

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

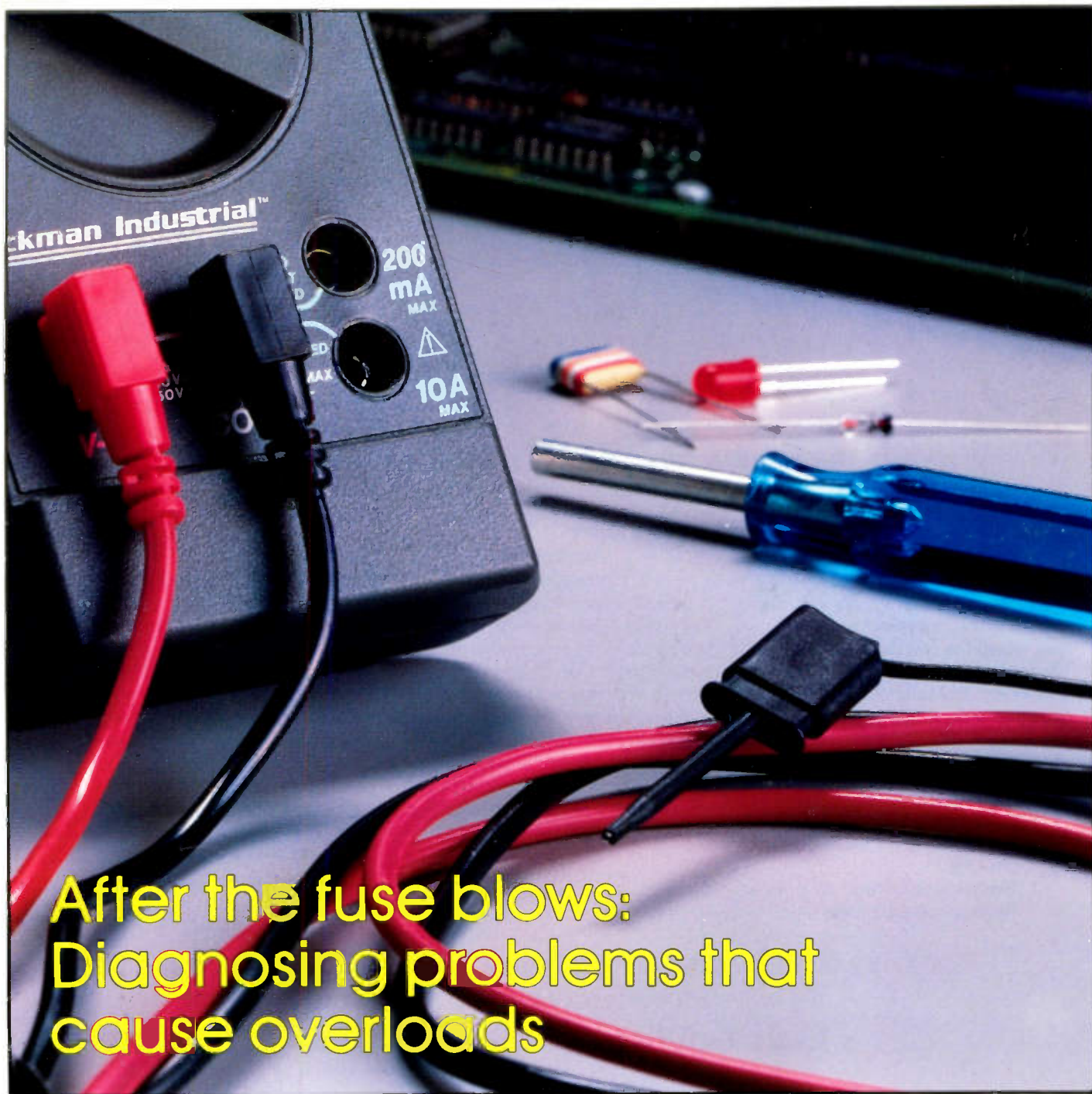
ELECTRONICTM

Servicing & Technology

September 1997/\$3.00

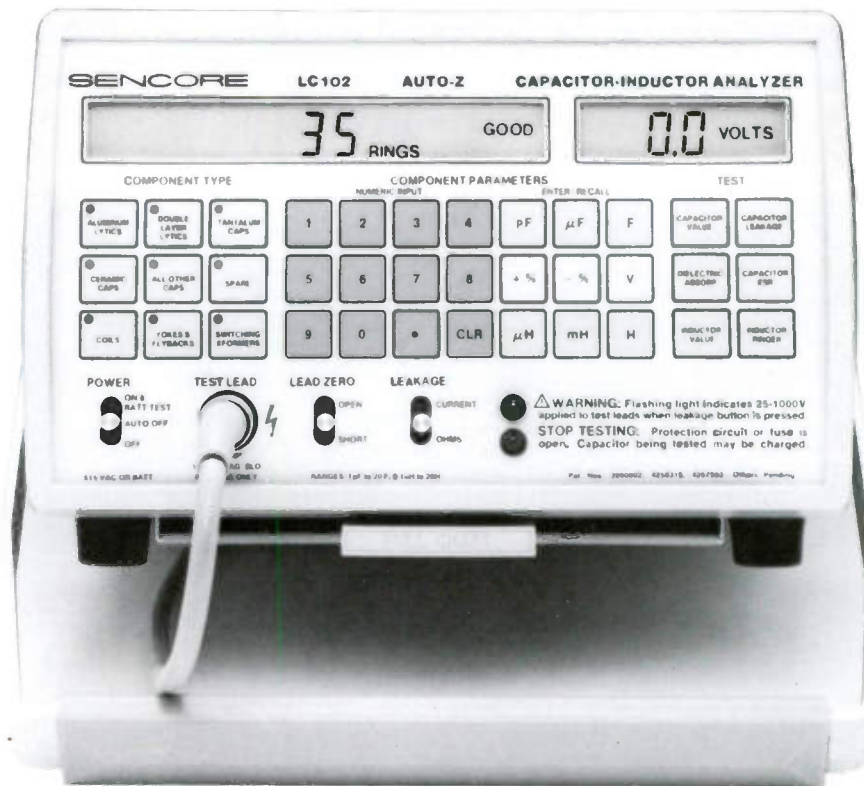
Understanding and troubleshooting switching power supplies

Testing CD player jitter with a jitter meter



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Diagnosing problems that
cause overloads

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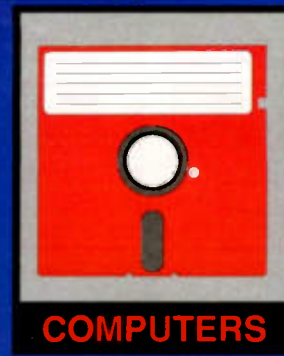
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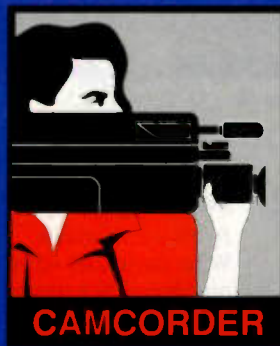
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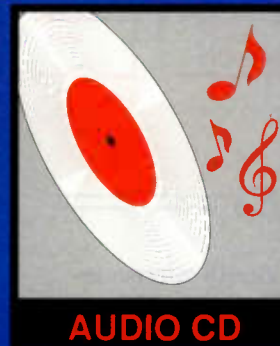
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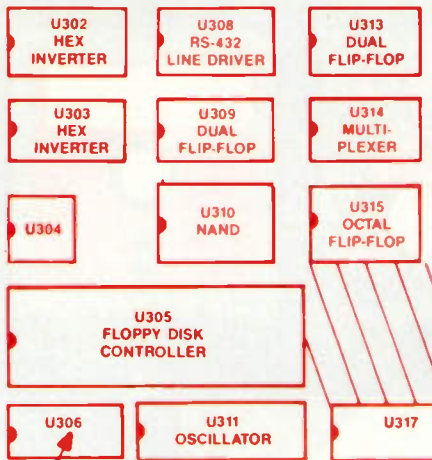
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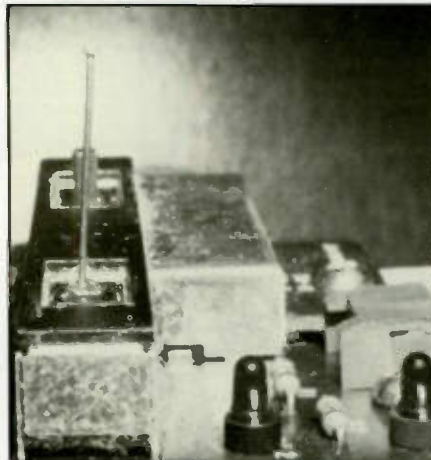
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Page 10



Page 22



Page 40

FEATURES

10 Servicing Zenith microcomputers—The floppy disk controller card

By John A. Ross

This series of articles has thoroughly dissected a Zenith microcomputer, describing the hardware in detail. This installment covers the floppy controller portion of the floppy controller/video output card.

16 Switching power supplies

By Robert Arso

Switching power supplies are lighter in weight, more energy efficient, and provide better regulation than yesterday's series regulated supply. Unfortunately, these improvements in performance come at the cost of vastly increased complexity. Not only are they more complex, but they come in a bewildering variety of types.

21 Service center ideas

By the ES&T staff

Sharing of ideas among service centers can help any service center improve its operation. You might want to consider trying some of these suggestions generated during the best idea session at NPEC 90.

22 Switch repair

By Victor Meeldijk

What do you do when the only problem with a product you've been asked to fix is a broken switch actuator, but the cost of a replacement is prohibitive? Improvise.

38 Combatting jitter in CD players

By Joseph Fisher

In just about every mechanical product in which there's motion you'll run across random, quick changes of motion that are known as "jitter." Even though compact disc players represent the pinnacle of sophisticated computer-operated products in the average living room, real-world limitations leave them afflicted by jitter along with the simplest tape deck.

40 After the fuse blows

By Homer Davidson

A blown fuse or other dead set symptom in a TV set may mean nothing more than there has been a surge on the ac line and the fuse blew because of the attendant increase in power supply current. If the replacement fuse blows, the technician may have a difficult diagnostic problem on his hands.

48 Ten steps to prevent equipment failure

By John Shepler

Follow these ten important steps and you will extend the life of your electronic equipment.

DEPARTMENTS

4 Editorial

Successful servicing

6 News

7 Business Corner

Accounting software for the consumer-electronics service center

8 Literature

15 Audio Corner

Use stress tests to solve tricky problems

27 Profax

39 Books/Photofacts

46 What Do You Know About Electronics?

Resonance-continued

51 Video Corner

52 Test Your Electronics Knowledge

53 Products

57 Computer Corner

Service logs

58 Troubleshooting Tip

59 Readers Exchange

60 Advertiser's Index

ON THE COVER

Diagnosing and repairing a problem in a consumer electronics product requires the right diagnostic equipment, proper tools and an array of replacement parts. While these are all necessary, the most important element in the procedure is a trained technician with acute senses. (Photo courtesy Beckman Industrial)

They work hard for the money.



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Successful servicing

I just recently had a long chat with a service center owner who has only been in business for a few years. He's successful. Oh, he's not large: there's only him, his wife, and four part time technicians. But when he started the business, he set goals, and formulated a business plan. Today he's considerably beyond where he expected to be at this point in the development of his business.

The reason for his success is simple. He provides good service at a reasonable (not cheap) price, offers flat rate labor, so the customer has a pretty good idea going in how much the service will cost. He has an attractive, clean facility with a show room out front and keeps the service benches behind closed doors where customers can't see the clutter. Though in this service center there really isn't anything you could call clutter—he keeps it clean and neat. Oh, and of course, he's an extraordinarily competent technician, and the technicians who work for him are competent.

It's a little hard to know if the reason for his success is the service he provides, the competency of himself and the techs who work for him, or the communication and education he provides for his customers. Whatever it is, it works.

One of the things that sets this service center apart from many of the other facilities I've visited is the constant effort he makes to let his clients know what to expect, and to treat them as truly valued. For starters, there is a large sign in the showroom that lists the products he services, and the labor cost for a minimal, regular and extensive service procedure on the product.

One of the other pieces of informa-

tion he provides to his clients is a posted notice of the cost to estimate the repair bill: whether the product will require just minimal service, a regular service procedure, or if it will need extensive care. He doesn't charge for this service up front, but includes it in the posted cost of the repair if the customer decides to have the procedure done. If the client decides to have the work done elsewhere, he collects the estimate fee before giving the unit back.

Because a few customers expressed surprise when he demanded an estimate fee, even though he had explained it at the time they brought their product in for service, he developed an agreement form. Now when a client brings in a product for service, he explains the estimate policy, provides the client with a form, and asks the client to sign, acknowledging that he understands the policy and agrees to it.

Something else that this service center does is to provide every client with a warranty form, explaining exactly what is covered by a repair warranty and for how long. That way there is never any question.

Another information sheet that this center provides is one with a brief description of how to reconnect the product. The owner of the service center has found in many cases that the owner of the product brought in for service may have forgotten that when the product was new that someone else; the selling dealer, a friend or a relative may have come in and hooked it up. Then when the product malfunctioned the client blithely pulled the connecting cords out and carried the product in for service. After the service has been completed,

the client picks it up, carries it home and then realizes that he hasn't got the foggiest idea of how to hook it back up.

The form provided by the service center gives generalized instructions on how to reconnect the unit. This not only makes the client appreciate the service center for this thoughtfulness, it has reduced the number of nuisance calls the center gets asking for help in reconnecting the unit. The time spent in writing up the instructions and the money required to copy them has been compensated for many times over in time saved on these nuisance calls.

How successful is this service center? Here's an example. The service center is located in the capital city of the state, and although he's only been in business for about three years, the other day the wife of the governor brought in a product, nearly obsolete, that the governor has grown used to and likes very much. She said that she'd asked around where she should bring it for service and almost everyone she asked told her to bring it to this service center.

Technical competence is necessary in the consumer electronics servicing business, good business practices are necessary to be sure it's making a profit, but the thing that keeps people coming back and insures that they will recommend the business to friends is good ethical business practices, a friendly, helpful attitude, and good open communications between service center people and their clients.

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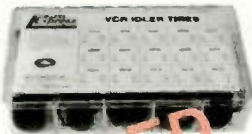
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News

Thomson Consumer Electronics introduces line of Japanese (JEDEC/GENERIC) semiconductors
Thomson Consumer Electronics, has announced the introduction of a line of Japanese (JEDEC/GENERIC) semiconductors. "These devices are genuine, original Japanese name-brand semiconductors, not universal or approximate substitutes," said Barbara McNally, manager of parts and merchandising. "We have assembled a selection of the most commonly used items and the most frequently called for devices."

The servicer, when repairing equipment, is often faced with replacing a device imprinted with the original Japanese manufacturer's device number, but not the equipment maker's stock number. This causes the servicer to take time to search the equipment maker's data to find the stock number. By utilizing the Thomson line, the servicer can order the original Japanese type number from any authorized Thomson distributor.

Zoning info pack for dish owners, dealers, zoning boards

The *American Home Satellite Association* has published a complete information package on zoning regulations affecting dish ownership and use. The package is designed as a resource to help dish owners, dealers, and their attorneys defend the right to install and use satellite TV receiving systems.

The information was developed in response to widespread concern over regulations that fail to comply with FCC's 1986 order pre-empting local zoning ordinances that discriminate against and restrict the installation of satellite TV antennas or dishes.

The package includes issue summary, model zoning ordinance, and facts for understanding the communications benefits and operating requirements of a home satellite TV receiving system. It also highlights court decisions on zoning matters.

Publication of the package is the first step in a new AHSA effort to help create an atmosphere of informed awareness that will make discriminatory restrictions against satellite TV installations passe.

This issue is now a Congressional concern and the draft of the House Cable Bill approved by the Telecommuni-

cations Committee June 27, calls for the FCC to determine the extent to which local zoning or other regulations have hampered the development of C-band satellite TV.

It should be cautioned that obtaining a copy of the AHSA Zoning information package should not be seen as a substitute for the support of competent legal representation. Says Lauritz Hellad AHSA's general counsel "Cities and towns involved in such lawsuits are almost always represented by trained attorneys well versed in zoning law. Homeowners who attempt self representation in such lawsuits handicap themselves seriously and, in our view, needlessly."

Monthly newsletter for the small small business

Lynco Publications of Glenside, PA has launched *The Small Small Business*, a monthly newsletter designed to provide management guidance for owners and managers of small businesses.

Publisher William J. Lynott explains "In today's economic environment, the term "small business" has become almost meaningless in the business press. Even Uncle Sam is guilty of lost perspective in this."

"According to the Small Business Administration, business in some industries can gross as much as \$17 million annually and still be classified as small. Other organizations consider \$45 million as small. I don't know about you, but to me, that's big business," he adds.

Lynott, who is also a management consultant to small business, goes on to say, "As a result of this situation, owners of truly small businesses have a difficult time finding published management guidance that is truly relevant to their needs. Many publications identifying themselves with small business actually cater to multi-million dollar operations that have little or no relevance to truly small business. SSB is a publication exclusively for owners of businesses that really are small."

The new publication, a six-page monthly goes out to subscribers in the U.S. and Canada. A seven-member panel of advisors includes an attorney, physician, banker, CPA, psychologist, investment counselor, and an employee relations consultant.

Accounting software for the consumer-electronics service center

By William J. Lynott

Last month we talked about the pros and cons of computerizing the accounting records in your small service business. Now let's take a look at some of the off-the-shelf programs available to do that job.

Accounting programs share one major similarity with most other classes of software for desktop computers: they come in all shapes and sizes.

Some off-the-shelf accounting programs have attained an astonishing degree of sophistication. For a few hundred dollars, you can buy programs in the same league as those used on mainframe computers by the biggest of companies. On the other hand, for well under a hundred dollars, you can buy simple programs that still have more power than most small service dealers will ever need. So how do you decide?

It's important to understand that there are now virtually scores of accounting programs available. They come in every price range from a few dollars to a few hundred dollars. There are so many of them, in fact, that it would be impossible to include any sort of meaningful list in a brief column such as this.

Instead, I'm going to discuss two of the many programs I've directly worked with. One is a basic program at the low end of the price range, the other a full-featured double-entry accounting program capable of handling all but the biggest of businesses.

The first is called "The Company Books" (Swiedler Information Systems, 4224 Sturgeon Circle, Buford, GA 30518. Phone: 404/932-5814). List price \$225 (Software is widely

discounted. Discounts up to 40% off list are common.)

This program is for business owners who already have a substantial business and expect it to grow. It's a powerful double-entry system that will do just about anything that you will require in an accounting program.

"Company Books," utilizes a display screen designed to resemble the pages of manual journals and ledgers. If you're already familiar with handwritten double-entry accounting, this feature will help to ease your transition to electronic accounting.

The top half of the entry screen resembles handwritten journal pages, the lower left portion displays menus that make it easy to work your way through the program.

Offsetting entries, where required, are made automatically to the proper accounts. When an account is out of balance, the amount needed to restore balance is displayed on screen. The cash journal will record either accrual or cash-based transactions.

This was one of the first double-entry programs to be offered complete at one price with no separate modules to purchase. Everything you need to begin your accounting records is included. Accounts payable and receivable, general ledger, and reports. They're all there.

The other program I want to tell you about is called "Quicken," a basic single-entry bookkeeping program. Quicken, the best-selling of all accounting programs, is the easiest to use personal and small business finance program I've seen. While it doesn't have the complexity and power of programs such as "Company Books," it is far easier to learn and much less expensive. In fact, at \$59.95 list, Quicken may well be the best bargain in your local software store.

Quicken has been designed as a vis-

ual metaphor of your checkbook. The check-writing and register screens allow you to write checks and make entries just as you do in your regular checkbook. A big difference, of course, is that Quicken does all of the arithmetic, and it never makes a mistake. Quicken reports include profit/loss statements, simplified balance sheets, and tracking of accounts receivable/payable, among others.

One of the perennial headaches in the check-book finance is reconciliation, and Quicken has made that job easier than ever. Just enter the closing balance from your statement, fill in the spaces for service charges or interest earned, clear each returned check with a single keystroke and the program instantly lets you know whether there is a discrepancy. If you're out of balance—a difficult thing to do when you use Quicken-finding the problem is a breeze.

But don't be misled by Quicken's simple structure and ease of use. This little program has enough flexibility to allow you to manage some surprisingly elaborate reports and analyses of your personal or small business financial activity.

If your service business requires full-fledged double-entry bookkeeping, or if you want a program to help you determine what percentage of your assets to invest in mutual funds, you'll have to look elsewhere. But if you want to simplify your business check-writing and record keeping, Quicken would be a good choice.

Either program will print checks on your printer or allow you to write them out manually.

As I said, there are scores of other programs on the market, each with its own combination of advantages and disadvantages. Whatever your decision on computerizing your accounting records, I hope the information here will be of help. ■

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

1990 New product update

A new supplement to the *Contact East* General Catalog is now available. This important reference guide for engineers, managers and technicians offers a wide range of reliable, brand-name products for testing, repairing, and assembling electronic equipment. Included in this update are many analog/digital oscilloscopes, inspection products, soldering/desoldering equipment, temperature/humidity chart recorders, static protection products, plus much more. Also included are DMM's and precision tools. All products are described in detail with specifications, full color photos, and discount pricing.

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Overcurrent protection and bulletin NE 90

Overcurrent protection and the 1990 National Electrical Code, Bulletin NE 90, is now available from *Bussman Division Cooper Industries*. This is a collection of questions and answers about overcurrent protection as required by the 1990 National Electrical Code. The bulletin provides the reader with a basic understanding of overcurrent protective devices and their application. Pertinent sections of the National Electrical Code are translated into simple, easy to understand language, complemented by one-line diagrams. Fifty-five different articles are analyzed in 40 pages, including charts, diagrams, and tables.

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Free catalog of electronic instruments for rent

The 1990-91 rental catalog featuring electronic test equipment is now available from *Genstar Rental Electronics*. New equipment from many major instrumentation manufacturers are represented, including Hewlett Packard, Tektronix, Intel, Fluke and others.

Product categories include analyzers, meters, generators, oscilloscopes, desktop computers and telecommunications.

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Videotape of new product line

The *Eraser Company* announces the availability of new videotaped demonstrations of its product line. Each vid-

eotape in the 11-tape series is 10 to 20 minutes in length, and each covers a different segment on the company's product line. There are tapes available on magnet wire strippers, rotary blade strippers, cable equipment, wire testers, and Glo-Ring infrared heat tools.

Each product is demonstrated, showing features, applications, and set-ups required. The tapes clearly show how each unit operates.

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EIA/CEG issues pamphlet on electronic devices for special needs

EIA/CEG have made it possible for those with disabilities to reach beyond their limitations to live full and productive lives. "Extend Their Reach," a pamphlet designed to provide and introduce the general public with an introduction to electronic devices is designed to assist people with physical or sensory limitations, produced by the Assistive Devices Division (ADD) of the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

The pamphlet will be distributed nationwide to concerned individuals, physicians and groups dealing with disability issues. "The timing of the pamphlet's publication is extremely important," stresses Thomas Lauterback staff vice president of EIA/CEG's Communications Department "because there is now a lot of attention focusing more and more on the potential changes possible with the Americans With Disabilities Act. It is now critical to provide the public with accurate information about the products available to assist disabled individuals in the workplace," he adds.

The pamphlet includes sections on overcoming impairment of sight, speech, hearing and mobility. It also has a section introducing the ADD companies that manufacture and sell products to overcome these limitations, and other sections offer suggestions on funding and how to obtain further information. Single copies of the pamphlet may be obtained by sending a self-addressed business envelope (No.10) with 25-cent stamp to: Extend Their Reach, c/o Electronic Industries EAI/CEG, P.O. Box 19100, Washington, D.C. 20036.

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ELECTRONIC

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS
Servicing & Technology

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SALES OFFICE

Electronic Servicing & Technology
76 N. Broadway, Hicksville, NY 11801
516-681-2922; Fax, 516-681-2926

Jonathan Kummer, *Advertising Manager*
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EDITORIAL CORRESPONDENCE

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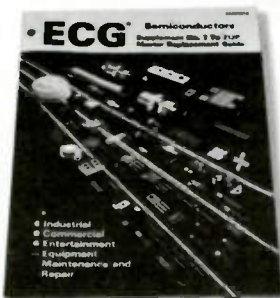
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Servicing Zenith microcomputers

Part VIII: The floppy disk controller card

By John A. Ross

In Part VII of this series (see the February 1990 issue) we discussed the video section of the floppy controller/video output card found in the early versions of the Zenith microcomputers. Completing the look at the dual-purpose card, we will now discuss the floppy controller portion. Primarily, we can look at this portion of the card as an interface between electronic and electro-mechanical assemblies. The electronic sections in-

clude the system microprocessor circuitry and data bus plus the floppy disk control circuitry. The electro-mechanical assembly consists of the actual floppy disk drive. One flat, multi-wire cable physically connects the floppy control circuitry to either one or two floppy disk drives. Figure 1 illustrates the basic relationship of the different sections.

Before we move into a discussion of the actual floppy disk control circuitry, some background information may prove beneficial for most technicians. Specifically, an under-

standing of the operation of all involved sections—the microprocessor circuitry, the direct memory access circuitry, the floppy disk control circuitry and the floppy disk drive—becomes necessary.

Back to the basics

Stepping back to the second article of the series, you will remember that several key signals arrive from the microprocessor to initiate either a floppy read or write operation. In some ways, this operation compares with the random-access memory

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

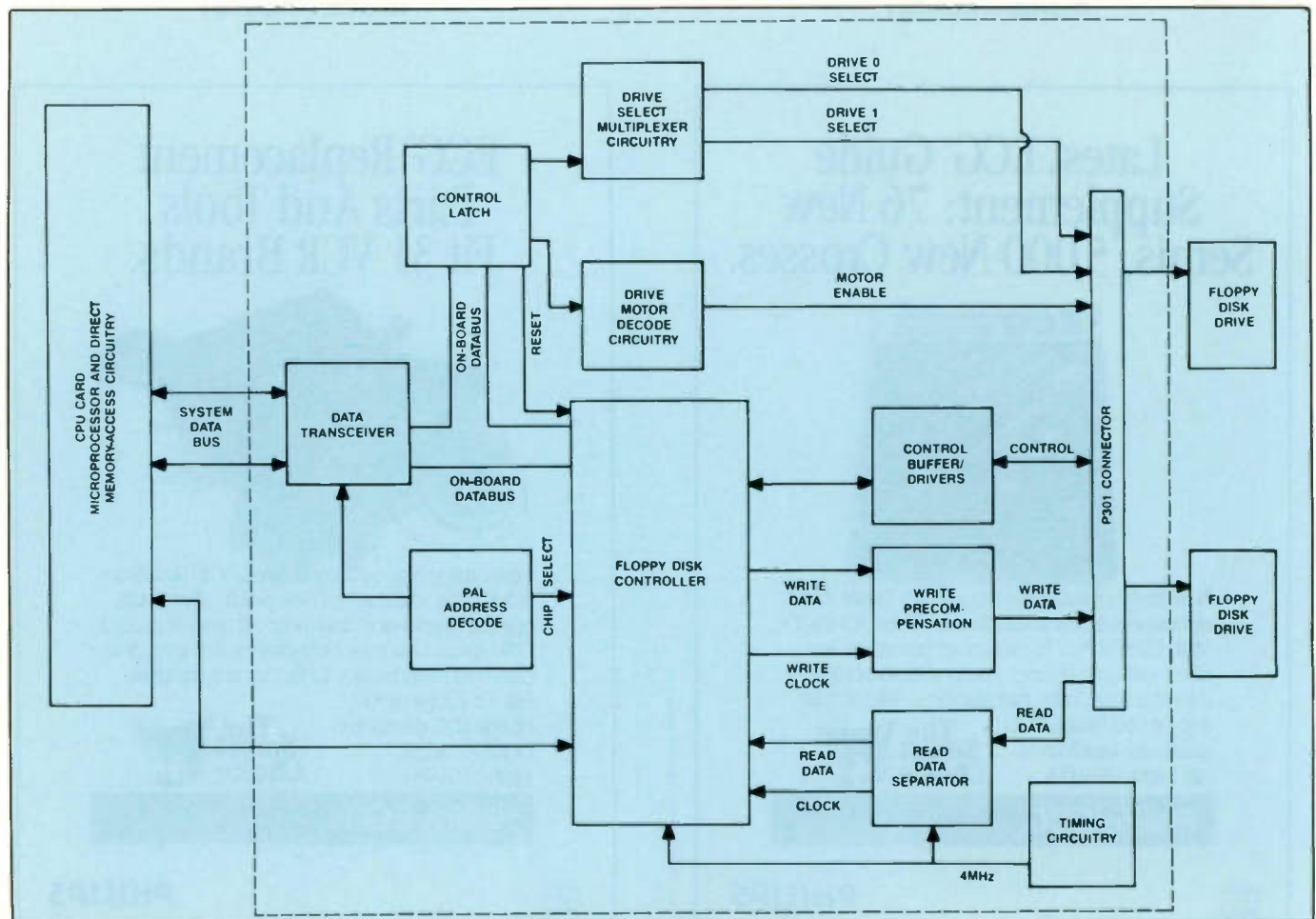


Figure 1. The floppy disk controller circuit card is essentially an interface between electronic and electro-mechanical assemblies.

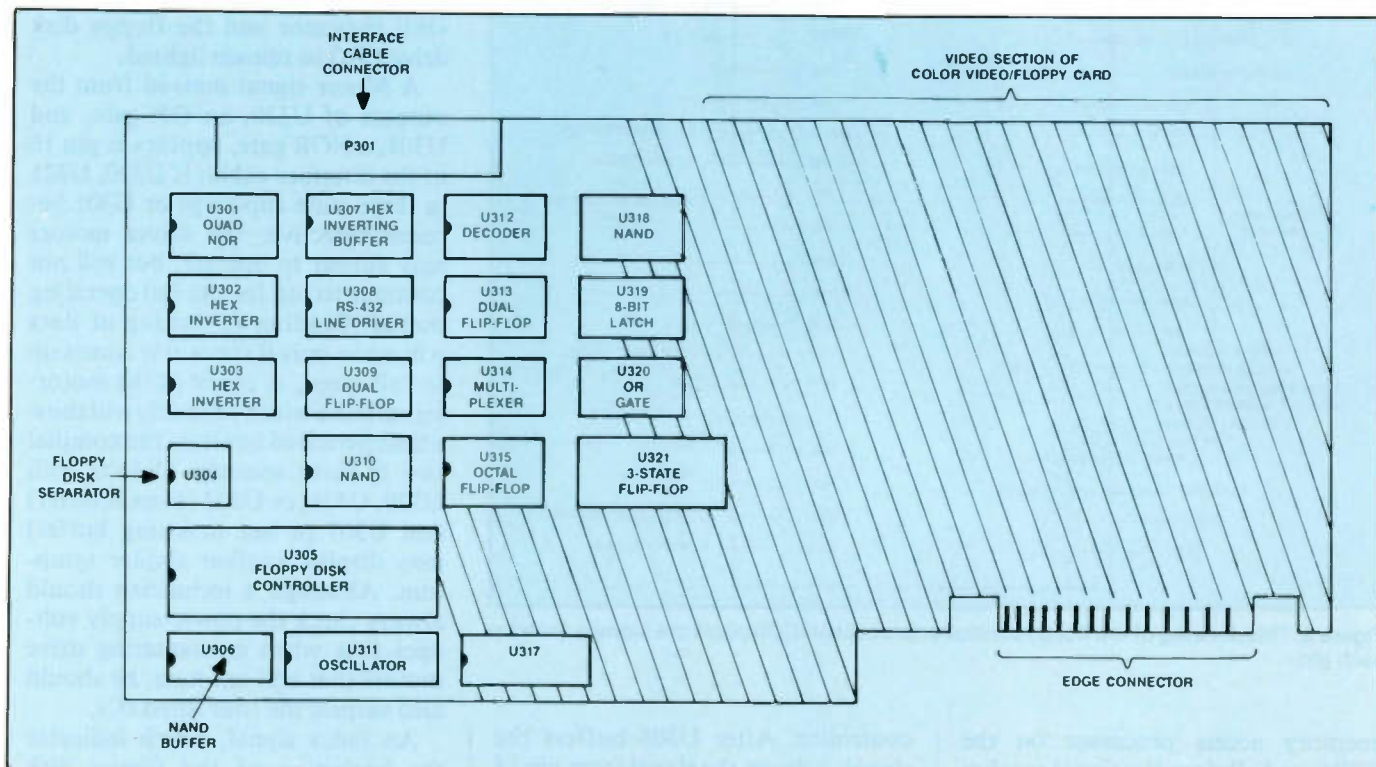


Figure 2. This portion of the color video/floppy disk controller card contains the ICs for the floppy disk controller section of the dual-function board.

read/write operation seen in an earlier article. The floppy disk controller originates the request for direct memory access to the DMA controller on the CPU card. When the microprocessor acknowledges the request, the data transfer to or from the magnetic media of the floppy disk begins.

Understanding a few basics about the disk drive operation in the Zenith microcomputer may simplify troubleshooting the entire system. Bad disks, dirty disk drive heads or misuse may trigger different error messages. As with other sections of the microcomputer, the designers provide LED diagnostic indicators for the floppy disk control and drive section. As the microcomputer boots and with the autoboot configuration switch in the off position, the DSK indicator is the last LED to extinguish. The RDY indicator normally remains lit. An autoboot switch left in the on position will cause the microprocessor to wait for the insertion of a floppy disk before finishing the boot sequence.

After those instructions arrive, the floppy disk controller executes the

seek and recalibrate commands, monitors the drive status and converts the form of the data seen during the write or read operations. Using input signals from the controller, the floppy disk drive head moves to a different location of the magnetic floppy disk. Signals from the controller determine the direction of the head movement and whether the drive can write to or read the disk.

Figure 2 shows the location of the ICs found in the floppy disk controller section of the dual-function board. As the microcomputer system goes through its power-up sequence, the third bit (DB2) on the eight-bit data bus goes to a digital active low state. U321, a three-state flip-flop, latches onto the low signal at pin 6 and sends the signal to U302, a hex inverter. U302 inverts the digital low signal. This inverted signal arrives at pin 1 of U305, the floppy controller IC, as a hard reset signal. U305 remains in a reset condition until a software command changes the state of the original data bit seen as DB2.

When the transfer of data begins, several address bits become buffered to the floppy controller IC. Figure 3

shows a diagram of the floppy controller/processor and the signals found at each pin. Pin 6 of U339, a three-state buffer, buffers the signal found at the A1 location of the data bus and combines the signal with another signal from pin 17 of U338, the programmable address controller. This combined signal becomes recognizable as the chip select signal found at the floppy controller IC.

A defective programmable address controller will cause bad card addressing or wrong chip selection. Pin 11 of U339, a three state buffer, buffers the signal found at the A0 line of the data bus. After buffering, this signal, now seen as the register select signal, appears as the input at pin 5 of the floppy controller and enables either the internal data or the status register. With the register select signal, the floppy controller can transfer its contents onto the card data bus.

After receiving those signal inputs, the floppy controller IC prepares to initiate a data transfer. To initiate the data transfer, the floppy controller sends a DRQ2 or direct memory request signal from pin 14 to the direct

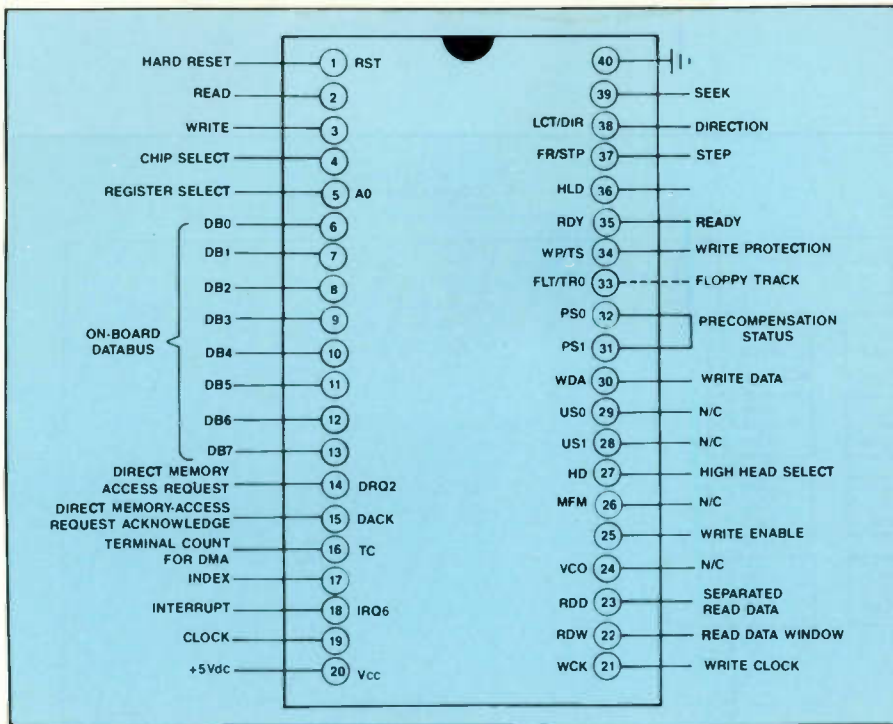


Figure 3. This drawing of the floppy controller/processor IC displays the signals found at each pin.

memory access processor on the CPU card. Before the signal reaches the DMA processor, a flip-flop seen at U313 delays the signal for additional buffering and then relays the signal to pin 10 of U308, a NAND buffer. Referring to the CPU card article (see the September 1989 issue) remember that direct memory access occurs when a peripheral device, such as the floppy disk drive, needs a faster transfer of data than the microprocessor can provide.

Once the microprocessor recognizes the request signal, it sends a direct memory access acknowledge or DACK2 signal back to the floppy controller. Receiving the DACK2 signal enables the internal registers of the floppy controller. Enabling allows the reading or writing of data to the internal registers. The DACK2 signal also causes the programmable address controller, U338, to output the transceiver direction control or XCVRD signal. A digital low XCVRD signal allows the transceiver, U348, to transfer data from the card data bus to microprocessor data bus. Conversely, a high XCVRD signal allows data transfer from the microprocessor data bus to the on-board card data bus through the transceiver. When the floppy controller IC senses the completion of the data transfer, an interrupt request signal, seen as IRQ6, appears at pin 18 of the

controller. After U308 buffers the signal, it drives the signal from pin 14 to the system backplane bus. Arriving at the microprocessor, the signal causes the direct memory access operation to stop.

Disk drives

Two internal floppy disk drives, designated as "A" or "B", can reside within the microcomputer. Because the floppy controller can select only one drive at a given time, the output of U312, a decoder, provides the disk drive select signals. After the microprocessor places data onto the data bus, the signal levels of bits DB0 and DB7 determine which disk drive to select. These signals are latched by a flip-flop and applied as input signals for U312. U320, an OR gate, latches onto data bits DB4 and DB5, sends the bits through an OR gate and finally applies the combined signal as an input to pin 1 of U312. Another data input, seen at pin 15 of U312, comes from latching the NOR gating of data bits DB6 and DB7 by U301, a NOR gate.

U321 outputs the drive select signals—DS0, DS1, DS2, DS3—through pins 10, 12, 14, or 6 of the interface cable. Figure 4 illustrates the pin connections of the interface cable. In addition to the drive select signals, other signals also appear at the interface cable pin connections. Although

a loose or disconnected interface cable will result in the "Disk Error: Seek Failure" error message, a reversed interface cable will cause the DSK indicator and the floppy disk drive LED to remain lighted.

A Motor signal derived from the outputs of U320, an OR gate, and U301, a NOR gate, appears at pin 16 of the interface cable. If U320, U321 (a three-state flip-flop) or U301 become defective, the driver motors may appear to operate, but will not continue to run for the full operating period. Reading or writing of data will occur only if the motor comes up to full speed. A check of the motor-signal pulse width probably will show a time period of less than the nominal two to three seconds. Defects with U320, U321, or U302 (a hex inverter) and U307 (a hex inverting buffer) may display another similar symptom. Although a technician should always check the power-supply voltages first when encountering drive motors that will not turn, he should also suspect the four listed ICs.

An index signal, which indicates the beginning of the floppy disk track, operates at pin 8 of the cable connector. A loss of index signal, sometimes caused by a defective U302, will cause read-sector errors. Several signals affect the drive-head selection and direction during a read or write operation. Pin 32 of the connector is the point of origin of the read/write head selection signal, while pin 18 carries the head direction or DIR signal. Another signal, found at pin 20, called the head stepping or STP signal, moves the drive head from track to track.

Writing to the disk

A floppy disk write operation calls for several other signals. If you look at Figure 5, the timing of the write cycle becomes evident. The floppy disk controller converts the write data from parallel to serial form. Again, the interface cable connector becomes a logical starting point. Appearing at pin 24 of the connector, the WRITE GATE signal tells the floppy disk drive to accept data. Starting as the write enable signal at pin 25 of the floppy controller IC, the signal is buffered by the tri-state buffer and inverted to become the write gate. If either U302 or U308 becomes defective, the write enable signal either drops to a low level or dis-

appears. With no write-enable signal, the floppy disk drive will not write data to the floppy disk. Pin 8 of U320 provides the clock frequency or WCK signal that determines the data transmission rate. The WCK signal determines the rate at which data writes to the floppy disk.

Another signal, called the WRDATA* or inverted Write Data signal, shows at pin 22 of the connector. This signal is derived from the WDA or write data output signal found at pin 30 of the floppy disk controller IC. After leaving the floppy disk controller, the signal flows to the flip-flop, NAND gates and multiplexer labeled as U315, U310 and U314. These three ICs make up the write precompensation circuitry. Write precompensation guarantees the stability of the read/write heads before writing to the disk. At times, a phenomena called data bit shift can occur on the floppy disk. Two input signals at the multiplexer determine early, nominal or late precompensation which counters the effects of bit shift.

Problems within several areas, aside from the write precompensation circuitry, can trigger errors within the precompensation signals. Technicians generally should suspect the floppy disk controller, the NAND buffer shown at U306, the oscillator or the 4-bit counter if the errors persist. Located at U311, the 8 MHz oscillator provides timing signals to a flip-flop and the counter. Found at U317, the 4-bit counter sets up frequency outputs for the floppy controller, the delay flip-flop (U313) and the write precompensation flip-flop located at U315.

In many cases, a user may place a write-protect tab on a floppy disk so that data will not be overwritten. The DIR and STEP signals become disabled during the write cycle if the floppy disk has write protection. This action results from a digital low signal at pin 39 of the floppy disk controller, which disables pins three and six of U306. Working as a write-protection signal for the floppy controller, an output at pin 11 of U306 then goes to a digital active high state. Almost the same sequence happens during an active read cycle. Again, the DIR and STEP signals become disabled so that the signal action will not affect the operation of the floppy disk drive read/write head. Nevertheless, the signal at pin

11 of U306 goes to a digital low state instead of the active high state seen during the write cycle. A low state at pin 11 tells the floppy disk controller that the floppy disk has double-sided media.

Reading from the disk

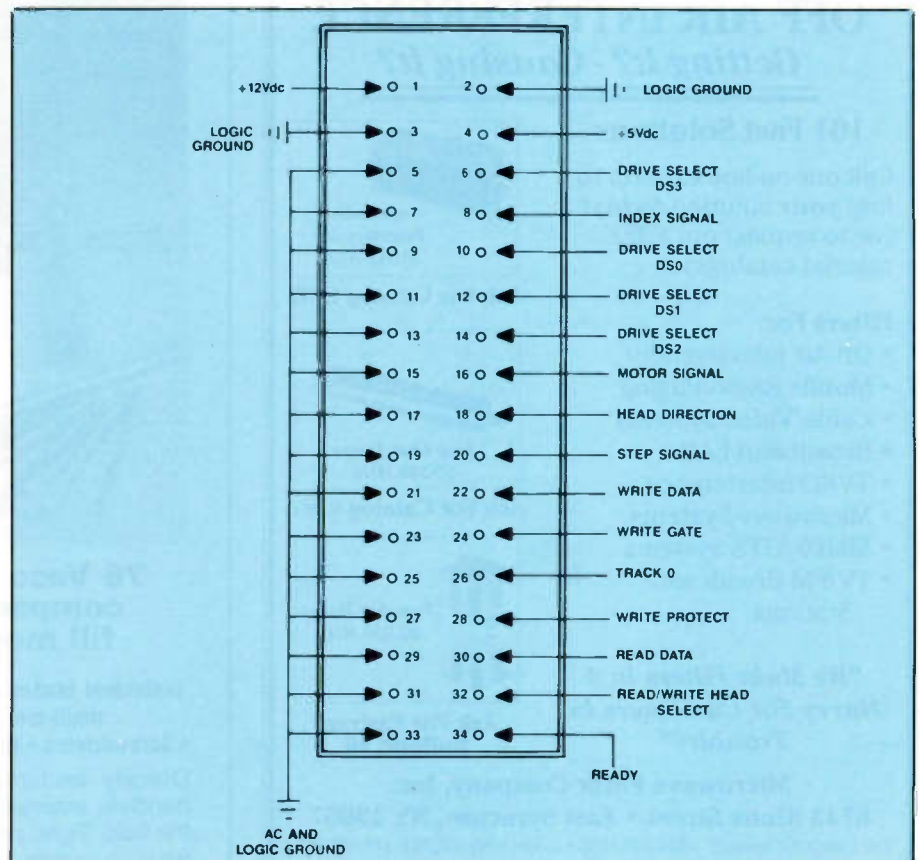
Looking at the read-data cycle, you will find one other signal that remains at pin 30 of the interface cable. Data flows from the floppy disk drive through pin 30 to the floppy controller card. Figure 6 shows a waveform representation of the read data cycle. In contrast to the write cycle, the floppy disk controller converts the serial data to a parallel form during the read cycle. Raw serial data flows to U304, the data-separation IC, and separates into either serial clock signals or serial data signals. After separation, the data travels on to the on-board data bus.

Because of the separation factor, timing becomes important during the read cycle. A reference clock input of 4Mhz at the input of U304 activates the IC on the leading edge of a pulse. As the reference clock inputs at pins 5 and 6 of the IC go to a digital low

state, the internal division ratio of the SCLK or separated clock signal becomes one. With the ratio at one, 4 MHz timing signals appear at pin 22 along with the read-data-window input signal. Separated data, in the form of the SEPD signal, exists as an input at pin 23 of the floppy controller IC. At this point, the data converts from serial form to parallel form.

If either the data separation circuit or the inverter malfunctions, the drive may read erroneous data from a known-good floppy disk. Incorrect read-window timing may cause the error. However, problems within other circuitry may cause the same symptom. A defective floppy disk controller, RS-432 line driver or quad flip-flop (found at U305, U308 and U309 respectively) may generate read errors when the data enters the system memory. Another possibility lies within a defective DMA IC. Moving back to the CPU card, a bad DMA IC may induce errors into the processing of any data.

As with other microcomputer-related technology, floppy disk drive designs and specifications have gone through an evolution. Early micro-



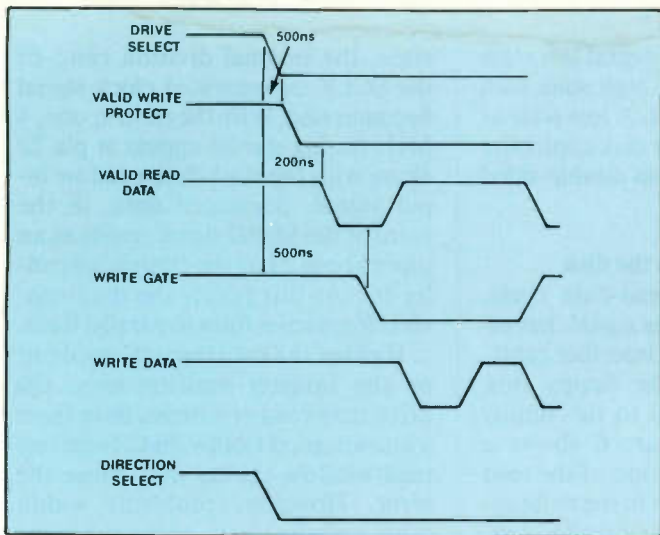


Figure 5. A look at this waveform gives an idea of the timing of the write cycle. The floppy disk controller converts the write data from parallel to serial form.

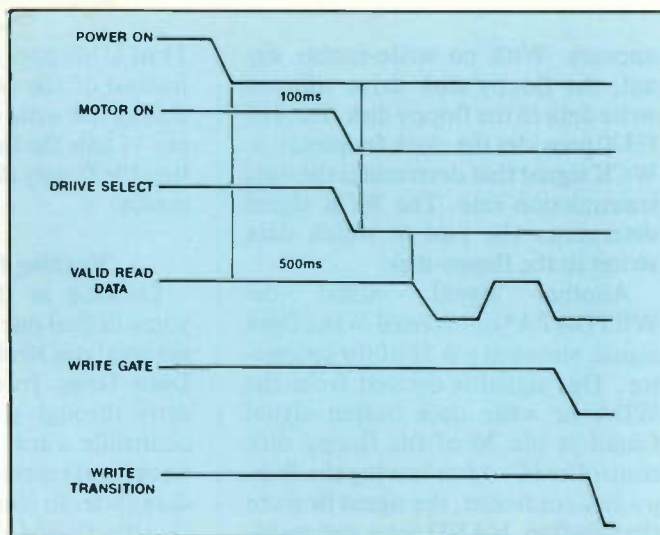


Figure 6. A waveform representation of the read data cycle. In contrast to the write cycle, the floppy disk controller converts the serial data to a parallel form during the read cycle.

computers introduced a short-lived 8-inch floppy disk drive. For a long period of time, the 5½-inch floppy disk drives with 360Kb of storage memory reigned as the standard. Gradually, the 5½-inch standard has begun to give way to a smaller 3¼-inch floppy disk that contains

720Kb of storage space. With changes in technology, the capability of the floppy disk drive to store data has increased dramatically. Today, users can purchase floppy disk drives that will read and write to 2Mbyte floppy disks. Another size of floppy disk—the 2¼-inch—now exists for

new smaller, lap-top microcomputers.

Regardless of the changes in media, the principles behind controlling the read/write operation of the disks remain the same. In the next part of this series we'll move to the cousin of the floppy disk controller card—the hard disk drive controller. ■

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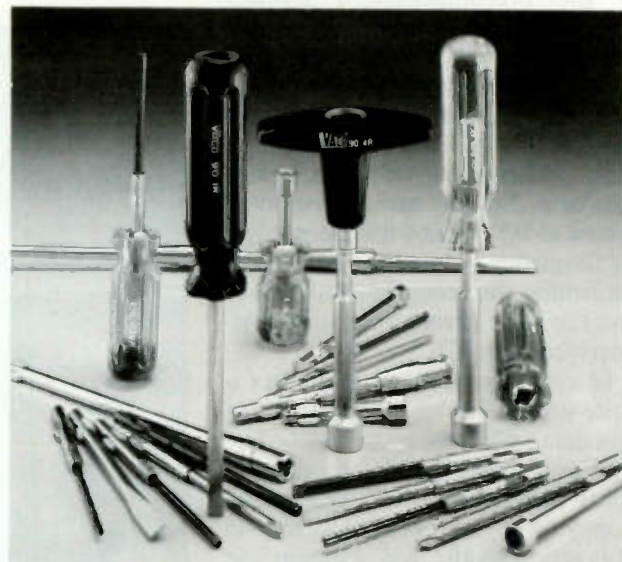
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Circle (46) on Reply Card

Use stress tests to solve tricky problems

By John Shepler

Some problems seem to defy troubleshooting. These are ones we call strange, tough-dog, intermittent, or just plain impossible. In this column, we'll look at some examples and how to approach them.

The toughest problems are always those where the equipment behaves differently on the bench than in the customer's home. A typical complaint might be: "it just doesn't sound right."

You'll never unravel the mystery with that information. You need to dig further to find out if this is an interfacing problem between components, or an intermittent where the symptoms come and go.

Interfacing problems will be discussed in another column. Suffice it to say that one component can have drastic effects on another and the only way to see this is to have both units in the shop and connected together.

Problems that come and go are even more maddening. Not long ago I dealt with a sequencing computer that refused to access discs memory. Unfortunately, it ran fine when I had it on the bench with scope probes on the suspected chip.

Learning nothing from signal waveforms, I elected to try a little stress testing. First, a little freeze spray on the disc controller components one by one. No change. Then I bathed the entire circuit board with the heat from a 1200 watt hair dryer. In a few seconds, the machine started to act up. Now for the freon spray again. Yes, the symptoms would only come and go when the controller chip itself was alternately heated and cooled. Of course it ran fine on the bench. There was plenty of air to keep the circuit board cool as it was being probed. A new controller chip solved the problem permanently.

Audio chips exhibit the same problems. Many of today's circuits are built on silicon dice with hundreds and even thousands of transistors.

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

Typical examples are AM stereo chips, modems, telephones, FM stereo demodulators, and audio op-amps. You have only limited ability to see what is going on inside these circuits with conventional test equipment. Typical problems involve chips that change behavior when the temperature is higher or lower than ambient, leakage currents that vary with temperature and affect external components, changes of operation with changes in power supply voltage, or circuits that intermittently cut in and out for no apparent reason.

Many of these problems are due to errors in fabrication, such as bad silicon or poor bonding of connections. Other problems are overloading the chip due to marginal designs or failure of outside components.

When faced with these tough-dog problems, you want to introduce a small amount of stress to encourage the problem to recur while you are watching. Just be careful not to overdo it and damage circuit boards or other parts. For that reason, I suggest hair dryers over heat guns. Also, use as little freeze spray as you can.

Another good stress test is to vary the voltage to the unit under test. A variable AC transformer allows you to test at the upper limit of the AC line voltage. Or, you can cause "brown outs" to the lower line limit just like the power company does. Caution: don't go beyond the equipment's rated operating voltage or you might inadvertently damage the good components.

A variable DC supply allows you to simulate discharging batteries. Some equipment only works right on a fairly fresh set of batteries. The customer needs to see and hear this low voltage effect to understand.

Best of luck in your stress testing to uncover tricky problems. Don't forget to apply the correct signal inputs and loads to amplifiers and other audio components while you run the tests. This is the normal operation that provides the most stress and thus, the greatest likelihood of problems appearing while you watch. ■

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Switching power supplies

By Robert Arso

Switching power supplies can at first glance be confusing. This article will help you understand these circuits and gain confidence to troubleshoot them.

The first circuit that we will discuss is the CTC 133 chassis, Sams Photo-fact 2513, Folder 2. RCA calls this power supply a Variable Frequency Switching Regulator Power Supply. As its name implies the regulation of a raw B+ is accomplished by the switching on and off of a primary current through a transformer. The rectified secondary voltage is the regulated output voltage. In this chassis the switching device is a power MOSFET, Q100. A drive signal to

the MOSFET is a pulse frequency modulated (PFM) signal whose on time is fixed, but whose off time varies depending on the load presented to the power supply. By keeping the on time constant and changing the off time, the period of the signal changes. This is equivalent to a change in frequency.

In this circuit, a heavy load, one that represents a decrease in resistance and an increase in load current, increases the frequency of the PWM drive signal to Q100. This in turn increases the average on time of Q100 and increases the average primary current in T101. The secondary voltage increases to a point that maintains the output of the regulated 131V supply constant. If the load decreases, represented by an increase in load resistance and decrease in load

current, the frequency of the PFM drive signal will decrease and cause a smaller average primary current to flow. This in turn will prevent the output of the 131V supply from rising. Figure 1, is a representation of the PWM signal for these three conditions.

Startup of the variable frequency switching regulator

Refer to Figure 2 and the schematic for the following. TP 423 goes low when the set is turned on. This causes Q400, the on/off transistor to be forward biased. The LED in U101 is forward biased and in turn forward biases the phototransistor in U101. This action allows approximately 2.8V to be applied to pin 12 of U100. This voltage is provided by zener diode CR116 through R109 and the

Arso is the chairman of the electronics technology department of Bismarck State College, Bismarck, ND.

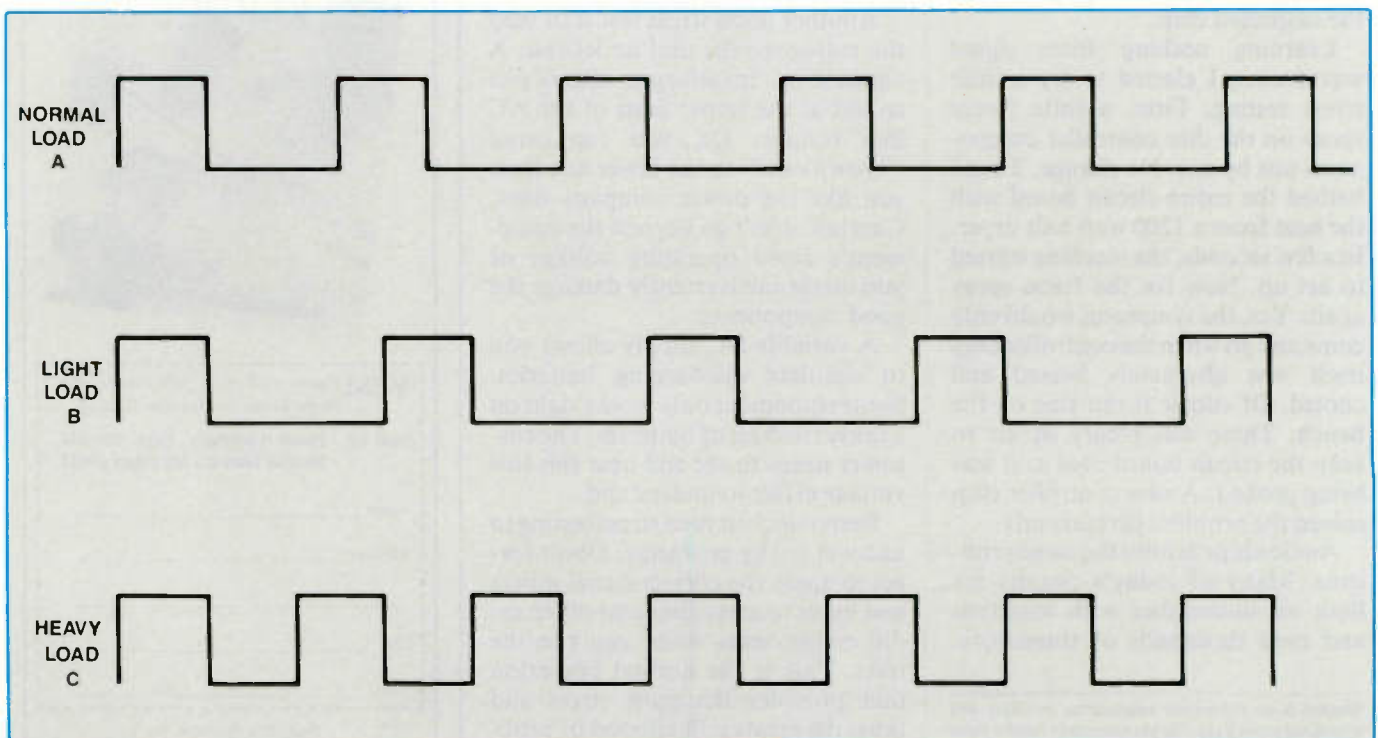


Figure 1.

phototransistor. This is one of three inputs to the shutdown latch. The second input is from a B+ sensing circuit. This circuit actually monitors the Vcc voltage at pin 7 of U100. If the voltage is above 8.5V the shutdown circuit receives a signal from the B+ sense circuit that will allow startup. At this time Vcc is less than 11 volts but more than 8.5V. Once the circuit is operating properly CR112 will supply a run voltage of approximately 12 volts. This will reverse bias CR105, which now acts like an open switch preventing CR116 from supplying power to U100. The third input to the shutdown latch is to pin 11 of U100 from the overcurrent sense circuit for Q100. As long as the source current

of Q100 is within limits the voltage drop across its source resistor, R120, will be below a reference voltage of 1.2V. During these conditions the regulator is allowed to operate normally.

Let's assume that the set is turned on and that all of the voltages at pins 7, 11 and 12 are of the correct value for proper operation. The output of the shutdown latch will output two control signals. One signal controls the PFM amplifier and the other controls the slow-start circuit. Under normal conditions the amplifier is enabled. This allows a PFM drive signal to be applied to the gate of Q100. The other control signal is applied to the slow-start circuit and enables its operation during startup.

The function of the error amplifier

Before we take a look at the slow-start circuit, let's take a look at the error amplifier and see what its function is. During normal operation, the voltage at terminals 10 and 11 of T101 will produce a voltage that when rectified by CR112 and applied to pin 1 of U100 will not produce an error signal. The pulse frequency modulator continues to operate at its present mode. Now let's assume that the load on the regulator increases: a decrease in load resistance along with an increase in load current. This would feed back a smaller dc signal to the error amplifier. In this situation the error amplifier would generate a control signal that would increase the frequency of the PFM sig-

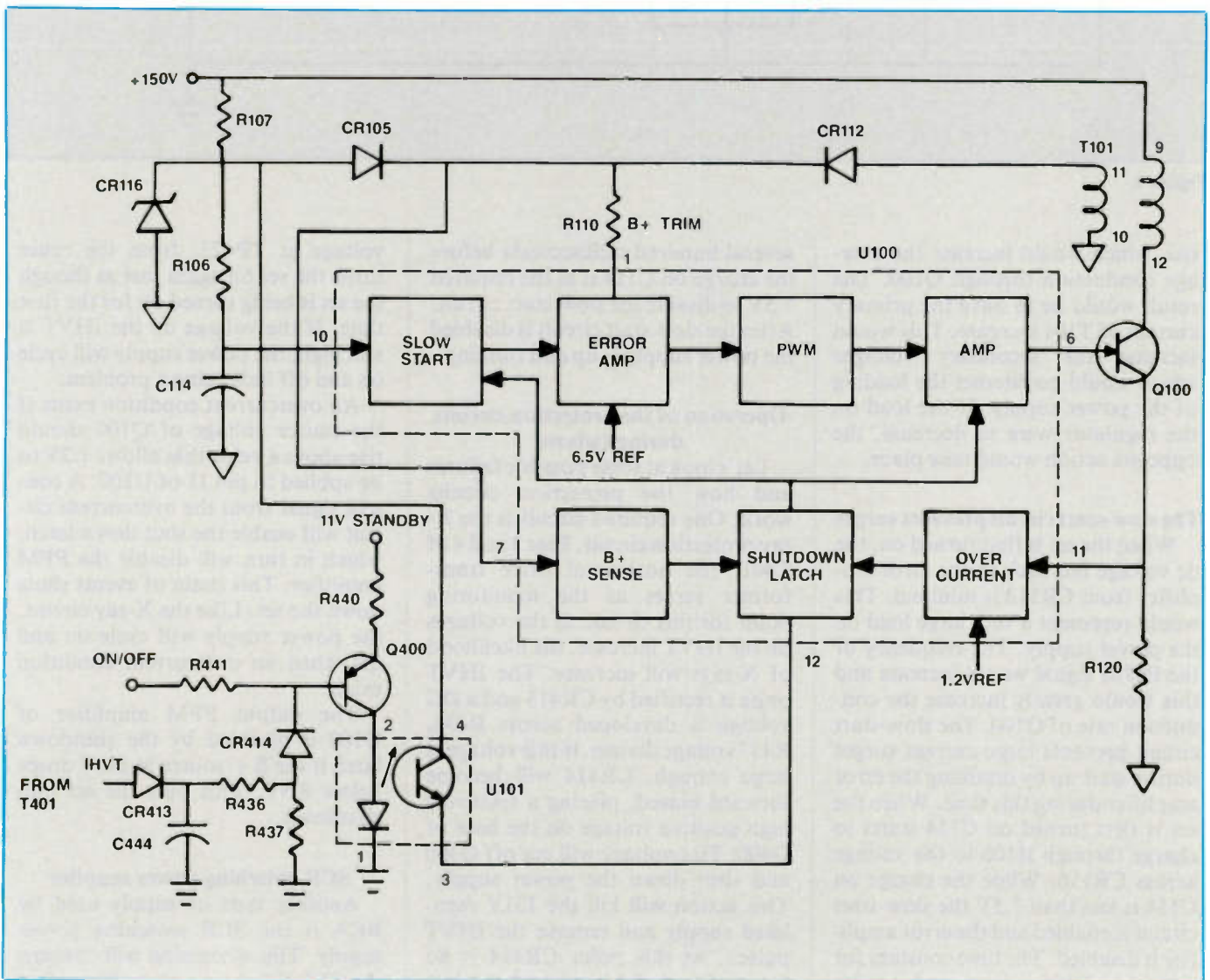


Figure 2.

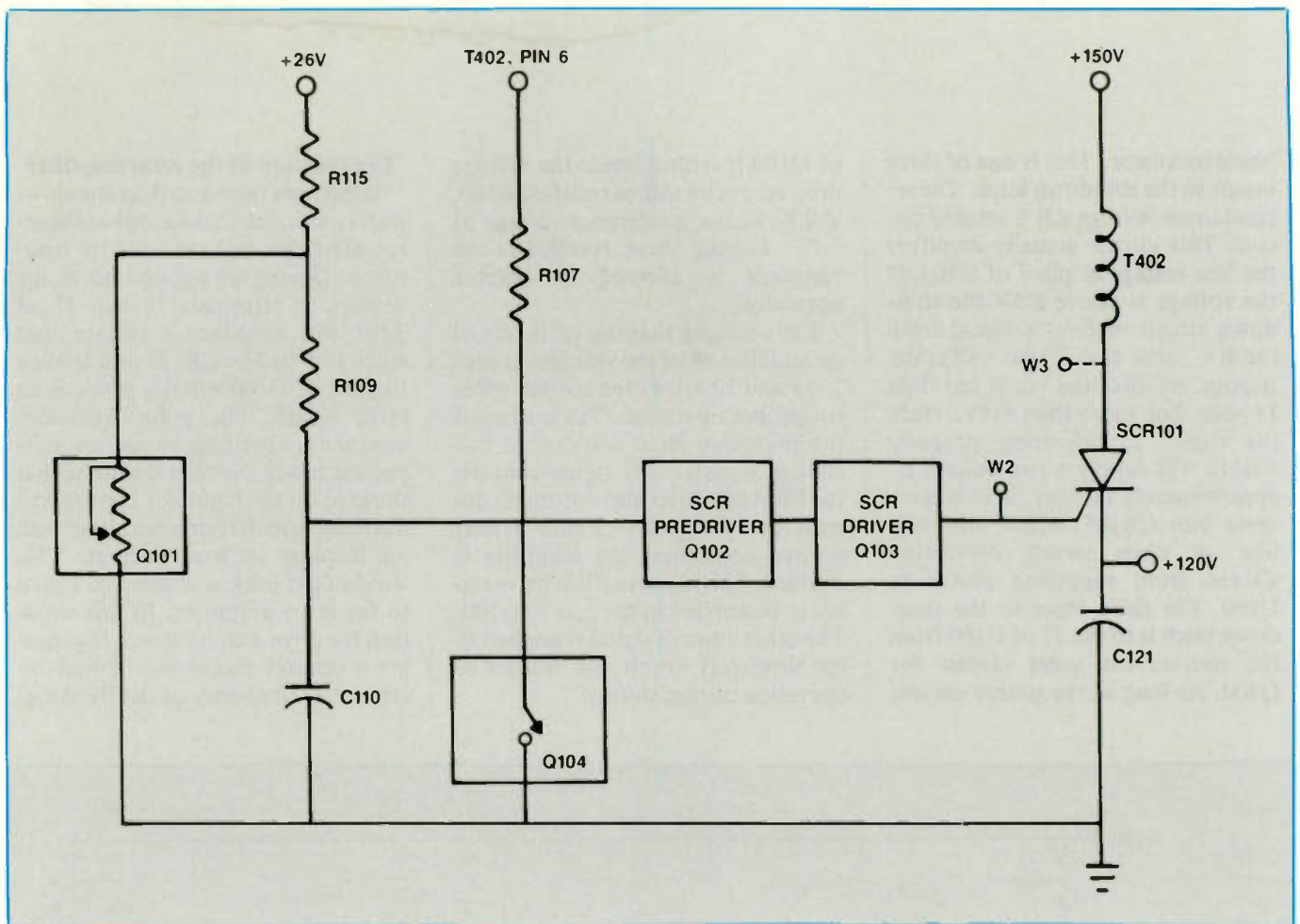


Figure 3.

nal, which would increase the average conduction through Q100. The result would be to have the primary current of T101 increase. This would increase the secondary voltages which would counteract the loading of the power supply. If the load on the regulator were to decrease, the opposite action would take place.

The slow-start circuit prevents surges

When the set is first turned on, the dc voltage fed back to the error amplifier from CR112 is minimal. This would represent a very large load on the power supply. The frequency of the PWM signal would increase and this would greatly increase the conduction rate of Q100. The slow-start circuit prevents large current surges during start up by disabling the error amplifier during this time. When the set is first turned on C114 starts to charge through R106 to the voltage across CR116. While the charge on C114 is less than 7.5V the slow-start circuit is enabled and the error amplifier is disabled. The time constant for C114 and R106 is long, and it takes

several hundred milliseconds before the charge on C114 is at the required 7.5V to disable the slow-start circuit. After the slow start circuit is disabled the power supply is up and running.

Operation of the protection circuits during failures

Let's look at some possible failures and how the protection circuits work. One required circuit is the X-ray protection circuit. Pins 3 and 4 of T401, the horizontal drive transformer serves as the monitoring point for this circuit. If the voltages on the IHVT increase, the likelihood of X-rays will increase. The IHVT pulse is rectified by CR413 and a DC voltage is developed across R436, R437 voltage divider. If this voltage is large enough, CR414 will become forward biased, placing a relatively high positive voltage on the base of Q400. This voltage will cut off Q400 and shut down the power supply. This action will kill the 131V regulated supply and remove the IHVT pulses. At this point CR414 is no longer forward biased and the low

voltage at TP423, from the tuner turns the set on again just as though the set is being turned on for the first time. If the voltage on the IHVT is still high, the power supply will cycle on and off indicating a problem.

An overcurrent condition exists if the source voltage of Q100 should rise above a value that allows 1.2V to be applied to pin 11 of U100. A control signal from the overcurrent circuit will enable the shut down latch, which in turn will disable the PFM amplifier. This chain of events shuts down the set. Like the X-ray circuit, the power supply will cycle on and off when an overcurrent condition exists.

The output PFM amplifier of U100 is disabled by the shutdown latch if the B+ source at pin 7 drops below 8.5V. This puts the set into shutdown.

SCR switching power supplies

Another type of supply used by RCA is the SCR switching power supply. This discussion will concern the CTC 136 chassis, Sams Photofact

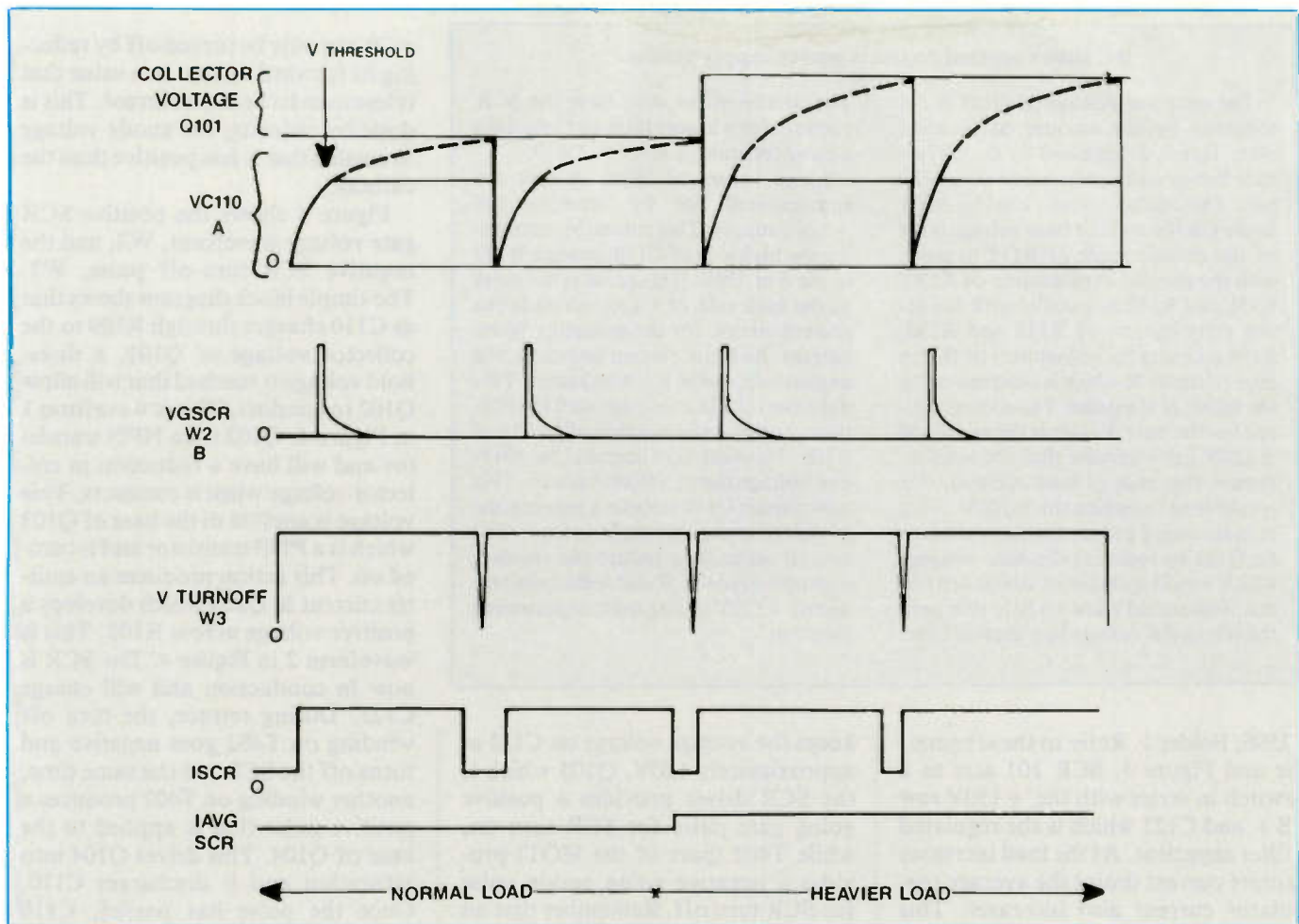


Figure 4.

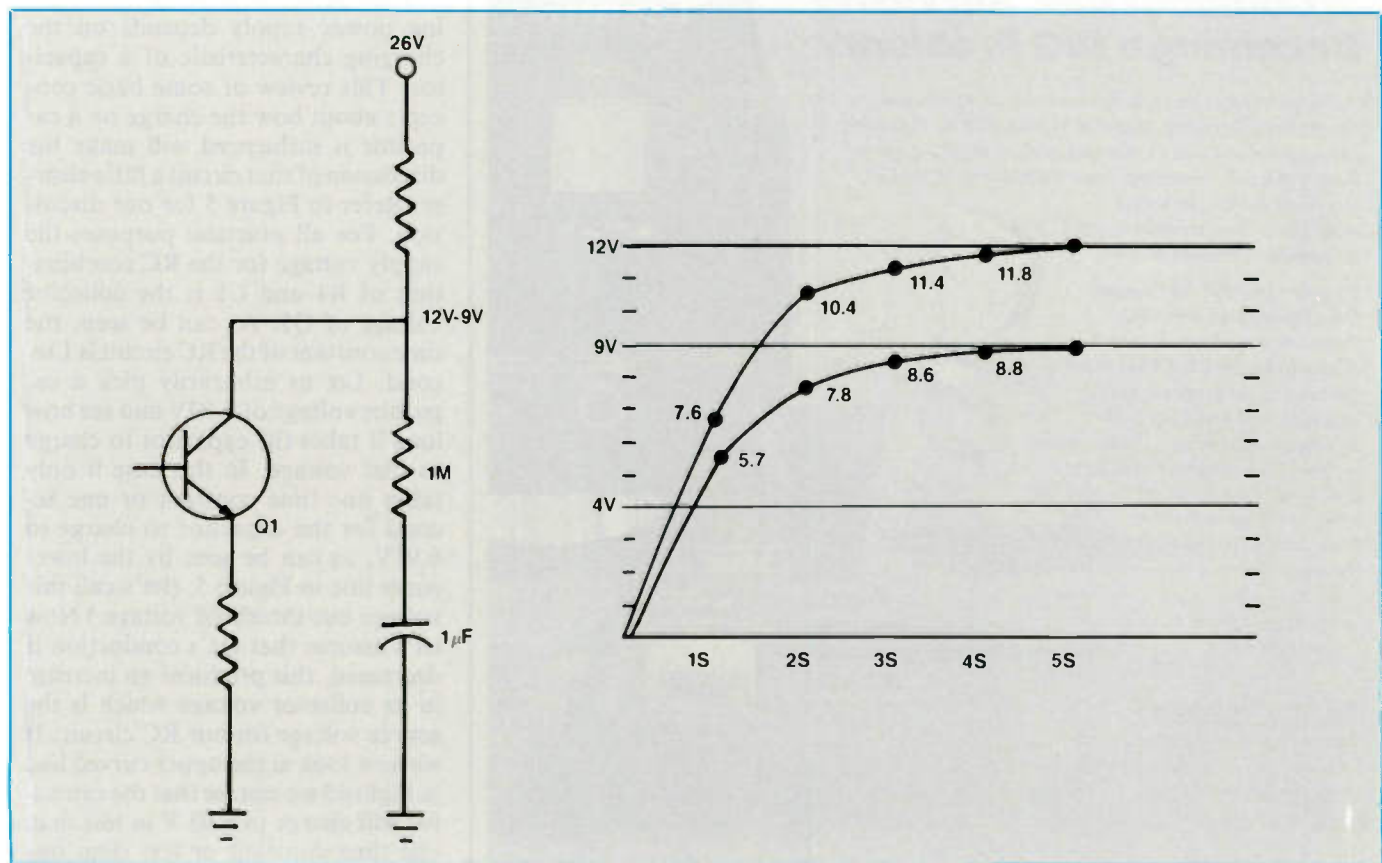


Figure 5.

RC time constant controls power supply action

The collector voltage of Q101 is determined by the amount of forward bias. This is determined by the difference between the emitter and base voltages. The emitter voltage is set by zener diode CR106 and the base voltage is set by the divider made of R112 in series with the parallel combination of R130, R131 and R132 in parallel with the series combination of R133 and R138. R138 provides for adjustment of the on time of the SCR which is determined by the width of the pulse. The source voltage for the base divider is the regulated +120V. Let's assume that the load increases (increase in load current), this would tend to reduce the +120V. This in turn would reduce the forward bias on Q101 by reducing the base voltage, which would increase its collector voltage. This would allow C110 to charge to the threshold voltage in a shorter time.

The overall effect is to have the SCR conduct for a longer time and maintain a more constant +120V on C110.

Large values of beam current are compensated for by lowering the +120V supply. This is done by connecting the high side of C110 through R107 to pin 6 of T402. This point is the same as the high side of C126, which is the ground return for the pulsating beam current. As beam current increases, the negative charge on C126 increases. This negative voltage combines with the positive voltage at the junction of C110 and R109. The result is to decrease the effective voltage that C110 charges to. This now causes C110 to take a longer time to charge to the threshold voltage. The overall result is to reduce the conduction time of the SCR and reduce the regulated +120V during these high current intervals.

2596, Folder 1. Refer to the schematic and Figure 3. SCR 101 acts as a switch in series with the +150V raw B+ and C121 which is the regulated filter capacitor. As the load increases (more current drain) the average regulator current also increases. This

keeps the average voltage on C121 at approximately 120V. Q103 which is the SCR driver provides a positive going gate pulse for SCR turn on, while T402 (part of the HOT) provides a negative going anode pulse for SCR turn off. Remember that an

SCR can only be turned off by reducing its forward current to a value that is less than its hold on current. This is done by reducing the anode voltage to a value that is less positive than the cathode.

Figure 4 shows the positive SCR gate voltage waveform, W2, and the negative SCR turn-off pulse, W3. The simple block diagram shows that as C110 charges through R109 to the collector voltage of Q101, a threshold voltage is reached that will allow Q102 to conduct. This is waveform 1 in Figure 4. Q102 is an NPN transistor and will have a reduction in collector voltage when it conducts. This voltage is applied to the base of Q103 which is a PNP transistor and is turned on. This action produces an emitter current in Q103 which develops a positive voltage across R103. This is waveform 2 in Figure 4. The SCR is now in conduction and will charge C121. During retrace, the turn off winding on T402 goes negative and turns off the SCR. At the same time, another winding on T402 produces a positive pulse that is applied to the base of Q104. This drives Q104 into saturation and it discharges C110. Once the pulse has passed, C110 starts to charge again and the cycle repeats itself.

The operation of the SCR switching power supply depends on the charging characteristic of a capacitor. This review of some basic concepts about how the charge on a capacitor is influenced will make the discussion of that circuit a little clearer. Refer to Figure 5 for our discussion. For all practical purposes the supply voltage for the RC combination of R1 and C1 is the collector voltage of Q1. As can be seen, the time constant of the RC circuit is 1 second. Let us arbitrarily pick a capacitor voltage of 6.93V and see how long it takes the capacitor to charge to that voltage. In this case it only takes one time constant or one second for the capacitor to charge to 6.93V, as can be seen by the lower curve line in Figure 5, (let's call this voltage our threshold voltage.) Now let's assume that Q1's conduction is decreased, this produces an increase in its collector voltage which is the source voltage for our RC circuit. If we now look at the upper curved line in Figure 5 we can see that the capacitor will charge to 6.93V in less than one time constant or less than one second.

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Service center ideas



During the 1990 National Professional Electronics Conference, the annual NESDA convention and show, a general session was held in which members shared with the rest of the group their ideas for improving their service center operation.

Following are some of the ideas that were generated during that session.

1. Establish a pre-estimate repair price range for each product category at the carry-in service counter. Then, when a product is brought in for service, you can request an approval authorization so that if the cost to repair is in that range you can avoid calling with an estimate for minor or normal repairs.

2. Tag all incoming sets with color-coded work detail tags to expedite the technician's repair explanations. Establish a series of numeric codes to make billing and estimating easier. (Could be similar to the EIA warranty codes). This system also assists the technician in not missing routine checks.

3. After repairing a computer, install a floppy drive protector into the drive slot with your company logo. It is safe and neat and an advertising reminder.

4. Prepare a packet of information to give to the client when you return the repaired product. Include an explanation of the warranty, a description of how to select a surge suppressor, and a copy of the company business card.

5. Include a detailed description of chemicals and chemical charges with each invoice. The individual who suggested this provided a sample of such a listing that came from an auto service company. It listed about 75 unseen overhead line items such as forms, cleaners, credit card costs, drill bits, lubricants, cleaning towels, and various other miscellaneous sup-

port items. The heading of this list is an explanation that some of these are billed as a percentage of the labor charge.

6. When a client is inconvenienced because of a recall, a long delay in obtaining parts for a repair, or any other reason, apologize and give them a discount certificate for the next repair or head cleaning. You could use a business card with a note on the back or a formal coupon.

7. When scheduling site calls, attempt to find the time of day when someone will be home. An attitude of cooperation makes a positive impression.

8. Sell service contracts on repaired units. Keep the agreement simple and have information available at the front counter card stands and on outgoing units. This is a good source of additional revenue and important to many clients who have just spent a sum to have their product repaired. It also builds confidence in the results of the service performed because it qualifies for this warranty extension.

9. Charge a surcharge of \$15.00 for all rush jobs. Dedicate this money to local public broadcast stations or charities, and have the client choose which one. Send the money in the name of the client and request the tax credit for the client. Much good goodwill for a little paperwork comes from this.

10. Use a brown marker, or specially made touch up pen to touch up scratched TV cabinets. The results of

this are better than it sounds.

11. After calling clients two times letting them know that their product is ready, send a postcard.

12. The terminology you use makes a difference. Call it a diagnostic fee, not a deposit.

13. When a client has received a unit as a gift, or lost their paperwork, have a statement of circumstance made out in lieu of a bill and have it notarized. This protects the warranty status of the product.

14. Repair antenna rods for brands for which it is impossible to get replacement antennas. This can be done by cutting off the bad antenna and replacing it with a rod from another antenna by crimping it on the original antenna base. The antenna rod is a hollow tube crimped into place at its base on a hardened metal stub. If a rod is very expensive or not available, use a heavy wire cutter and peel the thin broken rod shell from the hard metal crimped base. Using a clean cut open antenna rod of a diameter that will slide onto the stub, (try a copper tube cutter and reamer to accomplish this quickly) position it neatly and run a crimp around the base with the cutter's edge. It looks just like the original rod or other side of the dipole and holds strongly.

15. Put your company name on connecting cords of units used for rentals. Microphone and antenna and ac cords can be effective advertising and identification spots. Use a thin cylindrical sleeve with printed ID inside.

Switch repair

By Victor Meeldijk

If a common double pole throw switch, or a toggle switch, breaks you just replace it. What do you do if it is a front panel switch or a multi-pole special slide switch which is too expensive to warrant the repair, or is no longer available? Here are some repair techniques you can use.

Those of you who are long time readers of this magazine may remember the "Knob Repair Nightmare" written by Larry Critchlow, in the May 1987 issue, an article that gave some suggestions for repairing knobs that were either too expensive or impossible to replace. In this article, which can be considered its companion piece, we illustrate how to repair a custom slide switch and a front panel switch of a VCR.

Figure 1 shows a slide switch assembly used in a Canon (and Panasonic) portable VCR power supply. The switches are ganged together such that one switch will also change the setting of the other switch. To replace this switch would be costly as it is a custom part in a machine over 6 years old.

Those of you who have tried using epoxy or other adhesives in repairs know that they do not work well when a shearing pressure is applied to the joint. If this were a push/pull application, the use of an adhesive would probably work very well. To provide a reinforcement to the repair it is necessary to add a supporting post to the switch.

To do this, drill a small hole into the center of the switch slide assembly using a variable speed drill at a slow speed, and a #60 drill bit (see Figure 2). Drill about $\frac{1}{16}$ of an inch into the switch, being careful not to drill all the way through the switch.



Figure 1. The slide switch actuator in this portable VCR sheared off. Simply gluing it would result in an unreliable repair. A stiff piece of metal between the two parts would reinforce the repair.

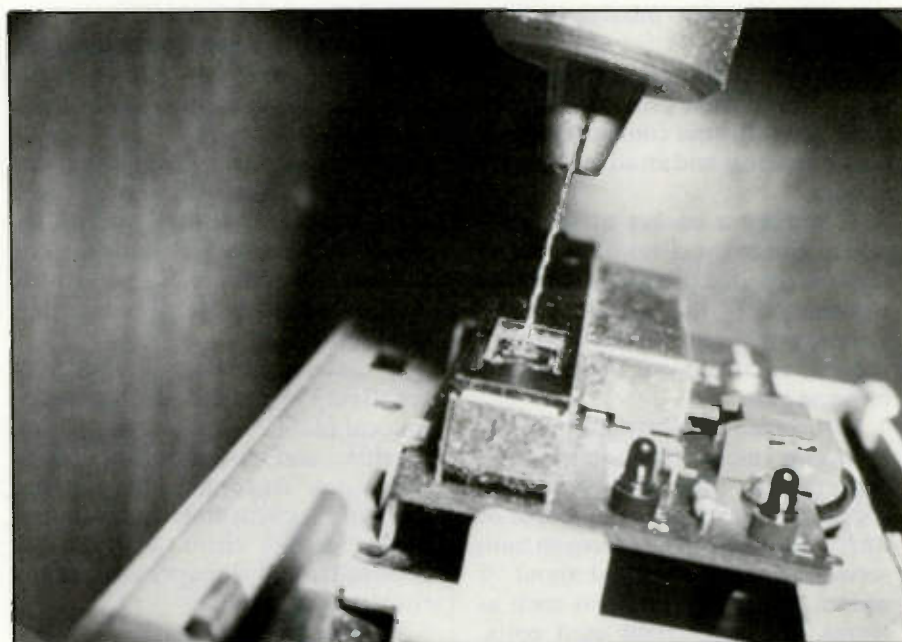


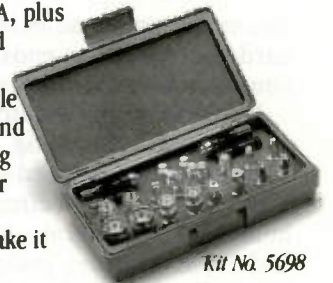
Figure 2. Use a variable-speed drill with a drill bit of the appropriate size to make a shallow hole in the slide switch assembly.

Meeldijk is Reliability/Maintainability Engineering Manager Diagnostic/Retrieval Systems, Inc. Oakland, NJ

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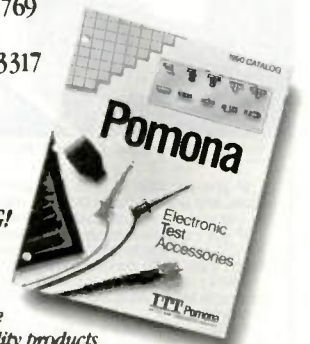
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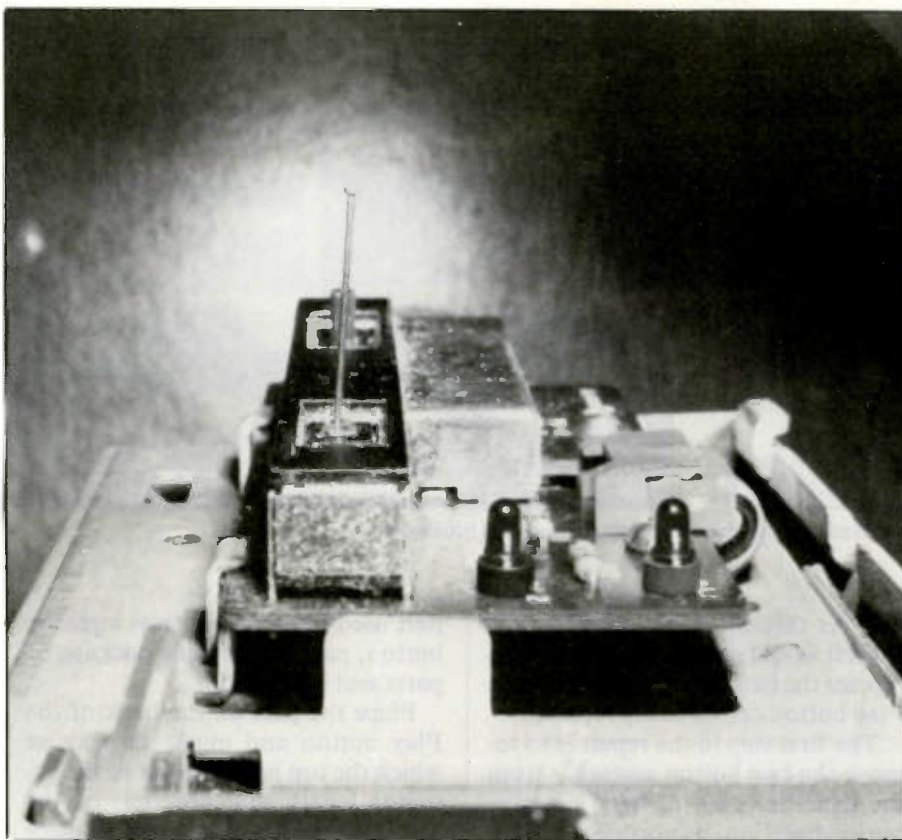


Figure 3. A straight pin makes a good reinforcing rod.

Do the same thing with the actuator part of the switch slide assembly. A straight pin, which is a stiff piece of metal, can now be used as a supporting post (see Figure 3). Cut the pin using a pair of diagonal cutters, holding the upper portion of the pin so it does not fly away. Fit the actuator

piece over the post to make sure that the post is not too long (see Figure 4). Remove the actuator and put an epoxy adhesive (the two part 5 minutes kind works very well) around the post. Fit the actuator on the post and position it such that any flat surfaces are properly oriented. Wipe away

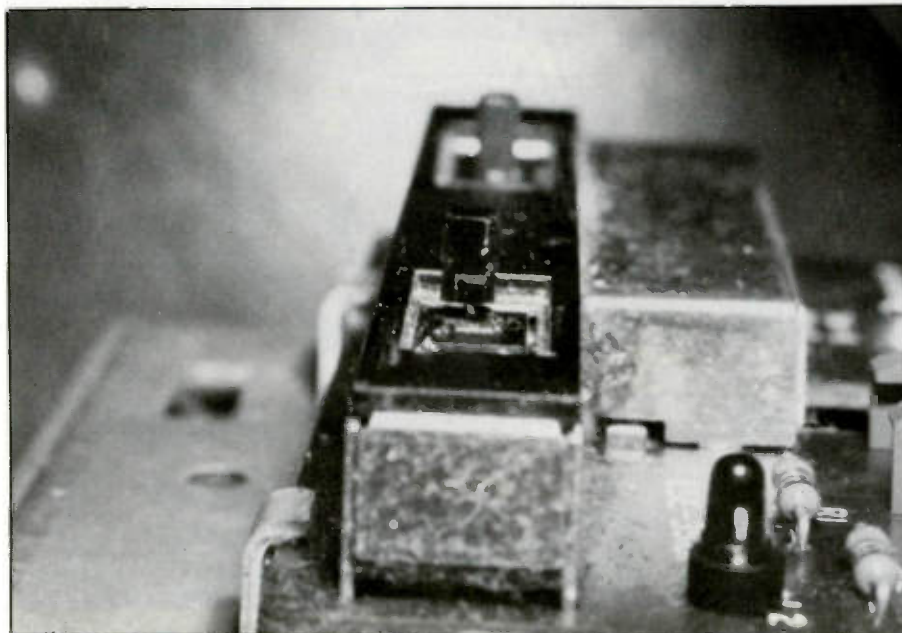


Figure 4. Check that everything lines up properly before applying the adhesive.

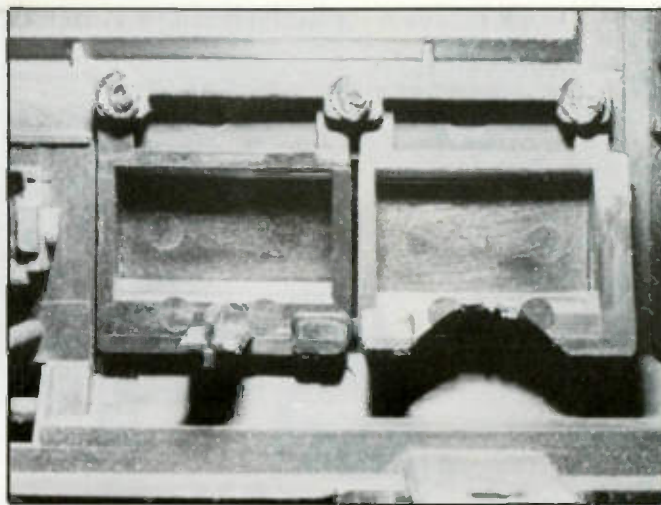
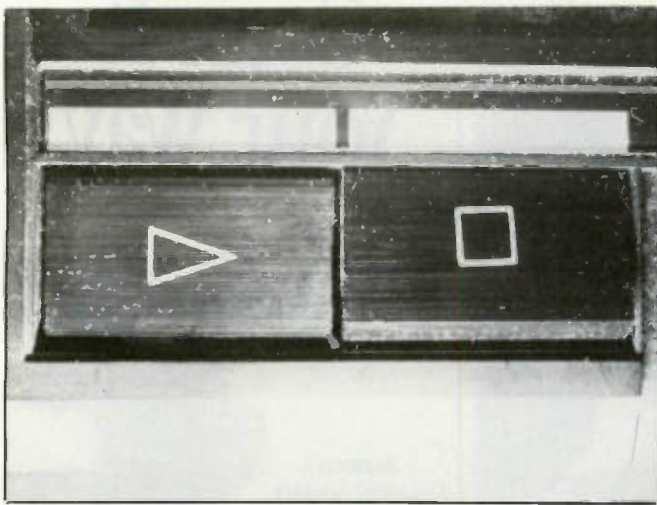


Figure 5. The Play switch on this VCR had been pushed in so hard that the actuator switch broke off.

any excess epoxy adhesive before it hardens. When the epoxy hardens, you can reassemble the unit.

Figure 5a shows the stop and play switches of a Samsung VCR. The Play button was pressed so hard that it broke (the printed circuit card behind the front panel also cracked and had to have traces jumper wired). Figure 5b shows the back side of these switch actuators. You can see that the actuator has completely broken

off. As this is a low end, low cost VCR it would not be cost effective to replace the front panel. However, the Play button can be easily repaired.

The first step in the repair is to remove the two button assembly from the panel in order to bend the play button back into its normal position. To do this, carefully cut around the three heat molded fastenings with a hobby knife, trying to remove as little material as possible to free the buttons. With the buttons free, bend the play button forward until it returns to a rest position similar to the Stop button. Check around in your junk box for a plastic part which looks something like a chess pawn (wide base with a small head), the

part used in this repair was a plastic button, part of a sample package of parts sent by a vendor.

Place the part on the back of the Play button and mark the spot at which the top has to be cut so the actuator length matches that of the Stop button. After the "paw" piece has been trimmed to its length, secure it in place on the Play button with some epoxy adhesive (again the two part 5 minute kind works very well). The completed repair is shown in Figure 6.

The repair methods illustrated here should demonstrate that with a little thought, costly or impossible repairs can be inexpensively done with a minimal effort. ■

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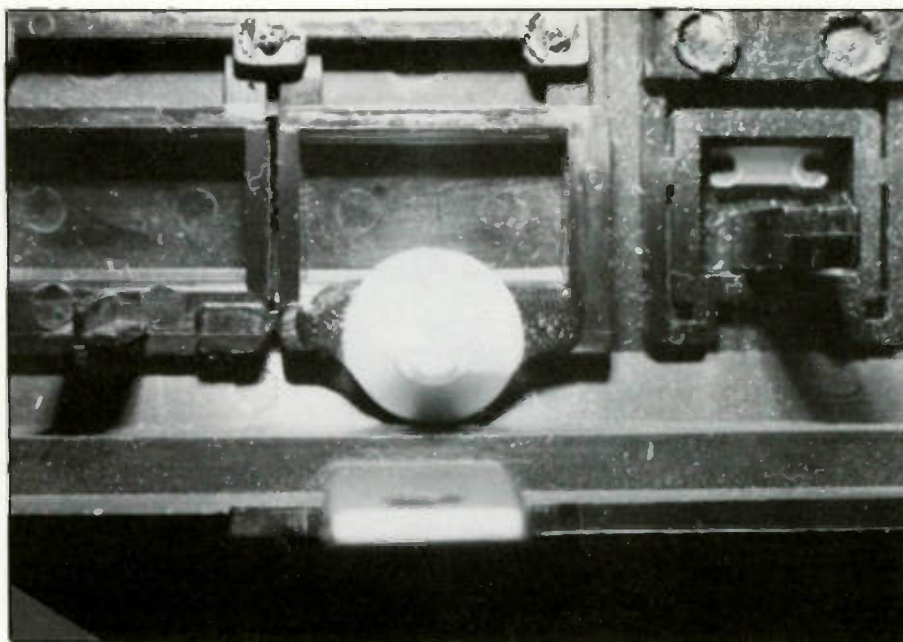


Figure 6. A plastic piece, trimmed as necessary to fit and glued in place, served as a suitable replacement for the broken actuator.

October 1990

Profax Number

Hitachi
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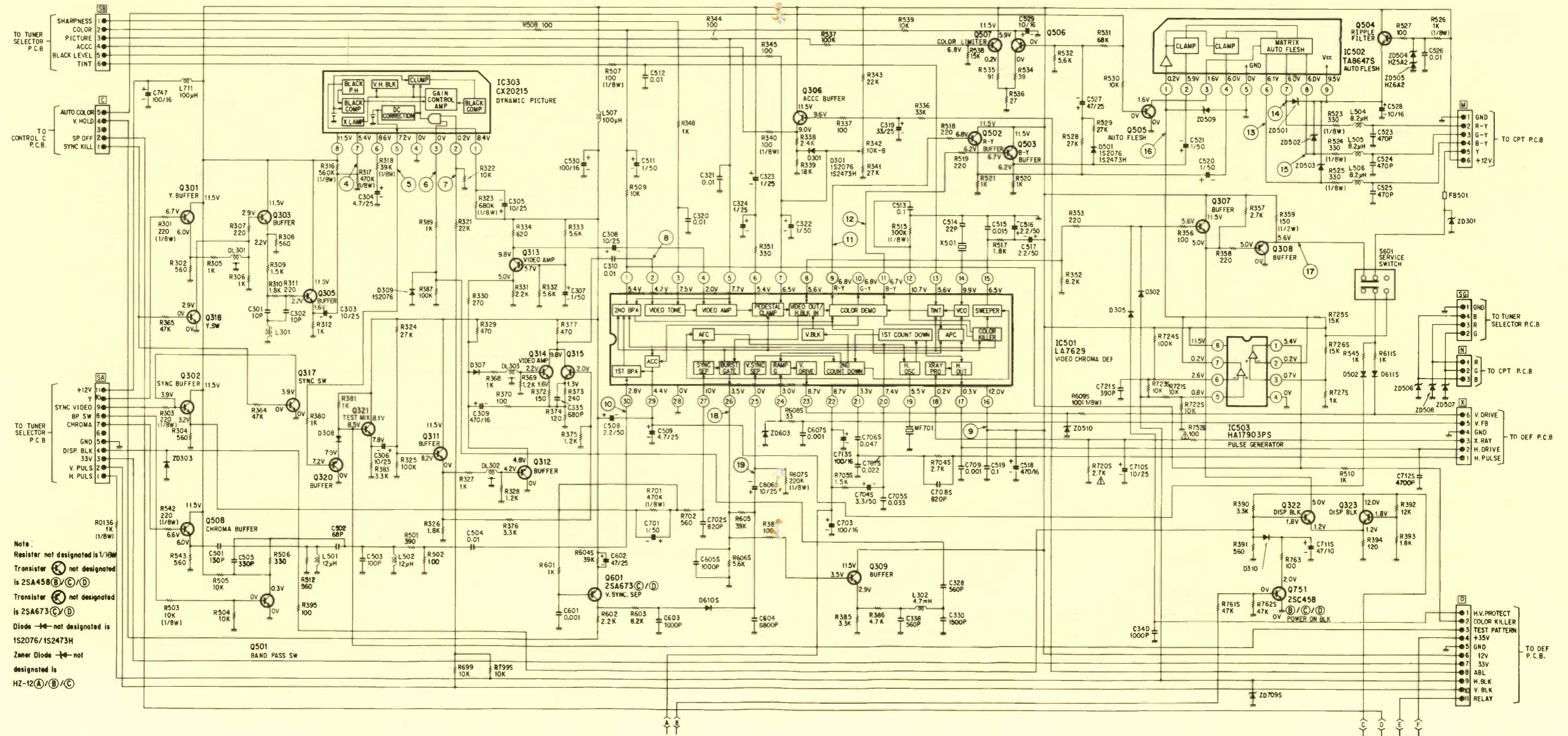
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SIGNAL CIRCUIT DIAGRAM (1/2)



DEFLECTION CIRCUIT DIAGRAM

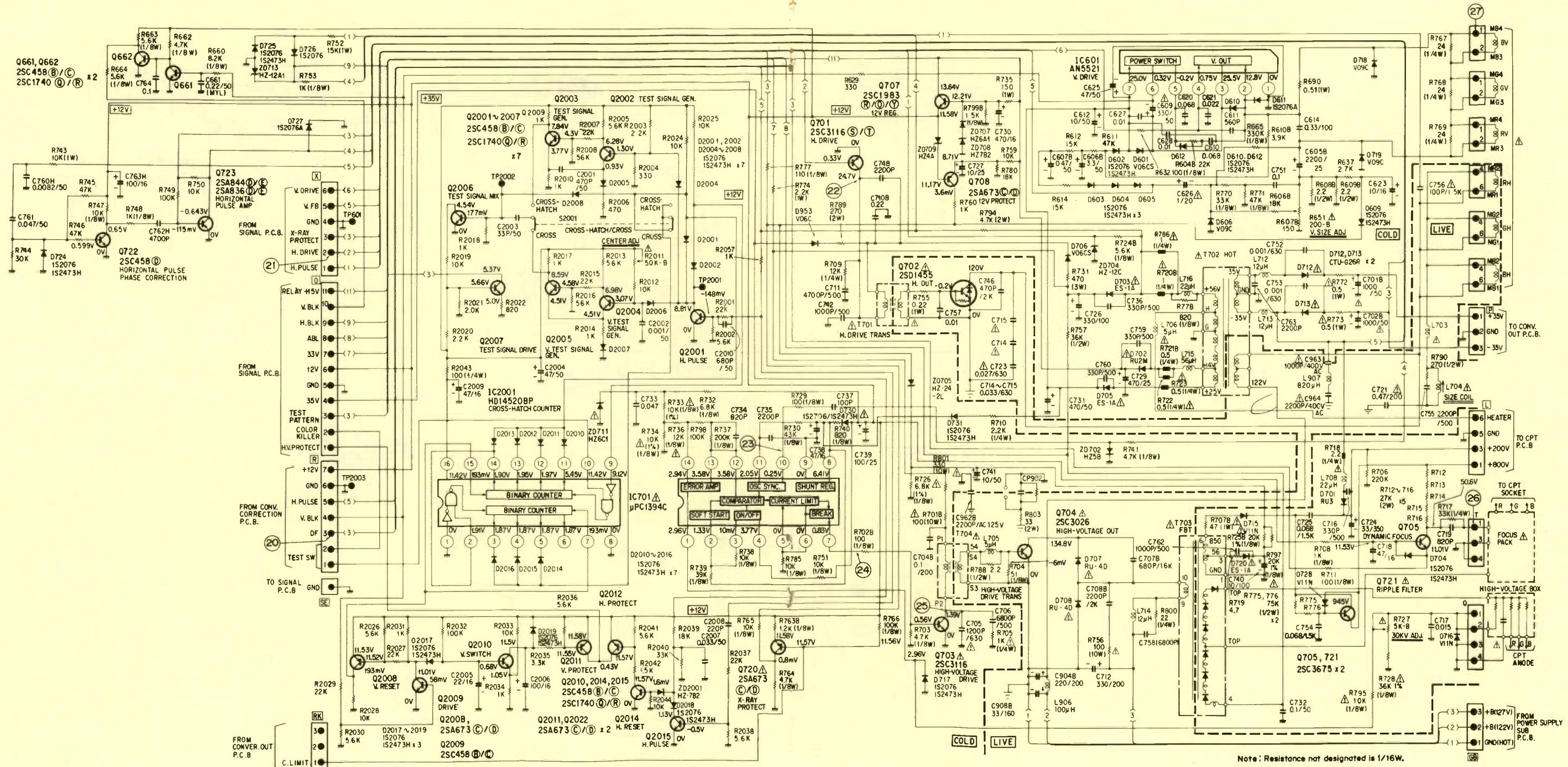
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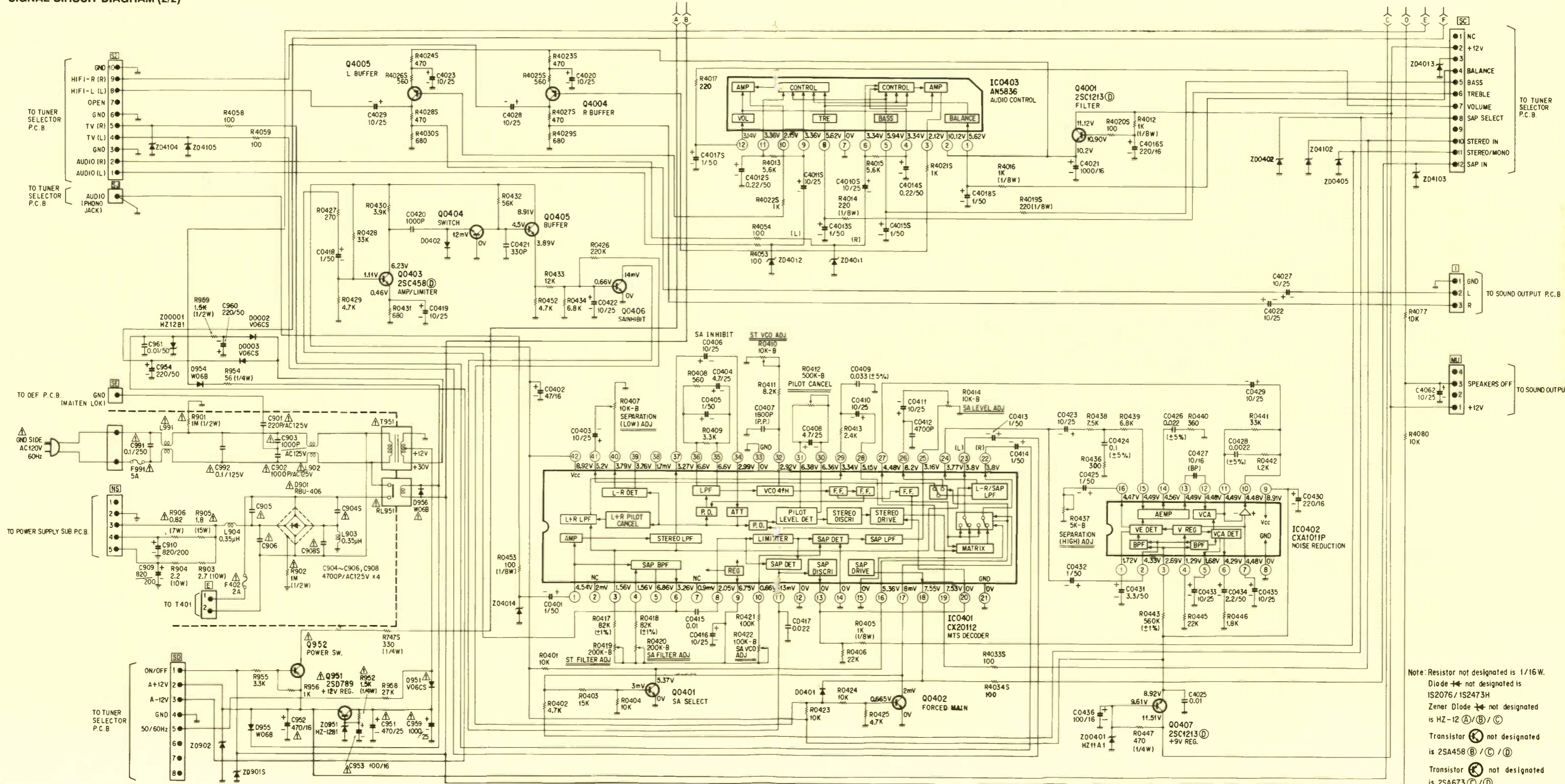
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SIGNAL CIRCUIT DIAGRAM (2/2)



SIGNAL CIRCUIT DIAGRAM (2/2)

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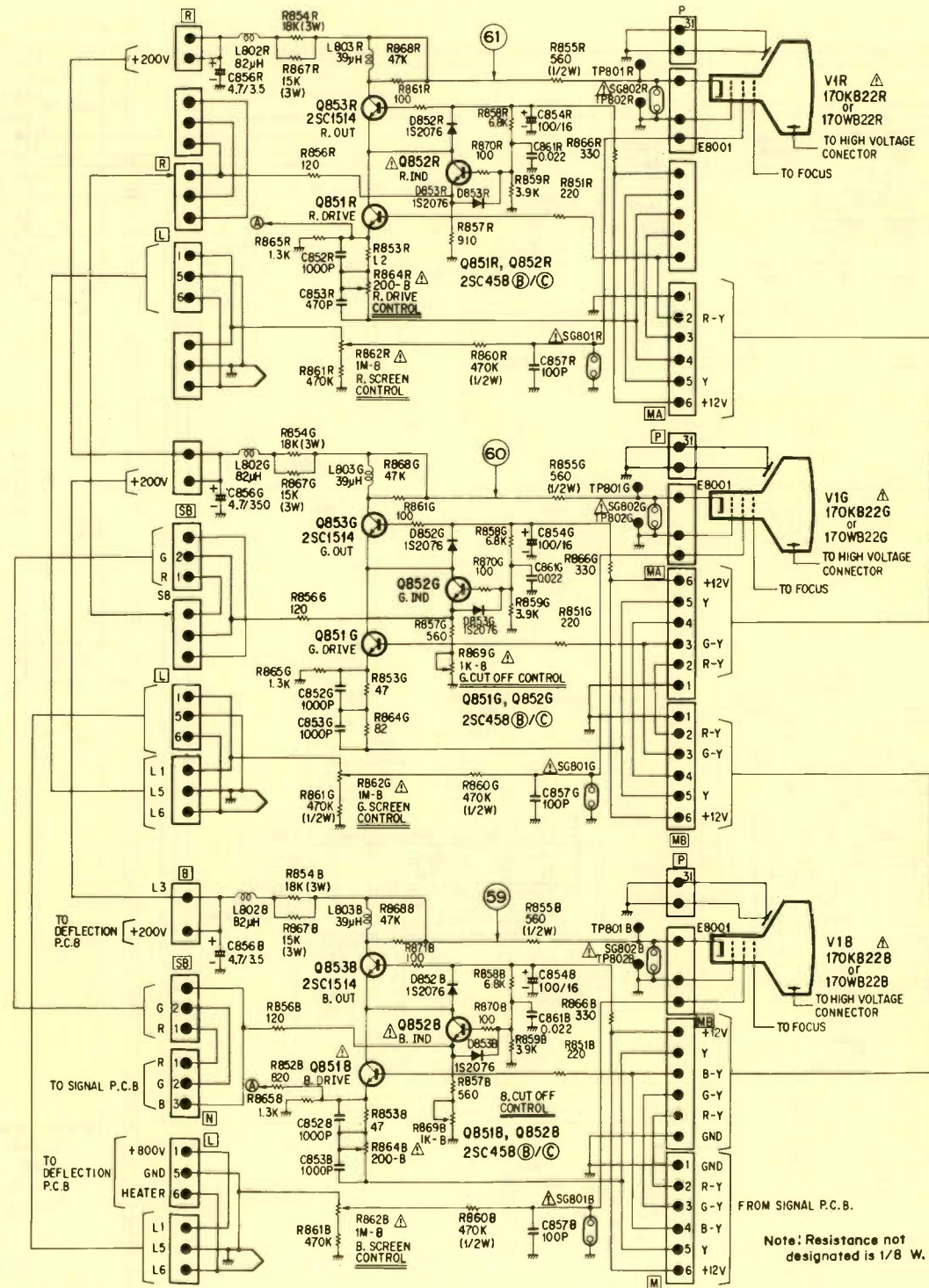
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Note: Resistor not designated is 1/16W. Diode not designated is IS2076 / IS2473H. Zener Diode not designated is HZ-12 (A) / (B) / (C). Transistor not designated is 2SA458 (B) / (C) / (D). Transistor not designated is 2SA673 (C) / (D).

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CPT CIRCUIT DIAGRAM



Note: Resistance not designated is 1/8 W.

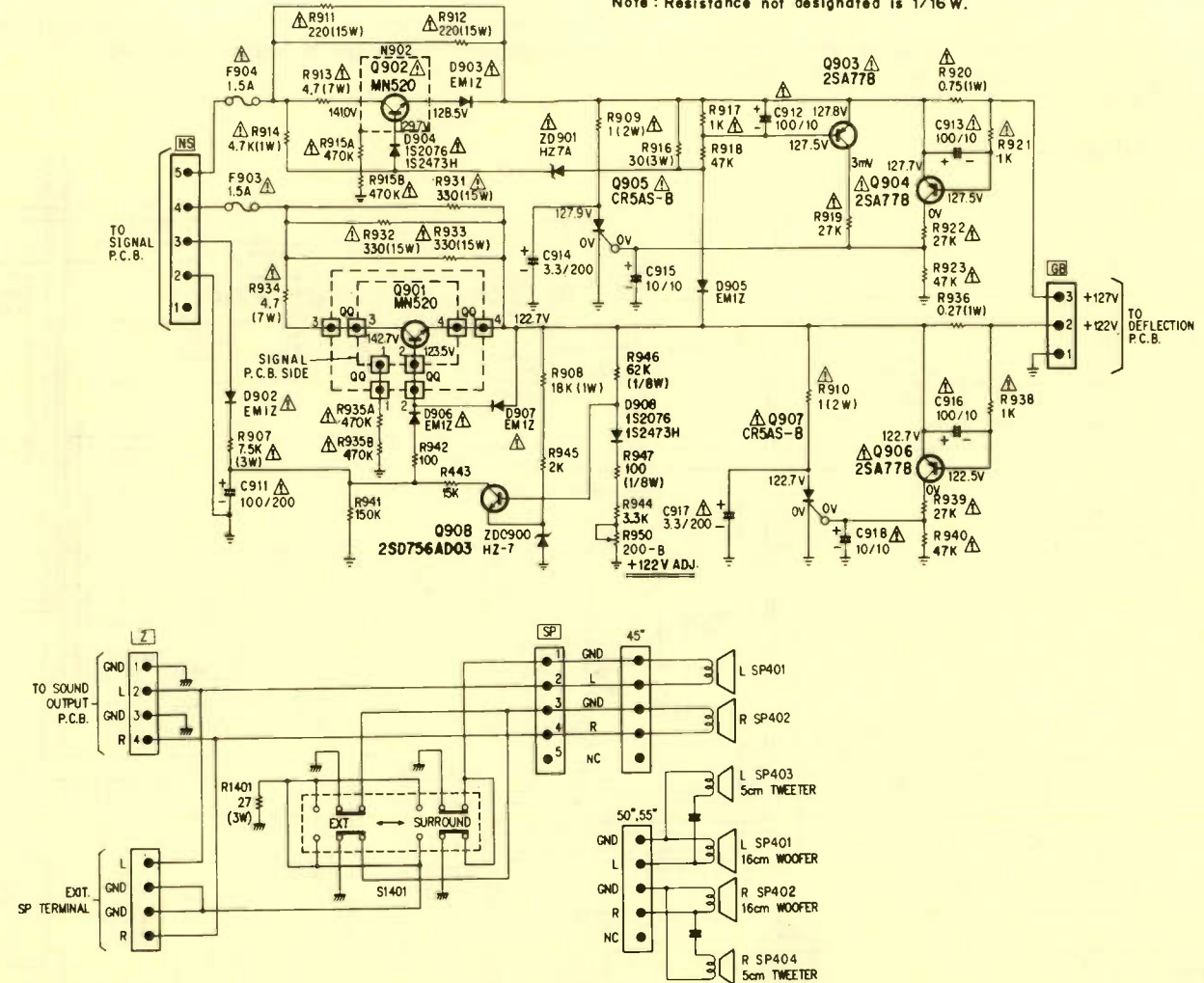
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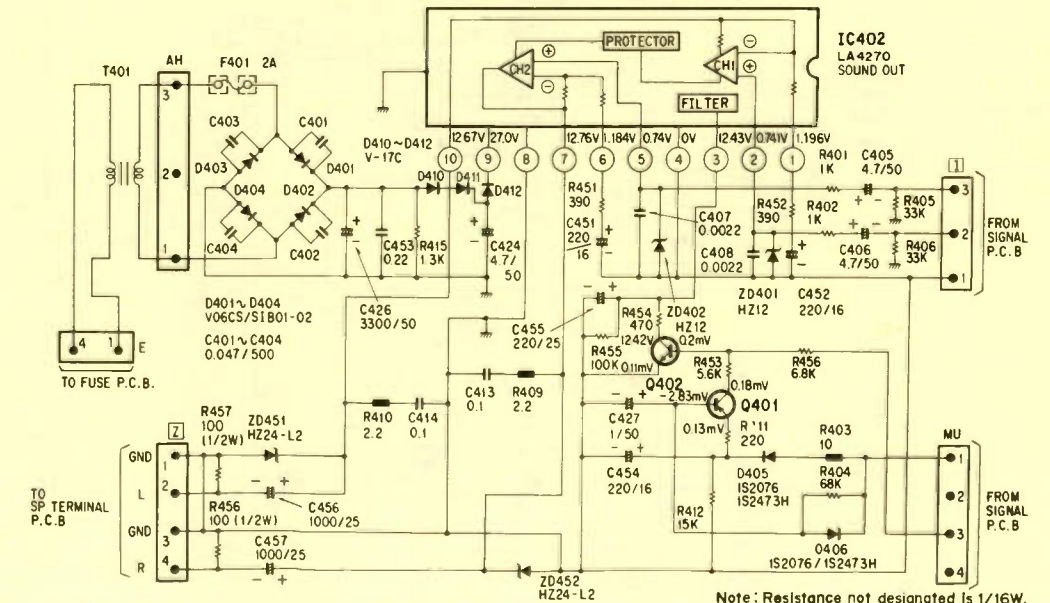
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POWER SUPPLY SUB CIRCUIT DIAGRAM

Note: Resistance not designated is 1/16 W.



SOUND OUTPUT CIRCUIT DIAGRAM



Note: Resistance not designated is 1/16W.

ES&T periodically publishes reviews on books that are particularly applicable to our readers. We do not have any information other than supplied below each review. Contact the publishing company for further ordering and pricing details.

Basic Digital Electronics, 2nd Edition, by Ray Ryan; TAB Books; 256 pages; \$16.95 paperback; \$25.95 Hardbound.

This is an easy-to-follow introduction to the fundamentals of modern digital electronics. Digital circuits are rapidly becoming the standard in almost every area of electronics today, including such diverse applications as television receivers, stereos, telephones, automobiles, and of course computers. Despite the fact that digital circuits operate at low voltages, they are being used in an increasing number of radio-frequency and high

power applications. The book provides a comprehensive examination of the various types of digital circuits and the features that each offers without subjecting the readers to a lot of technical jargon. For those who are new to the digital world of ones and zeros, this is the perfect place to start.

The edition features new material on EX-OR and EX-NOR logic gates, the CMOS logic family, microprocessors, parity generators and demultiplexers, LCD's and much more.

TAB Books Inc., Blue Ridge Summit, PA 17294-0850; 800-822-8138.

Simplified Filter Design, by Irving M. Gottlieb; TAB Books Inc., 200 pages, \$16.95 paperback, \$26.95 Hardcopy.

This is a great back-to-basics guide to designing and building practical electronic filters for engineers, technicians and hobbyists. This book re-

jects the complex and rigorous calculations that many technical personnel associate with the field of filter design, while at the same time promoting a thorough understanding of filter components and their effects on circuit operation. Author Irving Gottlieb demonstrates how filters suitable to virtually any application can be designed using simple mathematics and straightforward procedures. Readers learn practical techniques for laying out and assembling low pass filters bandpass filters, m-derived filters as well as crystal and more. Most importantly readers learn the difference between the real-world and "textbook" filters. With this book anyone can begin producing high-performance filters in a matter of hours, using readily available parts and without any specialized instruments.

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 RPJ930AKO1, RPJ936PEO1,
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Combatting jitter in compact disc players

By Joseph Fisher

Jitter is a fact of life in any kind of playback device. It consists of quick random variations of the desired signal caused by any of a number of anomalies in either the recording process or the playback, or both. This article examines the jitter meter and related alignment techniques recommended to improve the accuracy and reliability of servicing compact disc players.

Jitter for CD discs/players can be defined as any spurious variation in the absolute timing of the data bit stream as it is recorded on to a disc or read from the disc by the player. Jitter is especially important for high frequency signals of high amplitude to minimize the creation of modulation noise in the S/H circuits. The magnitude of the random timing error is in terms of where and at what time the transitions of the pits/flats

occur relative to the theoretical model.

Theoretical model

The RF data bit stream rate associated with CD technology is 4.3218 MHz. One clock pulse, hereafter called (T), is the inverse of this frequency or approximately 231ns. The RF signal contains an additional nine separate sine waves/bits that are defined due to the physical lengths of the pit/flat transitions. This encoding scheme makes it possible to record the greatest possible amount of data on a single disc. Frequencies range from:

$$3T = 4.3218 \text{ MHz}/(3 \times 2) = 720.3 \text{ kHz}$$
$$11T = 4.3218 \text{ MHz}/(11 \times 2) = 196.4 \text{ kHz}$$

Note: the clock terms in the denominators are multiplied by two for a complete sine wave. To properly read the RF signal it is necessary to maintain a high degree of accuracy within the sampling window.

Consider the following example where we add a jitter or a timing error of $115\text{ns} = 0.5T$ to the $3T = 720.3 \text{ kHz}$ signal and then subtract the same $115\text{ns} = 0.5T$ timing error from the adjacent $4T = 540.4 \text{ kHz}$ signal:

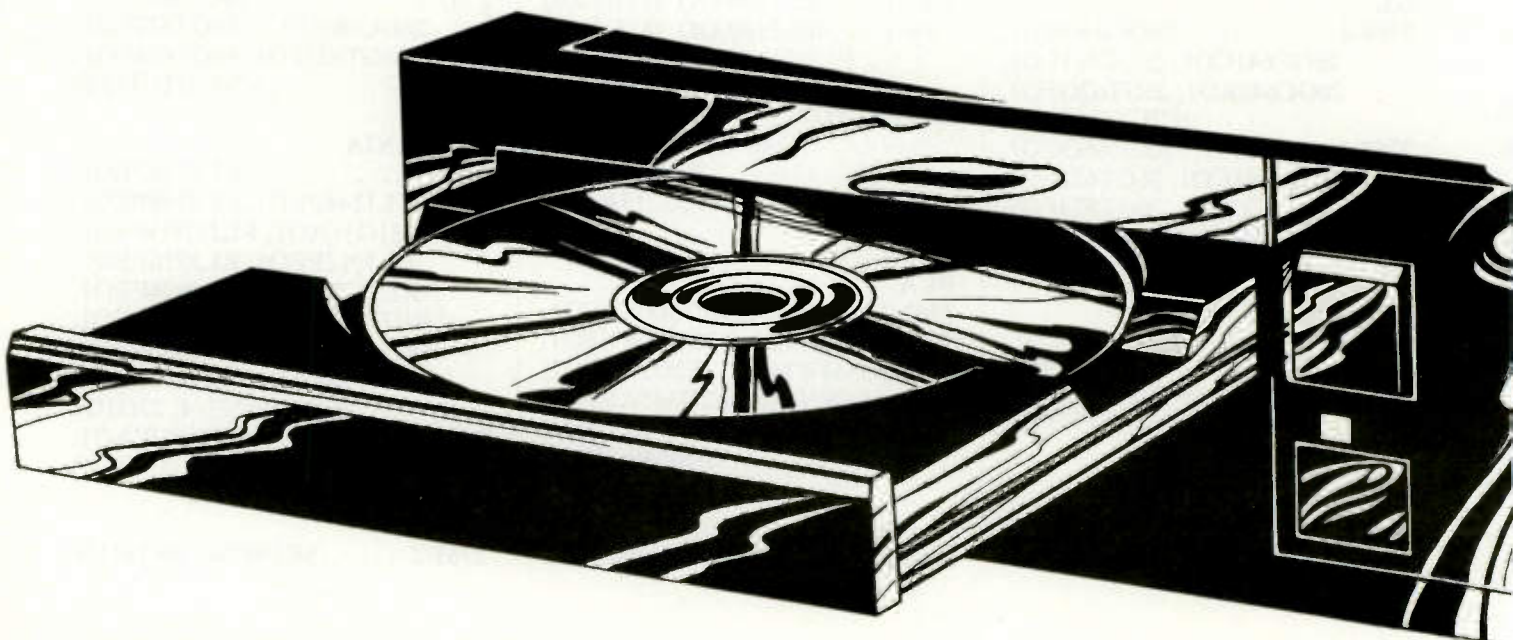
$$3T + 0.5T = 4.3218 \text{ MHz}/(3.5 \times 2) = 617.4 \text{ kHz}$$
$$4T - 0.5T = 4.3218 \text{ MHz}/(3.5 \times 2) = 617.4 \text{ kHz}$$

This would lead to an erroneous condition where $3T = 4T$. Consequently it is necessary to maintain jitter levels within acceptable sampling windows.

Other factors

However, in the real world there are other additional variables to contend with. Different discs exhibit different amounts of jitter. Test discs on a normally functioning player will typically exhibit SIGMA jitter levels on the order of 15 to 20ns. Manufactured discs on the other hand can range up to 40ns and still play. Some

Mr. Fisher is Product Marketing Manager with Leader Instruments Corp.



manufacturers have even been able to increase the maximum time they can put on a disc beyond the 74 min 42 sec limit set by the standard. By varying certain parameters such as $1.6 \pm 0.1\mu\text{m}$ track pitch and scanning velocity 1.2 to 1.4m/s, up to 88 minutes has been obtained on a single disc. Real world discs are less than perfect, exhibiting such imperfections as pit shape variations, flatness or wobble, track eccentricity, birefringence, scratches, pin holes.

In spite of the above issues CD players also have to maintain the proper laser beam spot focus/size, constant linear velocity and optimum servo response time.

Jitter meters

Currently there are at least four different methods for measuring jitter as applied to CD players. There seems to be a trend toward measuring jitter on the fastest 3T bit signal which seems to have several merits. Additionally, there are different conversion, weighting and display techniques. Finally, depending on model, costs vary considerably. Some manufacturers are starting to include jitter specifications in their service manuals. If the customer who complains that his compact discs don't sound as good as they did when he bought them has played frisbee with them, it is immediately apparent and this can be demonstrated to the customer.

Alignment procedures

One of the first alignment procedures to check is sometimes referred to as the vertical tilt angle or Y-AXIS adjustment. This adjustment, where applicable, will minimize the asymmetry of the circular laser beam spot returning, through the optics, to the photo-detect diodes thus reducing inter-symbol errors and optimizing the signal to noise ratio of the RF signal. This adjustment is also (depending on the unit) sometimes further divided into both tangential and radial adjustments.

Minimum jitter is obtained within a tilt angle window of ± 0.5 degrees from the vertical. The next adjustment is the focus offset which can be optimized for minimum jitter when focus is within a $\pm 0.5\mu\text{m}$ window. This distance maintains the proper

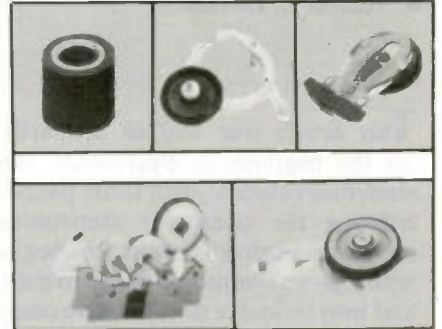
laser beam diameter, approximately 1.2 to $1.7\mu\text{m}$, on the disc's information layer. For most technicians this involves evaluating the RF/eye pattern of a test disc on an oscilloscope to adjust for the highest amplitude, most stable and clearest signal possible. Unfortunately, because of the tolerances noted above, it is not the most accurate method possible. Even though the oscilloscope's vertical amplifiers and horizontal time base sections are accurate, interpretation of the complex eye pattern is an educated judgment and unfortunately subject to errors.

Here's an analogy to this procedure as applied to a tape deck. Imagine trying to judge the quality of an analog tape deck without the aid of a wow/flutter and drift meter. This would involve a similar test; i.e., viewing the tape deck's output of a wow/flutter test tape on an oscilloscope, and making a judgment of the fidelity or accuracy of the waveform relative to the deck's rated wow/flutter and drift specifications. Of course wow/flutter and drift meters and test tapes with specified residual wow and flutter specifications make this a routine matter. And in this case the measurement is a direct indication of the quality of the tape deck's transport mechanism. Furthermore various standards, NAB, JIS, DIN and CCIR exist for wow and flutter for analog tape decks. This is not the case when it comes to jitter specifications for CD discs and players.

Currently CD players are specified for wow and flutter. However, for most if not all players, this seems to me to be an almost totally useless specification. The issues are first, as far as I am concerned, they are beyond audibility. I will leave that judgment to the "golden eared". Next, in terms of being statistically significant, they are beyond being meaningfully measured. Hopefully a standard which offers a relevant figure of merit of the mechanical accuracy with which a CD player can track a "jitter test disc" with a specified residual jitter level could replace wow and flutter in the future. Realizing that the CD player has only been with us for a short time compared to the tape deck this could happen in the near future. ■

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SATISFACTION GUARANTEED

After the fuse blows

By Homer L. Davidson

This article was written primarily for the beginner in electronics, the electronics student, and those people entering the consumer electronics servicing business. How to begin with a given symptom, where to start and how to locate the defective component are fundamentals of troubleshooting the TV chassis. Of course,

Davidson is a TV servicing consultant for ES&T.

each experienced electronic technician will have his own method, but let's take a look at one approach to seven typical symptoms found in the TV set (Figure 1).

Sight sound and smell

Your eyes, ears and nose are the most important tools in servicing electronic equipment. By looking at the TV screen, sometimes you can determine what stage the defect is in. A

quick peek at burned resistors, blown capacitors or burned marks on a flyback transformer helps in troubleshooting. You may see smoke rise from leaky components and connections.

With your ears you can isolate the sound stages with distorted, intermittent and popping sounds. You can hear the tic-tic of a flyback transformer that will not start up or operate. The arcing of high voltage at the

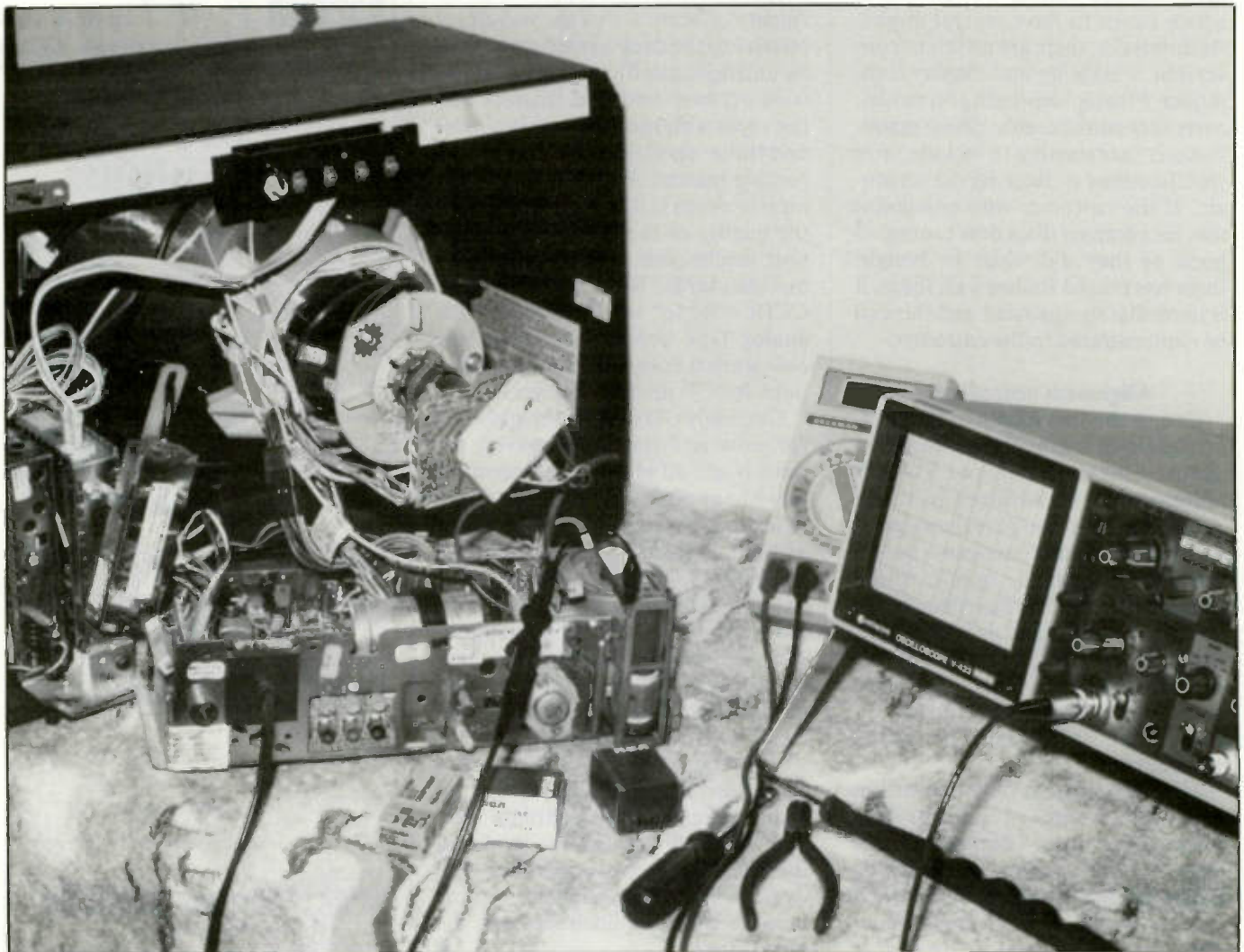


Figure 1. Most blown fuse problems can be located with a scope and DMM.

tripler or anode lead tells one of excessively high voltage. Arcing noises within the chassis may point to a poor or burning connection.

Besides sight and hearing, your sense of smell will sometimes reveal an overheated or burned component. Some experienced technicians can tell the difference between a silicon and germanium high voltage rectifier by the sweet smell of arcing between layers of germanium. You may not see the puff of smoke from a flyback that burns out, but in many cases you can smell the point where the arcing occurred.

After the fuse blows

Where does one start after the fuse blows? Some technicians replace the fuse, and if it opens right away again, check for an overload in the low voltage power supply or horizontal circuits. Often, other circuits may cause the fuse to blow, but most overload problems occur in the power supply and horizontal output circuits. Sometimes the fuse blows as a result of a surge on the power line or arcing of components.

If the TV chassis operates correctly after replacing the fuse, let the set run for several days to see if it will act up. The TV chassis may never blow the fuse again. You may never know what caused the fuse to blow.

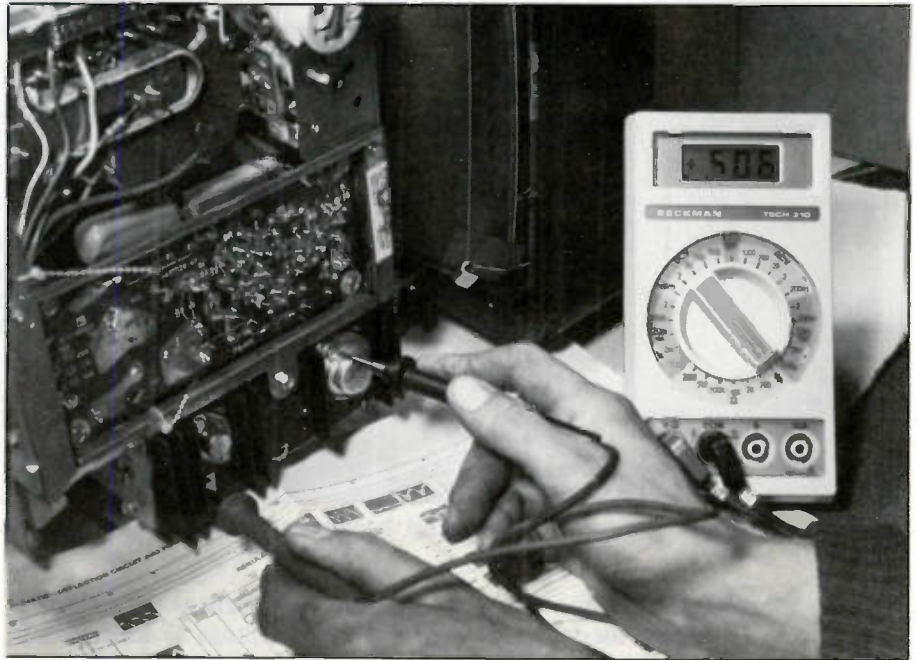


Figure 2. Here the technician takes a diode resistance measurement between collector terminal (body) and chassis ground, indicating the 0.506 Ω measurement in one direction is normal.

Symptom #1: Keeps blowing the fuse

After replacing a fuse that has blown, check for an overloaded circuit in the low voltage power supply and output circuits. A quick resistance measurement between collector terminal of the horizontal output transistor (body) and chassis may clear the horizontal circuits of suspi-

cion. Resistance measurements of less than 100 Ω may indicate a leaky output transistor or damper diode. A normal diode test between collector and chassis indicates resistance in only one direction (Figure 2).

Some technicians will check the low voltage diodes, filter capacitor and regulator in that order. A low re-

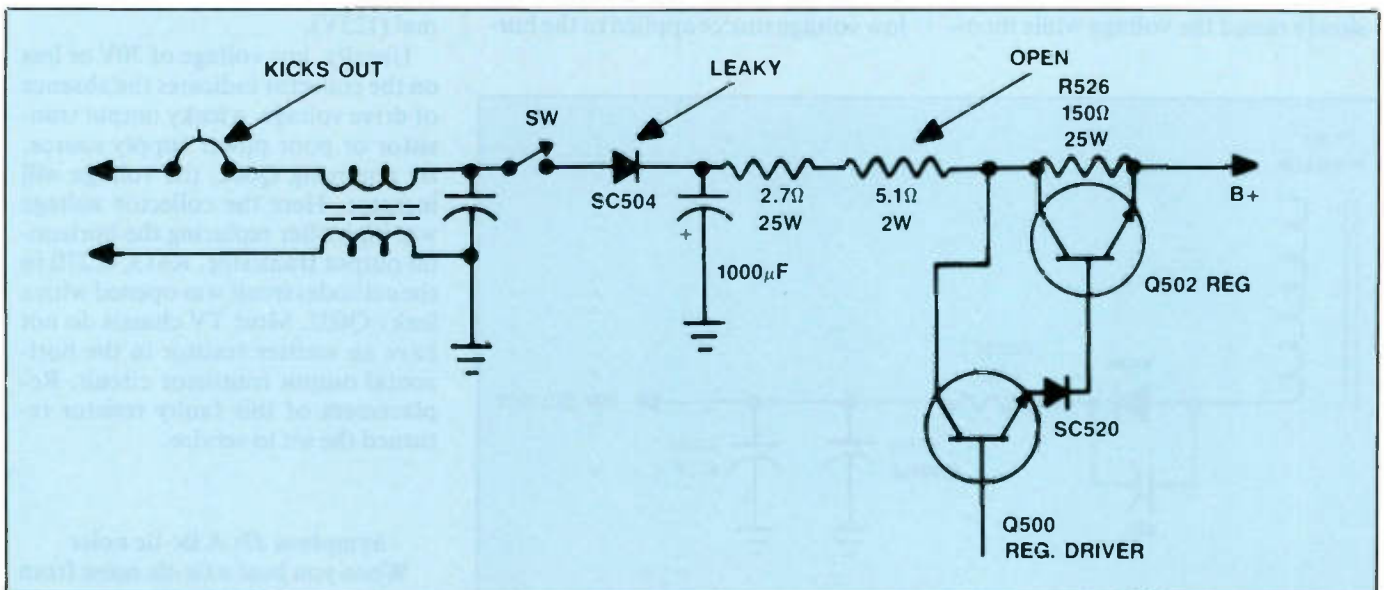


Figure 3. The circuit breaker of this set kicked out every time it was turned on. The problem was found to be a leaky output transistor (Q402), a leaky diode and an open 5.1ohm resistor.

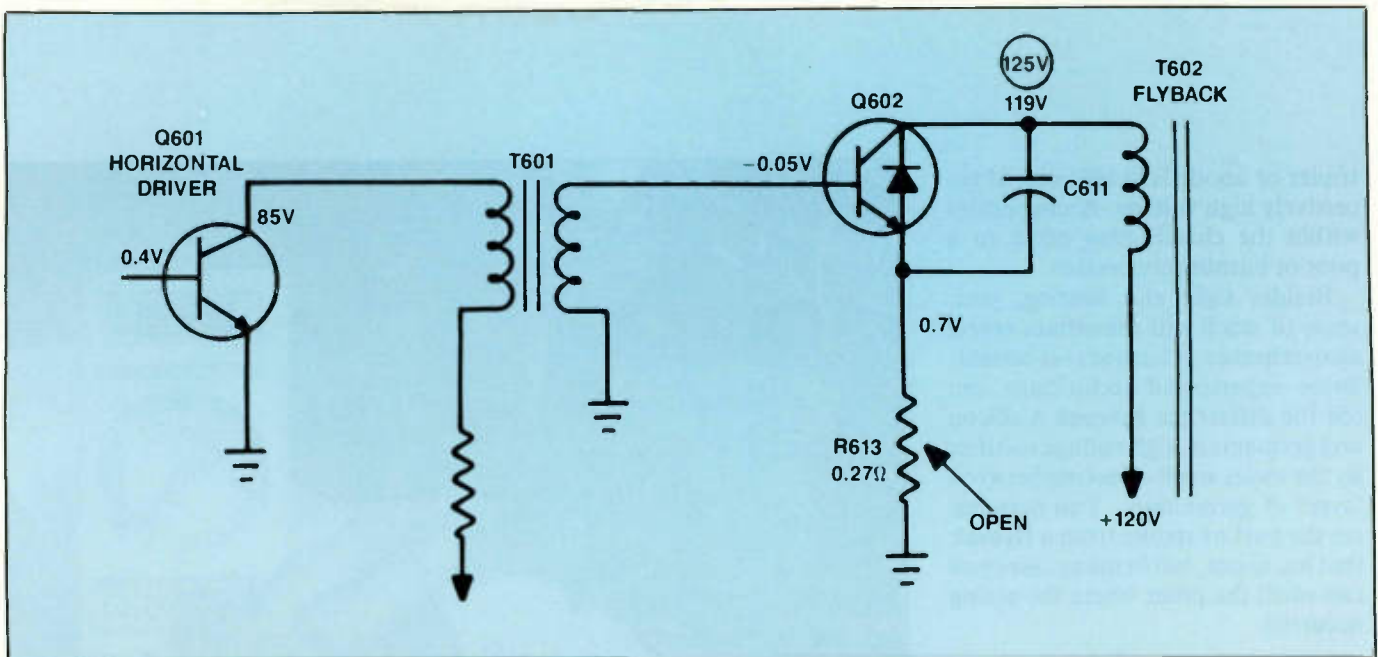


Figure 4. In this Montgomery Ward GSK 12981B portable TV, replacement of leaky Q602 and open R613 solved the problem.

sistance measurement in one direction across each silicon diode is normal. A low resistance measurement in both directions suggests a leaky diode. When you take a resistance reading across a capacitor, the meter needle should start high and slowly recede.

If the fuses protecting the horizontal circuits or isolation resistor are also open, suspect trouble in the horizontal output circuits. In a Philco E25-7 chassis, CB500 would kick out when the set was turned on. As a first step, R524, 5.1Ω, leaky SC504 and Q402 were replaced (Figure 3). To prevent damage to Q402 after replacement, I powered the set through a variable isolation transformer and slowly raised the voltage while moni-

toring the waveform at the collector of Q402 and voltage at collector of Q502 regulator. Everything was now fine. No doubt the original problem was caused when the horizontal output transistor shorted taking out R524.

Symptom #2: No sound, no picture, no raster

As in the case previously discussed, this symptom points toward the low voltage power supply or horizontal circuit. Often, no raster indicates the absence of high voltage. The no-sound symptom reinforced this theory because the horizontal circuits must function before there will be any sound. So, we check the low voltage source applied to the hor-

izontal circuits. The defective horizontal output transistor may open the fuse or cause the low voltage circuits to malfunction. A quick waveform check on base and collector terminals of the horizontal output transistor will indicate if horizontal oscillator and output circuits are functioning.

After locating and replacing a leaky horizontal output transistor (2SD870) in a Montgomery Wards 6SK12981B chassis, the set was still dead (Figure 4). The input waveform on Q602 did not look right but was there with no output waveform to the flyback transformer. A quick voltage measurement at the collector terminal indicated higher voltage than normal (125V).

Usually, low voltage of 70V or less on the collector indicates the absence of drive voltage, a leaky output transistor or poor power supply source. By removing Q602, the voltage will increase. Here the collector voltage was high after replacing the horizontal output transistor. R613, 0.27Ω in the cathode circuit was opened with a leaky Q602. Most TV chassis do not have an emitter resistor in the horizontal output transistor circuit. Replacement of this faulty resistor returned the set to service.

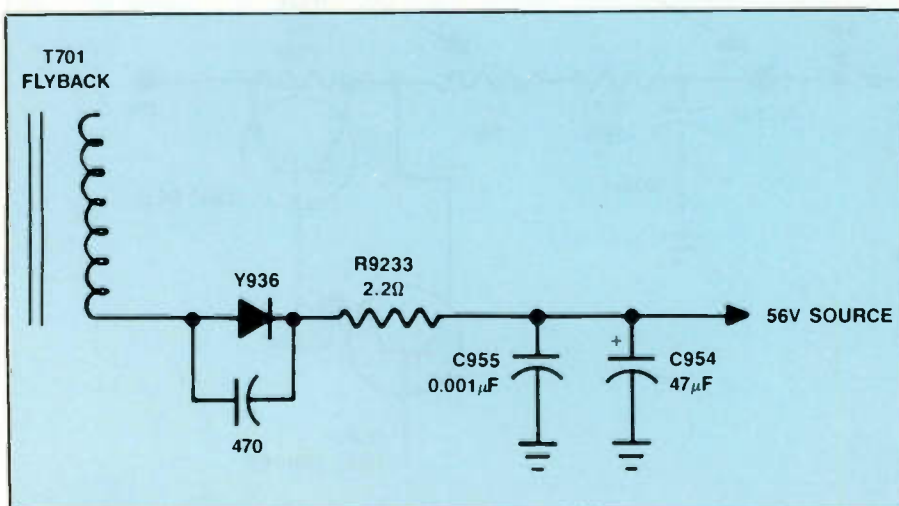


Figure 5. Replacing Y936, R923, Q601, and Q603 cured the symptom of the appearance of a horizontal white line followed by chassis shut down.

Symptom #3: A tic-tic noise

When you hear a tic-tic noise from the flyback transformer, suspect a defective flyback, an overloaded fly-

back, insufficient horizontal output drive pulse or overloaded derived secondary circuits of the horizontal output transformer. Often you'll hear a rush, as the high voltage comes up and then the set shuts down with only a tic-tic noise. The fuse may blow with a damaged horizontal output transistor. But the singing or noisy flyback may be the result of loose particles or transformer core assembly.

First determine if the x-ray circuitry is shutting down the set as a result of excessive high voltage or if some component is causing the chassis to shut down. Plug the set into a variable isolation transformer and slowly bring up the line voltage. Monitor the waveform at the collector terminal of the horizontal output transistor. Measure the voltage at the B+ source and check the high voltage with an HV meter at the anode of the CRT.

If the chassis shuts down before the line voltage reaches 80Vac, suspect a defective horizontal output circuit, or an overloaded secondary of the flyback transformer. The horizontal output transistor will become hot and its collector voltage will be lower than normal in the case of a leaky flyback transformer or overloaded derived secondary voltage.

When the chassis shuts down before normal ac voltage is applied and the HV at the picture tube is excessive, check the horizontal output transistor and circuits. High voltage shut down may be occurring as a result of a defective x-ray protection circuit. Note the high voltage reading. If it's within the manufacturer's specification, remove or disable the high voltage protection circuit and raise the transformer voltage once again. If the chassis does not shut down at the noted HV measurement, suspect a defective x-ray protection circuit.

When the flyback is defective, it may cause the horizontal output transformer to become very hot, become leaky and blow the fuse. When you're operating the set at reduced line voltage, and there's no signal at the HOT collector terminal even though the drive waveform is normal, suspect a leaky flyback. Often, when the flyback secondary is overloaded, some type of waveform can nevertheless be seen at the horizontal output transistor. If the symptoms are ambiguous, if the flyback is de-

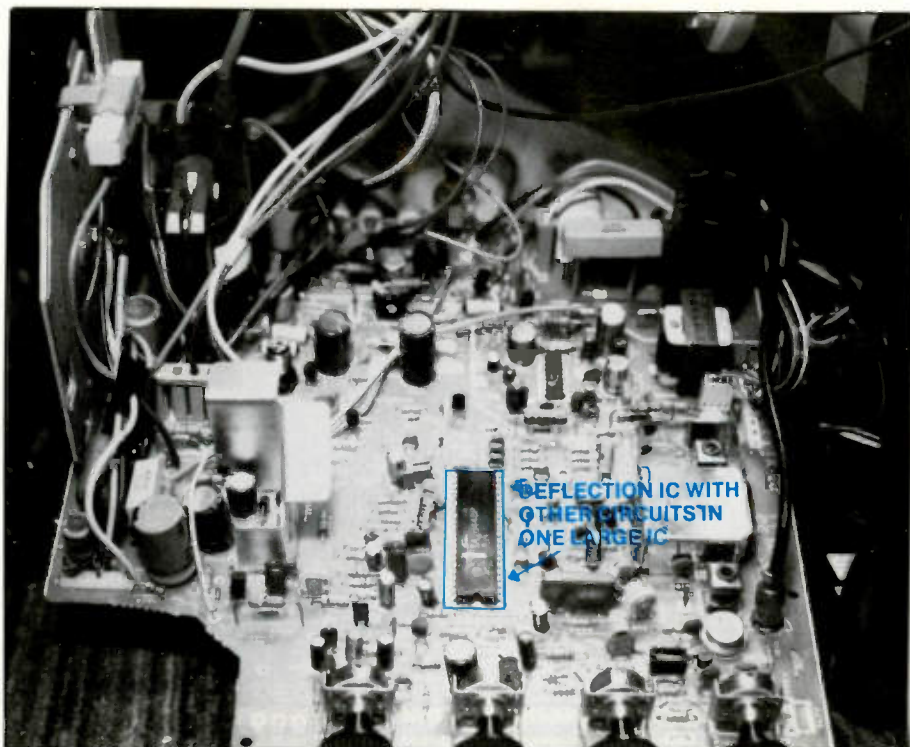


Figure 6. The defective deflection IC in the J.C. Penny 685-2084 portable was caused by a leaky IC on the secondary scan-derived voltage source.

fective, tapping it with a screwdriver handle may cause it to arc and blow the fuse.

Symptom #4: On for seconds—then shutdown

When the TV chassis comes on for a short time and then shuts down, some component is breaking down after operating. It's possible for the

HV and horizontal circuits to come up, be on for several seconds and then shut down. A damaged horizontal output transistor may cause the fuse to blow. After replacing the fuse and transistor, connect the ac cord to the variable isolation transformer. You may hear a tic-tic noise from the transformer.

Slowly advance the ac voltage

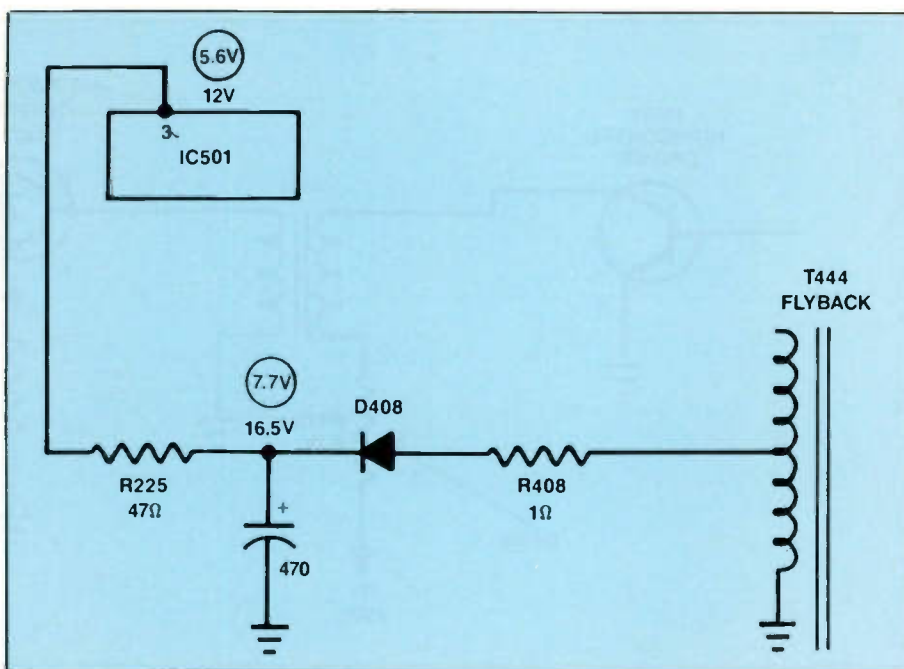


Figure 7. Low voltage on the voltage supply pin of IC501 indicated the deflection IC was leaky.

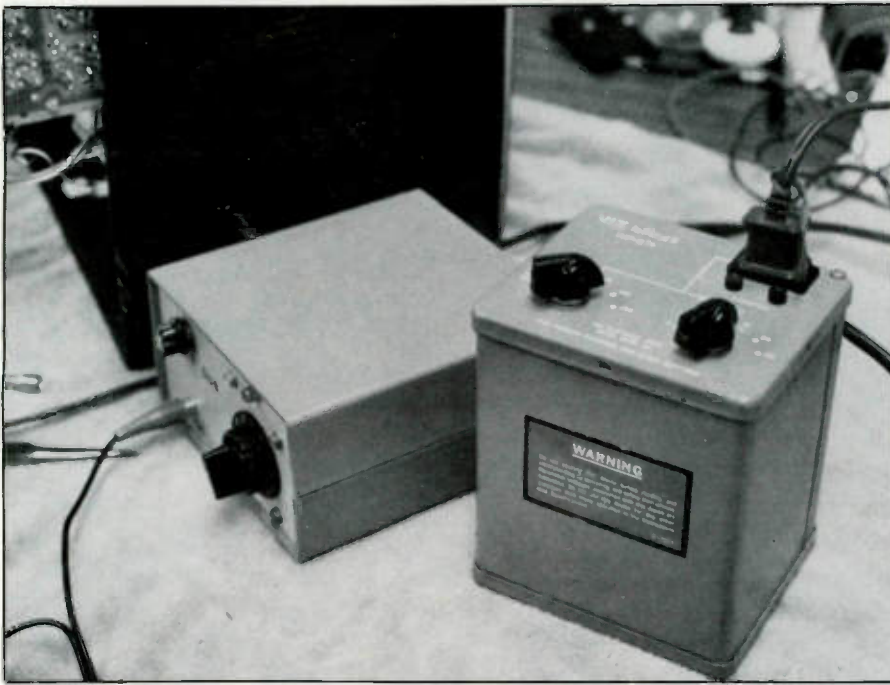


Figure 8. Always use a variable isolation transformer to slowly increase line voltage to prevent destroying another fuse and output transistor.

while monitoring the B+ voltage, scope horizontal output transistor and anode voltage. Note the B+ voltage when the set shuts down. Feel the horizontal transistor after shut down. When a few seconds elapse before shut down, one of the scan-derived supply circuits may be loading down the flyback transformer. Sometimes a leaky low-voltage rectifier, module or tripler may be the cause of the overloading.

Check each diode of the scan-derived voltages on the secondary of the horizontal output transformer for leakage. Notice if an isolation resistor is burned or open. In an RCA CTC85 chassis the shutdown was caused by a shorted vertical module.

Symptom #5: White line then shutdown

Sometimes the raster gives you a clue as to which stage is causing shut

down. In one TV set, a horizontal white line appeared across the screen before chassis shut down. When this symptom occurs, go directly to the vertical circuits and check for leaky components causing the overloaded condition.

The schematic of a J.C. Penny 2505 portable that exhibited this symptom showed that the vertical circuits were powered with a +128V and 56V voltage source (Figure 5). The 128V source comes from the switching power supply and the 56V source from the secondary voltage of the horizontal output transformer (T701).

A quick voltage check of Q601 and Q603 indicated low collector voltage. The 128V source was normal at Y930. Of course, the 56V source was dead since the horizontal output transformer was shut down. A check of components in this area of the set revealed that Y936 was shorted and R933 was burned. Replacing both Y936 and R933 did not entirely solve the problem. Further checking showed that Q601 had a dead short from emitter to cathode, and although Q603 tested normal, I replaced both Q601 and Q603. This completed the repair.

Symptom #6: Blown fuse - dead

In checking into the cause of a blown fuse in a J.C. Penny 685-2083 portable, I found that the horizontal output transistor was shorted be-

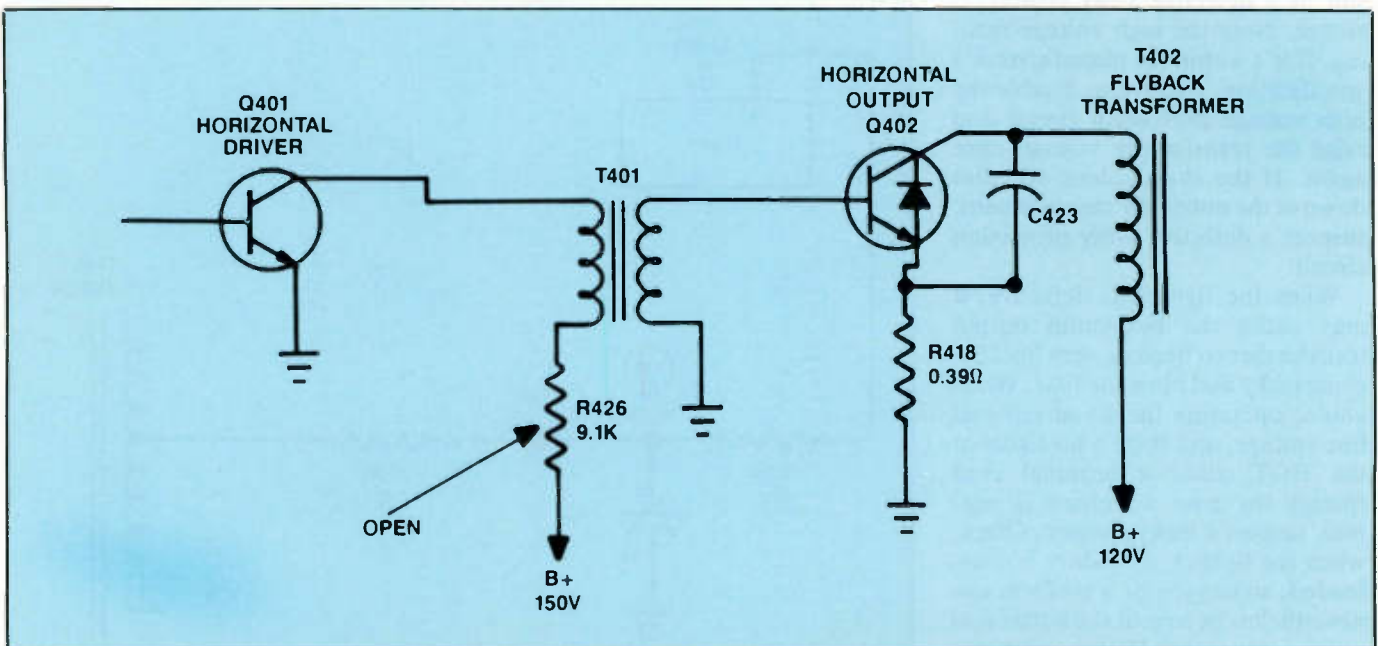


Figure 9. After replacing leaky horizontal output transistor (Q402) the chassis would not start up since R426 was found open in collector circuit of Q401.

tween collector and chassis (Figure 6). Even after both fuse and chassis were replaced, the chassis would shut down. To prevent further damage to the horizontal output transistor, I powered the set with a variable isolation transformer and slowly raised the power line voltage.

When 80Vac was reached, the chassis would shut down. I turned the set off, lowered the transformer voltage, turned the set on and raised the voltage to 70Vac. I made voltage measurements and checked waveforms at the horizontal output transistor. The horizontal waveforms were quite close to those shown on the schematic considering the reduced ac voltage. Since the high voltage was fairly normal, the horizontal circuits were eliminated from suspicion.

The secondary voltages of the fly-back transformer were normal except the 16.5V source feeding IC501 (Figure 7). The voltage on pin 3 was 2.6V and should be at least 12V. Although the power line voltage was not up to normal, IC501 was sus-

pected of leakage. The resistance from pin 3 to chassis ground was 62Ω. When I disconnected pin 3 from the pc board the voltage raised up to 10.7V. A replacement for IC501 solved the chassis shut down problem.

Symptom #7: Keeps destroying horizontal output transistors

Not only is it expensive, but quite time consuming when the main fuse blows and the horizontal output transistor is repeatedly destroyed. Whenever you have replaced the original horizontal output transistor and fuse in a defective TV set, always use a variable line voltage isolation transformer to slowly bring up the power line voltage. Monitor the horizontal output transistor output pulse with a scope, measure the anode voltage with a high-voltage meter and monitor the B+ source with a voltmeter (Figure 8).

Q402 and line fuse were defective in an RCA CTC117 chassis. The only thing this set did was make a tic-tic noise. After Q402 was replaced the

chassis would not start up and the horizontal output transistors began to warm up at 70Vac (Figure 9). The horizontal driver transistor (Q401) had no collector voltage. After I had taken several voltage checks, I found R426 to be open.

Since the 9.1K, 150V supply resistor was open, no collector voltage was applied to Q401. With no pulse waveform at Q402, the transistor eventually became hot, shorted out and blew the main 5A fuse.

Conclusion

The variable isolation transformer may be quite effective in troubleshooting the popular ac/dc chassis, but is of no use in TV chassis with switched mode (SMPS) or variable frequency switching power supply (VIPUR). Just learning how to repair the low voltage power supply and horizontal circuits covers 85% of troubles in the TV chassis. Try to isolate the area in which the problem occurred using symptom analysis before working on the chassis. ■

Come Out of the Dark.

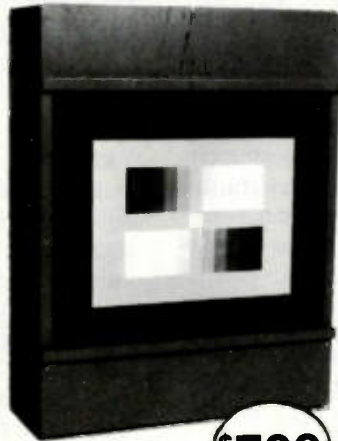
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Resonance-continued

By Sam Wilson

The subject of resonance can get heavy in math. Technicians are often interested in the "bottom line." That is unfortunate because the math can be a great help in understanding what is actually happening in a circuit.

Be that as it may, I've cut math to the bone in this series on resonance. You can jump over the math and concentrate on key sentences if you really want to. Or, you can put your mind to work. Do it your way, but remember, math is not your enemy.

In this issue we will continue to look at series and parallel resonance. Some unusual features of these articles will be emphasized. This subject was suggested by Frank Grabiec of Phoenix, Arizona.

In the previous issue there were some important definitions and concepts. They are summarized here.

The equation for the resonant frequency (f_r) of a series-tuned circuit is obtained by setting voltages across L and C equal. So, $IX_L = IX_C$.

The equation obtained is $f_r = \frac{1}{2\pi\sqrt{LC}}$.

There is no resistance in the equation for series resonance. Therefore, resistance is not a factor in determining the series-resonant frequency. Saying it another way, varying R in the circuit of Figure 1 will not affect the resonant frequency.

In a simple parallel-resonant circuit, that is one with no resistance, the equation for the resonant frequency is obtained by setting the currents in the L and C branches equal.

$$V/X_L = V/X_C$$

If you solve this equation you get the same equation as for series resonance:

$$f_r = \frac{1}{2\pi\sqrt{LC}}$$

When there are resistances in either or both branches, as shown in Figure 2, the same basic procedure is used for writing the equation for resonance. However, the branches now

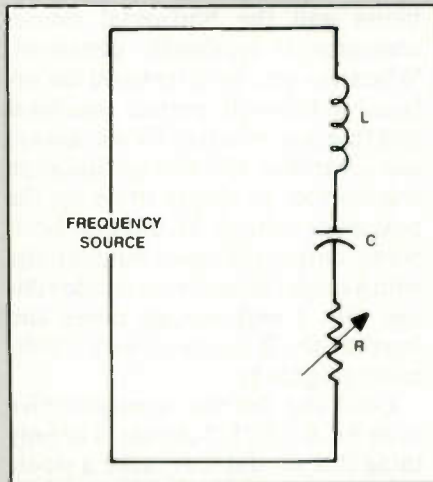


Figure 1.

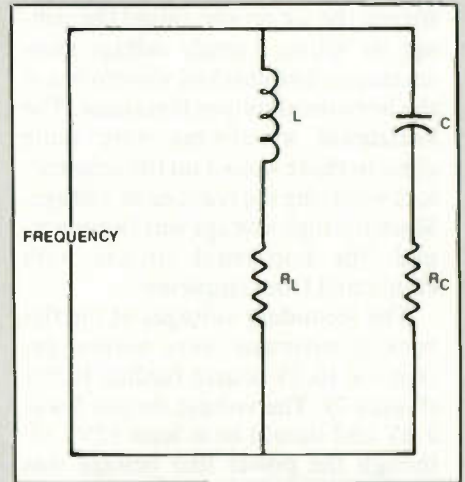


Figure 2.

have impedance rather than just reactance.

$$V/Z_L = V/Z_C$$

where Z_L = the impedance of the inductive branch and Z_C = is the impedance of the capacitive branch.

The equal voltages cancel, and the reciprocals of impedance ($1/Z$) are set equal. Admittance (Y) is the reciprocal of impedance. So, $Y_L = Y_C$.

When this equation is solved for f_r :

$$f_r = \frac{1}{2\pi\sqrt{LC}} \left[\frac{\sqrt{(CR_L^2 - L)}}{(CR_C^2 - L)} \right]$$

Changing the resonant frequency

The presence of R_L and R_C in the equation for parallel resonance shows that f_r in a parallel-tuned circuit can be varied by making either or both of those resistances variable as shown in Figure 3!

When $L = CR_L$ there is no resonant frequency ($f_r = 0$). When $L = CR_C$ the resonant frequency is not defined.

When $CR_L - L = CR_C - L$ the effect of R_L and R_C on f_r can be disregarded. Saying that another way, if the resistances in the branches are equal the equation is the same as for series resonance.

Knowing these things will help you

to get 100% on the quiz for *Test Your Electronics Knowledge* in this issue.

Voltages in series resonant circuits

It is very important to know the relationship between voltages and currents in resonant circuits. The meter you save could be your own!

Consider the circuit of Figure 4. The component values, frequency and voltage are given in the illustration. Using $X_L = 2\pi fL$ and $X_C = \frac{1}{2\pi fC}$, the following values are obtained:

$$X_L = 628\Omega$$

$$X_C = 628\Omega$$

The reactance values cancel, so, the generator sees only 2Ω resistance. The generator current is $I = V/R = 5/2 = 2.5A$.

That current flows in all parts of the series circuit, so, the voltages across L and C can be calculated.

Voltage across L = $V_L = IX_L = 2.5 \times 628$ so $V_L = 1570$ volts!

Voltage across C = $V_C = IX_C = 2.5 \times 628$ so $V_C = 1570$ volts!

Is it possible that these voltages can occur in a circuit that has only a 5V ac generator? The answer is a definite Yes!

It is not a good idea to try to mea-

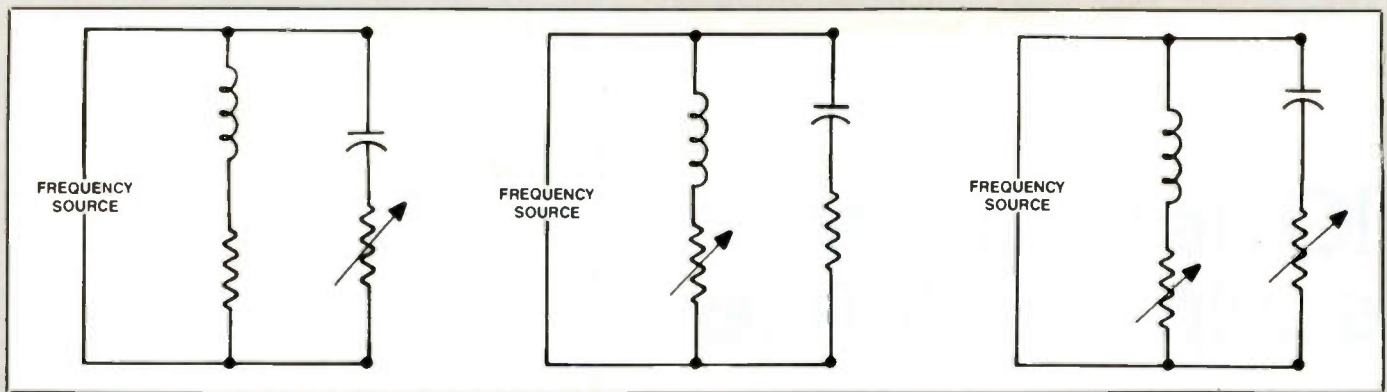


Figure 3.

sure voltages across the reactive components in a series-resonant circuit! Keep in mind the fact that the ac generator may actually be a vacuum tube, transistor, or FET amplifier. It is a common practice to represent those circuits with an ac generator as shown in Figure 4.

Currents in parallel-resonant circuits

In a simple no-resistance parallel circuit the generator current is minimum. However, there are circulating currents flowing back and forth within the parallel LC circuit. Those circulating currents are sometimes called flywheel currents. This condition is shown in Figure 5. At certain times the voltage across the capacitor will be maximum, and at other times the voltage across the inductor will be maximum.

Consider the instant when the voltage across the inductor is maximum and the voltage across the capacitor is zero volts. There is no opposition offered by the capacitor to a charging current.

So, the voltage across the inductor is for all practical purposes, across a short circuit. That results in a very high current! As the capacitor charges, its opposition to the charging current increases and the current decreases.

At the instant the voltage across the capacitor is maximum there is no current flowing through the inductor. The only opposition to current as seen by the voltage across the capacitor is the resistance of the wire in the inductor. It is nearly a short circuit. At that instant the current supplied by the capacitor voltage is very high.

As soon as the capacitor starts to discharge the counter voltage across the inductor opposes the current. But, for a moment the current can be very high.

The overall result is that the cur-

rents within the parallel-resonant circuit can be very high even though the current supplied by the generator is a low value.

The next time I discuss this subject I will show some curves that help to further explain the voltages and currents in series-and parallel resonant circuit. That will be in the issue after the next one.

I'm not going to say stay tuned. That would be too corny for such a high-level discussion.

Merchandising moxie

You need to keep a watchful eye open for new selling techniques. The reason is not that you want to use them. What you want to do is protect yourself from them.

Two years ago I received a form letter from a large company saying that a free flashlight had been reserved for Sam Wilson—a "preferred customer." I need another flashlight like a moose needs a bathing cap, but the price was right. So, I went after mine. They even put the necessary D cells in it!

This week the flashlight merged to

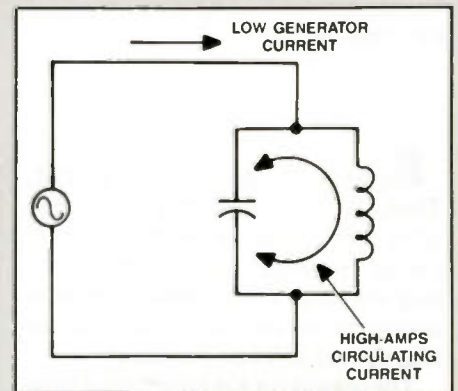


Figure 5.

the surface when I was digging down to layer three in my office. I decided it would be a good time to replace the cells even though I have never used it.

It needs five cells. However, there is no place in town that sells them in any way except in pairs. You have to buy six, then, try to figure out what to do with the extra one you had to buy that you didn't need. Now, that is the way to sell dry cells: sell the customer a dry cell that isn't needed!

Before buying the six dry cells I decided to find a good use for the sixth (extra one).

I worried over that problem for a week. I looked through books of "one-night projects" which require one cell. I dug out all of the magazines I have been saving for years and searched the pages for a one-cell project. I made long-distance calls to people who are in the know about such projects. I visited many stores looking for some kind of gadget that required one dry cell. I hated the idea that I had been taken in with this trick.

After a week of this, Norma couldn't stand it any more. "If you had just asked me, I could have solved this problem a week ago."

"O.K." I replied, "let's see how you solve it."

She gave the flashlight away. ■

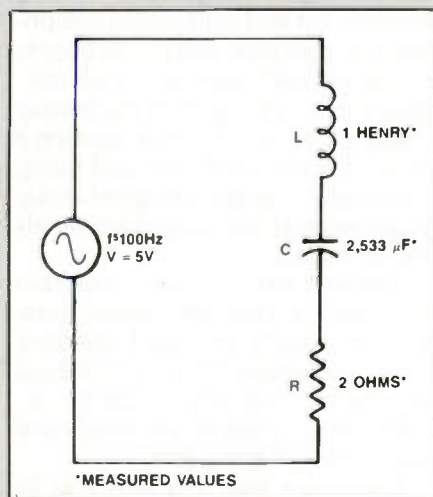


Figure 4.

10 steps to prevent equipment failure

By John Shepler

Equipment doesn't have to fail. There is no reason that electronic equipment, with no moving parts, should suddenly and inexplicably stop working. Why, then do we get so many irate service calls on equipment that should still be operating?

The reason for electronic problems are seldom related to parts wearing out. The causes are usually built into the product or the result of stress. Yes, amplifiers and computers are victims of stress just like you and I.

The keys to keeping electronic equipment up and running are eliminating built-in problems and preventing stress induced failures. This article offers 10 steps you and your customers can take to keep electronic equipment operating reliably.

1 Burn in before use

Electronic components have a failure pattern that looks like the cross section of a bath tub. It is even called the "bath tub" curve.

Most failures occur right away. They are due to some defect in manufacturing that will become apparent within hours. After this "infant mortality" period, the failure rate decreases to a low level and stays there for years. When age or normal environmental factors begin to take their toll, the failure rate rises rapidly to 100%.

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

The best way to weed out unreliable equipment is to run it for a while. Power the equipment and let it idle a few days in the shop before delivery. Better yet, apply a normal load and operate for 24 or 48 hours.

This is called "burn-in." Some manufacturers burn-in expensive products themselves. Most consumer equipment, however, goes straight from the production line to the shipping dock. You can do the burn-in and catch the marginal units before they ever have a chance to disappoint your customer.

2 Maintain a constant temperature environment

The baking sun of summer and icy blasts of winter take a harsh toll on streets and buildings. Electronic equipment is stressed by less severe temperature fluctuations.

It is not only temperature extremes that damage. The periodic cycling between hot and cold causes components, connectors, and circuit boards to expand and contract. This constant flexing can result in the weaker joints giving out. It's like bending a piece of sheet metal back and forth. Eventually, it snaps. Marginal solder joints and internal component bonds also will snap.

The best environment is one that maintains a constant temperature, with no drafts or rapid changes. True, car radios take a continuous beating and generally outlast the car. They are designed to. Personal computers and VCR's aren't.

Encourage your customers to be sensitive to the environment the

equipment operates in. Give the equipment an hour or so to stabilize when it is transported through large temperature changes.

3 Reduce heat buildup

Heat is the enemy of electronic components. The life of any part will be reduced by elevated temperatures. Electrolytic capacitors and power transistors are especially vulnerable.

Electronic products are designed to cool themselves by convection or with a small fan. Most products depend on convection currents through the cabinet or across the heat sinks. You can bet that these products were tested on an open bench with plenty of breathing room.

Now, consider how the equipment is installed. It may be stacked on top of other heat producing components or shoved against a wall. The cooling air currents can't get near the hot spots. The circuit board parts will run hotter than expected due to lack of cooling.

The problem with heat is that it does its damage gradually. A computer that should run ten years, without a glitch fails within a year. The capacitors in a stereo amplifier dry out from baking and the frequency response changes.

The best approach is to run the equipment as it was intended. The case should sit unobstructed with air flow all around.

The next best idea is to install a small fan or blower to increase the air flow. Moving air is an excellent cooler of components. You don't need

much movement to get results. A small quiet fan, such as a "Muffin" fan, may be all that is needed to increase the reliability of the equipment 2 times, 3 times or even ten times.

4 Reduce dirt buildup

Most dirt is non-conductive and won't damage the equipment by itself. But, dirt is an insulator and traps heat. A regular dusting is recommended. Be sure to check and clean fan filters. A dirty fan will sound fine, but no air will move.

Some dirt is corrosive. Installations in industrial areas may collect films or dust that will eat away at fine finishes. Regular cleaning will help.

Consider plastic covers for computers. The constant rain of duct clogs keyboards and is attracted by the high voltage of video displays. Remember that in most businesses, the computers are only used 1/3 of the day. The dust covers will prevent 2/3 of the problem. In homes, computers are used even less, so the benefits are greater.

Regular cleaning is mandatory for tape equipment. Cassette drives need the pinch rollers, guides, and heads cleaned to maintain sound quality. VCR's should be cleaned professionally every year or so, depending on use. Educational and industrial equipment that is constantly in use needs more frequent attention.

5 Suppress power surges

Power lines are full of noise and glitches that are seldom noticed. If you monitor your line with a scope or recorder, you may be horrified at the high voltage spikes from thunderstorms, line switching, and the effects of other equipment. These spikes, sometimes hundreds of volts above normal, can rip their way right through a power supply.

Semiconductors are intolerant of even momentary surges. If the volt-

age gets above the breakdown point, the transistors, and chips self-destruct. In a fraction of a second, thousands of dollars worth of electronics is damaged beyond repair.

Expensive electronics should be protected. The better power line pro-

ectors use a combination of inductive/capacitive filtering and MOV (metal oxide varistor) voltage clamps.

The MOV is a semiconductor that switches rapidly from high to low impedance when its threshold voltage is exceeded. Since the spikes are only

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microseconds to milliseconds in duration, the MOV absorbs them like a sponge. You can buy large MOV's in NEMA boxes for installation at the service entrance. For most applications, surge protectors at the equipment will work fine.

Other lines running to the equipment also should be protected. This includes telephone lines to modems, faxes and point of sale terminals. Antennas to communication equipment should have a grounded lightning arRESTOR in-line.

The ultimate protection is to isolate the equipment completely. It makes sense to unplug expensive home computers during thunderstorms. This is especially important in rural areas where there are long overhead power lines and few loads to absorb the lightning strikes. Even shutting off the most sensitive equipment during a storm will offer considerable protection.

6 Isolate equipment from vibration

It is best to avoid surfaces that are vibrating from out of balance fans, motors, or other reasons. Vibration makes tight mechanical assemblies loose. Screws and nuts work loose. Circuit boards work out of their sockets. Plugs and jacks come apart. Small parts work loose and fall into fan blades.

Feel the surface before setting the equipment there. If you can't avoid the vibration, then isolate the equipment. Rubber feet or a rubber pad will help.

Consider isolating the source of the vibration. Maybe rubber mounts on a power transformer or blower will reduce the vibration to all the equipment on your shelf.

If you are forced to accept some vibration, then periodically check the equipment to make sure circuit boards are still seated firmly and fasteners are tight.

Shock can be worse than vibration. Keep equipment out of locations that are always hit by doors or people. Just setting back the equip-

ment back farther on a shelf might be adequate protection.

7 Maintain mechanical parts that wear

Electronic equipment isn't completely electronic. Electromechanical switches need cleaning from time to time. Motors may need lubrication, though the small ones are generally sealed. Printers and electronic typewriters have moving carriages that can jam or get dirty. Print heads clog with dirt or ink.

Most mechanical maintenance is nothing more than inspection, cleaning, and occasionally lubrication. The key is to look. You can see the dirt building up long before the mechanism jams.

One good course of action is to follow the manufacturer's recommended maintenance plan. It is easy to skip maintenance when the equipment is new or running smoothly. Eventually, lack of maintenance will result in problems. Take action today to prevent failure tomorrow.

8 Control humidity and condensation

Few things electronic like water. Moisture gums up mechanical assemblies. It provides a current path in high impedance circuits. Water also carries acids and other pollutants that slowly destroy equipment.

Most locations where people enjoy working are also ok for electronic equipment. A dehumidifier helps in basement locations where humidity collects.

Condensation occurs in very humid atmospheres. It also occurs while transporting equipment through temperature extremes. In winter, a cold VCR will collect moisture when brought from outside into a dry room. Some sensitive devices, like VCR's have condensation detectors built-in. Though, it's best to play it safe. Wait a half hour to an hour before powering equipment that has undergone a big temperature change.

9 Inspect periodically

As mentioned previously, you have to look to find problems as they are developing. This is especially important for components like amplifiers that have no regularly scheduled maintenance. Be sure that power cords are seated tightly and other plugs and jacks are firmly in place. Check for dust buildup. Check for moisture problems like condensation or mildew. Make sure the heating and cooling systems are still functioning in back rooms full of equipment.

Many problems can be stopped before they cause real damage, if only someone takes the time to look.

10 Operate within specifications

It is tempting to push a few extra watts from an amplifier or drive a printer a few thousand copies past the recommended monthly level. In the short term you get away with this. In the long term, you pay for repair or replacement.

Input and output specifications are often violated unknowingly. Amps that drive lower than specified impedances may sound ok, but they work harder and generate more heat. The same is true of overloaded computer buses, motors, power supplies, and even some test equipment. If you want reliability, observe the manufacturer's specs.

A plan of action

Take these 10 simple steps and you will extend the life of your electronic equipment. The customer must be a partner in this process, because once the equipment leaves your shop, it is out of your hands. Out of your hands, until it fails again.

When a customer has persistent problems or failures in normally reliable equipment, take a minute and review these 10 steps together. Often, a simple precaution or change of environment will convert a troublesome component into a trouble-free component.

Diagnosing servo problems

By the ES&T staff

In order for a VCR to reproduce the 6MHz range of frequencies needed to produce a picture on a TV screen, it's necessary that the tape be pulled past the video head drum at a precise speed while the video head drum spins at a precise speed. In addition, in order for the video heads to correctly record the video tracks in the recording process, or to properly track the video tracks in the playback process, the position and speed of the tape relative to the video heads must be precisely controlled.

This relationship of tape to video heads is maintained by the VCR servos: drum and capstan, controlled by signals that are generated by components in the VCR and/or recorded on the tape along with the video signal. When one or both of these servos malfunction, the picture and/or sound will be degraded.

Certain symptoms that can be observed during playback of a VCR point directly to the servos. Other symptoms suggest that the problem is anything but a servo problem. Still other symptoms are ambiguous; the problem might be caused by a servo, or it might not. This article consists of a list of the symptoms in each category.

Symptoms that are likely caused by servo problems

1. Linear audio at wrong speed or changing pitch: Problems that affect the tape speed affect linear audio. The most likely cause of problems of this nature is a bad capstan servo. If this is not the case, the next most likely cause is mechanical tape transport problems that have to do with hold-back or takeup tension.

2. Picture alternates between snow and clear: This symptom is a sign that the video heads are not staying locked to the video signal recorded on the tape. The periods of snow show that the heads are 180 degrees out of phase with the signal on the tape part of the time. This symptom could be caused by either a drum or a capstan servo error. If the audio on the test tape is bad, it's the capstan servo. If the audio is good, the tape speed is correct and the problem must be with the drum servo.

3. Noise bar passing through picture: This problem will only occur at slower tape speeds, but it is similar to the previous symptom. Because at the slower tape speeds each recorded stripe of video overlaps adjacent video stripes the picture does not drop out completely when the heads are out of lock with the recorded signals.

4. Picture noisy, tracking control has no effect: A constantly noisy picture alone does not indicate a servo problem. However, if adjusting the tracking control through its full range results in no change, this points to a servo problem. If this happens, the servo's tracking adjust circuits are probably at fault.

Probably not caused by servo problems

1. Picture always snowy: If the noise affects the entire screen, the most likely causes are a bad video head, a noisy video stage, or the head disk is mounted backwards on the drum (causing the A head to follow the B track, and vice versa).

2. Noise bar at fixed location: If a noise bar stays in a fixed location, the servos are doing their job of keeping the relationship of tape tracks and

video heads in synchronization. Adjustment of the tracking control should result in a change in the position or the appearance of the noise. If the tracking control has no effect, you should troubleshoot the tracking circuits. Since the noise stays at the same place, you know that the problem is synchronized to the heads. Probable causes are dirt on the head drum, a bad rotary transformer, poor mechanical tape-path alignment, or a bad head selection relay.

3. Horizontal line: A thin black or white line running across the screen is a sign that the tape is scratched. Check for an object in the tape path, or for a damaged tape guide or roller. Once a tape is scratched, it will always show the line, even after the problem is corrected. The VCR being diagnosed might not have been the one that caused the problem. The scratch could have been caused by a different deck before it was played on the VCR that is suspected.

4. Luminance ok, color affected: A good black and white signal is evidence that the servos are working, even if there is no color or color is intermittent. To troubleshoot this symptom, decrease the color level control on the TV receiver or monitor to observe the luminance signal without confusion from the color. Problems related to color are probably in the color circuits or caused by a weak color signal coming from the video heads.

5. Picture changing in brightness: If this only happens on copies of pre-recorded tapes, it is probably because of copy protection. The most common form of copy protection causes the brightness of copies made from the original to have extreme brightness fluctuations or intermittent loss of sync. ■

This article is based in part on the article "How to service VCR servos" which appeared in Issue #150, May/June, of the Sencore News.

Test your electronics knowledge

By Sam Wilson

1. Is the following statement correct? A series RLC circuit is resonant when $X_L = X_C$.

- A. Correct
- B. Not Correct

2. The resonant frequency of a series-resonant circuit can be changed by changing the circuit resistance.

- A. Correct
- B. Not Correct

3. The reciprocal of impedance $[1/Z]$ is

- A. Reluctance
- B. Admittance

4. You know that the reciprocal of resistance is conductance. The reciprocal of reactance is _____.

5. Which of the following RLC circuits may not have a resonant frequency?

6. What is the lowest possible radix of 11090? _____.

7. Which transistor configuration has a low input impedance and a high output impedance?

8. In the circuit of Figure 1, varying the resistance of R

Wilson is the electronics theory consultant for ES&T.

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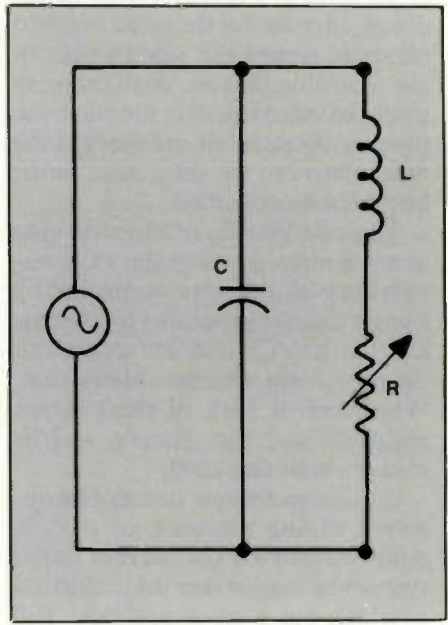
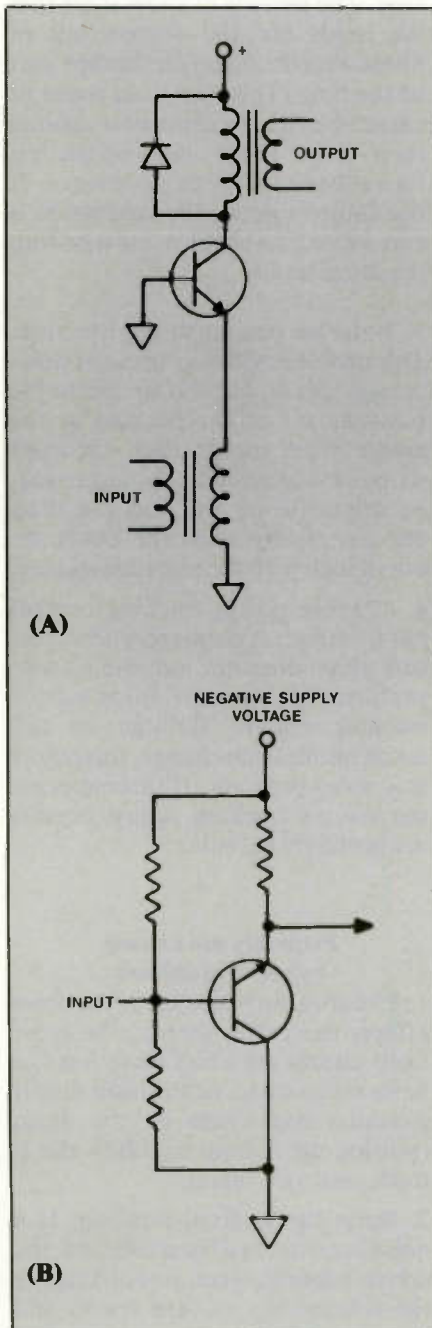
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- A. Will affect the resonant frequency.
- B. Will not affect the resonant frequency.

9. The collector voltage of an NPN transistor is 0V.

- A. The transistor must be saturated.
- B. The collector resistor must be open.

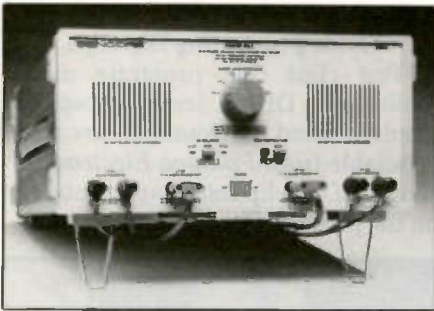
10. Increasing the capacitance in a parallel-tuned circuit having no resistance will

- A. Raise the resonant frequency
- B. Lower the resonant frequency

(Answers on page 58)

PM82 power max decade audio power multiplier

New from *Sencore* is the Power Max 5KW EIA/IHF Decade audio power multiplier. It is an ideal expander for your audio service bench and PA81 stereo power amplifier analyzer. It equips you for stereo power amplifier analyzing to 5000 watts. In-



cludes all common audio amplifier damage, sweats out intermittents and heat problems, load resistors fan cooled and portable-built rugged for full power testing at any job site. The PM82's exclusive EIA/IHF specified loads and built-in protection makes accurate, dynamic performance testing possible and allows for practical and safe "burn-in" after repairs.

Circle (68) on Reply Card

Dual banana jacks for grounding wrist straps

Desco Industries, Inc., announces a wrist strap ground terminal which is designed to mount beneath the



front edge of the work bench. It provides two grounded banana jacks for grounding a wrist strap for both an operator and a supervisor. It also has two .160" studs located on the lower left and right hand corners for "parking" ground cords when removed from the wristband. The ba-

nana jacks have bright yellow plastic terminals and the nomenclature on the front is also bright yellow. This includes the words "wrist strap ground" and a ground symbol below each banana jack.

Circle (69) on Reply Card

Permanently static dissipative products

New from *Plato Products Inc.*, is permanently static dissipative products for the production work station which meets the requirements of DOD-STD-1686 and the physical characteristics that comply with Mil-B-81705, Type 2. These new products include flux dispensers, and liquid



dispensers. Additional static safe products include lead cutters with permanently static dissipative handles and 25 foot rolls of desoldering wick in a variety of sizes with permanently static dissipative covers. Specification information on electrical properties, clean room acceptance, solvent resistance, etc., is available upon request.

Circle (70) on Reply Card

CD jitter meter

Leader Instrument Corporation's CD jitter meter, the LJM 1851, performs simultaneous measurements of jitter (3T) and HF levels (3T or 11T) for the EFM (Eight to Fourteen Modulation) signals used in CD players. Displayed objective values are

New 4,000 Count Digital/Analog DMMs

If you need a high performance hand-held DMM, check out the new Models 2912 and 2911 from B&K-PRECISION. Both feature 3¾ digit and linear bar graph readouts for measurement display to 4,000 count. Both also feature selectable auto or manual ranging and measurement of voltage, current and resistance, and offer diode check as well as audible continuity check.

Model 2912

\$149

- 0.3% DC accuracy
- Capacitance measurement to 40 mF
- Frequency measurement to 400 kHz
- High-energy fuse



Model 2911

\$99

- 0.5% DC accuracy
- 10 amp range
- Diode check



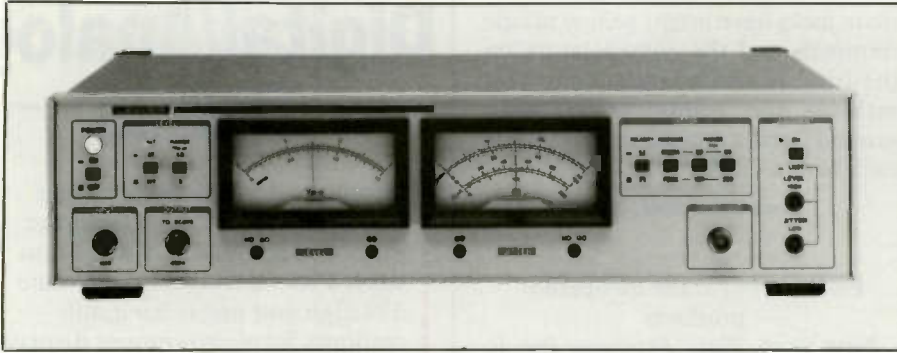
Both meters are available for immediate delivery. For additional information see your local distributor or contact:



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Circle (27) on Reply Card



not dependent on human interpretation and judgment of CD player transmission quality currently observed when viewing the EFM eye pattern on an oscilloscope.

The CD jitter meter improves the accuracy, reliability, and speed of CD player alignment and repairs.

Circle (71) on Reply Card

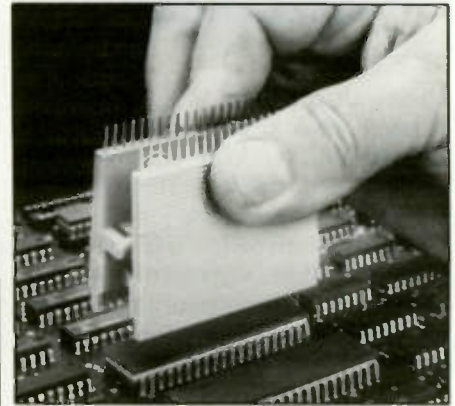
The sigma measuring mode computes the jitter within one standard deviation to produce a near steady state reading of jitter, facilitating accurate quantitative measurements. The EFM signal level is indicated as a peak value for the 3T or 11T bit component and is selected by pushbutton.

graph with data hold capabilities. Measurement ranges are: 400mV (diode test) to 1000V DC; 4 to 750 VAC; 40mA to 20A DC; 400 microamps to 20A DC or AC; and 400 to 40M Ω resistance. High and low current ranges are fused in each model.

Circle (73) on Reply Card

Oxide penetrating Dip clips

Test clips that penetrate oxide built-up on DIP IC leads exposed to contaminated environments are now available from *Pomona Electronics*. The six DIP clip test adapter models in the product family function, simi-



larly to standard test clips while featuring a roughened, stainless steel, surface coating on their serrated contacts to provide good electrical connections on contaminated surfaces.

The clips provide hands-free testing of standard DIP ICs, from 8 through 40 pins, on high density PC boards. The 1.02mm (0.40") wide, serrated and rough coated contacts are to be made on "live" boards without accidental shorting of adjacent contacts.

Circle (74) on Reply Card

Dual iron soldering systems

Royal Soldering Systems Inc., has introduced both alternating and simultaneous dual iron workstations with either digital or analog temperature control. All four dual iron soldering stations exceed U.S. Depart-



ment of Defense specification DOD-STD-2000-1B and offer 28 second heat-up with 15 second recovery. Tip-to-ground connection requires little operator maintenance, due to a patent pending design that provides an airtight connection, resisting oxidation for the life of the tip.

Circle (72) on Reply Card

Auto-Ranging DMM

Drop-proof and sealed in a watertight case, is the hand-held AR-3200,



top of the line DMM from *ARI/American Reliance Inc.*

The AR-3200 features: Programmable level comparator, fast-display mode, autodata hold mode, relative measurement mode, min-max memories, range modes, and 40MHz logic monitor modes with user-selectable thresholds and three audible tones. It provides DC volts, AC dBm, DC and AC current, continuity, diode junction, and resistance measurements.

The unit has a 40 segment bar

money owed by vendors. Hot-line support people can now dispatch technicians more rapidly using a page number in the personnel file. Parts and equipment are easier to locate with a tag/ID number in the inventory file. The program tracks hot-line telephone support, on-site service calls, and depot repair. It keeps up-to-date information on customer histories and service contract status as well.

Circle (75) on Reply Card

Infra red beam detector

Projector-Recorder Belt Corp., now has the Infra-Red-DY, the instant infra red beam detector. This handy, pen size detector allows you to instantly check and detect the presence of an infra red beam. It eliminates the need of expensive diagnostic tests or the use of a time consuming specially coated card. The Infra-Red-DY is a convenient, easy to carry pen-like size, featuring rugged construction and a long lasting (up to 4 years)

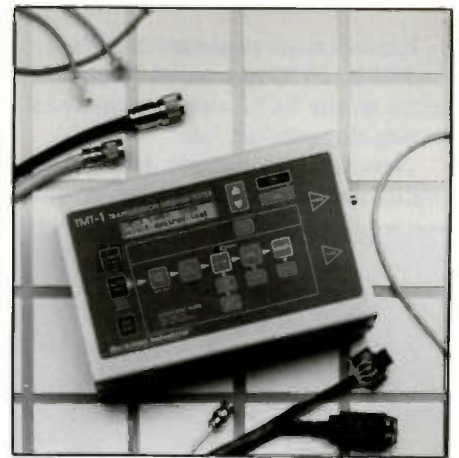


battery. It's ideal to use with a variety of equipment using an infra red beam including: hand held remote control units, grocery store scanners, automatic teller machines and any production line counting machines.

Circle (76) on Reply Card

LAN tester

Beckman Industrial has introduced the TMT-1 transmission medium tester for use in local area networks



(LANs) certification. It makes the following three products obsolete for LAN certification: the TDR (time domain reflectometer), the digital multimeter, and the noise meter. The TMT-1 cuts half the time required to do line mapping for twisted pair wires, and measures DC resistance, noise, impedance, and length. It is lightweight (under five pounds) and portable.

Circle (77) on Reply Card

Improve Your Form.

3-Part

A continuous feed form used for customer c.o.d. service or parts/accessory sales receipts (N3CN). Not for warranty billing. Computer generated software to be available soon.

5-Part

Available in snapout (N5SN) or continuous feed (N5CN). Matching fields with N3SN, except for customer estimate and receipts. For warranty billing.

7-Part

A universal snapout form (N7SN) designed for both customer service c.o.d. and manufacturer warranty billing. Complies fully with the requirements of state and local ordinances, including California.

Discounts

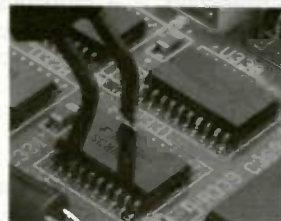
Carbonless NESDA Forms are available to NESDA members at additional savings. For pricing information and samples, or information regarding other NESDA membership benefits, write to NESDA, 2708 W. Berry St., Ft. Worth, TX 76109; or call (817) 921-9061.

The NESDA Form

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Fort Worth TX 76109
Phone: (817) 921-9061

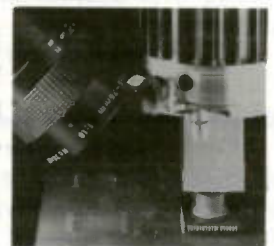
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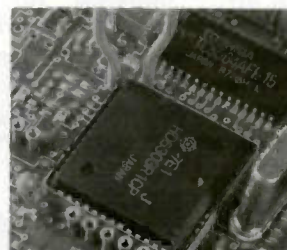
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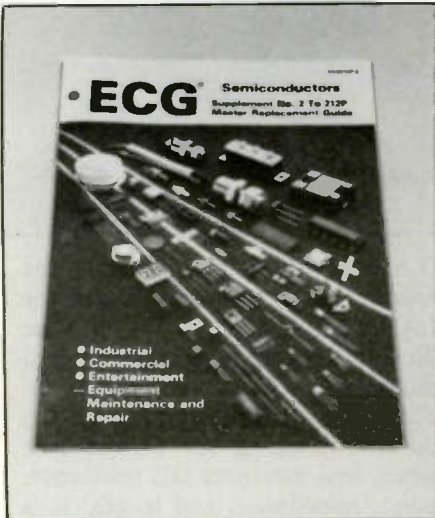
9893 Brewers Court
Laurel, MD 20723-1990
FAX: 301 498-3252

Circle (35) on Reply Card

Replacement semiconductor line

Philips ECG has added 76 new devices to the ECG replacement semiconductor product line.

New devices include transistors, industrial rectifiers, optoelectronic



devices, IC protectors, and linear ICs for TV, VCR audio (CD/stereo/auto), personal computer, and other applications.

Electrical and mechanical specifications of these new devices are featured in a new 40-page supplement to the ECG Semiconductor Master Replacement Guide. The supplement includes over 150 semiconductor devices and cross references nearly 13,000 industry part numbers. The ECG semiconductor line remains the broadest in the industry with approximately 4,100 solid state devices that replace over 250,000 industry part numbers.

Circle (78) on Reply Card

Directory for circuit board and disk drive repair

Coordinated Service, Inc., a consulting and information service company for the service industry has just updated its directory of independent circuit board and disk drive repair companies. First published in 1986, this directory is distributed free of charge to the 3,000 companies currently listed on Coordinated Service's data base of independent service companies, called "Service Sorcery, Too." In addition to the listings, which include company name, address, contact, equipment serviced,

pricing, turn around time and other services offered, there is also an index by location so users can find the depot nearest to them.

Circle (79) on Reply Card

Ozone-safe solvents

Micro Care has announced the introduction of its "Environmentally Superior" line of ozone-safe printed circuit board cleaners. Designed for benchtop cleaning applications, a total of five new products were introduced using unique low-pressure aerosol packaging. The announcement



featured two Genesolv-brand hydro-fluorocarbon blends from Allied-Signal, Inc. Micro Care also added two proprietary cleaning formulations. The first is the alcohol-based Pro-Clean flux remover and the second is a chlorocarbon based high performance circuit cleaner.

Circle (80) on Reply Card

Soldering irons

Easy to use lightweight soldering irons, designed for large miniature and micro-miniature circuit geometry, are available from Royal Soldering Systems Inc. These irons feature patented tip-to-ground connections which resist oxidation and include locked in tips which are easy to replace and have a life expectancy of 80 to 100 hours. The iron handles are designed for minimum thermal transfer, providing cooler handles



for operator comfort. A specially formulated static material is also used on the handles to prevent hazards of electrostatic discharge (ESD). The model T300 is a 40 watt, 1/2 oz. (14g) iron specifically designed for the latest miniature and micro-miniature circuits. The model T500 is a 60 watt, 2 oz. (50g) iron with extra thermal capacity to handle large terminations, and has a 5mm tip.

Circle (81) on Reply Card

AC gaussmeter

Integrity Research Corp., now has for monitoring powerline and appliance magnetic fields related to recently discovered health risks, a new 60 Hz AC gaussmeter, model -IRC-27. The hand-held meter is light weight and has a very readable LCD display. Its lowest sensitivity is 0.1



milligauss with a maximum range of 200 milligauss. Less than half the price of Integrity's professional model #IRC-109, the 60 Hz AC gaussmeter still retains many of the popular features of its brother. It is frequency-specific for 60 Hz, eliminating harmonic distortion, with a separate model (IRC-28) available for European 50 Hz measurements. A 200 mV strip chart recorder output is standard. Options include: an AC adapter with rechargeable battery, a larger professional size coil probe, a 3-axis coil probe, a zipper case, and a calibration checker.

Circle (82) on Reply Card

Service logs

By Glenn R Patsch

A personal computer is a complex electronic and mechanical device. I have found it helpful to keep a log of service and preventative maintenance performed. This can be as simple as noting the date and a brief description of the servicing problem on a sheet of paper. Be sure to note the model and serial number on the sheet.

A sample service log might look like this:

- Product IBM PS/2 model 60
- Model 8560-141
- S/N 72-8007800
- Key # ABC1234
- Install May 18, 1987
- Options external 5.25 inch, 360k drive model 4869
- Date Description
- 10-23-87 8560-141
- 11-23-87 Reference Disk Version 1.02, DASDDRVR.sys fix
- 01-08-90 Preventive maintenance. Clean and check.
- 05-11-90 Changed lithium battery

Why keep track of this information?

Similar PCs

If you service and maintain a large number of similar PCs you will save yourself a lot of time when you determine a problem that is common to them. In the above example many of the early model 50, 60 and 80's had floppy disk failures. IBM issued an engineering change to correct the problem. When you were servicing a model 50, 60, or 80 you could check the drive. This would save a later drive failure and another service visit. By locating these models in your organization that you service you could schedule service visits that minimize downtime for the users. This saves you the emergency service call.

Battery change

The log is especially handy to tell when the battery was last changed. A

Patsch is a consultant specializing in the selection, evaluation, and installation of IBM personal computer and compatible hardware and software.

battery failure will make the PC unable to boot since it does not have the configuration information. This is usually an emergency service call to replace the battery and discover no one bothered to make a backup of the configuration using the Reference diskette.

Repeat problems

The log will also uncover unusual problems and save you time trying to figure out why they occur. A particular PC kept coming in for a new power supply. Other similar PCs were not having this problem. By checking the location where the PC was used I discovered it was completely buried under mounds of paper with the disk drives barely visible. The PC was not getting any air flow at all. I explained that it was necessary for the PC to get air and it could not be buried. That fixed the mystery power supply power supply problem. I have discovered many a PC that is pushed up against a wall with very little air flow and save them a service trip. It is amazing how much dust builds up inside a PC and this tends to restrict air flow.

Frequent service

Another reason to keep a service log is it allows you to tell which PCs require a lot of service and which do not. If you work on many different brands of PCs you may discover some hardly ever require service while others seem to require a permanent space on the repair bench. You might also want to keep track in a parts log how long it takes to get parts for the PCs.

Of course you can keep your service logs on a PC. You might even want to set up a database. However you do it, I find it really does end up saving time. It takes a lot of work to get it set up, but only a few minutes to keep it updated.

While keeping a service log requires a little more work, I have found it very useful. The information in the log has saved time and allows me to provide better service.

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Circle (48) on Reply Card

ISCET VCR Cross Reference

VCR Model Number Cross Reference and VCR Parts Cross Reference

UPDATED - Feb. 1990. 272-page reference guide. \$35 plus \$3 shipping.

DISC - IBM-compatible disc with expandable data base. \$99 plus \$1 shipping.

COMBO OFFER: Book and disc for only \$125 plus \$3 shipping.

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Symptom: Set turns itself on or off erratically

Set ID: RCA GER768SR with chassis CTC 101B

Photofact: 1945-2

This set would occasionally turn itself on. At other times, when the set had been turned on with the remote control, it would turn itself off in the middle of a program. Then on occasion it would turn itself back on again.

The remote hand held transmitter is a seventeen function infrared control. All seventeen functions operated normally, which indicated that the MCR011A remote receiver and preamp were not at fault.

The mechanical on/off switch located on the front of the set is a small normally open, low voltage, low current pushbutton. Since this switch had not been operated in the nine years that the set had been in use, I reasoned that perhaps oxide or corrosion in the switch was causing enough leakage to turn the set off

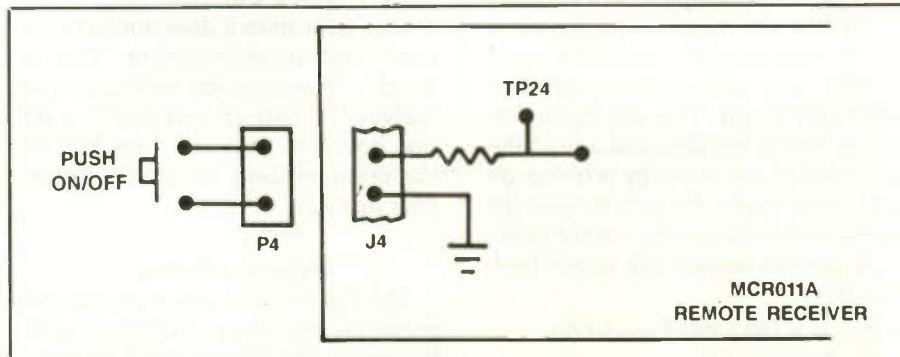


Figure 1.

and on. I disconnected the set and operated the pushbutton a dozen or so times. This cured the problem without even taking the back off of the set.

If the problem recurs, we will disconnect plug J4 from P4, which will

disconnect the pushbutton, as the pushbutton is never used. See the diagram in Figure 1.

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Circle (42) on Reply Card

Test your electronics knowledge

Answers to the quiz
(from page 52)

1. A—That is the condition required for series resonance.
2. B—The equation for series resonance is $f_r = 1/2\pi LC$. There is no resistance given in the equation.
3. B—By definition.
4. Susceptance—By definition
5. B—This condition was explained in a previous "What Do You Know About Electronics?" See last month's issue.
6. 10. Just because the numbers in the question range from 0 to 9, that

doesn't mean they represent the range of numbers in the radix.

7. Common base—The input signal is to the emitter and the output signal is taken from the collector. An example is shown in Figure A.
8. A—As explained in "What Do You Know About Electronics?" See last month's issue.
9. C—There is not enough evidence to judge the condition of the transistor. For example, the transistor may be connected as shown in Figure B.
10. B—It is the same as series resonance where there is no resistance in the branches.

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Contact Jeff Uschok, 516-681-2922, for information on frequency and pre-payment discounts, or to place your classified ad. Or send your order and materials to Jeff Uschok, Electronic Servicing & Technology, 76 North Broadway, Hicksville, NY 11801.

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B&K EQUIPMENT: 3010 Function generator, 470 CRT rejuvenator, 1479B oscilloscope, 1653 A/C Power Supply, 1610 DC power supply, 520B transistor tester, HV-44 probe. Simpson 431 pattern generator like new, with instructions. (913) 862-0174.

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TUBES WANTED: We buy receiving and transmitting tubes. Send your list for bid. New tubes in original boxes only. Also need radio. I.F. XFMRs. Antique Electronic Supply, 688 West First St., Tempe, AZ 85281. Phone 602-894-9503, Fax 602-894-0124.

FOR SALE

VHS-VCR Repair Solutions Sets I,II,III,IV,V. Each contains 150 symptoms and cures, cross reference chart, free assistance, \$11.95 each all five \$49.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530.

REDUCED 85%: Diehl Mark 111 scanner \$89. Diehl Mark V scanner \$219. New. Restore remote control keypads with our conductive coating \$8.99 ppp. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629. 608-233-9741.

TV TOUGH DOGS: 300 symptoms and cures. Send \$9.95 to DAVIS TV, 11772 Old Fashion Way, Garden Grove, CA 92640.

TELEVISION AND MONITOR TROUBLESHOOTING BOOKS: 336 Problems/Solutions, \$12.00, 35 Steps to Easier Television Repairs, \$15.00 Add \$1.50 shipping. Refunds if not satisfied. Fred Jones, 407 Morningbird, Niceville, FL 32578.

TV/VCR REPAIR SOLUTIONS: Printout or IBM compatible with hard drive. 3,400 solutions. Time saver, quick scan by make, model chassis or stage \$90.00. Post paid to electronics Solutions 407 W. Ave "N", San Angelo, TX, 76903.

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TV TROUBLESHOOTING: Over 150 solutions. Easy to read chart. Send \$2.00 to: Angel Books, P.O. Box 862, Dept 20., Renton, WA 98057.

SENCORE VCR EQUIPMENT: SC61, PR57, VC63, NT64, DVM37, Excellent condition. Call Glen Brooks, 838 Judson Apt. 1A.

DIEHL: Mark series scanner parts and circuit boards. Jerry's Radio Service, 409 S. Oklahoma St., Shamrock, Texas 79079. (809) 256-3405.

PHOTOFACTS: Folders under #1400, \$4.00. Above #1400, \$6.00, sent same day first class postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554.

Readers' Exchange

Readers' Exchange has been reinstated as a free service, effective with the February issue.

The following restrictions apply to Readers' Exchange:

- Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.

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

Send your Readers' Exchange submissions to:

**Readers' Exchange
Electronic Servicing & Technology
76 N. Broadway
Hicksville, NY 11801**

WANTED

Dual trace delayed sweep, 40Mhz oscilloscope; counter, timer 2 channel, 100Mhz; ac/dc Hi-Pot, 4KV. George Demaris, 7387 Pearshing Ave., Orlando, Fla 32822.

Tentel VCR Test Accessories. *Debbie, (219) 264-2147*

Volume Control Pot for Realistic model SASD0 tube amp. Schematics for Alupent 10tid, digital tuner model. CAT head receiver CR400, Saffas Heathkit Cop Checker, UJB-IKYR-CC-78-Syracuse. *Larry Kat, 49 Raffertson St., Finadine, Texas 75683.*

Schematic for Samsung color TV model CT-334KA. Will pay any reasonable price. *M. Morales, 2265 Davidson Avenue, Bronx, N. Y. 10453 (212)-367-4852.*

Schematic for multicheck MV-070, VCR and K-Mart, KMC131C9901A, TV. *O. Bilgic, 301 Ball St. No. 2087, College Station, TX 77840, (409) 845-7407.*

TEAC A-4070 Reel-to-Reel tape deck. Need not be working. Owners manual for AKAI AA-V201 receiver. *Walter Yuknovis, 7036 Black Oak, RD #31, Gary IN 46406; 219-845-5123.*

Any information on servicing garage door openers. Including hand held transmitter and receiver. *Douglas Walter, D&D Service ALL, 13314 Lake George Lane, Tampa, Florida 33618.*

Service Manual/Schematic for Toshiba Beta VCR Model V-5530 T. Will buy borrow/copy. *Charles Olsefsky, 17429 Napa St., Northridge, CA 91325, (818) 349-7128.*

FOR SALE

Used electronics books old and current. *Carl Beckett, 116 Tawn Dr. East Flat Rock, NC., 28726.*

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Tektronix scope model 465, with piggyback meter. 100MHz, dual channel, with delayed sweep, \$895. *(503-692-3337) David Watson, 21265 SW Makah St., Tualatin, OR 97062.*

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Sams Photofact folders #29-1700 (95% complete) \$195.00, or best offer. Score CR31A, Super Track CRT Tester & Beam. Builder \$295.00, or best offer. Score Caddy Bar Generator \$50.00, plus shipping on all items. Ace Electronics, M 6717 Calispel, Spokane, Wash. 99208, 1-509-467-2575.

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