching the neck of this monochrome CRT The problem turned up in the CRT's heater: it wasn't lighting up.

What could cause the heater to fail? The resistance of it is only a few tenths of an ohm when cold, and the meter confirmed continuity. Bad flyback? Good guess, but this monitor didn't get its heater voltage from the flyback; instead it used a 6.3Vac secondary tap from the huge main transformer sitting in the bottom of the game cabinet. Could the heater have shorted against something else inside the tube? The DMM said no.

With everything operating, I measured only a few tenths of a volt at the heater pins. Yet when I pulled off the neck board, the voltage in the corresponding socket pins shot up to normal: 6.3Vac.

It was always the same: when the neck board was removed, the heater voltage was normal. When the board was attached to the CRT, the heater voltage disappeared.

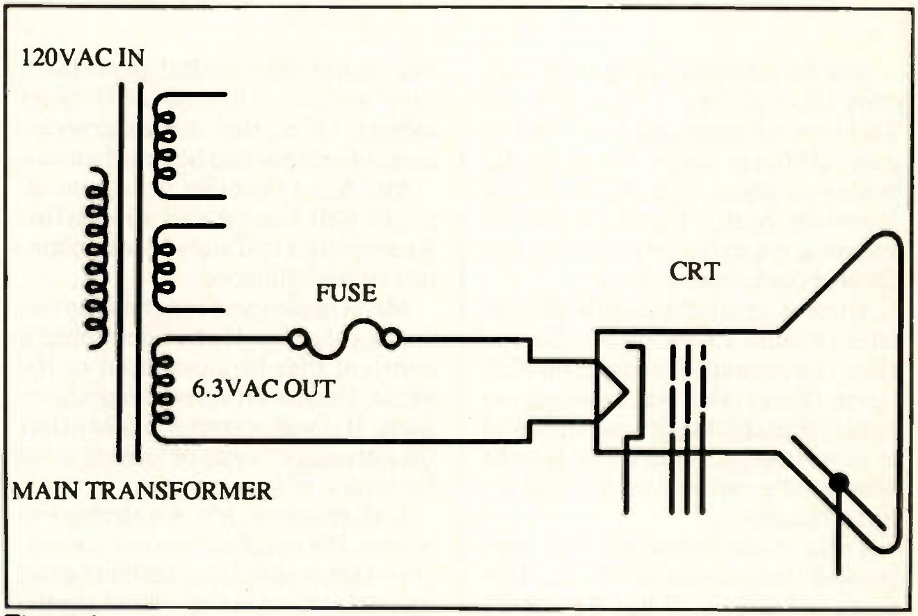


Figure 1.

I sighed; replacement CRTs for this antique were as rare as Sunday mail. I'd hate to ditch the entire game because of it.

As you can see from the schematic in Figure 1, this circuit defines simplicity. Transformer, fuse, picture tube. I placed the meter probes across the fuse and the buzzer went off. "Fuse is okay," I said to myself.

At this point I walked away and worked on another project for a while. When I returned I played a hunch and removed the fuse. It looked okay and tested okay. But I replaced it with a new fuse anyway. Success! The heater lit up and the CRT displayed a beautiful picture just like the day it rolled out of the factory. The new fuse cured all.

Normally, fuse resistance is very small, only a few tenths of an ohm (except for low-current fuses, which can be up to ten Ω or so). What happened in this case was the fuse had weakened, causing its internal resistance to slowly increase until the voltage drop across it was enough to shut off the heater voltage to the CRT.

My DMM's continuity test did not recognize this because, as the manufacturer said in the manual, anything under 30Ω will be recognized as continuity and the buzzer goes off. Since this experience I always turn off the continuity test and instead get a direct resistance measurement. If a fuse's resistance is out of range, the digital display will say so and no doubt remains.

My father is a retired electrical engineer and I asked him if he had ever had a similar experience. "Oh yeah," he said. "Once a high voltage substation in west Texas got knocked off-line for a while because a fuse had worn out without opening. The technicians didn't notice it at first because an internal connection with one of the endcaps was giving out. To the eye, the entire element looked okay. But the trouble lurked inside an endcap, where they couldn't see it. Circuit breakers can wear out this way, too."

McCullar is an independent computer and electronics servicing technician.

Are you a genius?

By Sam Wilson, CET

Now I want to tell you an important story about a nice guy I'll call Mr. A. This type of story has been told in many different ways. For example, you know about Babe Ruth and his homerun record. However, he was known as the strikeout king before he became the homerun king.

There is another example that relates to Ohm's Law. When George Ohm first submitted his paper on what is now Ohm's law it was so wrong - so full of mistakes - that it was considered to be worthless. About a year later he submitted a revised version and became famous.

There is one important difference between those stories and the one I am going to tell now. When Babe Ruth and George Ohm made their mistakes they were at a low point in their careers. Later, they made the necessary corrections and became famous.

Mr. A, on the other hand, was already well known and successful. Astronomers had already seen examples of his brilliance.

Mr. A made some computations involving algebra. He had developed a constant that he announced to the world. He called it a *cosmological constant*. If it was correct it would affect the astronomer's way of looking at the beginning of the universe.

Unfortunately, Mr. A's algebra was wrong. His constant was not correct. If you knew about the fact that he had a terrible record in high school algebra you probably wouldn't be surprised that he got the wrong answer.

Astronomers and scientists worked hard to verify Mr. A's constant. No way! After a respectful period of time they began to suspect the constant was wrong. Have you ever heard of a Russian named Alexander Friedmann? Probably not. In 1992 he recalculated Mr. A's math and found the error. In 1931 Mr. A - better known as Albert Einstein - conceded that his calculation of the constant was "the greatest mistake of his life." (See "Forty Minutes with Einstein" by Douglas A. Vibert in the Journal of the Royal Astronomical Society of Canada, 1956, page 100).

Did you ever give a poor performance in algebra when you were in high school? Listen to me. You could very well be a brilliant person. I sure wouldn't bet against you!

NOTE: This story was first brought to my attention in a book titled "The

Wilson is the electronic theory consultant for ES&T.

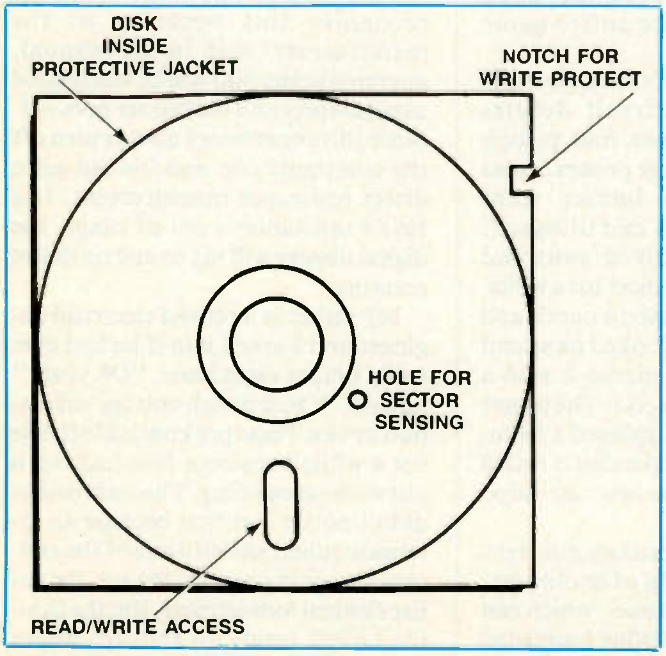


Figure 1.

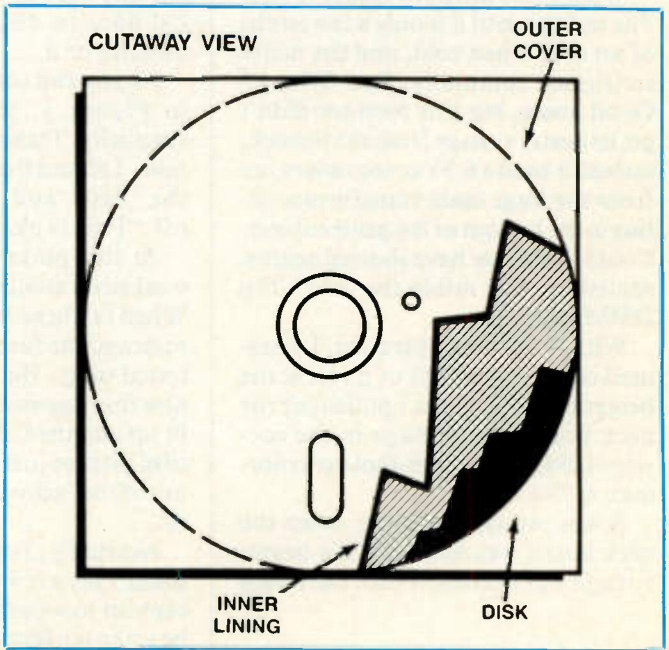


Figure 2.

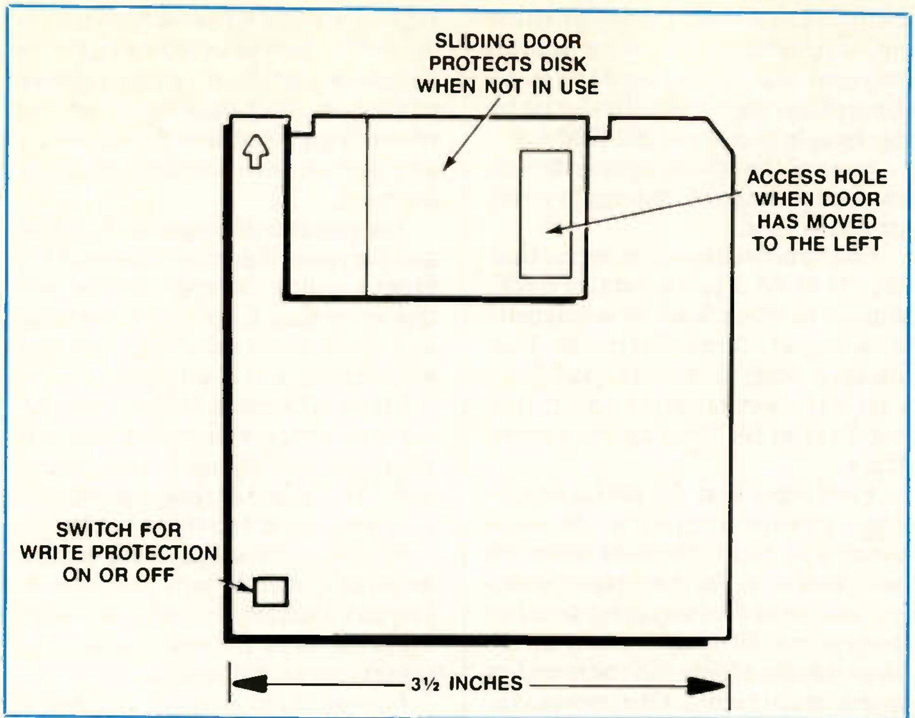


Figure 3.

Fingerprint of God" by Hugh Ross, published by Promise Publishing Co., Orange, California 92667.

More on the birth of the computer

I'm still getting letters about the student who married logic and Boolean algebra to get a very useful method of designing and understanding digital systems. John J. Huff of Technical Electronics in Stockton, California sent details and I appreciate his response.

Mr. Huff reports that coincidence was at work because the April issue of IEEE Spectrum had an article about Claude Shannon. He was the student I referred to in a previous issue.

Computer memory

I still haven't heard from Ron Weinstein. Every time I call him I get disconnected! (?) Anyway, the last time he was here he left his notebook so I will go on with the subject of computer memory. I am also using some material provided by Lou Frenzel.

The WORM

The WORM (Write Once Read Many times disk) contains a heat-sensitive material at the bottom of the grooves. To write on this disk, laser power is stepped up to the point where it burns through the heat sensitive layer to create pits. The pits look like those at the bottom of grooves on CD ROM disks.

Writing can only be done once. There is no provision for rewriting on the WORM system.

Once the pits have been burned and checked they can be read with a conventional low-power laser device similar to the CD ROM method discussed in a previous issue. In a WORM system the same laser that burns the pits (that is, writes on the disk) is operated at a lower power to read the pits.

The Magneto-optical disk system

Magneto-optical storage is actually a hybrid system that combines optical methods with magnetic storage.

The magnetization of the two layers is in opposite directions. The total magnetization on the surface is the vector difference between the two.

This is a read/write optoelectronic storage system. The most popular of these disks utilizes the *Kerr Effect* which says that when light strikes a smooth magnetic surface its polarization is changed.

The surface used for storing and retrieving data is made by one or more rare earth elements such as terbium or gadolinium. They are deposited in a thin film mixture. A thin layer of iron oxide or cobalt is placed behind the rare earth thin film layer. The magnetic field is perpendicular to the disk. When the magnetic field is in one direction the polarity of the light striking the thin film is rotated in one direction. Reversing the direction of magnetization reverses the direction of polarization. The data from the thin film surface is read by detecting the rotation of polarization of laser light.

At low temperatures the magnetization of the rare earth elements in any alloy dominates. The oppositely-directed magnetization of the transition metal (iron oxide or cobalt) dominates at higher temperatures.

There is a particular temperature - called the compensation point - where the two magnetic fields are equal and opposite so, at that temperature, net magnetization is zero.

Working around that point, it is possible to flip the magnetic fields by adding the heat from the laser. Therefore, the laser stores a bite of data by controlling the direction of resultant magnetization of the two layers.

Usually the amount of rotation of reflected light is small - being only a few degrees. However, that rotated polarity is sufficient to affect the amount of light striking the light transducer.

At this time magneto optical storage has not made any impact on the total mass storage industry. There is still much experimenting being done. One proposed method uses a dye that changes color when it is being written upon. Another uses special crystalline material that can be changed to an amorphous (non-crystalline) state by applying a strong electric field.

None of the optoelectronic devices can match magnetic storage in terms of access time.

One approach to faster access time on CD ROM is to use parallel tracks similar to those used on a magnetic disk instead of the spiral tracks. That makes it possible to more quickly access data but requires additional mechanism for locating the desired track.

Remember that the magnetic systems cannot approach the huge amount of data that can be stored on an optical disk. For that reason the impact of the optical storage system has been primarily in areas where a very large volume of data must be stored on a permanent record. One popular application has been the storage of a complete encyclopedia on one single disk. Although the access time can be as high as 20 seconds, it is still much faster than going to the library, locating the required book, then locating the required page before accessing the information.

Magnetic disks

Retrieving and recording data from magnetic media is basically the same regardless of the type of magnetic storage device. Instead of recording the information on tape, magnetic disks are often used. They have the advantage of making it possible to quickly access any part of the recording by using indexing.

The concepts of magnetic recording and the terms that were explained for tape recording also apply to magnetic disk recording. Examples are vertical and horizontal recording, read and write heads, and controllers.

Major differences in disk recording compared to tape recording are in the physical size of the read/write heads, and, in the speed of the magnetic surface with respect to those heads.

Blocking (discussed in the section on tape) is used in tape subsystems. For disk systems, sectoring accomplishes the same purpose - that is, to conserve recording space.

Floppy disks. Figure 1 shows a popular type of recording medium called a floppy disk. As shown in the illustration of Figure 2, there is a heavy outer jacket protecting the floppy disk. Inside is a second jacket - called a liner. This encloses the disk. The liner is made with a smooth anti-static material, and the disk spins inside that liner.

There is a write protect notch on one side of most floppy disks. This prevents accidental overwrite or erasure when there is a piece of tape across the notch. Without the tape it is possible to write as well as read on the magnetic surface. The location of the notch is not the same for all manufacturers and all sizes of floppy disks.

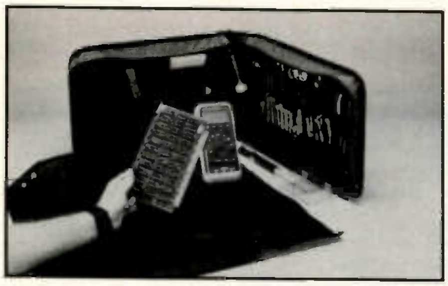
There are two popular floppy disk sizes: 8 inch and 5-1/4 inch. The 5-1/4 inch size, which is sometimes called a *Diskette,* is the most popular one used for microcomputer applications.

A more recent popular size disk is the 3.5 inch *microdiskette*. Suprisingly, it can hold more stored information than the 5 1/4 inch diskette. The microdiskette is illustrated in Figure 3. It shows that the microdisk has a smooth inner lining like the floppy disk. The 3.5 inch diameter disk turns inside that liner.

There are many important features of the 3.5 inch and 5¼ inch floppy disks. Disks made by other manufacturers may vary slightly from these specifications. (I'll try to get in touch with Ron Weinstein before the next WDYAE? If not, I'll put in his notes on hard disks and disk controllers.)

ESD-safe workstation kit

Jensen Tools, Inc. has introduced a new tool kit that takes dead aim at reducing electrical overstress of sensitive components in the field. Specifically engineered to simulate a fully equipped work station environment, the JTK-6000 ESD also provides the best built-in ESD/EOS protection. This is a versatile field service product

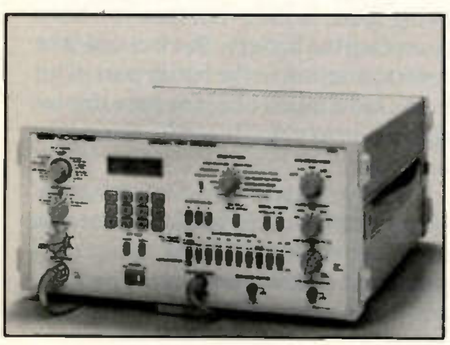


containing 40 tools for repair and maintenance of a broad range of electronic systems and equipment on-site. When opened, the kit stands upright behind an ESD workmat which is permanently attached to the case. The tools, including pliers, drivers, torx set, wire strippers, cutters, soldering iron, alignment tools and more are presented in a well organized pallet on the right.

Circle (81) on Reply Card

Universal video generator

The new model VG91 universal video generator from *Sencore* provides all standard off-air and cable TV channels (1-125) with fullv modulated vid-

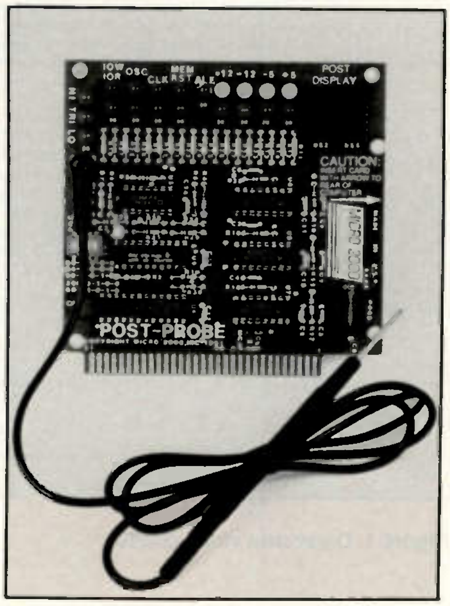


eo and MTS stereo audio. All TV-RF signals are adjustable through a full dynamic range of levels to check operation of the automatic gain circuits. The generator includes video IF and audio IF troubleshooting signals (45.75 MHz IF, 3 strap setting signals, and 4.5 MHz FM audio) to isolate video defects in either the tuner or IF stages. Also provided is the manufacturer's exclusive AFT analyzing tests.

Circle (82) on Reply Card

P.O.S.T. card for all PC's

Micro 2000 Inc. introduces POST-PROBE, universal (POST) card that can diagnose all IBM compatible PCs that won't boot, including all ISA, EISA, and Micro Channel computers. According to the manufacturers this

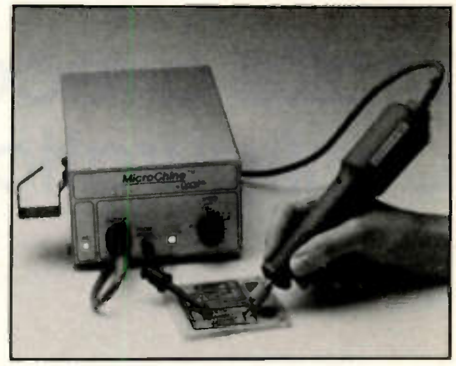


is the only card that displays all the diagnostic signals at the same time. You can watch the whole P.O.S.T. process and monitor all computer functions as they happen. This allows you to isolate problems even if the system BIOS does not emit post codes. It also makes diagnosis easier and faster if the BIOS does emit P.O.S.T. codes.

Circle (83) on Reply Card

Machining handpiece for PCB repair

PACE introduces its new MicroChine a lightweight, variable-speed miniature machining handpiece designed especially for electronic circuitry and substrate repair. The unit's "smooth start" integral handpiece motor provides measured acceleration to selected RPM for control and ease of use for delicate applications. The closed-loop tachometer feedback feature maintains controlled drilling and milling rates under varying loads. Torque limiting circuitry helps prevent overload damage.



Circle (84) on Reply Card

Automatic 100MHz waveform and circuit analyzer

Sencore announces the new model SC3100 Auto Tracker, automatic 100 MHz waveform and circuit analyzer. The unit is a complete waveform and circuit analyzing system that allows servicers to measure any circuit parameter and view all of the waveforms shown in the service literature. The analyzer provides AutoTracking digital readout of waveform voltage and frequency for measuring the key parameters of any waveform with one probe connection. Auto Tracker provides integrated measurements of all circuit parameters. Now there's no need to reach for a separate DVM to analyze the rest of the circuit parameters. With this product, the servicer receives a full performance, 100 MHz, dual trace oscilloscope for viewing any waveform quickly, easily, and accurately. Fiddle free trigger circuits provide rock solid viewing of any signal, and includes a special TV mode for complex video waveforms. No signal is too large or too small with the units 2mV to 2kV input range.

Circle (85) on Reply Card

Digital multimeters

Goldstar has developed and is making available this fall for U.S. distribution a line of digital multimeters. The new 200 series will feature 4 models each having several standard features. Standard features include: Diode & Continuity check, transistor Hfe, battery check, auto power off and a rugged yellow safety holster.

Circle (86) on Reply Card

Make a record of the system configuration

By the ES&T Staff

In order for a computer to operate properly, the computer has to have information about what the various elements of the system are. For example, if the computer has a hard disk drive, in order for the computer to read from and write to that drive, it has to be provided with the information that tells it that there is a hard disk drive present, and what type of drive it is. Other information that the computer needs to have in order to operate properly and to interface with the various peripherals is information about any floppy disk drives that might be part of the system, the type of video display in use, and the memory amount and type.

All of this information is called "configuration" information, because it describes how the system is configured, or set up. Computers offer a way to enter this information the first time the computer is placed into operation, or any time this information has been lost, or any time the system configuration is changed.

The setup program

All recently manufactured personal computers have a setup program that allows the dealer, the technician or the owner to enter the appropriate setup information. Access to this setup program is usually possible during the startup of the computer through some combination of keystrokes.

As an example, on the computer I'm now using, when it's first turned on, the top of the screen shows the information that describes the processor on which the computer is based, the name of the company that manufactured it, and some other general information.

Then the next line says:

Hit <DEL>, if you want to run SETUP.

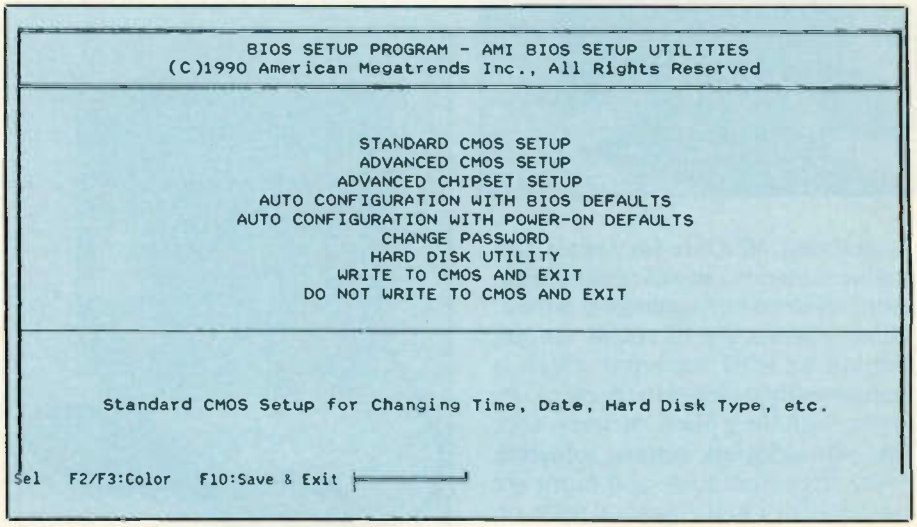


Figure 1. On screen video display.

Another computer that I used to operate displays a message that instructs the user that if he wants to run the setup program to press the CTRL-ALT-ESC keys. Pressing that combination accessed the setup program. The method to access the setup program should also be contained in a computer's operating instructions.

Record the configuration information

Of course in most cases when you're servicing someone's personal computer you won't need to get into the setup program. However, if the computer experiences a power surge, or if the backup battery has died, the computer memory where this information is stored may have been erased, and you'll have to restore the information.

It really isn't a big deal to do a little inspection, a little investigation and a little research through the computer documentation to find out what kind of hard disk is in use, what kind of floppies are on the system, what memory there is, or what kind of display is being used, in the event that you have to replace the battery. But it could take several minutes to the better part of an hour. How much better to have this information at your fingertips when you need it.

An easy way to have this information available after you've replaced a dead battery is to run the setup program when the computer's healthy and make a record of the information.

Print the screen

I've made a record of this information for my computer against the day when I may have to reconfigure it. It's simplicity itself. During boot-up, I simply pressed the Delete key, as instructed on the screen. The screen

```
                    BIOS SETUP PROGRAM - STANDARD CMOS SETUP
              (C)1990 American Megatrends Inc., All Rights Reserved

Date (mn/date/year): Wed, Oct 07 1992                Base memory : 640 KB
Time (hour/min/sec): 08 : 09 : 53                    Ext. memory : 3072 KB
Daylight saving    : Disabled          Cyln  Head  WPcom LZone Sect  Size
Hard disk C: type  : 47 = USER TYPE    872   8     65535 873   35    119 MB
Hard disk D: type  : Not Installed
Floppy drive A:    : 1.2  MB, 5¼"
Floppy drive B:    : 1.44 MB, 3½"                 Sun Mon Tue Wed Thu Fri Sat
Primary display    : VGA/PGA/EGA
Keyboard           : Installed                     27  28  29  30   1   2   3
                                                    4   5   6   7   8   9  10
                                                   11  12  13  14  15  16  17
  Month : Jan, Feb,.....Dec                        18  19  20  21  22  23  24
  Date  : 01, 02, 03,...31                         25  26  27  28  29  30  31
  Year  : 1901, 1902,...2099                        1   2   3   4   5   6   7

Select F2/F3:Color PU/PD:Modify
```

Figure 2.

shown in Figure 1 appeared. I simply pressed "Print Screen" to print it out. It doesn't show on the printout of Figure 1, but the line "Standard CMOS Setup for Changing Time, Date, Hard Disk Type, etc." at the bottom appeared because the line at the top "STANDARD CMOS SETUP" was highlighted. Moving the cursor down to each of the successive lines resulted in a different message.

When I pressed the "Enter" key with the STANDARD CMOS SETUP line highlighted, the screen shown in Figure 2 appeared. Again, the screen was slightly different from this printout, but I obtained the print by pressing the "Print Screen" key.

Armed with this information, now if the configuration information on this computer is ever lost, I only have to go to this sheet and restoration will be no problem.

Make two copies

If you have a number of computers that are your responsibility to service on a regular basis, or that you expect to service on a regular basis, it might be to your advantage to record this information for all of them. Then you could keep a copy at the computer site, and another copy in your files, just in case the customer copy is lost or destroyed. ■

On-screen video display circuitry

By Walt Herrin

Adopted from the June 1990 issue of "The Expander," a publication produced by Mitsubishi Electric Sales America, Inc., to inform their authorized service centers.

On-screen video displays have been used for some time in both direct view and projection televisions. Once a novelty, in today's video products the display has become a crucial factor in the interface between the product and the consumer, informing the user of virtually all current operating conditions. In addition to displaying current channel and time of day, the on-screen display is an integral part of the user adjustments and selection process.

The selection of a signal source (Tuner, External Video input or S-VHS input) is made while viewing an On-screen display, along with common adjustments (brightness, contrast, sharpness, balance, etc.) If the on-screen display is not generated, the user will not know the operational mode or the channel selected, what adjustments are being made, or the status of the adjustment. No longer an embellishment, the proper operation of the on-screen display is imperative.

Herrin is Division Manager, Customer Service, for Mitsubishi Electronics America, Inc.

The Mitsubishi V10 projection chassis

This article will be based on the V10 projection chassis by Mitsubishi. In the V10 chassis, both the Menu and Test modes produce full-screen displays, with internally generated display signals substituted for the current video signal. In all other modes requiring a display, the display signal is inserted into the existing picture. To insure display stability and positioning, the display signal must be synchronized to the sync pulses in the current video signal.

When no signal is present on a channel, the display is synchronized to the free running output of the deflection circuitry. This is possible because the deflection circuitry drive of this chassis is highly stable, even when not synchronized to an incoming signal. The increased stability is achieved by divid-

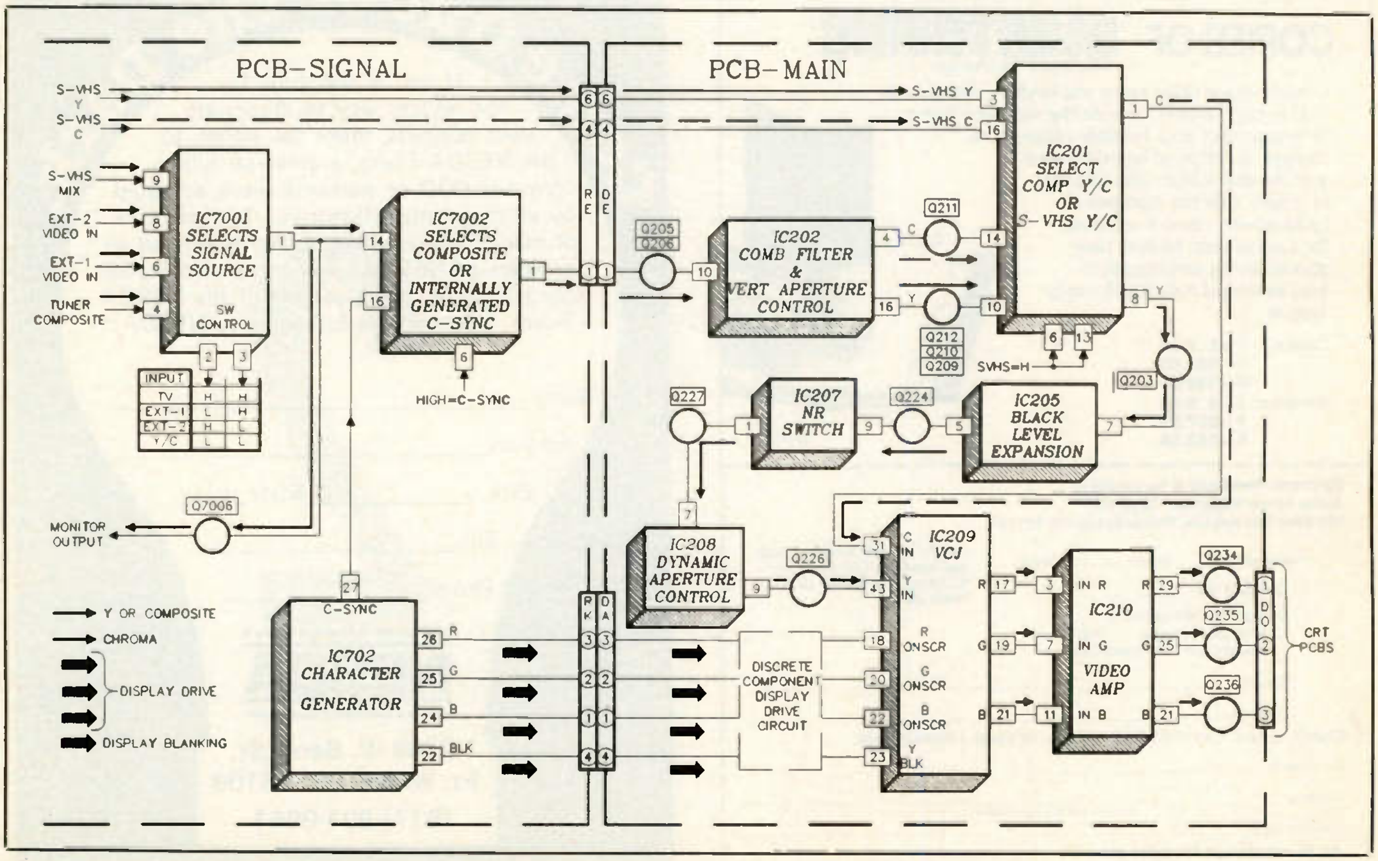


Figure 1.

ing the output of a high frequency crystal controlled oscillator to generate deflection drive, rather than using conventional horizontal and vertical oscillators.

If the selected signal source is an external input (video or S- VHS), and no signal is present, the display signal is synchronized to an internally generated sync signal. The necessity of using internally generated sync when using an external input will be described at a later time.

Because of the extensive interface between the video, chroma and display circuitry, a defect in the display circuit often affects the normal color picture.

Video/chroma/display signal path

a simplified diagram of the video/chroma/display Signal path for the V10 projection TV chassis is illustrated in Figure 1. A composite signal source, (either antenna A or B, or external video 1 or 2), is selected by the signal select circuitry in IC7001. The selected composite signal is directed through IC7002 to the comb filter and vertical aperture control circuitry in IC202.

Separate luminance (Y) and chroma (C) from the composite signal are output from IC202 and are directed to IC201. When used, separate chroma and luminance from the S-VHS input are also directed to IC201. The control logic at pins 6 and 13 of IC201 selects the S-VHS input, or the output of IC202.

The selected chroma signal is applied directly to the chroma Processing circuitry in the Jungle IC, IC209.

Luminance is enhanced by black expansion (increasing contrast range) in IC205, NR (noise reduction) in ic207, and aperture control (increasing edge sharpness) in IC208. The luminance is then directed to the video processing circuitry in IC209. After processing, red, green and blue video signals are applied to the video amplifiers in IC 210 and then to their respective light tubes.

When an on-screen display is activated, display signals (R, G and B) are generated by the character generator IC, IC702, and directed to the video/chroma Jungle IC, IC209. Internal to IC209, the on-screen display signals are substituted for, or inserted into the normal video, depending on the specific display mode.

Besides the red, green and blue display signals, IC702 also provides a blanking signal (BLK) that is directed to IC209. The blanking signal is utilized to produce a black border around the characters in the video display, enhancing the display.

Note that the character generator, IC702, also generates a C- SYNC (composite sync) signal, available at pin 27. The C-SYNC Signal consists of non-interlaced horizontal and vertical sync pulses with no video. When the internally generated sync is required, IC7002 selects C-SYNC as the alternate synchronizing source to maintain deflection circuitry synchronization and display positioning and stability.

If synchronization is lost, the video display is unstable or may be completely scrambled. The C-SYNC signal is automatically selected in full screen display modes, such as menu and test, to insure synchronization whether or not a signal is present.

In next month's installment of Video Corner we'll cover the character generator and display synchronization circuitry of this set.

High tech, commercial products are key to success at Page TV

By Jeffrey Uschok

Figure 1. At Page TV, located in Bethpage, NY, you will find top notch service and quality work done in a professional manner.

Page TV, located in Bethpage, NY, has been a successful service center for over 35 years. Vic Gerry, owner of Page TV, has been at the helm for the last ten years. Gerry feels that the main reason for his success is that over the years he has combined his technical experience, starting out as a road technician, with business sense which was developed primarily through on the job training.

In the early years, Page TV started out servicing TV's, antennas and audio equipment. The company has gone through many changes since then, and now has primarily focused their attention toward commercial equipment, which accounts for about 80% of their business.

For the last ten years, Page TV has also specialized in servicing security systems. This type of service work has been very profitable, Gerry says, but does have some drawbacks. People are, quite understandably, always in a rush to get their security systems back in operation. Another drawback to security system service is that the service center does carry a high dollar value of accounts receivable for this work.

Page TV still services consumer products, but today consumer products account for only 15% of their business. They still continue to service consumer TV's, VCR's and camcorders. Page TV gave up on stereo equipment, which to them was unprofitable.

"We have cut out all products that are unprofitable, and try to do as little warranty service as possible. We are also in the process of phasing out air conditioner service as well," said Gerry.

Focusing on successful business segments

Page TV focuses on a few key areas which they feel are very profitable: security and industrial equipment, consumer products such as VCR's and camcorders and projection TV's. Gerry feels that to be successful, a service center must target equipment that will provide a reasonable profit; it's just that simple.

Another reason for success at Page TV is the company's policy regarding estimates for the cost of performing service. Page TV will service any VCR for not more than $125.00, and camcorders for not more than $165.00. Under this policy, which is stated on signs in the service center, the customer is aware of the maximum amount he will have to pay for each service procedure.

If the customer agrees to pay up to this amount, depending on the nature of the problem, the technicians can service the equipment immediately, without worrying about waiting a week for a customer to get back to them to authorize a service procedure.

This policy was instituted three years ago, and although customers were hesitant about it at first, it has become a key ingredient in the success of Page TV. "Not only does the estimate eliminate long periods of time on the phone with customers, it weeds out all those customers who are under the impression that they will get a product serviced for $25.00," Gerry says.

This kind of policy reflects the good business sense that Gerry has acquired. In fact, he developed the "Cost of Doing Business" Formula that is used by NESDA. Gerry is very involved with NESDA, and has just finished a term as Regional Director,

Uschok is Associate Editor of **ES&T.**

Figure 2. Inside Page TV, the customer is fully aware of costs and policies and what type of service to expect as posted inside the service center.

Figure 3. State-of-the-art equipment is what keeps Page TV on top and successful in the servicing industry.

and was the Industrial Relations Chairman.

High Tech

Gerry feels that in order to continue at the level of success that it has enjoyed in the past, Page TV will have to expand the assortment of high tech products that it services. Although he was reluctant to provide any details of his plans in this area, Gerry says "we are very excited about moving into new areas of high tech."

This move will be made easier by the high level of skills possessed by all of Page TV's technicians, most of whom are specialists in specific areas of consumer electronics service. Part of the reason that these technicians are so highly skilled is that, encouraged by Gerry, they attend meetings of local service associations, where they pick up valuable information that they can apply to their work.

In addition, where possible, Gerry sends his technicians to electronics servicing classes and seminars that are put on in the local area by consumer electronics product manufacturers.

Open communication with others

There is not one day that goes by that Gerry does not converse with other service centers. He feels that they are not competitors, and they need open lines of communication to stay in business. "Education is important, and you can't be successful on your own," says Gerry. He emphasizes

Figure 4. The staff at Page TV is well trained and service always comes with a smile.

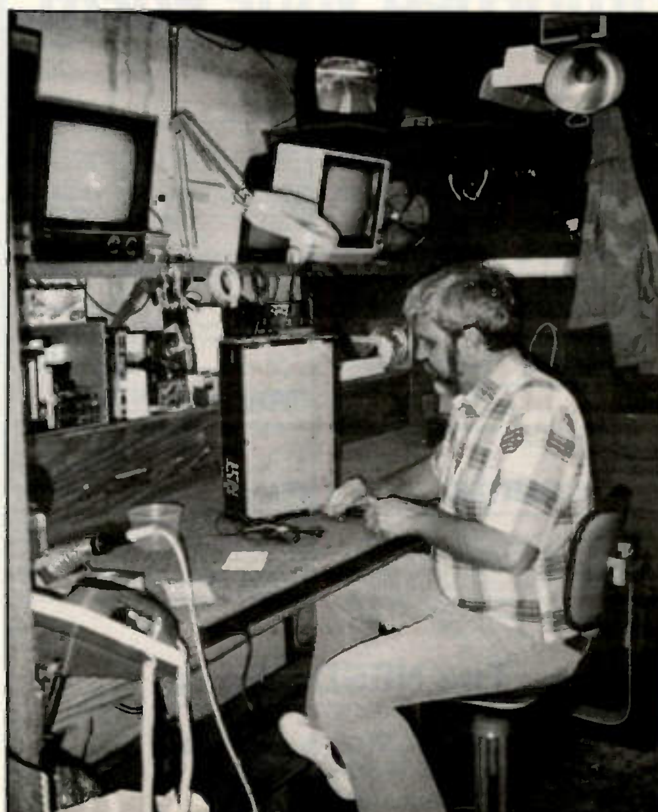


Figure 5. VCR specialist Jim Johnson works on repairing a VCR. Johnson and all of Page TV's technicians specialize in many areas of the servicing industry.

strongly the value of being associated with consumer electronics servicing associations as being the key to success in the servicing business today.

"Anyone who thinks that they can be successful today without support from other people in the business is going to fall flat on his face," he says. Gerry feels that exchanging ideas and keeping an open line of communication with these associations, as well as other service centers in the area are vital for survival in today's economic climate.

Smart business sense

Page TV is now targeting areas of commercial electronics and mechanical equipment on the expensive side that are profitable: many high-tech products and specialty products particularly. Gerry feels that a smart business should only target those products that can return a profit and satisfy the customer at the same time. He prefers commercial customers because they provide a high repeat business compared to the consumer customer.

Consumer service tends not to provide a great deal of repeat business for two reasons, according to Gerry. First, once a consumer product is serviced is will usually hold up well. Second, many consumer products are so inexpensive that many of them will be discarded instead of serviced when they fail.

Gerry has also had to downsize his business to remain successful. Seven years ago Page TV had 20 employees and three trucks. Today the company is down to six to eight people, and one truck that doesn't even go out every day. In spite of this, Page TV's profit margin has remained the same, or perhaps even improved, with the smaller staff, because Gerry keeps all his employees busy all of the time by having enough business to keep a constant flow in the shop.

"To be successful you have to keep expenses to a minimum and always target profitable items," Gerry says. "You always want to be a Mr. Nice Guy and always provide whatever service a customer requests at an affordable price, but by the same token, you need to turn a profit," he added.

Camcorders are very profitable for Page TV. Although it's important to be very careful to charge enough for the time spent working on one, these products have been turning a good profit for the service center. All of the work by Page TV is guaranteed for up to 90 days. Commercial product service is given a six month warranty, which Gerry feels is longer than the typical service center would offer. Because commercial accounts provide high repeat business, Page TV attracts then by offering this type of guarantee.

Page TV, like many other service centers today is facing increasing problems. But Page is coping by fostering good communication, as well as concentrating on servicing of profitable equipment.

Vic Gerry's advice to anyone who is struggling to survive in the consumer electronics servicing business today is that they should think seriously about servicing products that are not consumer related, and phase out those products that are not turning a profit. These may just be the keys to being successful, like Page TV.

Business Corner *(from page 7)*

Another element that some service centers add to this up front technical evaluation fee, is to ask the customer to agree, at the time the product is left for service, to pay up to some reasonable maximum amount for service. An example of this can be seen in the "Successful Servicing" article in this issue.

Expect to be paid for services rendered

Many service centers find it difficult at first to bring themselves to charge for technical evaluation. They feel that it isn't right to charge the customer for a service that doesn't directly benefit him. On the other hand, many service centers have gone out of business because they have failed to insure that they are adequately compensated for their service. That's even worse.

Consumer electronics service centers can be treated as professionals who deserve to be adequately compensated for their time, effort and service. But first they must see themselves as professionals and demand it. ■

Test your electronics knowledge

Answers to the quiz

1. B - Given identical rectifiers, a choke-input filter gives better regulation and a capacitor-input filter gives a higher output voltage.

2. C - The cosecant of an angle is the reciprocal of the sine of that angle.

3. B - The ohms-per-volt rating of an analog meter is a measure of its deflection sensitivity. The reciprocal of the ohms-per-volt rating is the full-scale deflection current.

4. B - The atomic bomb converts energy from one form to another. A transducer permits the energy of one system to control the energy of another system.

5. A - The forward bias makes it unnecessary to overcome the emitter-base junction voltage in order to start conduction.

6. C - The laminations reduce the space for eddy current flow.

7. A - Power factor is equal to the cosine of the phase angle between the voltage and current in an ac circuit. Power = V x I x power factor. The maximum value of power occurs when power factor = 1. That occurs when the voltage and current are in phase - meaning that the phase angle is zero degrees.

8. Form factor. The use of form in voltage measurement was discussed in an earlier issue of **ES&T**.

9. A - Do not confuse the terms load and load resistance. Load is determined by the current the battery must deliver. For example, "under heavy load" means high battery current.

10. B - PIN diodes are used in television and VCR remote control systems.

A few thoughts on audio cable

By John Shepler

Wiring is the most mundane part of any audio system. Often, we don't give it much thought. If the cables that came with the components aren't long enough, then we'll cobble something together that will reach. In the excitement of getting a new tuner or CD player to produce music, performance may be lost in the connections.

People will use anything conductive to wire their systems. Telephone cable is cheap and readily available. It is easily fished through walls or stapled to basement beams and provides 4 wires that seem perfect for connecting 2 speakers.

So, what's wrong with phone wire? Nothing, unless you're expecting high performance at high power levels. Remember that the normal signal level of a telephone set is on the order of 1 milliwatt. That's acceptable for headphones or low volume levels on small speakers. However, you can't expect to conduct 300 Watts or more throughout the phone wiring and have it sound right at the other end.

The main problem with telephone cable is the small size of the wires. Long lengths of small gauge copper start adding resistance between amplifier and speaker. Speakers are low resistance devices to begin with. You can't afford to add much resistance to 4 or 8 ohms. Any extra resistance will absorb power that should go to the speakers.

There's another factor, too. Speaker performance depends on extremely low amplifier impedance to act as a brake in damping out resonances in the speakers. Even an extra fraction of an ohm impedes this action and changes the dynamic response of the speaker. The result is that the sound isn't right even at lower power levels.

How should you wire a system? Use the largest wire that makes sense, typically 12 AWG. Keep the connections as short as possible between the amplifier and the speakers. Five or ten feet won't hurt anything. Fifty or a hundred feet might. Long runs bring out other effects, such as cable inductance and capacitance that further affect the purity of the amplifier output.

Be especially careful with the miniature 24 AWG speaker wire. It's OK for small, high efficiency speakers that you might find in a clock radio, intercom, or the extension speakers for a portable cassette deck. It is really too small for car audio systems or medium power living room systems. Whether listeners can or cannot detect the loss of fidelity depends on the length of the cable and how discriminating their tastes.

Should anyone invest in those outrageously priced deluxe cable sets? You know the ones; you can spend $100 for a couple of lengths of wire.

I've yet to see an independent study that states conclusively there is an audible benefit. I suppose it depends on what they replace. The cables with heavy gauge braided wire, anti-corrosion plating, and heavy duty connectors may very well sound better when they replace an ineffective set of conductors.

I guess it's also true that if your ears can appreciate the nuances of a $10,000 stereo system, you may be able to detect low level effects lost on the rest of us.

For mylsef and the 99+% readers of this column of more modest taste, let's simply keep ohm's law in mind. Match the capacity of the wire to the power and quality of the components and don't scrimp on copper wire. You should be able to get a terrific sound from most systems for only a few dollars. For those long distance runs, use heavier gauge wire, higher efficiency speakers, or consider a remotely located amplifier. ■

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

Readers' Exchange

FOR SALE

Sencore VA62 Universal Video Analyzer with NT64, NTSC Pattern Generator, and ST65 stereo TV adder $2,000. All like new with all cables, manuals, and original cartons. *Brett Hering, 214-276-5522.*

Fisher 500G Hifi tube receiver $175.00. Fisher X-2002B, 80 watt tube amp, $185.00, plus many others. S.A.S.E. for list. *C. Kittleson, P.O. Box 691, Belmont, CA 94002.*

245 tubes (most TV tubes) in RCA treasure chest tube caddy. $200.00 (plus shipping). Send SASE for list. *Eli Schwartz, 1119 Foster Ave., Brooklyn, NY 11230.*

Test equipment (mainly Sencore) and service manuals for computer monitors, TV's and floppy drives. Too numerous to list. Good to excellent condition. *John Dews, 4608 Charles Lane, Montgomery, AL 36116. (205) 288-8479.*

110 Cordless phone antennas $45 plus shipping. *Boulevard TV and VCR service 1431 Robinson Ave. Havertown, PA 19083, (215) 446-4519.*

Sencore DVM56A microranger, NLS mini oscilloscope MS15, B&K tube tester model 607. Make offer. Call for list. *Al Desjardin, (512) 836-4932.*

Sencore - VC93, SC3080, New 6 months old, will back up warranty - $2500. Each. *Ray Brewinston, Rt.9 Box 464, Morsanton, NC 28655. 704-438-8329.*

TV/VCR service shop - all tubes (1300) modules - test equipment - manuals etc. *K&S Electronics 119 Hamilton Blvd. So. Plainview, NJ 07080. 908-755-4204 - make offer.*

Hitachi vectroscope and waveform monitor - 1 yr old. B&K 415 SWP/MKR generator, Sencore SG 165, B&K 1611 power supply, call Ed at 209-686-5938. *Tulare Audio - Video, 1921 E. Tulare Ave, Tulare, CA 93274. 209-686-5938.*

B&K 40MHz scope model 1541 B never used $549.00. *George Rossett TV, 203-653-9877.*

B&K CRT tester and restorer - 2 years old new in box hardly used with manual and adapter sockets. $375.00. *Angelo Pagliarulo, 305-370-7419.*

Service manual, schematic or copy for the following: Pilot stereo model 8005; Sharp (European model) color DV-2625SPN; will pay plus the S/H. She-Can-Too. Rt3 Box 95, Cedar Creek, Texas 78612, phone 512-321-1326.

Wells Gardner 15" color monitor RGB model 7806 - new CRT. $185.00 plus shipping. Call Sal, 708-455-3160.

Sencore equipment full shop for sale. S.A.S.E. *Fred Ingersoll, 6845 LA thers Garden City, MI 48135.*

Tektronix 492 spectrum analyzer in excellent condition, 50Hz to 60Ghz with options. *Able Video Electronics, 903, Eigth Avenue South Nashville, TN 37203.*

Sencore SC61 waveform analyzer, $2000.00 or best offer. *Cliff, 209-674-5171.*

WANTED

Pinch roller for my VM reel to reel tape recorder model #711, Fisher VCR RF modulator #4-1164-011610, Panasonic flyback #14712F. *Ed Hebert, 410 N Third St. Minersville, PA 17954.*

Picture tube for an Emerson PC5A TV. Tube # is 160DB22, 160 DB22. *Murray Goldstein, Murrays Repair Service 1622, Granfern Ave, West Palm Beach, FL 33415.*

Flyback transformer part # 79A195-1 for Abmiral color TV. *Willies TV, P.O. Box 252 Palanda, CA 95365.*

Ejector cage for KMC (VCR) model No. KMV15 SH. With or without loading motor. *Call Jackson VCR 1-205-643-5906.*

Sencore VA48 or VC62 in good condition. *Campbell TV/VCR 1798 East Ave I, Lancaster, PA 93535, (805) 949-2122.*

Lafayette RKD-600 three head dolby cassette deck. Must be in excellent condition and seldom used (Mint Condition). Unit was manufactured in 1979. Contact *John P. Miller, 813-471-2007.*

Tubes many types: 6973, 7199, 6GC5, 761, 2050, 5879, 6L6, also old (1940's to 60's) electronics catalogs. *Mike Zuccaro 8795, Corvus Way, San Diego, CA, 92126. 619-271-8294.*

Schematic and service info on RCA Senior Valt Ohmist models WV 97-A and WV 98-C. Also superior lust, CO. Genometer TV-50. *W.H. Calhoun, Route 5, Box 331 Colquitt, CA, 31737.*

Magnavox Vert load choke-LI from T995-01 chassis part #3201240023. Most measure approx 90 HMS. *Nick collect, 219-836-8840.*

Service manual for Hitachi VCR VT1370A copy will do. Will pay fair price. *Bob Nelson, 602-855-5400.*

Schematic/service manual for Teaberry CB, model "T" control, Sams CB-88: Jensen car stereo, model JR115: *M. Meckling, Box 131, Fairview, KS 66425. (913) 467-8431.*

Instruction manual for a B&K, model 162 transistor/F.E.T. tester. *Ray Wood 402, Fire Tower Rd. Elizabeth City, NC 27909. (919) 771-5322.*

Schematic or service literature on a Fisher model 201 AM/FM receiver. Will pay for copy. *Bob Tamson 296A Piney Forest Rd. Danville, VA 24540.*

Service and operations manuals for a "Data Communications Test Instrument" model DT-1100, and service and operations manuals for an "ARP" model 2483 synthesizer Omni. *Lorin E. Owens, 301 Ashland Ave #7* Santa Monica, CA 90405.

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

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VHS-VCR Repair Solution Sets I, II, III, IV, V, VI, VII. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each, all seven $69.95. Schematics available. Visa/MC. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 6-92-7t

PHOTOFACTS: Folders and specialized books; AR, CB, CM, HTP, MHF, SD, TR, TSM, VCR. A.G. Tannenbaum, P.O. Box 110, E. Rockaway, NY 11518. 516-887-0057. 11-92-1t

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FOR SALE: Sencore test equipment. NT-64, SC-61, VC-63, VA-62, PR-57, LC-53, IBM large screen reader and more. 704-664-5434. 11-92-1t

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CAMCORDER/VCR REPAIR: Don't turn away good profits let our experienced technicians provide your shop with complete camcorder/VCR repair service. Also, VCR, "Tough Dogs." Call 1-800-846-4648. Edington VCR/TV, 204 North Kimble Drive, Bloomington, IN 47404. 11-92-1t

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Manufacturers Parts and Literature Directory

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

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Panasonic 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672	**Philips ECG** 1025 Westminister Drive Williamsport, PA 17701 800-526-9354 fax 800-346-6621	**Quasar** 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672
Technics 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672	**Thomson Consumer Electronics** 2000 Clements Bridge Road Deptford, NJ 08096 800-257-7946 fax 800-524-1498	**Zenith Electronics Corp.** 1900 N. Austin Avenue Chicago, IL 60634 312-745-2000

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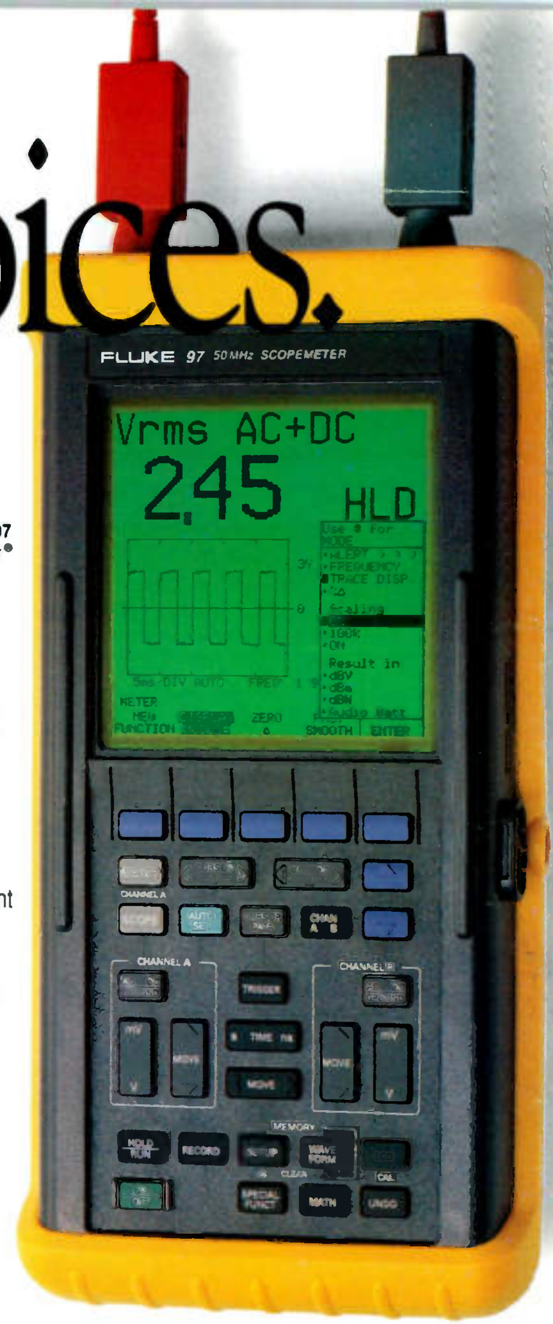

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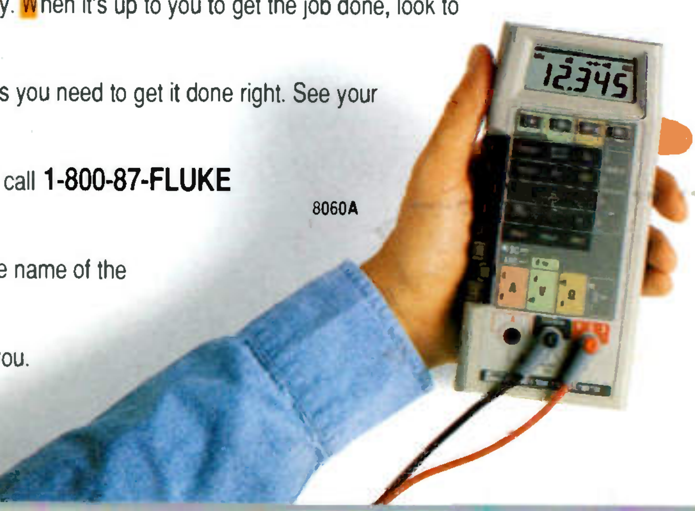

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