

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

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Servicing & Technology

March 1997

Servicing technicians glossary

Motors in electronics

Buyers' Guide

ES&T

1997

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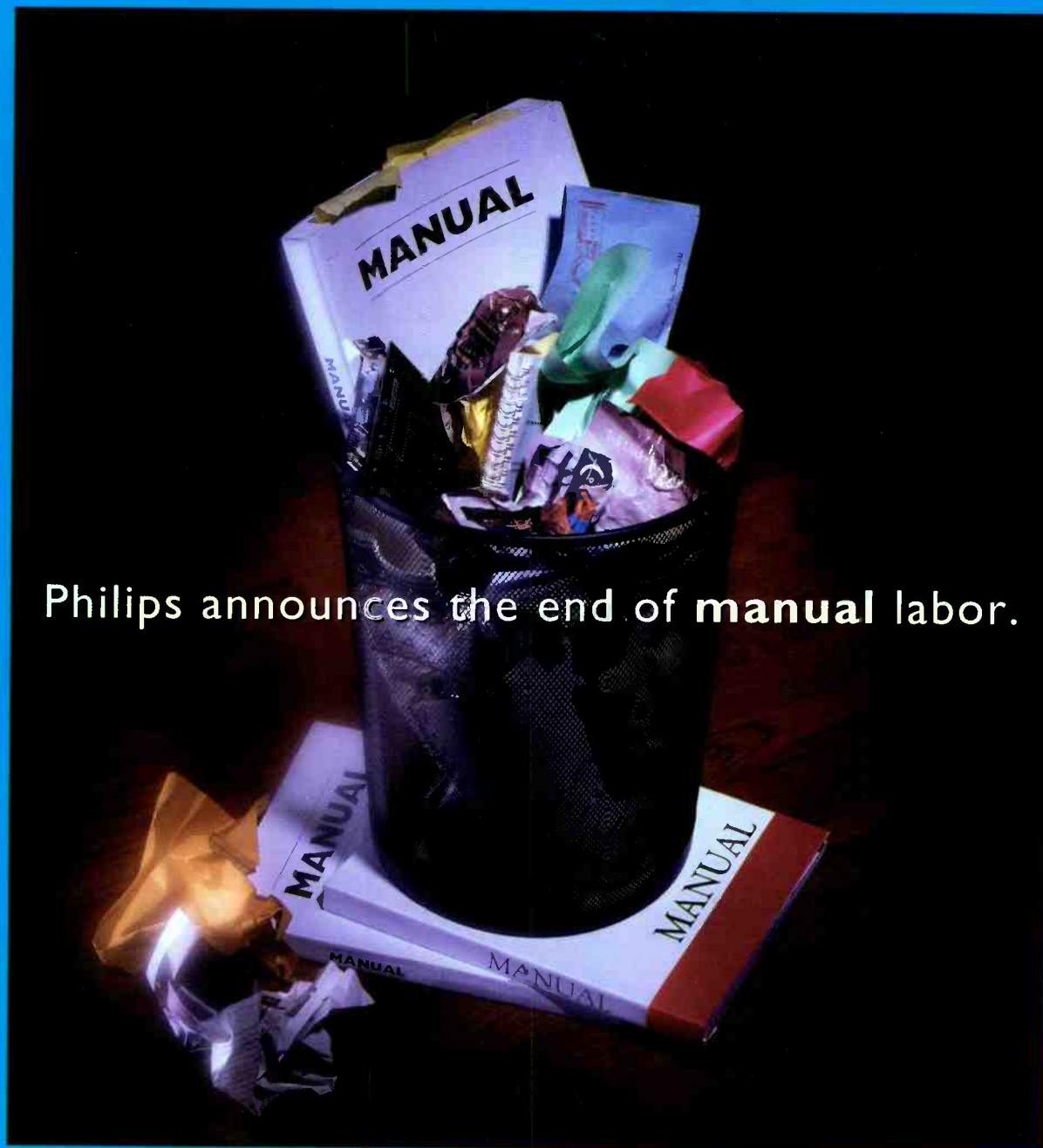
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Servicing & Technology

Volume 17, No. 3 March 1997

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By The ES&T Staff

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By The ES&T Staff

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1997 BUYERS' GUIDE

To run a service center you must command a wide variety of skills and materials. You must have technical skills, management ability, an up-to-date comprehensive library, tools, test equipment, accessories and replacement parts. The ES&T Buyer's Guide contains useful information on hundreds of manufacturers and distributors who make and sell the products you buy. Through all of our research and visits to trade shows throughout the country we have come up with the list you will find in this magazine.

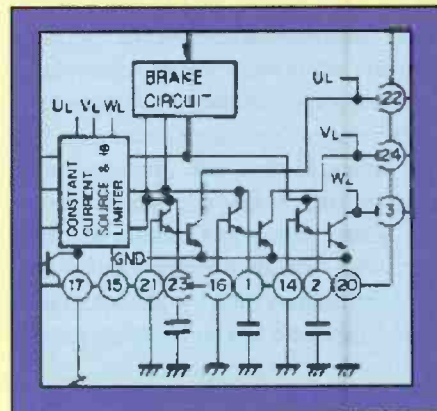
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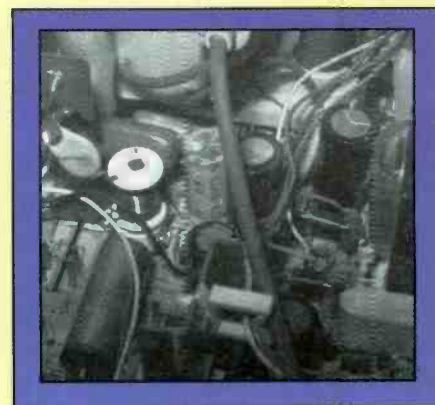
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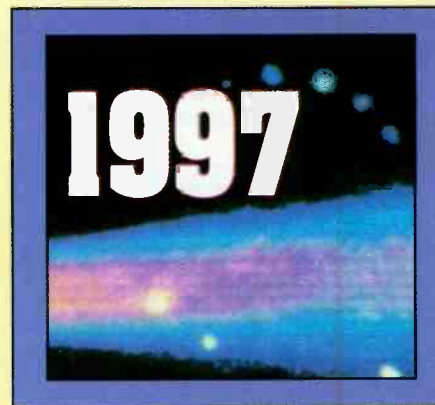
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ON THE COVER

Sometimes finding a replacement for a faulty part that you've spent hours to track down is difficult or nearly impossible. This annual Buyers' Guide contains listings of hundreds of manufacturers and distributors, one of whom may carry just the replacement part, tool or piece of test equipment you need.

We goofed. In the November/December annual Profax Schematics Issue, we neglected to identify the companies that provided us with those beautiful photos that enhanced the look of our cover. Cooper Tools supplied us with the photo of the blue-handled tools, their Erem Series line of hand tools. Fluke provided us with the photo of the DMM being used to take measurements in a television set. Thanks to Cooper Tools and Fluke for providing us with those photos.

Building the Buyers' Guide

Welcome to the 1997 Annual **ES&T Buyers' Guide**. The *Buyers' Guide* grew out of an idea developed 11 years ago to gather the names, addresses and telephone numbers of manufacturers, distributors and other companies that provide products and services to consumer electronics service centers in one place. For many years a listing such as this one was not necessary. There were only a handful of manufacturers, a handful of products and a handful of distributors carrying test equipment, service literature and replacement parts.

The growth of consumer electronics

Gradually, however, the range of products that came under the heading of "consumer electronics" expanded from merely radios and TVs to include VCRs, microwave ovens, camcorders, CD players, personal computers, video games and more. And the number of manufacturers producing those products grew from a few dozen to a few hundred. The number of distributors of products to the industry that services those products grew as well.

Moreover, some of the companies that seemed to be rooted in one place moved for one reason or other—to enjoy a more benign climate, to have access to a more stable work force, to take advantage of a tax advantage offered by one state or to escape excessively stringent environmental laws. The net result was that the average service center became unable to keep track of who was entering the business, who was leaving it, or who was moving to a new location.

Here's how we do it

So we have developed this annual *Buyers' Guide* issue in which we include the latest information on companies of interest to consumer electronics service centers. For this 11th edition of the *Buyers' Guide* we started back in October. That's when we had question-

naire forms printed up. Next, using the then current database, we printed labels and brought the forms to a mailing house to have them sent out.

For several weeks there was a steady stream of questionnaires, then the stream slowed to a trickle, then stopped. Unfortunately, many of the companies to which we sent questionnaires did not fill them out or return them. We've found that what happens is that the individual to whom the questionnaire was sent received it, but was busy and put it aside, whereupon it disappeared into a stack of papers and never again saw the light of day. So we do a second mailing, to all of the companies that failed to respond to the first mailing. That results in a spate of additional returns.

All of this new information is keyed into the database and then printed out as two files: the company name and address list and the product listings. There's no way that we can force companies to return the questionnaires, so, unfortunately, the listings are almost certainly not 100% accurate. But they're as accurate as we could possibly make them.

Internet addresses

Those of you who have been receiving the *Buyers' Guide* for a while will note a new feature. This year, in addition to the other information in the name and address listings, we have listed Internet information. We included spaces in the questionnaire where companies could add their Internet Web site and an e-mail address. We have included this information for each company that provided it. The Web site address provides yet another way that service centers can find out about the products and services offered by companies listed in the *Buyers' Guide*.

Article coverage changes, too

All of the changes that led us to insti-

tute the *Buyers' Guide* have also lead to changes in the mix of articles in this magazine. During those early years, articles were largely confined to TV servicing. However, since the definition of consumer electronics has changed and many readers are now servicing many other products, the articles we publish now include video, audio, microwave ovens, computers and more.

In December, we included a survey form that asked the following: "So much change and activity has happened in consumer electronics in the past several years, and so much continues to happen, that we'd like to take this opportunity to make sure that the mix of articles in **ES&T** is meeting the information needs of readers." We asked readers to rate their interest in the various subjects on a scale of 1 to 5. Subjects included TV servicing, TV theory, VCR servicing, VCR theory, business, computers, computer peripherals, computer software, the internet, general electronics theory, audio servicing and audio theory.

The results are still trickling in, but in the main there appear to be two schools of thought. First of all, almost everyone still finds TV and VCR servicing of utmost importance. Secondly, the judgment of readers as to the usefulness of computer-related articles seems to be split. A majority of respondents seem to find them extremely useful, but a significant minority seem to have no use whatsoever for computer-related articles. We'll keep these findings in mind when we establish the mix of articles in the future, and we'll provide you with a more detailed report on the results of this survey in a future issue.

Nile Conrad Pearson

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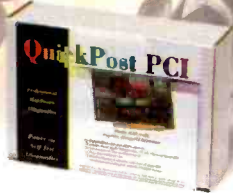
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Bigger is better for September video sales

Sales of video products rose modestly in September and in the first nine months of the year as compared to 1995, according to data from the Consumer Electronics Manufacturers Association (CEMA). Impressive sales of big screen TVs (both direct-view and projection) helped continue the video market's positive momentum from August.

"After a slow start for 1996, the industry is seeing steady growth for video products—four of the last five months," said Jack L. Osborn, president and CEO of Mitsubishi Consumer Electronics America, Inc. "Big screens have anchored this growth, due primarily to improved picture quality and the continuing proliferation of home theaters. The Olympics and the fall sports season have motivated many to invest in a large direct-view or projection television. VCRs—notably the hi-fi stereo models—continue to shine, as do the mini-dish satellite systems.

CEMA data shows that shipments of projection TVs rose a hearty 27 percent in September, pushing the gain in the year to date to 12 percent. Meanwhile, the biggest models—60 inches and over—nearly doubled from September 1995.

Sales of direct-view color TVs with screens 30 inches and larger jumped 34 percent in September, the best monthly gain for the category this year. Meanwhile, slumping sales of mid-sized sets brought the overall TV category down six percent in September.

Sparked by sales of smaller models (13 inches and under), TV/VCR combinations continued to rebound from early sluggishness to post a six percent gain.

A ten percent increase pushed shipments of VCRs past 10 million for the year. The month of September continued the five-month trend in which the VCR market has scored gains over 1995.

Dealers purchased 470,000 camcorders in September—a four percent gain.

The Consumer Electronics Manufacturers Association (CEMA) is sector of the Electronic Industries Group (CEG). CEMA represents U.S. manufacturers of audio, video, consumer information, accessories, mobile electronics and multimedia products.

Consumer electronics accessories sales hold steady for first half of 1996

According to the Consumer Electronics Manufacturers Association (CEMA), sales of audio, video, camcorder and telephone accessories for the first half of 1996 held steady, remaining virtually unchanged from the previous year. Sales for 1996's second quarter totaled \$173 million, off a slight one percent from 1995's second quarter.

"In a recent CEMA consumer survey, only 31 percent of respondents said they got accessories information directly from salespeople, and only three percent of consumers depended on the advice of the salesperson when selecting which accessories to purchase. Manufacturers and retailers need to work together to educate consumers on the value of accessories," said Olin Lippincott, Manager of Zenith/Allegro Accessories Division. "Consumers do see quality as the most important factor to consider when purchasing accessories. However, not only do we as an industry need to impress upon consumers the quality of our products, but also the enhanced quality and value our accessories bring to existing consumer electronics hardware. Accessories help change the functionality of hardware products so that they better match a consumer's individual lifestyle."

Audio Accessories, spurred by strong sales of separate components for home theater use, were up a robust 12 percent in the second quarter, bettering results from the first quarter. In the first half volume rose nine percent. Tape cassette accessories totaled \$15 million in the year-to-date, up 12 percent over 1995. CD accessories were off 13 percent to \$20 million. The big gainer was headphones. Sales of standard and earbud models rose 21 percent in the first half on shipments of \$58 million.

Factory sales of video accessories were down six percent in the quarter to \$68 million and fell five percent in the first half. Nearly all categories were down in the first half, including universal remotes (down 10 percent), and VCR head cleaners (down 23 percent).

Camcorder accessories ended the first half virtually unchanged from the previous year with sales off a scant half percent. Telephone accessories were off sharply in the quarter and were down seven percent in the year-to-date. ■

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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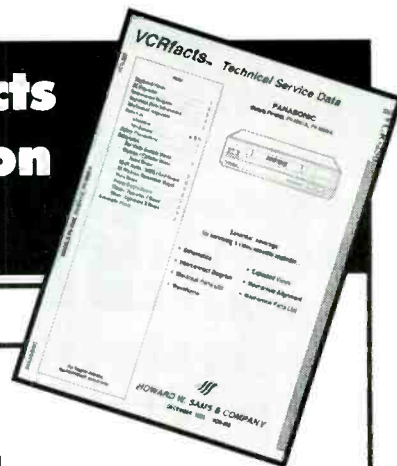
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Motors in consumer electronics

By The ES&T Staff

Back in the good old days of consumer electronics, when consumer electronics consisted of radio, TV and phonograph, the only motor that consumer electronics technicians had to contend with was the motor in the turntable. That motor was pretty straightforward, and pretty reliable. It ran on 120V and as long as the ac voltage was close to 60Hz, it ran at the correct speed.

Lots of motors today

In today's consumer electronics milieu, motors are everywhere. When you place a tape in a front-loading VCR, it actuates a switch, and a motor pulls the tape into

place. Once the tape is inside the VCR, a motor pulls the tape through the tape path, while another motor turns the head drum.

In a camcorder, you'll find motors that provide the same functions as those in a VCR, as well as motors that provide focus, zoom and aperture control.

Every tape player, CD player, disk drive and printer has one or more motors. It really helps in servicing these products to have an understanding of the basics of motors and the circuits that drive them.

The drum motor

For the purposes of this article, we'll concentrate on the drum, or cylinder,

motor of a VCR or camcorder. Interestingly, the typical drum motor is actually a three-phase motor. Most technicians have some knowledge of three-phase motors from studies of three-phase motors that are used in industrial plants.

In a three-phase motor, rotation occurs as the result of a rotating magnetic field that is created by the application of three-phase power to the three separate windings of the motor. The three phases of applied power are 120 degrees out of phase as they are applied to each of the windings of the motor.

One of the advantages of a three-phase motor is that it does not require brushes.

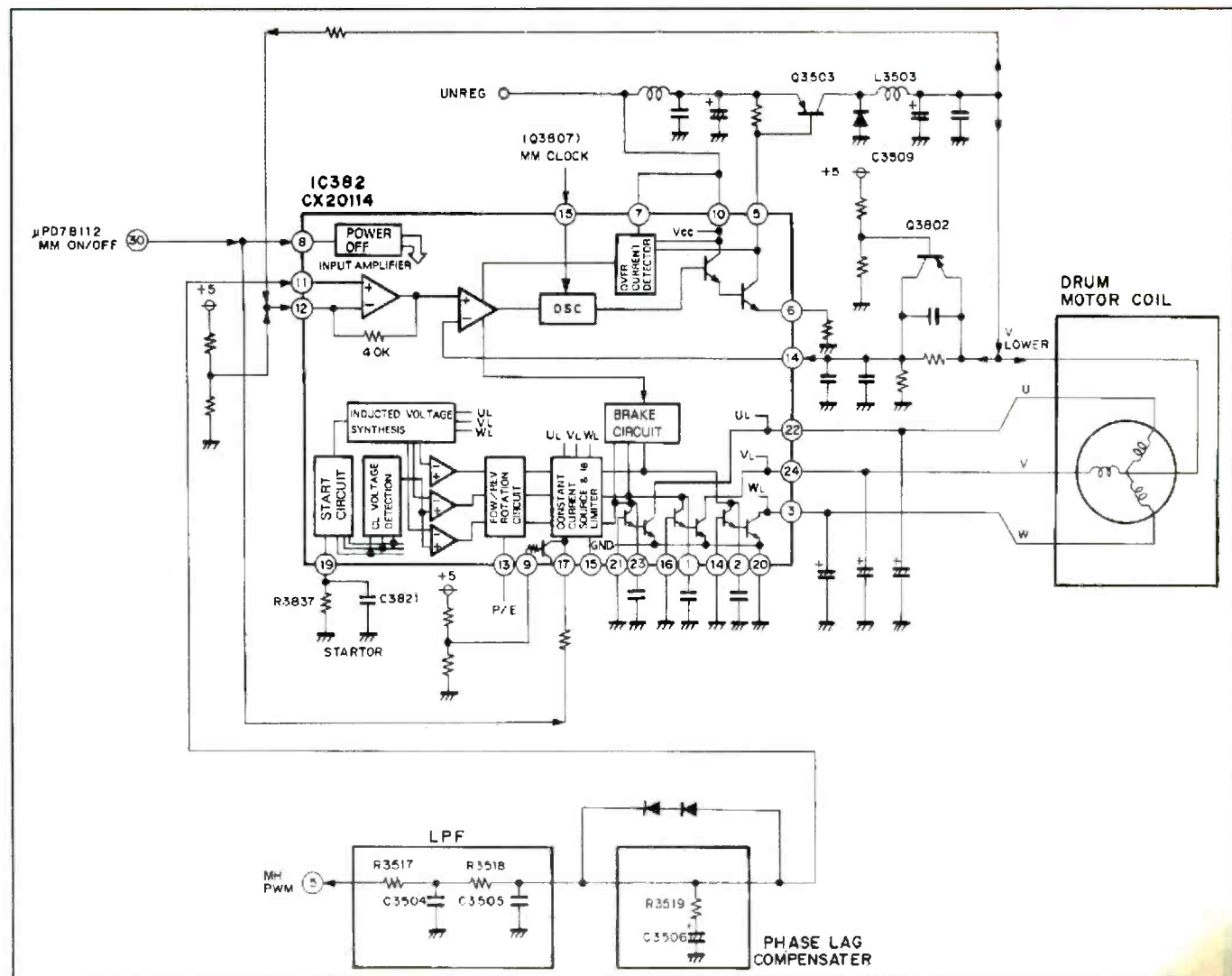


Figure 1. The head drum motor in a VCR is a three-phase motor. The motor drive circuits provide the three-phase alternating current signals needed to generate the rotating magnetic field that spins the motor.

The rotating magnetic field caused by the combination of the individual fields induced in each of the three windings is what creates the rotational force. Another advantage of a three-phase motor is that its speed of rotation is determined by the frequency of the applied power.

Switching to achieve three phases

The following is a generalized description of the manner in which the capstan motor power supply is switched in order to generate the three phase signal that drives the motor.

The switching timing for the power supply to the three motor windings is determined by the windings themselves through detection of the voltage waveform induced by the rotor. No voltage is induced when rotation is stopped, so a device called a ring generator supplies current to each of the windings in turn in order to start the motor. CX20114 (IC382) is the driver for this motor. The starter oscillation frequency is determined by the capacitor and resistor connected to pin 19.

The signal input to pin 11 passes through the internal op amp, is converted to a PWM (pulse-width modulated) wave, output from pin 5 and power amplified by the power transistor (Q3503).

Next, the carrier is eliminated by the LC LPF (low-pass filter) and is connected to the common terminal for motor power supply. Current is supplied to the windings through this terminal and pins 22, 24, and 3 of CX20114. The current only flows in one direction.

The voltage of this common terminal is also fed back to the previous stage op amp (pins 12 and 14) through a resistor. After the signal is converted to a PWM wave, a power amplifier offsets any power loss that was caused by switching.

The frequency of the carrier of the PWM wave is 23.4kHz. After the 23.4Hz MH PWM output from pin 5 of μ PD-78112 (IC351) is converted to a triangular wave (Q4306, 07), it is input to pin 15 as the PWM reference wave. The rotation and stop control signals are input to pin 8 of the integrated circuit.

Troubleshooting one of these motors

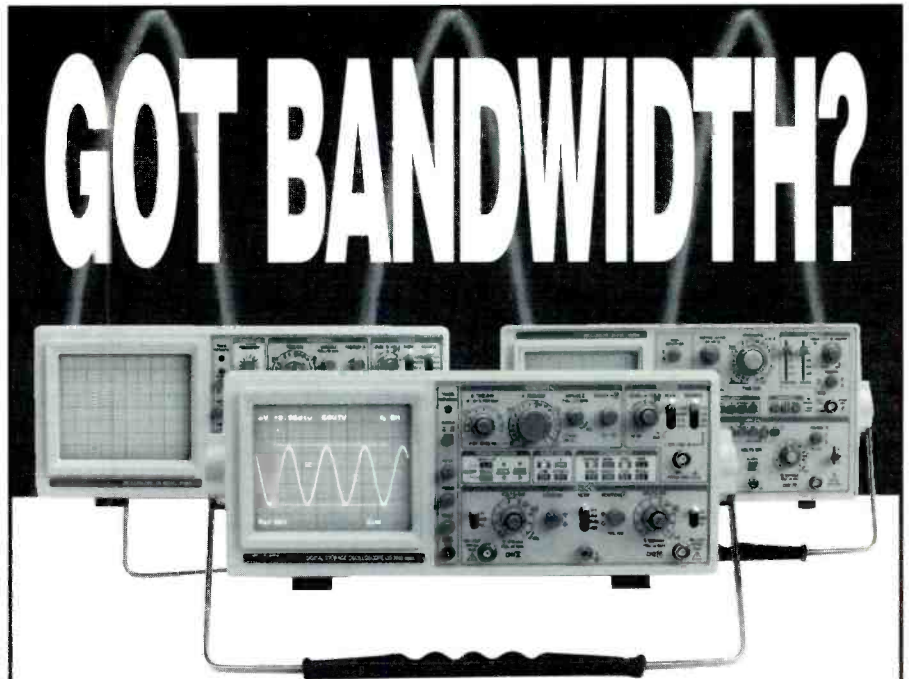
Inspection of Figure 1 suggests that if the drum motor appears not to be operating properly, there may be a number of

reasons, so it makes a lot of sense to check the circuits carefully before you order a new drum motor. For starters, check the mechanical condition of the drum motor by rotating the drum gently by hand. If it turns easily and smoothly, it's most likely sound, mechanically.

Next, with the VCR turned on, observe the waveforms at U, V, and W, and see how they compare to the waveforms specified on the schematic. If the waveforms look to be within spec, then the problem

is most likely somewhere in the motor. Check its connections to see if any of the windings are open. If so, the motor will have to be replaced.

If the waveforms are not within spec, the problem is not in the capstan motor, but in the drive circuits. Check to see if the input(s) to the drive circuits are as specified. If they are, you've isolated the problem to the IC and its connected components. If they're not, you'll have to check further upstream. ■



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Some new terms for some of the new products: A technician's glossary

By the ES&T Staff

The old saying goes, "you can't tell the players without a program." When it comes to consumer electronics, it might well be said that "you can't tell the technologies without the right vocabulary." Unfortunately, as the scope of consumer electronics expands, so does the vocabulary necessary to describe it.

There have been a number of developments recently in consumer electronics that have contributed to the vocabulary. For example, the many disparate parts of consumer electronics; TV, video, audio, computers, etc. seem to be converging to a common set of technologies.

There was a time when audio and video were analog and computers were digital. Now, audio and video signals are transmitted via digital signals and stored on disks in digital format, and digitized TV signals are showing up on computer screens. The familiar television set now may very well have internet access.

As all of these changes are taking place, a whole new vocabulary is being generated. The following are some of the terms you'll be seeing in the literature.

Aspect ratio: The ratio of the horizontal dimension of a viewing screen to its vertical dimension. Standard television screens have a 4x3 aspect ratio. That is, if the screen were 20 inches in width, for example, the height would be 15 inches. In contrast, HDTV screens will have an aspect ratio of 16x9, much closer to the aspect ratio of movie screens.

Convergence: This definition of the term, which has only recently entered the vocabulary, has nothing to do with improving the picture on a color TV screen. The new usage of "convergence" that has been introduced by consumer electronics manufacturers describes the current tendency of all consumer electronics to use the same technologies, that is, converging toward a common technology.

DAR: Digital audio radio. A radio broadcast system that will provide CD quality audio via the airwaves.

DBS: Direct broadcast satellite.

DSS: Digital satellite system. A form of direct broadcast satellite.

DVD: Digital video (versatile) disk. This recording technology allows full motion video and stereo high fidelity sound to be recorded on a disk that is the size of a standard compact disk. Because of the high densities of data recording used, along with advanced digital compression techniques, it is possible to record a full length movie on a 4-1/2 inch digital disk.

Electronic organizer: A calculator-like device that can store names addresses and telephone numbers, as well as personal schedules. It is the electronic equivalent of the paper-based personal organizer/scheduler systems.

HDTV: High definition TV.

Home theater: A video/audio system that provides a theater-like experience in the home. According to the Consumer Electronics Manufacturers Association, within the industry it is felt that a home theater should at least include a large-screen (25-inch or larger) color TV, a source for stereo surround sound, front- and rear-channel stereo speakers, and a stereo VCR or videodisc player. The complete home theater system would include the TV display, either a large-tube or projection color set, alternative video-sourced components, and stereo audio components, all hooded into an audio/video (A/V) receiver.

Internet TV: A television set that either contains within it an interface device, or has a separate interface device, so that it may be used to connect to the Internet.

These sets and interfaces are being sold with the notion that the user can connect to the internet without buying a computer. It may be transparent to the user, but there is some kind of reasonably powerful computer in those units.

MPEG: Motion picture experts group. A method of compressing video so that the huge amounts of picture information represented by a motion picture can be stored in a relatively small space.

PCTV: Personal computer/television. Manufacturers, such as Toshiba, are beginning to manufacture high-performance cathode ray tubes (CRTs) specifically designed for emerging PC/TV applications. These new tubes provide the high contrast, high brightness excellent picture sharpness that these applications demand and can be used for both personal computer and TV display.

PDA: Personal digital assistant. A hand-held wireless mobile computer, disguised as an easy-to-use consumer electronics device. Depending on the specific type of product, they can incorporate capabilities associated with electronic organizers, pen-based computers, electronic books, online services, multimedia players, pagers, and cellular telephones.

SmartCard TV: A Philips development that allows the user to select the degree of integration and interactivity that they want in a TV. For example, viewers will be able to simultaneously access the internet, receive telephone calls and watch TV, or use a drag and drop method of programming their VCRs.

SO/HO: Small office/home office. This is a term that is used in the industry to describe the types of electronics products that may be found in a small or home office. It includes such products as personal computers, fax machines, answering machines, cordless telephones, etc. ■

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Servicing RCA's CTC130 startup and shutdown symptoms

By Homer L. Davidson

Most TV startup and shutdown problems originate in the horizontal and power supply voltage sources. Startup and shutdown conditions in the RCA CTC130, CTC131 and CTC132 chassis are very similar. The CTC130 chassis includes a variable frequency switching power supply (VIPUR), while the CTC131 and CTC132 contain a chopper type power supply. Both types of power supplies are furnished with a raw +150V source from a bridge rectifier circuit.

The variable frequency power supply used in the CTC130 chassis is similar to that used in a previous chassis, except that in the CTC130 the components are mounted on a separate circuit board assembly known as the PW VIPUR. The primary purpose of the VIPUR power supply is to provide a "hot-to-ground" isolation between the primary TV power supply source (hot ground) and the cold ground circuits.

When observing waveforms or measuring voltage and resistance, check to see if the measurement should be made with respect to a hot ground or cold ground. If you make your measurements with respect to the wrong ground, the measurements will not match what you see on the schematic. The primary winding circuits of the VIPUR transformer (T1) contain the hot ground, while the secondary windings have a cold ground. There are several different modifications found in the CTC130 chassis.

The PW VIPUR module also develops the standby voltage sources for the MTT101 tuner and module. DC voltage sources are also developed for the stereo broadcast, video/audio in/out circuits, and stereo power amp circuits.

While the +150V source of the PW VIPUR is regulated, it is also applied to the familiar SCR regulator circuit on the main chassis board to generate the +127V regulated source. The regulated +127V

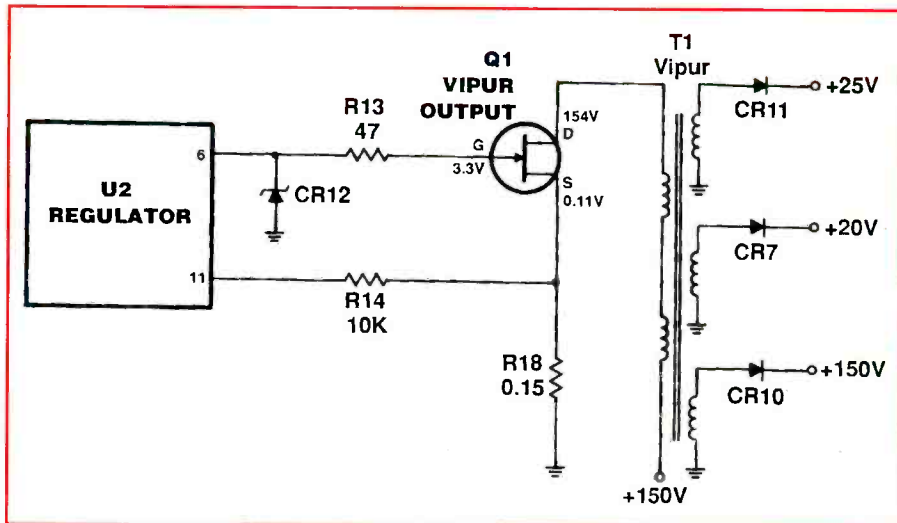


Figure 1. Check Q1, CR11, CR7 and CR10 for defects if the VIPUR power supply appears to be not operating properly.

source is fed through VIPUR (T402) to the horizontal output transistor.

Regulator IC (U2), receives on/off commands from the remote amp circuit (part of MTT module) or the on/off TV button. Transistor Q2 and opto-isolator IC (U1) provide input operation to U2. U1 provides hot and cold ground isolation with the VIPUR transformer T2. The regulator IC U2, provides a drive signal to the gate terminal of MOSFET transis-

tor (Q1). This on/off drive signal switches Q1 on and off causing energy to be stored in and discharged from the primary winding of switching regulator transformer T1. Transformer T2 provides rectified voltage supply sources of +150V, +25V and +20V for the set.

The dead chassis

The dead CTC130 chassis may be caused by defective components within

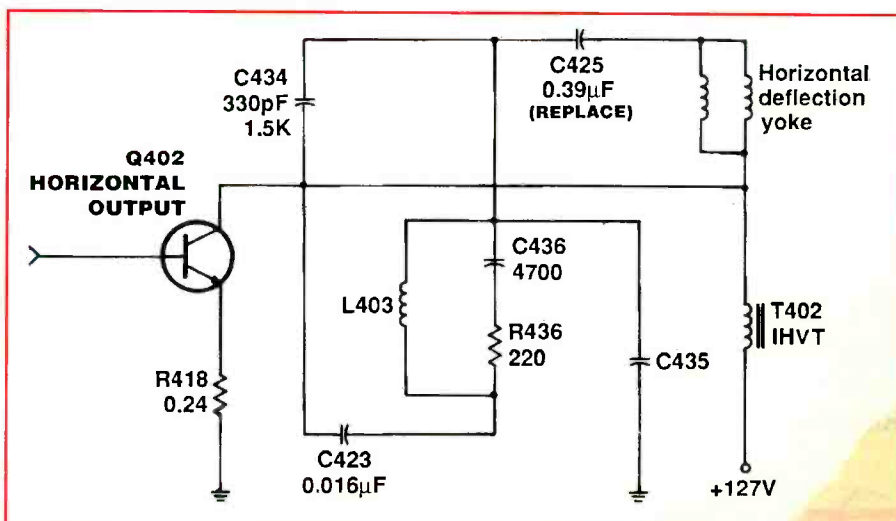


Figure 2. Suspect C425 when Q402 is found to be short circuited.

Davidson is a TV servicing consultant for ES&T.

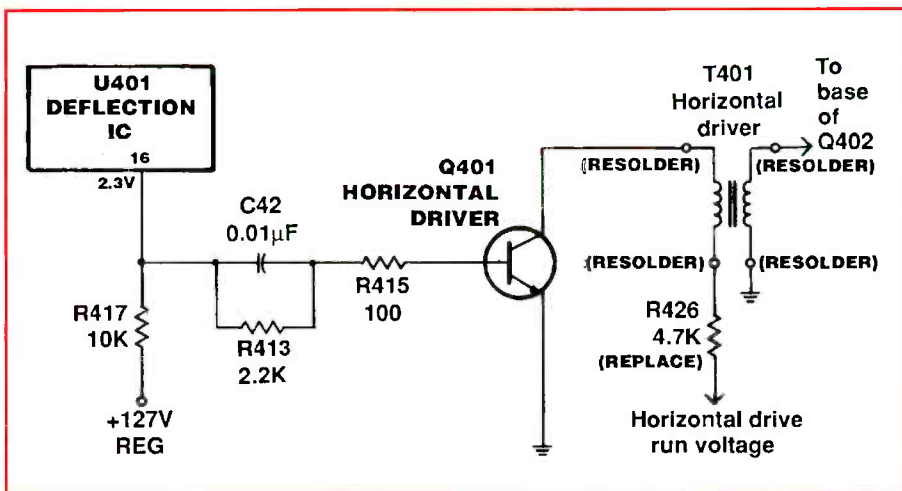


Figure 3. Intermittent start up and shutdown can result from a defective R426, horizontal drive transformer, or poorly soldered T401 contact connections.

the VIPUR power supply sources or horizontal circuits. A blown line fuse may result from a shorted or leaky VIPUR MOSFET output transistor, leaky horizontal output transistor, shorted SCR regulator, or leaky or shorted capacitors in the flyback and yoke circuits.

If you encounter a dead CTC130, check the raw +150V power source from the low voltage filter capacitor C105 (680µF). Next measure the dc voltage applied to the drain element of Q1 (Figure 1). To determine if the VIPUR circuits are functioning, measure the dc voltage at CR11, CR7 and CR10. The most common causes of problems in the VIPUR output circuits are Q1, CR11, CR7, and CR10. A leaky or shorted VIPUR output (Q1) can destroy the line fuse (5A) and source resistor R18 (0.15Ω).

If the set becomes dead, the 5A fuse in

the horizontal circuits may blow. Suspect a leaky SCR101 if there is no regulated +127V applied to the horizontal output transistor (Q402). Check for bad contacts on the SCR socket terminals. Test for a leaky Q402 if you find that the line fuse is blown or if the supply voltage becomes extremely low.

Improper drive waveform at the base of Q402, caused by poor soldered connections on the driver transformer (T401) or leaky horizontal driver transistor Q401, can destroy Q402. Replace capacitor C425 (0.39µF) in the horizontal deflection yoke lead if the voltage is low, or if the line fuse blows (Figure 2).

Intermittent startup

If the problem is intermittent startup and shutdown, it may be difficult to locate the defective component until you have

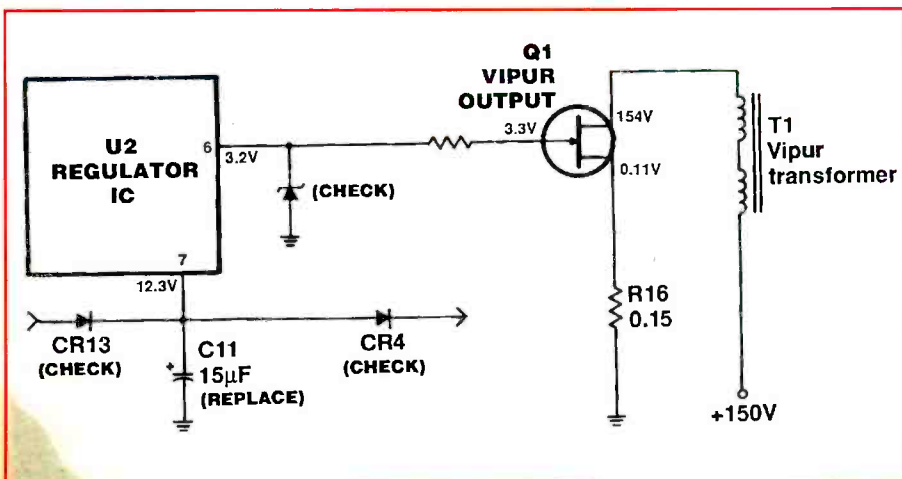


Figure 4. When the problem is intermittent startup and shutdown, check capacitor C11, and diodes CR12, CR13 and CR4.

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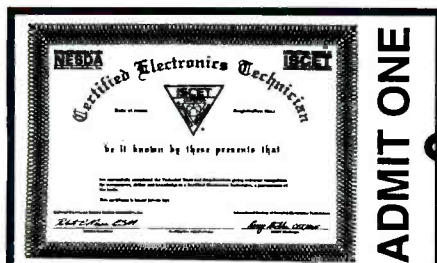
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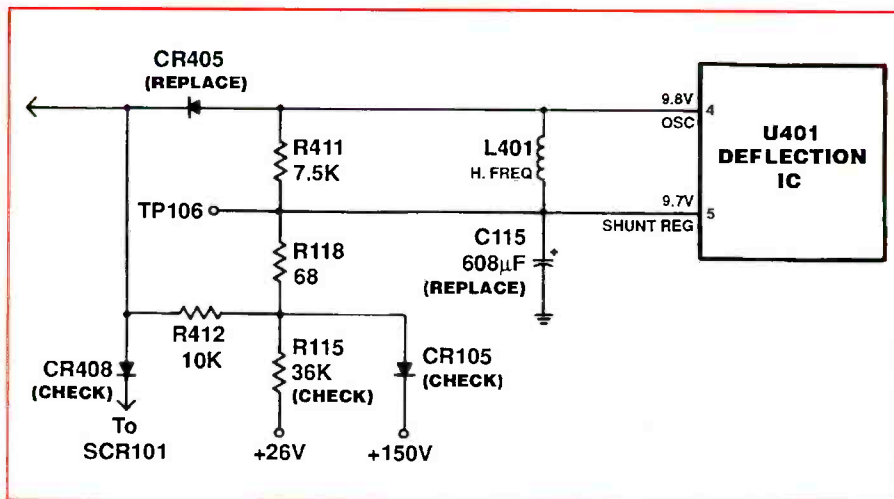


Figure 5. In cases of intermittent start up in the deflection circuits, check C115, CR405, CR105, and CR408 in the oscillator section of integrated circuit U401.

conducted some tests. Try to isolate the defective part in the low voltage sources or in the horizontal circuits. Monitor the low +150V source feeding the VIPUR horizontal circuits. Check and monitor the regulated B+ 127V feeding the horizontal output Q402 from SCR101 source. Scope the base terminal of Q402.

As with all TV chassis, a dirty or defective switch, poor driver transformer terminals, defective driver transformer or voltage dropping resistor can cause intermittent startup (Figure 3). Go directly to the driver transformer and solder all terminals. Check R426 for overheated conditions or a change in value. It is best to replace R426 with another 4.7KΩ, 5W resistor. Measure the primary resistance

of the driver transformer (T401) for a decrease in resistance.

After replacing a leaky horizontal output transistor (Q402) in a dead set, the chassis will sometimes start up and then shut down. If this occurs, suspect R416. The 0.15Ω resistor in the emitter circuit of Q402 can be damaged if the horizontal output transistor is shorted or leaky. An increase in resistance of R416 can produce intermittent start up symptoms.

Off and on problems

Sometimes small electrolytic capacitors and diodes will cause the chassis to turn on and off and then shut down. The CTC130 chassis can cycle on and then off when certain small capacitors dry up or

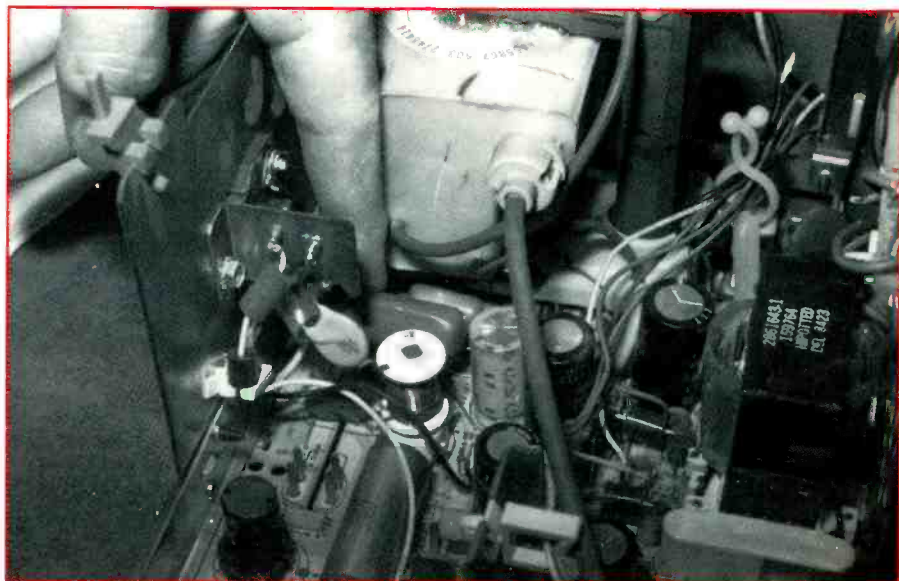


Figure 6. Locate the horizontal output transistor and clip the scope lead to it to monitor the signal at the base terminal.

become lessened in capacitance. Usually, these symptoms do not occur until the chassis has been operating for some time.

Faulty diodes can break down at any time. The zener diodes may take time to become overheated thus delay the onset of the intermittent start up or shut down.

Replace capacitor C11, located off of pin 7 of U2 regulator in the VIPUR power supply circuit if the set cycles off and on. Electrolytic capacitor C11 (15 μ F) can appear open or become leaky causing shutdown and start up problems (Figure 5). Check the voltage on pin 7 of U2 and pin 6 for correct voltage. A low voltage measurement indicates a leaky capacitor or diode. Disconnect one end of C11 and CR12 from the circuit, then check to see if there is leakage through these components. If in doubt, automatically replace C11 and CR12. While in the circuit, check CR13 and CR14 to see if they're normal.

Intermittent deflection circuits

Intermittent start up and shutdown problems may be caused by defects in the deflection IC circuits. IC U401 can become intermittent and shut down or produce intermittent startup problems. De-

fective components tied to the deflection IC U401 have been known to cause intermittent start up problems.

Suspect electrolytic capacitor C115 (68 μ F) tied to pin 5 of the shunt regulator terminal of U401. A leaky C115 can cause intermittent start up conditions. Replace both CR405 and C115 for intermittent start up symptoms (Figure 5). Do not overlook a change in resistance of R115 (36K Ω) start up resistor, and diodes CR408 and CR105 in the same circuit.

Measure the voltage at pins 4 and 5 of U401. If these voltages are lower than specified, the problem may be a leaky capacitor or diode. U401 will not provide vertical or horizontal drive waveforms if there are defective parts within the horizontal oscillator frequency circuits. Monitor the horizontal output drive waveform on pin 16 of U401 for intermittent start up and shutdown problems produced in the deflection IC circuits.

Intermittent turn on and shutdown

In another CTC130 chassis, sometimes the chassis would operate for days and then shutdown. When the chassis became intermittent, the regulated voltage was

monitored at the SCR101 regulator gate terminal. I suspected the deflection IC (U401) because the voltages on pins 7, 9, 10 and 11 were not within specification.

Before replacing U401, I carefully measured the voltage and resistance at each terminal. Everything seemed normal when the chassis was turned off for resistance tests. When the TV was on and in the intermittent state however, the voltages at pins 9 and 10 were very low, and about the same. The resistance between pins 9 and 10 was around 101K Ω . Perhaps C107 (1500) or C108 (0.022 μ F) were intermittently leaky or became open. Another possible cause of the problem was that the deflection IC might have internal leakage. (Figure 6).

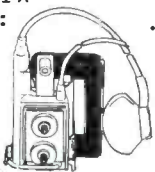
After taking another resistance measurement, which proved normal, I turned the set back on. The chassis operated normally. Suspecting that capacitor C107 was the problem I replaced it. After another day however, the CTC130 chassis was again intermittent in the start up mode. While I was in the process of measuring several voltages, the chassis began to operate normally. Strongly suspecting that the deflection IC (U401) was the

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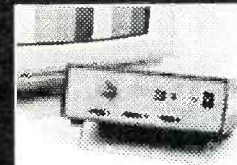
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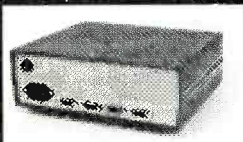


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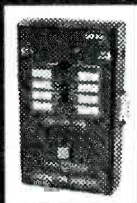
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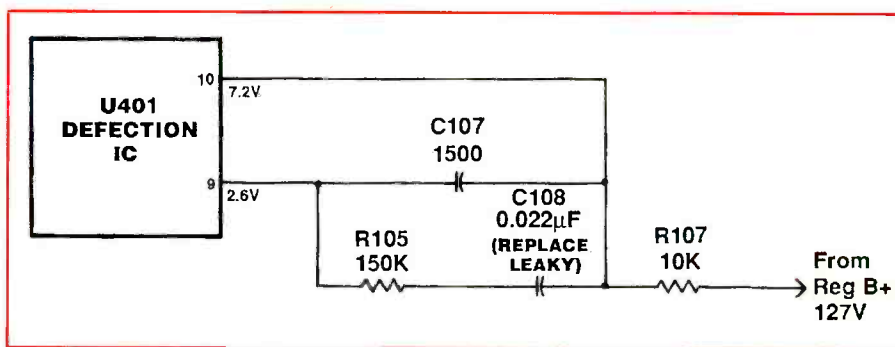


Figure 7. Intermittent turn on and shutdown may be caused by leaky C108.

cause of the problem, I was replaced it with the exact part number. This appeared to solve the problem.

This time the TV chassis played for three days before it acted up. The set acted the same as it had before I began servicing it. The intermittent chassis was set aside for a few days. When I again began working on it, at first it would not start up. I measured resistances, and found that capacitor C108 was shorted. Replacing C108 with a 0.022uF capacitor solved the intermittent start up and shutdown.

Shutdown and damaged horizontal output

When the problem is intermittent start up and shutdown, it may take days or weeks before the chassis will act up. Often, if the intermittent chassis is left to operate until it dies, so to speak, the intermittent part becomes leaky, shorted or open. To save valuable service time it may be best to leave the chassis in the home until it quits altogether.

If the horizontal output transistor has been destroyed, check for improper drive voltage, defective components in the horizontal output circuits, flyback, and over-

loaded components in the secondary winding of the flyback (Figure 7). After replacing Q402, slowly bring up the power line voltage with the variable transformer. Monitor the horizontal output base terminal with the scope and connect a voltmeter to the +127V regulated power source. Notice if the correct waveform is found at the base of Q402 as the line voltage is raised.

If the base waveform is very weak at 80V of line voltage and the regulated voltage is weak, suspect a leaky component within the collector circuits. Shut the chassis down and feel to see if Q402 is hot or warm. Check all components in the output circuits if the output transistor is running abnormally warm.

Suspect C423 (0.016uF), C425 (0.39uF), and C426 found in the yoke and primary winding of the flyback (Figure 8). Check diodes CR411 and CR412, C431, C432, and C433 in the collector circuit of Q402. Next check all diode rectifiers found in the secondary voltage sources of T402. Do not overlook a possible defective yoke winding or flyback for damaged horizontal output transistor and chassis shutdown.

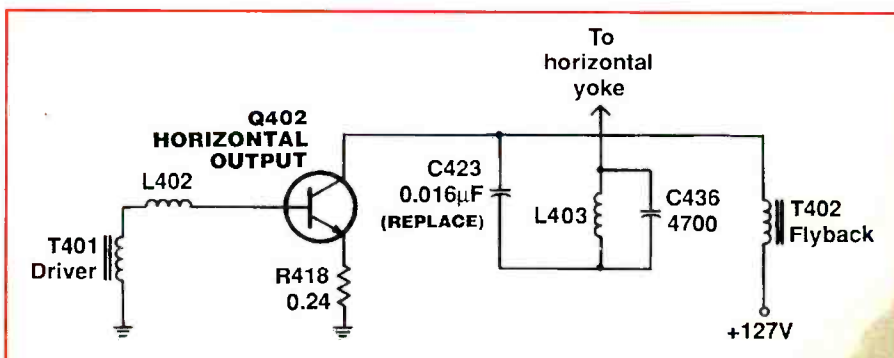


Figure 8. Check C423, C425, C426, CR411 CR412, C431, C432 and C433 if the set has shut down and Q402 was damaged.

Test Your Electronics Knowledge

What are these components/circuits?

By Sam Wilson

Each question is worth 9 points. Add 1 point if you subscribe to ES&T.

1. It looks like a tiny donut. It is slipped onto a wire and it acts like an inductor. It is a(n) _____.
2. It is a linear, bilateral circuit element and it produces heat in response to current flowing through it. It is a(n) _____.
3. It opposes any change in voltage across its terminals. It is a(n) _____.
4. Depending upon how you wire it, it can amplify a signal with or without phase inversion. It is a(n) _____.
5. The correct way to look at it is that it allows the energy of one system to control the energy of another system. It is called a(n) _____.
6. It opposes any change in current through it. It is a(n) _____.
7. It passes an ac signal but does not pass dc. It is a(n) _____.
8. It passes a signal from the input to the output with hundreds of thousands of ohms isolation. It is a(n) _____.
9. It is an electronic circuit that connects a dc to an ac signal. It is a(n) _____.
10. It is used to prevent capacitive coupling in power transformers. It is a(n) _____.
11. By adding three resistors and a capacitor (along with a power supply) it becomes a non-sinusoidal oscillator. It is a(n) _____.

(Answers on page 79)

Wilson is the electronics theory consultant for ES&T.

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DISCOVER 16th
COD LINDENHURST, NY 11757 YEAR
1-800-645-5833 • FAX 516-226-2770

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1997 Buyer's Guide

What could be more frustrating than to complete a diagnosis on some consumer electronics product, be exulting in that "eureka" feeling of having determined exactly why the unit won't work right, then to order a replacement from a distributor or manufacturer and find out that the component is listed as NLA (no longer available)? You could simply abandon the job and return the product to the owner. But if you take that route, not only do you disappoint the customer, you also lose the value of whatever time you have spent on diagnosing the problem.

It's just possible that some distributor with whom you don't ordinarily do business has dozens of just the replacement part you need. But where do you find a list of names, addresses and telephone numbers of distributors that might be able to supply you with that elusive part.

One source of that type of information is this annual **ES&T Buyers' Guide**. Every year we send questionnaires to hundreds of companies that have products our readers might find useful. The questionnaire asks the recipient to update all of the vital information that makes it easy for a service center to contact them: name, address, telephone, toll-free and fax numbers.

The questionnaire also includes a list of over 100 products, services, documents, information products, software products, and more that service centers commonly use. The recipients check off those products that apply to them, and, when we receive that information, we enter it into our database.

So what you see in this *Buyers' Guide* is current as of the fourth quarter of 1996, or possibly even January of 1997.

Except...well there are always exceptions. We don't understand it, but many of the companies to whom we send questionnaires don't send them back.

So please keep in mind as you use this *Buyers' Guide* that it is as current, up to date and useful as we could make it. If you call one of the listees and find that the information you found in this guide was out of date, it may not have been our fault. Of course, the way companies move around these days, it's possible that the

information was up to date when we published it, but has since gone out of date.

And one other word of caution. These days telephone area codes are changing constantly, so that the area code for any of the companies listed here may have changed since the publication date. If you have a problem with any of the area codes listed here, please check with your local telephone company or with directory assistance. They can provide you with any updated area code information.

Using the Buyers' Guide

We've broken down information in the *Buyers' Guide* into five categories:

- Product Directory page 19.
- Replacement Parts/Components Directory page 47.
- Services Directory page 52.
- Association/Educational Sources Directory page 53.
- Company Address Directory page 54.

Finding a product or part

We have subdivided the product directory according to certain types of products:

- Test equipment.
- Test equipment accessories.
- Circuit damage protective equipment and supplies.
- Supplies/accessories equipment.
- Audio and video accessories.
- Tools.

For example, if you are looking for a VCR test jig kit, turn to the test equipment accessories section of the Product Directory. The companies listed there all say they offer test jig kits. If the company name is followed by a *D, that tells you this company is a distributor, not a manufacturer, of that product; a *MD means that the company is both.

You will notice that certain company names are in color. Those companies have advertised in this issue. If you want to learn a little more about that company, turn to the page number listed to the far right. The ad alone might give you enough information to help you decide.

Once you know who you want to contact for more information, turn to the Company Address Directory. The

address, telephone number and fax number for each company are listed there. (Of course, if the company you are interested in has advertised in this issue, you can just pull out your Reader Service card on page 45 and circle the reply number listed under the advertisement.)

The Replacement Parts/Components Directory works the same way. Just look up the type of component you need, then turn to the Company Address Directory to find out how to contact a company that supplies that product. The Company Address Directory lists information on nearly 700 companies and associations that offer products or services for the electronics servicer.

Checking out services

Consult the Services Directory if you need to contact a consultant, get a disk drive or head refurbished, plug into an on-line service, find a company to repair or rework a PC board, rent or lease equipment, calibrate your older test equipment, or repair a tuner.

Your source for continuing education

The Association/Educational Sources Directory helps you find books, schools and training seminars for continuing your servicing education. It also points you toward sources for service literature and schematics for the products you service. Finally, it lists those companies that produce management software systems that can help you run your business.

Keep in touch

Although the annual *Buyers' Guide* is a year in the making, we realize it can't be absolutely complete—companies are always starting up, going out of business or moving. And technology keeps adding new products to track. If you know of a company that you think other readers should be aware of, or if you would like us to extend our coverage to new product areas, drop us a line. If you become aware that a company listed has changed its address or telephone number, please let us know. Of course, if you find a mistake, please contact us immediately. We'll publish a correction in the first issue that we can get it into. ■

Product Directory

Note: An entry followed by *D means that this company is a distributor, not a manufacturer. An entry followed by a *MD means that this company is both a manufacturer and a distributor.

A line listing that is in color indicates that the company has an ad in this issue. The number following the listing is the number of the page on which the ad is located. BC means Back Cover; IBC means Inside Back Cover; IFC means Inside Front Cover.

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Test equipment

AC LEAKAGE TESTERS

Accutest Instruments, Inc.*D
Alfa Electronics*D
Amprobe Instrument
Vance Baldwin Inc.*D
Consolidated Elctnics, Inc.*D
The Current Source*D
East Coast Transistor*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Extch Instruments Corp.*D
Fotronic Corporation*D52
Global Specialties
Herman Electronics*D73
Joseph Electronics*D
L-Com Inc.
Marshall Industries*D
MCM Electronics*D
Metric Supply*D
Omnitron Electronics*MD
Philips Consumer Elctnics*MD.....IBC
Print Products International*D
RAG Electronics Inc.*D
RS Electronics*D
Sencore Electronics.....BC
Simpson Electronic Company
Snap-On Incorporated
Specialized Prods Company*D
Techni-Tool Inc.*D
Test Equipment Depot*D52
TIF Instruments, Inc.
Time Motion Tools*D
Tucker Electronics Co.
Wavetek Corporation
Wholesale Electronics Inc.*D

AUTOMATED TEST EQUIPMENT

Analogic Corp.
Vance Baldwin Inc.*D
Computer Svcs of America*D
CSTS Inc.
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electronic Prod. Specialties*D
Elgar Corp.
Fotronic Corporation*D52
Herman Electronics*D73
Hi-Techniques, Inc.
Hy-Tronix Instruments, Inc.
International Test Technologie
Jameco Electrnc Components*D
Joseph Electronics*D
Kelvin Electronics*D
LaserImpact
Leader Instruments Corp.
Marshall Industries*D
National Instruments Corp.
Omega Engineering, Inc.
PC Instruments Incorporated
Philips Consumer Elctnics*MD.....IBC
Print Products International*D
Protek
Racal Instruments Inc.
RS Electronics*D
Schlumberger Technologies

Snap-On Incorporated
A.W. Sperry Instruments, Inc.
Techni-Tool Inc.*D
Tektronix, Inc.
Tektronix Test & Meas. Group
Telogy*D
Telulex, Inc.
Temptronic Corp.
Test Equipment Depot*D52
Time Motion Tools*D
Tucker Electronics Co.
Ultra-X, Inc.

BREAKOUT BOXES

Arrow Electronics
B&B Electronics Manufacturing
Vance Baldwin Inc.*D
B-B&W Electronics*D
Benedict Computer
Computer Svcs of America*D
Contact East, Inc.*D
The Current Source*D
Dalco Electronics*D
E.I.L. Instruments, Inc.*D
Electro Standards Lab, Inc.
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Elenco Electronics, Inc.
Fotronic Corporation*D52
Galco Industrial Electronics*D
Harco Electronics*D
Heath Company
HMC - Hub Material Co.*D
Hostelt Electronics, Inc.*D
Innovative Solutions
International Disk Svcs, Inc.
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
L-Com Inc.
Marshall Industries*D
Omnitron Electronics*MD
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Specialized Prods Company*D
Techni-Tool Inc.*D
Test Equipment Depot*D52
Time Motion Tools*D
Wavetek Corporation
Wholesale Electronics Inc.*D

CELLULAR TELEPHONE TEST EQUIPMENT

Advanced Electronic Applications
Analogic Corp.
Vance Baldwin Inc.*D
Bird Electronics Corp.
Contact East, Inc.*D
The Current Source*D
Electronics Warehouse Corp.*D
Fotronic Corporation*D52
Harco Electronics*D
Joseph Electronics*D

Keithley Instruments
Marconi Instruments
MCM Electronics*D
Omnitron Electronics*MD
Print Products International*D
Racal Instruments Inc.
Schlumberger Technologies
Techni-Tool Inc.*D
Tektronix, Inc.
Telogy*D
Test Equipment Depot*D52
Wavetek Corporation

CONTINUITY TESTERS

Amprobe Instrument
Vance Baldwin Inc.*D
B-B&W Electronics*D
Behlman Electronics
Bel Merit Corporation
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
Consolidated Elctnics, Inc.*D
Contact East, Inc.*D
CSTS Inc.
The Current Source*D
Daibani Corporation*D53
Desco
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electro Tool, Inc.
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Extch Instruments Corp.*D
Foley-Belsaw*D
Fotronic Corporation*D52
Galco Industrial Electronics*D
GC Electronics*D
Global Micro-Parts Depot*D
Harco Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
Hy Tec Dealer Service
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
JIT Resources, Inc.
Joseph Electronics*D
Kelvin Electronics*D
Klein Tools, Inc.
L-Com Inc.
L'il Bitty Tester
Marshall Industries*D
M.A.T. Electronics*D
Mouser Electronics*D
Omega Engineering, Inc.
Omnitron Electronics*MD
Philips Consumer Elctnics*MD.....IBC
Philips ECG
Print Products International*D
Progressive Electronics
RAG Electronics Inc.*D
RNJ Electronics Inc.*D17
RS Electronics*D
Salen Enterprises*D
Simpson Electronic Company
Specialized Prods Company*D
A.W. Sperry Instruments, Inc.
Sun Equipment Corporation
Techni-Tool Inc.*D
Test Equipment Depot*D52
TIF Instruments, Inc.

Time Motion Tools*D
Union Electronics Distrib*D
Weidmuller Inc.
Wholesale Electronics Inc.*D

CRT TESTERS/RESTORERS

Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
C&S Sales*D
Computer Svcs of America*D
Compuvideo
Connector Corporation
Consolidated Elctnics, Inc.*D
Conway Engineering, Inc.
The Current Source*D
Dandy Mfg. Co.
East Coast Transistor*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Elenco Electronics, Inc.
Fotronic Corporation*D52
Herman Electronics*D73
W.S. Jenks & Son*D
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Metric Supply*D
Omnitron Electronics*MD
Philips Consumer Elctnics*MD.....IBC
Philips ECG
Print Products International*D
RNJ Electronics Inc.*D17
Sencore Electronics.....BC
Sun Equipment Corporation
A.G. Tannenbaum*D
Techni-Tool Inc.*D
Telematic33
Test Equipment Depot*D52
Time Motion Tools*D
Tritronics, Inc.*D
Tucker Electronics Co.
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

CURVE TRACERS

Accutest Instruments, Inc.*D
Vance Baldwin Inc.*D
Bursma Electronic Distrib.*D
Computer Svcs of America*D
The Current Source*D
East Coast Transistor*D
Fotronic Corporation*D52
Hameg Instruments, Inc.
Joseph Electronics*D
Key Tek Instrument Corp.
LaserImpact
Leader Instruments Corp.
Marshall Industries*D
MCM Electronics*D
NCS*D
Omega Engineering, Inc.
Omnitron Electronics*MD
Philips Consumer Elctnics*MD.....IBC
Print Products International*D
RAG Electronics Inc.*D
Herman H. Sticht Co., Inc.*D
Sun Equipment Corporation
Tektronix Test & Meas. Group

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Test Equipment Depot*D.....52
Time Motion Tools*D
Tucker Electronics Co.
Union Electronics Distrib*D

DATA COMMUNICATION ANALYZERS/MONITORS/ TESTERS

Advanced Electronic Applications
B&B Electronics Manufacturing
Vance Baldwin Inc.*D
Benedict Computer
Contact East, Inc.*D
Conway Engineering, Inc.
The Current Source*D
Dalco Electronics*D
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electronics Warehouse Corp.*D
Fluke Corporation
Fotronic Corporation*D.....52
Frederick Engineering, Inc.
Gould Instrument Systems Inc.
Harco Electronics*D
Huntron Instruments, Inc.
International Disk Svcs, Inc.
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kasco Distributing*D
Marshall Industries*D
NCS*D
Omega Engineering, Inc.
Omnitron Electronics*MD
Philips Consumer Elctrcns*MD.....IBC
Print Products International*D
Racal Instruments Inc.
RNJ Electronics Inc.*D.....17
RS Electronics*D
Schlumberger Technologies
Simpson Electronic Company
Specialized Prods Company*D
Techni-Tool Inc.*D
Tektronix, Inc.
Tektronix Test & Meas. Group
Telogy*D
Test Equipment Depot*D.....52
Time Motion Tools*D
Tucker Electronics Co.
Ultra-X, Inc.
Wavetek Corporation
Wholesale Electronics Inc.*D

DISC DRIVE ANALYZERS/TESTERS

Accurite Technologies Inc.
Analogic Corp.
Computer Svcs of America*D
Dalco Electronics*D
Data Depot, Inc.
Fotronic Corporation*D.....52
HMC - Hub Material Co.*D
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kenwood U.S.A. Corp.
Leader Instruments Corp.
Marshall Industries*D
Omnitron Electronics*MD
Pioneer Research
Print Products International*D
RAG Electronics Inc.*D
Test Equipment Depot*D.....52
Time Motion Tools*D
Ultra-X, Inc.

DISTORTION ANALYZERS

Accutest Instruments, Inc.*D
Vance Baldwin Inc.*D
Brunelle Instruments, Inc.
East Coast Transistor*D
Electronics Warehouse Corp.*D
Fotronic Corporation*D.....52
Instek Corp.*D
Joseph Electronics*D
Leader Instruments Corp.
MCM Electronics*D
Metric Supply*D
NCS*D
Omnitron Electronics*MD
Philips Consumer Elctrcns*MD.....IBC
Print Products International*D
RAG Electronics Inc.*D
Schlumberger Technologies
Herman H. Sticht Co., Inc.*D
Sun Equipment Corporation
A.G. Tannenbaum*D
Tektronix Test & Meas. Group
Telogy*D
Test Equipment Depot*D.....52
Time Motion Tools*D
Tucker Electronics Co.

FREQUENCY COUNTERS

Accutest Instruments, Inc.*D
Alfa Electronics*D
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bel Merit Corporation
B&K Precision
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Computer Svcs of America*D
Consolidated Elctrcns, Inc.*D
Contact East, Inc.*D
The Current Source*D
Dalbani Corporation*D.....53
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electro Tool, Inc.
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Elenco Electronics, Inc.
Exttech Instruments Corp.*D
Fluke Corporation
Fotronic Corporation*D.....52
Galco Industrial Electronics*D
Global Specialties
Hameg Instruments, Inc.
Harco Electronics*D
Heath Company
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Instek Corp.*D
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Keithley Instruments
Kelvin Electronics*D
Kenwood U.S.A. Corp.
Leader Instruments Corp.
LG Precision.....9
Marconi Instruments
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Metric Supply*D
Mouser Electronics*D
NCS*D
Omnitron Electronics*MD

Parts Express International*D16
Philips Consumer Elctrcns*MD.....IBC
Philips ECG
Print Products International*D
Protek
RAG Electronics Inc.*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
Salen Enterprises*D
Sencore Electronics.....BC
Sibex, Inc.
Simpson Electronic Company
Specialized Prods Company*D
Herman H. Sticht Co., Inc.*D
Sun Equipment Corporation
Tandy National Parts*D
A.G. Tannenbaum*D
Techni-Tool Inc.*D
Tektronix Test & Meas. Group
Telogy*D
Test Equipment Depot*D.....52
Time Motion Tools*D
Tucker Electronics Co.
Union Electronics Distrib*D
Wavetek Corporation
Wholesale Electronics Inc.*D

FUNCTION GENERATORS

Accutest Instruments, Inc.*D
Alfa Electronics*D
American Reliance
Analogic Corp.
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bel Merit Corporation
B&K Precision
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Consolidated Elctrcns, Inc.*D
Contact East, Inc.*D
The Current Source*D
Dalbani Corporation*D.....53
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electro Tool, Inc.
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Elenco Electronics, Inc.
Fluke Corporation
Fotronic Corporation*D.....52
Galco Industrial Electronics*D
Global Specialties
Hameg Instruments, Inc.
Harco Electronics*D
Heath Company
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Instek Corp.*D
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Keithley Instruments
Kelvin Electronics*D
Kenwood U.S.A. Corp.
Leader Instruments Corp.
LG Precision.....9
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Metric Supply*D
NCS*D
Omega Engineering, Inc.
Omnitron Electronics*MD
Parts Express International*D16
PC Instruments Incorporated
Philips Consumer Elctrcns*MD.....IBC

Philips ECG
Print Products International*D
RAG Electronics Inc.*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
Salen Enterprises*D
Sibex, Inc.
Specialized Prods Company*D
Herman H. Sticht Co., Inc.*D
Sun Equipment Corporation
Tandy National Parts*D
Techni-Tool Inc.*D
Tektronix Test & Meas. Group
Teledata Systems
Telogy*D
Telulux, Inc.
Test Equipment Depot*D.....52
Tucker Electronics Co.
Union Electronics Distrib*D
Wavetek Corporation
Wholesale Electronics Inc.*D

GAUGES:

HEAD PROTRUSION/ SPRING TENSION/ STYLUS FORCE/OTHER

Vance Baldwin Inc.*D
Bursma Electronic Distrib.*D
Dalbani Corporation*D.....53
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Exttech Instruments Corp.*D
Fotronic Corporation*D.....52
HMC - Hub Material Co.*D
Hunter Products, Inc.
Jonard Industries Corp.
Joseph Electronics*D
M.A.T. Electronics*D
Omega Engineering, Inc.
Philips Consumer Elctrcns*MD.....IBC
Print Products International*D
Techni-Tool Inc.*D
Tentel.....11
Test Equipment Depot*D.....52
UBM Corp
Wavetek Corporation

GENERATORS, AUDIO

Accutest Instruments, Inc.*D
Alfa Electronics*D
AudioVisual Inc.*D
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bel Merit Corporation
B&K Precision
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Compuvideo
Consolidated Elctrcns, Inc.*D
The Current Source*D
Dalco Electronics*D
East Coast Transistor*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Express*D
Elenco Electronics, Inc.
Fotronic Corporation*D.....52
Heath Company
Herman Electronics*D.....73
Instek Corp.*D
Jameco Electrnc Components*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kelvin Electronics*D
Kenwood U.S.A. Corp.

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Omnitron Electronics*MD
Philips Consumer Elctrnics*MD.....IBO
Print Products International*D

Print Products International* ^D	
Q B Products* ^D	
RNJ Electronics Inc.*^D	17
RS Electronics* ^D	
Sencore Electronics	BC
Snap-On Incorporated	
A.W. Sperry Instruments, Inc.	
Herman H. Sticht Co., Inc.* ^D	
Sun Equipment Corporation	
Techni-Tool Inc.* ^D	
Test Equipment Depot*^D	52
Time Motion Tools* ^D	
Trumco of California Inc.* ^D	
Tucker Electronics Co.	
Union Electronics Distrib* ^D	
Vavetek Corporation	

Accutest Instruments, Inc.*D
American Reliance
Vance Baldwin Inc.*D
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
CSI/SPECO
The Current Source*D
Daibani Corporation*D53
East Coast Transistor*D
Electronics Warehouse Corp.*D
Electronix Express*D
Fotronic Corporation*D52
Harco Electronics*D
Herman Electronics*D73
W.S. Jenks & Son*D
Joseph Electronics*D
Leader Instruments Corp.
Marshall Industries*D
NCS*D
Omega Engineering, Inc.
Omnitron Electronics*MD
Philips Consumer Electrnics*MDIBC
Prime Technology, Inc.
Print Products International*D
RAG Electronics Inc.*D
RNJ Electronics Inc.*D17
RS Electronics*D
Sencore Electronics.....BC
Snap-On Incorporated
Specialized Prods Company*D
Herman H. Sticht Co., Inc.*D
Sun Equipment Corporation
Techni-Tool Inc.*D
Tektronix, Inc.
Telogy*D
Telulex, Inc.
Test Equipment Depot*D52
Time Motion Tools*D
Tritronics, Inc.*D
Tucker Electronics Co.
Union Electronics Distrib*D
Wavetek Corporation
Wholesale Electronics Inc.*D

Accutest Instruments, Inc.*D	Test Equipment Depot D *****52
Advanced Electronic Applications	Time Motion Tools*D
Alfa Electronics*D	Tritronics, Inc.*D
Vance Baldwin Inc.*D	Tucker Electronics Co.
Bird Electronics Corp.	Union Electronics Distrib*D
Brunelle Instruments, Inc.	Wavetek Corporation
	Wholesale Electronics Inc.*D

Accutest Instruments, Inc.*D
Alfa Electronics*D
American Reliance
Vance Baldwin Inc.*D
Brunelle Instruments, Inc.
Consolidated Elctrnics, Inc.*D
CSI/SPECO
The Current Source*D
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electronics Warehouse Corp.*D
Extch Instruments Corp.*D
Fotronic Corporation*D 52
Harco Electronics*D

Product directory

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Herman Electronics*D	73
HMC - Hub Material Co.*D	
Hunter Products, Inc.	
Jameco Electric Components*D	
W.S. Jenks & Son*D	
Joseph Electronics*D	
Marshall Industries*D	
Metric Supply*D	
NCS*D	
Omnitron Electronics*MD	
Pacer Industries, Inc.	
Parts Express International*D	16
Philips Consumer Electronics*MD	IBC
Prime Technology, Inc.	
Print Products International*D	
RAG Electronics Inc.*D	
RNJ Electronics Inc.*D	17
Simpson Electronic Company	
Snap-On Incorporated	
Sun Equipment Corporation	
Techni-Tool Inc.*D	
Test Equipment Depot*D	52
Time Motion Tools*D	
Trumco of California Inc.*D	
Tucker Electronics Co.	
Universal Enterprises (UEI)	
Wholesale Electronics Inc.*D	

METERS, VOLTMETERS, AC

Accutest Instruments, Inc.*D	
Alfa Electronics*D	
American Design Components	
American Reliance	
Amprobe Instrument	
Analogic Corp.	
Antique Electronic Supply*D	
Arrow Electronics	
AVO International	
Vance Baldwin Inc.*D	
B-B&W Electronics*D	
Bel Merit Corporation	
B&K Precision	
Brunelle Instruments, Inc.	
Bursma Electronic Distrib.*D	
C&S Sales*D	
Consolidated Electronics, Inc.*D	
Contact East, Inc.*D	
CSI/SPECO	
The Current Source*D	
Dalbani Corporation*D	53
Digi-Key D*	
Dranetz Technologies, Inc.	
East Coast Transistor*D	
Eiger Electronics*D	
E.I.L. Instruments, Inc.*D	
Electro Tool, Inc.	
Electronic Design Specialists	33
Electronic Parts Supply*D	
Electronics Warehouse Corp.*D	
Electronix Corp.*D	80
Electronix Express*D	
Extex Instruments Corp.*D	
Fluke Corporation	
Foley-Belsaw*D	
Fotronic Corporation*D	52
Fox International*D	
Galco Industrial Electronics*D	
GC Electronics*D	
Harco Electronics*D	
Herman Electronics*D	73
HMC - Hub Material Co.*D	
Hosfelt Electronics, Inc.*D	
Hy Tec Dealer Service	
Instek Corp.*D	
Jameco Electronic Components*D	
JDR Micro*D	
W.S. Jenks & Son*D	
Joseph Electronics*D	
Keithley Instruments	
Kelvin Electronics*D	
Kenwood U.S.A. Corp.	

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Leader Instruments Corp.	
Marconi Instruments	
Marshall Industries*D	
MCM Electronics*D	
Metric Supply*D	
NCS*D	
Omega Engineering, Inc.	
Omnitron Electronics*MD	
Parts Express International*D	16
Philips Consumer Electronics*MD	IBC
Philips ECG	
Prime Technology, Inc.	
Print Products International*D	
Protek	
RAG Electronics Inc.*D	
RNJ Electronics Inc.*D	17
RS Electronics*D	
Schlumberger Technologies	
Sencore Electronics	BC
Simpson Electronic Company	
Snap-On Incorporated	
Specialized Prods Company*D	
A.W. Sperry Instruments, Inc.	
Herman H. Sticht Co., Inc.*D	
Sun Equipment Corporation	
A.G. Tannenbaum*D	
Techni-Tool Inc.*D	
Tegam Inc.	
Tektronix, Inc.	
Telogy*D	
Telulux, Inc.	
Test Equipment Depot*D	52
TIF Instruments, Inc.	
Time Motion Tools*D	
Triplett Corp.	
Tritronics, Inc.*D	
Tucker Electronics Co.	
Union Electronics Distrib*D	
Universal Enterprises (UEI)	
Wavetek Corporation	
Wescorp	
Wholesale Electronics Inc.*D	

METERS, WOW AND FLUTTER

Accutest Instruments, Inc.*D	
Alfa Electronics*D	
Arrow Electronics	
Vance Baldwin Inc.*D	
Brunelle Instruments, Inc.	
East Coast Transistor*D	
E.I.L. Instruments, Inc.*D	
Electronic Parts Supply*D	
Electronics Warehouse Corp.*D	
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American Reliance	
Amprobe Instrument	
Analogic Corp.	
Arrow Electronics	
AVO International	
Vance Baldwin Inc.*D	
B-B&W Electronics*D	
Bel Merit Corporation	
B&K Precision	
Brilliant King, Inc.	
Brunelle Instruments, Inc.	
Bursma Electronic Distrib.*D	
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Simpson Electronic Company	
Snap-On Incorporated	
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A.W. Sperry Instruments, Inc.	
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Universal Enterprises (UEI)	
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Alfa Electronics*D	
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Arrow Electronics	
Vance Baldwin Inc.*D	
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Bel Merit Corporation	
B&K Precision	
Brunelle Instruments, Inc.	
Bursma Electronic Distrib.*D	
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Fluke Corporation
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Galco Industrial Electronics*D
Global Micro-Parts Depot*D
Gould Instrument Systems Inc.
Hameg Instruments, Inc.
Harco Electronics*D
Heath Company
Herman Electronics*D73
Hitachi Denshi America Ltd.
Hi-Techniques, Inc.
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Instek Corp.*D
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
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Oldaker Corp.
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Orion Instruments, Inc.
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Parts Express International*D16
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Salen Enterprises*D
Sencore Electronics.....BC
Snap-On Incorporated
Specialized Prods Company*D
Herman H. Sticht Co., Inc.*D
Sun Equipment Corporation
Tandy National Parts*D
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Techni-Tool Inc.*D
Tektronix, Inc.
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Telogy*D
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Tucker Electronics Co.
Union Electronics Distrib*D
Universal Enterprises (UEI)
Wavetek Corporation
Wholesale Electronics Inc.*D

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American Design Components
Aristo Computers, Inc.
Arrow Electronics
B&B Electronics Manufacturing
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Dalco Electronics*D
Data Depot, Inc.
Eagan Technical Services, Inc.
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Electronix Corp.*D80
Fluke Corporation
Fotronic Corporation*D52
Harco Electronics*D
Huntron Instruments, Inc.
Hy-Tronix Instruments, Inc.
ICM Components*D
Innovative Solutions
International Test Technologie
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
Jensen Tools, Inc.*D
Jonard Industries Corp.
Joseph Electronics*D
Kasco Distributing*D
LaserImpact
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Micro 2000, Inc.
MicroData3
National Advancement Corp.
Network Technologies Inc.
O.K. Industries, Inc.
OmniTron Electronics*MD
Philips Consumer Elctrnics*MD.....IBC
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Sencore Electronics.....BC
SMH Electronics Co., Inc.
Sonera Technologies
Specialized Prods Company*D
Sun Equipment Corporation
Techni-Tool Inc.*D
Test Equipment Depot*D52
Time Motion Tools*D
Ultra-X, Inc.
Union Electronics Distrib*D
Warrantech Corp.

RECEPTACLE CIRCUIT TESTERS

Alternative Technical Services
Vance Baldwin Inc.*D
Contact East, Inc.*D
The Current Source*D
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electro Tool, Inc.
Electronics Warehouse Corp.*D
Foley-Belsaw*D
Fotronic Corporation*D52
HMC - Hub Material Co.*D
W.S. Jenks & Son*D
Jensen Tools, Inc.*D
Joseph Electronics*D
L-Com Inc.
Marshall Industries*D
OmniTron Electronics*MD
Philips Consumer Elctrnics*MD.....IBC
Print Products International*D
RS Electronics*D
Schurter, Inc.
Sencore Electronics.....BC
Specialized Prods Company*D
Techni-Tool Inc.*D
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Elenco Electronics, Inc.
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Fox International*D
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D73
Hosfelt Electronics, Inc.*D
Huntron Instruments, Inc.
Hy-Tronix Instruments, Inc.
IET Labs, Inc.
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Keithley Instruments
Key Tek Instrument Corp.
L'il Bitty Tester
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Omega Engineering, Inc.
OmniTron Electronics*MD
Philips Consumer Elctrnics*MD.....IBC
Philips ECG
Print Products International*D
RAG Electronics Inc.*D
RNJ Electronics Inc.*D17
RS Electronics*D
Sun Equipment Corporation
Techni-Tool Inc.*D
Telogy*D
Test Equipment Depot*D52
Trumincos of California Inc.*D
Tucker Electronics Co.
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

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Accutest Instruments, Inc.*D
Analogic Corp.
Arrow Electronics
Vance Baldwin Inc.*D
B&B Precision
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Consolidated Elctrnics, Inc.*D
The Current Source*D
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electronics Warehouse Corp.*D
Electronix Express*D
Elenco Electronics, Inc.
Fotronic Corporation*D52
Global Specialties
Hameg Instruments, Inc.
Harco Electronics*D
Herman Electronics*D73
Hi-Techniques, Inc.
Integrity Design & Research
Jameco Electrn Components*D
W.S. Jenks & Son*D
Joseph Electronics*D
Leader Instruments Corp.
Marconi Instruments
Marshall Industries*D
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Philips Consumer Elctrnics*MD.....IBC
Philips ECG
Print Products International*D
Protek
RAG Electronics Inc.*D
RNJ Electronics Inc.*D17
RS Electronics*D
Schlumberger Technologies
Sencore Electronics.....BC
Smith Design
Specialized Prods Company*D
Tandy National Parts*D
Techni-Tool Inc.*D
Technology Programs
Tektronix, Inc.
Tektronix Test & Meas. Group
Telogy*D
Test Equipment Depot*D52
Tucker Electronics Co.
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

TELEPHONE ANALYZERS/TESTERS

American Reliance
Analogic Corp.
Vance Baldwin Inc.*D
B&K Precision
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Consolidated Elctrnics, Inc.*D
Contact East, Inc.*D
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East Coast Transistor*D
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Marshall Industries*D
M.A.T. Electronics*D
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Metric Supply*D
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Parts Express International*D16
Philips Consumer Elctrnics*MD.....IBC
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Print Products International*D
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Tandy National Parts*D
Techni-Tool Inc.*D
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Triplet Corp.
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TEMPERATURE SENSORS

Accutest Instruments, Inc.*D
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Wavetek Corporation

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Hosfelt Electronics, Inc.*D
Hy-Tronix Instruments, Inc.
Innovative Solutions
ITT Pomona Electronics
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JDR Micro*D
W.S. Jenks & Son*D
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Kelvin Electronics*D
Marshall Industries*D
MCM Electronics*D
Mouser Electronics*D
Oldaker Corp.
Omnitron Electronics*MD
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Premium Parts+ Electrncs Co*D
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Behlman Electronics
Bel Merit Corporation
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Techni-Tool Inc.*D
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M.A.T. Electronics*D
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TEST LEADS AND PROBES

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American Design Components
Avex Probes, Inc. (API)
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bel Merit Corporation
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
CSI/SPECO
CUI Stack
The Current Source*D
Dalbani Corporation*D53
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electro Standards Lab, Inc.
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Elenco Electronics, Inc.
E-Z Hook
Fluke Corporation
Fotronic Corporation*D52
Galco Industrial Electronics*D
Harco Electronics*D
Heath Company
Herman Electronics*D73
Richard Hirschmann of America
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Innovative Solutions
Instek Corp.*D
Interconnect Devices, Inc.
ITT Pomona Electronics
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Jim-Pak*D
Joseph Electronics*D
Kelvin Electronics*D
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Keystone Electronics Corp.
LG Precision9
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M.A.T. Electronics*D
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Philips ECG
J.S. Popper, Inc.
Premium Parts+ Electrncs Co*D
Probe Master, Inc.
RAG Electronics Inc.*D
RNJ Electronics Inc.*D17
RS Electronics*D
Russell Industries*D
Schurter, Inc.
Sencore Electronics.....BC
Simpson Electronic Company
Smith Design
Specialized Prods Company*D
Techni-Tool Inc.*D
Tegam Inc.
Tektronix, Inc.
Test Equipment Depot*D52
Test Probes, Inc.
Time Motion Tools*D
Triplett Corp.
Tritronics, Inc.*D
Tucker Electronics Co.
Union Electronics Distrib*D
Universal Enterprises (UEI)
Wavetek Corporation
Wholesale Electronics Inc.*D

TRANSFORMERS: ISOLATION/VARIABLE

Accutest Instruments, Inc.*D
American Design Components
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
C&S Sales*D
Compuvideo
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Electro Tool, Inc.
Electronic Parts Supply*D
Electronic Specialists, Inc.
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Elenco Electronics, Inc.
Fotronic Corporation*D52
Galco Industrial Electronics*D
Global Specialties
Harco Electronics*D
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kelvin Electronics*D
Marshall Industries*D
Mouser Electronics*D
Omnitron Electronics*MD
Parts Express International*D16
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Print Products International*D
RAG Electronics Inc.*D
RNJ Electronics Inc.*D17
RS Electronics*D
Sencore Electronics.....BC
Tandy National Parts*D
A.G. Tannenbaum*D
Test Equipment Depot*D52
Union Electronics Distrib*D
Warner Electric
Wholesale Electronics Inc.*D

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VCR TEST JIG KITS

Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
The Current Source*D
Dalbani Corporation*D.....53
East Coast Transistor*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Foley-Belsaw*D
Fotronic Corporation*D.....52
Herman Electronics*D.....73
Hitachi Home Electronics
Joseph Electronics*D
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Omnitron Electronics*MD
Parts Express International*D.....16
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
RNJ Electronics Inc.*D.....17
Tentel.....11
Test Equipment Depot*D.....52
Tritronics, Inc.*D
Wholesale Electronics Inc.*D

OTHER TEST EQUIPMENT ACCESSORIES

Accutest Instruments, Inc.*D
A.P.E.
Vance Baldwin Inc.*D
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Chicago Case Company
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
CRC Industries, Inc.
The Current Source*D
Dalbani Corporation*D.....53
Dalco Electronics*D
East Coast Transistor*D
E.I.L. Instruments, Inc.*D
Electro Standards Lab, Inc.
Electronic Parts Supply*D
Electronic Software Developers.....14
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Elenco Electronics, Inc.
E-Z Hook
Fluke Corporation
Fotec Inc
Fotronic Corporation*D.....52
Galco Industrial Electronics*D
Gemini Inc.
Global Specialties
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hy-Tronix Instruments, Inc.
Innovative Solutions
Interconnect Devices, Inc.
ITT Pomona Electronics
Jameco Electrnrc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kenwood U.S.A. Corp.
LaserImpact
L-Com Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Mouser Electronics*D
National Instruments Corp.
Omnitron Electronics*MD
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG

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Premium Parts+ Electrncs Co*D
Print Products International*D
Probe Master, Inc.
RAG Electronics Inc.*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
Russell Industries*D
Sencore Electronics.....BC
Simpson Electronic Company
Specialized Prods Company*D
Synergetix
A.G. Tannenbaum*D
Techni-Tool Inc.*D
Tektronix, Inc.
Tentel.....11
Test Equipment Depot*D.....52
Test Probes, Inc.
Time Motion Tools*D
Tritronics, Inc.*D
Tucker Electronics Co.
Ultech Corp
Union Electronics Distrib*D
Universal Enterprises (UEI)
Wavetek Corporation

Circuit damage protective equipment/supplies

GROUNDING SYSTEMS

Arrow Electronics
Vance Baldwin Inc.*D
Contact East, Inc.*D
The Current Source*D
HMC - Hub Material Co.*D
Jameco Electrnrc Components*D
W.S. Jenks & Son*D
Joseph Electronics*D
M.A.T. Electronics*D
Print Products International*D
Time Motion Tools*D
Union Electronics Distrib*D

POWER LINE MONITORS

Accutest Instruments, Inc.*D
Amprobe Instrument
Arrow Electronics
Vance Baldwin Inc.*D
Bi-Tronics Inc.
BMI-Basic Measuring Instrument
Brunelle Instruments, Inc.
Computer Power Inc.
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Dragnet Technologies, Inc.
EFI Electronics Corporation
E.I.L. Instruments, Inc.*D
Electronics Warehouse Corp.*D
Global Specialties
Hosfelt Electronics, Inc.*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
MCM Electronics*D
NCS*D
Perma Power Electronics, Inc.
PowerTronics
Print Products International*D
RS Electronics*D
SL Waber, Inc.
Specialized Prods Company*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tripp Lite
Tucker Electronics Co.

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Union Electronics Distrib*D
Vector-VID Inc.
Wholesale Electronics Inc.*D

STANDBY POWER SYSTEMS

Alpha Technologies
American Design Components
Arrow Electronics
Vance Baldwin Inc.*D
Bi-Tronics Inc.
Bursma Electronic Distrib.*D
Computer Power Inc.
Consolidated Elctnrcs, Inc.*D
Controlled Power Co.
The Current Source*D
Dalco Electronics*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Jameco Electrnrc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kalglo Electronics Co., Inc.
Meirick, Inc.
Minuteman UPS
Parts Express International*D.....16
Perma Power Electronics, Inc.
Print Products International*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
SL Waber, Inc.
Sutton Designs, Inc.
Tripp Lite
Warner Electric
Wholesale Electronics Inc.*D

SURGE/SPIKE PROTECTORS

Alternative Technical Services
American Design Components
American Power Conversion Corp
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Best Power
Bi-Tronics Inc.
Bursma Electronic Distrib.*D
Clary Corp.
Computer Power Inc.
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
Controlled Power Co.
The Current Source*D
Dalco Electronics*D
Delta Warranty
EFI Electronics Corporation
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Elgar Corp.
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
International Power Tchnlgies
Jameco Electrnrc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kalglo Electronics Co., Inc.
M.A.T. Electronics*D
MCM Electronics*D
Meirick, Inc.
Minuteman UPS
Perma Power Electronics, Inc.
Philips Consumer Elctnrcs*MD.....IBC
Philek Power Corp.
Print Products International*D
RNJ Electronics Inc.*D.....17
RS Electronics*D

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JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kalglo Electronics Co., Inc.
Kasco Distributing*D
L'il Bitty Tester
Marshall Industries*D
MCG Electronics
MCM Electronics*D
Meirick, Inc.
Minuteman UPS
Mouser Electronics*D
Omega Engineering, Inc.
Panamax, Inc.
Parts Express International*D.....16
Perma Power Electronics, Inc.
Philips Consumer Elctnrcs*MD.....IBC
Print Products International*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
Schurter, Inc.
Shape Electronics
SL Waber, Inc.
Specialized Prods Company*D
Sutton Designs, Inc.
Tandy National Parts*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tripp Lite
Tritronics, Inc.*D
Union Electronics Distrib*D
Warner Electric
Wholesale Electronics Inc.*D

UNINTERRUPTIBLE POWER SUPPLIES

Alpha Technologies
Alternative Technical Services
American Design Components
American Power Conversion Corp
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Behlman Electronics
Best Power
Bi-Tronics Inc.
Bursma Electronic Distrib.*D
Clary Corp.
Computer Power Inc.
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
Controlled Power Co.
The Current Source*D
Dalco Electronics*D
Delta Warranty
EFI Electronics Corporation
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Elgar Corp.
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
International Power Tchnlgies
Jameco Electrnrc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kalglo Electronics Co., Inc.
M.A.T. Electronics*D
MCM Electronics*D
Meirick, Inc.
Minuteman UPS
Perma Power Electronics, Inc.
Philips Consumer Elctnrcs*MD.....IBC
Philek Power Corp.
Print Products International*D
RNJ Electronics Inc.*D.....17
RS Electronics*D

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SL Waber, Inc.
Specialized Prods Company*D
Staco Energy Products
Sun Equipment Corporation
Sutton Designs, Inc.
Techni-Tool Inc.*D
Total Power International*MD
Tripp Lite
Warner Electric
Wholesale Electronics Inc.*D

VOLTAGE REGULATORS

Alternative Technical Services
Arrow Electronics
Vance Baldwin Inc.*D
Bi-Tronics Inc.
Clary Corp.
Computer Power Inc.
Compuvideo
Contact East, Inc.*D
Controlled Power Co.
The Current Source*D
Daibani Corporation*D.....53
Dalco Electronics*D
Digi-Key D*
E.I.L. Instruments, Inc.*D
Electronic Parts Supply*D
Electronic Specialists, Inc.
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D.....73
Hosfelt Electronics, Inc.*D
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kalglo Electronics Co., Inc.
Kelvin Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Minuteman UPS
Mouser Electronics*D
Parts Express International*D.....16
Perma Power Electronics, Inc.
Philips Consumer Elctrnics*MD.....IBC
Print Products International*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
Shape Electronics
SL Waber, Inc.
Snap-On Incorporated
Specialized Prods Company*D
Staco Energy Products
Time Motion Tools*D
Tripp Lite
Warner Electric
Wholesale Electronics Inc.*D

Electrostatic discharge protection

ANTISTATIC CHEMICALS

Aervo-Pacific Co.
Alternative Technical Services
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
CAIG Laboratories, Inc.....73, 75
Charleswater
Chemtronics
Computer Component Source*D
Computer Svcs of America*D
Consolidated Elctrnics, Inc.*D

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The Current Source*D
Daibani Corporation*D.....53
Desco
East Coast Transistor*D
Electro Dynamics, Inc.*D
Electronic Prod. Specialties*D
Electronix Corp.*D.....80
Electronix Express*D
Fox International*D
Galco Industrial Electronics*D
GC Electronics*D
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hy Tec Dealer Service
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
JIT Resources, Inc.
Joseph Electronics*D
Klein Tools, Inc.
Marshall Industries*D
M.A.T. Electronics*D
MG Chemicals
Micro Care Corp.
Miller-Stephenson Chemical Co.
Philips Consumer Elctrnics*MD.....IBC
Philips ECG
Print Products International*D
Prostat Corporation
RNJ Electronics Inc.*D.....17
Rogers Anti-Static Chemicals
RS Electronics*D
Specialized Prods Company*D
Syon Corporation
Tech Spray, Inc.
Techni-Tool Inc.*D
3M Electrical Specialties Div
3M Electronic Prods Division
Time Motion Tools*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Wescorp
Wholesale Electronics Inc.*D

ANTISTATIC IONIZATION DEVICES

Vance Baldwin Inc.*D
Charleswater
Computer Svcs of America*D
Contact East, Inc.*D
The Current Source*D
Desco
Electronic Prod. Specialties*D
Harco Electronics*D
HMC - Hub Material Co.*D
W.S. Jenks & Son*D
JIT Resources, Inc.
Joseph Electronics*D
Marshall Industries*D
Print Products International*D
RS Electronics*D
Semtronics Corp.
Simco
Specialized Prods Company*D
Techni-Tool Inc.*D
3M Electrical Specialties Div
3M Electronic Prods Division
Time Motion Tools*D
Union Electronics Distrib*D
Wescorp

ANTISTATIC MATS/ BENCHTOPS/WRIST STRAPS/OTHERS

Armand Mfg. Inc.
Vance Baldwin Inc.*D
B-B&W Electronics*D

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Bursma Electronic Distrib.*D
Charleswater
Claus Electronics Div.
Computer Svcs of America*D
Contact East, Inc.*D
The Current Source*D
Dalco Electronics*D
Desco
Digi-Key D*
Electro Tool, Inc.
Electronic Prod. Specialties*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Excel Distributing*D
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
ITT Pomona Electronics
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
Jim-Pak*D
JIT Resources, Inc.
Joseph Electronics*D
Kasco Distributing*D
Lista International Corp.
Marshall Industries*D
Micro Care Corp.
Mouser Electronics*D
Parts Express International*D.....16
Philips Consumer Elctrnics*MD.....IBC
Philips ECG
Print Products International*D
Prostat Corporation
Richmond Technology Inc.
Rogers Anti-Static Chemicals
RS Electronics*D
Seco Industries
Semtronics Corp.
SAT/ A SPIRIG CO.
Specialized Prods Company*D
Tandy National Parts*D
Techni-Tool Inc.*D
Teclab
3M Electrical Specialties Div
3M Electronic Prods Division
Time Motion Tools*D
Trace Racks
Tritronics, Inc.*D
Union Electronics Distrib*D
Waldmann Lighting Company
Wescorp
Wholesale Electronics Inc.*D

ESD FLEXIBLE PACKAGING

Armand Mfg. Inc.
Vance Baldwin Inc.*D
Charleswater
Consolidated Elctrnics, Inc.*D
Contact East, Inc.*D
Desco
Electronic Prod. Specialties*D
Electronix Corp.*D.....80
Harco Electronics*D
HMC - Hub Material Co.*D
Jameco Electrn Components*D
W.S. Jenks & Son*D
JIT Resources, Inc.
Joseph Electronics*D
Marshall Industries*D
Plato Products, Inc.
Print Products International*D
Richmond Technology Inc.
RS Electronics*D
Seco Industries
Semtronics Corp.
Specialized Prods Company*D
Techni-Tool Inc.*D

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3M Electrical Specialties Div
3M Electronic Prods Division
Time Motion Tools*D
Wescorp
Wholesale Electronics Inc.*D

STATIC DETECTION METERS

Accutest Instruments, Inc.*D
Vance Baldwin Inc.*D
Charleswater
Computer Svcs of America*D
Contact East, Inc.*D
The Current Source*D
Desco
E.I.L. Instruments, Inc.*D
Electronic Prod. Specialties*D
Galco Industrial Electronics*D
Harco Electronics*D
HMC - Hub Material Co.*D
W.S. Jenks & Son*D
JIT Resources, Inc.
Joseph Electronics*D
Marshall Industries*D
Print Products International*D
Prostat Corporation
RS Electronics*D
Semtronics Corp.
Simco
Specialized Prods Company*D
Tech Spray, Inc.
Techni-Tool Inc.*D
3M Electrical Specialties Div
3M Electronic Prods Division
Time Motion Tools*D
Union Electronics Distrib*D
Wescorp
Wholesale Electronics Inc.*D

Supplies/ accessories equipment

BATTERIES

Alpha Technologies
American Design Components
Andrews Electronics*D
Antique Electronic Supply*D
Arrow Electronics
Avex Probes, Inc. (API)
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Compuvideo
Consolidated Elctrnics, Inc.*D
Contact East, Inc.*D
Controlled Power Co.
The Current Source*D
Daibani Corporation*D.....53
Dalco Electronics*D
Digi-Key D*
East Coast Transistor*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Express*D
Entech Corp
Excel Distributing*D
Fedco Electronics, Inc.*D
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Jameco Electrn Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D

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Kelvin Electronics*D
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Mouser Electronics*D
Nesco Batteries
Omega Engineering, Inc.
ORA Electronics
Panasonic Industrial Co.
Parts Express International*D16
Philips Consumer Elctrnics*MD.....IBC
Premium Parts+ Elctrnics Co*D
RNJ Electronics Inc.*D17
RS Electronics*D
Russell Industries*D
Specialized Prods Company*D
Tadiran Computer Batteries*D
TEC
Techni-Tool Inc.*D
Time Motion Tools*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D
Zenith Sales Co.

BENCHES/CABINETS

Arrow Electronics
Vance Baldwin Inc.*D
Computer Svcs of America*D
Contact East, Inc.*D
The Current Source*D
Dalco Electronics*D
East Coast Transistor*D
Electronic Prod. Specialties*D
Harco Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
I.A.C. Industries
Jameco Electrnc Components*D
W.S. Jenks & Son*D
Jensen Tools, Inc.*D
Joseph Electronics*D
Klein Tools, Inc.
Lista International Corp.
Marshall Industries*D
MCM Electronics*D
Philips Consumer Elctrnics*MD.....IBC
Print Products International*D
RS Electronics*D
Specialized Prods Company*D
Techni-Tool Inc.*D
Teclab
Time Motion Tools*D
Wholesale Electronics Inc.*D
Workplace Systems, Inc.
Zero Corp., East Div.

CHEMICALS

Alternative Technical Services
Andrews Electronics*D
Antique Electronic Supply*D
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Brunelle Instruments, Inc.
Bursma Electronic Distrib.*D
CAIG Laboratories, Inc.73, 75
Chemtronics
Computer Component Source*D
Computer Svcs of America*D
Consolidated Elctrnics, Inc.*D
CPR Systems Inc
CRC Industries, Inc.
The Current Source*D
Dalbani Corporation*D53
Dynaloy, Inc.
East Coast Transistor*D
Echelon Industries*D
Eiger Electronics*D

E.I.L. Instruments, Inc.*D
Electro Dynamics, Inc.*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Excel Distributing*D
Foley-Belsaw*D
Four Star Chemical
Fox International*D
Galco Industrial Electronics*D
GC Electronics*D
Global Micro-Parts Depot*D
Harco Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Hy Tec Dealer Service
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Klein Tools, Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
MG Chemicals
Micro Care Corp.
Miller-Stephenson Chemical Co.
Mouser Electronics*D
Multicore Solders
P.K. Neuses*D
Omega Engineering, Inc.
Parts Express International*D16
Philips Consumer Elctrnics*MD.....IBC
Philips ECG
Planned Products
Premium Parts+ Elctrnics Co*D
Print Products International*D
Rawn Co. Inc.
RNJ Electronics Inc.*D17
Rogers Anti-Static Chemicals
RS Electronics*D
Specialized Prods Company*D
Stoner, Inc.
Syon Corporation
Tandy National Parts*D
Tech Spray, Inc.
Techni-Tool Inc.*D
The Texwipe Company/CleanTex
3M Electronic Prods Division
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D
Zenith Sales Co.

CLEANING SUPPLIES

Aervo-Pacific Co.
Alternative Technical Services
Andrews Electronics*D
Vance Baldwin Inc.*D
Bursma Electronic Distrib.*D
CAIG Laboratories, Inc.73, 75
Computer Component Source*D
Computer Svcs of America*D
Consolidated Elctrnics, Inc.*D
Contact East, Inc.*D
CPR Systems Inc
CRC Industries, Inc.
The Current Source*D
Dalbani Corporation*D53
East Coast Transistor*D
Echelon Industries*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Falcon Safety Products

Foley-Belsaw*D
Four Star Chemical
Fox International*D
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Hy Tec Dealer Service
Jameco Electrnc Components*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kasco Distributing*D
Klein Tools, Inc.
Leland Ltd., Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Micro Care Corp.
Miller-Stephenson Chemical Co.
Multicore Solders
P.K. Neuses*D
Parts Express International*D16
PC Service Source*D
Philips Consumer Elctrnics*MD.....IBC
Print Products International*D
Rawn Co. Inc.
RNJ Electronics Inc.*D17
Rogers Anti-Static Chemicals
RS Electronics*D
Specialized Prods Company*D
Stoner, Inc.
Syon Corporation
Tech Spray, Inc.
Techni-Tool Inc.*D
The Texwipe Company/CleanTex
3M Consumer & Pro
Time Motion Tools*D
Tritronics, Inc.*D
Wholesale Electronics Inc.*D

LAMPS

Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bonkote America, Inc.
Bursma Electronic Distrib.*D
Computer Svcs of America*D
Consolidated Elctrnics, Inc.*D
Contact East, Inc.*D
The Current Source*D
Dalbani Corporation*D53
Dazor Manufacturing Corp.
Digi-Key D*
East Coast Transistor*D
Eiger Electronics*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Foley-Belsaw*D
Global Micro-Parts Depot*D
Harco Electronics*D
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Jameco Electrnc Components*D
Joseph Electronics*D
Kelvin Electronics*D
Luxe Corp.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Mouser Electronics*D
O.C. White
Parts Express International*D16
Premium Parts+ Elctrnics Co*D
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Specialized Prods Company*D

Techni-Tool Inc.*D
Teclab
Time Motion Tools*D
Tritronics, Inc.*D
Waldmann Lighting Company
Wholesale Electronics Inc.*D

MAGNIFIERS

Vance Baldwin Inc.*D
B-B&W Electronics*D
Bonkote America, Inc.
Consolidated Elctrnics, Inc.*D
Contact East, Inc.*D
The Current Source*D
Dalbani Corporation*D53
Dalco Electronics*D
Dazor Manufacturing Corp.
Digi-Key D*
East Coast Transistor*D
Edroy Products
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Foley-Belsaw*D
Harco Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Jameco Electrnc Components*D
W.S. Jenks & Son*D
Joseph Electronics*D
Luxe Corp.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
O.C. White
Parts Express International*D16
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Specialized Prods Company*D
Techni-Tool Inc.*D
Teclab
Time Motion Tools*D
Waldmann Lighting Company
Wholesale Electronics Inc.*D

SHELVES/RACKS/BINS

Arrow Electronics
Vance Baldwin Inc.*D
Bonkote America, Inc.
Contact East, Inc.*D
The Current Source*D
Dalco Electronics*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Galco Industrial Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Hy Tec Dealer Service
I.A.C. Industries
Jameco Electrnc Components*D
W.S. Jenks & Son*D
JIT Resources, Inc.
Joseph Electronics*D
Lista International Corp.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Parts Express International*D16
Print Products International*D
Snap-On Incorporated
Techni-Tool Inc.*D
Teclab
Tektronix, Inc.
Time Motion Tools*D
Trace Racks

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SOLDER/DESOLDERING BRAID/FLUX

American Design Components
Andrews Electronics*D
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
C&S Sales*D
Chemtronics
Computer Component Source*D
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
CPR Systems Inc
The Current Source*D
Den-On Instruments (USA), Inc.
Digi-Key D*
East Coast Transistor*D
Eiger Electronics*D
Electro Tool, Inc.
Electro Dynamics, Inc.*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Excel Distributing*D
Foley-Belsaw*D
Fox International*D
Galco Industrial Electronics*D
Global Micro-Parts Depot*D
Harco Electronics*D
Herman Electronics*D73
Hexacon Electric Co.
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Hy Tec Dealer Service
Internat'l Components Corp.*D80
Jameco Electrnc Components*D
JDR Micro*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Kester Solder
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
MG Chemicals
Mouser Electronics*D
Multicore Solders
Oldaker Corp.
OmniTron Electronics*MD
Parts Express International*D16
Philips Consumer Elctnrcs*MDIBC
Philips ECG
Plato Products, Inc.
Premium Parts+ Electrncs Co*D
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Soder-Wick Fine-Braid
SAT/ A SPIRIG CO.
Specialized Prods Company*D
Tandy National Parts*D
Tech Spray, Inc.
Techni-Tool Inc.*D
Time Motion Tools*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

TUBING

Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Consolidated Elctnrcs, Inc.*D
The Current Source*D

Digi-Key D*
East Coast Transistor*D
Eiger Electronics*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Fox International*D
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D73
Hosfelt Electronics, Inc.*D
Jameco Electrnc Components*D
W.S. Jenks & Son*D
Joseph Electronics*D
Manhattan/CDT
M.A.T. Electronics*D
MCM Electronics*D
M.M. Newman Corporation
Omega Engineering, Inc.
Parts Express International*D16
RS Electronics*D
Russell Industries*D
Tandy National Parts*D
Techni-Tool Inc.*D
Wholesale Electronics Inc.*D

WIRE, CABLE AND ACCESSORIES

American Design Components
Antique Electronic Supply*D
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Belden Wire & Cable Company
Bi-Tronics Inc.
Bursma Electronic Distrib.*D
Computer Component Source*D
Computer Svcs of America*D
Compuvideo
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
The Current Source*D
Dalbani Corporation*D53
Dalco Electronics*D
Digi-Key D*
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electro Standards Lab, Inc.
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
The Eraser Company, Wybar Div.
Excel Distributing*D
Fox International*D
Global Micro-Parts Depot*D
Harco Electronics*D
Herman Electronics*D73
Hosfelt Electronics, Inc.*D
Internat'l Components Corp.*D80
ITT Pomona Electronics
Jameco Electrnc Components*D
JDR Micro*D
Jim-Pak*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Manhattan/CDT
M.A.T. Electronics*D
MCM Electronics*D
Mouser Electronics*D
Oldaker Corp.
Omega Engineering, Inc.
Parts Express International*D16
Premium Parts+ Electrncs Co*D
RF Industries
RNJ Electronics Inc.*D17
RS Electronics*D

Support Systems International
Tandy National Parts*D
TEC
Techni-Tool Inc.*D
3M Electronic Prods Division
Time Motion Tools*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Waytek Inc.*D
Wholesale Electronics Inc.*D
Winegard Co.
Zenith Sales Co.

Audio/video accessories

A/B SWITCHES

American Design Components
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bi-Tronics Inc.
Bursma Electronic Distrib.*D
Channel Master Div of Avnet
Computer Svcs of America*D
Consolidated Elctnrcs, Inc.*D
CSI/SPECO
The Current Source*D
Dalbani Corporation*D53
Dalco Electronics*D
East Coast Transistor*D
Eiger Electronics*D
Electro Standards Lab, Inc.
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Fox International*D
GC Electronics*D
Herman Electronics*D73
Hosfelt Electronics, Inc.*D
Innovative Solutions
JDR Micro*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Multidyne Inc
Parts Express International*D16
Pfanstiehl Corp.*D17
RNJ Electronics Inc.*D17
RS Electronics*D
Support Systems International
Tandy National Parts*D
TEC
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D
Winegard Co.
Zenith Sales Co.

COUPLERS/SPLITTERS

Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Channel Master Div of Avnet
Compuvideo
Consolidated Elctnrcs, Inc.*D
CSI/SPECO
The Current Source*D
Dalbani Corporation*D53
Dalco Electronics*D
East Coast Transistor*D
Eiger Electronics*D
Electro Standards Lab, Inc.

Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Fox International*D
GC Electronics*D
Herman Electronics*D73
Hosfelt Electronics, Inc.*D
Internat'l Components Corp.*D80
Jameco Electrnc Components*D
JDR Micro*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Microwave Filter Company, Inc.
Multiplex Technology, Inc.
Parts Express International*D16
Pfanstiehl Corp.*D
Premium Parts+ Electrncs Co*D
RF Industries
RNJ Electronics Inc.*D17
RS Electronics*D
Support Systems International
Tandy National Parts*D
TEC
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D
Winegard Co.
Zenith Sales Co.

FILTERS

American Design Components
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Dalbani Corporation*D53
East Coast Transistor*D
Eiger Electronics*D
Electronic Parts Supply*D
Electronic Specialists, Inc.
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Fox International*D
Herman Electronics*D73
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Microwave Filter Company, Inc.
Mouser Electronics*D
Multiplex Technology, Inc.
RNJ Electronics Inc.*D17
RS Electronics*D
Schurter, Inc.
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

RF SWITCHES

Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Channel Master Div of Avnet
Compuvideo
Consolidated Elctnrcs, Inc.*D
CSI/SPECO
The Current Source*D
Dalbani Corporation*D53
East Coast Transistor*D
Eiger Electronics*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Excel Distributing*D
Fox International*D
Herman Electronics*D73

Product directory

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Joseph Electronics*D
Kelvin Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Multiplex Technology, Inc.
Planstiehl Corp.*D
RF Industries
RNJ Electronics Inc.*D17
Schurter, Inc.
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

SIGNAL MIXERS

Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Compuvideo
The Current Source*D
Dalbani Corporation*D53
East Coast Transistor*D
Eiger Electronics*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Herman Electronics*D73
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Multiplex Technology, Inc.
Planstiehl Corp.*D
RNJ Electronics Inc.*D17
Tritronics, Inc.*D
Wholesale Electronics Inc.*D
Zenith Sales Co.

Tools

HEAT GUNS

Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bi-Tronics Inc.
Bursma Electronic Distrib.*D
Computer Svcs of America*D
Consolidated Elctnrcs, Inc.*D
Contact East, Inc.*D
Cooper Tools
The Current Source*D
Dalbani Corporation*D53
Den-On Instruments (USA), Inc.
Digi-Key D*
East Coast Transistor*D
Eiger Electronics*D
Electro Tool, Inc.
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Express*D
The Eraser Company, Wybar Div.
Foley-Belsaw*D
Galco Industrial Electronics*D
Harco Electronics*D
Herman Electronics*D73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Jameco Electrc Components*D
JDV Products Inc.
W.S. Jenks & Son*D
Joseph Electronics*D
Kelvin Electronics*D
The Malcom Company
Manhattan/CDT
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Mouser Electronics*D
Omnitron Electronics*MD

Parts Express International*D16
Philips Consumer Elctnrcs*MD.....IBC
Portasol, Inc.
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Snap-On Incorporated
Specialized Prods Company*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tritronics, Inc.*D
Ungar, A Rubbermaid Co.
Union Electronics Distrib*D
Wahl Clipper Corporation
Weidmuller Inc.
Weller/Cooper Tools
Wholesale Electronics Inc.*D
Xytronic

JIGS/FIXTURES/VISES

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Consolidated Elctnrcs, Inc.*D
Cooper Tools
The Current Source*D
Dalbani Corporation*D53
Eiger Electronics*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Excel Distributing*D
Harco Electronics*D
Herman Electronics*D73
Hitachi Home Electronics
HMC - Hub Material Co.*D
Jameco Electrc Components*D
JDR Micro*D
JDV Products Inc.
W.S. Jenks & Son*D
Joseph Electronics*D
Kelvin Electronics*D
MCM Electronics*D
Mouser Electronics*D
PanaVise Products
Parts Express International*D16
Philips Consumer Elctnrcs*MD.....IBC
Premium Parts+ Elctnrcs Co*D
Print Products International*D
RNJ Electronics Inc.*D17
RS Electronics*D
Snap-On Incorporated
Specialized Prods Company*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

SOLDERING/DESOLDERING EQUIPMENT

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Alternative Technical Services
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Vance Baldwin Inc.*D
B-B&W Electronics*D
Bonkote America, Inc.
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Wouldn't it be great if bad parts just lit up and whistled at you?



LeakSeeker 82A can lead you right to the culprit with whistles and flashing lights!



\$149 60 DAY MONEY-BACK GUARANTEE

So you've got a leaky part bringing down the power supply bus and you don't know where the defect is because your meter shows 3 ohms everywhere and the supply feeds seven boards stuffed with 4 million parts and now you'll have to hack up the foil and unsolder and check each and every part one by one and it'll take hours, maybe even days, and the customer is getting irate...

-OR-

Simply touch **LeakSeeker's** gold-plated probe anywhere on the foil that has a low resistance and **LeakSeeker** will automatically calibrate itself to the resistance of the defect (up to 150 ohms!) and beep higher or lower, and light the nine LED distance indicators as you touch each pad along the foil.

The pad where the beep is highest is the defective part!

ELECTRONIC DESIGN SPECIALISTS

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Circle (66) on Reply Card

Service the JUMBO and PROJECTION TV's with One MAN

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- * AVOID CABINET DAMAGE
- * CONSERVE SHOP SPACE
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Method used by Sears, N.A.P., Sony, Mitsubishi, GE/RCA, Sharp, Toshiba, Emerson, Samsung and other major manufacturers.

More than twenty years; over 50,000 test jigs are now in use.

TELEMATIC'S TEST JIG SYSTEM

Quick to hookup...Easy to use...For all popular makes and models

The TeleMatic Test Jig System is designed to facilitate TV chassis trouble-shooting without the need for bringing the cabinet and picture tube to the shop. With the trend toward larger-27-, 30- and 35-inch-picture tubes and projection sets, a test jig is needed more than ever!

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East Coast Transistor*D
Eiger Electronics*D
E.I.L. Instruments, Inc.*D
Electro Tool, Inc.
Electro Dynamics, Inc.*D
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Fox International*D
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Jensen Tools, Inc.*D
Jim-Pak*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Leads Metal Products (ENDECO)
The Malcom Company
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
METCAL
Metric Supply*D
Mouser Electronics*D
Multicore Solders
P.K. Neuses*D
M.M. Newman Corporation
O.K. Industries, Inc.
Oldaker Corp.
Omega Engineering, Inc.
OmniTron Electronics*MD
PACE, Inc.
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Philips ECG
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Portasol, Inc.
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Print Products International*D
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RS Electronics*D
Snap-On Incorporated
SAT/ A SPIRIG CO.
Specialized Prods Company*D
Sun Equipment Corporation
Tandy National Parts*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tritronics, Inc.*D
Tucker Electronics Co.
Ungar, A Rubbermaid Co.
Union Electronics Distrib*D
Virtual Industries
Wahl Clipper Corporation
Weller/Cooper Tools
Wholesale Electronics Inc.*D
Xytronic

TOOL CASES

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Vance Baldwin Inc.*D
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C&S Sales*D
Chicago Case Company
Computer Component Source*D
Consolidated Electrncs, Inc.*D
Contact East, Inc.*D
Cooper Tools
The Current Source*D
Dalbani Corporation*D.....53
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East Coast Transistor*D
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Electro Dynamics, Inc.*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Express*D
Elenco Electronics, Inc.
C.H. Ellis Company, Inc.
Fox International*D
Galco Industrial Electronics*D
Gemini Inc.
Willi Hahn Corp U.S.A.
Harco Electronics*D
Herman Electronics*D.....73
Highland Products, Inc.
HMC - Hub Material Co.*D
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Hy Tec Dealer Service
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W.S. Jenks & Son*D
Jensen Tools, Inc.*D
Jonard Industries Corp.
Joseph Electronics*D
Kelvin Electronics*D
Klein Tools, Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
P.K. Neuses*D
Omega Engineering, Inc.
OmniTron Electronics*MD
Parts Express International*D.....16
Philips Consumer Electrncs*MD.....IBC
Philips ECG
Platt Luggage, Inc.
Premium Parts+ Electrncs Co*D
Print Products International*D
RNJ Electronics Inc.*D.....17
RS Electronics*D
Snap-On Incorporated
Specialized Prods Company*D
Spencer Industries
Sun Equipment Corporation
Tandy National Parts*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tritronics, Inc.*D
Tucker Electronics Co.
Union Electronics Distrib*D
Weller/Cooper Tools
Wholesale Electronics Inc.*D
Zero Corp., East Div.

TOOL KITS

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Arrow Electronics
Vance Baldwin Inc.*D
Bi-Tronics Inc.

Bursma Electronic Distrib.*D
C&S Sales*D
Clauss Electronics Div.
Computer Component Source*D
Computer Svcs of America*D
Consolidated Electrncs, Inc.*D
Contact East, Inc.*D
Cooper Tools
The Current Source*D
Dalbani Corporation*D.....53
Dalco Electronics*D
Den-On Instruments (USA), Inc.
East Coast Transistor*D
Electro Tool, Inc.
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Elenco Electronics, Inc.
Foley-Belsaw*D
Galco Industrial Electronics*D
Willi Hahn Corp U.S.A.
Harco Electronics*D
Heath Company
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Hy Tec Dealer Service
Jameco Electrnc Components*D
JDR Micro*D
JDV Products Inc.
W.S. Jenks & Son*D
Jensen Tools, Inc.*D
Jim-Pak*D
Jonard Industries Corp.
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Klein Tools, Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Moody Tools, Inc.
P.K. Neuses*D
Omega Engineering, Inc.
OmniTron Electronics*MD
Parts Express International*D.....16
PC Service Source*D
Philips Consumer Electrncs*MD.....IBC
Premium Parts+ Electrncs Co*D
Print Products International*D
RF Industries
RNJ Electronics Inc.*D.....17
RS Electronics*D
Russell Industries*D
Snap-On Incorporated
Specialized Prods Company*D
Spencer Industries
Sun Equipment Corporation
Tandy National Parts*D
Techni-Tool Inc.*D
Time Motion Tools*D
Tucker Electronics Co.
Union Electronics Distrib*D
Weidmuller Inc.
Weller/Cooper Tools
Wholesale Electronics Inc.*D

TOOLS, MISCELLANEOUS

Aervo-Pacific Co.
Alternative Technical Services
American Design Components
AMP
Andrews Electronics*D
Antique Electronic Supply*D
A.P.E.
Arrow Electronics
Vance Baldwin Inc.*D
B-B&W Electronics*D

Bi-Tronics Inc.
Bursma Electronic Distrib.*D
C&S Sales*D
Computer Component Source*D
Compumideo
Consolidated Electrncs, Inc.*D
Contact East, Inc.*D
Cooper Tools
CPR Systems Inc.
CRC Industries, Inc.
The Current Source*D
Dalbani Corporation*D.....53
Dalco Electronics*D
Den-On Instruments (USA), Inc.
Digi-Key D*
Dremel
East Coast Transistor*D
Eiger Electronics*D
Electro Tool, Inc.
Electro Dynamics, Inc.*D
Electronic Prod. Specialties*D
Electronic Parts Supply*D
Electronic Software Developers.....14
Electronics Warehouse Corp.*D
Electronix Corp.*D.....80
Electronix Express*D
Elenco Electronics, Inc.
Foley-Belsaw*D
Fox International*D
Galco Industrial Electronics*D
GC Electronics*D
The Granite Corp.
Willi Hahn Corp U.S.A.
Harco Electronics*D
Herman Electronics*D.....73
HMC - Hub Material Co.*D
Hosfelt Electronics, Inc.*D
Hy Tec Dealer Service
Jameco Electrnc Components*D
JDR Micro*D
JDV Products Inc.
W.S. Jenks & Son*D
Jensen Tools, Inc.*D
Jonard Industries Corp.
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Klein Tools, Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Micro Care Corp.
Mouser Electronics*D
P.K. Neuses*D
O.K. Industries, Inc.
OmniTron Electronics*MD
Parts Express International*D.....16
Philips Consumer Electrncs*MD.....IBC
Philips ECG
Plato Products, Inc.
Portasol, Inc.
Premium Parts+ Electrncs Co*D
Print Products International*D
Ripley Company
RNJ Electronics Inc.*D.....17
RS Electronics*D
Russell Industries*D
Snap-On Incorporated
Specialized Prods Company*D
Sun Equipment Corporation
Tandy National Parts*D
Techni-Tool Inc.*D
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Tritronics, Inc.*D
Tucker Electronics Co.
Ungar, A Rubbermaid Co.
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Virtual Industries
Wahl Clipper Corporation
Weidmuller Inc.
Weller/Cooper Tools
Xytronic

Video Schematic Diagram (5 of 8)

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

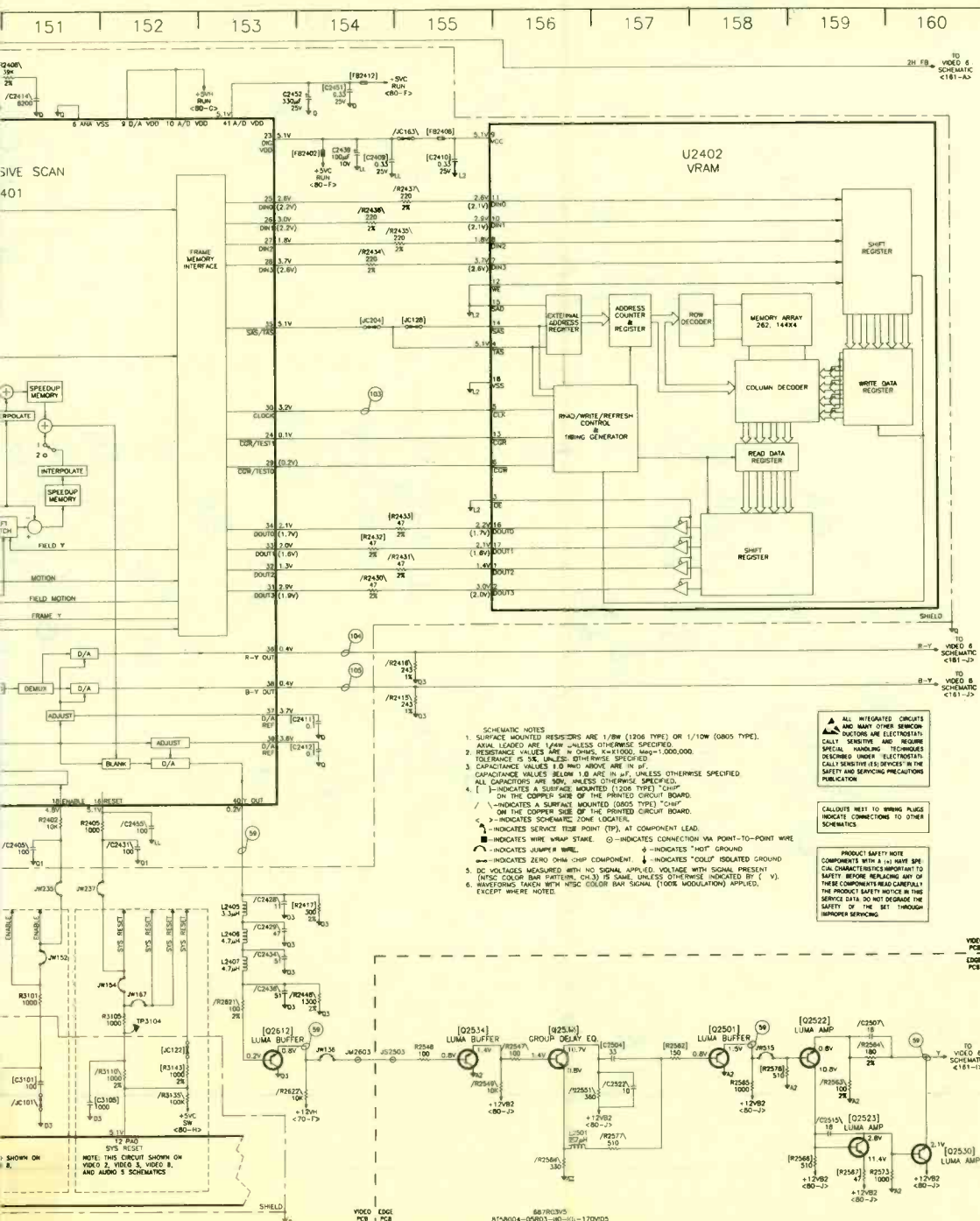
Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

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

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

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

*Please note that these schematics are a continuation from February.



Video Schematic Diagram (6 of 8)

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

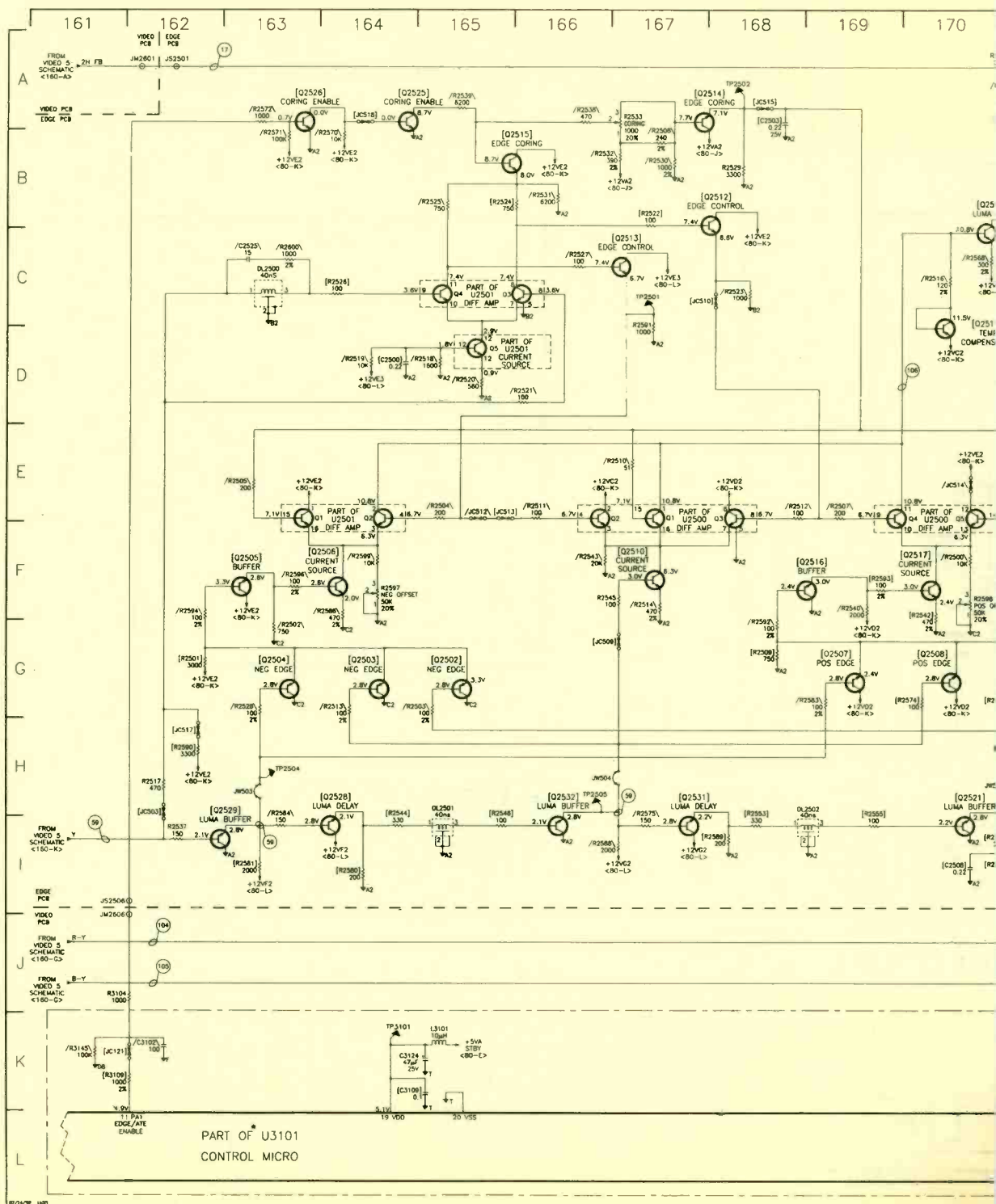
Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

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

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

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

**Please note that these schematics are a continuation from February.*



Video Schematic Diagram (7 of 8)

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

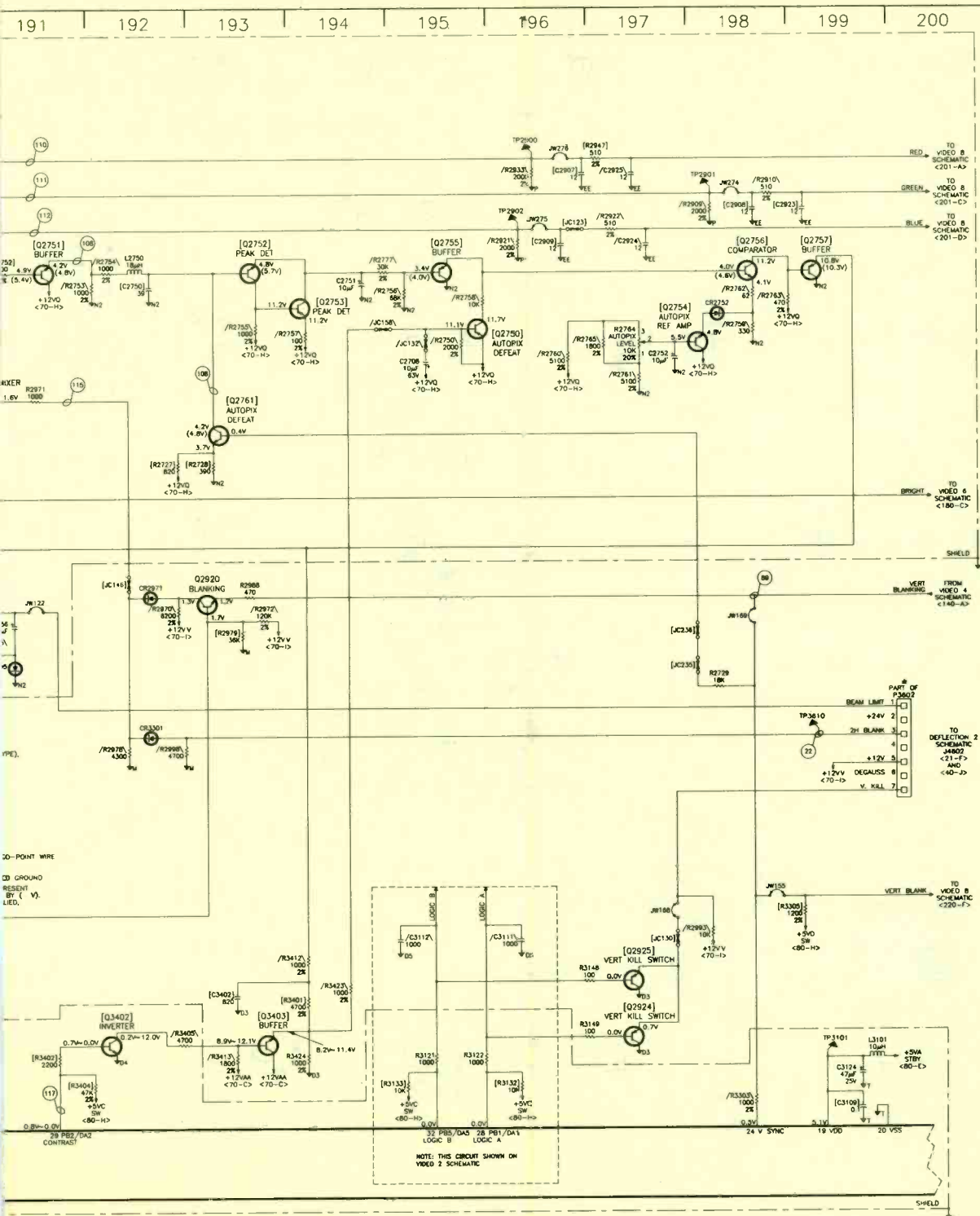
Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

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

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

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

**Please note that these schematics are a continuation from February.*



Thomson
Video Cassette
Recorder
Model No. PTK171

PROFAX ES&T
Manufacturers' schematics

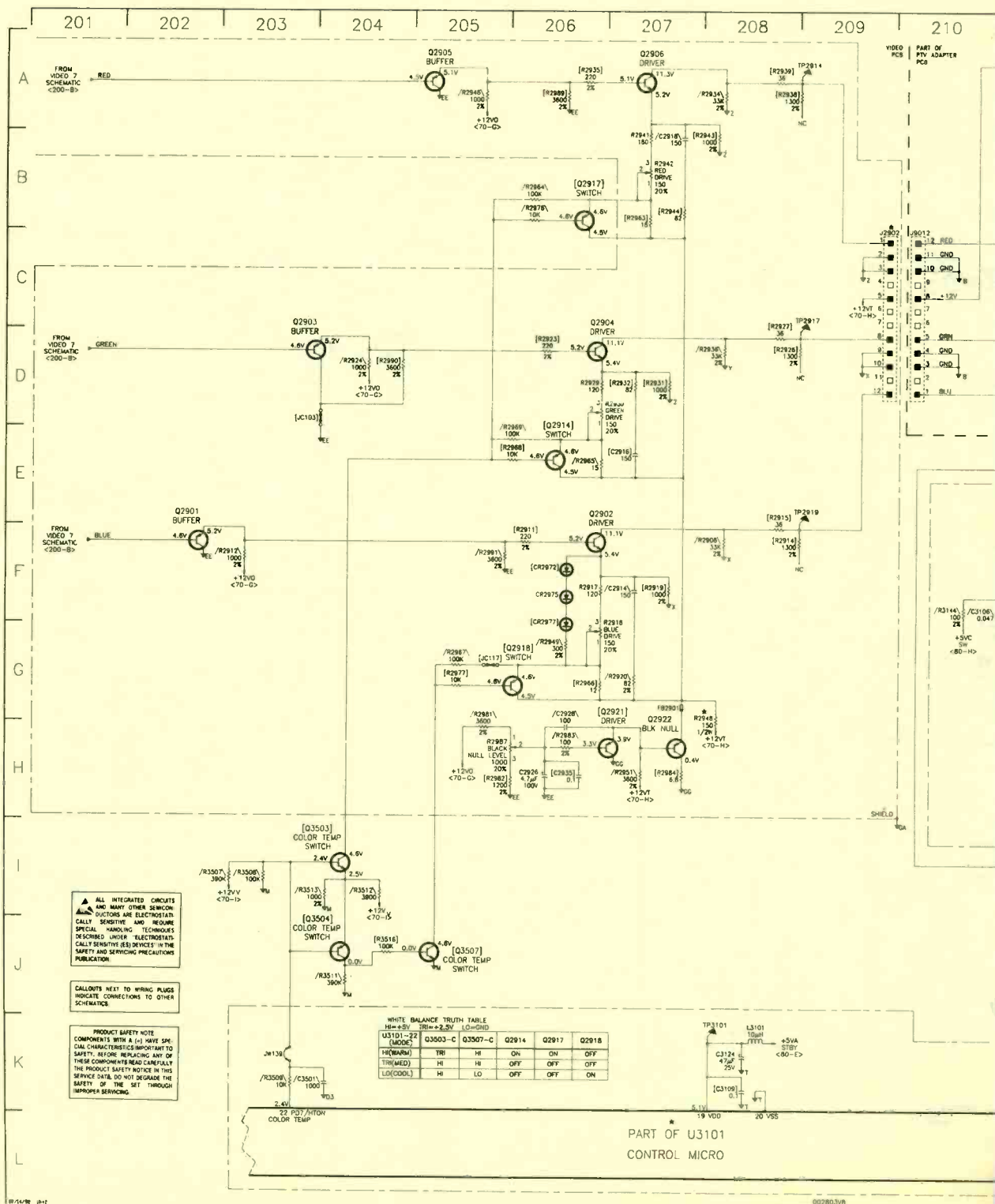
February 1997

Video Schematic Diagram (8 of 8)

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.

*Please note that these schematics are a continuation from February.

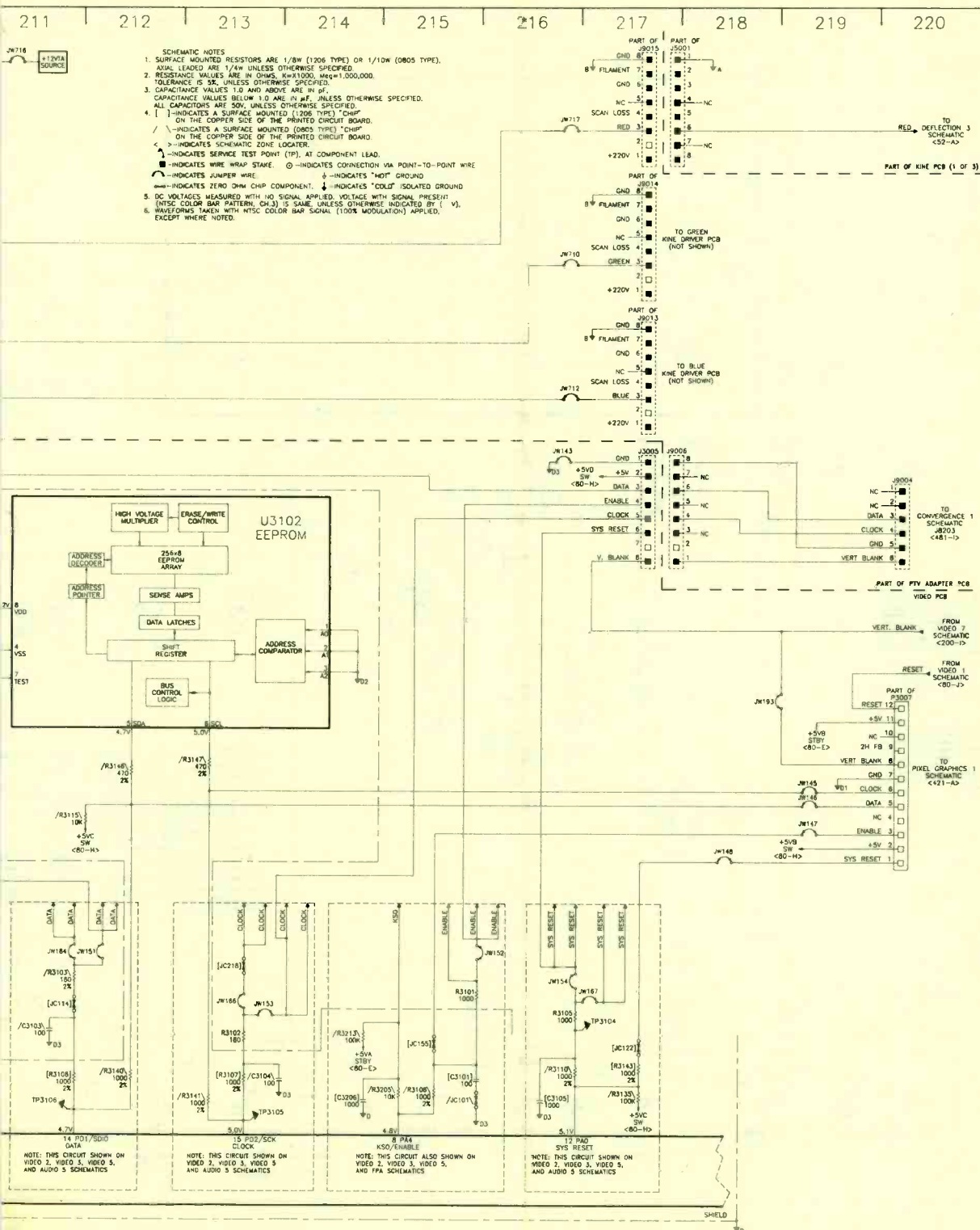


This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

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

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

**Please note that these schematics are a continuation from February.*



Video Schematic Diagram (7 of 8)

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

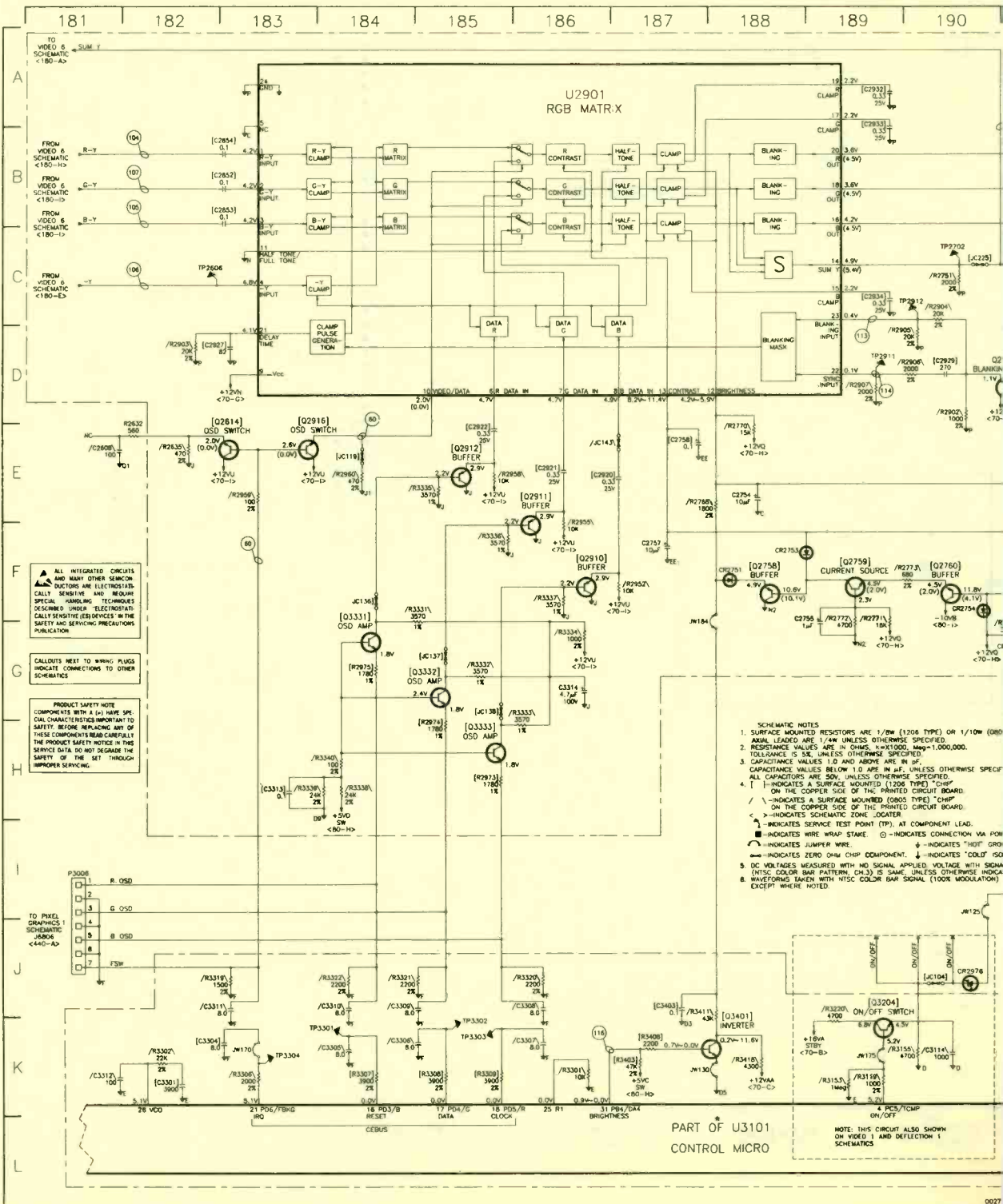
Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

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

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

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

**Please note that these schematics are a continuation from February.*



Video Schematic Diagram (6 of 8)

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

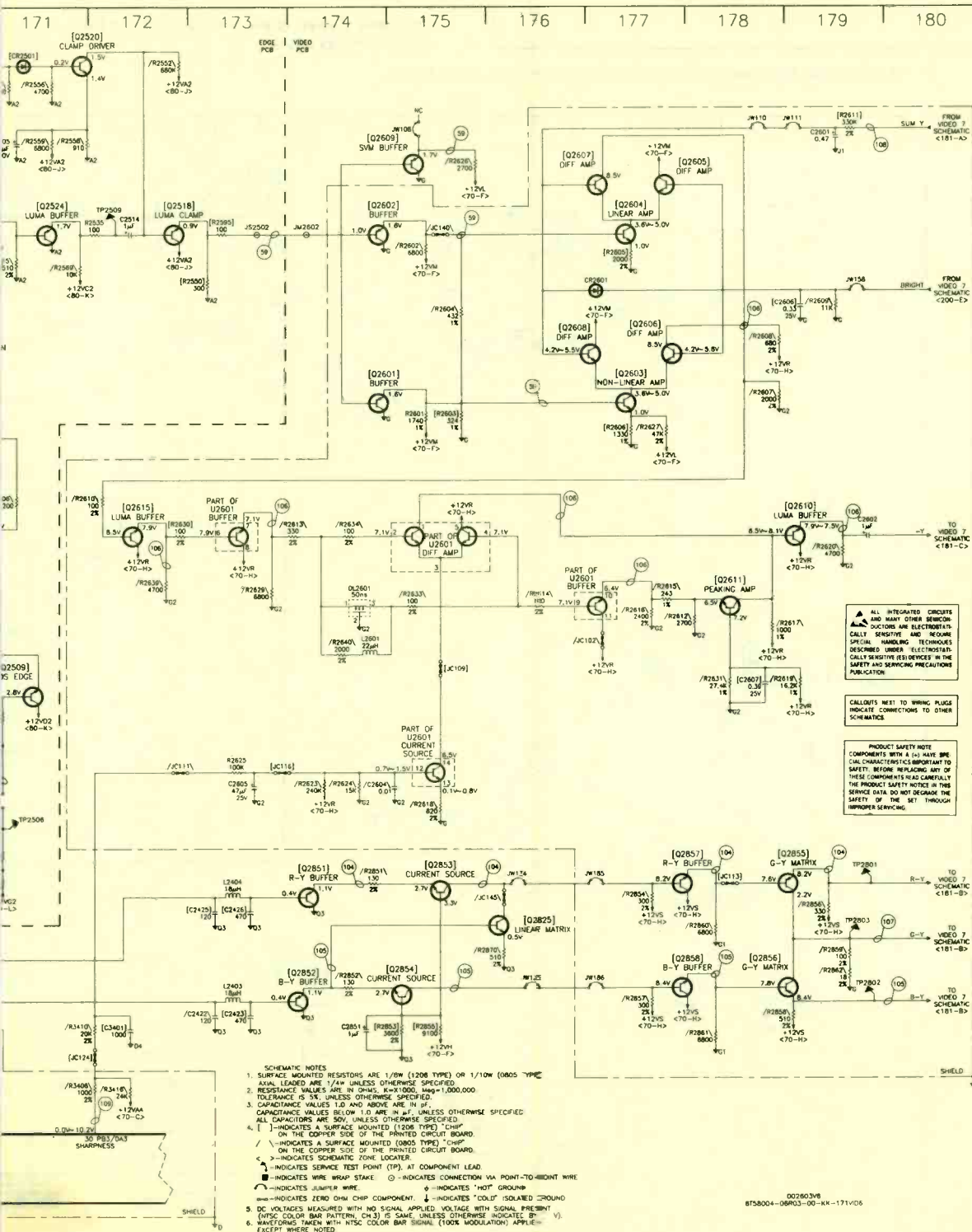
Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

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

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

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

*Please note that these schematics are a continuation from February.



March 1997

Thomson

Video Cassette Recorder, Model PTK171

Profax
Number

3147

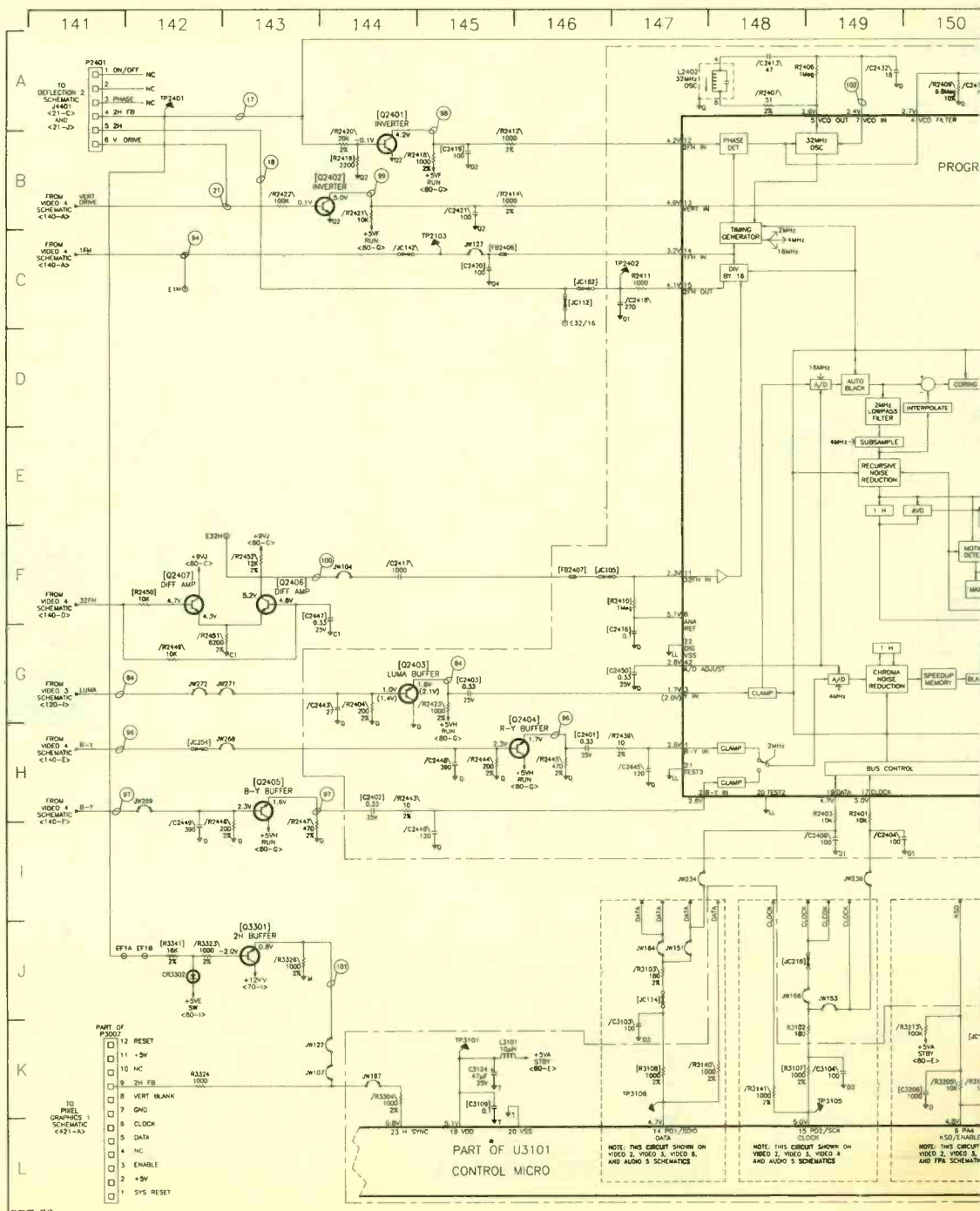
Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

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 of other hazards.

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

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

*Please note that these schematics are a continuation from February.



Replacement parts/ components directory

Note: An entry followed by *D means that this company is a distributor, not a manufacturer. An entry followed by a *MD means that this company is both a manufacturer and a distributor.

A line listing that is in color indicates that the company has an ad in this issue. The number following the listing is the number of the page on which the ad is located. BC means Back Cover; IBC means Inside Back Cover; IFC means Inside Front Cover.

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ANTENNAS/ROTORS/ SATELLITE SYSTEMS

Andrews Electronics*D
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
The Current Source*D
Dalbani Corporation*D53
Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Excel Distributing*D
Fox International*D
GC Electronics*D
Hitachi Home Electronics
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Parts Express International*D16
Philips Consumer Elctnrcs*MD.....IBC
Premium Parts+ Elctnrcs Co*D
RNJ Electronics, Inc.*D17
Russell Industries*D
Sony Service Co.
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics, Inc.*D
Winegard Co.

AUDIO HEADS

Andrews Electronics*D
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Compuvideo
The Current Source*D
Dalbani Corporation*D53
Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Hitachi Home Electronics
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Parts Express International*D16
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Premium Parts+ Elctnrcs Co*D
Quasar
RNJ Electronics, Inc.*D17
Sony Service Co.
Sprague Magnetics, Inc.*D
Technics
Tritronics, Inc.*D
Trumco of California, Inc.*D
Union Electronics Distrib*D

Wholesale Electronics, Inc.*D
Yamaha Electronics Corp, USA

BELTS/DRIVE WHEELS

Andrews Electronics*D
Antique Electronic Supply*D
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Compuvideo
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Dalbani Corporation*D53
Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
E.M.T. Parts, Inc.*D
Excel Distributing*D
Foley-Belsaw*D
Fox International*D
Herman Electronics*D73
Hitachi Home Electronics
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Parts Express International*D16
Pfanstiehl Corp.*D
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Premium Parts+ Elctnrcs Co*D
Quasar
RNJ Electronics, Inc.*D17
Russell Industries*D
Sony Service Co.
Tandy National Parts*D
Technics
Tritronics, Inc.*D
Union Electronics Distrib*D
Warrantech Corp.
Wholesale Electronics, Inc.*D
Yamaha Electronics Corp, USA

CAPACITORS

American Design Components
Andrews Electronics*D
Antique Electronic Supply*D
Arrow Electronics
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Computer Svcs of America*D
Compuvideo
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Curtis Mathes
Dalbani Corporation*D53
Digi-Key D*

Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Electronix Express*D
Excel Distributing*D
Foley-Belsaw*D
Fox International*D
Galco Industrial Electronics*D
Global Micro-Parts Depot*D
Herman Electronics*D73
Hitachi Home Electronics
Hosfelt Electronics, Inc.*D
Jameco Electrnrc Components*D
JDR Micro*D
Jim-Pak*D
Joseph Electronics*D
Kelvin Electronics*D
L.J. Enterprises*D69
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Microline
Mouser Electronics*D
NTE Electronics, Inc.*D
Panasonic Industrial Co.
Parts Express International*D16
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Premium Parts+ Elctnrcs Co*D
Quasar
Richardson Electronics, Ltd.*D
RS Electronics*D
Russell Industries*D
Sony Service Co.
Tandy National Parts*D
A.G. Tannenbaum*D
Technics
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics, Inc.*D
Yamaha Electronics Corp, USA

CIRCUIT BREAKERS

American Design Components
Andrews Electronics*D
Arrow Electronics
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
The Current Source*D
Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Fox International*D
Galco Industrial Electronics*D
Herman Electronics*D73
Hitachi Home Electronics
Hosfelt Electronics, Inc.*D
Internat'l Components Corp.*D.....80
Jameco Electrnrc Components*D
Jim-Pak*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Keystone Electronics Corp.
Klein Tools, Inc.
Marshall Industries*D
M.A.T. Electronics*D
MCM Electronics*D
Microline
Mouser Electronics*D
Parts Express International*D16
Pfanstiehl Corp.*D
Philips ECG
Quasar

Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Mouser Electronics*D
NTE Electronics, Inc.*D
Panasonic Industrial Co.
Parts Express International*D16
Pfanstiehl Corp.*D
Philips Consumer Elctnrcs*MD.....IBC
Quasar
RS Electronics*D
Schurter, Inc.
Sony Service Co.
Technics
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics Inc.*D

CONNECTORS/TERMINALS

Amcom Corporaton*D
American Design Components
AMP
Amphenol Corporation
Andrews Electronics*D
Arrow Electronics
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Curtis Mathes
Dalbani Corporation*D53
Dalco Electronics*D
Digi-Key D*
Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D
Electronix Corp.*D80
Excel Distributing*D
Foley-Belsaw*D
Galco Industrial Electronics*D
Herman Electronics*D73
Hitachi Home Electronics
Hosfelt Electronics, Inc.*D
Internat'l Components Corp.*D.....80
Jameco Electrnrc Components*D
Jim-Pak*D
Joseph Electronics*D
Kasco Distributing*D
Kelvin Electronics*D
Keystone Electronics Corp.
Klein Tools, Inc.
Marshall Industries*D
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RS Electronics*D	Eiger Electronics*D	Quasar	MCM Electronics*D
Russell Industries*D	Electro Dynamics, Inc.*D	RS Electronics*D	Microline
Schurter, Inc.	Electronic Parts Supply*D	Russell Industries*D	Mouser Electronics*D
SHOGYO International Corp.	Electronics Warehouse Corp.*D	SMH Electronics Co., Inc.	Panasonic Industrial Co.
Sony Service Co.	Electronix Corp.*D80	Sony Service Co.	Parts Express International*D16
Tandy National Parts*D	Electronix Express*D	A.G. Tannenbaum*D	Quasar
Technics	Excel Distributing*D	Technics	RS Electronics*D
Techni-Tool, Inc.*D	Foley-Belsaw*D	Tritronics, Inc.*D	SHOGYO International Corp.
Tritronics, Inc.*D	Fox International*D	Union Electronics Distrib*D	Sony Service Co.
Trompeter Electronics	Galco Industrial Electronics*D	Wholesale Electronics, Inc.*D	Tandy National Parts*D
Union Electronics Distrib*D	GC Electronics*D	Yamaha Electronics Corp, USA	Technics
Wholesale Electronics, Inc.*D	Global Micro-Parts Depot*D		Tritronics, Inc.*D
Yamaha Electronics Corp, USA	Herman Electronics*D73		Wholesale Electronics, Inc.*D
	Hitachi Home Electronics		Yamaha Electronics Corp, USA
	Hosfelt Electronics, Inc.*D		
FLYBACKS	Internat'l Components Corp.*D80	HOLDERS/CLIPS	
American Design Components	Jameco Electrn Components*D	Andrews Electronics*D	
Andrews Electronics*D	Joseph Electronics*D	Arrow Electronics	
Vance Baldwin, Inc.*D	Kelvin Electronics*D	Vance Baldwin, Inc.*D	
B-B&W Electronics*D	L.J. Enterprises*D69	B-B&W Electronics*D	
Bursma Electronic Distrib.*D	M.A.T. Electronics*D	Bursma Electronic Distrib.*D	
Cititronix/Panson*D	MCM Electronics*D	Cititronix/Panson*D	
Computer Component Source*D	Microline	Computer Component Source*D	
Computer Svcs of America*D	Mouser Electronics*D	The Current Source*D	
Consolidated Elctrnics, Inc.*D	Parts Express International*D16	Dalbani Corporation*D53	
The Current Source*D	Pfanstiehl Corp.*D	Dalco Electronics*D	
Curtis Mathes	Philips Consumer Elctrnics*MDIBC	Dialight Corporation	
Dalbani Corporation*D53	Philips ECG	Digi-Key D*	
Diversified Parts*D	Premium Parts+ Electrnics Co*D	Diversified Parts*D	
East Coast Transistor*D	Quasar	East Coast Transistor*D	
Eiger Electronics*D	RNJ Electronics Inc.*D17	Eiger Electronics*D	
Electro Dynamics, Inc.*D	RS Electronics*D	Electro Dynamics, Inc.*D	
Electronic Parts Supply*D	Russell Industries*D	Electronic Parts Supply*D	
Electronics Warehouse Corp.*D	Schurter, Inc.	Electronics Warehouse Corp.*D	
Electronix Corp.*D80	Sony Service Co.	Electronix Corp.*D80	
E.M.T. Parts, Inc.*D	Tandy National Parts*D	E-Z Hook	
Excel Distributing*D	Technics	Hitachi Home Electronics	
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Herman Electronics*D73	Union Electronics Distrib*D	Jameco Electrn Components*D	
Hitachi Home Electronics	Wholesale Electronics Inc.*D	Joseph Electronics*D	
ICM Components*D15	Yamaha Electronics Corp, USA	Electronix Corp.*D80	
Joseph Electronics*D		Electronix Express*D	
M.A.T. Electronics*D		Foley-Belsaw*D	
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Microline		GC Electronics*D	
NTE Electronics, Inc.*D		Hitachi Home Electronics	
Panasonic Industrial Co.		Industrial Devices, Inc.	
Parts Express International*D16		Jameco Electrn Components*D	
Parts Port Ltd*D		JDR Micro*D	
Philips Consumer Elctrnics*MDIBC		Jim-Pak*D	
Philips ECG		Joseph Electronics*D	
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Wholesale Electronics, Inc.*D		RNJ Electronics, Inc.*D17	
		RS Electronics*D	
		Schurter, Inc.	
		SHOGYO International Corp.	
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		Tandy National Parts*D	
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		Union Electronics Distrib*D	
		Wholesale Electronics Inc.*D	
		Yamaha Electronics Corp, USA	
		INDUCTORS	
		Andrews Electronics*D	
		Arrow Electronics	
		Vance Baldwin, Inc.*D	
		B-B&W Electronics*D	
		Bursma Electronic Distrib.*D	
		Cititronix/Panson*D	
		Computer Component Source*D	
		Computer Svcs of America*D	
		The Current Source*D	
		Digi-Key D*	
		Diversified Parts*D	
		Electro Dynamics, Inc.*D	
		Electronics Warehouse Corp.*D	
		Electronix Corp.*D80	
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		Hosfelt Electronics, Inc.*D	
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		MAGNETRONS	
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Herman Electronics*D.....73
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M.A.T. Electronics*D
MCD Electronics *D
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Premium Parts+ Elctnrcs Co*D
Q B Products*D
Quasar
Richardson Electronics, Ltd.*D
RNJ Electronics, Inc.*D.....17
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MODULES

Andrews Electronics*D
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
The Current Source*D
Dalbani Corporation*D.....53
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East Coast Transistor*D
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Fox International*D
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Jameco Electnrc Components*D
Joseph Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Module Exchange
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Premium Parts+ Elctnrcs Co*D
PTS Corporation.....80
Quasar
RF Industries
Richardson Electronics, Ltd.*D
Schurter, Inc.
Synergetix
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics, Inc.*D

MOTORS

Amcom Corporaton*D
American Design Components
Andrews Electronics*D
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Cititronix/Panson*D
Computer Component Source*D
Computer Svcs of America*D
The Current Source*D
Dalbani Corporation*D.....53
Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
Electronics Warehouse Corp.*D

Electronix Corp.*D.....80
Electroservice Laboratories
Fox International*D
Herman Electronics*D.....73
Hitachi Home Electronics
Hosfelt Electronics, Inc.*D
Jameco Electnrc Components*D
Joseph Electronics*D
Kelvin Electronics*D
M.A.T. Electronics*D
MCM Electronics*D
Microline
Panasonic Industrial Co.
Parts Express International*D.....16
Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Premium Parts+ Elctnrcs Co*D
Quasar
RNJ Electronics, Inc.*D.....17
RS Electronics*D
Sony Service Co.
Sprague Magnetics, Inc.*D
Technics
Tritronics, Inc.*D
Truminc of California, Inc.*D
Union Electronics Distrib*D
Yamaha Electronics Corp, USA

PHONO CARTRIDGES/STYL

Andrews Electronics*D
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Consolidated Elctnrcs, Inc.*D
The Current Source*D
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Diversified Parts*D
East Coast Transistor*D
Eiger Electronics*D
Electro Dynamics, Inc.*D
Electronic Parts Supply*D
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Joseph Electronics*D
M.A.T. Electronics*D
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Philips ECG
Richardson Electronics, Ltd.*D
RNJ Electronics Inc.*D.....17
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Sony Service Co.
A.G. Tannenbaum*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics, Inc.*D

PICTURE TUBES/CRTS

American Design Components
Andrews Electronics*D
Vance Baldwin Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Svcs of America*D
Compuvideo
The Current Source*D
Curtis Mathes
Diversified Parts*D
Eiger Electronics*D
Electronic Parts Supply*D
Excel Distributing*D
Fox International*D
Herman Electronics*D.....73
Hitachi Home Electronics
Joseph Electronics*D

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Quasar
Richardson Electronics, Ltd.*D
RS Electronics*D
SMH Electronics Co., Inc.
Sony Service Co.
Technics
Tritronics, Inc.*D
Tucker Electronics Co.
Union Electronics Distrib*D
Video Display Corporation
Video Display Corporation
Warrantech Corp.
Wholesale Electronics, Inc.*D
Zenith Sales Co.

POTENTIOMETERS

American Design Components
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Antique Electronic Supply*D
Arrow Electronics
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B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Consolidated Elctnrcs, Inc.*D
The Current Source*D
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Diversified Parts*D
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Hitachi Home Electronics
Jameco Electnrc Components*D
JDR Micro*D
Jim-Pak*D
Joseph Electronics*D
Kelvin Electronics*D
L.J. Enterprises*D.....69
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MCM Electronics*D
Mouser Electronics*D
Panasonic Industrial Co.
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Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Quasar
RS Electronics*D
SHOGYO International Corp.
Tandy National Parts*D
A.G. Tannenbaum*D
Technics
Techni-Tool, Inc.*D
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics, Inc.*D
Yamaha Electronics Corp, USA

RECTIFIERS

American Design Components
Andrews Electronics*D
Antique Electronic Supply*D
Arrow Electronics
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Consolidated Elctnrcs, Inc.*D
The Current Source*D
Curtis Mathes

Dalbani Corporation*D.....53
Data Business Publishing
Digi-Key D*
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Eiger Electronics*D
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Electronix Corp.*D.....80
Electronix Express*D
Excel Distributing*D
Fox International*D
Galco Industrial Electronics*D
Global Micro-Parts Depot*D
Hitachi Home Electronics
Jameco Electnrc Components*D
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Joseph Electronics*D
Kelvin Electronics*D
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M.A.T. Electronics*D
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MCM Electronics*D
Microline
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NTE Electronics, Inc.*D
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Philips Consumer Elctnrcs*MD.....IBC
Philips ECG
Quasar
Richardson Electronics, Ltd.*D
RS Electronics*D
Tandy National Parts*D
Technics
Tritronics, Inc.*D
Union Electronics Distrib*D
Wholesale Electronics, Inc.*D
Yamaha Electronics Corp, USA

RELAYS

American Design Components
Andrews Electronics*D
Antique Electronic Supply*D
Arrow Electronics
Vance Baldwin, Inc.*D
B-B&W Electronics*D
Bursma Electronic Distrib.*D
Cititronix/Panson*D
Computer Component Source*D
Computer Svcs of America*D
Consolidated Elctnrcs, Inc.*D
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Digi-Key D*
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Jim-Pak*D
Joseph Electronics*D
Kelvin Electronics*D
M.A.T. Electronics*D
MCD Electronics *D
MCM Electronics*D
Microline
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Mouser Electronics*
 NEC Technologies, Inc.*
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 Quasar
 Richardson Electronics, Ltd.*
RNJ Electronics, Inc.*17
 RS Electronics*
 Sony Service Co.
 Tandy National Parts*
 Technics

SEMICONDUCTORS, TRANSISTORS

SEMICONDUCTORS, TRANSISTORS

American Design Components
Andrews Electronics*
Arrow Electronics
Vance Baldwin, Inc.*
B-B&W Electronics*
Bursma Electronic Distrib.*
Cititronix/Panson*
Computer Component Source*
Computer Svcs of America*
Compuvideo
Consolidated Elctrnics, Inc.*
The Current Source*
Curtis Mathes
Daibani Corporation*53
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 ServiceWare Corporation
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 Philips ECG
 RAM Software Enterprises
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email: afoti@fotronic.com 617-665-1400 FAX 617-665-0780

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Company mailing addresses

A

Abbot, Langer & Associates

548 First Street
Crete, IL 60417
708-672-4200
E-mail: Slanger@abbot-langer.com

ACCSCT

750 First Street N.E.
Suite 905
Washington, DC 20002-4242
202-336-6850
Fax: 202-842-2585

Accurite Technologies Inc.

48460 Lakeview Blvd
Fremont, CA 94538
510-668-4900
Fax: 510-668-4905

Accutest Instruments, Inc.*D

PO Box 130
Clarksburg, NJ 08510
609-259-0460
800-524-0747
Fax: 609-259-0227

Adaptive Research

665 King St. East, #3
Hamilton, ON
905-577-6936

Addison-Wesley Publishing Co.

One Jacob Way
Reading, MA 01867
617-944-3700 X2714
800-822-6339 Order

Advanced Electronic Applications

PO Box C2160
Lynnwood, WA 98036
206-774-5554
Fax: 206-775-2340

Advanced Technology Group, Inc.

205 Regency Executive Park Dr.
Suite 306
Charlotte, NC 28217
704-521-8113

AeroAstro

550 East Rogers Road
Longmont, CO 80501
303-651-7552

Aervo-Pacific Co.

1198 Sawmill Rd.
PO Box 485
Gardnerville, NV 89410
800-227-0196 Order
Fax: 702-782-4027

Air 1 USA Inc.

Micro Services Division
PO Box 3035
Pueblo, CO 81005
719-566-0018
Fax: 719-566-0024

Aiwa America, Inc.

800 Corporate Drive
Mahwah, NJ 07430-2048
201-512-3600

Alfa Electronics* D

P.O. Box 8089
Princeton, NJ 08543
609-520-2002
800-526-2532
Fax: 609-520-2007

Allison Technology Corporation

8343 Carvel
Houston, TX 77036
713-777-0401
800-980-9806
Fax: 713-777-4746

Alpha Technologies

3767 Alpha Way
Bellingham, WA 98226
360-647-2360 Fax: 360-671-4936

Alternative Technical Services

17853-107 Santiago Blvd #505
Villa Park, CA 92861
714-633-8231
800-343-3530
Fax: 714-744-3870

Amcom Corporaton* D

6205 Bury Drive
Eden Prairie, MN 55346
612-949-9400
800-328-7723
Fax: 612-949-9400

American Design Components

PO Box 2601
Secaucus, NJ 07096-2601
201-601-8999
800-776-3700
Fax: 201-941-7480

American Megatrends, Inc.

6145-F Northbelt Parkway
Norcross, GA 30071
770-246-8600
800-U-BUY-AMI
Fax: 770-246-8790

American Power Conversion Corp

132 Fairgrounds Road
West Kingston, RI 02892
401-789-5735
800-800-4080
Fax: 401-789-3710

American Reliance

11801 Goldring Road
Arcadia, CA 91006-5880
818-303-6688
800-654-9838
Fax: 818-358-3838
E-mail: sandra@amrel.com
Web site: <http://www.amrel.com>

Ames Supply Co.* D

2537 Curtiss St
Downers Grove, IL 60515
800-323-3856

America West Communications

And Electronics, Inc
1900 Elk Street
Rock Springs, WY 82901
307-382-5663
800-542-9378
Fax: 307-382-7323

AMP

PO Box 3608
Harrisburg, PA 17105-3608
717-564-0100
800-522-6752
Fax: 717-986-7575

Amphenol Corporation

Comm. and Network Prods. Div.
One Kennedy Avenue
Danbury, CT 06810
203-743-9272
800-825-5577
Fax: 203-796-2091

Amprobe Instrument

630 Merrick Rd.
PO Box 329
Lynbrook, NY 11563-2348
516-593-5600
800-477-8658
Fax: 516-593-5682

Analog Technology Center Inc

62 Route 101A
Amherst, NH 03031
603-673-0404

Analogic Corp.

8 Centennial Drive
Peabody, MA 01960
508-977-3000
Fax: 508-977-6814
Web site: <http://www.analogic.com>

AnaTek Corporation

PO Box 1200
100 Merrimack Rd
Amherst, NH 03031
603-673-4342
800-999-0304
Fax: 603-673-5374

Andrews Electronics* D

PO Box 914
Santa Clarita, CA 91380-9014
805-257-7700
800-289-0300
Fax: 800-289-0301

Anritsu Meter Co. of America

P.O. Box 193
Franklin Lakes, NJ 07417
201-848-0033
800-457-2999
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800-933-4926
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Irving, TX 75060

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Beaverton, OR 97008-5484
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800-327-4786
Fax: 503-626-6492

Armand Mfg. Inc.

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702-565-7500
Fax: 800-669-9811

ASC Capacitors

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308-284-3611

Arrow Electronics

25 Hub Drive
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Fax: 516-391-1640

ASG Division of Jergens Inc.

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216-486-6163

ASTEA International, Inc.

100 Highpoint Drive
Chalfont, PA 18914
215-822-8888

Astea International

55 Middlesex Turnpike
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617-275-5440
Fax: 617-275-1910

ASTI Magnetics Corp.

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Bergenfield, NJ 07621-2866
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800-221-1828
Fax: 201-385-1702

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Los Angeles, CA 90019
213-933-2141

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Fax: 612-949-6000

Automated Systems, Inc.

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402-489-2717
800-279-7312
Fax: 402-489-2370

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Ann Arbor, MI 48108
313-973-0099

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PO Box 1026
Bensalem, PA 19020
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800-877-7623
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215-646-9200
800-723-AVO1
Fax: 215-643-2670
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Fax: 815-434-7094

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Pompano Beach, FL 33069-4802
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Fax: 954-969-0226

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Berwin, IL 60402
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Fax: 708-749-0325

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Ventura, CA 93003
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317-983-5200
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Fax: 317-983-5294
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Menlo Park, CA 94025
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Fax: 415-323-0156
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800-666-0996
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Web site: http://www.bi-tronics.com

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http://www.contact-east.com

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Web site:
http://www.controlledpwr.com

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813-446-3402
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Fax: 813-443-4377

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Fax: 303-799-4082

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800-837-7574
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800-345-9103
Fax: 314-652-2069
E-mail: info@dazor.com
Web site: http://www.dazor.com

Company mailing addresses

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Fax: 206-450-1311

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Fax: 909-595-7028
E-mail: dbermani@desco.com
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800-726-1503
Fax: 512-219-0021

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800-543-2130
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Fax: 914-347-4203

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Fax: 800-708-9888

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Glendale, CA 91205
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Company mailing addresses

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What Do You Know About Electronics?

Transformers and equivalent circuits

By Sam Wilson

Here is a quick question that needs a quick answer. If you have studied basic theory you should be able to answer it.

The primary-to-secondary turns ratio of a certain transformer is 1:2. The current in the primary winding is 1A. Calculate the secondary current. I'll wait at this point until you get it done.

Are you ready? Did you use the equation that is given in many books?

$$\frac{N_P}{N_S} = \frac{I_S}{I_P}$$

If so, you set the product of the means equal to the product of the extremes and solve for I_S .

$$N_S I_S = N_P I_P$$

$$I_S = \frac{N_P I_P}{N_S} = \frac{1 \times 1}{2} = \frac{1}{2} \text{ A}$$

That's very clever, isn't it? The only problem is that it is incorrect. The truth is that the secondary current must be obtained by using Ohm's law.

$$\text{secondary current} = \frac{\text{secondary voltage}}{\text{secondary circuit resistance}}$$

The primary-to-secondary voltage ratio is the same as the primary-to-secondary turns ratio:

$$\frac{N_P}{N_S} = \frac{V_P}{V_S}$$

That equation is correct. So, using the same transformer as before, and, assuming a primary voltage of 2V, the voltage across the secondary winding (disregarding losses):

$$\frac{\text{Primary turns}}{\text{Secondary Turns}} = \frac{V_P}{V_S}$$

Wilson is the electronics theory consultant for ES&T.

So,

$$V_S = \frac{N_2 V_P}{N_1} = \frac{2 \times 2}{1} = 4 \text{ V}$$

Now, if the resistance across the secondary winding is 1Ω , then, by Ohm's law we can find the current:

$$I = \frac{V_S}{R} = \frac{4}{1} = 4 \text{ A}$$

What is wrong here?

Using the equation

$$\frac{V_P}{V_S} = \frac{I_S}{I_P}$$

you can get a *calculated* secondary current. That may not be anywhere near the actual secondary current. It is the short circuit current that *could* flow if the manufacturer of the transformer used wire for the secondary winding that can withstand the actual current.

A black box problem

Regie Felps decided to sleep late because it was his day off. When he got up at 5:00 a.m. he found the following note under his door: "Good morning, Mr. Felps: Here is your assignment for today. The black box in Figure 1 has only linear resistors inside. The resistors are interconnected, but the resistance between terminals B and D is 0Ω ."

Your mission, should you decide to accept it, is to design an equivalent circuit

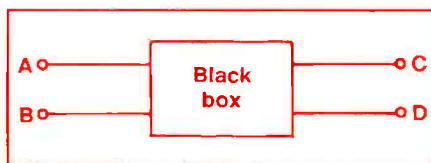


Figure 1. This black box has only linear resistors inside. They are interconnected, but the resistance between terminals B and D must be zero ohms.

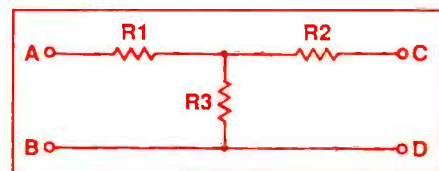


Figure 2. If you know the input resistance with output terminals open, the input resistance with output terminals shorted, the output resistance with input terminals open and the output resistance with input terminals shorted of a circuit that you know is made up only of linear resistors, you can design an equivalent T circuit such as the one shown here.

circuit consisting only of linear resistors. The circuit you design can be substituted for the black box in Figure 1 such that there will be no change in external voltages, currents and resistances.

As always, if you fail to find the correct answer to this problem, we will deny any knowledge of your existence."

The solution

Here is Regie's Solution. His ohmmeter measurements are also shown.

The circuit has four possible ohmmeter measurements:

- Input resistance with output terminals open (R_{AB}) = 40Ω
- Input resistance with output terminals shorted (R'_{AB}) = 22Ω
- Output resistance with input terminals open (R_{CD}) = 50Ω
- Output resistance with input terminals shorted (R'_{CD})

With those measurements and with the stated conditions, it is possible to design an equivalent "T" circuit. See Figure 2.

Regie had saved his notes from school and knew he could design the equivalent circuit using the following three equations:

$$R_3 = \sqrt{(R_{AB})(R_{CD}) - (R_{AB})(R_{CD})}$$

$$R_2 = R_{CD} - R_3$$

$$R_1 = R_{AB} - R_3$$

(Note: The resistance R'_{CD} is not needed to find the solution.)

Regie plugged the values (given above) into the three equations; here are the values he got for R_1 , R_2 and R_3 :

$$\begin{aligned} R_3 &= 30\Omega \\ R_2 &= 20\Omega \\ R_1 &= 10\Omega \end{aligned}$$

Figure 3 illustrates the equivalent circuit. This does not mean that the circuit inside the black box is a T circuit. The T circuit can be substituted for whatever circuit is inside.

$$\begin{aligned} R'_{AB} &= 10 + \frac{20 \times 30}{20 + 30} = 10 + 12 = 22\Omega \\ R_{AB} &= 10 + 30 = 40\Omega \\ R_{CD} &= 20 + 30 = 50\Omega \end{aligned}$$

Where did those equations come from? The resistors in the equivalent T circuit are the three unknowns to be determined. There are four possible equations. See Figure 1. If you have three equations and four unknowns, or four equations and three unknowns, a solution is very doubtful. So, you pick three of the four equations and the three unknowns and go after it. (If you have moxie you will pick the first three equations.)

I know what some of you readers are thinking: you have got enough problems of your own without reading this column to get another one. Other readers will see it as fun and try to develop the equations just to check their math memory.

OK. Now listen up. If you want the derivation for any reason, just send a note to me in care of this magazine:

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I'll send the derivation, free of course. Some readers will probably send a stamp, but, if you don't have one write for the solution anyway. If you do that, I'll also send you the EQUATIONS for designing a minimum loss pad of the type used for matching an amplifier to a speaker. (I'm NOT going to send a bunch of charts and graphs that usually work if you have certain values to work with.)

Anyway, the equivalent T circuit is shown in Figure 3.

Dis-like-its

Here are some things that I don't like to see in a book:

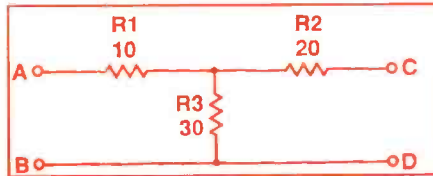


Figure 3. This circuit is equivalent to the circuit of Figure 1. This does not mean that the circuit inside the black box is a T circuit. The T circuit can be substituted for whatever circuit is inside.

"The proof is left to the reader." Translation: The author couldn't work the problem either.

"...and, as they say: 'Naka putsnik fumph trashnik'!" Translation: The author is living in a foreign country to avoid

paying income tax and is losing the ability to speak English.

"The answers to selected problems are given in Appendix A." Translation: The author could only work a few of the problems given in the book.

"The author assumes the reader is familiar with the simple solution of a simple 6 by 8 matrix." Translation: There is no such thing as a simple 6 X 8 matrix solution, and, if there were a simple solution, there are only three people in the world who understand it.

"The method of solving this equation is detailed in Volume 1 of the author's book." Translation: Volume 1 didn't sell very well, let's try to sell a few more. ■



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Catalog features expanded product line and web version

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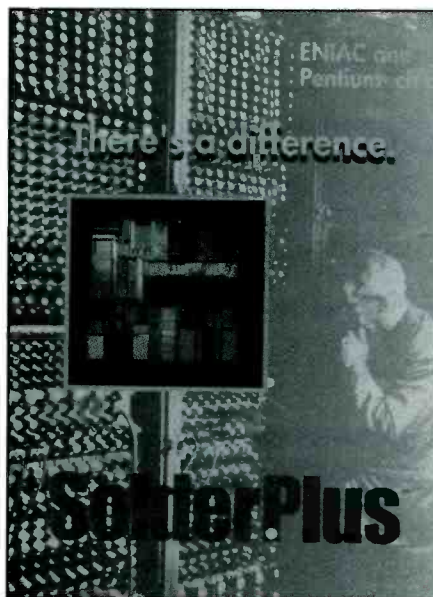
MCM Electronics announces their newest catalog - number 38.

This catalog is supported by over 6,000 new items. The additions include project accessories, semiconductors, connectors, test equipment, computer products, au-

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New franchised lines introduced for the first time in this catalog include Lexmark, ECG/Philips, and Sencore.

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Solder paste catalog

EFD, Inc. offers a color catalog describing the benefits of SolderPlus a new flux/alloy mixture that increases output, eliminates rework and improves joint reliability in manual and automated soldering operations.

Packaged in convenient 35 and 75 gram syringes, the paste is easily applied with manual or air-powered dispensing equipment. It will not clog, skip or separate and provides faster, more consistent deposits than flux-core wire or standard stencil-grade solder pastes.

The new material is available in popular flux/alloy combinations and can be reflowed with any common heating method in use.

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Tools catalog

The new Time Motion Tools catalog features 172 pages of tools for the service industry, including a variety of hand tools,

power tools, soldering tools, lighting and magnification tools, telecommunication, co-axial, test and measurement meters, and tool kits and cases. Specially featured in the fall catalog are the new Fluke meters, including the new Fluke 7-300. This low voltage (up to 300V ac or dc) meter automatically decides between measuring volts, continuity, or ohms.

Circle (94) on Reply Card

Brochure on high performance oscilloscopes

A new technical brochure is available from LeCroy Corporation for design/test engineers who would like information on high performance digital oscilloscopes. The brochure features numerous samples of real world signals and gives examples of how the engineer can capture, view and diagnose electronic circuits more accurately and more quickly. In addition to the application oriented information the brochure contains detailed technical specifications of a variety of oscilloscopes. The company also has a website at <http://www.lecroy.com>.

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Capacitor catalog detailing DynaCap series double layer capacitors offering highest capacitance density in industry

ELNA America, Inc., has published a new 16-page catalog detailing its ELNA DynaCap series of electric double layer capacitors, which are used for IC memory back-up or related energy storage.

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According to the company, the DynaCap Series is ideal as an energy storage device. In addition to integrated circuit memory back up, they are used as actuators for motors and electronic coils, in personal computers, cell phones and measurement devices, and can even function as a simple power supply.

Circle (96) on Reply Card

The Associate CET, Electronics Technicians Association, 22 Chapters, paperback \$24.95, five-disk tutorial \$50.00

New study material for technicians preparing for the Certified Electronics Technician Examinations is now available from the Electronics Technicians Association International, Inc. The two-book set is entitled *The Associate CET*.

Eleven authors, of whom six are electronics technology instructors, contributed to the texts, which contain materials closely related to the new CET Examinations. Major topics are: Electronics math and formulas; Inductance, capacitance and resistance; Power sources; ac/dc circuits; Power supply filtering and regulation; Antennas, transmissions lines and basic radio; Modulation; Block diagrams and schematics; Troubleshooting; Digital concepts, Computer basics; Test equipment; Safety; Semiconductors and integrated circuits; Signal processing; Amplification, conversion and compression; Basic controls, PLCs and programming; Hand tools and soldering; Technical writing, and new topics on Customer and co-worker relations, and Personal behavior. The two-book set contains over 500 practice quiz questions for the Associate CET.

The Associate CET, Books 1 and 2, contain a complete listing of ETA's 368 examination locations across the U.S., as well as many off shore sites.

ETA is also distributing a 5-Disk Computer Program (CET Tutorial) containing over 1,100 practice electronics questions, similar to those on the CET exams. While most of these practice quiz questions are related to actual questions on the Associate CET exams, also covered is advanced materials applicable to the Journeyman Option exams.

The practice computer quiz set contains four disks applicable to the CET exams, and one disk aimed at preparing technicians for the FCC General Radiotelephone Operator License exams. The diskettes are DOS based for IBM PCs and compatible personal computers. They are in color and are interactive.

The study guides can help students, on their own time, to fill in areas of their elec-

tronics education for which there is not time in many classes. The practice quizzes can easily be used for pre-employment examinations for companies who hire electronics technicians.

ETA, 602 N Jackson, Greencastle, IN 46135

FPGAs and Programmable LSI: A Designer's Handbook, by Geoff Bostock, Newnes, 240 pages, paperback \$47.95

This is the most comprehensive practical guide to designing with field programmable gate arrays (FPGAs) and programmable LSI. Programmable logic devices (PLDs) have been in general use for over 20 years. The demands of modern electronic design have caused traditional PAL technology to give way to a powerful new approach: FPGA technology.

The design process for an FPGA needs to be far more rigorous than for PAL since troubleshooting is far harder to perform. There are, moreover, a dozen or more manufacturers of FPGAs, each with a different architecture and performance, so choosing the right device for any particular application is a critical part of the design process. Similarly, there are various design methods, each with particular features. This book shows a designer how to choose the appropriate FPGA and design method for any application. It also gives hints and tips, based on the author's wide experience in the field, to allow designers to optimize performance of any particular family of devices.

Newnes, 313 Washington Street, Newton, MA 02158-1626

Embedded Microprocessor Systems: Real World Design, by Stuart Ball, Newnes, 184 pages, paperback \$29.95

Embedded Microprocessor Systems: Real World Design covers many microprocessor families while enumerating practical tips and pitfalls to avoid. This book is an introduction to the design of embedded microprocessor systems from concepts through debugging.

Unlike many microprocessor books, this book is not limited to any specific processor family, but describes interfaces and operations of several families, with emphasis on cost and design trade-offs. Two complete embedded systems are used throughout to illustrate specific concepts.

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The text includes numerous examples, tips, and pitfalls, which can help prevent time-consuming and expensive mistakes. Particularly important is the chapter on interrupts, with detailed descriptions of possible problems and warnings on what actions to avoid.

Stuart Ball is a Senior Electrical Engineer at Oregon Teknika, an Oklahoma City manufacturer of medical electronic equipment, and has worked for the past 15 years in the field of embedded microprocessor control systems.

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***Inside PC Card: CardBus and PCMCIA Design*, by Faisal Haque, Newnes, 254 pages, hardcover \$49.95**

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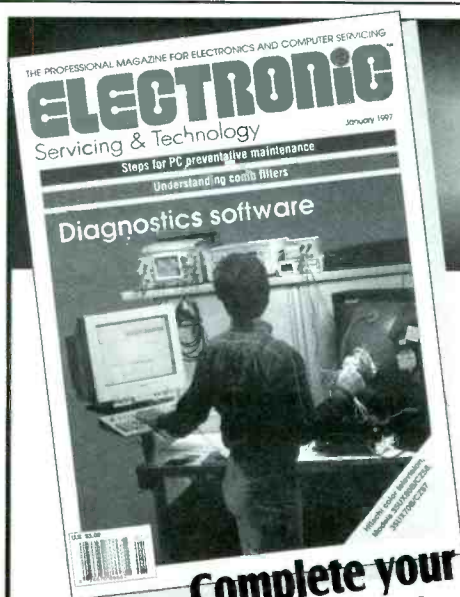
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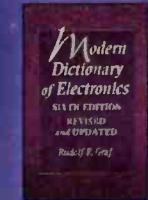
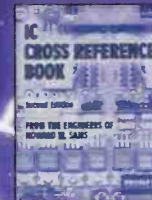
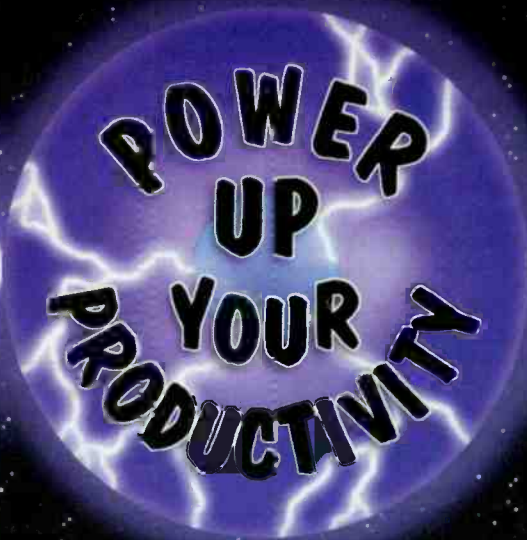
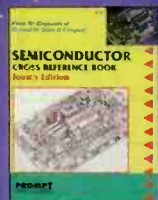
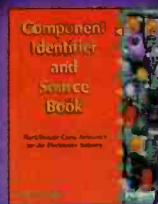
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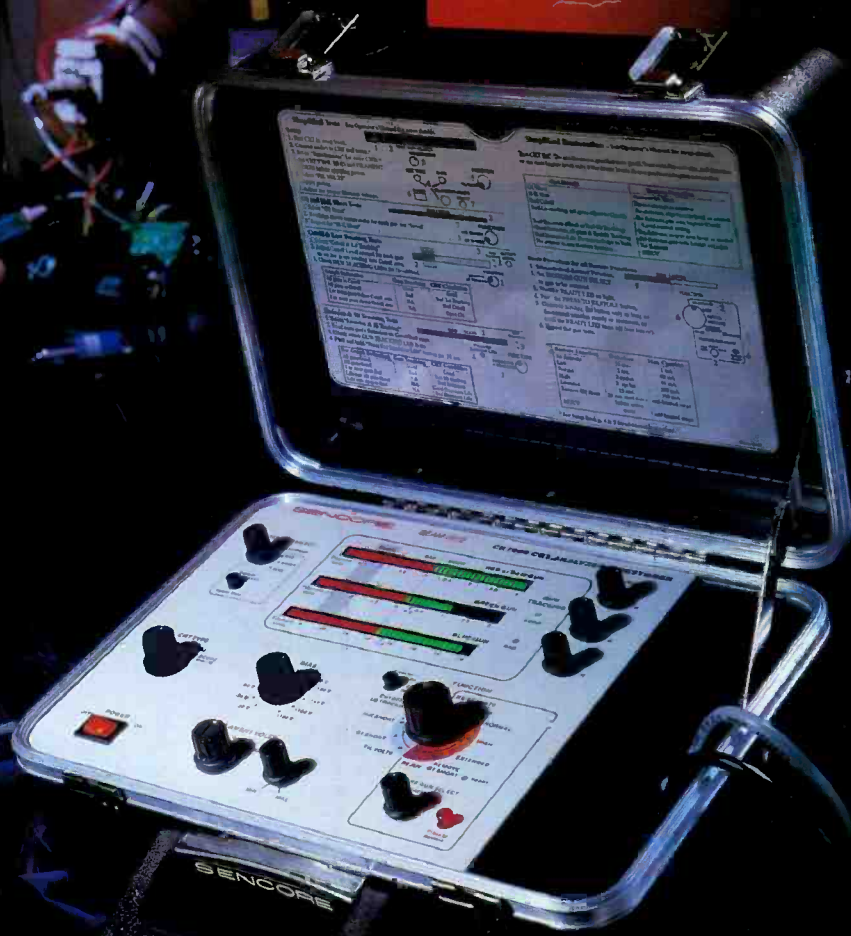
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