THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC T.M.

Servicing & Technology

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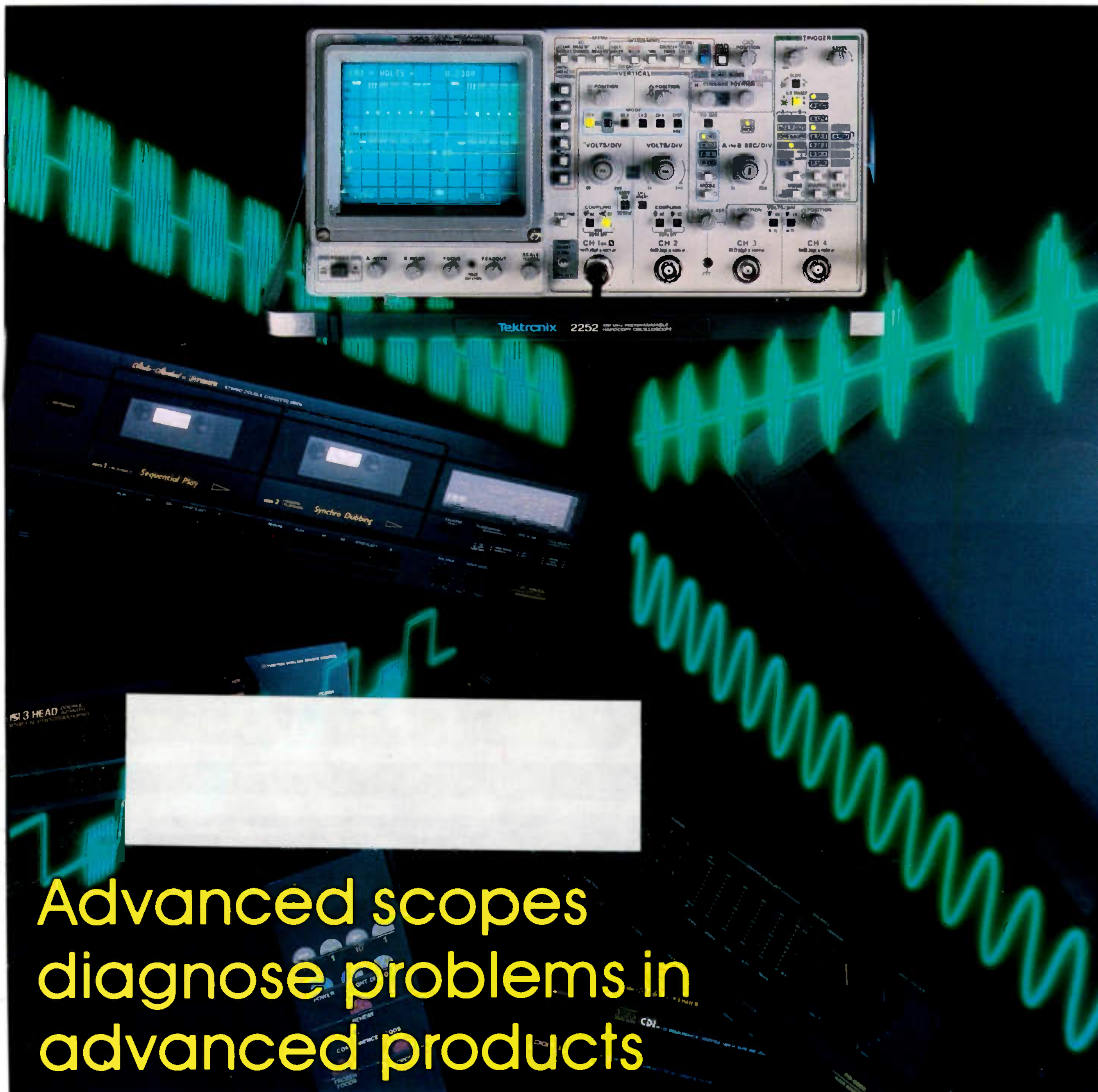
Understanding Automatic Gain Control - Part II

Troubleshooting RCA's CTC 109 Chassis



Advanced scopes diagnose problems in advanced products

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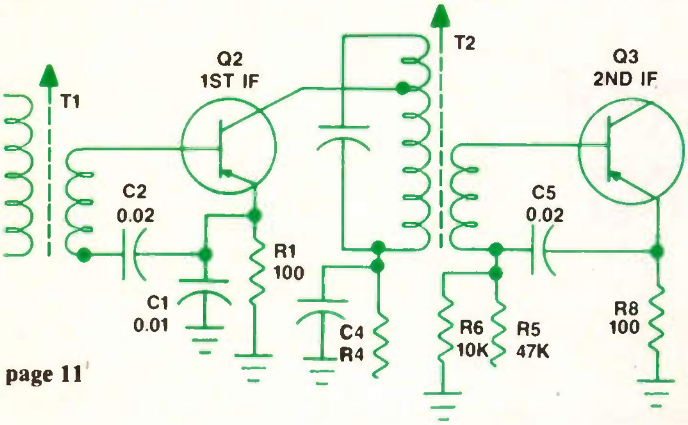

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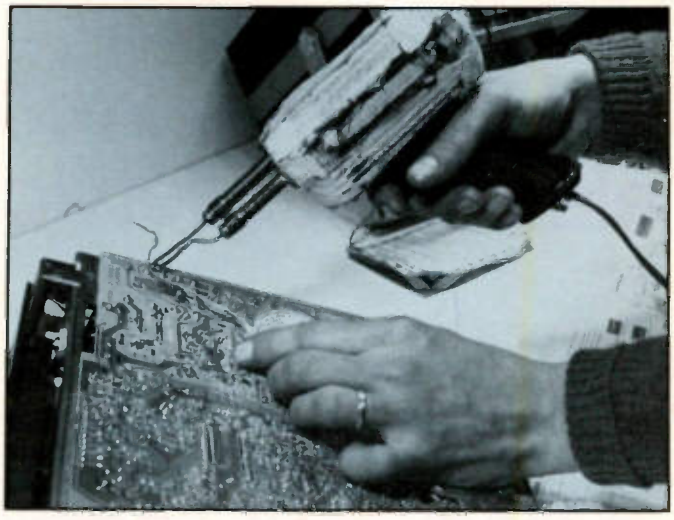

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ON THE COVER

The oscilloscope is the one piece of test equipment that can reveal the most information about what's going on within the circuitry that a servicing technician suspects of being faulty. Today's advanced oscilloscopes offer technicians unprecedented performance, yet are easier to use than their predecessors. *(Photo courtesy Tektronix).*

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The complex world of electronics servicing

In past editorials we have pointed out the wisdom of self-analysis as applied to the electronics servicing facility. After all, how can you know how well you're doing unless you know what it is that you're supposed to be doing, and what level of that thing is considered acceptable, good or excellent, or, perish forbid, deficient.

In thinking about this kind of analysis, it occurred to us that the business of consumer-electronics servicing is not only extremely complicated but requires expertise in so many areas that it almost boggles the mind to take a close look at it.

After talking recently to a manager at a large facility in the western U.S., I began to make a list of the many functions that have to be performed to make an electronics service center run. Some of that analysis are reproduced here. I think that many of you will be amazed at just how much you manage to do, in many cases without even being fully aware that you're doing it.

Let's start with the obvious function of a service facility: the technical end - fixing things. This seemingly simple function is actually broken down into a number of sub functions: handling the product, disassembling the product, testing, diagnosing the problem, and repair.

As involved as the mere repair function associated with consumer electronics servicing seems to be, based on the above analysis, that's only one, albeit the most important one, of the many functions performed by a service center.

Think about it. The running of any business requires that a surprising number of functions get done.

Here's a list of them (and don't forget, these are in support of, and secondary to the technical function):

- the business function
- the facility function
- the personnel function
- the organization function

As impressive as each of those functions may appear, give some thought to what each of them entails.

For example, look at the business function. If you're going to get business into the facility, there will have to be some advertising. That means that someone will have to decide where the advertising will be placed, how much is available to be spent on advertising, what form the advertising will take. Then, also on the business side, someone has to keep the books: the accounting function. If the customer is to be satisfied with the service received, he must be informed up front what level of service he may reasonably expect. This is called customer education. And when a customer, satisfied or dissatisfied, doesn't pay for the service received, someone has to collect it.

But take a look at the facility function. There must be somewhere to do the work. At the outset, decisions have to be made. How large will the facility have to be? Where should it be located? Should it be bought, leased, rented, or what? How much area should be allocated to service benches, how much to the administrative tasks of receiving the product to be serviced, talking to the customers via telephone, etc. What is adequate lighting for the difficult task of fixing today's complex consumer electronics products? How much storage area is enough, and how should it be laid out.

Then there's the organization task. This function includes such things as keeping track of the location and condition of the customers' products as they go from being taken in at the front counter, through the repair process, to the final staging area where they wait for a concerned owner to take them home. This is a multifaceted process, and if you plan to keep the customer satisfied, you had better be good at this.

For example, once a product comes in the door, who does it get assigned to? If you have to back order parts, when does the customer expect the product back, and will the back-ordered parts put the repair past that deadline?

And when you need to hire someone or fire someone, again, you've entered a world that needs experts. For starters, someone has to determine the precise job requirements. And once the job requirements have been defined you'll probably have to place a recruitment ad in the paper. Who gets to write the ad? But that's only the beginning. Depending on how good your ad sounds, the size of the community, where your shop is located, and the unemployment statistics in that area, you might get dozens of applications. Who will sift through them and decide who gets interviewed?

I'm sure that if you spend a little more time on this analysis you'll find yet more functions that have to be performed in order to make a service center run: for example education of the technicians, and for those businesses that have a number of vehicles, fleet management. But you get the idea. In today's business climate, electronic servicing has become an increasingly complex business. No wonder it's not easy for small electronics service centers to remain in operation.

Nils Conrad Persson

New ECG® Converter Offers Output Loop And Remote Controlled Volume.

Makes any TV cable-ready. TV-1500 features 75 channels, sleep timer, 10-channel memory, channel 3 accessory loop, A/V output jacks. Remote control of TV power, scan, mute and more. One of 4 models. UL listed.

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DAT issue on back burner, congressional staff tell WCES attendees

Congress is unlikely to revisit, let alone resolve, the digital audio tape (DAT) controversy at a time when DAT litigation is pending in federal court, a group of senior congressional staff assistants told attendees of the 1991 International Winter Consumer Electronics Show (CES) in Las Vegas. Substituting for members of Congress, who were forced to cancel their planned visit to the Winter CES because of the debate on Capitol Hill over US military involvement in the Persian Gulf, the staff aides agreed that the new Congress will be reluctant to tackle the DAT issue, looking instead to the courts—and to the parties themselves—for a resolution of this long-simmering dispute.

Patricia Delgado, legislative assistant to Rep. Henry A. Waxman (D-CA), noted that Congressman Waxman has "a long-standing interest in copyright and intellectual property issues." Rep. Waxman, whose Southern California district includes the Hollywood Hills and Universal City, was the principal House sponsor last year of legislation that would have codified the DAT agreement reached in Athens between the international record and audio hardware industries. That compromise unraveled at a Senate hearing last summer, when the nation's music publishers and songwriters refused to accept the terms of the agreement. House hearings on the Waxman bill were subsequently canceled, and an October meeting among the affected industries was described by Ms. Delgado as "a disaster."

"Congress is probably not the forum for resolution of this dispute," Ms. Delgado concluded. "Congress is not interested in addressing the (DAT) issue until such time as all parties make an honest effort to resolve it themselves."She noted that following the legislative impasse and the decision by Sony to ship DAT recorders to the United States, a class action suit was filed and is now pending in U.S. district court.

Mike Powell, legislative assistant to Rep. Howard L. Berman (D-CA), recalled former House Speaker Tip O'Neill's maxim that "all politics is local" in outlining Rep. Berman's position on copyright issues in general and DAT in particular. Representing Los Angeles, which he described as "the home of the recording industry and thousands of songwriters," Congressman Berman favors a royalty on blank tape, although Mr. Powell acknowledged that enactment of royalty taxes "most likely won't happen."

As far as the controversy surrounding DAT is concerned, Powell said the "Congress is not the focal point for resolving this dispute," although he cautioned that "the courts, with their adversarial approach, may find it difficult to reach a consensus solution."

Rob Wrigley, administrative assistant to Rep. Stephen L. Neal (D-NC), said that most members of Congress "are vaguely aware (of the DAT issue) but are not really familiar with the details.'' Unlike his counterparts from California, for example, Congressman Neal has "no real constituent interest" in this controversy and thus will seek to be "most responsive to the interests of consumers."

Organization formed to combat zoning and covenant restrictions on satellite dishes

The American Satellite Television Alliance (ASTA), a non-profit Washington corporation, has been formed to combat zoning and covenant restrictions that impede purchase and use of satellite TV systems. ASTA will engage in publishing, educational, press relations, and ultimately government relations activities related to zoning/covenant issues. ASTA shortly will publish a legal information package to equip dish owners, dealers and legal counsel to win zoning disputes. A near-term project will be publication of a similar package on restrictive covenants. Principals of the new organization include two former officials of the American Home Satellite Association (AHSA). For information about ASTA, and its zoning legal information package contact the American Satellite Television Alliance (ASTA) Suite 400, 16 Broadway, Valhalla, NY 10595, 914-997-8192. ■

Literature

Technical publication on causes and cures for power line harmonic problems

Drantez Technologies, Inc. is offering a free, 12-page technical publication called Power Line Harmonic Problems—Causes and Cures. This publication will give the reader a better understanding of what harmonics are, their effect on electrical equipment and what can be done when they become a problem. With the proliferation of personal computers and other office and factory automation devices, whose internal power supplies are often the source of harmonic generation, the problem is increasing at an alarming rate. Both commercial and industrial facilities are susceptible to this type of electrical power quality problem.

Catalog introduces SMT and microprocessor test accessories

Pomona Electronics has introduced a totally new, 140-page 1991 catalog of electronic test accessories. Highlights include a new 32 pin PLCC (0.5 pin spacing) clip for popular new EEPROM devices and 100- and 132-pin QFP SMT test clips for Motorola 68020/68030 and Intel 8036SX microprocessors. Additional accessories to make testing SMT devices easier and more reliable provide a complete solution for this growing area. The catalog also features new IC clip kits, coax/BNC universal adapter kits, digital multimeter test lead kits, cable and patch accessories and jumper kits.

Philips expands audio and video product line

Philips ECG has expanded its audio and video product line to include a larger selection of VCR mechanical replacement parts and replacement RF modulators. The expanded line of more than 270 products is described in the second edition of the ECG Audio and Video replacement Parts/Service Aids catalog and cross reference guide—a consolidated source of several previous ECG publications.

The catalog contains pictorial selector guides, specifications, cross reference sections and related replacement information on a variety of VCR modulators, opto-sensing devices, pinch rollers, idler wheels, assemblies and tires, individual belts and belt kits. Service aids for fine adjustments to tape equipment are also featured in the catalog and include precision adjustment tools, audio/video test cassettes, and audio/video lubricants and cleaning materials. The catalog cross references 31 popular VCR brands and over 2400 industry model/part numbers to the corresponding ECG replacement part. ECG replacement parts are designed to meet or exceed the original equipment manufacturer's specifications.

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

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Choosing a new scope

By Brad Harris

Technology marches on. And so should your test equipment—if you don't want to be left behind. Oscilloscopes are a good example. If you haven't looked at what's new in scopes for the past few years, you're in for a pleasant surprise. Never before have scopes offered so much performance and variety of capabilities for the dollar. What's more, it's the kind of performance you'll need to keep pace with technology.

Take bandwidth, for example. Five years ago, personal computers (PCs) typically had 5MHz clock rates. Today, 20MHz clocks are becoming common fare. Such jumps in clock rates require commensurately higher bandwidth scopes for accurate digital timing measurements.

But bandwidth isn't always everything. Many of today's scopes also offer an array of new features that simplify and speed up everyday measurements and troubleshooting. These include automatic setup, built-in measurements, glitch capture, screen copies to a printer, and much more.

The question is, of all the scopes and features on the market, what's the best choice for your needs? To answer this, let's take a look at some key scope features and what they can do for you.

Harris is Product Manager of the Oscilloscope Group at Tektronix, Inc.

First things first

When looking at something new, it's all too easy to get excited about special features and forget or minimize fundamental needs. Oscilloscopes are no exception to this human foible.

Keep in mind always that an oscilloscope has one fundamental purpose: to acquire and display waveforms. Virtually all other oscilloscope features, no matter how new and exciting, are based on that one fundamental purpose.

So the first thing you need to do is establish the basic waveform acquisition needs for your application. These include bandwidth and rise time, triggering, and special capture considerations.

Bandwidth and rise time

Digital clock rate offers a good example of the importance of scope bandwidth and rise time. In fact, with the amount of digital circuitry in today's consumer products, clock rate may well be the most important bandwidth consideration.

Take today's video equipment for example. Video signal bandwidths haven't changed for years. But video equipment features have certainly changed. Most video equipment today uses a substantial amount of digital control and programming circuitry. That can easily mean higher scope bandwidth requirements for overall video equipment servicing.

To get a feel for the higher bandwidth requirement, consider the waveform displays shown in Figure 1. The waveform in both cases is the same 5Mhz square wave. In one case, however, the waveform is displayed on a 20MHz scope. In the other case, it's displayed on a 50MHz scope.

The difference scope bandwidth makes in preserving the actual shapes of waveforms, especially digital pulses, is dramatic. The ability to see

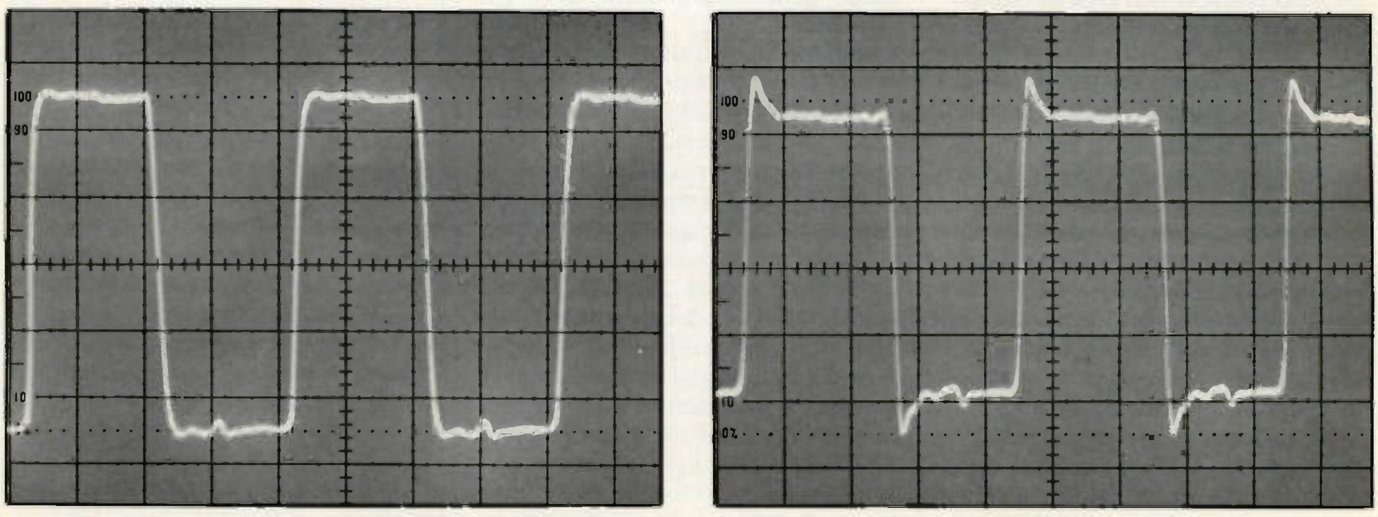


Figure 1. Bandwidth captures waveform detail as shown in these two oscilloscope displays of the same 5MHz square wave. The display on the left (a) is from a 20MHz scope, and the one on the right (b) is from a 50MHz scope.

all pulse aberrations can also be critical in troubleshooting digital circuitry. Pulses that look clean because of a low scope bandwidth may actually have overshoot, ringing, or glitches that can cause digital circuit problems. If you can't see symptoms, how can you find problems?

As a rule, scope bandwidth should be at least five times greater than the highest frequency signal that you expect to look at. Of course, more bandwidth is always nicer if you can afford it.

Figure 2 illustrates another guideline that's important in making timing measurements. To capture a pulse's rise time with 5% accuracy, the scope's own rise time must be not more than 1/3 that of the signal (3:1 signal-to-scope rise-time ratio). For 2% accuracy, the ratio needs to be 5:1.

Let's say you want to measure a 10.5ns rise time with about 5% accuracy. That means the scope's rise time must be three times faster, or (10.5ns)/3 = 3.5ns. This rise time (Tr) can be related to scope bandwidth (BW) by BW = 0.35/Tr. So, a scope with a 3.5ns rise time has a 100MHz bandwidth.

Keep in mind, too, that bandwidth and rise time considerations must include the effect of the scope probes. So if you are looking at a "50MHz" scope, for example, be sure to ask: "Does that 50MHz specification include the probes?"

Other acquisition considerations

Not only must a scope have adequate bandwidth and rise time for your needs, but it must also have adequate triggering. If a scope can't trigger on the specific waveform you want to see, then it can't display that waveform.

Take a close look at your triggering needs and then at the triggering features the scope provides. Most scopes today provide a standard complement of manual, single, and automode triggering. But if you are working with video equipment, you'll want TV Line and Field triggering, too. Not all scopes offer that.

Delayed triggering is another useful feature, especially in digital applications. You can use it, for example, to capture and expand on the full rise time of a pulse. Or, you can trigger on a system clock pulse and delay the sweep on the other channel to look at a bus line some time after the clock pulse.

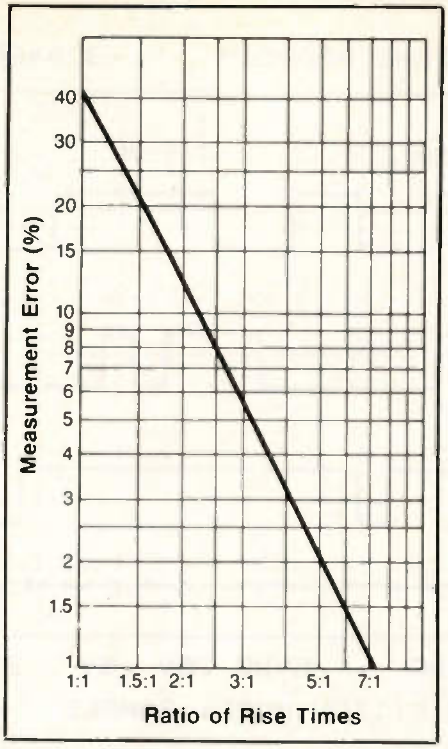


Figure 2. The ratio of a signal's rise time to a scope's rise time determines how accurately the signal's rise time can be measured. A scope's rise time (Tr) and bandwidth (BW) are related by Tr = 0.35/BW.

And that brings up another point. How many acquisition channels do you need? It's nice to have two at least. That way you can look at and compare a circuit's input and output signals simultaneously. But some circuits, most notably digital ones, have multiple inputs and outputs. So if you have a four-channel scope, you can at least look at bus signals four lines at a time.

Waveform recording

Let's say you want to compare more than four signals, an 8-wide bus for example. With a standard, four-channel scope, you look at four lines, try to remember what the signals look like, then look at the other four lines.

Another approach might be to use a digital storage oscilloscope (DSO). This allows you to store signals in digital memory and then recall them for viewing. Depending on the DSO, you may even be able to view four stored signals while simultaneously looking at four more signals on the DSO's real-time analog display.

A recent innovation allows you to connect a printer directly to the scope for display hardcopies. Such a scope hardcopy is shown in Figure 3.

Display hardcopies can be used for a wide range of things. In the case of an 8-line bus, you can print out the signals for four lines, then you can use that hardcopy for comparison while using the scope to look at the other four lines.

Or what about those files of TV schematics that you have? They show where the test points are, but in many cases not what the signals are supposed look like. When you use a schematic to troubleshoot a TV you could make hardcopies of what the "good" and "bad" waveforms actually look like, then write the testpoint numbers and any other information on the hardcopies and file them with the schematic. The next time you use that schematic you'll also have a complete waveform guide to troubleshooting.

Glitch capture

The scope hardcopy in Figure 4 illustrates still another useful waveform capture feature. The waveform in Figure 4 is the output of a DAC (digital-to-analog converter). Notice the glitches at several of the DAC levels. These glitches are so narrow that they wouldn't be visible on many standard oscilloscopes. In the case of Figure 4, however, they are clearly visible on the scope's screen and in the hardcopy because of the scope's peak-detect feature.

The issue is: How are you going to solve noise problems if you can't see the noise? Peak detection resolves that issue by capturing and displaying noise spikes using sampling methods. In scopes, this feature was originally employed in DSOs to catch noise spikes that might slip between samples. But today, peak detect features are moving into analog scopes. This can allow, for example, a 100MHz scope to capture glitches as fast as 10ns and display them clearly, even when using the scope at its slowest sweep speed.

The ability to see fast noise spikes at any sweep speed is an important trouble spotting capability. So peak detection is certainly an item worth adding to your list of scope needs.

Making life easier

Once you have the needed wave-

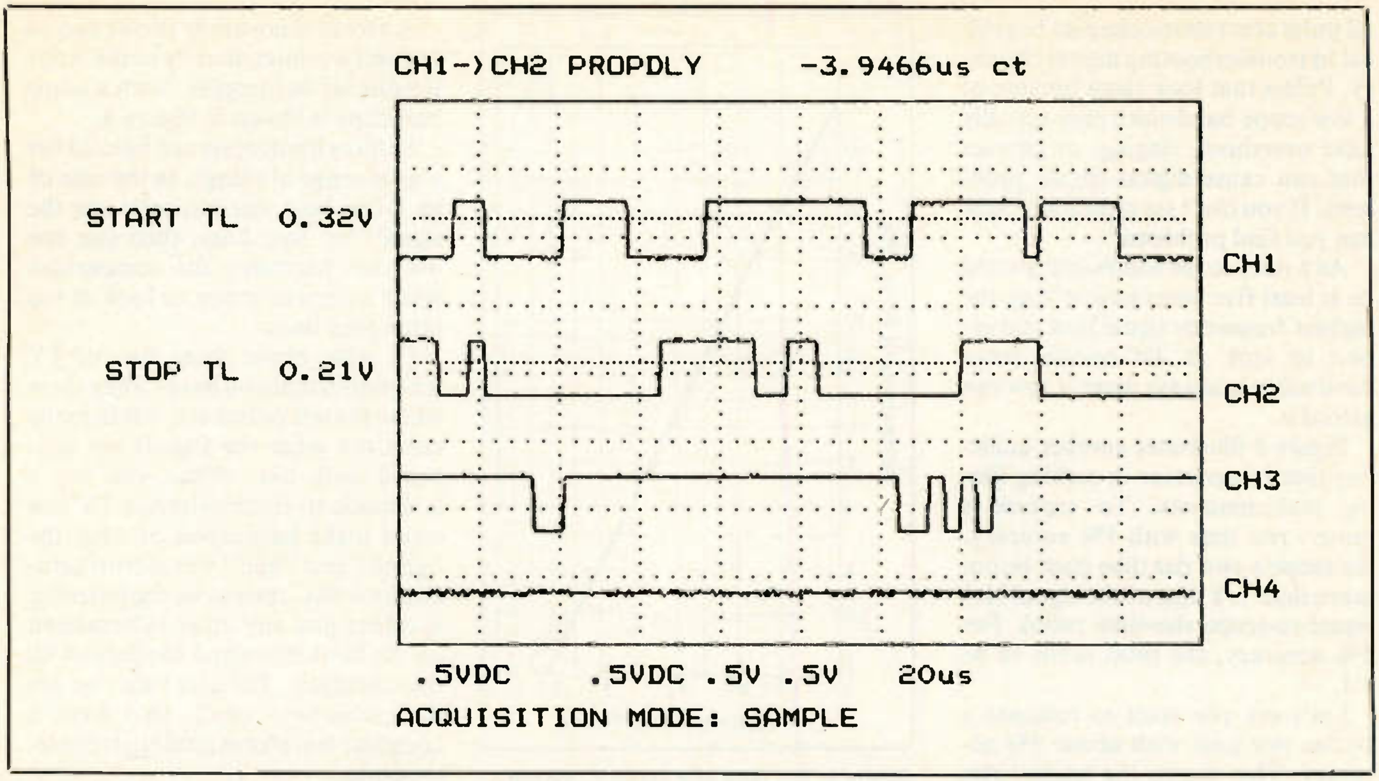


Figure 3. With hardcopy capability, screen displays can be output to a connected printer. This is useful for comparing signals on wide buses as well as preparing troubleshooting guides of what equipment testpoints should look like.

form acquisition capabilities in a scope, there are other features that can make your life a lot easier. For example, aren't auto-ranging voltmeters nice? Just touch a test point and read the voltage. You don't have to waste time fiddling with a range dial.

Scopes and waveform measurements are considerably more complex than a voltmeter. Just the same, though, life can be nearly as easy when the scope has an automatic setup feature. With an auto setup feature, you simply attach the scope probe to the test point and press the Auto Setup button. The scope automatically senses the key parameters of the probed waveform and automatically sets up a standard scope display for that waveform.

Touch a test point, push a button, see a waveform. What could be easier? And what could be faster for moving quickly through a circuit for waveform checks?

Of course, not everything can be done with a standard scope set up. Occasionally you may have to reach up and select a different triggering mode or make another adjustment for a special need. But even then you are making only a few adjustments as compared to a whole scope setup.

If the scope has a front-panel store/recall feature, even special setups can be automated. For example, let's say you regularly need to check video sync pulse width. You set up the scope for an overall display of the video waveform, then you adjust sweep speed, vertical sensitivity, vertical and horizontal positioning, and whatever else is necessary to expand just the sync pulse on the display.

When you've completed the setup, you can store it in the scope's setup

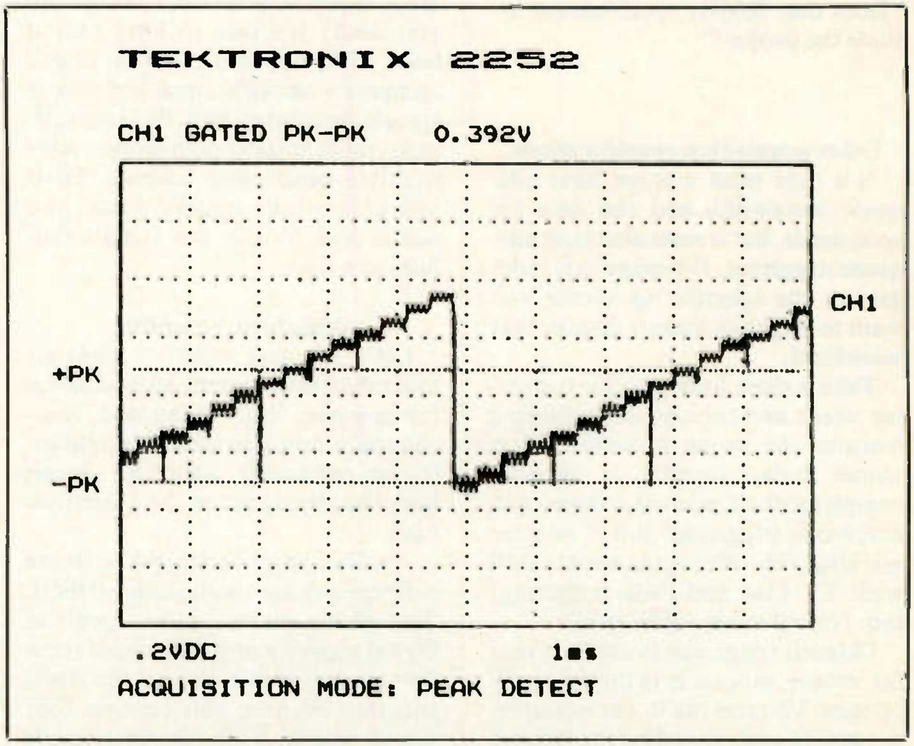


Figure 4. A peak-detect feature allows you to see glitches and other noise extremes that wouldn't be visible on many standard scopes and DSOs.

memory. Then the next time you need to look at a sync pulse, simply press a few buttons to recall the setup from the scope's memory. Depending on the scope mode, you may be able to store and recall as many as 20 or more complete front-panel setups for different needs.

So now you're able to quickly recall a sync pulse setup (or any other specialty setup) from the scope's setup memory. More than likely, the next thing you'll want to do is check the pulse's amplitude, width, and rise time.

The usual approach, to measure amplitude for example, is to vertically position the bottom of the pulse to a convenient graticule line. Then you count graticule divisions to the top of pulse, look at the vertical scale factor (Volts/Div), and do some mental calculations to get the pulse's amplitude. Then, to get pulse width and rise time, you do some more positioning and division counting.

All of these measurements are simplified, however, if the scope has built-in measurement functions. Measurement cursors, for example, can be placed on the waveform for readouts of voltage and time parameters. Some scopes have built-in voltmeter functions with cursors that track the waveform.

One advantage of the built-in voltmeter approach is that you don't have to manually position cursors for measurements. To make a measurement you select the voltmeter function and then push a menu button for the measurement you want (e.g., +peak, −peak, peak-to-peak). The voltmeter makes the measurement and displays the numeric result on the screen.

If you make an equipment adjustment to set the waveform's amplitude, the voltmeter automatically tracks the waveform. This allows, you to see the new amplitude values immediately in the measurement readout. You don't have to re-count divisions or reposition cursors to get the new reading.

In the same manner, a built-in counter/timer feature can automate measurements of frequency, period, width, rise time, fall time, and so forth. Additionally, if there is a measurement gating function, voltmeter and counter/timer measurements can be applied to specific aspects of the displayed waveform. For exam-

Analog-digital technology in test equipment

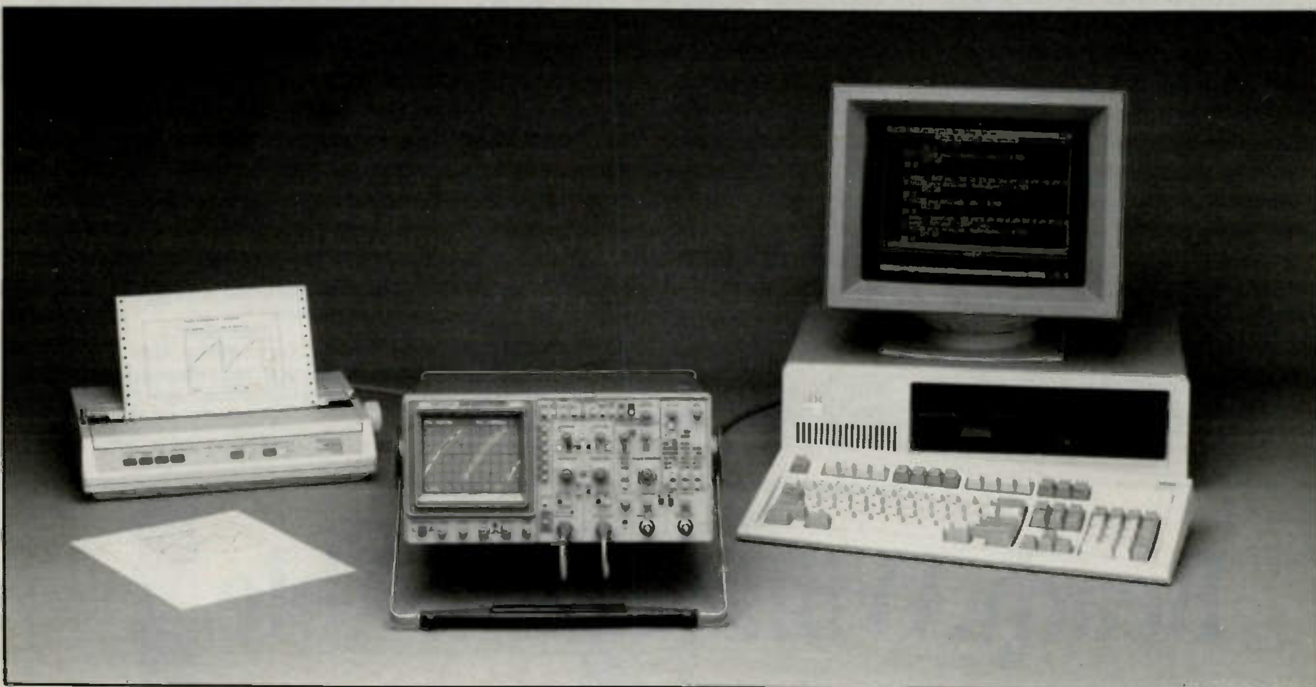
Recent innovations in oscilloscope technology allow manufacturers to use a blend of analog scope, digital storage scope, voltmeter, and counter/timer technologies in their products. The Tektronix 2252 is an example of this blending of analog and digital features.

The idea behind this technology is that the equipment is a familiar oscilloscope with a familiar oscilloscope front panel and familiar oscilloscope displays. But, behind the front panel is a blend of digital control, waveform sampling, and real-time measurements from a built-in voltmeter and crystal controlled counter/timer.

For example, when you press the AUTO SETUP button the scope samples the probed waveforms and automatically sets itself up for the best display of those waveforms. All the normal front-panel controls are still available for modifying the standard AUTO SETUP display for special needs. Built-in memory is also provided for storing and recalling as many as 20 different front-panel setups. Additionally, the scope can be controlled over the General Purpose Interface Bus (GPIB).

Waveform sampling and digitizing is provided on all four channels to give the unit several DSO-like qualities. These include 10ns glitch capture, on-screen cursor measurements, waveform transfer to a PC via the GPIB, or output directly to a printer for complete screen hardcopies.

The built-in automatic measurements, however, are not at all like a DSO's. They are not computed from a digitized waveform. Instead, standard amplitude and timing measurements are made directly on the live waveform using the built-in voltmeter and counter/timer functions. This provides real-time measurement results.



ple, setting the gate to cover aberrations on a pulse lets you measure peak aberrations, excluding the pulse. Gating with a counter/timer function allows you to selectively measure frequencies of ringing or burst structures in complex waveforms.

Making the choice

One thing is certain—there's a tremendous array of new features and capabilities available in today's portable scopes. This can make shopping for a new scope a bewildering experience. But that needn't be the case if you take a little time first to analyze your own particular measurement needs. As you do this, write down your specific needs and wants.

Start your shopping list with the fastest, most complex, and most difficult waveform that you ever have to deal with. This waveform will help you define your core scope requirements: bandwidth, rise time, and any special triggering needs. Then think about situations where you must look at more than one waveform at once. This will define the minimum number of input channels you need.

Add to the list any other special situations that you deal with. For example, if you have to deal with noise problems, write down, "Must be able to see glitches at any sweep speed."

Then think about things that will make your measurements easier—automatic setup, front-panel save/recall, built-in measurements, screen hardcopies. These things are often referred to as "convenience features." But they're really "efficiency features." Eliminate the time wasted in twisting setup knobs and counting graticule divisions, and you'll be finding and fixing problems faster. And that, in the final analysis, is what using an oscilloscope is really all about.

So make your shopping list as complete as possible. Then use it to zero in on the oscilloscope that's the right choice for all of your measurement and troubleshooting needs, including making life easier. ■

How AGC works - Part II

By Lambert C. Huneault

This is the second installment in a three-part series of articles on AGC by Huneault. In the first installment, which appeared in the February 1991 issue, the author described the fundamental principles of AGC and some of its applications. This installment will discuss forward AGC, reverse AGC, AGC in FM radios and AGC in television.

Please note that we have continued the figure numbers from the previous article, so there is no Figure 1, or 2 in this article. Figures 3, and 4, which appeared in Part I of this series are reproduced here as they are essential to this discussion.

Huneault now retired, was an electronics instructor and head of the REE Department at St. Clair College of Applied Arts and Technology in Ontario, Canada.

Forward AGC

Circuitry shown in Figure 5 operates in the forward AGC mode. Compare it to Figure 4. Notice something different? . . . The most obvious difference is the polarity of the detector diode. In this circuit, the rectified IF voltage at the output of X1 is *negative* because it's taken off the anode. When this pulsating dc voltage is fed back (through AVC filter network R3-C3) to the base of Q2, it actually *reinforces* the negative (forward bias) voltage already supplied to that base via R2. That's why the scheme is referred to as *forward AGC*.

Let's assume that, with no signal tuned in, the forward bias applied to the base of Q2 results in operating point 4 (current gain = 80) in Figure 3. When a medium strength signal is received, the negative AVC voltage increases the forward bias sufficiently to raise Q2's collector current to, say 1.2 mA, shifting the operation to point 5 on the curve. Note that the current gain is reduced to 50. If the signal is stronger yet, the increased AVC bias and Q2 current shift the operating point to number 6 in Figure 3, further reducing the gain to 20.

So, even though Figure 5 features *forward AGC*, the end result is similar to that in the *reverse AGC* circuit of Figure 4: the stronger the received signal, the lower the gain of the IF amplifier, thus avoiding disturbing blasts of sound and distortion when strong signals are tuned in.

Note that the R5-R6 voltage divider network provides Q3 with *fixed bias* in Figure 5, but this is incidental. As pointed out earlier, in some radios only the first IF transistor is AVC controlled.

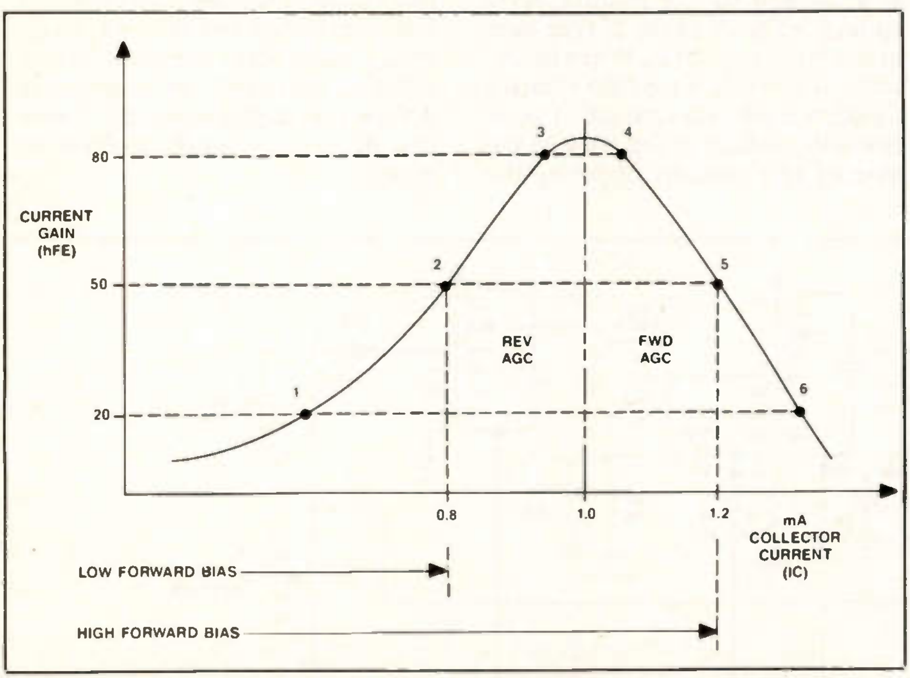


Figure 3. Transistors can operate in two different gain-control modes, depending on whether they are heavily or only lightly forward biased. Note that if the transistor is forward biased only slightly, its operating point falls on the left side of the characteristic curve, for example operating point 2. This is the reverse AGC region of the graph. If, on the other hand, forward bias is increased sufficiently to raise the collector current to, say, 1.2 mA (operating point 5), the transistor's current gain is once again 50 but the amplifier is now operating in the forward AGC mode (right side of the curve).

Reverse AGC vs forward AGC

Is one AGC mode preferred over the other? It depends on the application. One advantage of the reverse AGC circuit of Figure 4 has already been pointed out: X1 ends up slightly forward biased, improving the linearity of detection. This compares favorably with the forward AGC circuit of Figure 5, where X1 is actually reverse biased slightly by the −9V source, somewhat reducing the detector's sensitivity. Another advantage of reverse AGC can be significant in portable radios: because the gain-controlled IF/RF transistors are less heavily forward biased than in the case of forward AGC, transistor current is lower and so is battery drain.

In ac powered equipment, current economy is less important. Thus TV receivers commonly feature forward AGC, taking advantage of the greater linearity of the gain vs current curve in the FWD AGC region of Figure 3; this provides improved cross-

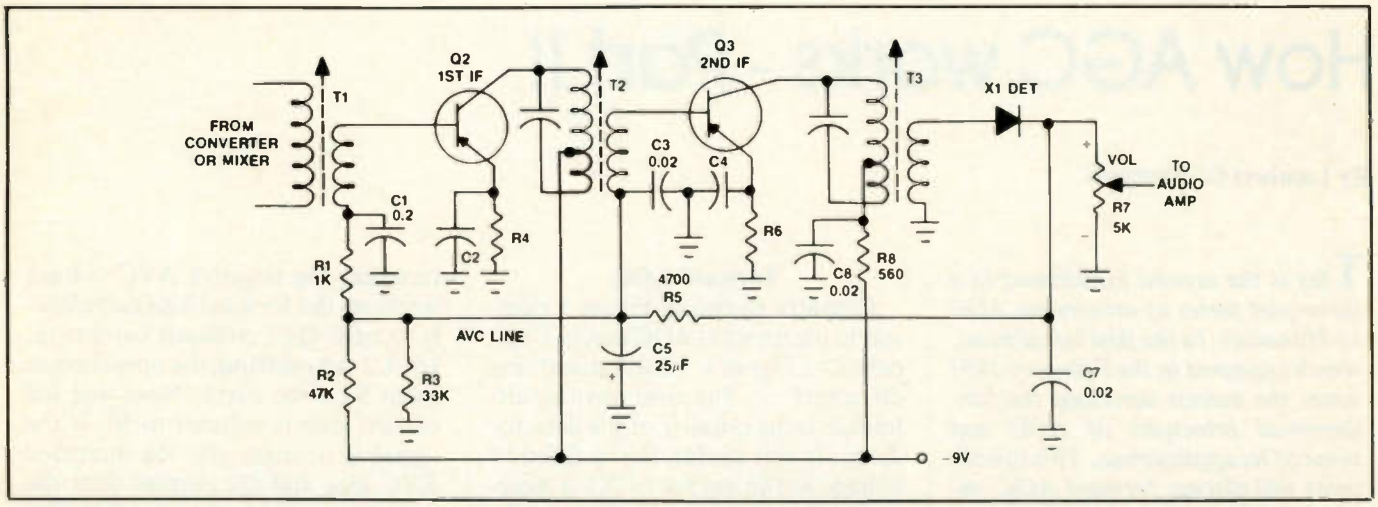


Figure 4. This is an example of reverse AGC. In this receiver, when a medium strength signal is tuned in, a moderate amount of positive dc voltage is produced at the detector's output and fed back via the AVC line to the N-type bases of the PNP transistors, thus opposing the negative bias provided by the power supply.

modulation characteristics. However, forward AGC produces greater changes in transistor impedances and junction capacitances. So the choice of AGC mode is left up to the designer . . . depending on the application.

AGC overload diode

While the circuits of Figures 4 and 5 have reasonably good AVC action, they do suffer from one shortcoming: on *very strong signals*, some overloading tends to occur due to the limited control action provided by those simple AVC circuits.

To overcome this deficiency and provide a greater range of control, a number of special circuits—featuring different degrees of sophistication—may be encountered in some radios. We'll only discuss one example: a circuit in which the primary AVC system is supplemented with an overload diode. See Figure 6.

This circuit features reverse AGC, as evidenced by the positive AVC voltage fed back to the N-type base of the 1st IF transistor. When the receiver is tuned to a medium strength signal, a moderate amount of positive AVC voltage is fed back to the base of Q2, partially opposing the forward bias voltage applied by the −7.5V power supply, via R3. Still, enough collector current flows to cause a voltage drop of more than 1V across R2; let's say that the Q2 collector voltage is reduced to −6V. The collector of Q1, on the other hand, has a fixed voltage of −6.5V (decoupling resistor R1 drops 1V). Under these conditions, overload diode X2 is reverse biased and behaves like an open circuit. Since the diode has no effect on the circuit, we have regular AVC action during reception of normal signals . . . weak, medium or strong.

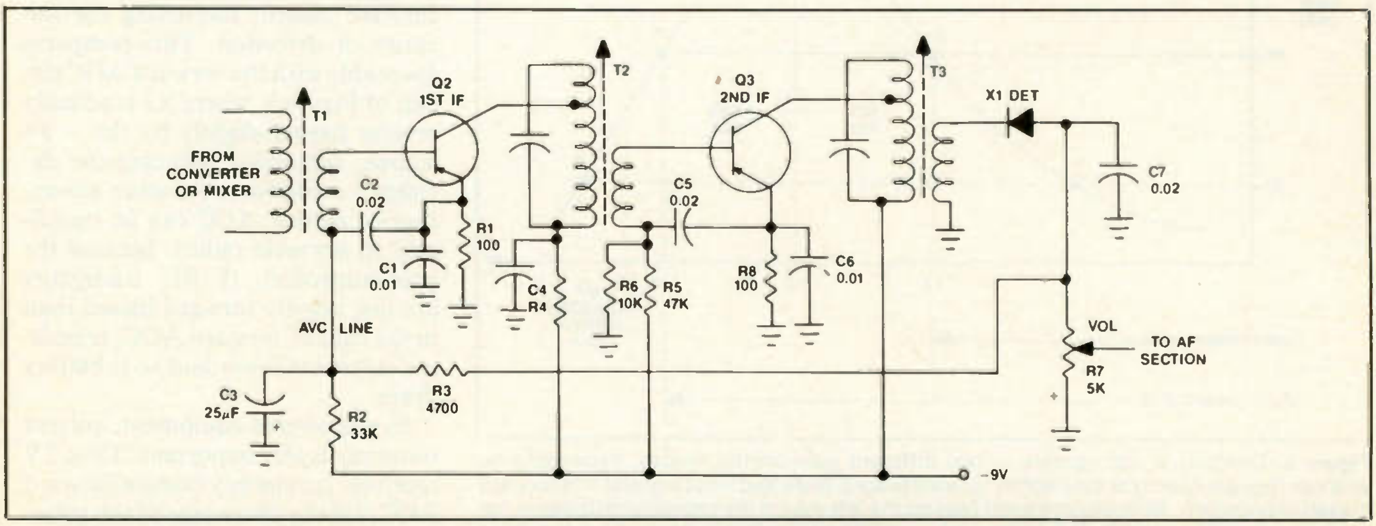


Figure 5. This scheme is referred to as *forward AGC*. In this circuit, the rectified IF voltage at the output of X1 is *negative* because it's taken off the anode. When this pulsating dc voltage is fed back (through AVC filter network R3-C3) to the base of Q2, it actually *reinforces* the negative (forward bias) voltage already supplied to that base via R2.

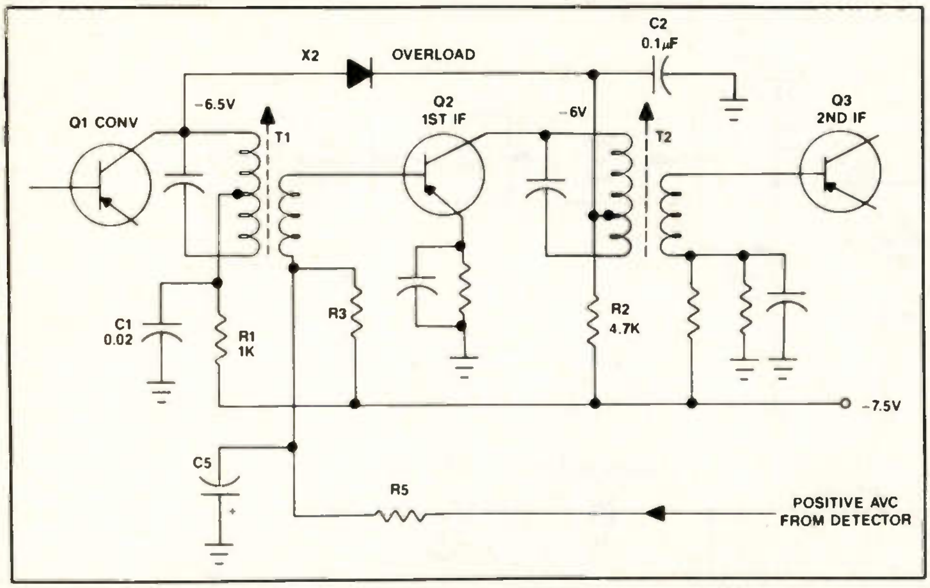


Figure 6. While the circuits of Figures 4 and 5 have reasonably good AVC action, on *very strong signals*, some overloading tends to occur. In this circuit, to overcome this deficiency and provide a greater range of control, the primary AVC system is supplemented with an overload diode.

But when a *very strong signal* is tuned in, the large positive AVC voltage fed back from the detector plays a dual role: its bucking effect on Q2's forward bias not only reduces the gain of the 1st IF transistor, but the latter's collector current is reduced so much that R2 drops only about 0.5V, allowing Q2's collector voltage to rise to, let's say −7V.

The overload diode thus becomes forward biased and conducts, acting like a low resistance in series with large bypass capacitor C2. This heavily loads down the converter's tuned circuit, substantially reducing the amplitude of the signal fed to the IF circuitry and avoiding IF overload.

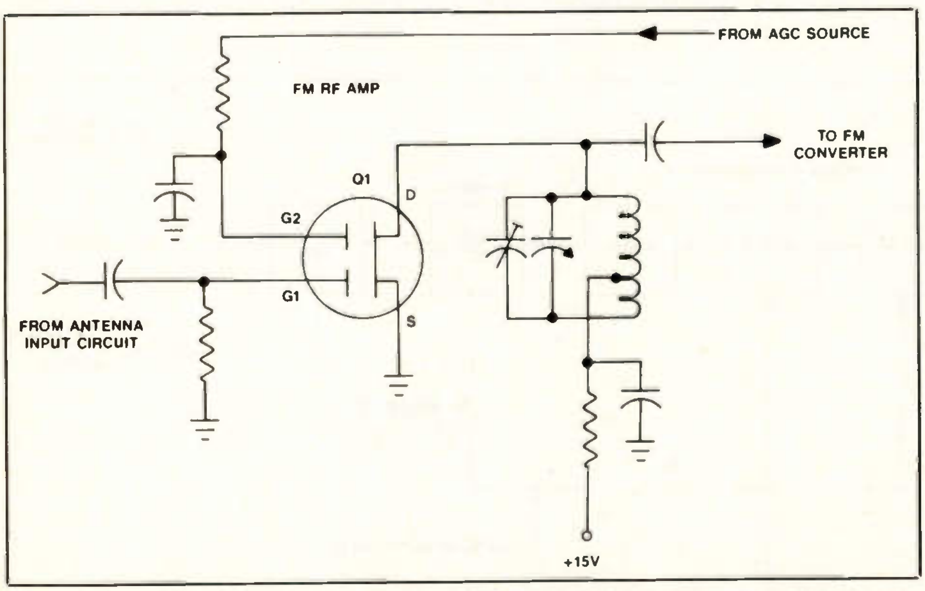


Figure 7. In an FM receiver, AGC control of the RF amplifier stage enables the receiver to tolerate a wider range of input signal levels. In this circuit, Q1 is a dual-gate MOSFET, providing convenient isolation for the AGC input. The RF input signal is coupled to gate 1, and the AGC voltage to gate 2.

AGC in FM radios

In FM radio, audio amplitude (volume) is related to the frequency deviation of the RF signal, not to its amplitude. Therefore controlling the gain of the IF amplifiers would not provide automatic volume control. As a matter of fact, an FM limiter stage usually clips the IF signal before it reaches the detector, but this is done to limit noise, not to control volume.

So, is AGC needed in FM receivers? Yes and no! The IF amplifier section can usually get by without it, but in the front end the RF amplifier stage can generally benefit from it, enabling the receiver to tolerate a wider range of input signal levels.

FM RF amplifiers may feature bipolar junction transistors (usually connected in the common-base configuration to avoid the need for neutralization), junction FETs (to minimize cross-modulation and intermodulation distortion), or MOSFETs (for increased dynamic range). Any of these active devices may be AGC controlled. We'll briefly examine one of them: the common-source MOSFET RF amplifier shown in Figure 7.

Q1 is a dual-gate MOSFET, providing convenient isolation for the AGC input. The RF input signal is coupled to gate 1 and the AGC voltage to gate 2. The AGC source may be the FM detector circuit, if the proper polarity of dc voltage can be obtained from it; or it may be a separate AGC detector diode receiving its input signal from one of the IF amplifiers.

As the signal strength changes, so does the AGC voltage fed back to gate 2; this varies the transconductance of the MOSFET and thus the gain of the FM RF amplifier.

Automatic level control (ALC)

Enough said about radio AGC. Next, let's move on to the domain of audio tape recorders. Better quality tape decks generally feature manual controls (with VU meters) which enable the user to adjust the signal level during recording. This is desirable, because if insufficient signal reaches the recording head, tape hiss and weak volume result during playback.

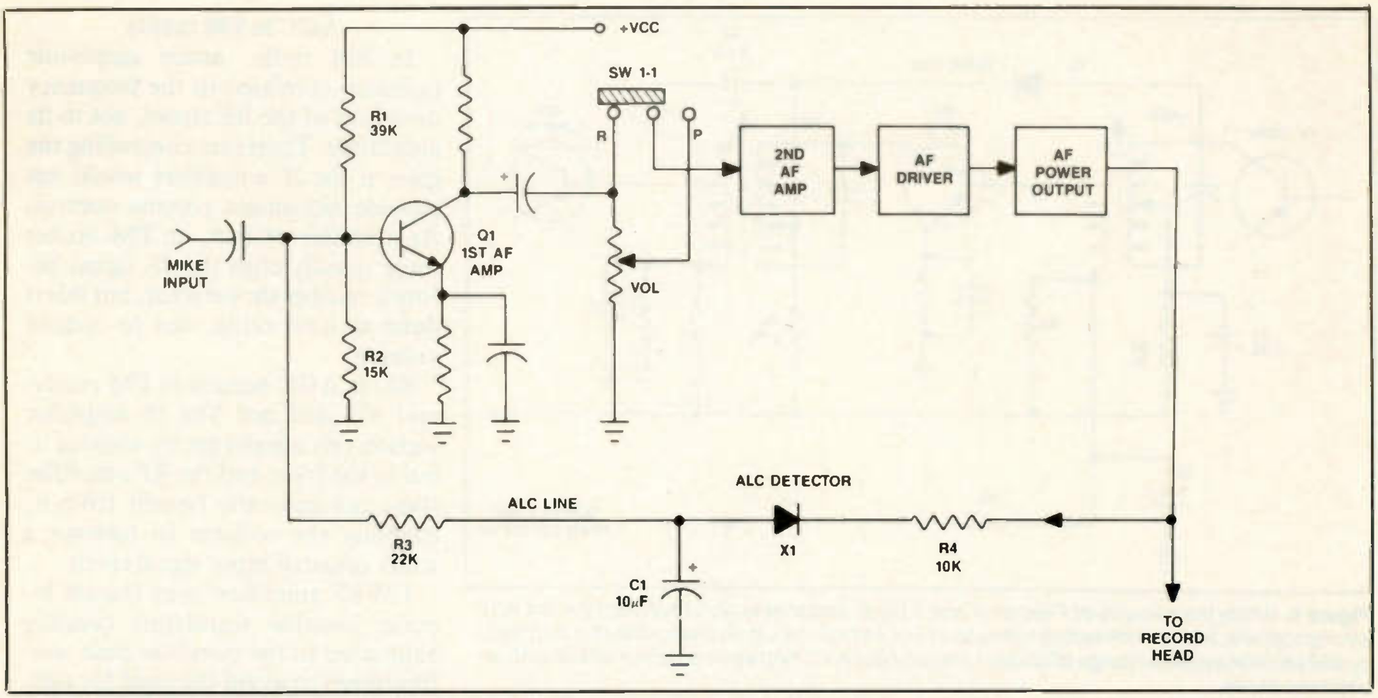


Figure 8. This tape recorder circuit uses automatic level control (ALC), a form of AGC, to automatically control the level of the signal recorded onto the audio tape.

An excessive signal level, on the other hand, results in distortion due to magnetic saturation of the tape.

Lower priced units, particularly portable cassette recorders, generally substitute manual level controls with an AGC circuit usually named Automatic Level Control (ALC). In a typical ALC circuit, a sample of the audio output signal going to the recording head is also applied to a half-wave rectifier, and the resulting dc voltage is used to automatically control the forward bias—and therefore the gain—of one of the audio amplifier transistors. This application of the AGC concept differs from radio AVC in that the signal rectified by the ALC detector is audio instead of RF; otherwise, the principle is essentially the same.

Figure 8 is a partial schematic of a cassette recorder, in the record mode. Forward bias for the Q1 base-emitter junction is partly opposed by the negative voltage produced by the ALC detector (half-wave rectifier) consisting of diode X1 and filter capacitor C1. Q1 operates in the reverse AGC mode.

Naturally, during recording the audio output signal is fed to the record head. But note that it is also fed

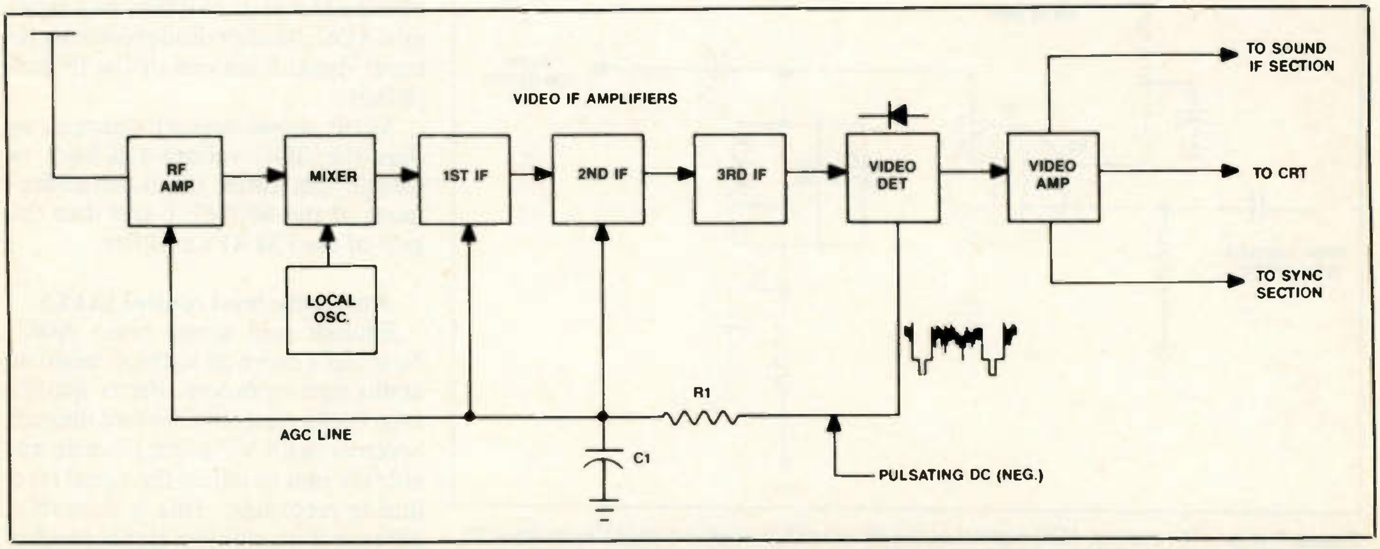


Figure 9. This is a partial block diagram of a monochrome receiver, showing how simple AGC used to be implemented before the advent of circuit improvements such as keyed, amplified and delayed AGC. See text for details of operation.

back through limiting resistor R4 to the ALC rectifier. The negative dc voltage at the output of X1 is filtered by C1 and applied through isolation resistor R3 to the base of Q1, where it opposes the fixed bias provided by the R1-R2 voltage divider. The stronger the average audio output signal, the more negative the ALC voltage and, therefore, the less the forward bias for Q1 and the lower the gain of the 1st AF amplifier. Therefore the audio signal amplitude at the recording head would be reduced, thus avoiding tape saturation during strong music or voice passages. On the other hand, weak microphone input signals would tend to produce low audio amplitude at the record head. But that would result in less ALC voltage; therefore the forward bias for Q1 would rise and so would the gain of the 1st audio transistor. The end result is that sufficient signal amplitude would be available at the record head to avoid tape hiss problems.

Note that although X1 produces a *negative* ALC voltage, the polarity of electrolytic capacitor C1 is correct as shown, because the *positive* dc voltage produced by the R1-R2 voltage divider—and present via R3 at the C1 terminal—is greater than the ALC voltage.

Note also that the volume control is unusable during recording because its wiper is disconnected by function switch SW1-1. In the playback mode the ALC circuitry gets disconnected (by another section of the switch, not shown) and the volume control is reactivated by SW1-1.

Television AGC

In TV receivers we can expect the video IF section to feature AGC because the picture signal is amplitude modulated. Without AGC, strong signals would tend to produce too much video amplitude and excessive picture contrast, as well as sync clipping due to circuit overloading. Weak signals, on the other hand, would tend to produce insufficient contrast, snowy pictures and possibly weak sync. Because the sound is frequency modulated in TV, sound IF amplifiers don't feature AGC. In the tuner, the RF amplifier is normally controlled by *delayed AGC*.

Let's begin with *simple AGC*. Figure 9 is a partial block diagram of a monochrome receiver, showing how simple AGC used to be implemented before the advent of circuit improvements such as keyed, amplified and delayed AGC. The output of the video detector (video signal) is a pulsating voltage whose dc component varies with the strength of the received signal. Therefore it can be used for automatic gain control, and works just like AVC in an AM radio. The polarity of the detector diode results in *negative-going* video; after filtering by R1-C1, the dc component is fed back to the RF amplifier and one or two video IF amplifiers, and can thus control the gain of these stages. The end result is that the video signal reaching the CRT remains virtually constant in overall amplitude (steady contrast) even when signals of different strength are tuned in. Or so it would seem!

Unfortunately, there's a fly in the ointment . . . three of them, as a matter of fact! The first problem is that in addition to varying in response to changes in the RF signal strength (as it should), the average voltage of the detected video signal also varies in response to changes in picture brightness. In Figure 9, the dc voltage at the output of the detector becomes more negative during a dark scene, while bright pictures produce less negative voltage. This affects AGC operation adversely. Secondly, if high amplitude noise is received with the signal, excessive AGC voltage is produced. And thirdly, simple AGC is too slow-acting to effectively combat aircraft flutter; the reason being the *long* time constant of the R1-C1 low-pass filter necessary to filter out the lowest frequency components of the video signal, such as 60-Hz vertical blanking and sync.

More to come

The concluding segment of this article will be published next month. That installment will contain information on keyed AGC, delayed AGC, AGC controls, AGC in integrated circuits, automatic color control (ACC), and automatic saturation control (ASC). ■

A servicing technician's glossary

By Conrad Persson

Once a year we normally publish a glossary to help readers keep up with the the constantly changing and expanding world of consumer electronics technology. This time we're going to place emphasis on the rapidly growing world of abbreviations, acronyms and computer terms, plus some of the terms associated with LCDs that a technician faces, or will soon face. Also thrown in will be definitions of a few terms that have piqued the interest of the ES&T staff. Here we go.

Please keep in mind that the number of definitions is limited here because of both space limitations and the speed with new terms are being introduced. If you don't see your favorite term defined here, by all means write or call us and we'll do our best to include it in our next glossary.

All-channel tuning: the ability of a TV set to receive all assigned channels; VHF and UHF channels 2 through 83.

ASCII: American standard code for information interchange.

ASIC: Application specific integrated circuit. An integrated circuit that is manufactured to perform a specific function, rather than as a general-purpose IC, such as a RAM or ROM chip, or a microprocessor.

ATV: Advanced television system. Television system currently being developed that uses a higher horizontal resolution than the current 525 lines of the NTSC standard.

BASIC: Beginners All-Purpose Symbolic Instructional Code. The most commonly used computer programming language.

Baud: A measure of the speed at which it is possible for computer equipment to send or receive information. It is commonly used as synonymous with characters per second.

Birefringence: When an electric field is applied to LCD material, the molecular orientation of the material is changed, causing it to darken. This change of the refraction index (tendency to bend light coming into or out of the material) is called "birefringence"; literally "two refraction characteristics."

BNC: As in BNC connector. We had heard that this stood for BayoNet Connector. Someone had reported that it stood for "Bayonet: Neill Concelman" after the name of the inventor. That sounded a little far-fetched until someone provided a copy of a page of a technical magazine that printed it in black and white. We're still not totally convinced. Does anyone have any documentation of this?

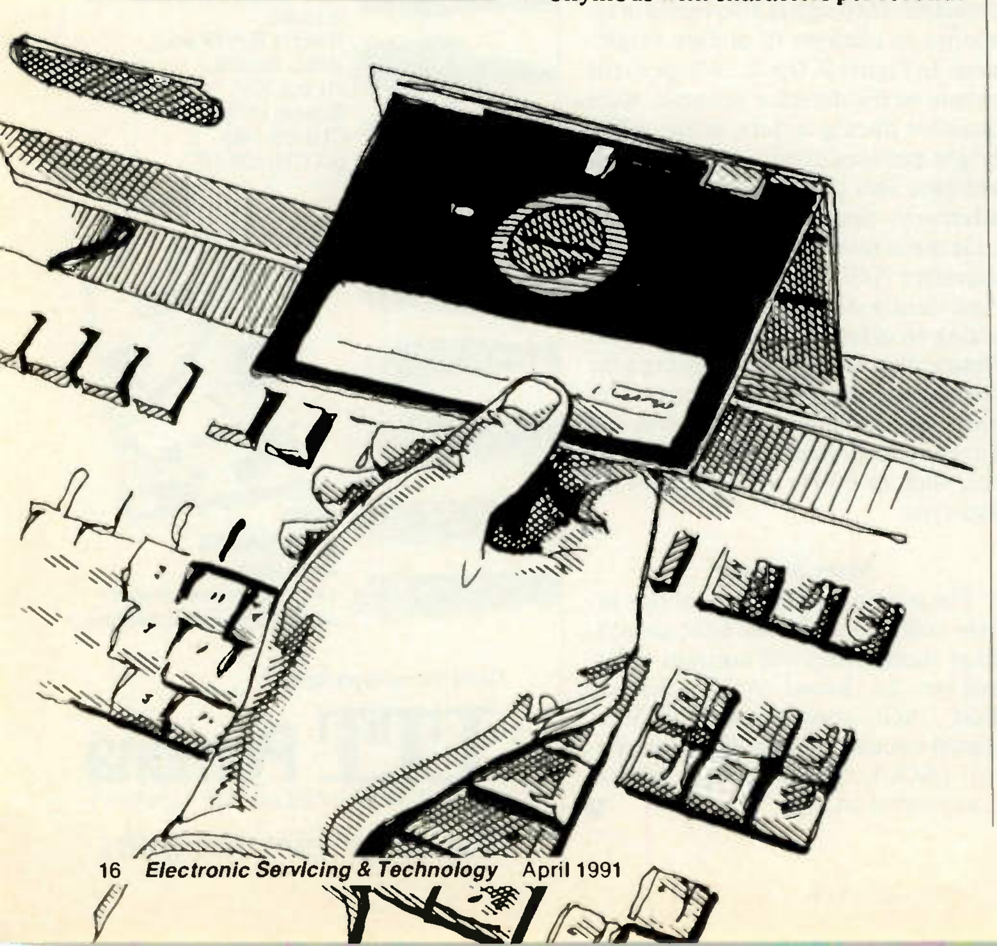
CCIR: International radio consultative committee. This term is also used to describe the 625 line television system used principally in Western Europe.

CCITT: International Telegraph and Telephone Consultative Committee.

CEBus: The Consumer Electronics bus is the home automation standard established by the Electronic Industries Association/Consumer Electronics Group (EIA/CEG). The CEBus Committee, comprised of both member and non-member companies, has developed the premiere standard for a unified control system whereby electronic products from different manufacturers can communicate with one another via existing power lines, twisted (telephone) pairs, coaxial cable and infrared means. The standard includes "bridge" devices that convert signals from one carrier to another to enable data transmission.

DAT: Digital audio tape. A form of audio tape recording and playback that encodes the sound in digital form, in much the same way as compact discs do. The result is superior audio reproduction.

Persson is editor of ES&T.



DISP: Digital signal processing. This is sort of a spread sheet for engineers and others interested in manipulating electrical or other signals using a computer to see what the results will be.

DOS: Disk operating system. This is the software program used by IBM and compatible computers that performs the so-called housekeeping functions; such as taking information from the keyboard, operating the disk drive, etc.

ED: Extended definition. This is the newest technology in videocassette recorders in the Beta format. An improvement over standard Beta, ED-Beta's separation of the luminance and chrominance signals during record and playback, a wider luminance bandwidth, and the use of high density tape result in sharper, more vivid picture quality.

EDTV: Enhanced or extended definition TV. System currently under development which involves advanced encoding and/or transmission techniques, but having less resolution than HDTV. Also called EQTV (Enhanced Quality Television).

ESD: Electrostatic discharge. This is the technical term for the discharge that crackles when static electricity is grounded. Until the introduction of semiconductors, electronics equipment was pretty much immune to damage from ESD. Some recently introduced components, notably MOS components, are so sensitive to ESD damage that a static-electric potential that the average individual can't even feel will destroy one.

HDTV: High-definition TV. A form of television that will, in the future, provide over 1,000 lines in a typical television picture, compared to the 525 currently used in generating an NTSC picture. Another feature of HDTV is wide aspect ratio and digital quality TV. The picture on developmental HDTV sets rivals the resolution of a photograph. No standard has yet been set for HDTV in the U.S.

Home automation: Unified control system whereby electronic products from different manufacturers can communicate with one another via existing power lines, twisted (telephone) pairs, coaxial cable and infrared means. (See CEBus).

IDTV: Improved definition TV. Intermediate system designed to improve resolution of existing NTSC standard without involving new transmission standard. This system would have less resolution than EDTV and HDTV.

LAN: Local area network. This is a collection of personal computers, sometimes quite varied in size and power, tied together via cables, phone line, etc. with a software program that allows them all to communicate and share information. There are a number of different types of LAN systems.

Laser-optical: A system of video recording on grooveless discs, employing a laser-optical-tracking pickup.

MATV: Master antenna television. This describes the kind of cabling system using a single central antenna, such as those used in apartment buildings and motels.

MTS: Multichannel TV sound. The initials MTS are commonly used to designate TVs, VCRs, tuners and adapters equipped for receiving the stereo audio signal channels, one each for the left and right stereo signals, the other for an independent second audio program (SAP) channel. The most popular use of the SAP channel is for the simultaneous transmission of a foreign language sound track or translation of a TV program. However, broadcasters are free to use the SAP channel for non-program related purposes.

MFLOPS: Million floating point operations per second. A number that characterizes the speed of a processor in performing mathematical operations.

MIPS: Million instructions per second. A number that characterizes the speed of a processor in carrying out software program instructions.

MOS: Metal-oxide semiconductor. This is a type of semiconductor that uses a thin metal oxide to achieve the desired electrical characteristics. They can be manufactured in large quantities on a single IC chip because of their small size, and are extremely fast, but have the disadvantage of being highly sensitive to ESD damage.

MOV: Metal-oxide varistor. This is a device whose electrical resistance drops rapidly when a voltage exceeding a specific design voltage is placed across it. The result is that the excessive voltage may be shunted to ground very quickly. MOVs are extensively used in spike suppression applications.

SMD: Surface-mount device. An electronic component such as a resistor, diode or transistor that is designed to be soldered directly to a pc board soldering pad without leads that penetrate the board.

Nematic: This term describes a class of liquid crystals that have the long axes of the molecules in parallel lines in large clusters. This material exhibits the characteristic of birefringence.

NTSC: National television system committee. This term describes the TV system designed by this committee, and currently used in the United States.

PAL: Phase alternate line. The color TV system adopted by Germany, Great Britain, and most other Western European Nations.

TFT: Thin-film transistor - a device that is used in liquid crystal technology to allow switching of an LCD device at a rate that makes it useful for TV display purposes.

RISC: Reduced instruction set computer. A computer central processing unit that has fewer instructions that it is capable of carrying out.

SCMS: Serial copy management system. A proposed copying limiting system being used in digital audio tape recorders that restricts the number of generational copies that can be made from a recording. Recording owners will be able to make a taped copy of recorded material, but not copies of the copies.

SECAM: Sequential color and memory. The color television system adopted by France and most Eastern European and Middle Eastern countries. ■

Hard disk space

By Glenn R. Patsch

It seems that there is never enough space on a personal computer (PC) hard disk. No matter how big a disk is installed, it always seems to be full. This leaves you with a choice between cleaning up by deleting files to make space or adding more capacity.

Checking disk space

How much space is currently available on the disk? Use the DOS CHKDSK command to find out. See CHKDSK example below:

```
>CHKDSK
Volume Hard Disk I

33419264 bytes total disk space
53248 bytes in 3 hidden files
178176 bytes in 73 directories
26337280 bytes in 1766 user files
20480 bytes in bad sectors
6830080 bytes available on disk

654336 bytes total memory
549984 bytes free
```

The bytes available on disk shows how much space is left on the hard disk. In the above example, about 6.8 megabytes is available on the disk. I suggest that about 20% of the hard disk or at least 5 megabytes remain unused. This allows for updates, disk space required for sorting, program swapping to disk and new files. A full hard disk operates slower. This causes programs to take longer to load and files take longer to save.

Cleaning Up

Cleaning off unused programs and files is the first step to making more disk space available. This is something that you will have to do with the customer. Many word processing programs like Microsoft WORD create backup files for each document file. These .BAK files result in double the storage space required for just the .DOC files alone. For documents that are complete, deleting the .BAK files can save a lot of disk space.

Often when programs are updated, the older version is left on the disk in a separate directory until the newer version can be tested to assure that it works correctly with older data files. All too often the older program version is never deleted, but is unused. In the case of a program like Microsoft Windows, this can be several megabytes of disk space. The best way to remove old program versions and files is to store them on floppy disks with labels describing what they are. If they are needed in the future, they can be quickly located and loaded back on the hard disk. Mark on the label the date the floppy was created so that in several years if it has not been used it can be erased and used for storing other files. Cleaning up a hard disk is just like cleaning out a file cabinet.

After cleaning up the disk by deleting a lot of files you should defragment the disk. This places all the files in contiguous locations on the disk and speeds disk performance.

Choices

There are three basic ways to add more hard disk space, You can add a second drive replace an existing drive with a larger one or add a Hardcard. In some situations it may not be possible to add an additional drive because there is no room for the drive or insufficient power supply capacity. This leaves only the option of changing the existing drive or adding a Hardcard. You will have to determine what type of controller is currently in the PC. You might have MFM, RLL, ESDI, or SCSI.

A Second Drive

Adding a second drive is often the most cost effective and easiest way to add capacity. Many PCs have room for a second drive, and the hard disk controller card can usually handle two drives. After physically installing the second drive, connect the power and signal cables and the drive is ready. Since most drives are already low level formatted all that remains is setting up the partition with the DOS FDISK command and formatting the drive with the DOS FORMAT command. Drives larger than 32 megabytes can be partitioned, or divided, into several logical drives. Be sure to set LASTDRIVE = to whatever the highest letter drive you need in the CONFIG.SYS file. DOS by default assigns E the last drive letter. You can also create very large drives with DOS 4 and MS-DOS 3.31.

Replacing the Drive

Replacing an existing drive if it's more than three to four years old and has been in constant use makes good sense. Hard disks like everything else wear out and require replacement. Replacing the existing hard disk drive with a newer larger drive is normally straightfoward. The new version sometimes has more capacity and comes in a half-height format instead of a full height, requiring a cover plate on the front. Just reconnect the new drive where the existing one went before. Not all controller signal cables are keyed to prevent them from being inserted upside down, so check which way the cable was on the old drive before removing it. I usually write the word "TOP" right on it. Check the instructions with the new drive to determine how to connect the signal cable. Key the cable if it was not already.

As a service to the customer you should backup all the files on the hard disk to a set of floppies and then restore these to the new drive. It never ceases to amaze me how many customers do not even think about this but assume their files will be on the new disk; and how many servicers do not even think about this until the old

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

drive has already been removed. Save yourself problems and wasted time, backup the files and restore them to the new drive. I prefer Fastback + by Fifth Generation as backup software. You can also use the DOS BACKUP and RESTORE commands, but they waste a lot of your time. Using a tape drive is the easiest and fastest, if you do a lot of disk upgrading.

Hardcard

The Hardcard by Plus Development is quite a nifty product. This card plugs into the PC bus and contains a hard disk. This is about the easiest way to add hard disk space. The Hardcard draws very little power, so power supply capacity is not a problem. You pay a little more for the Hardcard than a separate drive, but not much more. Available are 20, 40 and 80 megabyte sizes with a 28 or 29 millisecond access time.

Hard Disk Space

Additional disk space means the addition of a second hard disk drive, a larger hard disk replacing the existing drive, or the addition of a Hardcard. As programs get more complex and databases grow, the space on a hard disk continues to shrink. I always try to at least double the size of whatever disk is already in the PC. Even this is sometimes too small. For a small increase in price a user can often get a much larger disk. Increasing hard disk capacity is a very common service. ■

Distributors showcase

Entering a business relationship with a distributor is a lot like deciding on any other kind of business relationship. Whether you choose to do all of your business with a local distributor, or whether you do almost all of your business with a mail order firm, or some reasonable combination of the two, it makes sense to choose with care the distributor(s) with whom you do business.

As you have probably already learned, distributors are as different from each other as are any other kinds of selling organizations. Most distributors are well stocked, well organized, can help you with special requirements, can help you do research to help you find the part you need; some are not. Some mail-order distributors can take your order in a number of ways including mail, telephone (some with 800 numbers), fax, etc.; some can not. Some distributors charge a reasonable amount of money for shipping and handling; some will charge you what you will conclude is an exorbitant amount. Some distributors will send your order right away even before your check clears, some will wait until your check clears, and some will keep your money well beyond the point when they should have shipped your order.

Some points to keep in mind

You're probably a careful shopper when it comes to buying consumer goods. You should also be a careful shopper when choosing a distributor.

Here are some of the things you should consider when settling on a distributor. Some apply only to the local distributor, and some apply only to mail order, but it would be a good idea to keep them in mind any time you're thinking about doing business with a new firm. These items are not listed in any particular order, for the simple reason that their order of priority or importance depends upon your particular wants and needs. Put them in order of importance for yourself.

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

These questions can be important

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

Another practice that some distributors indulge in is to hold shipment of products for some time after the purchaser's check has cleared. This gives the distributor a nice little interest-free loan between the time the check clears and the time he decides to ship the merchandise. In contrast, to show that this is not necessary, when I recently ordered a product from a mail order company, they shipped the product immediately after receiving my order.

One other thing we have learned that some distributors do is to charge a restocking fee even when they were responsible for shipping the incorrect product in the first place.

Caveat emptor

Most replacement parts distributors are hard-working, well-organized, ethical companies, who will make every effort to help you obtain the correct replacement for a faulty component. It's not always easy to locate the good ones and avoid the ones that will give you problems. One approach when you're considering ordering products from a new distributor is to start out with a small order, see what kind of response you get. If the service you receive is not what you'd like, try someone else. There's nothing worse than not getting the products you ordered or being hit with exorbitant freight charges. ■

PanSon Electronics

268 Norman Avenue
Greenpoint, NY 11222
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FAX: 718-383-2425

For over 25 years, PanSon Electronics has been helping electronics dealers and service centers stay abreast of product changes, manage their parts inventories, and build their margins. In 1973, we were the first OEM parts distributor in the United States. Today, we're the largest independent parts distributor in the nation, with more than 2 million parts in stock and ready to ship. We're franchised with Sony, Panasonic, Sharp, JVC, RCA, GE, Hitachi, Aiwa, Optonica, Technica and Quasar. Not to mention a broad based catalog with all the tools and service aids any shop might need.

A company-wide commitment to the best service in the business

At PanSon, we have a state-of-the-art, custom designed computer order and information system to make sure you know the status of every order, every day. And we have a staff of capable, knowledgeable Sales Representatives to help you get the information you need on backorders, special orders, installation and troubleshooting.

- Accurate parts information—when you call for parts, our computer system enables us to provide complete information on price, availability and ETA. Our computer operators validate all parts and part numbers ordered, to ensure you get what you need.
- On-shelf availability—PanSon Electronics carries thousands of different parts for virtually every manufacturer, and we have more than 2 million parts in stock, ready to ship. And we can get backorders and special orders quickly, with a specific ETA.
- Same-day shipping—If you place your order by 4:00 p.m., EST, we guarantee to ship in-stock parts the same day, if necessary.
- Consistent low pricing—Our purchasing strength and volume, coupled with the efficiency of our own operations, enables us to keep our costs down and pass the savings on to you.

Responsiveness through programs like P.A.R.T.S.

The PanSon (P.A.R.T.S.) Program is designed to help you build your business, and an Account Representative will be assigned to help you take full advantage of the program.

- Price guarantees—PanSon customers are guaranteed warranty pricing consistent with warranty claim (NARDA) forms, with reimbursement through most major manufacturers. We also offer additional discounts to our Online Computer Link customers.
- To Order, Ship and Return—PanSon P.A.R.T.S. customers have access to our toll free order lines and to research services.
- PanSon P.A.R.T.S. customers can return up to 3% of annual net purchases with no re-stocking charges on in-stock items, in June and December. Or you can contact our Parts Department for a Return Authorization number anytime. You can also return defective parts for replacement within 90 days of installation with a P.A.R.T.S. Defective sticker with no prior Return Authorization requirement. Additionally, PanSon P.A.R.T.S. customers have access to service literature that is out of print or on back order. If we have it on file, we will send you a copy at our cost.
- Management Reports—PanSon customers receive management reports to help project parts stocking levels and plan future sales, including: Bonus Points Recap; Open Order by Item Number; Open Order by Order Number; and Quarterly Sales Reports.

The PanSon On-Line Computer Link

The PanSon On-Line Computer Link is the easiest and most accurate way of ordering your parts. This is your link to our computer-based ordering and information network, at your service 24 hours a day, 7 days a week. Just connect to our mainframe with your computer and modem and you'll have access to our tremendous database. The program includes the following services:

- Price & Availability—To give an immediate quote to your customer.
- Estimated Time of Arrival—On-line information supplied by the manufacturer for an ETA on all backordered items.
- Order Entry—Place an order 24 hours a day, 7 days a week
- Job Tickets—Linking each part of your order to your own internal records.
- Management Reports—For tracking sales trends, parts orders, and backorders.
- Model & Description—Order your parts by model and description, and get instant price and availability.
- User Bulletin Boards—To communicate with other users around the country.
- Semiconductor Search—Input a semiconductor number to instantly cross-reference and display Manufacturers, Price & Availability for over 28 manufacturers & over 300,000 semiconductors.

Shipping and handling policy actually saves you money

All UPS ground orders now carry a shipping rate that actually decreases the more you order.

Thomson Consumer Electronics Distributor and Special Products

2000 Clements Bridge Road
Deptford, NJ 08096-2000
800-257-7946
FAX 609-853-2231

Two of the most recognizable trademarks in the consumer electronics business are RCA and GE. Both represent a long and proud tradition of customer satisfaction and leading edge technology. That tradition is carried on today at Thomson Consumer Electronics Distributor and Special Products operation in Deptford, NJ. Offering exact replacement parts for RCA and GE consumer electronics products is a major part of the business. Distributor and Special products provides parts support to more than 7,000 authorized RCA and GE Servicenters plus thousands of after warranty servicers located throughout the United States through its extensive distributor network.

These authorized distributors stock and maintain inventory levels based on Thomson's IMP program which identifies the most commonly used parts and recommends an adequate stocking level to meet demand. Orders for all items can be placed via toll-free telephone, fax or by using the "Instant Access" system. Distributors with "Instant Access" computer software provided by Thomson can place orders directly into the system and check stock, pricing and delivery status. Distributors can request a Blue Ribbon or Emergency order and have their orders shipped overnight.

Also, Distributor and Special Products offers a line of replacement semiconductors. SK semiconductors replace more than 217,000 original devices, and the recently published SK Cross Reference Guide contains a 329 page cross reference section to make finding the replacement part easy. SK devices cover a variety of discrete devices and integrated circuits for consumer and industrial applications. Included in the SK line are thyristors, transistors, rectifiers, and optoelectronics and microprocessors. The new guide also contains expanded specifications in the discrete devices charts.

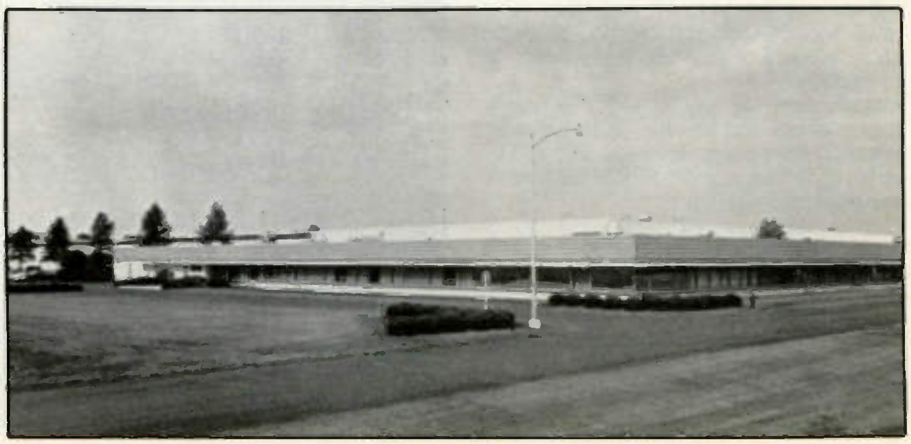
In addition to replacement semiconductors, Distributor and Special Products offers rapid delivery of small quantities of semiconductors and discrete devices produced by major manufacturers. This JEDEC/Generic line includes products from Harris, Fagor, International Rectifier and Powerex.

Another important reference book produced by Distributor and Special Products is the new VCR Key Items Cross Reference. This comprehensive, 120 page guide provides the servicer with a quick reference source of key wear items, such as belts, motors, pressure rollers and headwheels for nine different VCR brands: GE, RCA, Hitachi, Magnavox, Panasonic, Philco, Philips, Quasar and Sylvania. Listing more than 900 models the guide contains references to more than 90 percent of a servicer's parts needs for these brands. The VCR Key Items Cross-Reference provides the servicer with the Thomson stock number, as well as a reference number corresponding to the number shown on the service data parts list and on the exploded view diagram of the VCR model listed.

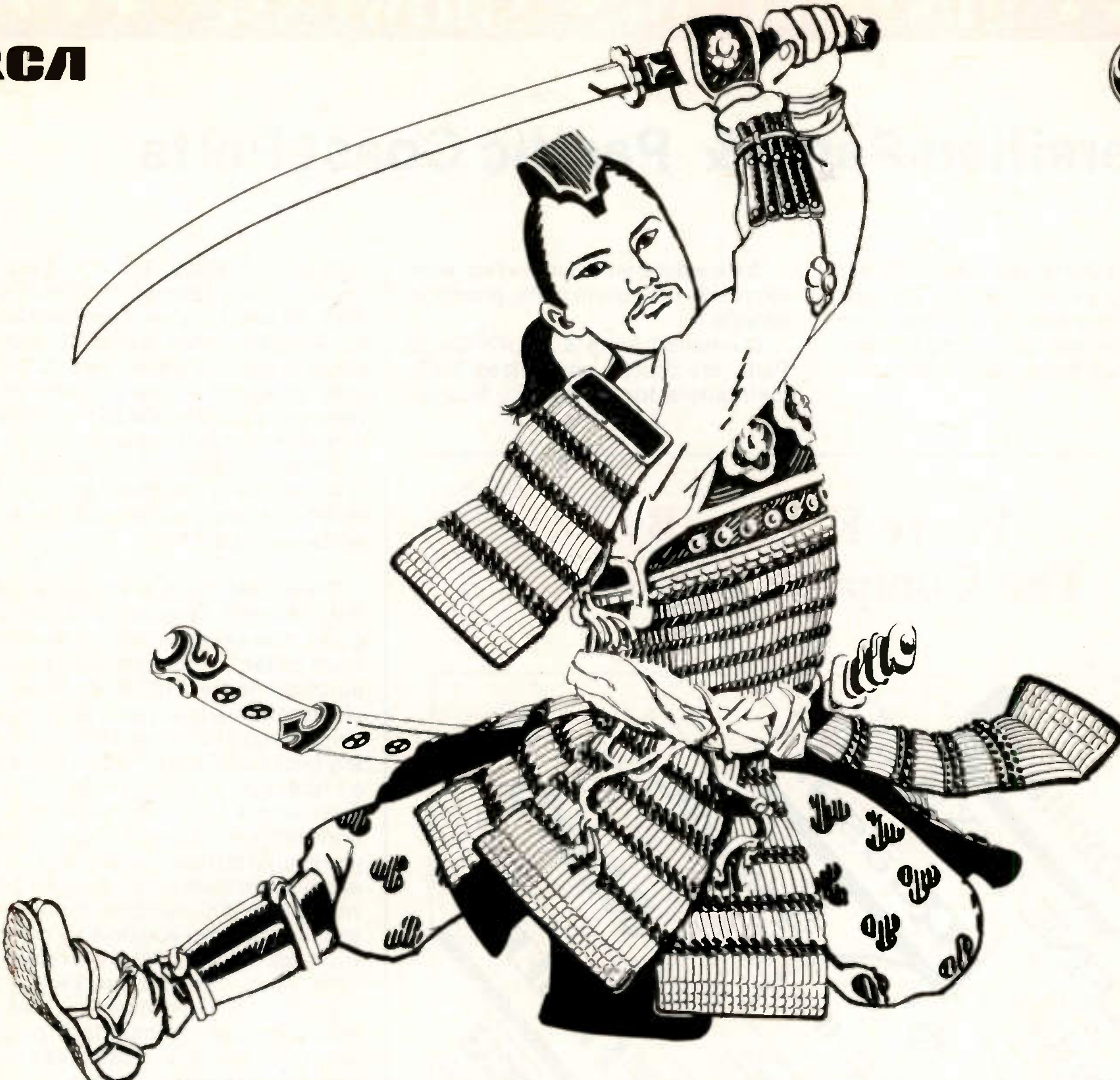
Another publication that Distributor and Special Products offers servicers is the 1991 edition of the RCA and GE Remote Controls Catalog. This catalog contains all available direct replacement remote control hand units for RCA and GE televisions, video recorders, video disc players, camcorders and audio components. The catalog is divided into three sections: One section contains more than 220 photos to aid in identifying the correct remote. The two other sections contain cross-reference material in model number sequence and in remote type number sequence.

Thomson Consumer Electronics Distributor and Special Products operation provides service from a 358,000-square foot facility with all aspects of the business located there—customer service, sales and marketing, quality assurance, product analysis, administrative departments, and warehousing. Some parts are also stocked in a satellite warehouse in EL Paso, TX. Technical support is available for distributors who cannot locate this information in the company's technical literature.

Other product lines at Distributor and Special Products include RCA and GE videotape and GE audiotape. Picture tubes, surge suppressors, anti-static kits and service aids are also marketed from this operation. The business is managed by Dennis D. Edson, general manager. Thomson Consumer Electronics Corporate headquarters is in Indianapolis, where several TV manufacturing facilities are located.



RCA



Cut through the Confusion

When you are repairing any electronic equipment and need a reputable and dependable source for high quality, original Japanese Semiconductors see your authorized Thomson Consumer Electronics distributor

Circle (94) on Reply Card

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ES&T Manufacturers' schematics PROFAX

CHASSIS SCHEMATIC-SIGNAL CIRCUIT

April 1991

Profax Number

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

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

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

ES&T Manufacturers' schematics PROFAX 3075

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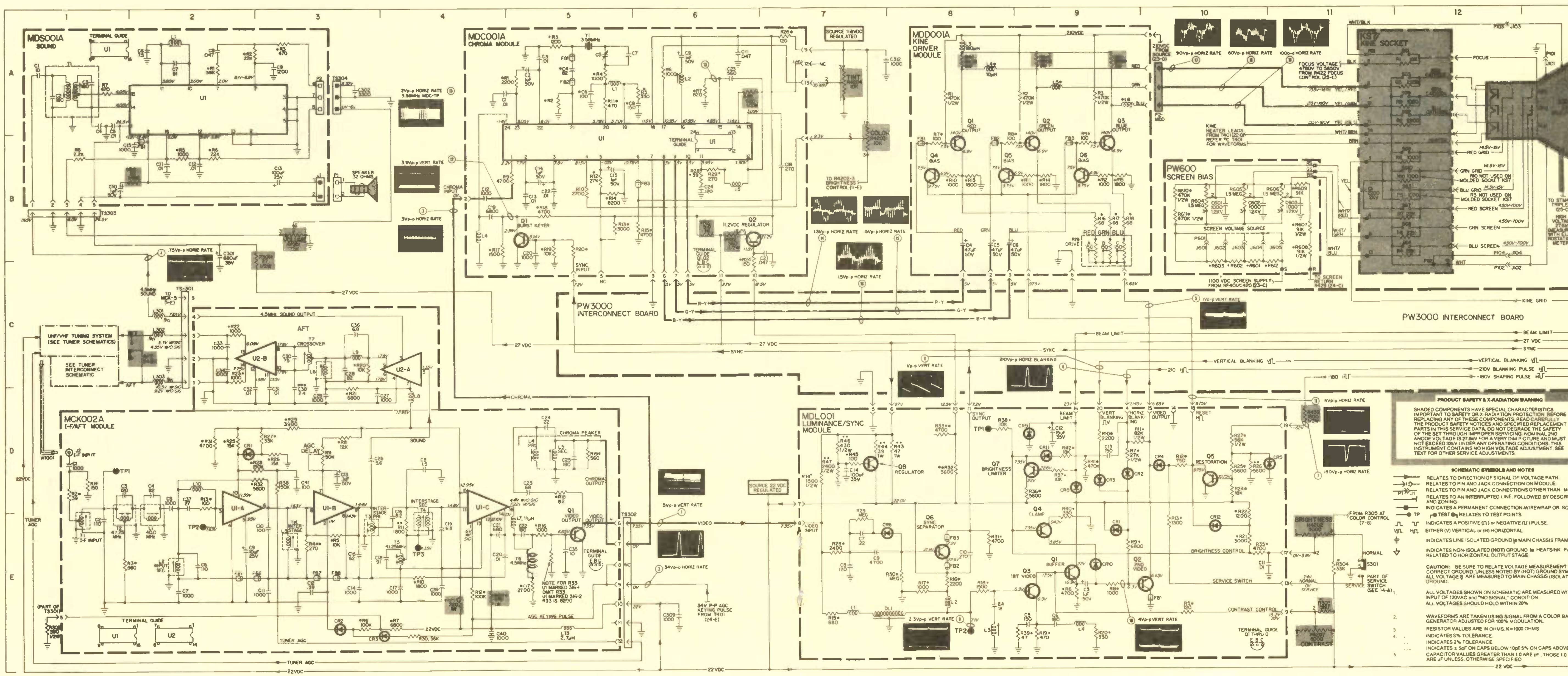
The other portions of this schematic may be found on other Profax pages.

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



CHASSIS SCHEMATIC-DEFLECTION CIRCUIT

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ES&T Manufacturers' schematics PROFAX 3075

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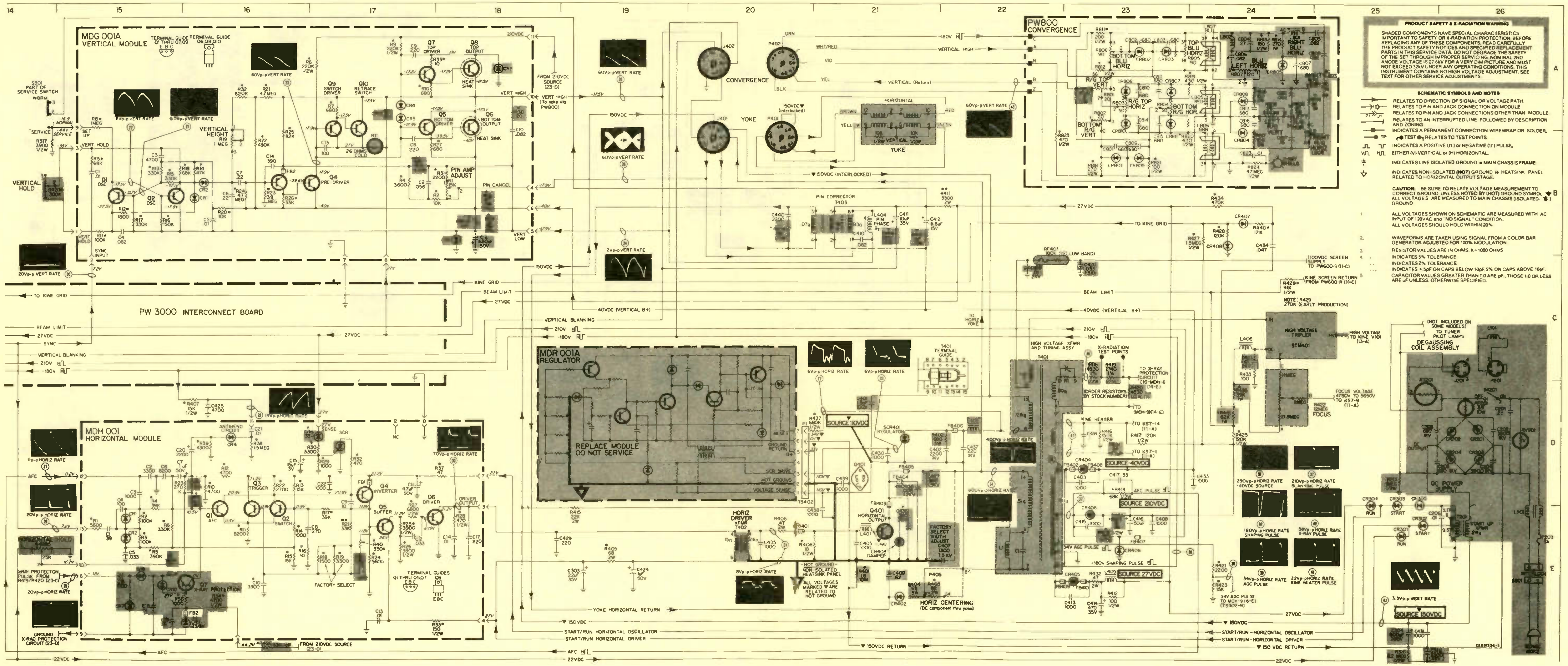

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MDS 001A SOUND MODULE & PW 300 INTERCONNECT CIRCUIT BOARD

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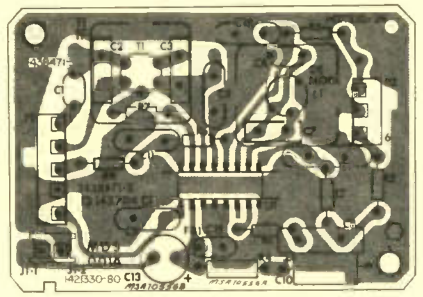


Figure 19. MDS 001A Sound Module Circuit Board

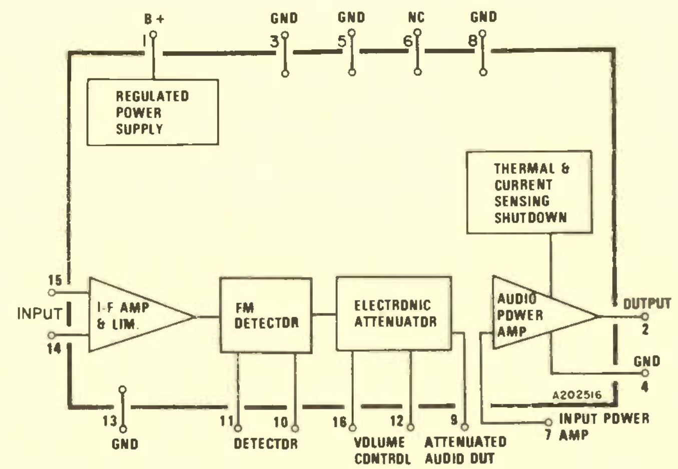
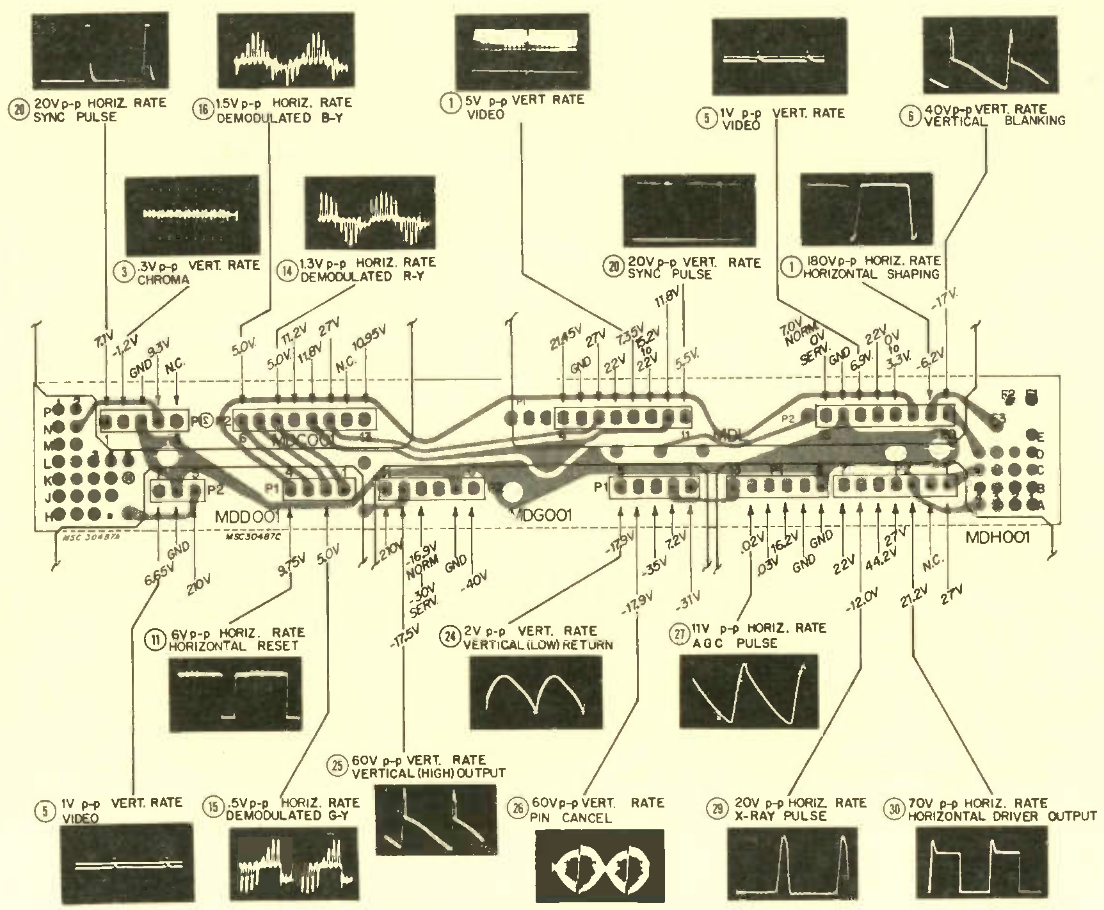


Figure 20. Integrated Circuit UI



TERMINAL BOARD ASSEMBLIES

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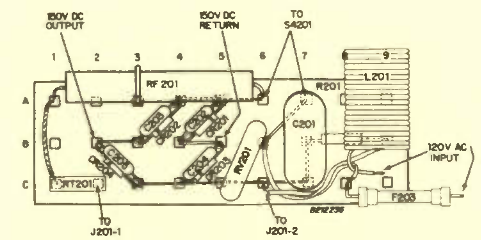


Figure 22. Power Components — TB 201

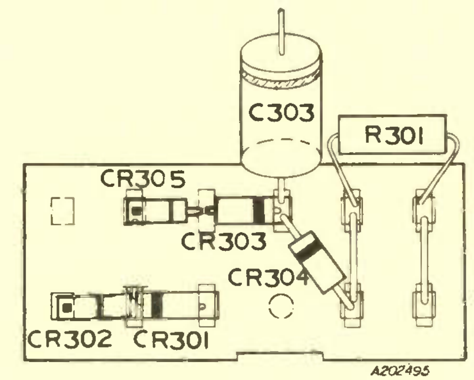


Figure 23. Start-up Components — TB 301

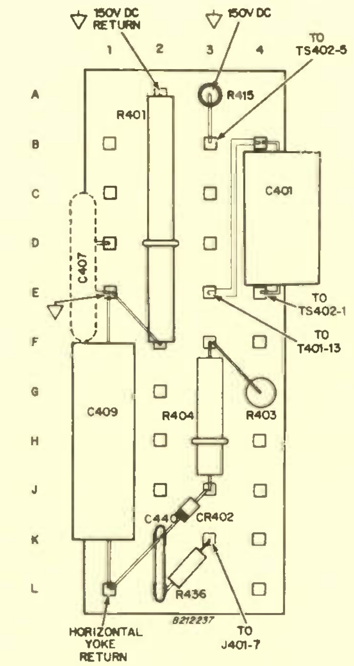
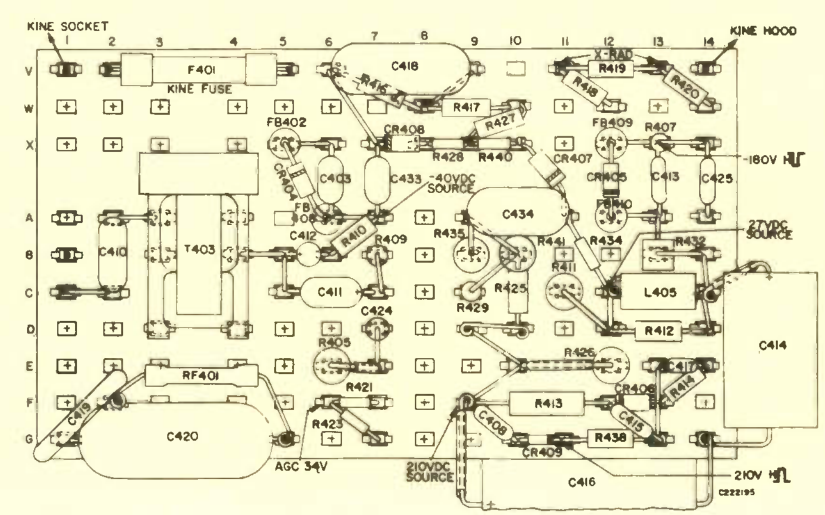


Figure 24. Deflection Components — TB 411

TB 410—Component Location Guide

C403	A6 to X6
C408	F9 to G10
C410	C2 to A2
C411	C5 to C7
C412	B5 to B6
C413	A13 to X13
C414	G14 to C14
C415	G13 to F12
C416	G9 to G14
C417	E13 to E14
C418	V6 to V9
C419	G1 to E2
C420	G1 to G4
C424	E6 to E7
C425	A14 to X14
C433	A7 to X7
C434	A9 to A11
CR404	A6 to X5
CR405	A12 to X12
CR406	F12 to F13
CR407	A11 to X10
CR408	X7 to X8
CR409	G10 to G11
F401	V2 to V5
FB402	X5
FB408	A6
FB409	X12
FB410	A12
L405	C12 to C14
R407	X13
R409	C7 to B7
R410	B6 to A7
R411	D12 to C11
R412	D12 to D14
R413	F9 to F12
R414	F13 to E14
R416	W8 to V6
R417	W8 to W10
R418	W12 to V11
R419	V11 to V13
R420	W14 to V13
R421	F6 to F7
R423	G7 to F6
R425	D10 to B10
R426	E11 to E12
R427	X9 to W10
R428	X8 to X9
R429	C9 to B10
R432	A13 to A14
R434	C12 to A11
R435	B9 to A9
R438	G11 to G13
R440	X9 to X10
RF401	F2 to G5
T403	D4 to A3



PROFAX ES&T Manufacturers' schematics

RCA/GE CTC 86 CHASSIS COLOR TV

APRIL 1991

VARACTOR TUNER CONTROL ASSEMBLY

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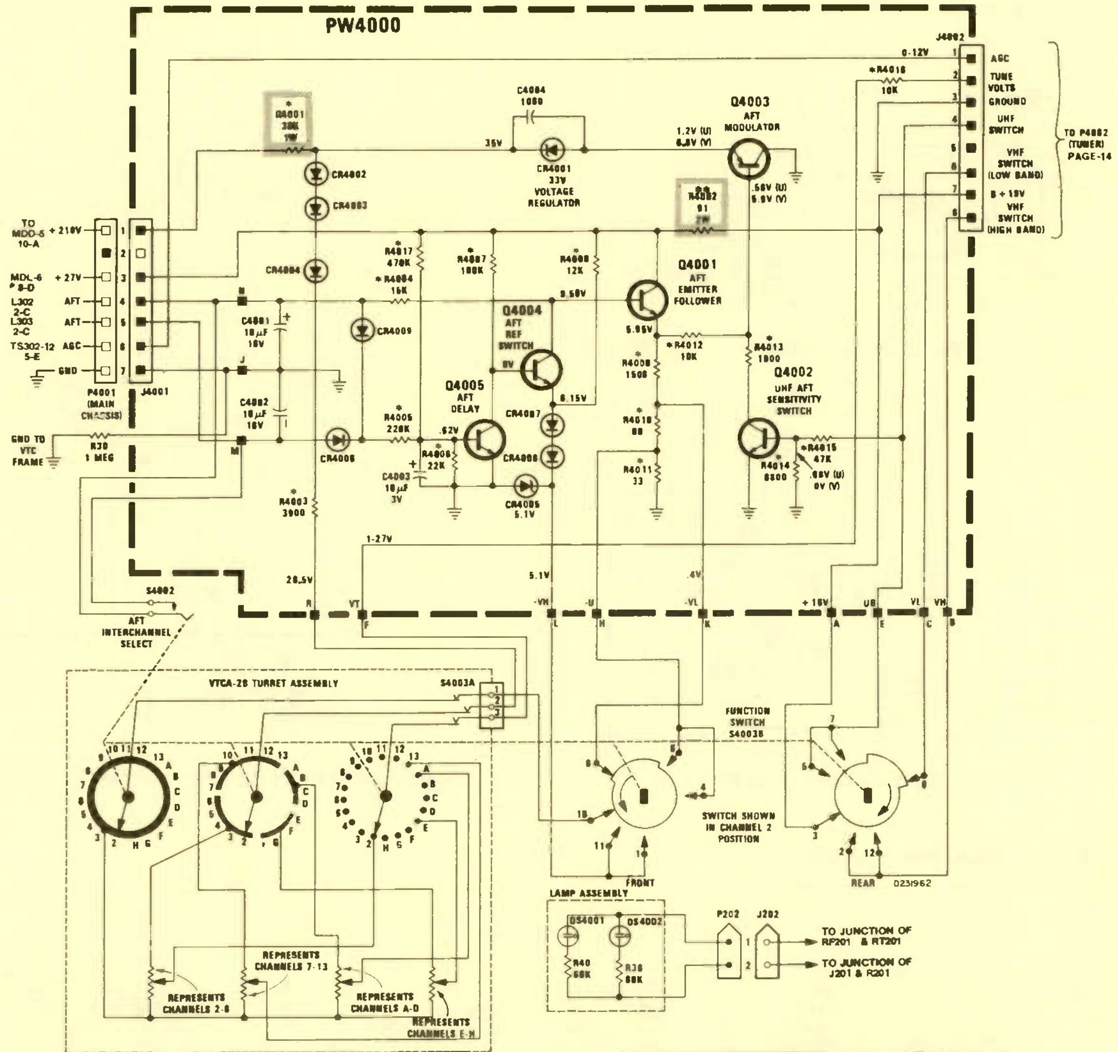

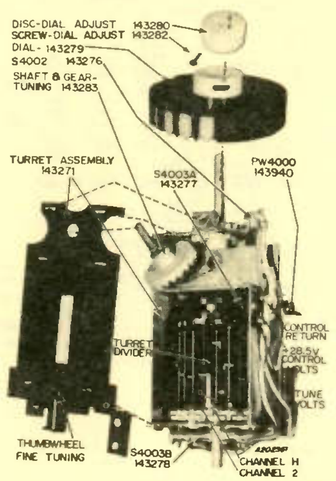

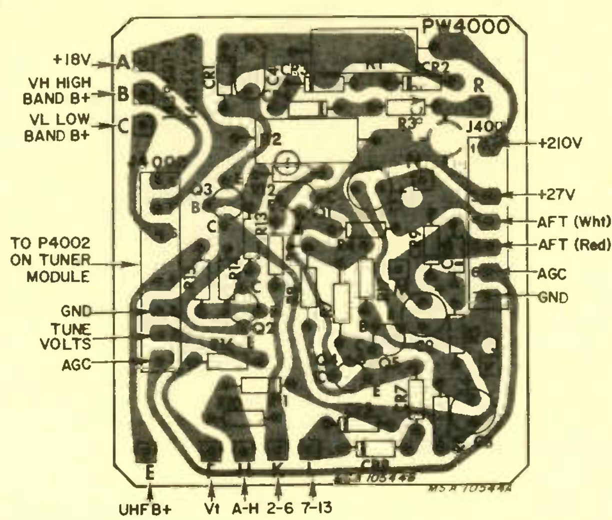

VHF/UHF TUNER SCHEMATIC

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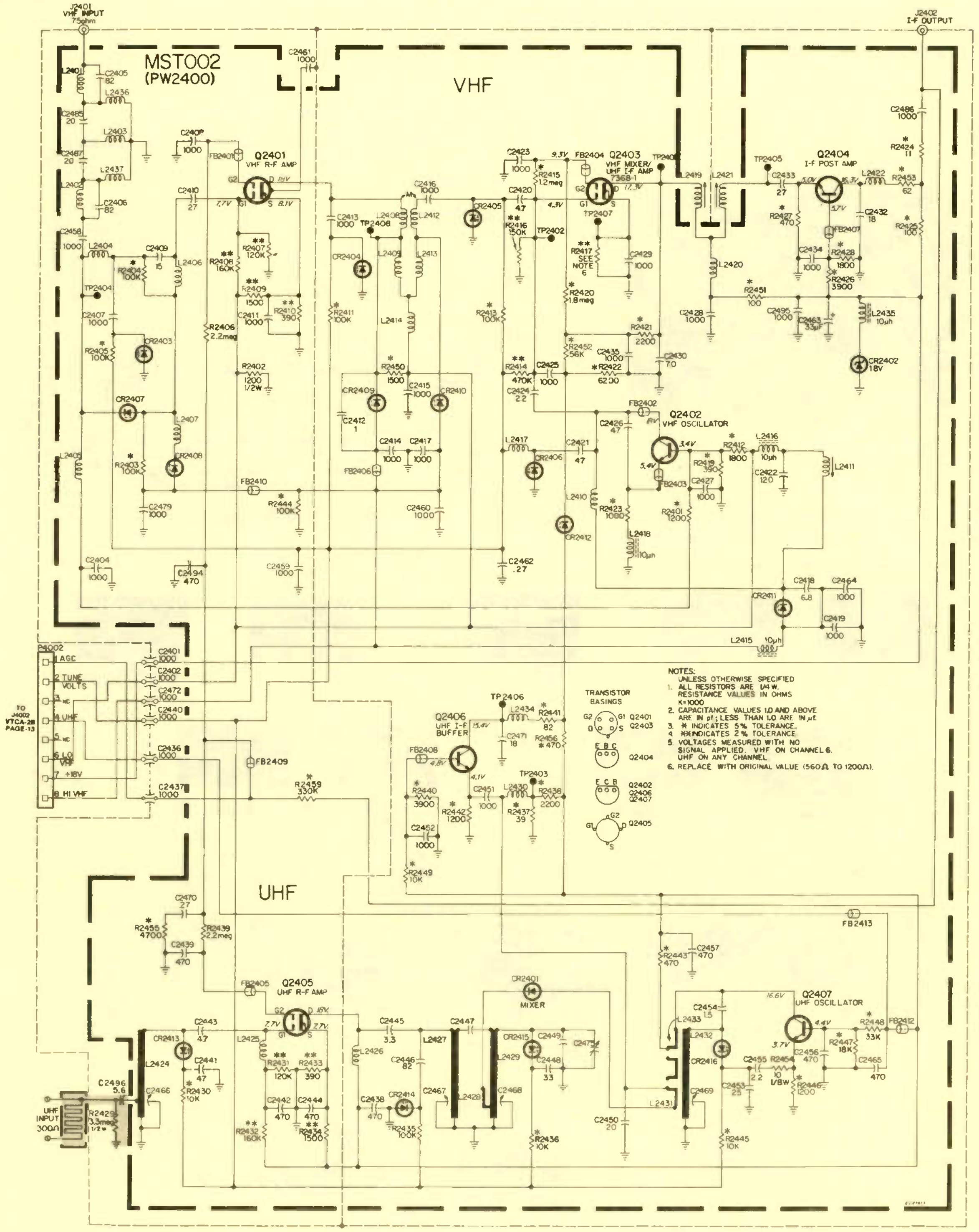

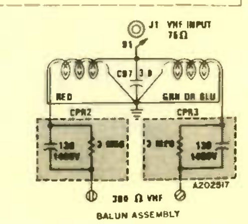

MCM Electronics

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

Because needs in the electronic industry are constantly changing, MCM Electronics continually and thoroughly researches the market and reacts to the changing demands. And MCM is constantly in touch with national and international manufacturers to bring both commonly used and the hard-to-find products to its customers. In fact, three full-sized catalogs are mailed each year, and the last issue introduced more than 800 new items. MCM is a full-line distributor for RCA/GE replacement parts and an exclusive distributor for MultiTech/DynaTech. We also carry other fine brand names including: Chemtronics, Fluke, Panavise, Sams Photofacts, Weller, Xcelite and many more.

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

The Sales/Customer Service Department has been thoroughly trained to answer all calls on the toll-free lines promptly and efficiently. These representatives are professionals who can provide immediate information on stock availability and pricing. They are available Monday through Friday, 7:OO. a.m. to 8:OO p.m. EST, and Saturday 9:OO. a.m. to 5:OO p.m. EST. Orders can be placed after hours with a national toll-free number; ensuring service 24 hours a day, seven days a week. Also, MCM has highly trained electronic technicians available to answer the customers product questions.

The company's Distribution Center houses an enormous inventory of parts and components. Every order is pulled and double-checked to strive for timely and error-free shipment. Because more than 17,000 of the items in the catalog are stocked and ready for shipment, orders are shipped within 24 hours.

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

For more information and a free catalog subscription, call 1-800-543-4330. (In Canada, call 1-800-824-9491; in Dayton, OH, call 513-434-0031).

C & S Sales

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

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

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

The company publishes a free 32-page catalog listing thousands of items. Their 25,000 square foot warehouse assures that these items are readily available for immediate delivery.

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

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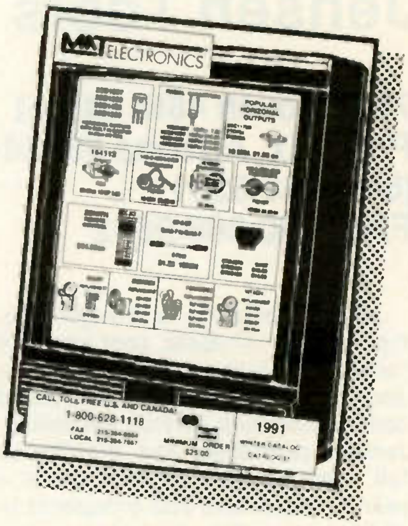

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Troubleshooting RCA's CTC 109 Chassis

By Homer L. Davidson

The RCA CTC 109 chassis had its share of problems in the horizontal circuits and the horizontal output circuits. During the early 1980's the flyback transformers in many CTC 109 chassis required replacement. The horizontal output transformer was also blamed for many problems that it wasn't responsible for, and replaced unnecessarily. Voltage and resistance measurements (Figure 1) will help determine if a component is faulty. Many of the same troubles that are common in this chassis may be encountered in the CTC 107 and CTC 108 chassis.

Dead - blown fuse

When you encounter a dead CTC 109 and the fuse is blown, after replacing the 5A fuse (F101) go directly to the horizontal output transistor Q412 and check to see if it is leaky. If Q412 is shorted, RF101 (3.9Ω, 10W) in the low-voltage power supply may also be open. In some cases, SCR101 may be destroyed when Q412 becomes leaky. Automatically replace SCR101 and Q412 whenever the flyback transformer is defective (Figure 2). They are almost certain to have been damaged. If the transformer, the transistor and resistor are all normal, check C417. If this capacitor is leaky, it may cause the fuse to open.

Once repairs have been made, you should take precautions against the possibility of a defective flyback. If you apply 120V line voltage to a set with a defective flyback, you might damage the new fuse, horizontal output transistor and SCR101. Therefore, before applying full line voltage to the chassis, plug the ac power cord into a variable isolation transformer and slowly raise the line voltage. If Q412 feels warm to the touch with 55V applied, the flyback transformer is shorted. Replace it.

Davidson is a TV servicing consultant for ES&T.

Dead - no startup

One dead set that I put on the bench to service exhibited a no-startup symptom and the transformer seemed to buzz all the time. The resistance measurement from the metal heat sink of Q412 to chassis ground measured open. The damper diode resistance was low in one direction. The B+ voltage on the collector of Q412 was quite high (137V). The voltage measurement at the anode of SCR101 was +178V and the voltage at the cathode terminal measured 137V (Figure 3).

Usually, when the collector voltage of a horizontal output transistor is high, the transistor is open or has improper drive voltage. Q412 cannot be measured effectively in the circuit because the base terminal is shunted to ground in common with the emitter terminal through the primary winding of transformer T401. After removing Q412 from the circuit, I performed out-of-circuit tests on it and found that it was open between base and emitter terminals.

If some component is causing overloading on the secondary of flyback transformer T402, chassis shutdown may result. T402 may make a tic-tic sound, or begin to buzz, and Q402 may become leaky. Isolate and replace the defective parts. Once the repair has been completed, check to be sure the set is operating properly.

For starters, defeat SCR101 by clipping a lead across it (between the heat sink and TP102). Then apply power to the set using a variable isolation transformer and start with lower voltage.

Slowly raise the voltage while monitoring the horizontal input and

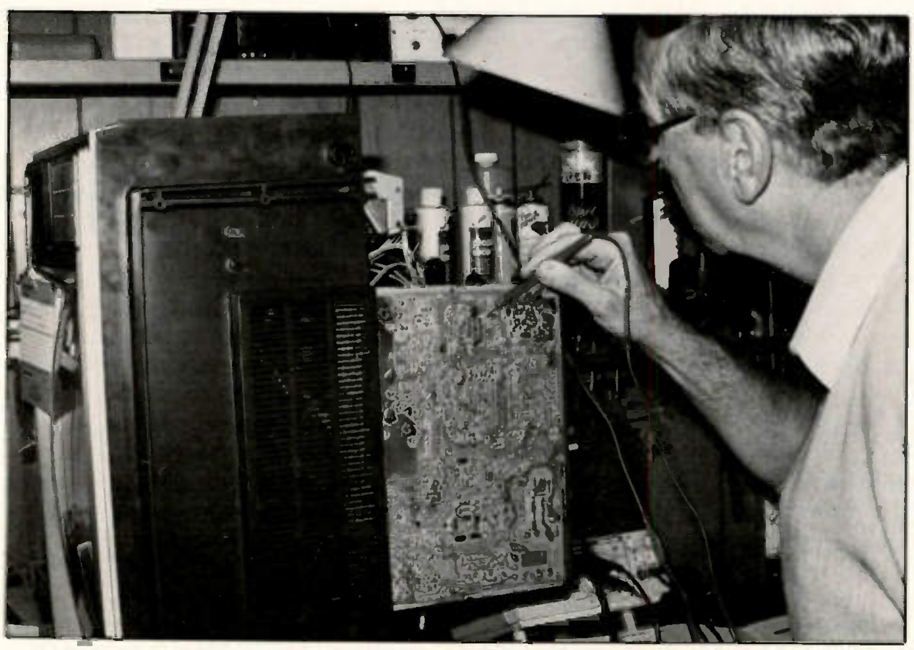


Figure 1. Voltage measurements can reveal a lot about the reasons for a defective TV chassis.

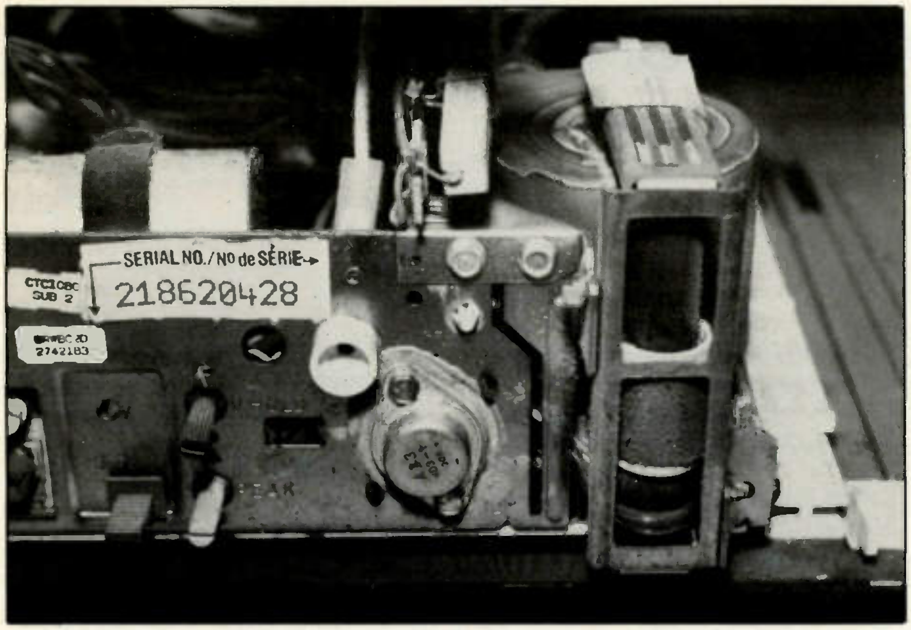


Figure 2. This flyback transformer in a CTC109 chassis was defective. Replace SCR101 and Q412 when T402 is defective.

output waveforms at base (TP402) and collector (TP110). Also, monitor the dc voltage at the cathode of SCR 101.

Check the waveform at the collector (TP110) when the voltage at the cathode of SCR 101 reaches 75 to 80 volts. The waveform should be clean. A defective diode or overloading of the scan derived voltages may be indicated by noise spikes in the waveform. Any ringing indicates possible shorted turns in the flyback. When the normal 120Vac voltage is applied to the chassis you should observe a normal base waveform of 9Vpp as shown in Figure 4 and collector waveform of 70Vpp as shown in Figure 5. This waveform, observed by placing the scope probe near the flyback, indicates that the horizontal output circuits are working.

To make sure that all defective components have been located, check each of the secondary voltage diodes for leakage. Check the resistance to ground of each voltage source for low resistance measurement, indicating overloading caused by a leaky component. The +120V source should measure 13.5KΩ to chassis ground; the +45.2V source should measure 10.9KΩ, the +19.9 volt source 5.5KΩ; and the +26.1 volt source should measure 21.2Ω to chassis ground.

Don't forget to remove the SCR 101 jumper before placing the TV back into service.

Flyback replacement

The flyback transformer is fastened to the pc board chassis with metal connections sticking through eyelets and filled with solder. All of the solder must be removed before the transformer is free (Figure 6). Use a high-wattage soldering gun and desoldering braid to remove the molten solder. A solder sucking tool may be used, except that the excess solder must be melted first with a large soldering iron.

Make sure all solder is removed from each eyelet before trying to remove the transformer. If you attempt to remove the transformer before all the solder is removed, you may crack the pc wiring at the eyelet connection. The transformer can easily be removed by slipping the blade of a large screwdriver under the transformer framework and prying upward gently. Replace the horizontal output transformer with the same part number (154494) and fill in the eyelets with solder. Check each eyelet connection and wiring with the ohmmeter after replacement.

Squealing noises

If flyback transformer T402 emits squealing noises, there are loose particles inside the transformer. Replace it. I encountered another case where squealing occurred when the set was turned on, and then stopped after a

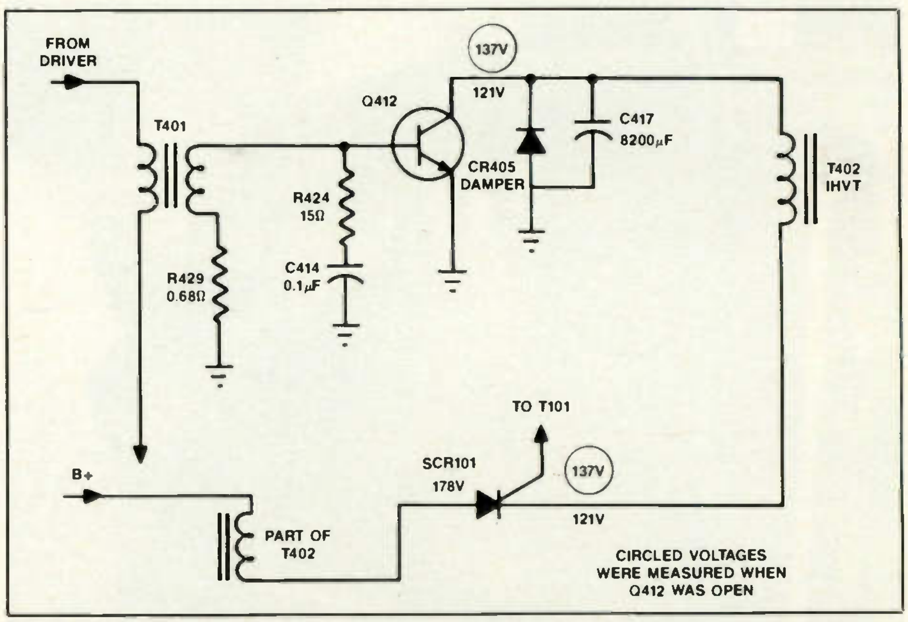


Figure 3. The circled voltages are the voltages I measured in a CTC 109 with an open Q412 horizontal output transistor. Most output transistors become leaky when they fail, but this one was open.

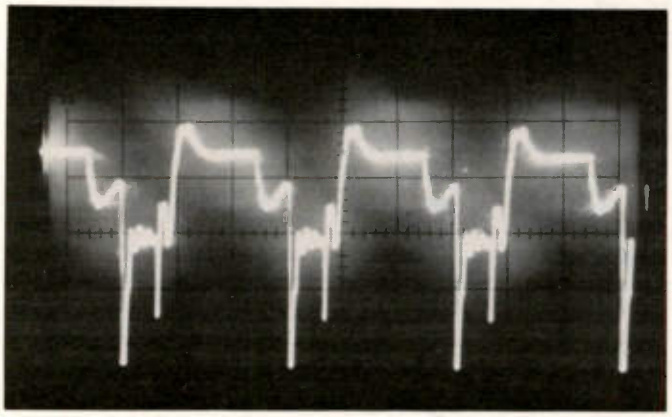


Figure 4. This is what the 9Vpp waveform at the base terminal of Q412 in the CTC109 chassis should look like if the set is operating normally.

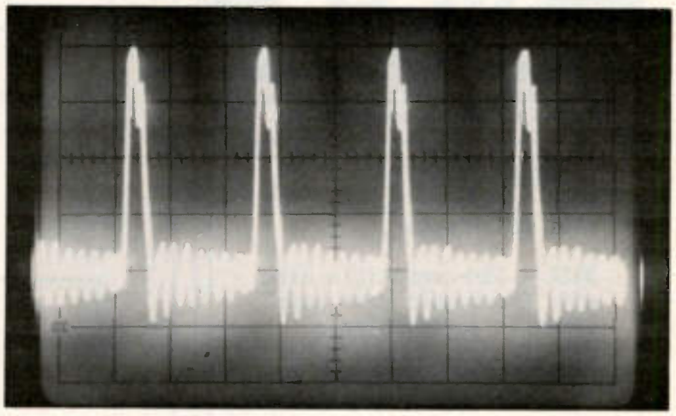


Figure 5. The 70Vpp waveform at the collector terminal of Q412 should look like this if the set is operating normally.

short time. The problem here was an intermittent SCR101. If you encounter a set that emits a high-pitched squeal accompanied by a distorted raster, check R126 (470KΩ) resistor connected to one side of CR111 in the secondary winding of T402 and terminal C of the regulator circuits.

Excessive brightness - chassis shutdown

One common complaint was a set in which the brightness became very high and then the chassis shut down. The brightness control had no effect on the raster. In several cases, replacement of the Luma/Chroma IC (U701; 146858) solved the problem. Another cause of this problem is a defective CRT, except in this case retrace lines are seen with the bright raster before shut down. In chassis that have collected a lot of dust, a first step is to check the CRT spark gaps. Spray out excessive dust with cleaning spray.

In another CTC109 chassis, the brightness was excessive and could not be adjusted with the brightness control. Sometimes the chassis would shut down at once. Other times it would continue to operate. At first U701 was suspected, but the voltage at pin 26 measured only 2.35V, instead of the specified 10.2V (Figure 7).

A resistance measurement from pin 26 to ground was only 1.5KΩ. This resistance measurement should be over 7KΩ. CR705 was found to be leaky and had a 2.2KΩ resistance. In another chassis with the same problems, the resistance of CR705 measured 1.75KΩ. Replacing CR705 solved the high luminance problem.

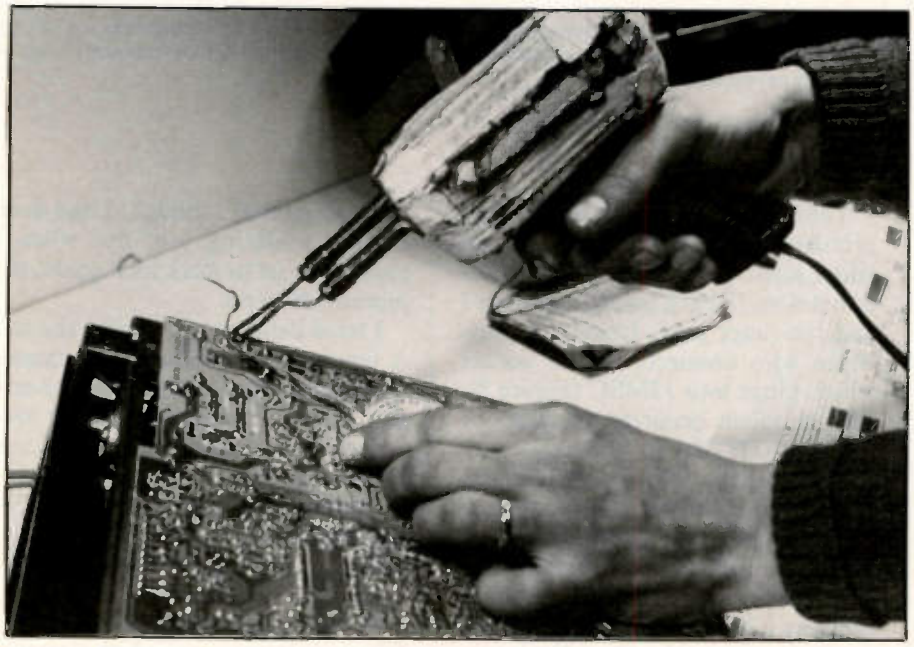


Figure 6. Before the defective flyback can be replaced, all solder from the 12 eyelets must be removed. Likewise, when a new transformer is replaced, fill up the metal eyelets with solder.

Intermittent - "Old Faithful"

Several early CTC109 chassis exhibited the same symptom: no picture - normal sound - no dial lights. This was such a common problem in those sets that we called this symptom "Old Faithful." The first diagnostic step in this case was to check for normal high voltage at the CRT anode terminal. Just the no-picture/normal-sound symptom could be a horizontal or horizontal output problem. The absence of dial lights and the presence of normal high voltage, meant that Old Faithful had showed up.

The first step in diagnosing this problem was to hook up the oscilloscope and check for a −60V pulse at pin 5 of the tuner module. Of course, as soon as I applied the probes, in order to foil my attempts at diagnosing the problem the TV servicing gremlins went to work, and the picture returned and the dial lights came back on. With the TV set back to normal, I just had to wait until it went out again.

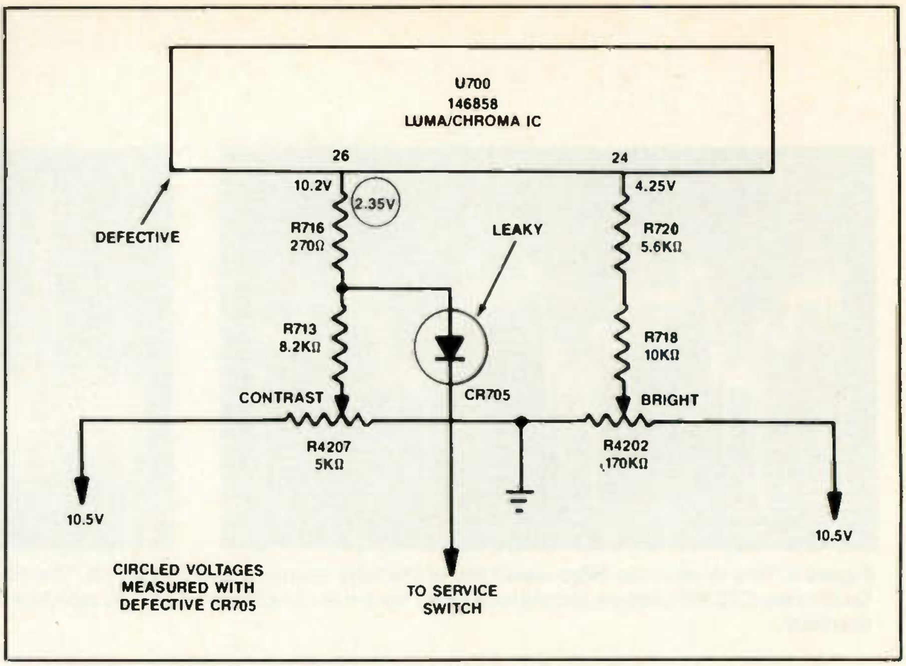


Figure 7. Leaky CR705 or U700 can cause brightness and shutdown problems.

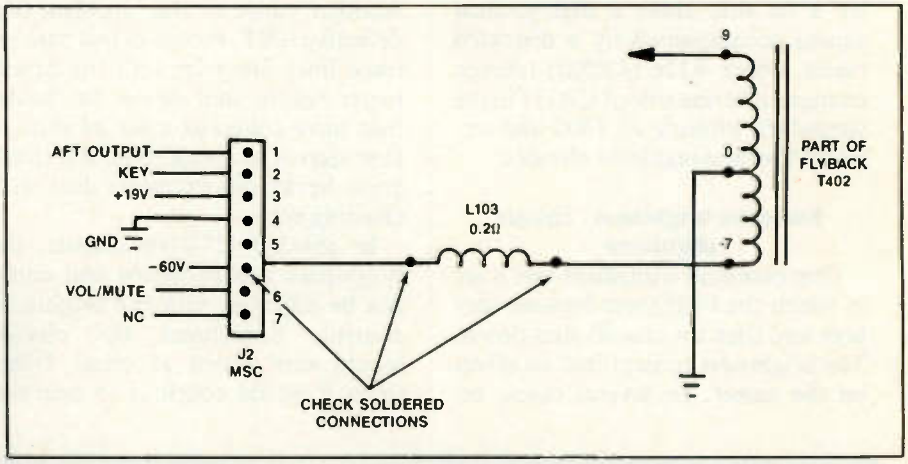


Figure 8. The "Old Faithful" symptom was caused by poor soldered connections of L103. This case was an exception: a corroded pin caused the same no-picture - normal sound - no pilot light symptom.

The usual cause of the Old Faithful problem was a poor solder joint on either side of L103. L103 is connected between flyback transformer pin 7 and the tuner plug. Usually a gray-white wire connects to the socket which plugs into J2MSC (Figure 8). This problem occurred in many of the early CTC109 TV chassis.

Thinking that this was an easy fix, I pulled the chassis and resoldered both sides of L103. A resistance measurement indicated continuity between the coil connections. After inspecting L103, I replaced the chassis, applied power to the set and let it run.

When I returned from lunch, the screen was black and the sound was normal. At first I thought I had done a poor soldering job, but when I moved the set to work on it again, the picture returned.

I tried deliberately jarring the set. A few raps on the metal TV chassis would cause the picture to come and go. When the tuner assembly was tapped, the chassis really acted up. Perhaps a defective tuner module? Here the tuner and FS modules are tied together on a metal mounting bracket. You can't measure this −60V with a voltmeter.

When plug J2 at the bottom of the FS module was moved the picture jumped in and out with the pilot light. A quick scope check on pin 5 of

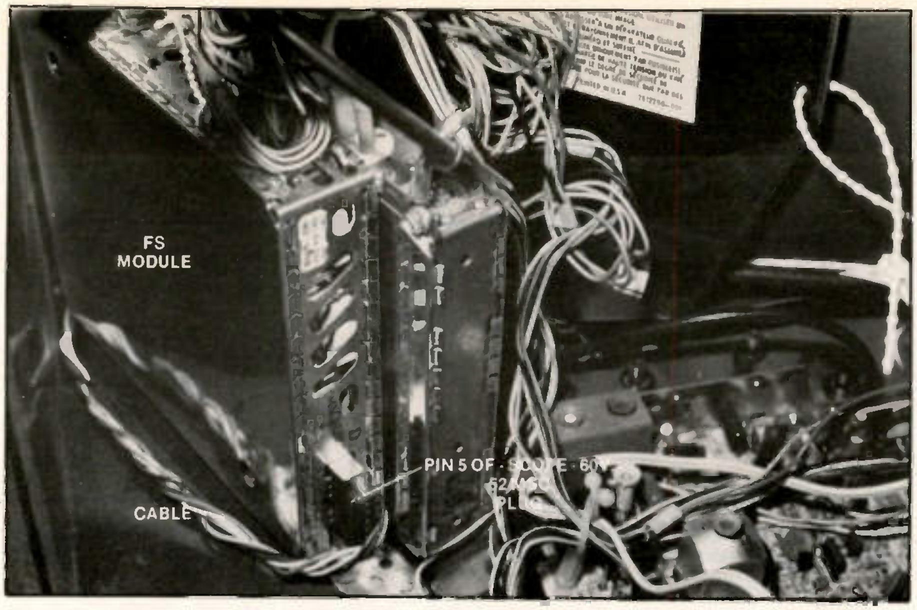


Figure 9. When the problem is no picture, sound normal, no dial lights, check for a −60V pulse with the scope at pin 5 of FS module plug. Remove plug and check contact points.

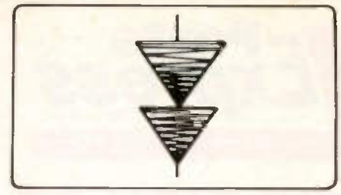


Figure 10. The unusual waterfall picture was caused by a defective electrolytic capacitor.

J2 indicated that the waveform was there when the picture went out. In fact the waveform was good at all times. A closer inspection of the male blade contact of pin 5 revealed that it was dark and corroded (Figure 8). Spraying contact cleaner down into the red socket and cleaning off the male contact solved this Old Faithful problem, at the other end.

Unusual waterfalls

This CTC109 chassis came in with a very unusual symptom: the picture on the screen resembled waterfalls, or a two tier cap, one spilling over into another. The customer had complained of a slow acting remote control unit before this picture appeared. At first, the remote was suspected also since it would not turn off the TV set. The only way to turn off the TV set was to pull the plug when the remote would not shut it off (Figure 10).

Where to start? The problem could be vertical or horizontal problems since the picture in a manner represented two small trapezoid patterns, one falling into the other. A quick scope check near the horizontal output transformer indicated insufficient drive or output pulse. Also, a voltage check at the vertical output transistors indicated lower than normal voltage.

I next checked to see if the power supply sources were normal. The B+ voltage applied to the horizontal output transistor (Q402) was only +129.5V instead of the specified +160V. No doubt one of the diodes or voltage dropping resistors had increased in value.

The ac voltage was normal up to switch S4201. RF101 (3.9Ω, 10W) resistor checked good. I shut down the chassis and checked all four silicon diodes with the diode test of the DMM right in the circuit.

Possibly the 160Vdc source was being pulled down by an overloaded circuit or component. Because this voltage went directly to the flyback transformer I tried removing the horizontal output transistor, but the voltage remained the same. Then a thought jumped into my head; why not check filter capacitor C105? Defective filter capacitors do strange things (Figure 11).

Because my capacitor tester was in need of repair, I decided to shunt the 600μF capacitor with a known good

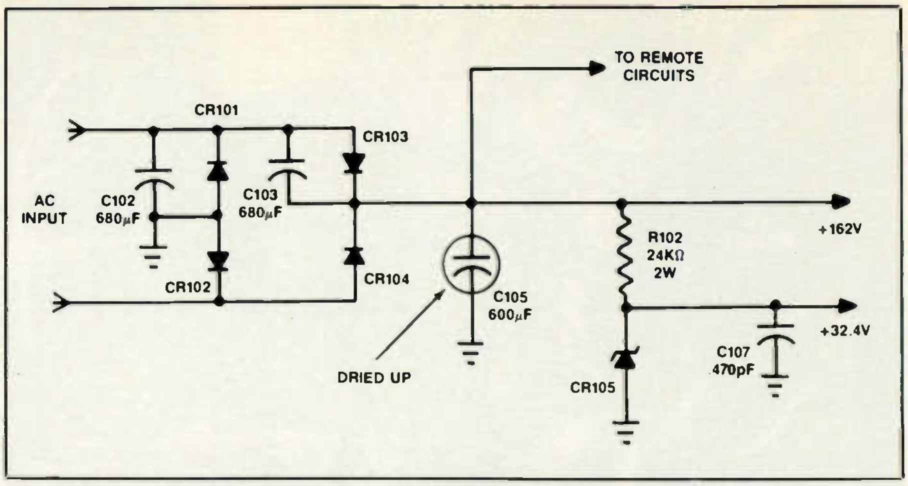


Figure 11. Shunt C105 (600µF) with another good electrolytic capacitor to restore the low output voltage. If the set returns to normal, the capacitor is defective and should be replaced.

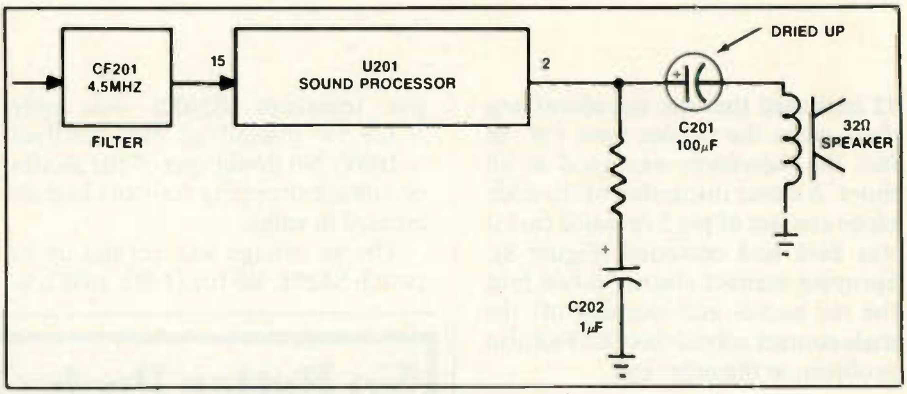


Figure 12. In one set, a weak sound problem was caused by a dried up C201 (100µf) electrolytic capacitor. U201 may also cause weak, intermittent or a dead sound symptom.

one. Remember, this operating voltage of C105 is 200V. I had an 800µF at 250V, so I shut the chassis down (so not to destroy solid-state devices) and clipped the capacitor across the terminals of C105.

Before plugging in the ac cord, I carefully checked the alligator clips to be sure that they were not touching the metal chassis or other components. When the chassis was turned on, the picture was normal - no waterfalls. Even the remote control would click the set off and on, right away, without hesitation. I replaced C105 with the exact part number replacement capacitor, 142573.

Weak sound

In another CTC109 chassis, the sound was weak without any distortion. The complete sound circuits of this chassis are found in one IC component (U201). A defective U201 may cause weak, intermittent, or no sound. A quick audio check at output terminal 2 of U201 with the audio tester indicated normal sound. When I connected the tester at the speaker terminal, the volume was low (Figure 12).

The 100µF speaker coupling capacitor had to be defective. When another electrolytic capacitor was shunted across C201, the sound was normal. No doubt the capacitor had dried up in this 7-year old TV chassis. Replacing C201 with a 100µF, 50V capacitor solved the weak sound.

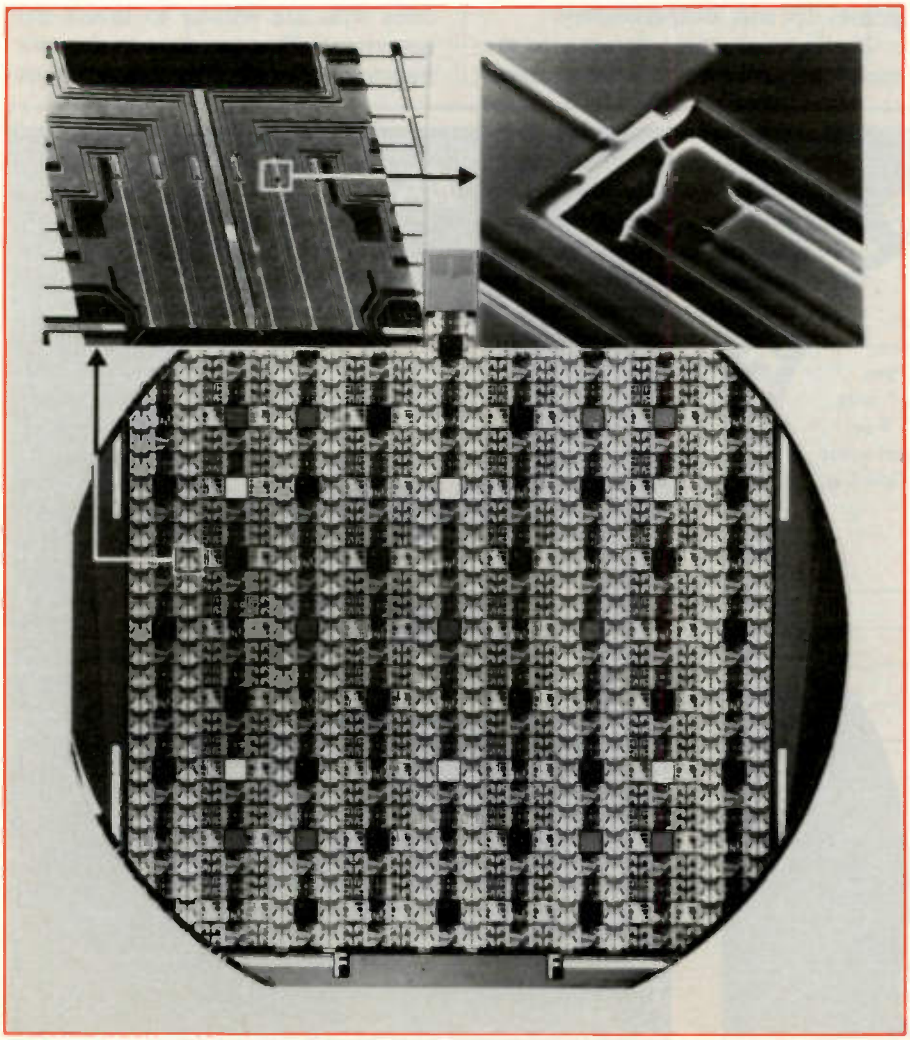
Conclusion

Remember to check for defective electrolytic capacitors in any TV chassis when the TV set may be 5 to 10 years old. Electrolytic filter capacitors, bypass, speaker coupling and vertical yoke coupling capacitors may dry up or lose capacitance after several years. Strange pictures, noise and vertical lines on either side of the picture may be caused by a defective electrolytic capacitor. ■

Tiny semiconductors can be mass produced

Scientists at IBM's Zurich Research Laboratory have developed a way to build as many as 20,000 tiny lasers - each only a fraction of an inch long - on a round semiconductor wafer just two inches across. It is the first time scientists have been able to both mass-produce and test the so-called "semiconductor lasers" on a complete wafer.

The development offers potential for practical and economic mass production and testing of semiconductor lasers. Such lasers are now used to read music in compact disc players, print copy in laser printers, read and write information on computer storage disks and transmit information along fiber optic networks. IBM scientists expect the new method of laser fabrication, called "full-wafer technology," to be faster, some 50 percent less expensive, and result in a much higher percentage of working lasers per wafer. And the advancement holds substantial promise for integration of the semiconductor lasers, which range in length from 1/32nd to 1/64th inch, with other electronic components on "optoelectronic" chips that use both light and electric current to carry information.



The key to success of the new process is the application of a standard semiconductor chip manufacturing technique, called etching, to the production of lasers on a wafer. In the new process, narrow "trenches"- each only 1/5,000th of an inch deep - are etched into the semiconductor wafer to form the laser mirrors, which are then coated with a semireflective material to improve the laser reliability. The mirrors enhance and direct the path of the light that is emitted when electric current travels through the semiconductor.

Previously, the mirrors were formed for each laser individually by "cleaving" or breaking the semiconductor crystal, a costly and time-consuming undertaking. The cumbersome process also involved handling very tiny pieces of semiconductor crystal, and coating the mirrors one-by-one. The lasers then had to be tested individually as well.

But now the scientists have successfully used the etching process to fabricate - and test - thousands of lasers at once on an uncut wafer. Process characterization, diagnostics, and screening for working lasers can be all done on the wafer. After fabrication and testing, the wafer is cut into individual lasers for use. Using their new etching process, the scientists have fabricated from 5,000 to as many as 20,000 lasers on a two-inch wafer. In repeated tests, they found the quality, performance and working life of the lasers to meet that of semiconductor lasers built with the cleaving process.

The full-wafer technology will allow researchers to etch convex and concave mirrors that are slightly curved and will bend the path of the laser beams. The researchers will also combine the lasers with focusing lenses and reflectors - steps forward in developing the kind of integrated optoelectronic circuits that hold hope for a wide range of future electronics applications. ■

Surviving hard times

By William J. Lynott

There's no doubt about it; tough economic times are with us. As I sit here tapping at the word processor, I can almost hear the plaintive chants of some of the old industry veterans out there singing, "Here we go again."

If you've been in the business for less than six or eight years, this will be your first head-to-head confrontation with a dismal economy. For us old-timers, though, it's just another spin of the cycle. Perhaps the most important lesson learned by those of us who have survived any number of these so-called recessions is that we do survive—and that this too shall pass.

In the meantime, how well we survive depends on how well we are able to adapt to changing business conditions.

To find out how the most successful service dealers I know keep on top of things during times like these, I did a mini telephone survey of a dozen or so service dealers scattered around the country. Of course, this can't qualify as a scientific survey; it was limited to only one industry, and involved too few respondents to provide scientifically acceptable evidence. Still, I've come to trust these little surveys of mine. In the past, they've turned out to be dependable indicators of where the service business—and sometimes the economy as a whole—was headed. In this latest survey, the results were discouragingly consistent: sales down, expenses up, soft local economy.

If the results are correct, we are most definitely involved in a major economic slowdown. Let's hope that it will be mild and short-lived.

The service dealers with whom I spoke aren't the only people who feel that genuinely tough times are upon us. As I write this (late January), most of the economic projections in business publications are reflecting at least some pessimism about the economy during the immediate future.

So this is a good time to take a hard look at what you can do to protect the fiscal health of your service business over the coming months. Here are a few suggestions. Most come from comments made by the service dealers I spoke with during my survey.

First, accept the fact that some electronics service dealers will make out just fine during this slowdown. For the most part, they will be the ones who are willing to invest the necessary effort to adapt to the new business climate, instead of just

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

shrugging their shoulders and saying, "What can I do?"

Then there is customer goodwill, a priceless commodity at any time; but when customers are scarce, you must be more liberal than ever in your customer satisfaction policies. Times like these present a great opportunity to make certain that you and your employees are well informed on the economic value of every individual customer. Any special effort you make now to wrap a warm blanket around an unhappy customer will help not only your current situation, but will be an investment in your future as well.

Next, consider how your employees may be of help. Several successful service dealers I know make it a point to keep their employees advised on how well the business is doing overall. Yes, I know this flies in the face of the entrepreneurial instinct to keep such matters very private, but in my view, discreetly sharing basic business results with employees can be a very smart move.

For one thing, it minimizes or eliminates the tendency for service technicians to equate their hourly wage with the hourly charge to customers. You've heard it before, "The boss is making a killing. He pays me $12 and hour and charges customers $40 an hour. He must be making a million."

Sharing information about such things as how much it really costs to do a bench job or send a technician to a customer's home can make a big difference in employees' attitudes. And their attitudes are conveyed to your customers in many subtle ways.

Most employees, even your hard-nosed technicians, are happiest when they feel they are doing well in their chosen work. That's one of the basic human drives. And it's one of the reasons you may be surprised at how employees will pitch in to help out when things slow down. Further, employees who are familiar with at least the basics of business arithmetic will usually be more receptive to the need to maintain or improve personal productivity.

Of course there are many other management concepts that increase in importance during economic slowdowns. Such times are usually not appropriate for major expansion plans or taking on new debt.

And a healthy cash flow can make the difference between survival and business failure if the economy falters badly over a long period. That means you must make an extra effort to collect on all outstanding accounts while keeping your own debts as low as possible. Seemingly minor points such as depositing funds every day and making sure that any cash not needed for daily operating expenses is invested in interest-bearing accounts take on additional importance during slow business periods.

You undoubtedly have your own list of steps to take when business slows. While I hope that today's economic slowdown will turn out to be just a temporary blip in the economy, we can't be sure. So you should be practicing your best tough-times strategy right now, just in case.

What do you know about electronics?

The final corrections

By Sam Wilson

In the January 1991 TYEK column the answer to question #1 had absolutely nothing to do with the question. I had called in a revision of the answer to a future test question and didn't make it clear where it was supposed to go.

There is no way I can explain what happened to the material in WDYKAE? My first thought was that I couldn't have written it. I got out the photocopies of the manuscript and -sure enough- the errors were all mine. I do remember that I had started writing it and then had to put it aside. When I got back to it the manuscript was already overdue. I gave it one of my breakneck finishes and sent it off.

Wilson is the electronics theory consultant for ES&T.

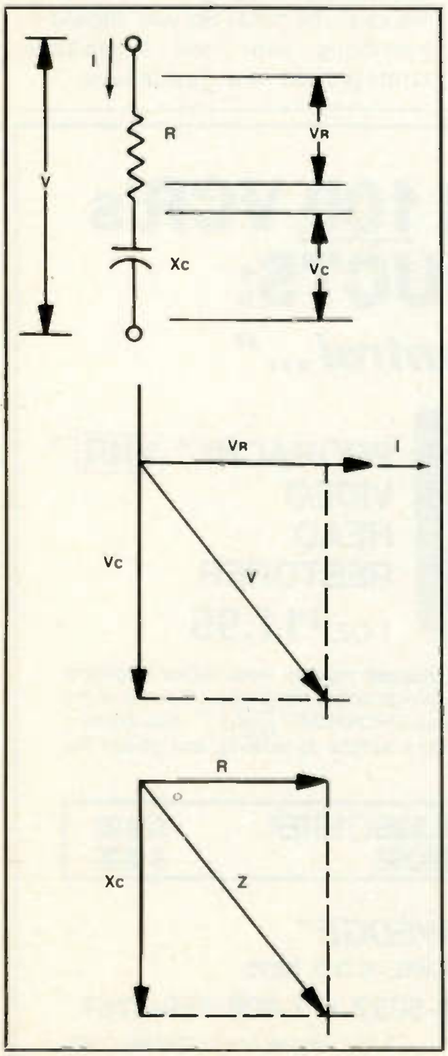


Figure 1

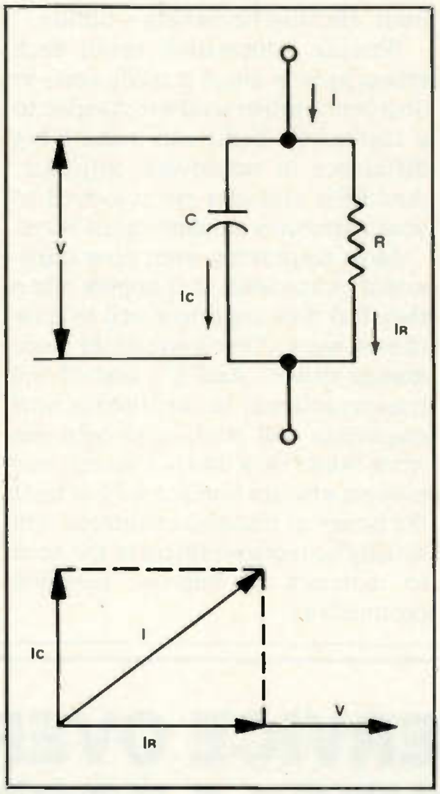


Figure 2

Unfortunately, there was practically nothing useful in the material that started with the heading "Try This Problem."

As can be expected, I got a rash of complaints. I got one envelope with nothing in it but a big question mark on a piece of paper.

In this issue I will tell it like it *really* is. I sincerely hope you will follow this graphical solution of ESR. There are some important definitions and relationships explained in this material.

You can still get the mathematical proof by sending a first class stamp along with your name and address to me in care of this magazine. Slip a piece of paper in an envelope with ESR written on it. Otherwise you are liable to get my favorite recipe for Key Lime Pie.

Try this problem

Take a look at Figure 1. What is the impedance of this series RC circuit? You can solve that problem graphically by drawing vectors [or phasors, or whatever you want to call them] representing R and X_C. They are drawn at an angle of 90°. Draw the parallelogram as shown with broken lines and draw the vector for Z.

Measure the length of Z using the same scale as for R and X_C and you have the impedance of the circuit in ohms. Measure the angle with a protractor and you have the phase angle between the voltage and current. The complete solution is shown in Figure 1.

Why do I call these vectors instead of phasors as they are sometimes called in books? A phasor is a line that represents a magnitude and a phase angle. Components like R, C and L do not have phase angles. I'll come back to that point later.

Figure 2 shows a capacitor in parallel with a resistor. The current and voltage phasor diagram is shown with the circuit. Compare this diagram with the one for the series circuit in Figure 1. Note that current phasor [I_C] is drawn in the opposite direction to the voltage phasor [V_C] in Figure 1. The reason is that the current through the series circuit is the reference phasor for the diagram in Figure 1. That, in turn, is because the current is the same in all parts of a series circuit. The voltage phasors are all drawn with reference to the current phasor in the series circuit diagram.

For the parallel circuit the voltage phasor is used as a reference because the voltage across all parts of a parallel circuit is the same. The current phasors for the parallel circuit are drawn with reference to that voltage phasor.

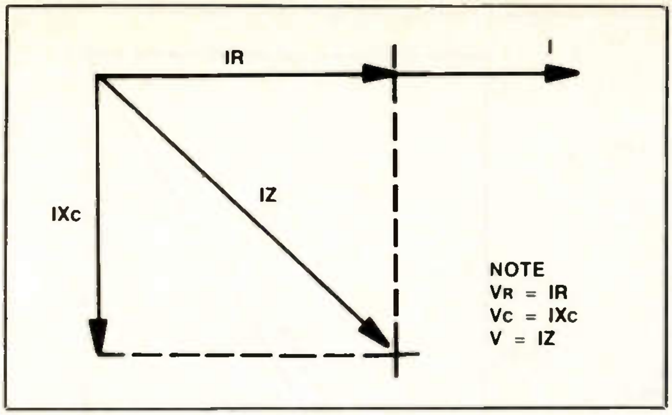


Figure 3

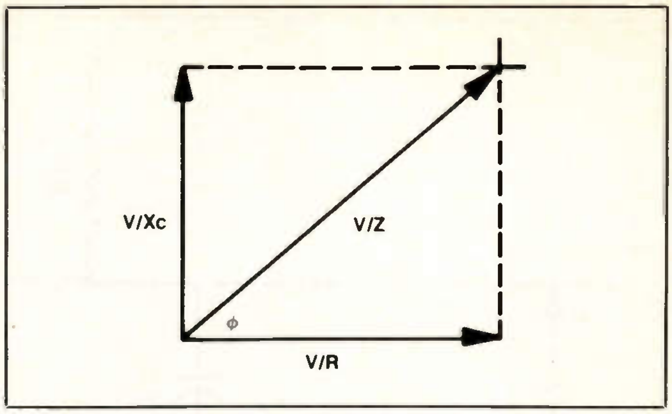


Figure 4

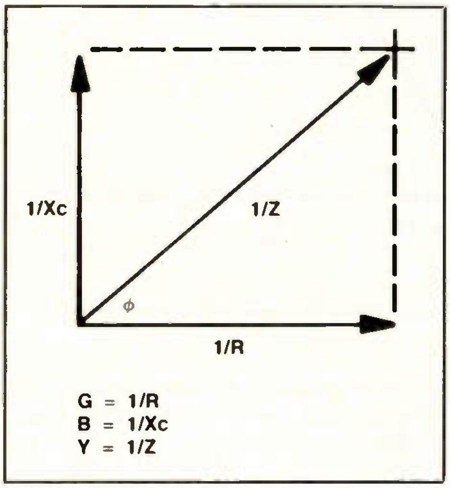


Figure 5

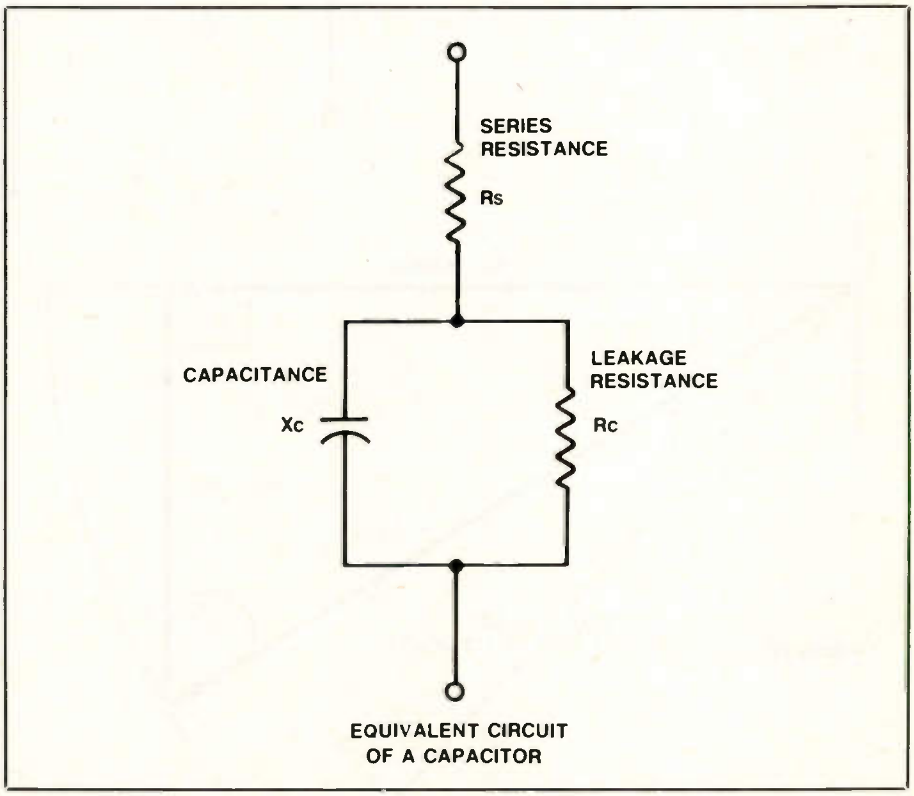


Figure 6

The arrows in the impedance diagram of Figure 1 are marked R, X_C and Z, *but their positions are based upon the current reference.*

To explain the difference between a vector and a phasor refer to the series-circuit phasor diagram of Figure 3. Note that the voltage phasors are now marked IR, IX_C and IZ. These are voltage phasors, and I is the reference. If you divide each voltage phasor by I you will get an impedance triangle like the one in Figure 1. This does NOT mean that R, C, and L have phase angles or that they are phasors. You can call the arrows in the diagram of Figure 1 phasors but that is not what they are.

Keeping in mind the fact that components do not have phase angles, how are resistance, capacitance and impedance represented in a phasor diagram for a parallel circuit? Since the voltage is now the reference, it is necessary to draw current phasors to represent the relationship between voltage and current. This is done in Figure 4.

Note that I_C is now represented by V/X_C [because $I_C = V/X_C$. By the same reasoning, I_R is represented by V/R.

We divide the voltage phasors by V to get the triangle for the parallel circuit. The triangle, shown in Figure 5, is made of 1/R, $1/X_C$ and 1/Z.

New names had to be invented for these quantities. You already know that 1/R is conductance. The fraction $1/X_C$ defines susceptance. The reciprocal of impedance [1/Z] defines admittance. The word definition of these quantities is given here-

Conductance [G] - a measure of the ease with which current flows through a resistance.

Susceptance [B] - a measure of the ease with which an ac current flows through a reactance.

Admittance [Y] - a measure of the ease with which current flows through an RC or RL circuit.

The admittance triangle for the parallel RC circuit is shown in Figure 5. A similar triangle can be drawn for an RL circuit, but it lies in the opposite quadrant. We will stay with the parallel RC circuit because it is part of the equivalent circuit for a capacitor. Remember that every RC [or, RL] circuit can be represented by an admittance diagram.

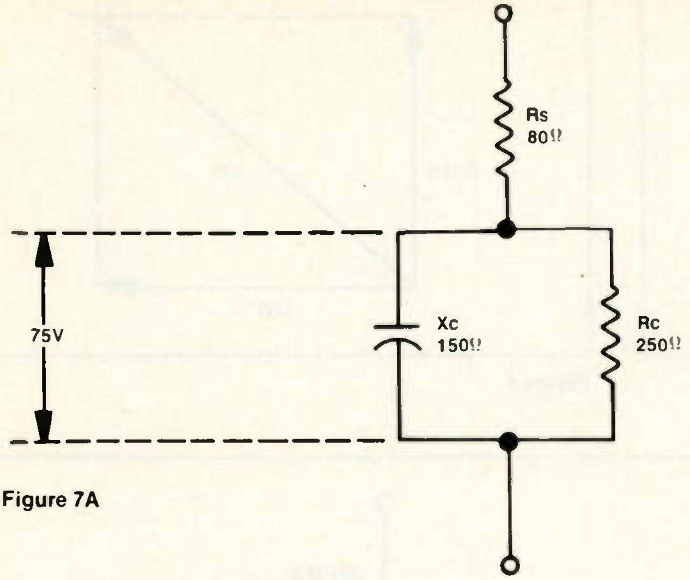


Figure 7A

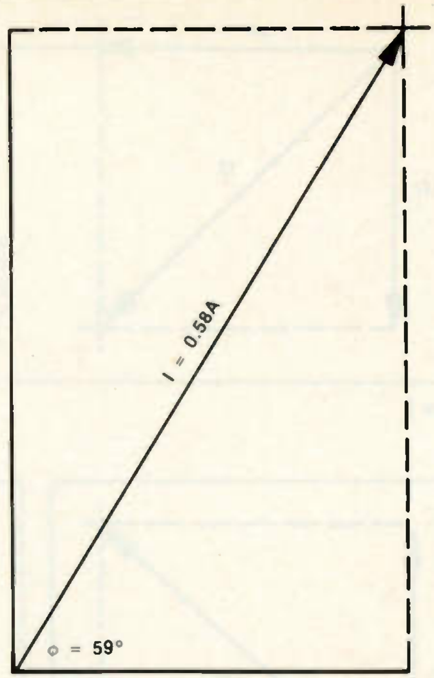


Figure 7B

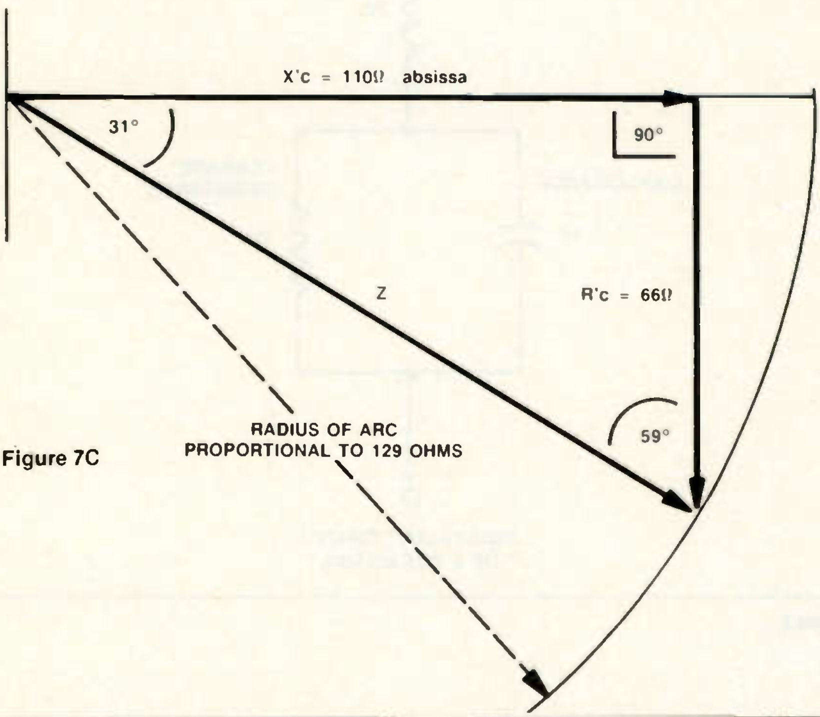


Figure 7C

Finding the ESR of a capacitor

Figure 6, a parallel RC circuit in series with a resistor, is the equivalent circuit of a capacitor. The first step in finding the ESR of this capacitor is to make an impedance diagram that will represent this circuit. In order to do that, it is necessary to convert the admittance diagram of the parallel RC circuit to an equivalent impedance diagram. This is easily done.

When I was teaching at Colorado State University I developed a graphical method of converting a parallel RC (or RL) circuit into an equivalent series circuit. I'll use that procedure in a sample problem which converts the circuit that simulates the capacitor (Figure 6) into an equivalent series RC circuit.

Sample problem

Refer to Figure 7. Find a series RC circuit that represents the equivalent of the capacitor circuit in Figure 7(a). Use the following values:

$X_C = 150\Omega$
$R_C = 250\Omega$
$R_s = 80\Omega$.

Note: These are not values that are typical of a capacitor. The values are chosen for the purpose of making the phasor and vector diagrams easy to read.

Step 1 - Assume an ac voltage across the parallel circuit. Any convenient value can be used. In this sample problem I am choosing 75V.

Step 2 - Find the current through each branch based upon the assumed voltage.
ac current through C = $I_C = V/X_C = 75/150 = 0.5A$

ac current through R = $I_R = V/R = 75/250 = 0.3A$

Step 3 - Plot these currents as phasors. Use any convenient scale. I used 1 inch = 0.1A. Because the voltage is the reference, the resultant current must be in the first quadrant (leading the voltage). Remember that the standard direction of rotation in the U.S. is counterclockwise. Figure 7(b) shows the currents and the resultant. Measure the resultant (I = 0.58A), and, measure the phase angle [$\emptyset = 59°$]. Use the same scale to measure I as you used for I_R and I_C.

Step 4 - Calculate the impedance (Z) of the parallel RC circuit:

$Z = V/I = 75/0.58 = 129\Omega$

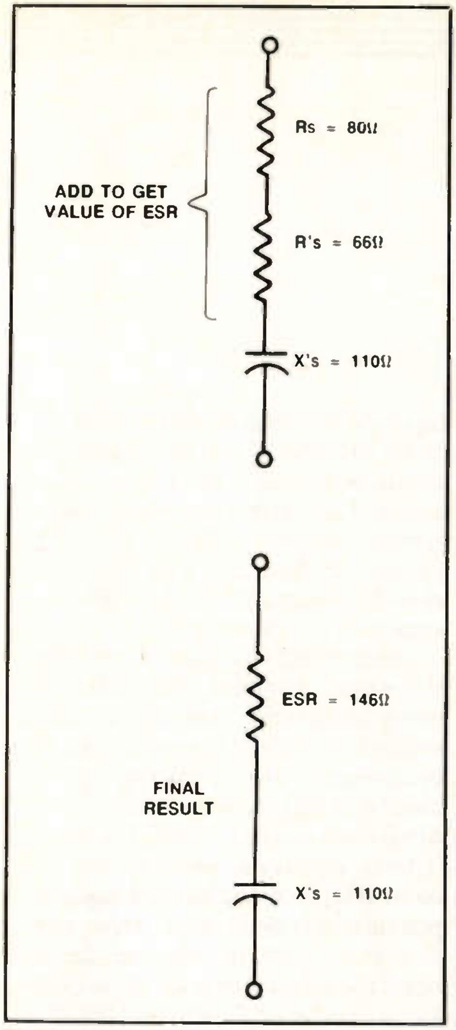


Figure 8

Step 5 - Draw an arc in the fourth quadrant. See Figure 7(c). Use a radius that represents Z [129Ω]. This arc is drawn in the fourth quadrant because we are looking for the series impedance.

Step 6 - Calculate the complement [C] of θ. $C = 90 - \theta = 90 - 59° = 31°$. Draw this angle [31°] from the abscissa as shown in Figure 7(c).

Step 7 - At the point where that line intersects the arc, drop a vertical line [R_C] to the abscissa. You have now drawn the equivalent impedance triangle for the parallel branch. Measure R'_S and X'_S. See Figure 7(c).

Step 8 - Replace the parallel RC circuit in Figure 7(a) with the equivalent series circuit as shown in Figure 8.

To calculate the equivalent series resistance of the capacitor you have to add R'_S and R_S. Figure 8 shows the final result.

Test your electronics knowledge

By Sam Wilson, CET

Figure 1 shows an oscilloscope display of two pulses. Which pulse occurred earlier?

A. The one marked A.
B. The one marked B.

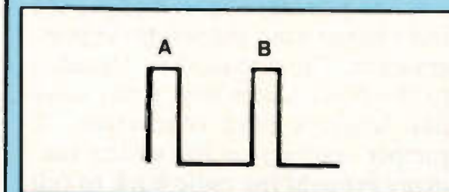


Figure 1.

2. Since 20KΩ for one type of resistor is the same as 20KΩ for another type, you can always replace a metal-oxide resistor with a carbon-composition resistor. This statement is

A. True
B. False

3. Some receivers use the television signal for making picture adjustments. The part of the signal used for tint control is called

A. VITS
B. VIRS

4. This question is related to pulse code modulation [PCM] such as used in compact disc technology. A false and undesired lower-frequency component in sampled data which occurs because the sample rate is too low is called a/an ________.

5. In some computer systems it is possible to quickly access frequently-used data and instructions by using a separate (smaller) memory. This memory is called a ________.

6. The transistor circuit in Figure 2 is used to amplify signals at a very high frequency. Resistor R is used to reduce the

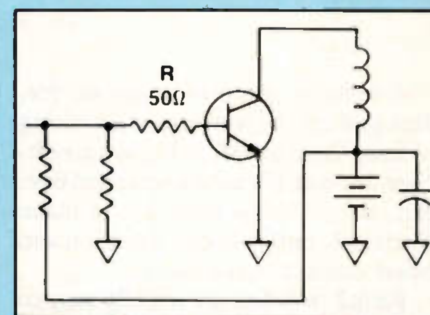


Figure 2.

A. storage time of the base
B. possibility of parasitic oscillations
C. base voltage for some applications
D. problem of noise in the amplifier

7. "It acts like an inductor but it looks like a tiny bead. It is called a bead ledge." This statement is

A. correct
B. not correct

8. The dB gain of a voltage amplifier is sometimes given as dB = 20 Log [output signal voltage/input signal voltage]. This equation can

A. always be used to calculate amplifier dB gain
B. seldom be used to calculate amplifier db gain

9. Which of the following is true?

A. Bandwidth is the range of frequencies that occur between maximum power and the points where the power is down 3dB.
B. Bandwidth is the range of frequencies that occur between maximum voltage and the points where the voltage is down 6dB.
C. (Both choices are correct)
D. (Neither choice is correct)

10. Carbon-zinc dry cells

A. can be recharged
B. cannot be recharged

Answers on page 58

Wilson is the electronics theory consultant for ES&T.

When switches go bad

By John Shepler

A switch is a pretty simple device. Just a couple of contacts and a spring to keep them apart. Sure, some switches are complicated and expensive. But, the principle is always to make electrical contact in one direction and break contact in the other.

Failed switches are usually easy to spot. The mechanism breaks and the lever flops back and forth. Pushbuttons get jammed so hard that you can't push them, or they become permanently forced into the panel.

These are the usual problems. They are easy to spot and relatively easy to fix. Once in a while, though, a sneaky switch can trick you into spending a lot of expensive troubleshooting time. Beware.

I was fooled by a radio that almost worked. Turn it on and it played. The volume control worked normally. The only problem was that the radio didn't play very loudly and sounded rather distorted. Could be a transistor, loudspeaker, or perhaps a failed IC, right? Some preliminary probing showed a distorting audio section. The supply voltage was only half what it should be. That pointed toward a bad regulator, rectifier, or filter. Working backward, I found the transformer output was also low. So was the primary. Sure enough, the lost voltage was right across the power switch. The contacts had degraded to the point where they acted more like resistors than conductors. A jumper lead across the switch suddenly brought the radio back to full performance.

Figure 1 shows the circuit for this particular switch problem. If you can measure voltage drop across the switch in the ON position, then you have a faulty switch.

How about switches that are found in other circuits? The same principle applies. Audio switches that develop a little corrosion will start to affect frequency response as well as volume. If the music loses the treble or bass inexplicably, try bypassing the switch contact with a small jumper lead and see if the sound changes. If so, apply contact cleaner and exercise the switch a dozen times or so.

What applies to switches is also true of other types of contacts. Many receivers use relays to mute the audio until the power supply has a chance to stabilize. This prevents horrendous pops in the loudspeakers that can cause damage. If the relay is one that routes audio, then dirty or oxidized contacts can affect the sound. Some speaker systems also use relays as protective devices. The normally closed contacts can develop a little resistance over the years.

Other switch-like contacts can have the same problems. For instance, many headphone jacks have a switch contact to cut out a speaker. Other components use miniature patch cords and jacks to route audio. These often have switch contacts inside.

Even electronic switches can become damaged and exhibit high impedance characteristics when they should be low impedance. Sometimes the effect is exactly the same as for a mechanical switch. Unfortunately, there is no repair you can do except to replace the switch chip.

For mechanical switches, you have several options. First, just exercise the switch a few times. The wiping action of most switches may break the oxidation film or other dirt and make new metal to metal contact. If there is still static in the speaker or a change of audio quality when jiggling the switch lever, you need to clean or replace the switch. Contact cleaner spray will often work well on low power circuits.

Power supply switches or high power audio switches may not cooperate. The reason is that voltage arcs from being turned on and off so often destroys the contacts, especially plated contacts, so that there is no metal left to carry the current. Failed springs and other mechanical parts also prevent a good solid electrical contact. The only choice left is to find a replacement switch.

I hope this information will come in handy the next time you are troubled by strange audio problems that don't seem to be caused by the electronic circuit components. Check out those switches. ■

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

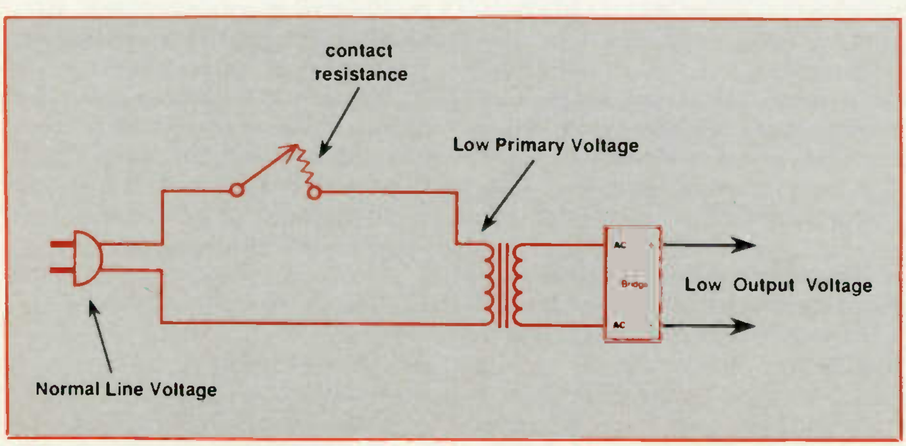


Figure 1: High resistance power switch

Variable power supply

Emco Electronics is pleased to announce the introduction of its new 30-volt 5 Amp variable power supply (the PSV-5). This unit features dual

panel meters, coarse and fine voltage adjustment, and a hi-lo current switch with min-max control. The PSV-5 is overload and short circuit protected.

Circle (52) on Reply Card

Environment conserving chemicals

New from *Philips ECG* are four industrial chemicals to its Hi-Tech Aerosol Chemical line designed to help

conserve the environment. Products OZ-100, OZ-600, and OZ-1100 contain no chlorofluorocarbon compounds (CFCs) which tend to deplete ozone in the upper atmosphere.

Circle (53) on Reply Card

Synthesized function generator

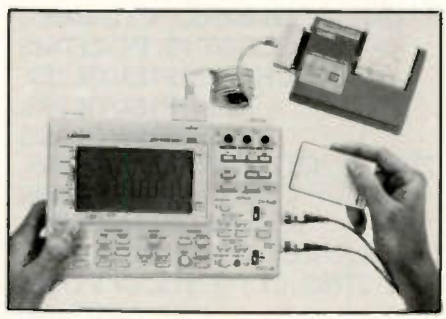
Global Specialties announces the 2003, an exciting new Synthesized function generator. The unit includes the most asked for and important specifications. The 2003 has a fre-

quency range of DC to 1.6 MHz, with sine, square, triangle and ramp outputs.

Circle (54) on Reply Card

Digital storage oscilloscope

Leader Instruments has announced a new battery powered 30 MS/s combination digital storage oscilloscope/digital multimeter with a number of unique features and functions. The



model 300 features dual, add, subtract and X-Y modes, peak to peak voltage of channels 1 and 2 and frequency readout, plus full auto set-up and auto ranging for both time base and volts per division for each channel.

Circle (55) on Reply Card

DMM test lead kit

New from *Pomona Electronics* is the Model 5673, a heavy duty test lead kit for use with digital multimeters (DMM) in plant maintenance and electrical servicing applications.

The kit remedies problems of loose test lead-to-probe or clip connections with a "Pop-Jack" banana connector. Besides providing a dependable electrical contact, the Pop-Jack test technicians easily and quickly interchange a variety of test clips and probes to meet different test requirements. A set of forty-eight inch test leads, each fitted with Pop-Jack con-

nectors, are silicon insulated for greater pliability, making them easier to handle than conventional PVC insulated leads, and protecting leads from accidentally burned or melted insulation, typically a problem when a hot soldering iron may touch the test lead.

Circle (56) on Reply Card

Digilog series multimeters

Extech Instruments announces a new generation of autoranging multimeters with special features that enable ease of use, safety and versatility. The super large 0.7″ LCD display functions both as a digital and analog meter with full function indi-

cation. Measurements are displayed on the 3½ digit display plus a 41 segment arc bargraph. The DigiLog Weatherproof is a 6 function multimeter designed for harsh environments and features water tight seals that keep out dust, dirt, moisture and is water resistant. The Digilog Deluxe is a top of the line model with 9 functions including capacitance and frequency. Autoranging functions include DCV from 200mV to 1000V with 0.5% accuracy, acV from 2V to 750V, acA/dcA from 200μA to 20A, and resistance from 200Ω to 20MΩ, diode check and continuity test.

Circle (57) on Reply Card

Books

Tips And Techniques For The Electronics Hobbyist, by Gordon McComb; TAB Books, 288 pp; $36.95 Hard; $23.95 Paper.

This book provides basic information hobbyists need when experimenting with electronics, and gives them advice on how to become more efficient, creative, and safe. Regardless of their level of experience, readers will be able to use this volume as a source of ideas, a textbook on electronics techniques and procedures, and as a databook on electronics formulas, functions and components. Each of the twenty chapters addresses a major aspect of electronics experimentation, such as how to:

- Buy, use and get the most from test equipment
- Find and identify inexpensive but quality components
- Read schematics and electronic symbols
- Build and repair printed circuit boards
- Use and understand electronic formulas

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

The Master IC Cookbook 2nd Edition; by Clayton L. Hallmark and Delton T. Horn; TAB Books; 390 pp, $43.95 Hard; $26.95 Paper.

The Master IC Cookbook - 2nd Edition is a source of design data on hundreds of integrated circuits, both digital and linear, from a wide variety of manufacturers. This volume now contains sections on TTL and CMOS products, memories, operational amplifiers, audio amplifiers, RF amplifiers, and other linear devices. It also includes information on a variety of integrated circuit specifications - pinouts, block diagrams, temperature ranges, truth tables, schematics, voltage and current ratings.

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

The Illustrated Dictionary of Electronics - 5th Edition, by Rufus P. Turner and Stan Gibilisco; 720 pp; $39.95 Hard; $32.95 Paper

From A (acoustic mirage, amplitude error, and attention display) to Z (zincolysis, zone candle power, and zymurgy), The Illustrated Dictionary of Electronics provides definitions, abbreviations and acronyms, illustrations, schematics and diagrams, and symbols and conversion tables. Now in its fifth edition - featuring hundreds of new entries, updated definitions of previous entries, and enhanced graphic support from front to back - it also contains answers on electronics, computers, mathematics, electricity, communications, and state-of-the-art applications. This 720-page volume includes such features as: definitions for more than 27,000 terms, abbreviations and acronyms in sequence with whole words, Updates of previous definitions, more than 650 informative drawings, charts, and formulas.

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

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2797-1...CTL-2063S, CTL-2068S, CLT-2075S, PC-21T68S (CH. AEDP183/GL7S2, ALEDP183/GL7S2, YAEDP189/GL7S2)
2798-1...CTL-2785S, CTL-2786S, CTL-2787S, CTL-2788S (CH. AEDP166/GL7S1,
2801-1...CLT-2770S, CLT-2771S, CLT-2778S, CLT-2781S, CLT2782S (CH. AEDP164)

SEARS

2796-1.564.42355951, 564.42455951
2797-2 .... 564.48711950
2799-1 .... 564.48840950/51

SHARP

2798-2 .... 20RV99
2800-1.........19RP59, 19RP519

SONY

2796-2...(CH. SCC-C59A-A/D-A, SCC-C60A-A)
2800-2 .... KV-27XBR15 (CH. SCC-C59H-A)
2802-2 .... KV-27XBR65 (CH. SCC-C60F-A)

SYLVANIA

RLX310WAO1/O2/O3/O4,
RLX342AKO1/O2/O3/O4,
RLX344HPO1/O2/O3/O4,
RLX346PEO1/O2/O3/O4,
RLX912AKO1/O2,
RLX916PEO1/O2 (CH. 25N1O1)

ZENITH

2801-2.......SE2503G, SE2505P, SE2507N, SE2509H

Test your electronics knowledge

Answers to the quiz

(from page 55

1. A - Time gets later as you move from left to right on a scope trace. The earliest part of the trace is on the left side.

2. B - Resistors are sold by resistance value, percent tolerance and reliability. Even if those are the same for two resistors, a fourth parameter - Temperature Coefficient - may make it undesirable to exchange resistor types with different TC ratings.

3. B - The Vertical Interval Reference Signal (VIRS) is used for picture adjustments (such as tint).

4. alias. Production of these false signals is called aliasing.

5. Cache - The cache system has become popular because it allows quick access to frequently-used data and instructions.

6. B - At high frequencies the internal and external capacitance, combined with resistance and/or inductance, can support undesired oscillations called *parasitics*.The resistor - called a *parasitic suppressor* helps to prevent those oscillations.

7. B - It is called a *ferrite bead.*

8. B - The equation is only valid when the input and output impedances (read that resistances) are equal, except for transmission line amplifiers, that seldom happens.

9. C - Choices A and B give two ways to define bandwidth.

10. B - They can be rejuvenated, but, not recharged. Recharging involves a reversal of the chemical process.

Classified

Classified advertising is available by the word or per column inch. By-the-word: $1.65 per word, per insertion. Initials and abbreviations count as full words. Blind ads (replies sent to ES&T for forwarding) are $40 additional. Minimum charge: $35 per insertion.

Per Column Inch (Classified Display): $235 per column inch, per insertion, with frequency discounts available. 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.)

Optional color (determined by magazine) $150 additional per insertion. No agency discounts are allowed for classified advertising.

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

FOR SALE

REDUCED 85%, Diehl Mark 111 scanner $79. Diehl Mark V scanner $199. New. Restore remote control keypads with our conductive coating $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629. 608-233-9741. 6-90-tfn

TV TOUGH DOGS: 300 symptoms and cures. Send $10.95 to DAVIS TV, 11772 Old Fashion Way, Garden Grove, CA 92640. 10-87-tfn

SAMS SALES: 0-1800 $1.00 each plus mailing. Call 516-286-4185. 4-91-2t

REPAIR MANAGEMENT SOFTWARE: for IBM PC's Repair Tracking, Inventory, Reports, Billing, Maillist, More. Demo Disk $10. CAHILL ELECTRONICS, PO Box 568, Kingston, NH 03848. 603-642-4292. 4-91-3t

COMPUTER AIDED TV/VCR REPAIR: 3,500 solutions, 37 manufacturers. Printout or IBM compatible. Hard drive, 5¼ disk. Time saver. Quick scan by model, chassis, and stage. Send $90 to Electronics Solutions 407 W. Ave "N", San Angelo, TX, 76903. 1-91-6t

PHOTOFACTS: Folders under #1400, $5.00. Above #1400, $7.00, sent same day first class postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 516-481-4380 4-91-3t

LARGEST SELECTION OF ORIGINAL TYPE TV AND VCR I.C.'S AND TRANSISTORS. WRITE FOR CATALOG. PRELCO, P.O. BOX 894, UNION, NJ 07083 2-91-4t

TELEVISION AND MONITOR TROUBLESHOOTING: 350 symptons and cures, nothing old listed, $13.00 refundable. Jones Enterprises, P.O. Box 702, Niceville, FL 32578 2-91-tfn

POCKET SIZED: Battery operated recess button controlled RF radio frequency generator. To make and break a 5 amp circuit at 1000 feet. In lost of 1000. Harry Drake, 217-826-5136. 4-91-1t

SENCORE: VA62, VC63, NT64, EX231. Includes all cables in original boxes. Excellent condition. $2,495 or best offer. Elmer's TV, 88 McLain Road, Indiana, PA 15701. 412-463-1314. Also parts send S.A.S.E. for list. 4-91-1t

ATTENTION VCR SERVICE CENTERS: 1000 VCR symptoms/cures fromexperience and manufacturers publications. Computer printout $90. Guaranteed satisfaction. VCR Tuneup Center, 43 James Avenue, Redwood City, CA 94063 or call 1-800-777-7883. Mastercard and Visa accepted. 4-91-tf

Sound Technology: 1700B, 1200A, 1000A Nakamichi T100, Kikisulan Oscilloscope. All for $5,000. Perfect Condition. (203) 443-6729.

VHS-VCR REPAIR SOLUTIONS SETS I,II,III,IV,V,VI. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each all six $59.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 12-89-tfn

BUSINESS OPPORTUNITIES

LARGE AUDIO/VIDEO SERVICE BUSINESS: In sunny S.W. city. Established 20 yrs. Well equipped. Price and terms negotiable. (602) 298-8827, Eves. 8-89-tfn

ARIZONA, ESTABLISHED TV/VCR REPAIR BUSINESS: Good reputation, 2 locations, service van. Sencore equipment, negotiable terms, evenings. 602-293-8058. 4-91-1t

VCR REPAIR: Learn the mechanics of VCR which account for 80% of all VCR malfunctions. Video and four part manual. Send $89.95 to ETL Video, PO Box 1711, Ft. Valley, GA 31030 or call 912-825-1736 for VISA and Mastercard. 4-91-2t

SATELLITE TV SALES & SERVICE VCR/TV SERVICE: Fully equipped shop includes 3 employees, 1990 truck, great test equipment, extensive technical library. In beautiful Northern California. Owner will stay for transition period. $100,000. 1540 Gamay Place, Ukiah, CA 95482. (707) 462-8082 1-91-2t

MISCELLANEOUS

LOTTERY NUMBERS: With a built in 100% guarantee! Hit the lottery on purpose! Catalog of 80 IBM/Comp. programs $5. Sigma Box 24759 Dept: 02 Baltimore, MD 21220. 11-90-12t

WANTED

OLD ANTIQUE RADIOS AND TV"S: Pre 1950. Any condition will repair some. Old tubes wanted. Thrifty TV, 16 E. Marie Hicksville, NY 11801, 516-822-4501. 12-91-tfn

USED TENTEL/SENCORE: VCR test equipment for new tech just starting. Ray Dorsner, PO Box 3405, Estes Park, CO 80517. 303-586-0585. 4-91-1t

Readers' Exchange

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

The following restrictions apply to Reader's Exchange:

- Only individual readers may use Reader's Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Reader's Exchange.
- Readers Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Reader's Exchange submissions to:

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

FOR SALE

Sencore VA62, VC63, NT64, EX231, PR57, TP212, SC61.$5100. T.W. Kennedy 171 N. 22nd St., El Centro, CA, 92243. (619) 353-5159.

Sams Photofacts from #81 to #2300. Must buy complete inventory $400.00 for all. *Daniels TV, Tucker Daniel P.O. Box 297, Camden, TN 38320.*

Tentel VCR test instruments. New cost - $1,670. Will sell for $1,000. 913-367-6133. *Harold Seever TV Service 913 Parallel Atchison, KS 66002.*

Viz WR 515B Color Bar signalyst. Video, sync and RF output (ch 4). New condition. *Manual and Hardware Inc. $150.00. Gerald Hebert 10010 Meadow Way Elk Grove, CA 95624, 916-686-6306.*

Sams Photofact folders numbered between 1000 and 1499. $3.00 each plus shipping. Call or write for list or inquire about availability. *Paul Lankow 2600 "T" St. #22*, Vancouver, WA 98661, 206-737-2605.

Two Macom dual "C" band satellite LNB for Macom "Black Magic" dish Pod nose." Van Der Veen - TV, 425 N. East St., Marengo, IL. 60152, 815-568-7434.

WANTED

Tentel VCR test accessories and Sencore FM stereo generator/analyzer ask for Paul. *(219) 264-2147*

A Microprocessor/Microcomputer trainer wanted: Rockwell AIM 65, CBM KIM 1, SDK-805 system design kit, E&L instr's ADD-8000 and MMD-1 (8080) computer trainer, TI TM 990/W89 16 BIT Microprocessor trainer, or Heathkit, NRI, CIE and others. Used, not-work, OK ask *Dave 415, Forest Hills, NY 11375, 718-275-2677.*

Service manuals or schematics for a Sears 934.53293750 and for a 934.53520650, VCR. *T.C. Shannon, PO Box 1021, Acton, MA 01720.*

Power transformer for Lectro-Tech scope model TO-60 PN # TP27 also 2 6HU8 tubes, transistor clinic 313-774-1230. *23419 Gratiot Ave, E. Detroit, MI 48021.*

Zenith TV hand remote 124-25 ("Space-phone") purchase/clone. (124-24 non-phone or repairable OK). *D.J. Christel, 219 Shady Lane, LaCrosse, WI 54601, 608-782-1508.*

Old time 25A - Amphere Meter, vertical board or whole chassis for Sony Model #KV-1722. Frequency Counter 10HZ to 150KHZ. *Ralph Dorough 117 Pecan St. Terrell, TX 75160, 214-563-7105.*

Sony flyback transformer, Part # 1-439-120-13. Part is "no longer available" from Sony. *Mr. William M. Suhy 309 Terrace Avenue,* #12, West Haven, CT 06516, 203-238-8997.

Advertisers' Index

Readers' Exchange

WANTED

High voltage transformer (P/N 154493) for RCA chassis CTC101. Focus and screen assembly (P/N 146168) for same RCA chassis. High voltage transformer (P/N 1-439-235-11) for Sony model KV1743R. Whole chassis is OK in both cases too. *Fred Jones 407 Morningbird Court, Niceville, FL 32578.*

Sony component TV tuner, model #VTX-1100R in working or repairable condition. *Smith Electronics, 2201 Elm Tree Inn, Crow Point, IND. 46307, 219-988-3409.*

VA 48 Sencore, VA 63, Z-meter, will pay reasonable price plus shipping. *Roger Goldberger 3909 Dora Circle Harrisburg, PA 17110, 717-652-1703.*

Parts needed for RCA Color TV CTC68: Transformer Part #132622, Condenser 0.18 μF 400 V. #137132, Cond. 0.066 μF. 600V .#131317, Cond. 0.075μF 138739, Coil 470μ. 132144. Parts needed for Philco color TV model #00AB - chassis #13A203 as follows: 1 schematic or diagram, 1 I.C. DSD8640V3FY. *Jorge Vargas B P.O. Box #9583*, Guayaquil, Ecuador.

Tuner Fanin board TNP62031 for veal color TV model CT9071. Surge and rally board. Larry Tealman, 49 Gaff, Memphis, TN 38112.

Service literature for Sony taperecorder model # TC-222-A, JVC tuner adapter model # TU-SIOU and JVC VCR model # HR-SIOU. Working JVC tuner adapter model # TU-SIOU. *Arthur Lucero, 714-788-7281*

IC #15-41545 or ECG .794. *Ben Bunin, 2230 N. 55th Ave. Hollywood, Fla. 33021, 305-987-5235.*

Service manual for ECA TV model #E-1600 distributed by Elkod Corp. Will buy a photocopy. Also need flyback for Sanyo model 91C30 part #275-2-1410-05600/F0211. *Dan Schafer 4215 Buechner Avenue, Cleveland, Ohio 44109, 216-351-4555.*

Service manual or Sams for Sony KV 1515 Trinitron TV (S# 577220). Will buy or copy. Leave message at *(303) 937-7882. Craig Rogers 369 Zenobia Denver, CO 80219.*

Used test equipment. Test jigs, for Zenith RCA service manuals for popular brands. *403-783-5454.*