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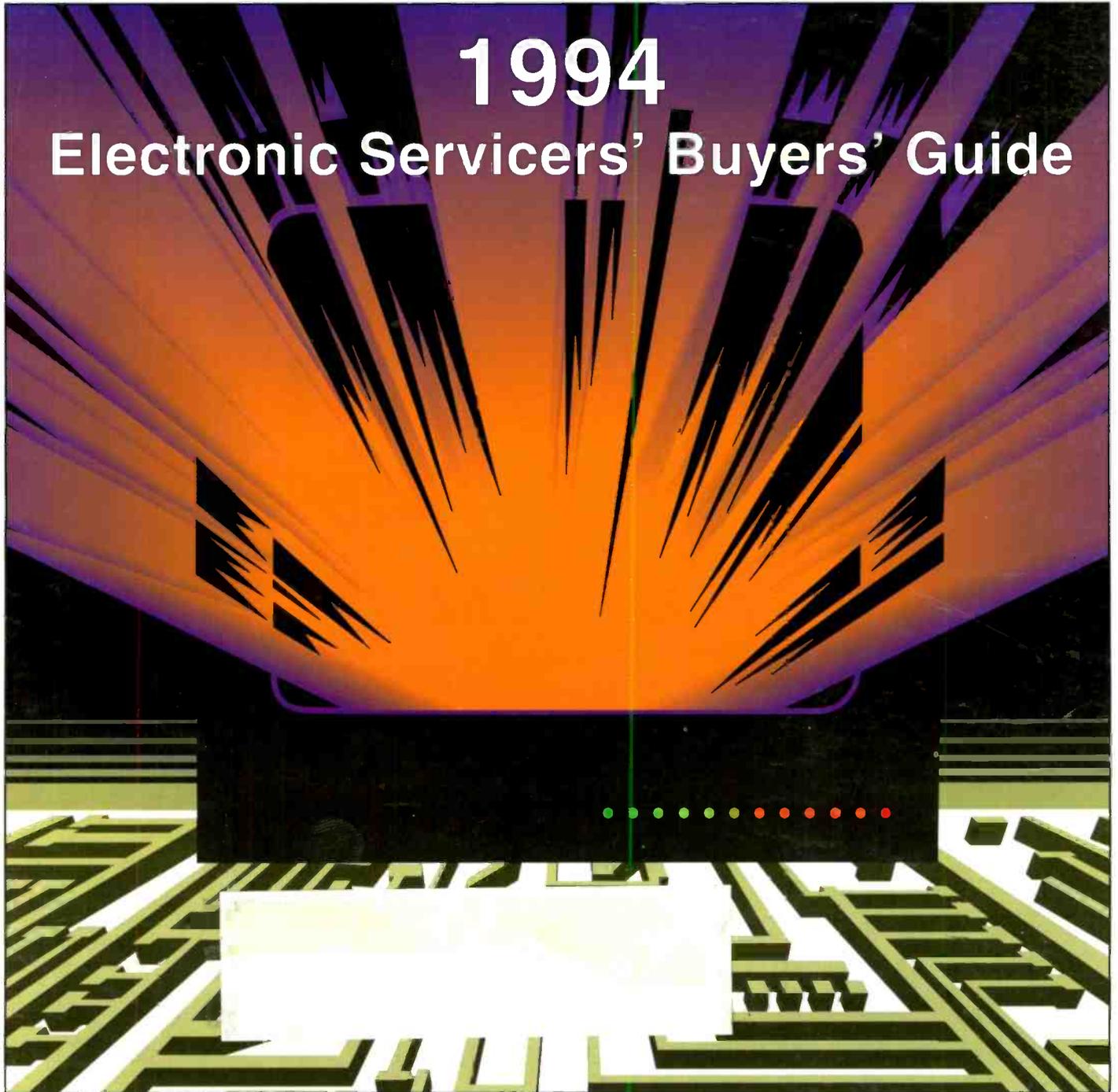
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1994 Electronic Servicers' Buyers' Guide



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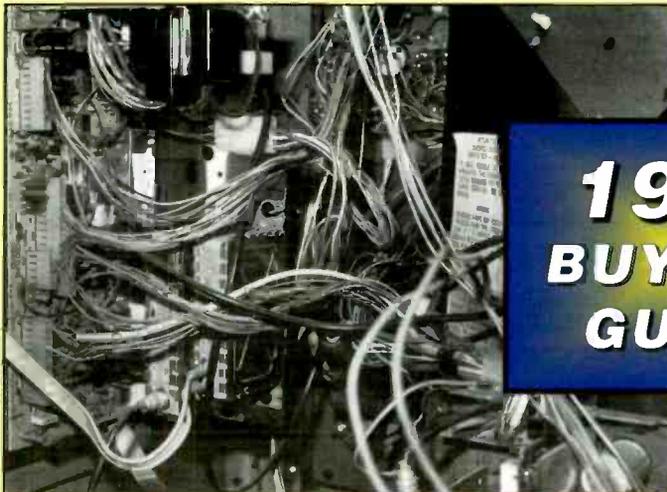
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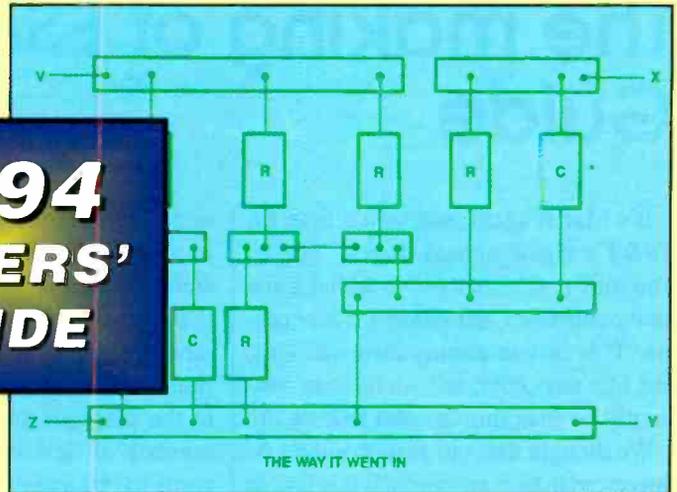
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By Homer L. Davidson

This article takes a close look at intermittent problems caused by bad connections, sockets, pc boards and components which produce more headaches and loss of time for the technician than any other type of symptom.

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By Dale C. Shackelford

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By John Kull

This story illustrates how a "simple" upgrade turned into an educational and lengthy troubleshooting experience.

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By The ES&T Staff

Because of the ever expanding list of products existing in the electronics field, there is a technician's vocabulary that is both constantly

and consistently expanding. Recently, ES&T has published a number of computer-related articles that have introduced some new terms and concepts. This Tech's Glossary presents some of these words and definitions, and also those that we expect will appear in future issues.

1994 BUYERS' GUIDE

The servicing of consumer electronics products requires a considerable investment in resources—perhaps the most important being the knowledge of what's inside a TV, VCR, or other product, and how they operate. This knowledge comes from the education and training a technician receives, and from the books, manuals and various types of service literature available. Armed with knowledge, the technician proceeds to diagnose problems in products and then he corrects them. In order to accomplish that, he needs tools, test equipment, replacement parts, supplies and materials. The Buyers' Guide contains information on hundreds of manufacturers and distributors who make or sell thousands of products.

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ON THE COVER

As this graphic implies, there is a lot more to consumer electronics than meets the eye. Servicing of all of the circuitry, subassemblies and components that hide under the exterior of a consumer electronics product falls under the purview of the technician. In order to keep that technician current concerning where to go to find the tools, test equipment and replacements to service those products, we publish this annual Buyers' Guide (Graphic designed by the ES&T art staff).

The making of ES&T's Buyers' Guide

It's March again, and so it's time for ES&T's eighth annual Buyers' Guide. You may notice that we've added some new companies and deleted a few others. This business constantly changes, just like any other, and we have to constantly be changing in order to keep up.

We thought that our readers might be interested in how we compile this list, so here goes.

Getting started

In order to establish a starting point, when the Buyers' Guide was new, we gleaned names and addresses of companies of interest to readers from a number of lists available, and our own lists of companies.

We also established the categories of products and services offered by companies on that list that would be of interest to readers.

With that as a starting point, we formulated questionnaires, had them printed, and mailed them to all of those companies. There are, as you can see, several hundred companies.

The questionnaires contained space for the company to make note of any changes of address, telephone numbers, etc. Also part of the questionnaire was a list of product categories, and within each category a list of individual products. Each company that returned the questionnaire checked off the products they make or distribute, and made any changes to their listing as it appeared on the questionnaire. The results of that first questionnaire became our first Buyers' Guide.

We do it every year

Old companies go out of business, and new companies enter the market. Consumer electronics companies are constantly introducing new products and introducing new technology into old prod-

ucts. Products that were not consumer products are introduced into the consumer market.

Because of these changes and many others, we send out Buyers' Guide questionnaires every year to every company in the previous year's guide, and to a number of new companies that have come to our attention.

Once we receive all of the questionnaires back, we compile the responses and publish the current year's Buyers' Guide issue.

Unfortunately, the Buyers' Guide is not perfect. For a number of reasons, this information does not exactly reflect reality. But you can help us make it better.

One reason that the information in this guide is not 100% accurate is the simple fact that because of the rapidity of changes at companies in this business, it is possible that changes of address, telephone numbers, or even product line may occur between the time the company fills out the questionnaire and the time of publication of this issue.

Another problem is that some companies to whom we send the questionnaires don't bother to complete them and send them back, in spite of the fact that we give them two opportunities to do so. When that happens, in most cases we publish the information based on the most recent information provided by that company.

Changes in the business

Moreover, the mix of products serviced by consumer electronics service centers is constantly changing. In the last decade, the category of "consumer electronics products" has expanded to include such products as VCRs, camcorders and compact disc players. In just the past few years, still more products have been added to the mix: office products, like computers and peripherals, fax

machines and more have become consumer electronics products. There is almost always a certain amount of lag time between the time new products are introduced to a given market and the time when that market responds to it with service. Consumer electronics is no exception. There may be categories of products of interest to readers that we are not addressing in this Buyers' Guide.

You can help

We hope you find the information in this guide useful, but at the same time, we suspect that some of the information you might hope to find isn't here.

Please do yourselves, other readers and us a favor. If you're trying to find an item of information on a company, product or replacement part in these listings and you don't find it, please let us know. Write to us telling us what you were trying to find but couldn't. If it's an item that would be of interest to a broad segment of our audience, we'll be sure to address it next year.

Conversely, if you find an item of interest in here and try to contact the company but fail, write us and let us know that too. We'll try to contact them and obtain information to update their listing.

Use the cards in the magazine

To make it easier for you to contact us with your comments/suggestions, we've keyed the Reader Survey card to the Buyers' Guide this month. Additionally, you can enter your comments on the Reader Service card.

In any event, if you have something you'd like to share with us about this issue, please let us hear from you. ■

Nile Conrad Penam

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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Electronic Servicing & Technology (ISSN 0278-9922) is published 13 times a year by CQ Communications, Inc. 76 N. Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. Second class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year \$24, two years \$40. Foreign countries—one year \$30, two years \$52. Entire contents copyright 1994 by CQ Communications, Inc. Electronic Servicing & Technology or CQ Communications, Inc. assumes no responsibility for unsolicited manuscripts. Allow six weeks for delivery of first issue and for change of address. Printed in the United States of America.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801.

CQ Communications, Inc. is publisher of CQ The Radio Amateur's Journal, Popular Communications, Micro-Computer Journal, CQ Radio Amateur (Spanish CQ), CQ Amateur Radio Equipment Buyer's Guide, CQ Amateur Radio Beginner's Buyer's Guide, Popular Communications Communications Guide, and Electronic Servicing & Technology.

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News

EIA releases retailer classification chart as industry benchmark

The Electronic Industries Association (EIA) has released its first retailer classification chart, in an effort to provide the consumer electronics industry with a clear definition of the ever-expanding, varied retail environment.

The chart, which lists 19 classifications of retailers from computer superstore to mass merchant (see attached list), will be used by *HFD* magazine in combination with its own measurement of retailer classification, by *TWICE* magazine to develop its 1994 *TWICE* Registry, and by the North American Publishing Company to classify retailers in the 1994 *Gold Book*, co-sponsored by EIA.

The chart was developed by EIA in conjunction with its statistics-reporting member companies, the EIA Marketing Services Executive Committee (which endorsed the chart upon its completion), consultants, and representatives from key trade magazines.

"Data is critical to any business," says Gary J. Shapiro, group vice president of the EIA's Consumer Electronics Group. "Until now, comparing consumer electronics retail data from different sources was like comparing grapes and grapefruits. The EIA retailer classification chart was created to allow meaningful market analysis.

"With so many different retail outlets occupying so many market niches, it has become increasingly difficult for the industry to arrive at a consensus as to how to segment sales data by retailer channel. This chart simplifies this task."

The major challenge in creating the chart, according to Shapiro, was to properly classify such vital retail types as electronic and mass market superstores. "The many parties that participated in the development of this chart,

from our member companies to trade magazine editors and industry consultants, considered each entry very carefully," he notes. "As the industry continues to diversify, and as former niche products adapt to the mass market, a chart like this becomes even more important and useful."

Video product sales gain

Video product sales rose five percent in November 1993 over the same period as the previous year, thanks to strong sales performances by projection televisions and TV/VCR combination units, according to statistics released by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Sales of video products rose nine percent in the three month period ending in November. The holiday gains posted so far by video products have eclipsed those realized in the total United States retail market. According to a December 14, 1993 report from the U.S. Commerce Department, retail sales during the recent holiday season were up seven percent.

"November's sales illustrate the direct link between the American consumer's desire to be entertained at home and the tremendous value of our industry's core products," says Ralph Palaia, Senior Vice President, Marketing and Sales, Philips Consumer Electronics Company.

"The continued tremendous increase in sales of TV/VCR combination sets indicates consumer interest in convenience, and the migration of VCR functions to more rooms in the household. Rather than simply replace an older color television in the master bedroom, many consumers who now find the VCR indispensable are investing in a new TV with built-in video playback and recording."

Sales of projection TVs rose 18 percent in November over the same period the previous year, the third straight month the product category has posted double-digit growth. For the first 11 months of 1993, projection TV sales were up a strong 13 percent, the best annual growth rate since 1990, when the rate was 29 percent.

TV/VCR combination unit sales rose 158 percent in November, boosted by a new entrant into the market and strong demand for existing suppliers' products. During August, September and October, sales increased by more than 100 percent compared to these same three months in 1992; sales in 1993 were up 77 percent.

Sales of color televisions rose five percent in November, and rose 13 percent over August, September and October.

Camcorder sales were up 11 percent in 1993, despite slipping four percent in November. VCR deck sales fell eight percent in November, and were basically flat in 1993. Laserdisc sales also fell in November, and were flat through November.

EIA Retailer classification chart categories (in alphabetical order)

1. Camera Store
2. Catalog Showroom
3. CD/Record/Tape Store
4. Computer/Software
5. Computer Superstore
6. Department Store
7. Drug/Grocery
8. Electronic/Appliance/TV
9. Electronic Specialty
10. Electronic Superstore
11. Mass Merchant
12. Mass Merchant Superstore
13. Mail Order
14. Miscellaneous
15. Mobile Electronic
16. Office Supply
17. Rental
18. TV Shopping Network
19. Warehouse Club

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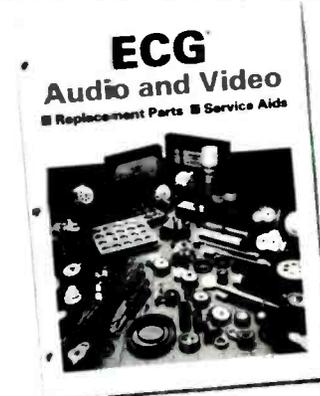
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Diagnosing intermittent television problems

By Homer L. Davidson

Intermittent problems caused by bad connections, sockets, pc boards and components produce more headaches and loss of time for the consumer electronics technician than any other type of symptom. A poor soldered connection covered by a blob of solder is difficult to locate. Poorly-rinned resistor or capacitor leads that become open circuited may cause many hours of wasted time (Figure 1). Fine cracks in pc wiring produce many intermittent problems. Improper soldering of the terminals of a surface mounted device (SMD) may cause hard to find intermittent problems that warrant a professional electronic detective.

Alternately applying heat and cold with hot air and coolant spray to suspect parts, boards and soldered connections may cause the problem to occur, thus allowing the technician to correct it. A bright fluorescent lamp with magnifier may reveal poor connections and damaged pc wiring. Raising and lowering the power line voltage using a variable isolation transformer has turned up many intermittent and defective components. Sometimes resoldering the entire pc board wholesale is the only answer.

Whatever the intermittent condition, the cracked board, dislodged component, poor socket connections and pc wiring will always haunt technicians. Newer double-sided pc wiring with fine traces are especially susceptible to breaks and intermittent symptoms. Poor tinning of electronic part leads may leave oxides that will cause the product to malfunction years later. Warping and bending of the main pc chassis may damage wiring connections of surface mounted components. Poor soldered joints are found even in the latest TV chassis.

Poor PC board connections

Ever since pc boards were first introduced, poor pc board connections caused problems. In some cases, when the chassis has been dropped in shipment or han-

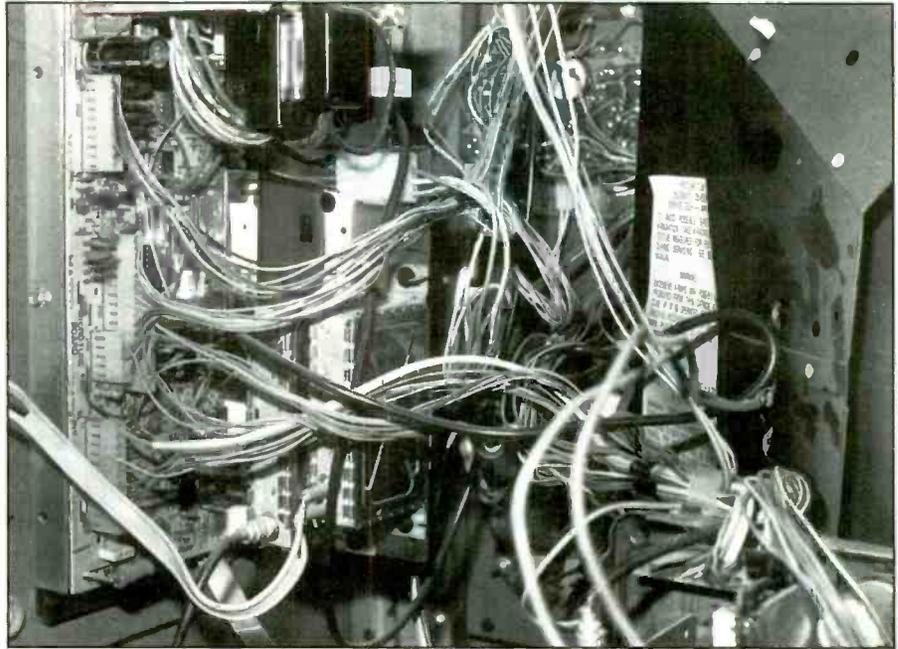


Figure 1. Poor crimped wires and plug connections may cause intermittent problems.

dled roughly, a break in a connection between the component and the pc wiring may occur, and only cause problems later. Small cracks around transformer lugs or

components may be visible with the magnifying glass, but breaks around capacitor and resistor leads may not be visible until the component is probed while the

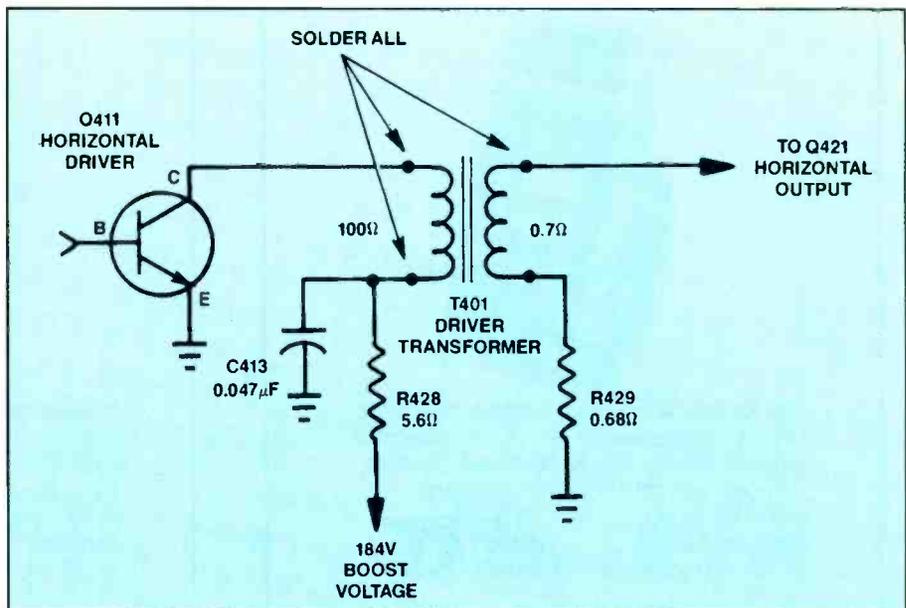


Figure 2. Solder the board connections when the problem is intermittent. The horizontal driver transformer in the horizontal circuits of this RCA GER654 model caused intermittent start up and shutdown.

Davidson is a TV servicing consultant for ES&T.

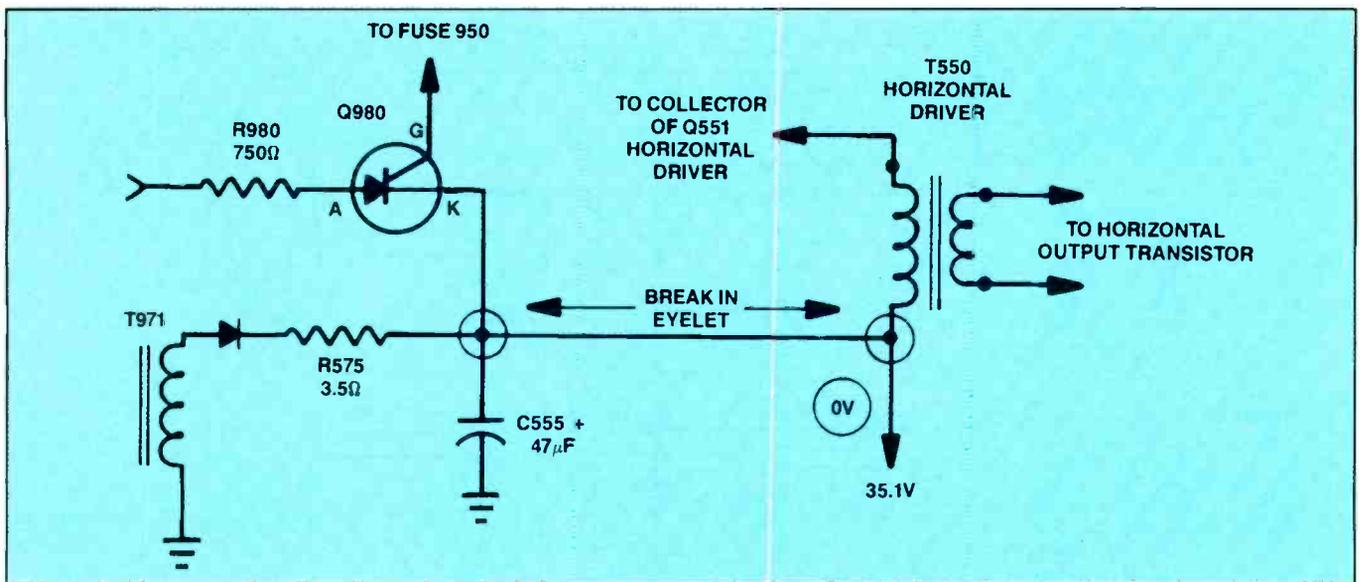


Figure 3. The no-raster, no-HV, no-sound problem was caused by a break in an eyelet at the pc wiring of a JC Penney 681-2018A model.

connection is examined under bright lighting and magnification.

You may be able to locate the poor connection using continuity, resistance and voltage tests. Locate the suspected sections on the schematic and compare the same section on the TV chassis. Then check each component within that sec-

tion. Probe small parts with an insulated tool. Large components can be wiggled to determine if that causes the intermittent problem to occur.

An intermittent Sony chassis

In several low-priced Sony (1988-1989) TV portables, the symptom was a

click of the relay followed by chassis shutdown. Sometimes the set would play for several minutes and at other times it would shut down immediately after being turned on. When I probed at the horizontal circuits, the chassis really acted up, especially when the horizontal driver transistor was moved.

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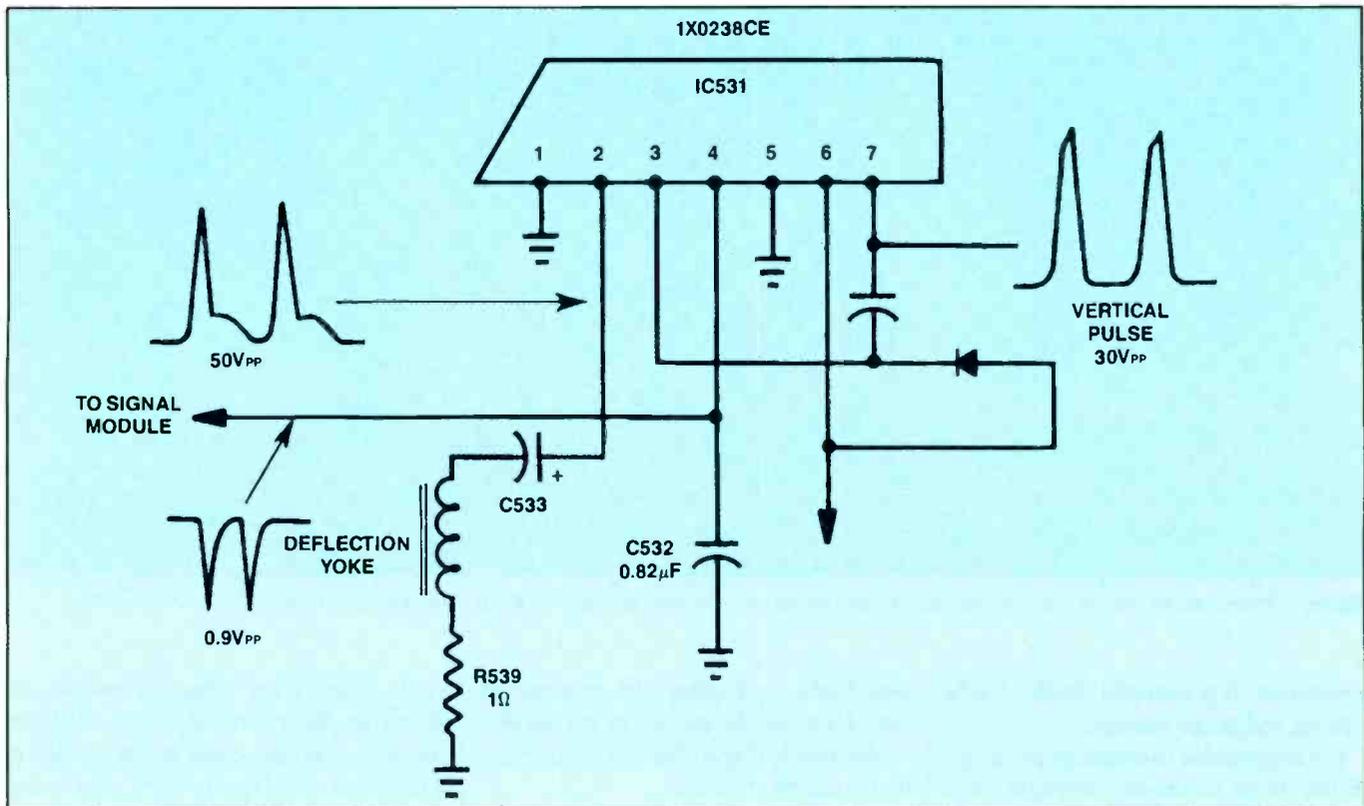


Figure 4. Intermittent vertical foldover in a Sharp 19SB60R portable was caused by a board connection of the signal board module.

Although all connections of the transformer appeared normal, I touched them up with the soldering iron, a method that had worked on a few chassis. In other chassis, replacing the driver transformer solved the chassis shutdown problem.

RCA intermittent start up and shutdown

The symptom was intermittent start up

and shutdown in an RCA GFR654 model. Sometimes the chassis would start up and operate for several hours before shutdown. At other times the chassis might not start up at all. If I happened to jostle the chassis or cabinet accidentally, the set began to act up.

Wiggling a few components in the horizontal section would cause the chassis to shut down. No doubt poor board connec-

tions in the horizontal circuits were the cause of the intermittent chassis. I found that the chassis would act up when I probed at the horizontal driver transformer (Figure 2). I soldered all connections on the driver transformer terminals. This solved the intermittent start up and shutdown problems.

Double-sided pc boards

Large double-sided pc main chassis have a tendency to warp, pull pc wiring and break connections. These small wiring cracks may occur where a component ties into the pc wiring or where soldered eyelets feed through to wiring on the other side of the chassis. If these breaks are clean breaks, the chassis will be dead. If the ends of the broken pc wiring maintain contact, the result may be intermittent problems. Of course, the dead chassis is easily repaired while the intermittent takes more service time.

In a JC Penney 681-2018A model, the chassis was intermittent. Any time the chassis was moved or prodded the set would shut down, resulting in the symptom of no HV, no raster and no sound.

Resistor R980 (750Ω) was running red hot, feeding Q980. Extremely low start-up voltage was measured between K and

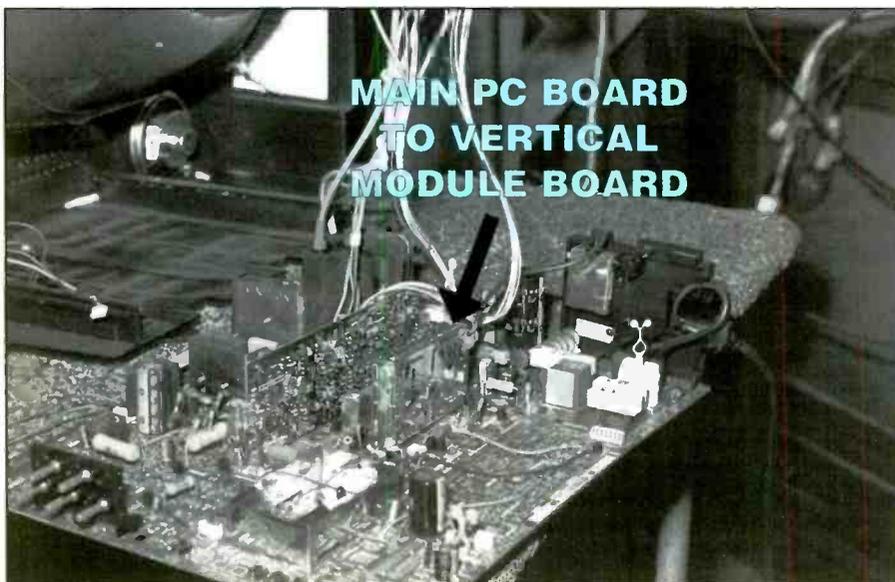


Figure 5. When the board module was probed the vertical raster would come and go in the Sharp TV portable.

Q980 (Figure 3). Finally, after several hours of voltage and continuity measurements, the wiring between K and the 35V source of the horizontal driver transformer (T550) opened completely. This allowed me to locate the broken eyelet and repair it by placing a small piece of hookup wire through the soldered eyelet and soldering each end of the wire on the top and bottom of the pc wiring.

Cracked boards

A large crack or break in a pc board is easily located, while a fine-line break in the pc wiring is more difficult to find. If the set is fairly old, it may be necessary to try to repair the broken area, rather than to hope to find a replacement board. Older boards frequently are not available. Cracked board wiring can be repaired with hookup wire.

Always use a magnifying glass while repairing the cracked board area. Run hookup wire over the cracked wiring section and solder to a component lead on each side of the broken wiring section. Make sure that the connections you make are on the same pc wiring, or you might cause additional damage. Creating a solder bridge across the broken wiring is not recommended. This might effect a repair temporarily, but this repair might become intermittent later.

Poor board-to-board connections

Another frequent cause of intermittent problems is board sockets that are mounted on top of a pc board and soldered directly to the pc wiring. Separate pc boards mounted on top of a large board chassis may have broken or cracked connections to the main chassis. Often, touching up these connections with solder and iron may solve the intermittent problem.

A new Sharp 19B60R exhibited the symptom of vertical foldover with the picture upside down. In addition, there was a bright white line through the center of the raster. The waveform at the input terminal was normal when I checked it with the oscilloscope. Most voltages on the vertical IC were within specification (Figure 4). I suspected a leaky or open IC (1X0238CE) and ordered a new one.

After I installed the universal replacement for the vertical IC (SK7673) the symptom was the same. A closer check of the schematic revealed that the vertical output pulse was connected to a sig-



Figure 6. Suspect socket and harness connections when the problem is intermittent.

nal module above the board. I noted that whenever the module or board was wiggled, the raster briefly appeared normal and then reverted to a folded over raster. Soldering the board-to-board connections solved the foldover symptom (Figure 5).

Crimped wiring and sockets

When the problem is intermittent, do not overlook poor board socket connections with crimped wire leads. Check for poor socket connections at the bottom side of the pc wiring. Remove the plastic plug and inspect each crimped wire. Sometimes a crimped wire lead does not make a good connection, or the wire becomes corroded and produces intermittent operation (Figure 6). Check the continuity of the connecting wire or cable.

Check wire leads and plugs attached to

the tuner modules. Poor pin and corroded plug connections may produce intermittent reception, or no reception at all.

In one RCA CTC140 chassis, a fuzzy picture and other picture problems occurred when I tapped around the tuner and chassis. Just moving the tuner caused the fuzzy picture. Soldering the tuner pins on U2300 solved the intermittent picture. In another CTC140 chassis, loose connections on IF Amp transistor Q2300 caused the same symptom.

Channels change spontaneously

A customer complained that the channels would intermittently change up from another channel without any one touching the control on an RCA EXR345. Sometimes the set would operate for days before the channel would automatically

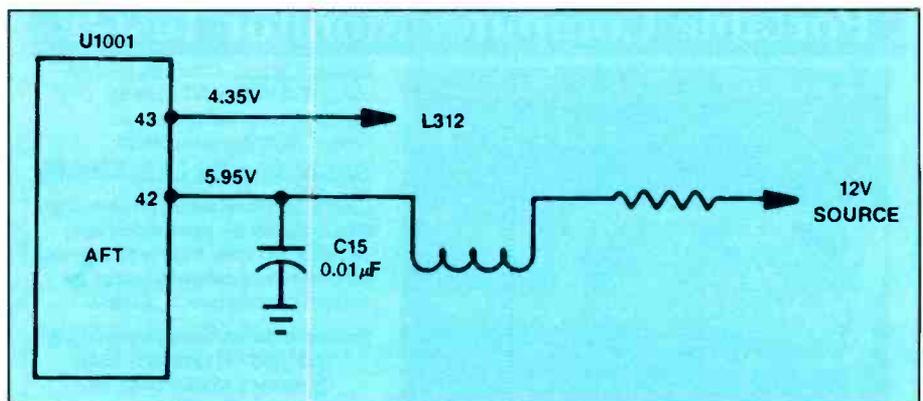


Figure 7. A poor connection in L312 caused the channels to change spontaneously in an RCA EXR345ER model.

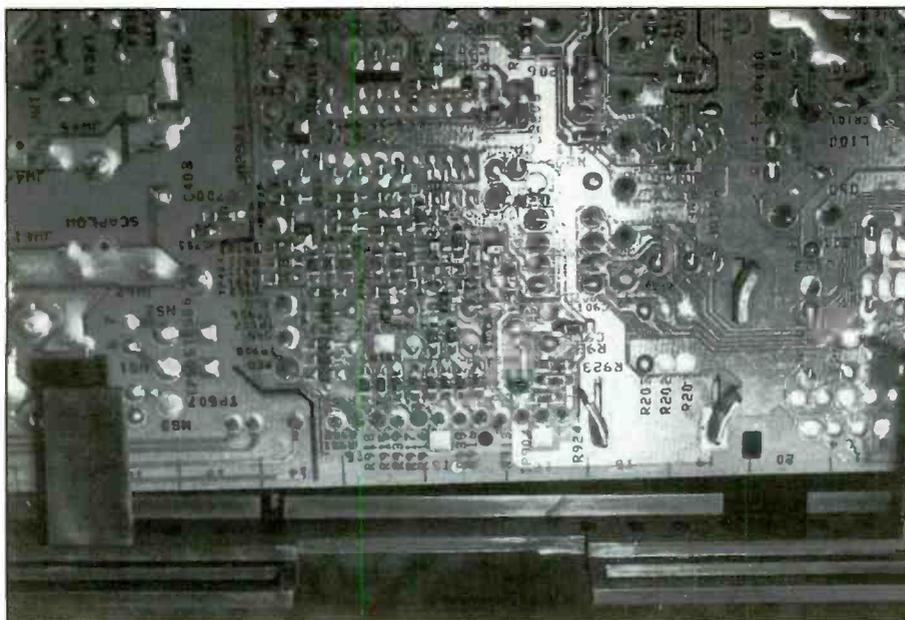


Figure 8. Look for fine SMD breaks and poor pc board connections when flexing the board chassis.

change upward. After the problem occurred a few days in a row, the owner brought this portable into the shop.

All voltages on the tuner terminals were normal. Of course this could change when the chassis acted up. I monitored the dc voltage source and AFT terminals of U1001. When the chassis began to change channels, the dc voltage at pin 42 of U1001 would vary between 1Vdc and 2Vdc. Pin 43 of U1001 appeared normal at a lower 3.2V (Figure 7).

Assuming U1001 was leaky, I disconnected pin 42 from the dc circuit by removing solder around the pin with desoldering braid and a soldering iron. I measured the voltage at pin 42 and also at the foil connection of 42. Both mea-

surements were low. Upon checking the circuit diagram once again, I noticed that there was a small coil (L312) between the 12Vdc source and pin 42. Although connections upon L312 looked okay, soldering both ends of the coil solved the self-changing channels.

Intermittent component leads

Besides poor component lead connections upon pc wiring, check for poor tinned or defective component wiring to the terminal connection. Look for poor soldered transformer and coil leads soldered to the terminal lead. Sometimes a broken coil wire or poor soldered joint at a terminal will result. These leads may be wound or pulled too tight, and any expan-

sion or rough treatment of the chassis may cause a poor connection. Improper tinning of the coil wires or terminal tie wires may result in a poor connection to the terminal lead.

Intermittent color and video were symptoms in an RCA CTC108 chassis. The audio was normal. After monitoring the voltage sources and checking for proper waveforms, the cause of the symptom was traced to L306. Removing the coil from the chassis and resoldering both leads to their respective terminals solved the intermittent color and video problems.

Intermittent SMD connections

In today's TV sets you may find through-hole components mounted on the top side of a TV chassis and surface mounted parts underneath. Intermittent breaks in fine pc wiring, surface mounted device connections and poor soldered component connections have produced numerous intermittent problems in these latest sets. Surface mounted components increase the problems, since parts are mounted on both sides of the pc chassis.

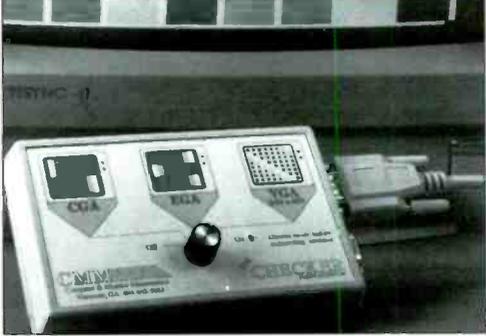
When you're faced with a product that features surface mount devices, try to isolate the symptoms to a given section. Monitor the different stages with waveforms and voltage tests. Take continuity measurements of the pc wiring and components. Probe small components with an insulated tool to locate a poor lead or soldered connection (Figure 8).

A lighted magnifying glass may be used to check out the small surface mounted devices on the pc wiring. The fine break between SMD terminal and pc wiring is difficult to see. Touch up the junction with small size solder and iron tip if it looks as though this might be necessary. Use a sharp pointed soldering iron tip to touch up poor board connections. Be careful when applying heat around surface mounted components.

Conclusion

Intermittent board, socket and pc connections may be more difficult to locate on sets with SMDs, than on other TV chassis. Special soldering techniques and equipment must be used to locate and repair poor board connections of surface mounted devices. Try to isolate the area on the pc wiring in which the poor connection occurs, using symptom analysis, before working upon the chassis. ■

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Test Your Electronics Knowledge

Some FCC exam questions & answers

By J.A. Sam Wilson

Here is your chance to see how you do with actual FCC questions and answers.

1. What is the term for the ratio between the largest tolerable receiver input signal and the minimum discernible signal?

- A. Noise floor
- B. Dynamic range

2. What is meant by the term noise figure of a communications receiver?

- A. The level of noise entering the receiver from the antenna.
- B. The level of noise generated in the front end and succeeding stages of a receiver.

3. Which stage of a receiver primarily establishes its noise figure?

- A. The i.f. strip
- B. The r.f. stage

4. What is an inverting op-amp circuit?

- A. An operational amplifier circuit con-

nected such that the input and output signals are 180 degrees out of phase.

B. An operational amplifier circuit connected such that the input and output signals are 90 degrees out of phase.

5. What is a noninverting op-amp circuit?

A. An operational amplifier circuit connected such that the input and output signals are 180 degrees out of phase.

B. An operational amplifier circuit connected such that the input and output signals are in phase.

6. How does the gain of a theoretically ideal operational amplifier vary with frequency?

- A. The gain decreases linearly with increasing frequency.
- B. The gain does not vary with frequency.

7. What determines the input impedance in a FET common-source amplifier?

- A. The input impedance is essentially determined by the gate biasing network.
- B. The input impedance is essentially

determined by the resistance between the source and substrate.

8. What determines the output impedance in a FET common-source amplifier?

- A. The output impedance is essentially determined by the drain resistor.
- B. The output impedance is essentially determined by the input impedance of the FET.

9. What is the purpose of a bypass capacitor?

- A. It removes alternating current by providing a low impedance path to ground.
- B. It acts as a voltage divider.

10. What is the purpose of a coupling capacitor?

- A. It blocks direct current and passes alternating current.
- B. It blocks alternating current and passes direct current.

Wilson is the electronics theory consultant for ES&T.

(Answers on page 20)

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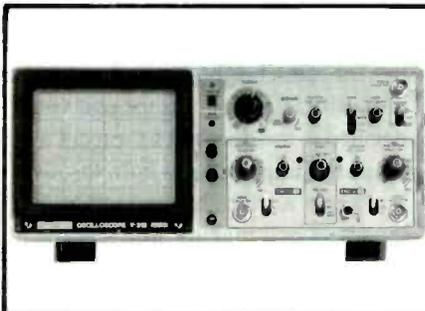


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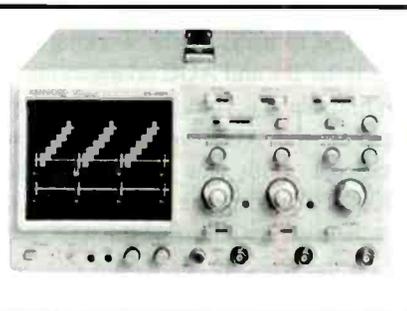
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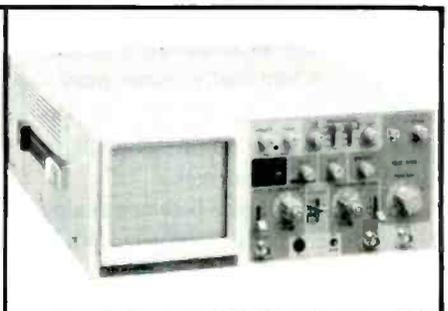
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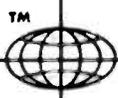
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Constructing a tuner subber

By Dale C. Shackelford

In addition to replacing defective components, cleaning dirty potentiometers and aligning coils, many consumer electronic servicing technicians use their skills and imagination to design and construct test equipment from spare parts which are often destined for the discard pile. One of the easiest and least expensive pieces of test equipment to construct is the tuner subber.

In the May 1993 issue, Homer Davidson showed us how to build a variable isolation power source, a device vital to any technician's work bench. While a tuner subber is not in the same league as Homer's power supply project, insofar as necessity is concerned, tuner subbers can save several man-hours in the diagnosis of a television receiver with signal processing problems, by verifying or absolving the tuner as the basis of a problem. With the investment of an hour of labor and less than \$10.00, any competent technician can construct a tuner subber which will provide years of service.

Obtaining the tuner

The main component of any tuner subber is, of course, the tuner. While almost any television tuner may be used as the cornerstone of the project, it is best to use a unit salvaged from a discarded color receiver rather than one from a monochrome set, because some monochrome tuners may employ components or filtering circuits to suppress certain signals used in color sets in an effort to reduce interference. Additionally, some monochrome tuners lack the ability to properly tune or process certain frequencies needed in the color receiver.

You also have a choice between analog or digital tuners for this project. While either type of tuner will provide a signal sufficient to check the receiver, the use of an analog tuner on a digital receiver will sometimes result in a garbled or distorted output. Analog tuners are much easier to convert to subber use than their digital descendants, as small variations in source

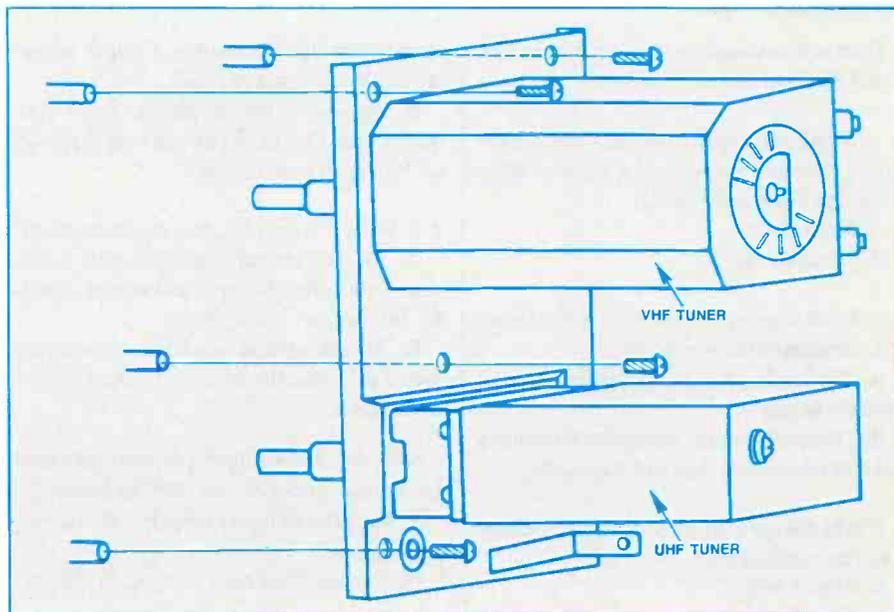


Figure 1. Many television sets have their tuners (both VHF and UHF) mounted on a single plastic or metal frame, which is, in turn, mounted inside the cabinet of the receiver.

voltages do not affect the overall signal processing capabilities of the analog unit to the extent that they affect the digital package. Also, electronic tuners usually require several conditioned sources to operate, while the analog version requires only two: B+ and Gain.

Before deciding upon a particular tuner, it is wise to determine whether or not a schematic diagram or other documentation is available for the particular model, to give you some idea as to the voltage requirements. An alternative is to find a working receiver with a similar tuner, and to measure the working voltages at the B+ and AGC connections.

While the B+ voltage should remain constant, the AGC voltage may vary somewhat with the relative signal strength. Checking the specifications on the schematic, or adjusting the AGC control on the working set should give you some indication of the AGC parameters. As a general rule, analog tuners require about 10Vdc at the B+ connection, while AGC voltages will vary between 1Vdc and 3Vdc.

Retrieving the tuner

Many television sets have their tuners (both VHF and UHF) mounted on a sin-

gle plastic or metal frame (Figure 1), which is, in turn, mounted inside the cabinet of the receiver. This configuration allows both tuners to be removed from the set as a single unit after all connections (i.f. cables, power supplies, etc.) to the main circuit board have been disconnected. Leaving enough wire on the tuner(s) means that new wires will not have to be soldered to the tuner, where heat or accidentally dropped solder could damage sensitive coils or other components.

In some instances, the frames to which the tuners are mounted are also used by the manufacturer to mount potentiometers for color, brightness, volume and other controls. In the event the unit you have decided to use does not have a pot mounted in it, simply drill a hole through the bracket in a space big enough to accommodate a pot, making sure that the positioning of the pot does not interfere with the operation of the tuner. This component will be used to manually adjust the gain to the tuner subber in lieu of the automatic gain control circuit. Here, we will be using a 5k Ω potentiometer, but the physical size is not important.

The power supply

The next consideration is the power

Shackelford is an independent electronic servicing technician.

supply. While almost any power supply with a dc output of at least 15V will suffice, the key to the project is simplicity and low cost. The easiest power supply to obtain, and the least expensive, is one salvaged from a portable stereo receiver. Often, these devices use fairly efficient power supplies which are often self-contained, meaning that the transformer, rectifier circuit and ac input connections are all mounted on a single circuit board. This configuration allows the power supply to be removed as a unit, while making it very simple to use as a power source for the tuner subber. A few of these self-contained power supplies also feature variable resistors, which allow the dc output to be adjusted.

A sample project

Because the actual components, values and wiring configurations will vary from project to project based upon technician preferences and availability of parts, a sample project will be discussed.

The tuners used in this project were salvaged from a scrapped KTV color television receiver (13CNR). Both the VHF and UHF tuners were removed as a unit and all VHF and UHF connections were left intact. The B+ voltage on a similar set measured about 9Vdc, while the average AGC voltage measured about 2Vdc. Because the potentiometer mounted in the bracket had a very high resistance, it was replaced with a pot with a maximum resistance of 5K Ω .

The power supply for this project was salvaged from the recycle bin, and looked to be from a Magnavox portable stereo receiver, the case of which had long since been discarded. The case for the tuner subber was constructed from pieces of 1/8th-inch plywood that had been laying around the shop for years, knowing that someday, someone would put it to good use. Had I not found the plywood, I had planned to use an old plastic television cabinet to construct the box. Since the plywood was already cut to a fairly uniform size, a little trimming with a razor knife resulted in an 8-inch by 8-inch by 8-inch plywood box, more than enough to contain the tuners, transformers, rectifier board and related hardware.

Figure 2 depicts the schematic of the sample project tuner subber which was built entirely from discarded parts found

around the service center, and took less than an hour after the design was finalized. Because the power supply is more or less typical, it is shown in block form, though the voltages pertinent to the project are indicated. Again, technician preferences and available components may change the overall design of the project. Some components may be added and others changed, while others might be deleted

altogether.

Figure 3 shows the various power and signal inputs for the project.

Overcoming a problem

The only head-scratcher encountered in this project was that the B+ would vary about 2V when I adjusted the gain control VR1. While the variation had no visible effect upon the operation of the tuner

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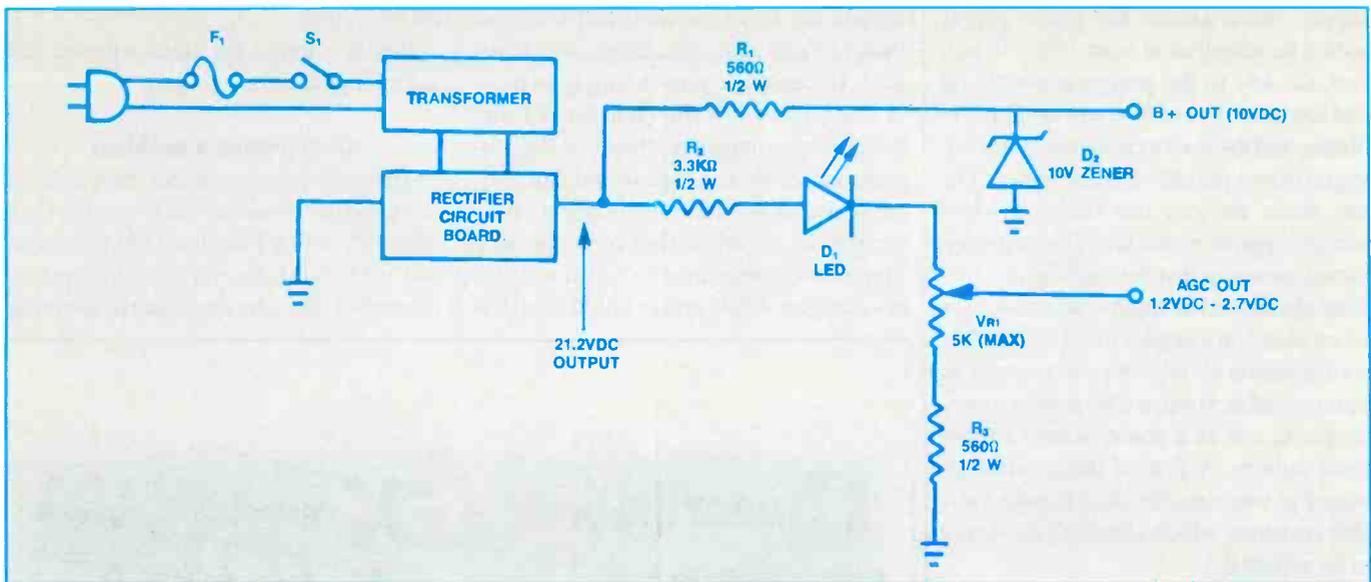


Figure 2. The schematic of this sample project tuner subber was built entirely from discarded parts found around the service center. Because the power supply is more or less typical, it is shown in block form, though the voltages pertinent to the project are indicated.

subber, it was obvious that there was a defect in the design of the circuit. After a little thought, I placed Z1 in the circuit, which held the B+ voltage at a steady 10Vdc while the gain control could be varied from 1.21Vdc to 2.71Vdc. Had the tuner required a B+ source voltage of a

different value, the value of the zener diode would simply have been changed to accommodate the requirement.

Obviously, D1 could have been replaced with a general-purpose rectifier diode, but the LED used in the circuit is not only functional, but is also used as a pow-

er-on indicator when mounted through the front of the cabinet. This LED also allows the capacitors in the rectifier circuit to completely discharge once the unit has been turned off. In this project, SW1 is ganged with VR1.

Antenna/cable inputs which can also be

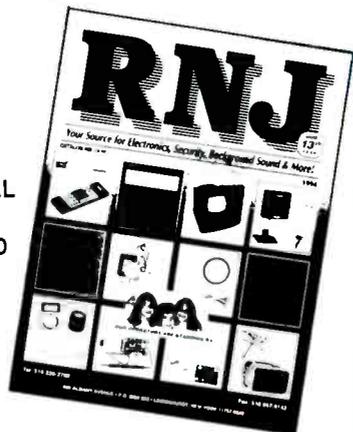
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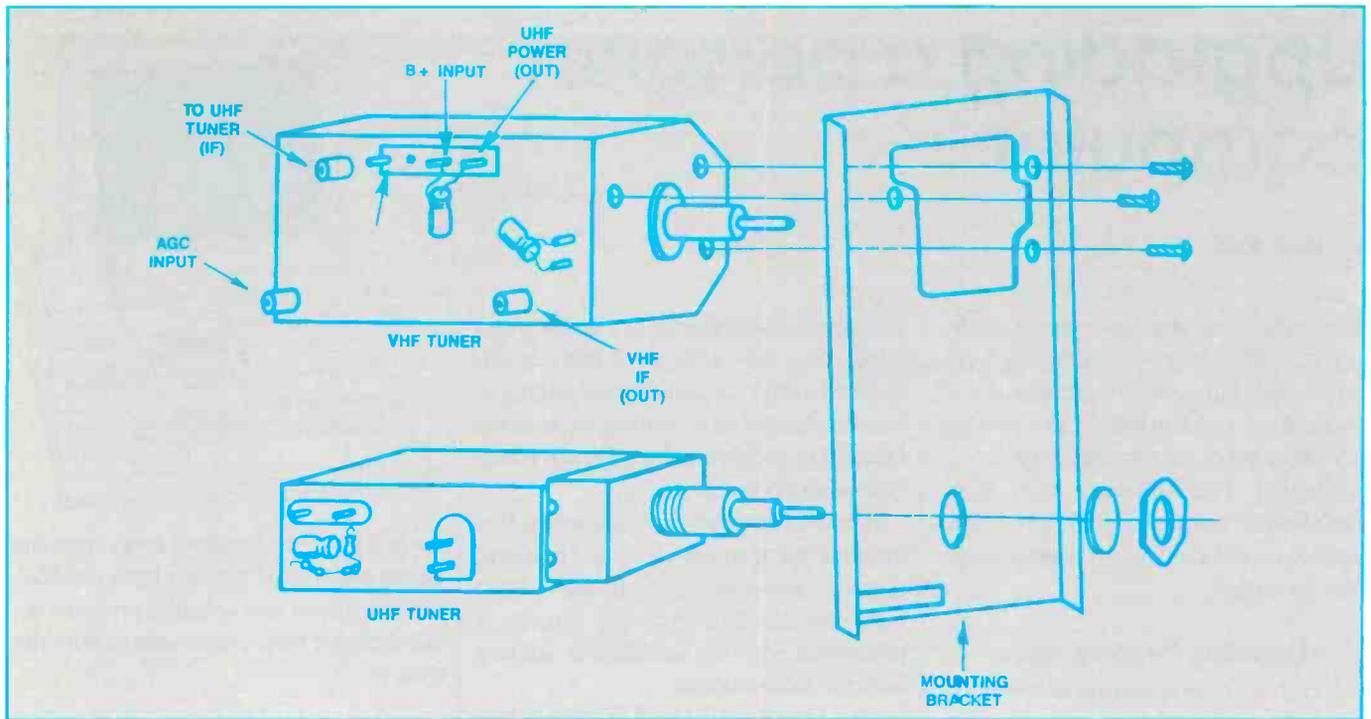


Figure 3. The various power and signal inputs for the project.

salvaged from a scrapped television, along with associated isolation circuitry can be mounted in the side or back of the project box. Make sure to use shielded coaxial cable or antenna ribbon wire to connect the antenna/cable inputs to the tuner. Additionally, the IF output cable can consist of a length of RG59 coaxial cable soldered on one end of the IF output termi-

nals of the tuner, while small alligator type clips (or whatever connectors are desired) are soldered to the other.

Using the subber

Once finished, you will have constructed a piece of test equipment which, on average, would have cost a couple of hundred dollars. While your project subber

may not take the place of a currently used off-the-shelf unit that you may now be using, it's good to know that you have a backup if the need ever arises. Those hobbyists who do not own a tuner subber will find that they can receive many hours of service from this inexpensive project unit, while having the satisfaction of building the unit themselves. ■

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March 1994 *Electronic Servicing & Technology* 15

Upgrading a personal computer

By John Kull

Servicing computer hardware is sometimes a simple matter of changing a circuit board. However, it can also be as challenging and frustrating as servicing any other piece of consumer electronic equipment. The following story illustrates how a "simple" upgrade turned into an educational and lengthy troubleshooting experience.

Upgrading for speed, space

A customer came into my shop with an older PC, requesting an upgrade of the case and mother board. When he originally purchased his machine, a tower style case was not available. He was rearranging his office and thought that the tower style would be more space effective. He also wanted to upgrade his existing motherboard to something "faster."

His existing motherboard was an 80286 running at 12MHz. I explained to him that several factors affect the "speed" of the system. One factor is the speed of the motherboard, but another is the access time and transfer rate of the hard drive. To truly optimize his system he should consider both. After thinking it over he decided to keep the existing hard drive because he felt it was fulfilling his needs at the present time.

He selected an 80386 40MHz motherboard and a mini tower case. His original motherboard had 4 MB of SIMM memory that could be used on the new motherboard. I quoted him a price of \$300.00 for parts and labor. This was quite a saving over a new system.

Performing the upgrade

I ordered the new motherboard, case and power supply. I removed all the components from his old system and was ready to reassemble the parts. Since his old case was a desktop style, I was unable to use his existing power supply because

the physical dimensions of a desktop and tower case are different. I had recommended a larger wattage power supply in case he planned on upgrading again in the future. The following week I received the new motherboard and case.

I consulted the motherboard manual for information on jumper settings for video, memory and connector pin outs. After verifying the correct jumper settings, I proceeded with the installation starting with the motherboard.

Next I mounted the hard drive and floppy drive. I then connected power to all the drives and the mother board. I finished the installation by connecting the video and disk controller cards. I connected a monitor and powered the system up. The BIOS setup screen came up and prompted me to configure the system. I went through the set-up procedure and configured the system as needed. I exited the set-up program and rebooted the system.

Unexpected problems

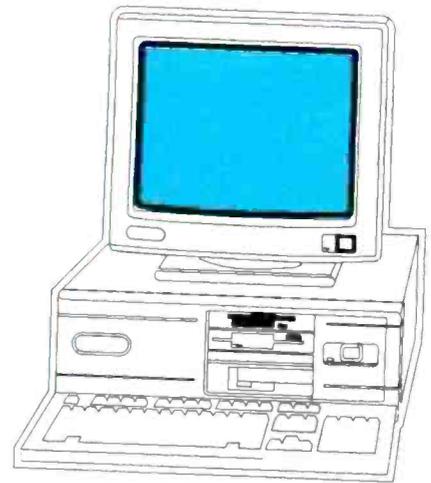
At first everything seemed normal. But that didn't last long. The monitor went blank and the computer would not respond to the keyboard. I pressed the reset button and the system rebooted. After several minutes passed, the monitor went blank again.

I powered the system down and began to check all connections. I consulted the motherboard manual and rechecked all jumper settings. Again, I powered the system up and after several minutes the display went blank.

I began to scratch my head at this point. I knew the monitor was working because I use it every day. I figured that the video card was probably functioning since the keyboard would not respond either, but I thought I would check it out anyway.

Troubleshooting the problem

I have a set of spare boards I use for troubleshooting, so I installed a new video card. The problem again appeared after



several minutes. I walked away from the bench and looked at notes from previous repairs. I once saw a similar problem occur during a brief power outage with my own PC.

Could it be the "power good" signal?

The power supply outputs a signal called "power good" that must make the transition from low to high to signal the motherboard that all supply voltages are correct for the system to operate. Sometimes during a brief power outage, this signal will stay low causing the motherboard to appear dead. The computer's keyboard or reset switch will have no effect bringing the system back to life. The only way to reset the system is to power down and then back up.

I knew the line voltage was good, so I thought perhaps the power supply might be dropping the power good signal low and causing the motherboard to appear dead. I grabbed a known good supply and connected it to the motherboard. After several minutes of operation the monitor went blank and the system locked up.

Well, now I knew one more thing that wasn't bad. I began to wonder if the new motherboard could be defective. I installed the old 80286 motherboard in place of the new one. I powered up the system and much to my surprise it would not even boot-up! I was really stumped.

Could it be the new tower case?

The only thing left was the case! I thought I would try to assemble the system on the bench without the case. I connected all the controller cards and power supply connections and applied power to the system. The system ran fine with no

Kull is a medical electronics technician at the St. Louis Regional Medical Center.

problems. I reinstalled the motherboard and looked at the mounting to see if the PC board came in close contact with the chassis at any point. I did not find any spots that appeared to be in close proximity to the chassis. I powered the system up and once again the problem started.

A defective reset switch

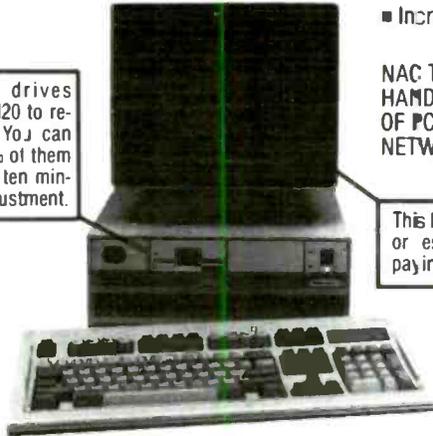
I began to think about what was different between mounting the board in the case and on the bench. Suddenly it hit me! When the board was on the bench I could not connect the reset switch because the wiring was not long enough. I immediately powered the system down and disconnected the reset switch from the motherboard. I reapplied power and the system ran fine. The RESET switch was defective!

I removed the reset switch from the case and tested it with a meter. The switch tested good with an ohmmeter. However, several hours of troubleshooting told me it was bad. I contacted my supplier for the case and requested a new switch. I replaced the switch and ran several diagnostic programs on the motherboard and hard drive. I returned the upgraded computer to my customer. ■

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A technician's glossary

By The ES&T Staff

One of the difficulties of a career in electronics is the sheer effort it takes to keep up with the vocabulary as it develops. One day we're talking about products containing vacuum tubes, and discussing parameters such as plate resistance and transconductance. The next day we're talking about transistors and the hybrid parameters. To make the problem of the expanding vocabulary even worse, new products are constantly being added to the already long list that the consumer electronics technician is expected to service. With the advent of microwave ovens, VCRs, and CD players, came a whole new vocabulary.

Now we have personal computers, and technicians have to learn terms like bit, byte, bus, and FAT, to name a few.

Because of this expanding vocabulary, we present a few words from time to time with definitions that we feel may be useful to consumer electronics technicians. Recently, ES&T has been publishing a number of computer-related articles that have introduced some new terms and concepts. Here are some definitions that should help with past articles, and articles expected to appear in future issues.

Just a few words

Rather than introduce a large number of new terms with abbreviated definitions, we prefer to introduce a few words with more detailed explanations. After all, we're dealing with some complex terms. Following are some definitions that deal with fixed disk drives, power-on self test (POST), and the various kinds of computer software.

BIOS

BIOS is the basic input/output system. This is a program contained in ROM (hence ROM BIOS). BIOS is the program that controls all of the input and output functions of the computer.

For example, if you press a key on your keyboard, the BIOS program contains the instructions that tell the computer to look to the keyboard for input, and to accept the input from the keyboard.

If you key in some instruction, or if there's an instruction in a program that requires a read from or write to the disk

drive, the ROM BIOS contains the actual detailed input/output instructions that cause the read or write.

If for some reason the BIOS does not recognize that particular device, the instructions will not be carried out.

Boot

The term "boot" describes all of the processes involved at turn-on, of checking out the computer, and then loading the operating system into the computer's memory. These days, the existence of ROM, which stores the required instructions even when the computer is turned off, makes loading of the operating system an automatic and quick procedure.

Back in the old days, mainframe computers had only magnetic cores for program storage. When power to the computer was shut down, all instructions, data, etc. in the computer's memory evaporated.

In order to start up a computer, technicians had to first apply power to the computer, then set individual cores until the computer contained enough instructions to be able to load the rest of the operating system via one of its input devices.

This procedure was considered to be something like "pulling yourself by your bootstraps," and hence the process of starting up a computer and loading the operating system became known as "bootstrapping" or "booting."

Fixed disk drives

Every computer of today that's used for serious work has a fixed, or hard disk installed. Because this disk is central to the operation of the computer, storing not only software programs and data, but information on how the computer is configured, the computer's operating system(s), and more, it is important that a technician be aware that there are different types of drives, and have some idea of how the different types of drives compare.

In today's small computers, the drives that are most frequently used are IDE (integrated drive electronics), and SCSI (small computer system interface). Another type of drive that is also used, but less frequently, is the ESDI (enhanced small device interface) drive, but these tend

to be more expensive than the other two.

Two other types of drives still in use are the MFM (modified frequency modulation) and RLL (run length drives), but these are larger and slower, and are seldom used.

MFM

MFM stands for modified frequency modulation. This term is used to describe one of the earlier types of hard disk drives. MFM drives create a format of a number of concentric tracks on the hard disk, similar to the method used on floppy disks. Each track is divided into sectors.

Information is interchanged between an MFM drive and the computer one bit at a time, so they are slow, as well as large.

RLL

RLL stands for run length limited. These drives are variations of the MFM scheme. RLL drives can store approximately half again as much data as can an MFM drive in a scheme that is similar, but contains a larger number of sectors. An RLL drive also operates about half again as fast as an MFM drive.

Neither MFM or RLL drives are used much any more.

IDE

IDE stands for integrated drive electronics. These drives are also called AT drives because they were developed for use on IBM and compatible AT 286 systems. IDE drives have all of the controlling electronics circuitry as part of the drive. These units are smaller than an MFM or RLL drive, and have much simpler interfaces.

ESDI

ESDI stands for enhanced small device interface. These drives are a variation of the MFM scheme. These tend to be large capacity drives. These are less common than the IDE drive, and are being phased out.

SCSI

SCSI stands for small computer system interface. These drives have most of the

drive control electronics as part of the drive. This type of disk requires an interface card to handle the transfer of the data eight bits at a time between the disk and the computer.

FAT

The FAT (file allocation table) consists of data stored in a specific location of either a fixed or floppy disk, which keeps track of which areas of the disk have files in them and which areas of the disk are unused. In addition, the FAT keeps track of which files occupy which areas of the disk. If the information in the FAT is lost or damaged, it becomes impossible for the computer to find the information on the disk.

POST

Each time the computer is turned on, a diagnostic program that is stored in ROM BIOS executes. This program tests all of the major functions of the computer. This test is called the POST (power on self test).

When the computer power switch is first turned on, the power supply develops the various voltage outputs. Once the +5V supply reaches close to the 5V, the power supply generates a "Power Good" signal, which is sent to the ROM BIOS. If the +5V supply doesn't develop a voltage close to its specified output, the computer remains dead.

If the +5V comes up good, the ROM BIOS initiates the power on self test. The POST tests occur in this order:

- The ROM BIOS directs the computer to test RAM, ROM, interrupt controllers and support logic.
- If the results of these tests are acceptable, one short beep will sound indicating that the POST was successful.

- Another ROM BIOS program, the "boot" program is executed. This program loads the software from the DOS boot sector of the active disk drive. Usually the computer looks for this program on floppy disk drive A:, and if it doesn't find a bootable disk in the A: drive, looks at the hard disk drive C:. If the computer doesn't find a boot sector on the hard drive, it will cease to function.

POST beep codes

An experienced computer technician, with the right information at hand can get

some idea of what might be ailing a malfunctioning computer by listening carefully to the beeps that a computer emits on startup.

- If the computer emits one short beep, it signifies that the power on self test (POST) has executed successfully.

- If the computer doesn't emit any beep, and the computer fails to come up, the power supply may have failed to generate the required voltages.

- If the computer emits a continuous tone, it is highly likely that the power supply is defective.

- If the computer emits one long beep, followed by one or more short beeps, POST has encountered some kind of error. The pattern of these beeps is not simply a series of random sounds, but actually provides some useful information about the nature of the problem. Technicians can interpret these beeps to glean some information about the problem, but it requires information from the manufacturer or other reference.

POST reader card

When a problem occurs during POST, the ROM BIOS detects the problem, notes where the problem is, and in addition to emitting a series of beeps, outputs to the bus a signal that signifies where the problem has occurred.

Several manufacturers offer products called POST reader cards, which can be plugged into any expansion slot and provide a visual indication of the problem, usually by lighting an LED. Armed with the information from the POST reader card, a technician who's faced with a dead computer knows in what area of that computer the problem lies and has an idea where to begin troubleshooting.

Software

In general, the term software means any program that causes a computer to execute a series of steps to produce a desired result. Software can be categorized into several different types: operating systems, applications, utilities, diagnostics. A technician who wishes to service computers needs to know what these various types of software are.

Operating system

The operating system is the software

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Test Your Electronics Knowledge

Answers to the quiz

(from page 11)

- B
- B
- B
- A
- B
- B
- A
- A
- A
- A

that makes a computer a computer. It contains the instructions that, as the name implies, make the computer operate. For example, the operating system tells the computer to look at the keyboard for input, tells it how to read and write information from the disk, etc.

Examples of operating systems are DOS, OS/2, Windows.

Applications

The computer wouldn't perform any useful tasks if only the operating system were loaded. The useful work is performed by applications programs. These are the programs that store and manipulate data, generate reports, and perform calculations.

Some examples of applications programs are word processors, spread sheets, data bases.

Utilities

Utilities are programs that allow the operator or service technician to more or less get inside the computer, see what's going on, and make changes to the computer's operation. For example, neither the operating system nor any of the applications programs allow the user to see how the data is recorded on the disk, or to make minute changes to the recorded information.

Some utilities read the disk and provide a representation of the disk information on the screen, so that the operator actually knows where any individual byte is stored on the disk. Utilities will even allow the user to change an individual byte on the disk.

Other utilities allow the computer user to perform such operations as resetting the system clock, rearranging the data on the disk to make it operate more efficiently, or unerasing a file that has been erased.

Diagnostics

Of particular interest to consumer electronics technicians is the class of software known as diagnostics. These programs allow the technician to run tests on the various subsystems that comprise the computer.

For example, diagnostics can be used to check the disk drive for proper operation, test RAM to make sure that it's all working properly, check the keyboard for proper operation.

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What Do You Know About Electronics?

VCR servos

By J.A. Sam Wilson

A reader sent a solution to a problem to the main office. He used a fax machine. This reader has earned a highly *desirable* (my adjective) certificate. However, all I have is his fax number—no address.

I am working out of Melbourne, FL not the main office. I have no fax machine and no funds for making long distance calls. Your fax is mailed to me.

If you fax something to me via the main office, please put your name and address on the correspondence.

I did not do it

In terms of reader response, a question in TYEK broke the record. I got nice letters, and, I'm told the waste basket got a few very heated letters.

The question we're addressing is: What is the resistance between 'X' and 'Y' for the illustrated circuit?

Figure A compares my original drawing and the published drawing. Note that a resistor (marked with an *) was changed to a capacitor. It is my belief that the post office did it. You can believe what you want to believe.

A surprising number of readers who responded believe that I do the illustrations for WDYKAE? and TYEK. That cannot be true. Look closely at an illustration in this month's column. Do you see a lot of erasures, peanut butter and jelly stains, lots of fingerprints, smudges, unrelated notes, etc.? No? Then those drawings are not mine.

That squared circle and other good reader stuff

I was pleasantly surprised by responses to this question I put in WDYKAE? "What is the length of the side of a square that has *exactly* the same area as a circle with a 3-inch diameter."

The correct answer is that it cannot be done. In the first place, you cannot find

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

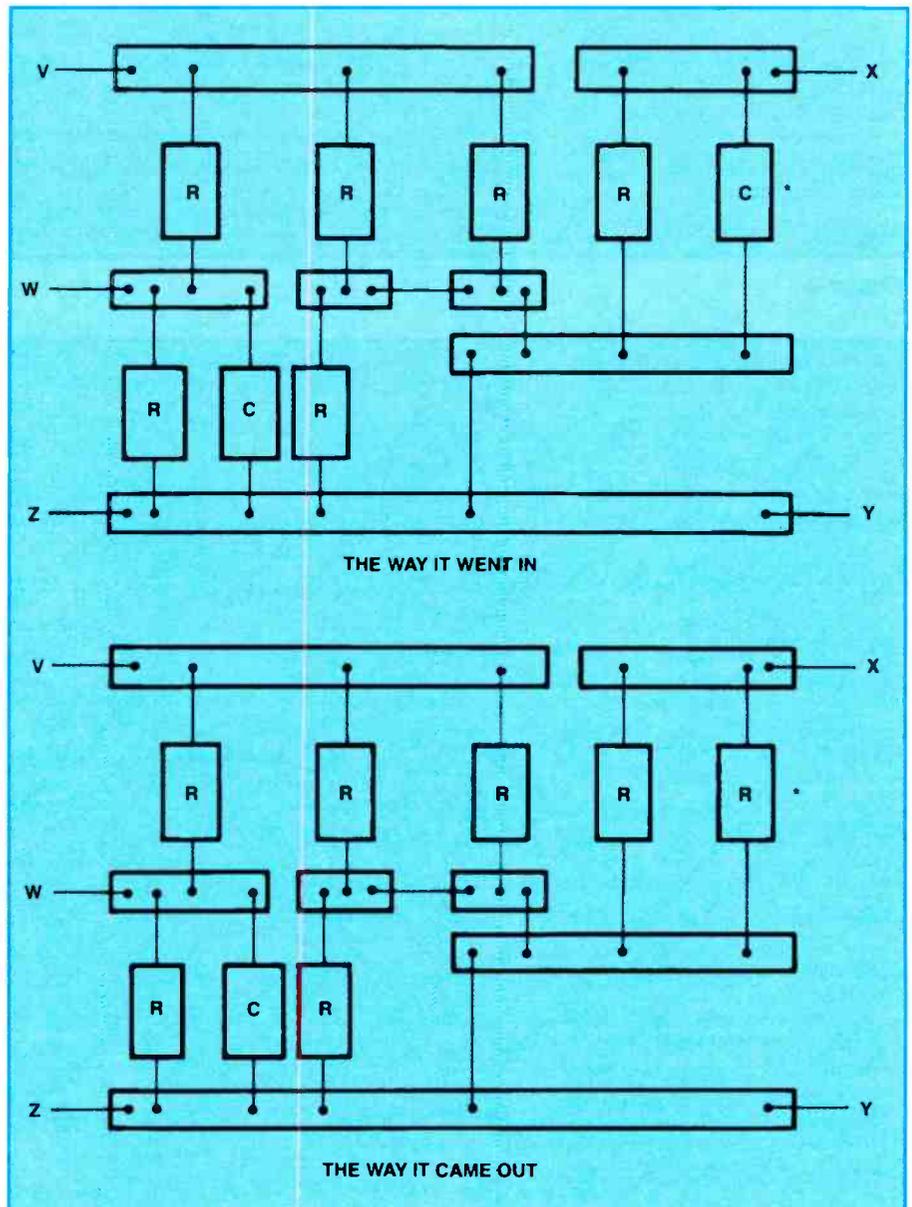


Figure A.

the exact area of a circle. The equation for the area of a circle is:

$$A = \pi r^2$$

Maybe you can give the exact value of the radius, but, nobody—I mean *nobody*

—can give the exact value of π . It has been carried out to many thousands of places and it never comes out even.

So, if you can't give the exact value of π , you can't get the exact value of the area for a circle. Furthermore, if you can't give the exact value of a circle you certainly

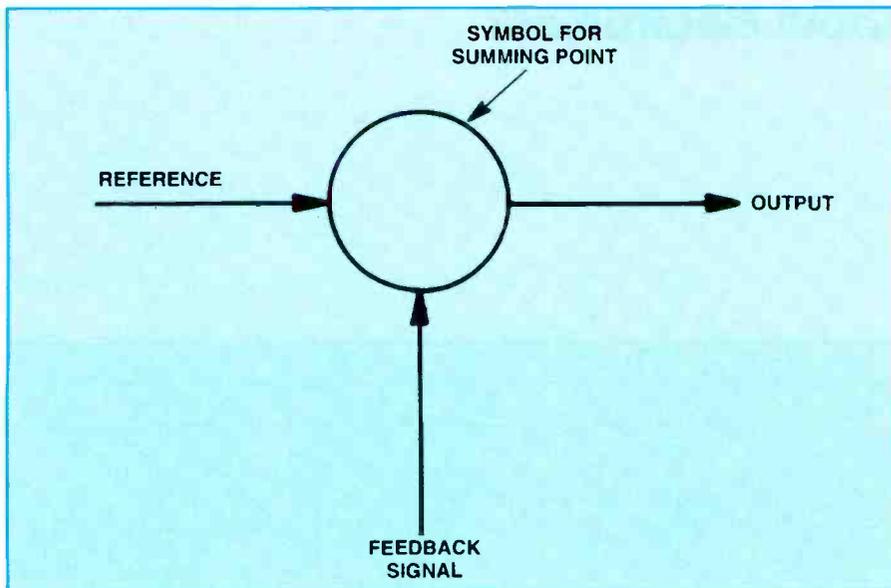


Figure 2.

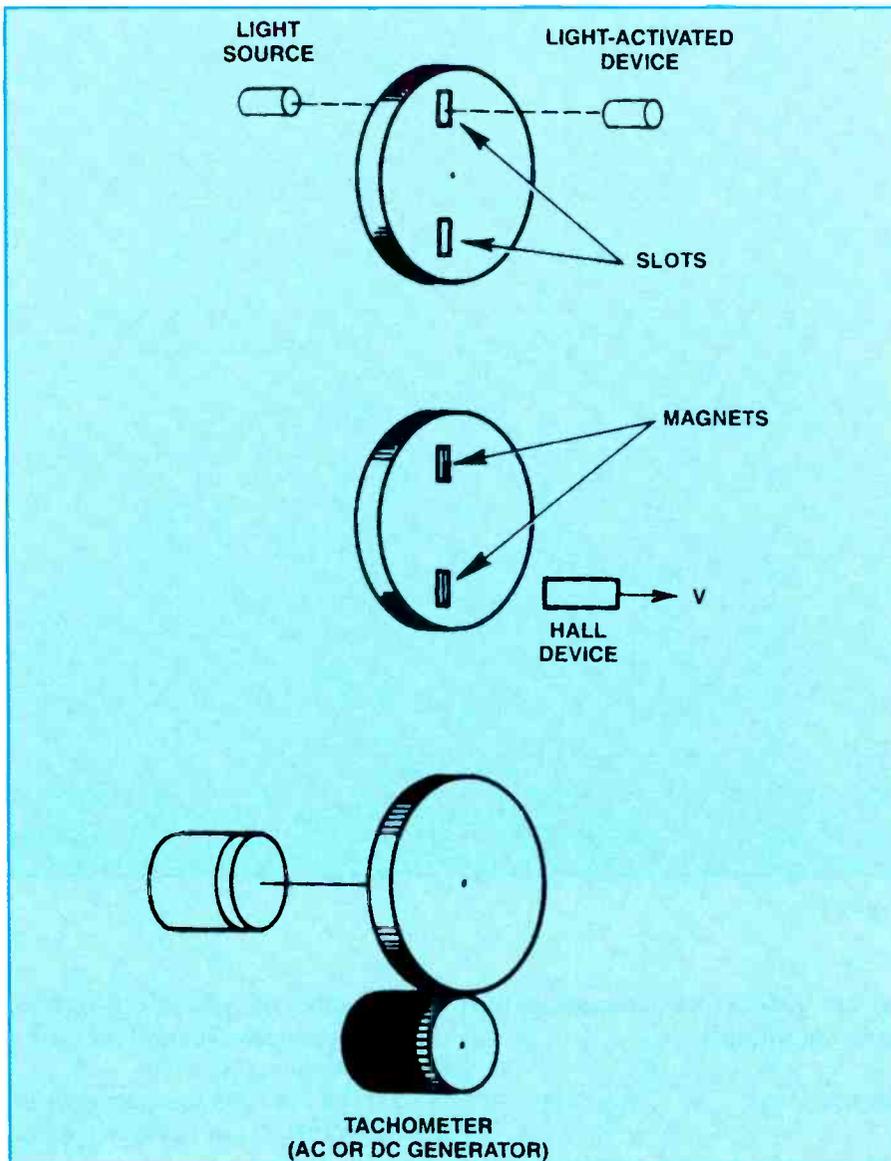


Figure 3.

can't give the exact area of a square with the same area as the circle.

Many of the readers who responded jumped over the word "exactly" in the question. The responses were very clever except for that little problem of evaluating π . In trying to solve the problem many brilliant mathematicians in past centuries developed new methods in math, so, it wasn't a total waste. For example, Archimedes developed a crude type of calculus while working on the problem.

Here is a list of people who gave it a good try: D. Kramer of Pittsburgh, PA; Christopher Novack of Rockville, MD; W.E. Geissinger of Myerstown, PA; and, O. Beland of Saskatoon, SK, Canada.

If I missed anyone let me know.

Another thing that can't be done is to find the exact length of a side of a square with an area of 2 square inches or 3 square inches. The reason that can't be done is that you can't find the exact square root of 2 or 3. In fact, you can't find the exact square root of any prime number. A prime number is one that you can't get as a product by multiplying two whole numbers. The square root of 2 or 3 and the value of π are both called *irrational numbers*. They go on and on to infinity without an exact value.

The time constant problem

There were also some super technicians who sent the solution to the time constant problem in the November issue. Here are their names: Larry L. Scalph of Tacoma, WA; Michael J. Miller of Beaver Falls, PA; Jack E. Lemasters of Lake Park, GA; Daniel Schimmel of Rome, NY; J.D. Hammoch of Seattle, WA; Michael Whitco of Wellsburg, W. VA; and, Bob Machutas of Schroon Lake, NY. (Some correspondence was accidentally destroyed. I am told to say it was my fault. Otherwise I will get very small portions at mealtime.)

I'm here—not there

I am working out of Melbourne—not the main office.

I got several letters telling me to "ask around the office" to see if anyone knows about widgets. (Norma doesn't know.)

More on the servo

In the previous issue I defined the term "servo" and discussed a typical block dia-

gram of a servo system for controlling motor speed. I pointed out that a servo system cannot work unless it has some way of sensing the output condition. At one point in that diagram I showed a "comparator" block. You will probably not find the symbol I used for that point on industrial diagrams. Instead, you will see the symbol shown in Figure 1. The summing point does the same job as the comparator. In other words, it compares the feedback signal with the reference signal.

Since so many of our readers are consumer electronics oriented, I will use the block symbol. It is commonly used in block diagrams of phase-locked loops so it puts us on familiar ground.

If the purpose of the servo system is to automatically control the speed of a motor it has to know the motor speed. Otherwise, it wouldn't be able to tell if the motor speed should be increased, decreased, or not changed at all. Figure 2 shows examples of how motor speed can be sensed.

According to one definition of a servo, a regulated power supply is an example of a servo system. The sense circuit for a regulated supply depends upon whether the output voltage or the output current is being regulated.

By far, most of the servo systems use a dc voltage to control the output. I said *control* the output—not operate the output. However, the sensed output may be an ac signal, a pulse or a dc voltage.

An example of a sensed signal is in a tuner automatic frequency control (a.f.c.) circuit. The i.f. signal is used as a sensed signal for the feedback loop. It is compared with the carrier frequency. If the comparison signals are not on target the oscillator frequency is adjusted. That, in turn, corrects the i.f. frequency.

Returning to the subject of motor control, when you are troubleshooting there are two good reasons for locating the motor speed transducer (sensor) in a servo system:

- If there is no output from the transducer you may have located the problem—assuming there is a problem.

- One way to troubleshoot a servo system is to open the loop and substitute a signal. For example, if the system is for motor speed control and the transducer delivers a dc voltage related to the motor speed, you can disconnect the transducer and substitute a variable dc voltage.

Not all transducers deliver a dc output. For example, there are ac tachometers.

A VCR speed transducer

Regulating the speed of a tape as it moves through a VCR system presents a problem over and above regulating the speed of the motor. After prolonged use the tape may have stretched. I know, they say it can't be done, but, it can.

If you only regulate the speed of the

motor you are going to have a problem when you run a stretched tape through the system. What you need is a servo system that senses the speed of the tape—not the speed of the motor. That is easily done by using pulses that are on the recorded tape to regulate tape speed. You can record special pulses on the tape, or you could use pulses that naturally occur on the video signal.

The actual method used will be discussed in the next installment on servos.

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1994 Buyers' Guide

The servicing of consumer electronics products requires a considerable investment in resources. Perhaps the most important of these resources is the knowledge of what's inside a TV, VCR or other consumer product, and how it operates. That knowledge comes from the education and training a technician receives, and from the books, manuals and various pieces of service literature.

Armed with that knowledge, the technician can proceed to diagnose problems in the products, and to correct them. To do that, he needs tools, test equipment, replacement parts, supplies and materials.

Where to find the resources

As the consumer electronics market has expanded to include such products as microwave ovens, VCRs, camcorders, compact disc players, personal computers and peripherals, fax machines and telephone equipment, the resources required by a technician to service them have also expanded. Moreover, as the technological sophistication of these products has steadily increased, the range, sophistication and capabilities of the technician's tools and test equipment have had to keep up.

In the face of all of these changes taking place in consumer electronics, it's a challenge for technicians to keep abreast of it all.

That's where this Buyers' Guide comes in. The staff at **ES&T** is constantly monitoring the world of consumer electronics to see what's new, what new products are being introduced, what new tools, test equipment, information resources and replacement components are becoming available to help technicians in their work.

The Buyers' Guide

One of the results of this constant attention to the marketplace is this annual Buyers' Guide. This eighth Buyers' Guide contains information on hundreds of manufacturers and distributors who make or sell thousands of products. The guide will tell you who makes what, and it will give you addresses and phone numbers to contact. Save this issue.

Using the Buyers' Guide

If you're in the market for a new oscilloscope this year, you would probably know the names of some of the major oscilloscope manufacturers, and you might have the addresses and telephone numbers of some of those companies somewhere in your files, but you'd have to do some digging to find them. Or maybe you would like to learn how to service computer monitors or fax machines, but you have no idea who offers a course on that subject. Even if you're pretty sure who offers that information, you still have to find that eternally misplaced address.

That's why we put together this Guide—all the information you need is gathered together in one place. No need to search through stacks of papers. Here's your one-source alternative.

If you want a DMM, turn to the Product Directory and look them up. Every DMM manufacturer that responded to our questionnaire will be listed there, and every company's address will be listed in the Company Address Directory.

We've broken down this information into five categories:

- Product Directory..... page 25.
- Replacement Parts/Components Directory..... page 49.
- Software/Services Directory page 55.
- Association/Educational/Sources Directory.....page 56.
- Company Address Directory page 57.

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.

You will notice that certain company names are in color. Those companies are advertisers 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 is listed there. (If the company you are interested in is an advertiser in this issue, you can just pull out your Reader Service card on page 39 and circle the reply number listed under the advertisement.)

The Replacement Parts/Components Directory works the same way.

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 electronics 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

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. Of course, if you find a mistake, please contact us immediately. We'll publish a correction as soon as we can. ■

Product directory

See Adv. Page

See Adv. Page

See Adv. Page

See Adv. Page

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RAG Electronics Inc.*D
RNJ Electronics Inc.*D 14
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Com-Kyl Inc.*D
Computer Component Source *D
Consolidated Electronics, Inc.*D
Contact East, Inc.*D
CSTS Inc.
Datatran Corp.
East Coast Transistor*D
Eiger Electronics*D
E.I.L. Instruments, SD
Electro Tool, Inc. *D
Electronics Warehouse Corp.*D
Extech Instruments Corp.
Galco Industrial Electronics*D
GC Electronics Div. of GC Thorsen Co.
GMB/dba Fox International*D
HMC-Hub Material Co.*D
Harco Electronics*D
International Data Sciences
JDR Micro*D
W.S. Jenks & Son*D
Jensen Tools Inc.*D
Joseph Electronics*D
Kelvin Electronics*D
Klein Tools, Inc.
L-Com Inc.
Lil' Bitty Tester, Inc.
MAI/Prime Parts*D
Marshall Industries*D
MCM Electronics*D
Mouser Electronics*D
PanSon Electronics*D
Print Products International *D 11
RAG Electronics Inc.*D
RNJ Electronics Inc.*D 14
Sencore Electronics IFC, 4
Simpson Electric Co.
Specialized Products Co.*D
A.W. Sperry Instruments, Inc.
3M Electronic Products Div.
3M Private Network Products
TIF Instruments, Inc.
Time Motion Tools
Tool Kit Specialists, Inc.*D
Tri State Electronics*D
Union Electric*D
Universal Enterprises
Vance Baldwin Inc.*D
Wavetek Corp. 3
Weidmuller, Paladin Tools
Wholesale Electronics Inc.*D 68

CRT TESTERS/RESTORERS

Accutest Instruments*D
Allied Electronics, Inc. An Avnet Co.*D
B-B&W Electronics*D
B&K-Precision Maxtec International Corp. 53
P.I. Burks*D
Bursma Electronic Distributing*D
Computer Component Source *D
Consolidated Electronics, Inc.*D
Contact East, Inc.*D
Conway Engineering, Inc.
C&S Sales*D
Dandy Mfg. Co.
East Coast Transistor*D
Eiger Electronics*D
Electronics Warehouse Corp.*D
GMB/dba Fox International*D
HMC-Hub Material Co.*D
Harco Electronics*D
W.S. Jenks & Son*D
Joseph Electronics*D
Kelvin Electronics*D
Philips Consumer Electronics Corp. Service Parts
Print Products International *D 11
RNJ Electronics Inc.*D 14

Sencore Electronics IFC, 4
Sony Service Co.
A.G. Tannenbaum*D
Tri State Electronics*D
Union Electric*D
Vance Baldwin Inc.*D
Wholesale Electronics Inc.*D 68

CURVE TRACERS

Accutest Instruments*D
Allied Electronics, Inc. An Avnet Co.*D
Computer Component Source *D
East Coast Transistor*D
Electronics Warehouse Corp.*D
GMB/dba Fox International*D
Hameg Instruments, Inc.
Harco Electronics*D
Joseph Electronics*D
KeyTek Instrument Corp.
Leader Instruments Corp.
Marshall Industries*D
Print Products International *D 11
RAG Electronics Inc.*D
RNJ Electronics Inc.*D 14
A.G. Tannenbaum*D
Tektronix Test & Measurement Group
Tucker Electronics Co.*D
Union Electric*D
Vance Baldwin Inc.*D

DATA COMMUNICATION ANALYZERS/MONITORS/TESTERS

Accutest Instruments*D
Allied Electronics, Inc. An Avnet Co.*D
American Reliance Inc.
Analogic Corp.
Anritsu Meter Co. of America
Atrix, Inc.*D
AT&T Capital Corporation Instrument Services Instrument Services Div.
B&B Electronics Mfg., Co.
Contact East, Inc.*D
Datacom Technologies, Inc.
Datatran Corp.
Digitech Industries Inc.
East Coast Transistor*D
E.I.L. Instruments, SD
Electronics Warehouse Corp.*D
Frederick Engineering, Inc.
GMB/dba Fox International*D
HMC-Hub Material Co.*D
Harco Electronics*D
International Data Sciences
JDR Micro*D
W.S. Jenks & Son*D
Jensen Tools Inc.*D
Joseph Electronics*D
Kelvin Electronics*D
Marshall Industries*D
MetraByte Corp.
M-Test Equipment
Omega Engineering Inc.
Print Products International *D 11
RNJ Electronics Inc.*D 14
Schlumberger Technologies Instruments Div.
Simpson Electric Co.
Sony Service Co.
Specialized Products Co.*D
Tektronix Test & Measurement Group
Tektronix Redmond Div.
3M Electronic Products Div.
3M Private Network Products
Time Motion Tools
Tri State Electronics*D
Tucker Electronics Co.*D
Vance Baldwin Inc.*D

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DISC DRIVE ANALYZERS/TESTERS				
Accurite Technologies Inc.	20			
Analogic Corp.				
AT&T Capital Corporation Instrument Services Instrument Services Div.				
AVA Instrumentation, Inc.				
Brian Instruments, Inc.				
Computer Doctors				
Contact East, Inc.*D				
GMB/dba Fox International*D				
Hi-Techniques Inc.				
HMC-Hub Material Co.*D				
JDR Micro*D				
W.S. Jenks & Son*D				
Kenwood U.S.A. Corp.				
Marshall Industries*D				
Orion Instruments, Inc.				
Pacific Electro Data, Inc.				
Pioneer Research				
Print Products International *D	11			
RAG Electronics Inc.*D				
RNJ Electronics Inc.*D	14			
Sony Service Co.				
Specialized Products Co.*D				
Ultra-X, Inc.				
Vance Baldwin Inc.*D				
DISTORTION ANALYZERS				
Accutest Instruments*D				
AT&T Capital Corporation Instrument Services Instrument Services Div.				
Digitex Industries Inc.				
Dranetz Technologies, Inc.				
East Coast Transistor*D				
E.I.L. Instruments, SD				
Electronics Warehouse Corp.*D				
GMB/dba Fox International*D				
Harco Electronics*D				
Joseph Electronics*D				
Leader Instruments Corp.				
MCM Electronics*D				
Print Products International *D	11			
RAG Electronics Inc.*D				
RNJ Electronics Inc.*D	14			
Schlumberger Technologies Instruments Div.				
Tektronix Test & Measurement Group				
Tucker Electronics Co.*D				
Union Electric*D				
Vance Baldwin Inc.*D				
FREQUENCY COUNTERS				
Acculex Corp. A MetraByte Co.				
Accutest Instruments*D				
Alfa Electronics				
Allied Electronics, Inc. An Avnet Co.*D				
American Reliance Inc.				
Analogic Corp.				
Arrow Electronics Inc. Catalog Sales Div.*D				
ARS Electronics*D				
AT&T Capital Corporation Instrument Services Instrument Services Div.				
B-B&W Electronics*D				
Bel Merit				
B&K-Precision Maxtec International Corp.	53			
Brunelle Instruments Inc.				
P.I. Burks*D				
Bursma Electronic Distributing*D				
Com-Kyl Inc.*D				
Computer Component Source *D				
Consolidated Electronics, Inc.*D				
Contact East, Inc.*D				
C&S Sales*D				
Daetron				
Datel, Inc.				
East Coast Transistor*D				
Eiger Electronics*D				
E.I.L. Instruments, SD				
Electro Tool, Inc. *D				
Electronics Warehouse Corp.*D				
Electronix Corp.*D				
Electronix Express*D				
Elenco Electronics, Inc.				
Extch Instruments Corp.				
Fluke Corp.	BC			
Fox International*D				
Galco Industrial Electronics*D				
Global Specialties A Div. of Interplex				
GMB/dba Fox International*D				
GoldStar Precision Co. Ltd.				
Hameg Instruments, Inc.				
Heath Co.				
HMC-Hub Material Co.*D				
Harco Electronics*D				
Jameco Electronic Components & Computer Products				
JDR Micro*D				
W.S. Jenks & Son*D				
Jensen Tools Inc.*D				
Joseph Electronics*D				
Keithley Instruments				
Kelvin Electronics*D				
Kenwood U.S.A. Corp.				
Leader Instruments Corp.				
MAI/Prime Parts*D				
Marconi Instruments				
Marshall Industries*D				
MCM Electronics*D				
Orion Instruments, Inc.				
PanSon Electronics*D				
Planstiehl Corp.				
Philips Consumer Electronics Corp. Service Parts				
Print Products International *D	11			
H.C. Protek				
RAG Electronics Inc.*D				
RNJ Electronics Inc.*D	14			
Salen Enterprises*D				
Sibex Inc.				
Simpson Electric Co.				
Specialized Products Co.*D				
Tektronix Test & Measurement Group				
Teledata Systems				
Tool Kit Specialists, Inc.*D				
Tri State Electronics*D				
Tucker Electronics Co.*D				
Union Electric*D				
Vance Baldwin Inc.*D				
Wavetek Corp.	3			
Wholesale Electronics Inc.*D				
68				
GAUGES: HEAD PROTRUSION/SPRING TENSION/STYLUS FORCE/OTHER				
East Coast Transistor*D				
E.I.L. Instruments, SD				
Electronics Warehouse Corp.*D				
GMB/dba Fox International*D				
Hunter Products, Inc.				
Kelvin Electronics*D				
Philips Consumer Electronics Corp. Service Parts				
RNJ Electronics Inc.*D	14			
Specialized Products Co.*D				
Techni-Tool Inc.*D				
Tentel Corp.	15			
Vance Baldwin Inc.*D				
GENERATORS, AUDIO				
Accutest Instruments*D				
Alfa Electronics				
AT&T Capital Corporation Instrument Services Instrument Services Div.				
B-B&W Electronics*D				
Bel Merit				
B&K-Precision Maxtec International Corp.	53			
Brunelle Instruments Inc.				
P.I. Burks*D				
Bursma Electronic Distributing*D				
Computer Component Source *D				
Consolidated Electronics, Inc.*D				
Contact East, Inc.*D				
C&S Sales*D				
East Coast Transistor*D				
Eiger Electronics*D				
Electronics Warehouse Corp.*D				
Electronix Corp.*D				
Electronix Express*D				
Elenco Electronics, Inc.				
GMB/dba Fox International*D				
Heath Co.				
Harco Electronics*D				
W.S. Jenks & Son*D				
Joseph Electronics*D				
Kelvin Electronics*D				
Kenwood U.S.A. Corp.				
Kikusui International Corp.				
Leader Instruments Corp.				
MAI/Prime Parts*D				
Marshall Industries*D				
MCM Electronics*D				
Orion Instruments, Inc.				
PanSon Electronics*D				
Planstiehl Corp.				
Philips Consumer Electronics Corp. Service Parts				
Print Products International *D	11			
H.C. Protek				
RAG Electronics Inc.*D				
RNJ Electronics Inc.*D	14			
Salen Enterprises*D				
Sencore Electronics				
IFC, 4				
Specialized Products Co.*D				
A.G. Tannenbaum*D				
GENERATORS, SIGNAL				
Accutest Instruments*D				
Alfa Electronics				
Allied Electronics, Inc. An Avnet Co.*D				
Analogic Corp.				
AT&T Capital Corporation Instrument Services Instrument Services Div.				
B-B&W Electronics*D				
Bel Merit				
B&K-Precision Maxtec International Corp.	53			
Brunelle Instruments Inc.				
P.I. Burks*D				
Bursma Electronic Distributing*D				
Computer Component Source *D				
Consolidated Electronics, Inc.*D				
Contact East, Inc.*D				
C&S Sales*D				
Digitex Industries Inc.				
East Coast Transistor*D				
Eiger Electronics*D				
E.I.L. Instruments, SD				
Electronics Warehouse Corp.*D				
Electronix Corp.*D				
Electronix Express*D				
Elenco Electronics, Inc.				
Fluke Corp.	BC			
Galco Industrial Electronics*D				
GMB/dba Fox International*D				
GMB/dba Fox International*D				
Heath Co.				
HMC-Hub Material Co.*D				
Harco Electronics*D				
Jameco Electronic Components & Computer Products				
JDR Micro*D				
W.S. Jenks & Son*D				
Jensen Tools Inc.*D				
Joseph Electronics*D				
Keithley Instruments				
Kelvin Electronics*D				
Kenwood U.S.A. Corp.				
Leader Instruments Corp.				
MAI/Prime Parts*D				
Marconi Instruments				
Marshall Industries*D				
MCM Electronics*D				
Orion Instruments, Inc.				
PanSon Electronics*D				
Planstiehl Corp.				
Philips Consumer Electronics Corp. Service Parts				
Print Products International *D	11			
H.C. Protek				
RAG Electronics Inc.*D				
RNJ Electronics Inc.*D	14			
Salen Enterprises*D				
Sencore Electronics				
IFC, 4				
Specialized Products Co.*D				
A.G. Tannenbaum*D				
Tektronix Television Div.				
Tool Kit Specialists, Inc.*D				
Tri State Electronics*D				
Tucker Electronics Co.*D				
Union Electric*D				
Vance Baldwin Inc.*D				
The Vector Group, Inc.				
Wholesale Electronics Inc.*D	68			
GENERATORS, VIDEO				
Accutest Instruments*D				
Alfa Electronics				
B-B&W Electronics*D				
B&K-Precision Maxtec International Corp.	53			
P.I. Burks*D				
Bursma Electronic Distributing*D				
Computer & Monitor Maintenance Inc.				
10				
Computer Component Source *D				
Consolidated Electronics, Inc.*D				
Contact East, Inc.*D				
C&S Sales*D				

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East Coast Transistor* D Electronics Warehouse Corp.* D Electronix Corp.* D Elenco Electronics, Inc. GMB/dba Fox International* D Heath Co. Hitachi Denshi America, Ltd. Harco Electronics* D W.S. Jenks & Son* D Joseph Electronics* D Kelvin Electronics* D Leader Instruments Corp. MAI/Prime Parts* D Marshall Industries* D MCM Electronics* D NCM Electronics Network Technologies, Inc. Orion Instruments, Inc. Philips Consumer Electronics Corp. Service Parts Print Products International *D 11 H.C. Protek Quantum Data 13 RAG Electronics Inc.* D RNJ Electronics Inc.*D 14 Sencore Electronics IFC, 4 Sirius Technologies Tektronix Television Div. Tri State Electronics* D Tucker Electronics Co.* D Union Electric* D Vance Baldwin Inc.* D Wholesale Electronics Inc.*D 68	AT&T Capital Corporation Instrument Services Instrument Services Div. Bitwise Designs, Inc. Bursma Electronic Distributing* D Computer Component Source * D Consolidated Electronics, Inc.* D C&S Sales* D East Coast Transistor* D E.I.L. Instruments, SD Electronics Warehouse Corp.* D Electronix Express* D Elenco Electronics, Inc. Emulation Technology Inc. Fluke Corp. BC Global Specialties A Div. of Interplex GMB/dba Fox International* D Heath Co. Hitachi Denshi America, Ltd. Harco Electronics* D Hy-Tronix Instruments, Inc. JDR Micro* D W.S. Jenks & Son* D Joseph Electronics* D Kelvin Electronics* D Leader Instruments Corp. MAI/Prime Parts* D Marshall Industries* D MCM Electronics* D MetraByte Corp. Orion Instruments, Inc. Pacific Electro Data, Inc. Print Products International *D 11 H.C. Protek RAG Electronics Inc.* D RNJ Electronics Inc.*D 14 Schlumberger Technologies Instruments Div. Specialized Products Co.* D Tektronix Test & Measurement Group Tucker Electronics Co.* D Union Electric* D Vance Baldwin Inc.* D	Print Products International *D 11 RAG Electronics Inc.* D RNJ Electronics Inc.*D 14 Salen Enterprises* D Specialized Products Co.* D Speco Div. Techni-Tool Inc.* D Tektronix Test & Measurement Group Tool Kit Specialists, Inc.* D Tri State Electronics* D Union Electric* D Vance Baldwin Inc.* D Wavetek Corp. 3 Wholesale Electronics Inc.*D 68	Electromatic Controls/ Soar Instruments Electronics Warehouse Corp.* D Electronix Express* D Elenco Electronics, Inc. Extech Instruments Corp. Fieldpiece Instruments Fluke Corp. BC Galco Industrial Electronics* D GMB/dba Fox International* D Herman Electronics*D 17 HMC-Hub Material Co.* D Hosfelt Electronics* D Harco Electronics* D IET Labs, Inc. JDR Micro* D W.S. Jenks & Son* D Joseph Electronics* D Keithley Instruments Kelvin Electronics* D L-Com Inc. Leader Instruments Corp. MAI/Prime Parts* D Marshall Industries* D M.A.T. Electronics* D MCM Electronics* D Mill Electronics Inc.* D Omega Engineering Inc. Philips Consumer Electronics Corp. Service Parts Philips ECG 5 Print Products International *D 11 H.C. Protek RAG Electronics Inc.* D RNJ Electronics Inc.*D 14 Salen Enterprises* D Sencore Electronics IFC, 4 Specialized Products Co.* D A.W. Sperry Instruments, Inc. A.G. Tannenbaum* D Techni-Tool Inc.* D TIF Instruments, Inc. Time Motion Tools Tool Kit Specialists, Inc.* D Tri State Electronics* D Triplett Corp. Tucker Electronics Co.* D Union Electric* D Vance Baldwin Inc.* D Wavetek Corp. 3 Wholesale Electronics Inc.*D 68 Yokogawa Corp. of America
HV PROBES Accutest Instruments* D Alfa Electronics Allied Electronics, Inc. An Avnet Co.* D B-B&W Electronics* D B&K-Precision Maxtec International Corp. 53 Brunelle Instruments Inc. P.I. Burks* D Bursma Electronic Distributing* D Computer Component Source * D Consolidated Electronics, Inc.* D Contact East, Inc.* D C&S Sales* D East Coast Transistor* D Eiger Electronics* D E.I.L. Instruments, SD Electronic Design Specialists/Southgate 53 Electronics Warehouse Corp.* D Electronix Express* D Fox International* D Galco Industrial Electronics* D GMB/dba Fox International* D Hameg Instruments, Inc. Herman Electronics*D 17 HMC-Hub Material Co.* D Harco Electronics* D W.S. Jenks & Son* D Joseph Electronics* D MAI/Prime Parts* D Marshall Industries* D M.A.T. Electronics* D MCM Electronics* D Oldaker Corp. PanSon Electronics* D Philips Consumer Electronics Corp. Service Parts Polaris Div. of UXL Corp. Print Products International *D 11 RAG Electronics Inc.* D RNJ Electronics Inc.*D 14 Sencore Electronics IFC, 4 Specialized Products Co.* D Tektronix Television Div. Tektronix Test & Measurement Group Test Probes, Inc. Time Motion Tools Tool Kit Specialists, Inc.* D Tri State Electronics* D Union Electric* D Vance Baldwin Inc.* D Wholesale Electronics Inc.*D 68	LOGIC PROBES Accutest Instruments* D Alfa Electronics Allied Electronics, Inc. An Avnet Co.* D American Design Components* D American Reliance Inc. Atrix, Inc.* D AT&T Capital Corporation Instrument Services Instrument Services Div. B-B&W Electronics* D B&K-Precision Maxtec International Corp. 53 Brunelle Instruments Inc. P.I. Burks* D Bursma Electronic Distributing* D Computer Component Source * D Consolidated Electronics, Inc.* D Contact East, Inc.* D C&S Sales* D Dalbani Corp.* D East Coast Transistor* D Eiger Electronics* D E.I.L. Instruments, SD Electronics Warehouse Corp.* D Electronix Express* D Elenco Electronics, Inc. Extech Instruments Corp. Fieldpiece Instruments Fox International* D Galco Industrial Electronics* D Global Specialties A Div. of Interplex GMB/dba Fox International* D Heath Co. HMC-Hub Material Co.* D Jameco Electronic Components & Computer Products JDR Micro* D W.S. Jenks & Son* D Joseph Electronics* D Kelvin Electronics* D Kenwood U.S.A. Corp. Kobatron Inc. MAI/Prime Parts* D Marshall Industries* D MCM Electronics* D Mouser Electronics* D O.K. Industries Inc. PanSon Electronics* D Philips Consumer Electronics Corp. Service Parts Philips ECG 5	LOGIC PULSERS Accutest Instruments* D American Reliance Inc. Brunelle Instruments Inc. P.I. Burks* D Computer Component Source * D Consolidated Electronics, Inc.* D Contact East, Inc.* D C&S Sales* D East Coast Transistor* D E.I.L. Instruments, SD Electronics Warehouse Corp.* D Electronix Express* D Elenco Electronics, Inc. Fox International* D GMB/dba Fox International* D HMC-Hub Material Co.* D JDR Micro* D W.S. Jenks & Son* D Joseph Electronics* D Kelvin Electronics* D Lil' Bitty Tester, Inc. Marshall Industries* D MCM Electronics* D Philips Consumer Electronics Corp. Service Parts Philips ECG 5 Print Products International *D 11 RAG Electronics Inc.* D RNJ Electronics Inc.*D 14 Salen Enterprises* D Specialized Products Co.* D Union Electric* D Vance Baldwin Inc.* D Wholesale Electronics Inc.*D 68	MAGNETRON TESTERS Computer Component Source * D Electronic Design Specialists/Southgate 53 Electronix Corp.* D GMB/dba Fox International* D W.S. Jenks & Son* D Joseph Electronics* D Print Products International *D 11 RNJ Electronics Inc.*D 14 Union Electric* D Vance Baldwin Inc.* D
LOGIC ANALYZERS: SIGNATURE/STATE Accutest Instruments* D Allied Electronics, Inc. An Avnet Co.* D			METERS, CLAMP ON Accutest Instruments* D AEMC Corp. Alfa Electronics Allied Electronics, Inc. An Avnet Co.* D American Reliance Inc. Amprobe Instrument AT&T Capital Corporation Instrument Services Instrument Services Div. AVO Biddle Instruments B-B&W Electronics* D Bel Merit B&K-Precision Maxtec International Corp. 53 Brunelle Instruments Inc. P.I. Burks* D Bursma Electronic Distributing* D Computer Component Source * D Consolidated Electronics, Inc.* D Contact East, Inc.* D C&S Sales* D Dranetz Technologies, Inc. East Coast Transistor* D Eiger Electronics* D E.I.L. Instruments, SD Electro Tool, Inc. * D Electromatic Controls/ Soar Instruments Electronics Warehouse Corp.* D Electronix Express* D Extech Instruments Corp. Fieldpiece Instruments Fox International* D Galco Industrial Electronics* D GMB/dba Fox International* D Heath Co. Herman Electronics*D 17 HMC-Hub Material Co.* D Harco Electronics* D ITT Pomona Electronics W.S. Jenks & Son* D
			METERS, CAPACITANCE/INDUCTANCE Accutest Instruments* D Alfa Electronics Allied Electronics, Inc. An Avnet Co.* D American Design Components* D American Reliance Inc. AT&T Capital Corporation Instrument Services Instrument Services Div. B-B&W Electronics* D Bel Merit B&K-Precision Maxtec International Corp. 53 Brunelle Instruments Inc. P.I. Burks* D Bursma Electronic Distributing* D Corm-Kyl Inc.* D Computer Component Source * D Consolidated Electronics, Inc.* D Contact East, Inc.* D Creative Electronics C&S Sales* D Daetron Dalbani Corp.* D East Coast Transistor* D Eiger Electronics* D E.I.L. Instruments, SD

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Bursma Electronic Distributing* Com-Kyl Inc.* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* C&S Sales* East Coast Transistor* E.I.L. Instruments, SD Electronics Warehouse Corp.* Electronix Express* Elenco Electronics, Inc. Emulation Technology Inc. E-Z Hook Fieldpiece Instruments Fox International* Galco Industrial Electronics* GC Electronics Div. of GC Thorsen Co. Global Specialties A Div. of Interplex GMB/dba Fox International* Herman Electronics* 17 HMC-Hub Material Co.* Hosfelt Electronics* Harco Electronics* Hy-Tronix Instruments, Inc. ITT Pomona Electronics JDR Micro* W.S. Jenks & Son* Joseph Electronics* Kelvin Electronics* MAI/Prime Parts* Marshall Industries* MCM Electronics* Mouser Electronics* O.K. Industries Inc. Oldaker Corp. PanSon Electronics* Philips Consumer Electronics Corp. Service Parts Print Products International *D 11 RNJ Electronics Inc.* 14 Specialized Products Co.* Techni-Tool Inc.* Tektronix Test & Measurement Group Time Motion Tools Tool Kit Specialists, Inc.* Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* 68	Mill Electronics Inc.* O.K. Industries Inc. Omega Engineering Inc. PanSon Electronics* Philips Consumer Electronics Corp. Service Parts Print Products International *D 11 H.C. Protek RAG Electronics Inc.* RNJ Electronics Inc.* 14 Salen Enterprises* Sola Specialized Products Co.* Speco Div. Tool Kit Specialists, Inc.* Tri State Electronics* Union Electric* Vance Baldwin Inc.* The Vector Group, Inc. Wholesale Electronics Inc.* 68	GMB/dba Fox International* Hameg Instruments, Inc. Heath Co. Herman Electronics* 17 HMC-Hub Material Co.* Hosfelt Electronics* Harco Electronics* Interconnect Devices, Inc. ITT Pomona Electronics JDR Micro* W.S. Jenks & Son* Joseph Electronics* Kelvin Electronics* Kenwood U.S.A. Corp. Keystone Electronics Corp. Klein Tools, Inc. MAI/Prime Parts* Marshall Industries* MCM Electronics* MetraByte Corp. Mouser Electronics* Oldaker Corp. Omega Engineering Inc. OPToelectronics, Inc. PanSon Electronics* Philips Consumer Electronics Corp. Service Parts Philips ECG 5 Print Products International *D 11 Probe Master H.C. Protek RAG Electronics Inc.* Ramsey Electronics Inc. RNJ Electronics Inc.* 14 Salen Enterprises* Schurter, Inc. Sencore Electronics IFC, 4 Simpson Electric Co. Specialized Products Co.* Speco Div. A.W. Sperry Instruments, Inc. Techni-Tool Inc.* Tegam, Inc. Tektronix Television Div. Test Probes, Inc. Time Motion Tools Tool Kit Specialists, Inc.* Tri State Electronics* Triplett Corp. Union Electric* Universal Enterprises Vance Baldwin Inc.* Wavetek Corp. 3 Wholesale Electronics Inc.* 68	Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* 68
VCR TEST JIG KITS			
B-B&W Electronics* P.I. Burks* Computer Component Source * Dalbani Corp.* Diversified Parts* East Coast Transistor* Eiger Electronics* Electronics Warehouse Corp.* Electronix Corp.* Fox International* GMB/dba Fox International* Herman Electronics* 17 Joseph Electronics* Marshall Industries* MCM Electronics* Philips Consumer Electronics Corp. Service Parts Premium Parts + Electronics Co.* 20 Projector-Recorder Belt Corp. RNJ Electronics Inc.* 14 Sony Service Co. Tentel Corp. 15 Tri State Electronics* Trumico* Union Electric* Vance Baldwin Inc.*			
TEST JIGS AND FIXTURES			
American Reliance Inc. B-B&W Electronics* Brian Instruments, Inc. P.I. Burks* Bursma Electronic Distributing* Computer Component Source * Consolidated Electronics, Inc.* Diversified Parts* Eagan Technical Services, Inc. Eiger Electronics* Electro-Metrics, Inc. A Penril Corp. Electronics Warehouse Corp.* Electronix Corp.* Emulation Technology Inc. E-Z Hook GMB/dba Fox International* Herman Electronics* 17 Hy-Tronix Instruments, Inc. W.S. Jenks & Son* Joseph Electronics* MCM Electronics* Philips Consumer Electronics Corp. Service Parts Philips ECG 5 Polaris Div. of UXL Corp. Schurter, Inc. Sony Service Co. Tentel Corp. 15 Union Electric* Vance Baldwin Inc.*			
POWER SUPPLIES, BENCH			
Accutest Instruments* Alfa Electronics Allied Electronics, Inc. An Avnet Co.* American Reliance Inc. Arrow Electronics Inc. Catalog Sales Div.* AT&T Capital Corporation Instrument Services Instrument Services Div. B-B&W Electronics* Behlman Electronics Bel Merit Brunelle Instruments Inc. P.I. Burks* Bursma Electronic Distributing* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* C&S Sales* Deltron, Inc. East Coast Transistor* Eiger Electronics* E.I.L. Instruments, SD Electronics Warehouse Corp.* Electronix Corp.* Electronix Express* Elenco Electronics, Inc. Elgar Corp. Galco Industrial Electronics* GMB/dba Fox International* Hameg Instruments, Inc. Heath Co. Herman Electronics* 17 HMC-Hub Material Co.* Hosfelt Electronics* Harco Electronics* W.S. Jenks & Son* Joseph Electronics* Kenwood U.S.A. Corp. Kikusui International Corp. Leader Instruments Corp. MAI/Prime Parts* Marshall Industries* MCM Electronics*			
TEST LEADS AND PROBES			
Accutest Instruments* Alfa Electronics Allied Electronics, Inc. An Avnet Co.* American Design Components* American Reliance Inc. Amprobe Instrument Anritsu Meter Co. of America Atrix, Inc.* Avex Probes Inc. AVO Biddle Instruments B-B&W Electronics* Bel Merit Brian Instruments, Inc. Brunelle Instruments Inc. P.I. Burks* Bursma Electronic Distributing* Com-Kyl Inc.* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* C&S Sales* CUI Stack, Inc. Dalbani Corp.* Diversified Parts* East Coast Transistor* Eiger Electronics* E.I.L. Instruments, SD Electro Standards Lab, Inc. Data Communications Products Div. Electromatic Controls/ Soar Instruments Electronics Warehouse Corp.* Elenco Electronics, Inc. Emulation Technology Inc. Extex Instruments Corp. E-Z Hook Fieldpiece Instruments Galco Industrial Electronics* GC Electronics Div. of GC Thorsen Co.			
TRANSFORMERS: ISOLATION/VARIABLE			
Accutest Instruments* Allied Electronics, Inc. An Avnet Co.* American Design Components* Arrow Electronics Inc. Catalog Sales Div.* B-B&W Electronics* P.I. Burks* Bursma Electronic Distributing* Computer Component Source * Computer Power, Inc. Consolidated Electronics, Inc.* C&S Sales* Eiger Electronics* E.I.L. Instruments, SD Electronics Warehouse Corp.* Electronix Express* Fox International* Galco Industrial Electronics* GMB/dba Fox International* Herman Electronics* 17 HMC-Hub Material Co.* Hosfelt Electronics* Hy-Tronix Instruments, Inc. IET Labs, Inc. ITT Pomona Electronics JDR Micro* W.S. Jenks & Son* Joseph Electronics* MAI/Prime Parts* Marshall Industries* MCM Electronics* Mouser Electronics* PanSon Electronics* Philips Consumer Electronics Corp. Service Parts Print Products International *D 11 RAG Electronics Inc.* Sencore Electronics IFC, 4 SHOGYO International Corp. Specialized Products Co.*			
OTHER TEST EQUIPMENT ACCESSORIES			
Accutest Instruments* AEMC Corp. Allied Electronics, Inc. An Avnet Co.* Amprobe Instrument Avex Probes Inc. Brian Instruments, Inc. P.I. Burks* Bursma Electronic Distributing* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* CRC Industries, Inc. C&S Sales* Dandy Mfg. Co. Eagan Technical Services, Inc. East Coast Transistor* Eiger Electronics* E.I.L. Instruments, SD Electro Standards Lab, Inc. Data Communications Products Div. Electron Processing Electronics Warehouse Corp.* Electronix Corp.* Emulation Technology Inc. E-Z Hook Fluke Corp. BC Fox International* Galco Industrial Electronics* Gemini Inc. GMB/dba Fox International* Hameg Instruments, Inc. Herman Electronics* 17 HMC-Hub Material Co.* Hosfelt Electronics* Hy-Tronix Instruments, Inc. ITT Pomona Electronics JDR Micro* W.S. Jenks & Son* Johnson Electronic Technologies Jonard Industries Corp. Joseph Electronics* Kenwood U.S.A. Corp. Kestor Solder MAI/Prime Parts* Marshall Industries* MCM Electronics* Mill Electronics Inc.* Oldaker Corp. OPToelectronics, Inc. Pacific Electro Data, Inc. Pfanstiehl Corp. Philips Consumer Electronics Corp. Service Parts Print Products International *D 11 Probe Master H.C. Protek			

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RAG Electronics Inc.*D
 Ramsey Electronics Inc.
 Republic Packaging Corp.
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 Schurter, Inc.
 Sencore Electronics IFC, 4
 Simpson Electric Co.
 Techni-Tool Inc.*D
 Tektronix Television Div.
 Tentel Corp. 15
 Tri State Electronics*D
 Truminco*D
 Union Electric*D
 Universal Enterprises
 Vance Baldwin Inc.*D

Circuit damage protective equipment/supplies

POWER CONDITIONING EQUIPMENT

GROUNDING SYSTEMS

AEMC Corp.
 Arrow Electronics Inc. Catalog Sales Div.*D
 Atrix, Inc.*D
 Computer Component Source *D
 Contact East, Inc.*D
 GMB/dba Fox International*D
 HMC-Hub Material Co.*D
 W.S. Jenks & Son*D
 MAI/Prime Parts*D
 MCM Electronics*D
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 Specialized Products Co.*D
 Static Prevention Inc.
 Vance Baldwin Inc.*D
 Verite

POWER LINE MONITORS

Accutest Instruments*D
 Allied Electronics, Inc. An Avnet Co.*D
 American Power Conversion Corp.
 Arrow Electronics Inc. Catalog Sales Div.*D
 Atrix, Inc.*D
 AT&T Capital Corporation Instrument Services Instrument Services Div.
 BMI-Basic Measuring Instruments
 Brunelle Instruments Inc.
 Bursma Electronic Distributing*D
 Computer Component Source *D
 Consolidated Electronics, Inc.*D
 Contact East, Inc.*D
 Dranetz Technologies, Inc.
 E.I.L. Instruments, SD
 Electronics Warehouse Corp.*D
 Extech Instruments Corp.
 HMC-Hub Material Co.*D
 Hosfelt Electronics*D
 Harco Electronics*D
 JDR Micro*D
 W.S. Jenks & Son*D
 Joseph Electronics*D
 MAI/Prime Parts*D
 MCM Electronics*D
 Mendon Electronics Corp.
 Omega Engineering Inc.
 Perma Power Electronics, Inc.
 Powertronics
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 SL Waber, Inc.
 Sola
 Specialized Products Co.*D
 The Superior Electric Co.
 Tri State Electronics*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Walker Scientific

STANDBY POWER SYSTEMS

Acme Electric Advanced Energy Systems
 AESI/Stedi Watt
 Allied Electronics, Inc. An Avnet Co.*D
 American Design Components*D
 American Power Conversion Corp.
 Arrow Electronics Inc. Catalog Sales Div.*D
 Best Power Technology
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Computer Component Source *D
 Computer Power, Inc.
 Contact East, Inc.*D
 Controlled Power Co.
 Eiger Electronics*D
 Electronics Warehouse Corp.*D
 Galco Industrial Electronics*D
 GMB/dba Fox International*D
 Herman Electronics*D 17
 HMC-Hub Material Co.*D
 Hosfelt Electronics*D
 Harco Electronics*D
 JDR Micro*D
 W.S. Jenks & Son*D
 Joseph Electronics*D
 Kalglo Electronics Co. Inc.
 MAI/Prime Parts*D
 M.A.T. Electronics*D
 MCM Electronics*D
 Minuteman UPS
 Perma Power Electronics, Inc.
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 SL Waber, Inc.
 Sola
 Specialized Products Co.*D
 Sprague Magnetics, Inc.*D
 Sutton Designs, Inc. Computer Power Div.
 Tri State Electronics*D
 Tripp Lite
 Tucker Electronics Co.*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68

SURGE/SPIKE PROTECTORS

Accutest Instruments*D
 AESI/Stedi Watt
 Allied Electronics, Inc. An Avnet Co.*D
 American Design Components*D
 American Power Conversion Corp.
 Arrow Electronics Inc. Catalog Sales Div.*D
 Atrix, Inc.*D
 B-B&W Electronics*D
 Best Power Technology
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Computer Component Source *D
 Computer Power, Inc.
 Consolidated Electronics, Inc.*D
 Contact East, Inc.*D
 Controlled Power Co.
 Dalbani Corp.*D
 Datatran Corp.
 Diversified Parts*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electro Standards Lab, Inc. Data Communications Products Div.
 Electron Processing
 Electronic Specialists, Inc.
 Electronics Warehouse Corp.*D
 Electronix Corp.*D
 Electronix Express*D
 Fox International*D
 Galco Industrial Electronics*D
 GC Electronics Div. of GC Thorsen Co.
 Geist Inc.
 GMB/dba Fox International*D
 Herman Electronics*D 17
 HMC-Hub Material Co.*D
 Hosfelt Electronics*D
 Harco Electronics*D
 JDR Micro*D
 W.S. Jenks & Son*D
 Joseph Electronics*D
 Kalglo Electronics Co. Inc.
 Kelvin Electronics*D
 MAI/Prime Parts*D

Marshall Industries*D
 M.A.T. Electronics*D
 MCG Electronics, Inc.
 MCM Electronics*D
 Mill Electronics Inc.*D
 Minuteman UPS
 Montgomery Ward National Parts Center*D
 Mouser Electronics*D
 Omega Engineering Inc.
 ORA Electronics
 Panamax
 Perma Power Electronics, Inc.
 Philips ECG 5
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 Schurter, Inc.
 Shape Electronics
 SL Waber, Inc.
 Sola
 Specialized Products Co.*D
 The Superior Electric Co.
 Sutton Designs, Inc. Computer Power Div.
 Techni-Tool Inc.*D
 Thomson Consumer Electronics, Inc. Distributor & Special Products*D
 Tool Kit Specialists, Inc.*D
 Tri State Electronics*D
 Tripp Lite
 Union Electric*D
 Vance Baldwin Inc.*D
 Verite
 Warranty Repair Corp.
 Wholesale Electronics Inc.*D 68

UNINTERRUPTIBLE POWER SUPPLIES

AESI/Stedi Watt
 Allied Electronics, Inc. An Avnet Co.*D
 American Design Components*D
 American Power Conversion Corp.
 Arrow Electronics Inc. Catalog Sales Div.*D
 B-B&W Electronics*D
 Behlman Electronics
 Best Power Technology
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Clary Corp.
 Computer Component Source *D
 Computer Power, Inc.
 Consolidated Electronics, Inc.*D
 Contact East, Inc.*D
 Controlled Power Co.
 Eiger Electronics*D
 Electronics Warehouse Corp.*D
 Electronix Express*D
 Elgar Corp.
 Galco Industrial Electronics*D
 General Power Systems, Inc.
 GMB/dba Fox International*D
 Herman Electronics*D 17
 HMC-Hub Material Co.*D
 Horizon Technology, Inc.*D
 Hosfelt Electronics*D
 Harco Electronics*D
 ICS, Inc. Electro-Pac Div.
 JDR Micro*D
 W.S. Jenks & Son*D
 Joseph Electronics*D
 Kalglo Electronics Co. Inc.
 Kelvin Electronics*D
 MAI/Prime Parts*D
 M.A.T. Electronics*D
 MCM Electronics*D
 Meirick, Inc.
 Minuteman UPS
 Mouser Electronics*D
 Pacific Power Source
 Perma Power Electronics, Inc.
 Philtek Power Corp.
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 SL Waber, Inc.
 Sola
 Specialized Products Co.*D
 Sprague Magnetics, Inc.*D
 The Superior Electric Co.
 Sutton Designs, Inc. Computer Power Div.
 Tool Kit Specialists, Inc.*D
 Tri State Electronics*D
 Tripp Lite

Tucker Electronics Co.*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68

VOLTAGE REGULATORS

Accutest Instruments*D
 Allied Electronics, Inc. An Avnet Co.*D
 American Power Conversion Corp.
 Arrow Electronics Inc. Catalog Sales Div.*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Computer Component Source *D
 Computer Power, Inc.
 Contact East, Inc.*D
 Controlled Power Co.
 East Coast Transistor*D
 E.I.L. Instruments, SD
 Electronic Specialists, Inc.
 Electronics Warehouse Corp.*D
 Electronix Express*D
 Galco Industrial Electronics*D
 GMB/dba Fox International*D
 Herman Electronics*D 17
 HMC-Hub Material Co.*D
 Hosfelt Electronics*D
 Harco Electronics*D
 JDR Micro*D
 W.S. Jenks & Son*D
 Joseph Electronics*D
 Kalglo Electronics Co. Inc.
 MAI/Prime Parts*D
 MCM Electronics*D
 Minuteman UPS
 Perma Power Electronics, Inc.
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 Shape Electronics
 SL Waber, Inc.
 Sola
 Specialized Products Co.*D
 The Superior Electric Co.
 Sutton Designs, Inc. Computer Power Div.
 Tri State Electronics*D
 Tripp Lite
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68

Electrostatic discharge protection

ANTISTATIC CHEMICALS

ACL Inc./Staticide
 Allied Electronics, Inc. An Avnet Co.*D
 Atrix, Inc.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Caig Labs, Inc.
 Chapman Corp.
 Charleswater, Div. of Desco Industries Inc.
 Chemtronics Inc.
 Com-Kyl Inc.*D
 Computer Component Source *D
 Contact East, Inc.*D
 Desco Industries
 Dow U.S.A.
 East Coast Transistor*D
 Eiger Electronics*D
 Electronic Production Specialist
 Electronics Warehouse Corp.*D
 Electronix Express*D
 Fox International*D
 Galco Industrial Electronics*D
 GC Electronics Div. of GC Thorsen Co.
 Herman Electronics*D 17
 HMC-Hub Material Co.*D
 Hosfelt Electronics*D
 Harco Electronics*D
 JDR Micro*D
 W.S. Jenks & Son*D
 JIT Resources Inc.
 Joseph Electronics*D
 Kelvin Electronics*D

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GC Electronics Div. of GC Thorsen Co. GMB/dba Fox International* Herman Electronics* HMC-Hub Material Co.* Harco Electronics* JDR Micro* W.S. Jenks & Son* Joseph Electronics* Kelvin Electronics* Klein Tools, Inc. MAI/Prime Parts* Marshall Industries* M.A.T. Electronics* MCM Electronics* Micro Care Corp. Mill Electronics Inc.* Multicore Solder P.K. Neuses Inc.* PanSon Electronics* Parts Express International Inc.* Philips Consumer Electronics Corp. Service Parts Philips ECG Planned Products Premium Parts + Electronics Co.* Print Products International * Projector-Recorder Belt Corp. Rawn Co. Inc., (Subsidiary of the Triangle Corp.) RNJ Electronics Inc.* Sony Service Co. National Parts Div.* Specialized Products Co.* Tech Spray, Inc. Techni-Tool Inc.* Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* Zenith Sales Co. A Div. of Zenith Electronics Corp.	Techni-Tool Inc.* The Twexpe Co. Thomson Consumer Electronics, Inc. Distributor & Special Products* 3M Consumer & Pro Video & Audio Markets Div. Time Motion Tools Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* LAMP All Electronics Corp.* Allied Electronics, Inc. An Avnet Co.* Arrow Electronics Inc. Catalog Sales Div.* ARS Electronics* Atrix, Inc.* B-B&W Electronics* P.I. Burks* Bursma Electronic Distributing* Com-Kyl Inc.* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* Dalbani Corp.* Dazor Mfg. Corp. East Coast Transistor* Eiger Electronics* Electronic Production Specialist Electronics Warehouse Corp.* Electronix Express* GMB/dba Fox International* Herman Electronics* HMC-Hub Material Co.* Harco Electronics* Jensen Tools Inc.* Joseph Electronics* Kelvin Electronics* Luxo Corp. MAI/Prime Parts* Marshall Industries* M.A.T. Electronics* MCM Electronics* Mill Electronics Inc.* PanSon Electronics* Parts Express International Inc.* Premium Parts + Electronics Co.* Print Products International * Projector-Recorder Belt Corp. RNJ Electronics Inc.* SHOGYO International Corp. Specialized Products Co.* Start International* Techni-Tool Inc.* Teclab/Kalamazoo Technical Furniture, Inc. Tool Kit Specialists, Inc.* Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* MAGNIFIERS Allied Electronics, Inc. An Avnet Co.* Atrix, Inc.* B-B&W Electronics* Bursma Electronic Distributing* Com-Kyl Inc.* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* Dazor Mfg. Corp. East Coast Transistor* Edroy Products Electro Tool, Inc. * Electronic Production Specialist Electronics Warehouse Corp.* Fox International* GMB/dba Fox International* Herman Electronics* HMC-Hub Material Co.* Harco Electronics* W.S. Jenks & Son* Jensen Tools Inc.* Joseph Electronics* Kelvin Electronics* Luxo Corp. Marshall Industries* M.A.T. Electronics*	MCM Electronics* Print Products International * RNJ Electronics Inc.* Solder Absorbing Technology, Inc. Specialized Products Co.* Start International* Techni-Tool Inc.* Teclab/Kalamazoo Technical Furniture, Inc. Tool Kit Specialists, Inc.* Tool Tron Industries Tri State Electronics* Union Electric* Vance Baldwin Inc.* SHELVES/RACKS/BINS Allied Electronics, Inc. An Avnet Co.* Arrow Electronics Inc. Catalog Sales Div.* P.I. Burks* Com-Kyl Inc.* Contact East, Inc.* Electronic Production Specialist Galco Industrial Electronics* Geist Inc. GMB/dba Fox International* HMC-Hub Material Co.* W.S. Jenks & Son* JIT Resources Inc. Joseph Electronics* Kelvin Electronics* Klein Tools, Inc. Marshall Industries* MCM Electronics* Melmat Inc. Print Products International * The Rex Co. Start International* Techni-Tool Inc.* Teclab/Kalamazoo Technical Furniture, Inc. Time Motion Tools Trace Racks Tri State Electronics* Vance Baldwin Inc.* SOLDER/DESOLDERING BRAID/FLUX All Electronics Corp.* Allied Electronics, Inc. An Avnet Co.* American Design Components* Andrews Electronics * A.P.E. Corp. Arrow Electronics Inc. Catalog Sales Div.* Atrix, Inc.* B-B&W Electronics* P.I. Burks* Bursma Electronic Distributing* Chemtronics Inc. Com-Kyl Inc.* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* C&S Sales* Dalbani Corp.* East Coast Transistor* Eiger Electronics* Electro Tool, Inc. * Electronic Production Specialist Electronics Warehouse Corp.* Electronix Corp.* Electronix Express* ESP, Inc. Fox International* Galco Industrial Electronics* GC Electronics Div. of GC Thorsen Co. GMB/dba Fox International* Herman Electronics* Hexacon Electric Co. HMC-Hub Material Co.* Howard Electronics Instruments Inc.* Harco Electronics* Jameco Electronic Components & Computer Products JDR Micro* W.S. Jenks & Son* Jensen Tools Inc.* Joseph Electronics* Kelvin Electronics* Kestor Solder MAI/Prime Parts*	Marshall Industries* M.A.T. Electronics* MCM Electronics* Mill Electronics Inc.* Multicore Solder Nu-Concept Systems, Inc. Oldaker Corp. Omega Engineering Inc. PanSon Electronics* Parts Express International Inc.* Philips Consumer Electronics Corp. Service Parts Philips ECG Premium Parts + Electronics Co.* Print Products International * RNJ Electronics Inc.* Solder Absorbing Technology, Inc. Sony Service Co. National Parts Div.* Specialized Products Co.* Start International* Tech Spray, Inc. Techni-Tool Inc.* Tool Kit Specialists, Inc.* Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* TUBING All Electronics Corp.* Allied Electronics, Inc. An Avnet Co.* Arrow Electronics Inc. Catalog Sales Div.* B-B&W Electronics* Bursma Electronic Distributing* Com-Kyl Inc.* Contact East, Inc.* East Coast Transistor* Electronics Warehouse Corp.* Electronix Express* Fox International* Galco Industrial Electronics* GMB/dba Fox International* Herman Electronics* Harco Electronics* W.S. Jenks & Son* Joseph Electronics* Kelvin Electronics* MAI/Prime Parts* MCM Electronics* Mill Electronics Inc.* M.M. Newman Corp. Omega Engineering Inc. Russell Industries Tri State Electronics* Union Electric* Vance Baldwin Inc.* Wholesale Electronics Inc.* WIRE, CABLE AND ACCESSORIES All Electronics Corp.* Allied Electronics, Inc. An Avnet Co.* American Design Components* Arrow Electronics Inc. Catalog Sales Div.* ARS Electronics* B-B&W Electronics* P.I. Burks* Bursma Electronic Distributing* Com-Kyl Inc.* Computer Component Source * Consolidated Electronics, Inc.* Contact East, Inc.* Dalbani Corp.* East Coast Transistor* Eiger Electronics* Electronics Warehouse Corp.* Electronix Corp.* Electronix Express* Fox International* GMB/dba Fox International* Herman Electronics* Harco Electronics* ITTE Pomona Electronics Jameco Electronic Components & Computer Products JDR Micro* Jensen Tools Inc.* Joseph Electronics* Kelvin Electronics* Kestor Solder MAI/Prime Parts*

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MAI/Prime Parts*D
 M.A.T. Electronics*D
 MCM Electronics*D
 Mill Electronics Inc.*D
 M.M. Newman Corp.
 Oldaker Corp.
 Omega Engineering Inc.
 ORA Electronics
 PanSon Electronics*D
 Parts Express International
 Inc.*D 19
 RNJ Electronics Inc.*D 14
 SHOGYO International Corp.
 Support Systems International Cables
 & Accessories Div.
 3M Electronic Products Div.
 Time Motion Tools
 Tri State Electronics*D
 Trompeter Electronics
 Truminco*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68
 Zenith Sales Co. A Div. of Zenith
 Electronics Corp.

Computer Component Source *D
 Consolidated Electronics, Inc.*D
 Dalbani Corp.*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electron Processing
 Electronics Warehouse Corp.*D
 Electronix Corp.*D
 Fox International*D
 GC Electronics Div. of GC Thorsen Co.
 GMB/dba Fox International*D
 Herman Electronics*D 17
 Jameco Electronic Components &
 Computer Products
 JDR Micro*D
 Joseph Electronics*D
 MAI/Prime Parts*D
 M.A.T. Electronics*D
 MCM Electronics*D
 Microwave Filter Co., Inc.
 Mill Electronics Inc.*D
 Montgomery Ward National Parts
 Center*D
 Multiplex Technology, Inc.
 ORA Electronics
 PanSon Electronics*D
 Parts Express International
 Inc.*D 19
 Philips ECG 5
 Premium Parts + Electronics
 Co.*D 20
 RNJ Electronics Inc.*D 14
 Sony Service Co. National Parts Div.*D
 Sprague Magnetics, Inc.*D
 Support Systems International Cables
 & Accessories Div.
 Tri State Electronics*D
 Trompeter Electronics
 Truminco*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68
 Zenith Sales Co. A Div. of Zenith
 Electronics Corp.

MCM Electronics*D
 Multiplex Technology, Inc.
 RNJ Electronics Inc.*D 14
 Sony Service Co. National Parts Div.*D
 Sprague Magnetics, Inc.*D
 Tri State Electronics*D
 Truminco*D
 Union Electric*D
 Vance Baldwin Inc.*D

SIGNAL MIXERS

Allied Electronics, Inc. An Avnet Co.*D
 Arrow Electronics Inc. Catalog Sales
 Div.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Dalbani Corp.*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electronics Warehouse Corp.*D
 GMB/dba Fox International*D
 Herman Electronics*D 17
 Joseph Electronics*D
 MCM Electronics*D
 Mill Electronics Inc.*D
 Multiplex Technology, Inc.
 RNJ Electronics Inc.*D 14
 Sony Service Co. National Parts Div.*D
 Sprague Magnetics, Inc.*D
 Tri State Electronics*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68
 Zenith Sales Co. A Div. of Zenith
 Electronics Corp.

JIGS/FIXTURES/VICES

Allied Electronics, Inc. An Avnet Co.*D
 Andrews Electronics *D 23
 B-B&W Electronics*D
 P.I. Burks*D
 Computer Component Source *D
 Consolidated Electronics, Inc.*D
 Electro Tool, Inc. *D
 Electronic Production Specialist
 Electronics Warehouse Corp.*D
 Electronix Corp.*D
 Electronix Express*D
 Fox International*D
 GMB/dba Fox International*D
 HMC-Hub Material Co.*D
 HSC Service Co. Div. of Hitachi Sales
 Corp. of America
 Jameco Electronic Components &
 Computer Products
 JDR Micro*D
 W.S. Jenks & Son*D
 Joseph Electronics*D
 Kelvin Electronics*D
 MCM Electronics*D
 PanaVise Products, Inc.
 Parts Express International
 Inc.*D 19
 Philips Consumer Electronics Corp.
 Service Parts
 RNJ Electronics Inc.*D 14
 Sony Service Co. National Parts Div.*D
 Specialized Products Co.*D
 Techni-Tool Inc.*D
 Tri State Electronics*D
 Union Electric*D
 Vance Baldwin Inc.*D

Audio/video accessories

A/B SWITCHES

Ambico
 American Design Components*D
 Arrow Electronics Inc. Catalog Sales
 Div.*D
 Atrix, Inc.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Channel Master Div. of Avnet, Inc.
 Computer Component Source *D
 Consolidated Electronics, Inc.*D
 Dalbani Corp.*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electro Standards Lab, Inc. Data
 Communications Products Div.
 Electronics Warehouse Corp.*D
 Electronix Corp.*D
 Electronix Express*D
 Fox International*D
 GC Electronics Div. of GC Thorsen Co.
 GMB/dba Fox International*D
 Herman Electronics*D 17
 Jameco Electronic Components &
 Computer Products
 JDR Micro*D
 Joseph Electronics*D
 L-Com Inc.
 MAI/Prime Parts*D
 M.A.T. Electronics*D
 MCM Electronics*D
 Mill Electronics Inc.*D
 Montgomery Ward National Parts
 Center*D
 ORA Electronics
 PanSon Electronics*D
 Parts Express International
 Inc.*D 19
 Philips ECG 5
 Premium Parts + Electronics
 Co.*D 20
 RNJ Electronics Inc.*D 14
 Sony Service Co. National Parts Div.*D
 Sprague Magnetics, Inc.*D
 Support Systems International Cables
 & Accessories Div.
 Tri State Electronics*D
 Truminco*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68
 Zenith Sales Co. A Div. of Zenith
 Electronics Corp.

FILTERS

Allied Electronics, Inc. An Avnet Co.*D
 American Design Components*D
 Arrow Electronics Inc. Catalog Sales
 Div.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Channel Master Div. of Avnet, Inc.
 East Coast Transistor*D
 Eiger Electronics*D
 Electron Processing
 Electronic Specialists, Inc.
 Electronics Warehouse Corp.*D
 GMB/dba Fox International*D
 Herman Electronics*D 17
 Joseph Electronics*D
 MAI/Prime Parts*D
 MCM Electronics*D
 Microwave Filter Co., Inc.
 Mill Electronics Inc.*D
 Multiplex Technology, Inc.
 RNJ Electronics Inc.*D 14
 Sony Service Co. National Parts Div.*D
 Sprague Magnetics, Inc.*D
 Tri State Electronics*D
 Union Electric*D
 Vance Baldwin Inc.*D
 Wholesale Electronics Inc.*D 68

RF SWITCHERS

Allied Electronics, Inc. An Avnet Co.*D
 Arrow Electronics Inc. Catalog Sales
 Div.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Computer Component Source *D
 Dalbani Corp.*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electron Processing
 Electronics Warehouse Corp.*D
 Fox International*D
 GMB/dba Fox International*D
 Herman Electronics*D 17
 Joseph Electronics*D
 L-Com Inc.

COUPLERS/SPLITTERS

Arrow Electronics Inc. Catalog Sales
 Div.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Channel Master Div. of Avnet, Inc.

Tools

HEAT GUNS

All Electronics Corp.*D
 Allied Electronics, Inc. An Avnet Co.*D
 Arrow Electronics Inc. Catalog Sales
 Div.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Com-Kyl Inc.*D
 Computer Component Source *D
 Contact East, Inc.*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electro Tool, Inc. *D
 Electronic Production Specialist
 Electronics Warehouse Corp.*D
 Electronix Express*D
 Eraser Co., Inc. Wybar Div.
 Fox International*D
 Galco Industrial Electronics*D
 GMB/dba Fox International*D
 Herman Electronics*D 17
 HMC-Hub Material Co.*D
 Harco Electronics*D
 Jameco Electronic Components &
 Computer Products
 W.S. Jenks & Son*D
 Joseph Electronics*D
 Kelvin Electronics*D
 Marshall Industries*D
 M.A.T. Electronics*D
 MCM Electronics*D
 Parts Express International
 Inc.*D 19
 Portasol, Inc.
 Print Products International *D 11
 RNJ Electronics Inc.*D 14
 Snap-On Tools Corp.
 Sony Service Co. National Parts Div.*D
 Specialized Products Co.*D
 Techni-Tool Inc.*D
 Time Motion Tools
 Tool Kit Specialists, Inc.*D
 Tri State Electronics*D
 Ungar, A Rubbermaid Co.
 Union Electric*D
 Vance Baldwin Inc.*D
 Weidmuller, Paladin Tools
 Wholesale Electronics Inc.*D 68

SOLDERING/DESOLDERING EQUIPMENT

Allied Electronics, Inc. An Avnet Co.*D
 American Design Components*D
 American Hakko Products
 Andrews Electronics *D 23
 A.P.E. Corp.
 Arrow Electronics Inc. Catalog Sales
 Div.*D
 Atrix, Inc.*D
 B-B&W Electronics*D
 P.I. Burks*D
 Bursma Electronic Distributing*D
 Caig Labs, Inc.
 Circuit Repair Corp.
 Com-Kyl Inc.*D
 Computer Component Source *D
 Consolidated Electronics, Inc.*D
 Contact East, Inc.*D
 CooperTools
 C&S Sales*D
 Dalbani Corp.*D
 Den-On Instruments, Inc. 14
 Digi-Key Corp.*D
 East Coast Transistor*D
 Eiger Electronics*D
 Electro Tool, Inc. *D
 Electronic Production Specialist
 Electronics Warehouse Corp.*D
 Electronix Corp.*D
 Electronix Express*D
 Elenco Electronics, Inc.
 Elvo Div. of Zumbach Electronics Corp.
 ESP, Inc.
 Fox International*D
 Galco Industrial Electronics*D
 GC Electronics Div. of GC Thorsen Co.
 GMB/dba Fox International*D
 Heath Co.
 Herman Electronics*D 17
 Hexacon Electric Co.
 HMC-Hub Material Co.*D
 Howard Electronics
 Instruments Inc.*D 68
 Harco Electronics*D
 HSC Service Co. Div. of Hitachi Sales
 Corp. of America
 Jameco Electronic Components &
 Computer Products
 JDR Micro*D
 W.S. Jenks & Son*D
 Jensen Tools Inc.*D
 Jensen Electronics*D
 Kelvin Electronics*D
 Leads Metal Products, Inc. (ENDECO)
 MAI/Prime Parts*D

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Marshall Industries*
M.A.T. Electronics*
MCM Electronics*
METCAL
Multicore Solder
P.K. Neuses Inc.*
M.M. Newman Corp.
Nu-Concept Systems, Inc.
O.K. Industries Inc.
Omega Engineering Inc.
ORA Electronics
PACE, Inc.
PanSon Electronics*
Parts Express International Inc.*D 19
Philips Consumer Electronics Corp. Service Parts
Portasol, Inc.
Premium Parts + Electronics Co.*D 20
Print Products International *D 11
RNJ Electronics Inc.*D 14
Royer Soldering Systems, Inc.
Snap-On Tools Corp.
Solder Absorbing Technology, Inc.
Sony Service Co. National Parts Div.*
Specialized Products Co.*
Start International*
Tech Spray, Inc.
Techni-Tool Inc.*
Time Motion Tools
Tool Kit Specialists, Inc.*
Tri State Electronics*
Tucker Electronics Co.*
Ungar, A Rubbermaid Co.
Union Electric*
Vance Baldwin Inc.*
Virtual Industries
Wholesale Electronics Inc.*D 68

Arrow Electronics Inc. Catalog Sales Div.*
Atrix, Inc.*
B-B&W Electronics*
P.I. Burks*
Bursma Electronic Distributing*
Chicago Case Co.
Com-Kyl Inc.*
Computer Component Source *
Consolidated Electronics, Inc.*
Contact East, Inc.*
CooperTools
C&S Sales*
Dalbani Corp.*
Diversified Case Co. Inc.
East Coast Transistor*
Electro Tool, Inc. *
Electronic Production Specialist
Electronics Warehouse Corp.*
Electronix Express*
Elenco Electronics, Inc.
C.H. Ellis Co., Inc.
Galco Industrial Electronics*
GC Electronics Div. of GC Thorsen Co.
Gemini Inc.
GMB/dba Fox International*
Herman Electronics*D 17
Highland Products, Inc.
HMC-Hub Material Co.*
Harco Electronics*
Jameco Electronic Components & Computer Products
JDR Micro*
W.S. Jenks & Son*
Jensen Tools Inc.*
Jonard Industries Corp.
Joseph Electronics*
Kelvin Electronics*
Klein Tools, Inc.
MAI/Prime Parts*
Marshall Industries*
MCM Electronics*
Meimat Inc.
P.K. Neuses Inc.*
PanSon Electronics*
Platt Luggage
Print Products International *D 11
R & K Supply Co.

RNJ Electronics Inc.*D 14
Snap-On Tools Corp.
Sony Service Co. National Parts Div.*
Specialized Products Co.*
Spencer Industries
Techni-Tool Inc.*
Thomson Consumer Electronics, Inc. Distributor & Special Products*
Time Motion Tools
Tool Kit Specialists, Inc.*
Tri State Electronics*
Union Electric*
Vance Baldwin Inc.*
Wholesale Electronics Inc.*D 68
Zero Corp., East Div.

TOOL KITS

Allied Electronics, Inc. An Avnet Co.*
American Design Components*
Andrews Electronics *D 23
Arrow Electronics Inc. Catalog Sales Div.*
Atrix, Inc.*
P.I. Burks*
Bursma Electronic Distributing*
Circuit Repair Corp.
Clauss Electronics Div.
Com-Kyl Inc.*
Computer Component Source *
Consolidated Electronics, Inc.*
Contact East, Inc.*
CooperTools
C&S Sales*
Dalbani Corp.*
Dremel
East Coast Transistor*
Eiger Electronics*
Electro Tool, Inc. *
Electronic Production Specialist
Electronics Warehouse Corp.*
Electronix Corp.*
Electronix Express*
Elenco Electronics, Inc.
Eraser Co., Inc. Wybar Div.
Fox International*
Galco Industrial Electronics*
GC Electronics Div. of GC Thorsen Co.
GMB/dba Fox International*
Heath Co.
Herman Electronics*D 17
HMC-Hub Material Co.*
Harco Electronics*
Jameco Electronic Components & Computer Products
JDR Micro*
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Thomson Consumer Electronics, Inc. Distributor & Special Products*
Time Motion Tools
Tool Kit Specialists, Inc.*
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Bondhus Corp.
P.I. Burks*
Bursma Electronic Distributing*
Channel Master Div. of Avnet, Inc.
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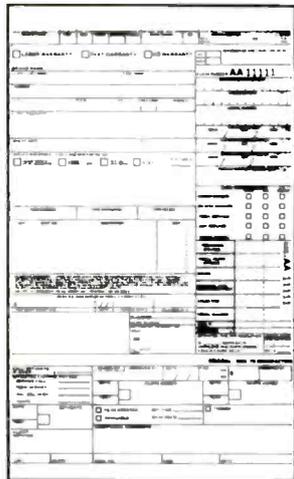
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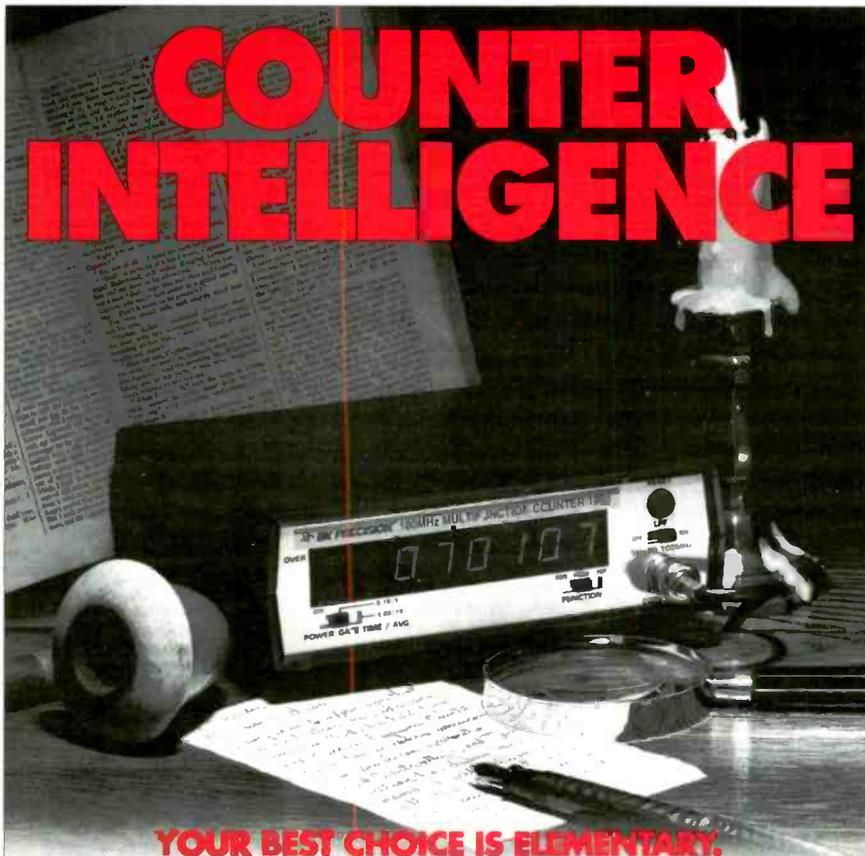
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A line listing that is in color indicates that the company listed has an ad in this issue. The number following the listing is the number of the page on which the ad is located.

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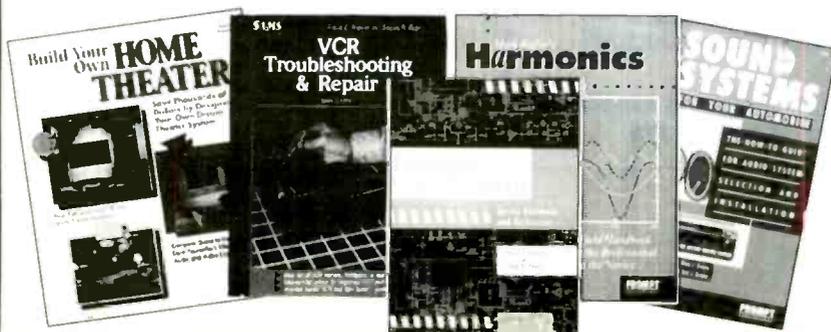
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401 W. Artesia Blvd.
Compton, CA 90220
800-HITACHI

Hi-Techniques Inc.
152 Owen Road
Madison, WI 53716
608-221-7500
800-248-1633
Fax 608-221-7509

HMC-Hub Material Co.* D
33 Springdale Ave.
Canton, MA 02021
617-821-1870
Fax 617-821-4133

Horizon Technology, Inc.* D
650 International Parkway, Suite
180
Richardson, TX 75081
800-888-9600
Fax 214-690-8648

Hosfelt Electronics* D
2700 Sunset Blvd.
Steubenville, OH 43952-1158
614-264-6464
800-524-6464
Fax 614-264-5414

**Howard Electronics Instruments
Inc.* D**
6222 N. Oliver
Wichita, KS 67220
316-744-1984
800-394-1984
Fax 316-744-1994

Howe Industries
P.O. Box 1040
Sanford, FL 32772

Harco Electronics* D
Route 22 Carsins Run
Aberdeen, MD 21001
410-838-7990
800-638-7616
Fax 410-734-7288

HSC Service Co.
Div. of Hitachi Sales Corp. of
America
401 W. Artesia Blvd.
Compton, CA 90220
800-447-2882

Hunter Products, Inc.
P.O. Box 6795
Bridgewater, NJ 08807
908-526-8440
800-524-0692
Fax 908-526-8348

Huntron
15720 Mill Creek Road
Mill Creek, WA 98012
206-743-3171
800-426-9265
Fax 206-743-1360

Hurley Electronics* D
2101 N. Fairview St.
Santa Ana, CA 92706
714-971-2992
800-4-HURLEY
Fax 714-971-5033

Hy-Tronix Instruments, Inc.
P.O. Box 827
Newton, KS 67114
316-283-5730
Fax 316-283-6662

I

I.A.C. Industries
895 Beacon St.
Brea, CA 92621
714-990-8997
Fax 714-990-0557

IC Master
Hearst Business Communications
645 Stewart Ave.
Garden City, NY 11530
516-227-1300
Fax 516-227-1453

ICS, Inc.
Electro-Pac Div.
520 Interstate Road
Addison, IL 60101
708-543-6200
Fax 708-543-6244

IET Labs, Inc.
534 Main St.
Westbury, NY 11590
516-334-5959
800-899-8438
Fax 516-334-5988

Impact Printhead Services
10435 Burnet Rd., Suite 114
Austin, TX 78758-4450

Independent Dealer Services
2600 Washington Ave.
St. Louis, MO 63103

Industrial Devices, Inc.
260 Railroad Ave.
Hackensack, NJ 07601
201-489-8989
Fax 201-489-6911

Industrial Training, Inc.
5376 52nd St. S.E.
Grand Rapids, MI 49512
616-698-8688
800-253-4623
Fax 616-698-9080

Interconnect Devices, Inc.
5101 Richland Ave.
Kansas City, KS 66106
913-342-5544
Fax 913-342-7043

International Components Corp.* D
105 Maxess Road
Melville, NY 11747
516-293-1500
800-645-9154
Fax 516-293-4983

International Correspondence Sch.
925 Oak St.
Scranton, PA 18515
717-347-1625
Fax 717-343-8172

International Data Sciences
501 Jefferson Blvd.
Warwick, RI 02886-1317
401-737-9900
800-437-3282
Fax 401-737-9911

International Instruments
Twin Lakes Rd., P.O. Box 185
North Branford, CT 06471
203-481-5721
Fax 203-481-8937

ISCET
2708 W. Berry
Fort Worth, TX 76109
817-921-9101
Fax 817-921-3741

ITT Pomona Electronics
1500 E. Ninth St.
Pomona, CA 91766
909-623-3463
Fax 909-629-3317

J

**Jameco Electronic Components &
Computer Products**
1355 Shoreway Road
Belmont, CA 94002
415-592-8097
800-831-4242
Fax 800-237-6948

JDR Micro* D
2233 Branham Lane
San Jose, CA 95124
408-559-1200
800-538-5000
Fax 408-559-0250

W.S. Jenks & Son* D
1933 Montana Ave. N.E.
Washington, DC 20002
202-529-6020
Fax 202-832-3411

W.S. Jenks & Son* D
6632 Electronic Drive
Springfield, VA 22151
703-750-5406

Jensen Tools Inc.* D
7815 South 46th St.
Phoenix, AZ 85044
602-968-6241
800-426-1194
Fax 800-366-9662

JIT Resources Inc.
300 S. Walnut, Unit 403
San Dimas, CA 91773
909-599-6090
Fax 909-592-9960

Johnson Electronic Technologies
5 Kane Industrial Drive
Hudson, MA 01749
508-562-1157

Jonard Industries Corp.
134 Marbledale Road
Tuckahoe, NY 10707
914-793-0700
Fax 914-793-4527

Joseph Electronics* D
8830 N. Milwaukee Ave.
Niles, IL 60714
708-297-4200
800-323-5925
Fax 708-297-6923

K

Kalglo Electronics Co. Inc.
6584 Ruch Road
Bethlehem, PA 18017-9359
610-837-0700
800-524-0400
Fax 610-837-7978

Keithley Instruments
28755 Aurora Road
Cleveland, OH 44139

Kelvin Electronics*D
10 Hub Drive
Melville, NY 11747
516-756-1750
800-535-8469
Fax 516-756-1763

Kenwood U.S.A. Corp.
2201 E. Dominguez St.
Long Beach, CA 90810
213-639-4200

Kestor Solder
515 E. Touhy Ave.
Des Plaines, IL 60018
708-297-1600
800-2-KESTER
Fax 708-390-9338

KeyPrestige, Inc.
11065 Knott Ave., Suite B
Cypress, CA 90630
714-893-1111
Fax 714-893-7997

Keystone Electronics Corp.
31-07 20th Road
Astoria, NY 11105-2017
718-956-8900
800-221-5510
Fax 718-956-9040

KeyTek Instrument Corp.
260 Fordham Road
Wilmington, MA 01887
508-658-0880
Fax 508-657-4803

Kikusui International Corp.
1980 Orizaba Ave.
Signal Hill, CA 90804-1203
310-986-1677
800-545-8784
Fax 310-986-1624

Klein Tools, Inc.
P.O. Box 599033
Chicago, IL 60659-9033
708-677-9500

Knight Business Systems Ltd.*D
266 Middle Island Rd., Bldg. 2-13
Medford, NY 11763
516-736-4440
800-333-5642
Fax 516-736-4228

Kobetron Inc.
2271 Arbor Blvd.
Dayton, OH 45439
513-298-8244

L

La Guardia Enterprises
5882 Rich Hill Way
Yorba Linda, CA 92686
714-579-1276

L-Com Inc.
1755 Osgood St.
North Andover, MA 01845
508-682-6936
800-343-1455-Ordering
Fax 508-689-9484

Leader Instruments Corp.
380 Oser Ave.
Hauppauge, NY 11788
516-231-6900
Fax 516-231-5295

**Leads Metal Products, Inc.
(ENDECO)**
P.O. Box 441186
Indianapolis, IN 46244-1186
317-631-7200
Fax 317-261-1208

Learning Group International
P.O. Box 45028
Los Angeles, CA 90045-0028
310-417-3484
800-843-8733
Fax 310-410-2952

Learning Group International
1805 Library St.
Reston, VA 22090
703-709-9019
800-421-8166
Fax 703-709-6405

Lil' Bitty Tester, Inc.
3154 Main St.
Chula Vista, CA 91911
619-425-1472
Fax 619-284-4567

Luxo Corp.
36 Midland Ave.
Port Chester, NY 10573
914-937-4433
800-222-5896
Fax 800-648-2978

W.J. Lynott, Associates
1044 Highland Ave.
Abington, PA 19001-4507
215-657-0776

M

Magic Solutions, Inc.
180 Franklin Turnpike
Mahwah, NJ 07430
201-529-5533
Fax 201-529-2955

MAI/Prime Parts*D
5736 N. Michigan Road
Indianapolis, IN 46208-1729
317-257-6811
Fax 317-257-1590

Marconi Instruments
3 Pearl Court
Allendale, NJ 07401
201-934-9050
800-233-2955
Fax 201-934-9229

Marshall Industries*D
9320 Telstar Ave.
El Monte, CA 91731
818-307-6000

Master Bond
154 Hobart St.
Hackensack, NJ 07601
201-343-8983
Fax 201-343-2132

M.A.T. Electronics*D
975 Jaymor
Southampton, PA 18966
215-364-7667
800-628-1118
Fax 215-364-8554

Matsushita Services Co.
50 Meadowland Parkway
Secaucus, NJ 07094
201-348-7000
800-447-4700

MaxServ
8317 Cross Park Drive, Suite 350
Austin, TX 78746
512-328-3939
Fax 512-328-3625

MCG Electronics, Inc.
12 Burt Drive
Deer Park, NY 11729
516-586-5125
800-851-1508
Fax 516-586-5120

MCM Electronics*D
650 Congress Park Drive
Dayton, OH 45459
513-434-0031
800-543-4330
Fax 513-433-3272

Meirick, Inc.
420 S. Hickory
Mount Vernon, MO 65712
417-466-3941
800-735-5069
Fax 417-466-4207

Melmat Inc.
24030 Frampton Ave.
Harbor City, CA 90710
310-325-1625
800-MELMAT-9
Fax 310-325-0603

Mendon Electronics Corp.
3800 Monroe Ave.
Pittsford, NY 14534
716-248-8480
800-227-6937
Fax 716-248-3021

METCAL
1530 O'Brien Drive
Menlo Park, CA 94025
415-325-3291
800-776-1778
Fax 415-325-5932

MetraByte Corp.
440 Myles Standish Blvd.
Taunton, MA 02780
508-880-3000
Fax 508-880-0179

Metrix, Inc.
20975 Swenson Drive, Suite 160
Waukesha, WI 53186
414-798-8560
800-543-2130
Fax 414-798-8573

Metro Data Vac
1 Ramapo Ave.
Suffern, NY 109C1
914-357-1600
800-822-1602
Fax 914-357-1640

Micro Care Corp.
34 Ronzo Road
Bristol, CT 06010-7792
800-638-0125
Fax 203-585-7378

Micro 2000
1100 E. Broadway, 3rd Floor
Glendale, CA 91205
818-547-0125
800-864-8008
Fax 818-547-0397

Microwave Filter Co., Inc.
6743 Kinney St. E.
Syracuse, NY 13057
315-437-3953
800-448-1666
Fax 315-463-1467

Mill Electronics Inc.*D
2026 McDonald Ave.
Brooklyn, NY 11223
718-336-4575
800-346-8994
Fax 718-627-4023

Miller-Stephenson Chemical Co.
George Washington Highway
Danbury, CT 06810
203-743-4447
800-992-2424
Fax 203-791-8702

Mindshare
2202 Buttercup Drive
Richardson, TX 75082

Minuteman UPS
P.O. Box 815188
Dallas, TX 75381
214-446-7363
800-238-7272
Fax 214-446-9011

Mitsubishi Electronics America, Inc.
P.O. Box 6007
Cypress, CA 90630-0007
714-220-2500
800-553-7278
Fax 800-825-6655

Module Exchange
706 Space Way
Duncanville, TX 75137
214-298-1212
800-632-6637
Fax 214-283-1778

Monitech
46 Graphic Place
Moonachie, NJ 07074
800-332-9349
Fax 201-933-5301

Monroe Electronics, Inc.
100 Housel Ave.
Lyndonville, NY 14098
716-765-2254
800-821-6001
Fax 716-765-9330

**Montgomery Ward
National Parts Center*D**
5750 McDermott Drive
Berkeley, IL 60163
800-323-1965
Fax 800-215-3767

Moody Tools, Inc.
42-60 Crompton Ave.
East Greenwich, RI 02818-0230
401-885-0911
300-223-9036
Fax 401-885-4565

Mouser Electronics*D
2401 Highway 287 N.
Mansfield, TX 76063
817-483-4422
800-346-6873
Fax 817-483-0931

M-Test Equipment
P.O. Box 77440
San Francisco, CA 94107
415-882-4100
800-334-4293
Fax 415-882-1988

Mueller Electric
1583 East 31st St.
Cleveland, OH 44114
216-771-5225
800-955-2629
Fax 216-771-3068

Multicore Solder
1751 Jayell Drive
Richardson, TX 75081
214-238-1224
Fax 214-437-0288

MultiFlex Seals, Inc.
Viziflex Keyboard Seals Div.
 16 E. Lafayette St.
 Hackensack, NJ 07601
 201-487-8080
 Fax 201-487-6637

Multiplex Technology, Inc.
 3200 E. Birch
 Brea, CA 92621
 714-996-4100
 800-999-5225
 Fax 714-996-4900

N

National Advancement Corp.
 2730-J S. Harbor
 Santa Ana, CA 92704
 714-754-7110
 800-832-4784
 Fax 714-754-7166

National Association of Service Dealers (NASD)
 10 East 22nd St., Suite 310
 Lombard, IL 60148
 708-953-8950
 800-621-0298
 Fax 708-953-8957

National Electronics Warranty Corp.
 44873 Falcon Place, Suite 174
 Sterling, VA 22170

National Instruments
 6504 Bridge Point Parkway
 Austin, TX 78730
 512-794-0100
 800-433-3488
 Fax 512-794-8411

NCM Electronics
 1500 Wyatt Drive, Suite 9
 Santa Clara, CA 95054
 408-496-0290
 Fax 408-496-0388

NEC Technologies*^D
 1255 Michael Drive
 Wood Dale, IL 60191
 800-366-3632

NESDA
 2708 W. Berry
 Fort Worth, TX 76109
 817-921-9061
 Fax 817-921-3741

Network Technologies, Inc.
 1275 Danner Drive
 Aurora, OH 44202
 216-562-7070
 800-742-8324
 Fax 216-562-1999

P.K. Neuses Inc.*^D
 1401 Rohlwing Road
 Rolling Meadows, IL 60008
 708-253-6555
 Fax 708-253-6652

M.M. Newman Corp.
 P.O. Box 615
 Marblehead, MA 01945
 617-631-7100
 Fax 617-631-8887

Nicolet Test Instruments
 5225 Verona Road
 Madison, WI 53711
 608-273-5008
 800-356-3090
 Fax 608-273-5061

Nippon Shokuhin Sangyo
 3912 Trust Way
 Hayward, CA 94545
 510-782-1558

NRI School of Electronics
 4401 Connecticut Ave. N.W.
 Washington, DC 20008
 202-244-1600
 Fax 202-244-2047

NTE Electronics, Inc.
 44 Farrand St.
 Bloomfield, NJ 07003
 201-748-5089
 800-631-1250
 Fax 201-748-6224

Nu-Concept Systems, Inc.
 P.O. Box 587
 Colmar, PA 18915
 215-822-8400
 800-762-4278
 Fax 215-822-1427

Nutronix Inc.
 P.O. Box 77103
 Sterling Heights, MI 48077
 313-726-1278
 Fax 313-726-9150



Oak Technical Inc.
 219 S. Sycamore St.
 Ravenna, OH 44266-1203
 216-296-3416
 Fax 216-296-6117

O.K. Industries Inc.
 4 Executive Plaza
 Yonkers, NY 10701
 914-969-6800

Oldaker Corp.
 301 N. Main St.
 Dunkirk, OH 45836
 419-759-3551
 Fax 419-759-3312

Omega Engineering Inc.
 P.O. Box 4047
 Stamford, CT 06907
 203-359-1660
 800-826-6342
 Fax 203-359-7990

OPTOelectronics, Inc.
 5821 N.E. 14th Ave.
 Fort Lauderdale, FL 33334
 305-771-2050
 800-327-5912
 Fax 305-771-2052

ORA Electronics
 9410 Owensmouth Ave.
 Chatsworth, CA 91311
 818-772-2700
 800-431-8124
 Fax 818-718-8626

Orion Instruments, Inc.
 180 Independence Drive
 Menlo Park, CA 94025
 415-327-8800
 800-729-7700
 Fax 415-327-9881



PACE, Inc.
 9893 Brewers Court
 Laurel, MD 20723-1990
 301-490-9860
 Fax 301-498-3252

Pacer Industries, Inc.
 1450 First Ave.
 Chippewa Falls, WI 54729
 715-723-1141
 800-283-1141
 Fax 715-723-7890

Pacific Electro Data, Inc.
 14 Hughes, Suite B205
 Irvine, CA 92718
 714-770-3244
 800-676-2468
 Fax 714-770-7281

Pacific Power Source
 15122 Bolsa Chica St.
 Huntington Beach, CA 92649
 714-898-2691
 800-854-2433
 Fax 714-891-1928

Panamax
 150 Mitchell Blvd.
 San Rafael, CA 94903
 415-499-3900
 800-472-5555
 Fax 415-472-5540

Panasonic Industrial Co.
 Two Panasonic Way
 Secaucus, NJ 07094
 201-348-7000

PanaVise Products, Inc.
 1485 Southern Way
 Sparks, NV 89431
 702-353-2900
 800-759-7535
 Fax 702-353-2929

PanSon Electronics*^D
 180 & Maple Ave.
 Pinebrook, NJ 07058
 800-225-5229
 Fax 800-332-3922

Parts Express International Inc.*^D
 340 E. First St.
 Dayton, OH 45402
 513-222-0173
 800-338-0531
 Fax 513-222-4644

Perma Power Electronics, Inc.
 5601 W. Howard Ave.
 Niles, IL 60714
 312-763-0763
 Fax 312-763-8330

Pfanstiehl Corp.
 3300 Washington St.
 Waukegan, IL 60085
 708-623-1360
 800-323-9446
 Fax 708-623-9107

Philips Consumer Electronics Corp.
Service Parts
 907 Snapps Ferry Rd.
 Greeneville, TN 37744
 800-851-8885
 Fax 800-535-3715

Philips Technical Training
Service Co.*^D
 P.O. Box 555
 Jefferson City, TN 37760
 615-475-0044
 Fax 615-475-0221

Philips ECG
 1025 Westminster Drive
 Williamsport, PA 17701
 717-323-4691
 800-526-9354
 Fax 717-323-4691

Philek Power Corp.
 4320 Sweet Road, Unit B
 Blaine, WA 98230-9110
 206-332-7252
 800-727-4877
 Fax 206-332-7253

Pioneer Research
 1745 Berkeley St.
 Santa Monica, CA 90404
 310-829-6751
 800-233-1745
 Fax 310-453-3929

Planned Products
 303 Potrero St., Suite 53
 Santa Cruz, CA 95060
 408-459-8088
 Fax 408-459-0426

Plastic Capacitors Inc.
 2623 N. Pulaski Road
 Chicago, IL 60639
 312-489-2229

Plastic Systems, Inc.
 261 Cedar Hill St.
 Marlboro, MA 01752
 508-485-7390
 Fax 508-480-0257

Platt Luggage
 4051 W. 51st St.
 Chicago, IL 60632
 312-838-2000
 800-222-1555
 Fax 312-838-2010

Plaza Distributing
 13268 66th Street N.
 Largo, FL 34643
 813-531-5484
 800-531-5484
 Fax 813-530-1821

Polaris Div. of UXL Corp.
 108-02 Otis Ave.
 Corona, NY 11368
 718-271-5200
 Fax 718-271-5738

Portasol, Inc.
 3129 Chaucer Drive
 Charlotte, NC 28210-4818
 704-543-6239
 Fax 704-543-6839

Power Technology Components
Microsemi Co.
 23201 S. Normandie Ave.
 Torrance, CA 90501
 310-534-3737
 Fax 310-530-5609

Powertronics
 P.O. Box 735
 Candia, NH 03034
 603-483-5876
 Fax 603-483-5938

Prelec Electronics
 605 Chestnut St.
 Union, NJ 07083
 908-851-8600
 Fax 908-686-4656

Premium Parts+ Electronics Co.*^D
 P.O. Box 28
 Whitewater, WI 53190
 414-473-2151
 800-558-9572
 Fax 800-887-2727

Print Products International *^D
 8931 Brookville Road
 Silver Spring, MD 20910
 301-587-7824
 800-638-2020
 Fax 800-545-0058

Probe Master
 215 Denny Way
 El Cajon, CA 92020
 619-258-7412
 800-772-1519
 Fax 619-258-7413

Professional Business Systems
 490 W. Arrow Highway, Suite F
 San Oiams, CA 91733

Projector-Recorder Belt Corp.
P.O. Box 176
Whitewater, WI 53190
414-473-2151
800-558-9572
Fax 800-887-2727

H.C. Protek
154 Veterans Drive
Northvale, NJ 07647
201-767-7242
Fax 201-767-7343

PTS Electronics Corp.
5233 S. Highway 37
Bloomington, IN 47402
812-824-9331
800-844-7871
Fax 800-844-3291



Quantum Data
2111 Big Timber Road
Elgin, IL 60123
708-888-0450
Fax 708-888-2802

Quasar
50 Meadowlands Parkway
Secaucus, NJ 07094
800-447-4700



Racal Instruments Inc.
4 Goodyear St.
Irvine, CA 92718
714-859-8999
800-722-3262
Fax 714-859-2505

Radio Age
636 Cambridge Road
Augusta, GA 30909

RAG Electronics Inc.*D
2450 Turquoise Circle
Newbury Park, CA 91320
805-498-9933
800-732-3457
Fax 805-498-3733

Ramsey Electronics Inc.
793 Canning Parkway
Victor, NY 14564
716-924-4560
Fax 716-924-4555

Rapid Systems
433 North 34th St.
Seattle, WA 98103
206-547-8311
Fax 206-548-0322

**Rawn Co. Inc., (Subsidiary of the
Triangle Corp.)**
P.O. Box 9
Spooner, WI 54801
715-635-8711
800-826-6791
Fax 715-635-2200

Rayovac Corp.
601 Rayovac Drive
Madison, WI 53711
608-275-4694
800-881-2562
Fax 608-275-4973

Republic Packaging Corp.
9160 S. Green
Chicago, IL 60620
312-233-6530
Fax 312-233-6005

Research Specialists Inc.
1816 Settlers Reserve Oval
Westlake, OH 44145
216-871-8909

The Rex Co.
12311 Lorealeen St.
Garden Grove, CA 92641
714-530-0330
Fax 714-530-8577

Richardson Electronics*D
40W267 Keslinger Road
La Fox, IL 60147
708-208-2200
800-348-5580
Fax 708-208-2550

Richmond Static Control Services
870 Research Drive, Building 9
Palm Springs, CA 92262
619-325-3211
800-538-0750
Fax 619-322-2073

Ripley Co.
46 Nookshill Rd.
Cromwell, CT 06416
203-635-2220
Fax 203-635-3631

R & K Supply Co.
1854 Hinckley Hills Road
Hinckley, OH 44233
216-278-7018
800-362-6780
Fax 216-278-2434

RNJ Electronics Inc.*D
805 Albany Ave.
Lindenhurst, NY 11757
516-226-2700
800-645-5833
Fax 516-957-9142

Rogers Anti-Static Chemicals
120 W. Madison, Room 1118
Chicago, IL 60602
312-276-0665
Fax 312-276-4371

Royal Soldering Systems, Inc.
244 E. Olive Ave., Suite 301
Glendale, CA 91502-1231

Russell Industries
3000 Lawson Ave.
Oceanside, NY 11572
516-536-5000
Fax 516-764-5747



**Sage Data Systems Div. America
West C&E, Inc.**
1900 Elk St.
Rock Springs, WY 82901-4005
307-382-5663
800-542-9378
Fax 307-382-7323

Salen Enterprises*D
P.O. Box 915
Morton Grove, IL 60053
312-465-1424
Fax 312-736-4238

Howard W. Sams & Co.
2647 Waterfront Parkway E. Drive
Indianapolis, IN 46214
800-428-SAMS
Fax 317-298-5604

Sanyo Energy Corp.
1201 Sanyo Ave.
San Diego, CA 92073
619-661-6620
Fax 619-661-6743

Sargent Tool
30 E. Industrial Road
Branford, CT 06405

**Schlumberger Technologies
Instruments Div.**
P.O. Box 7004
Billerica, MA 01821
508-671-9700
800-225-5765
Fax 508-671-9704

Schurter, Inc.
1016 Clegg Court
Petaluma, CA 94954
707-778-6311
800-848-2600, Ext. 175
Fax 707-778-6401

SDA
602 N. Jackson St.
Greencastle, IN 46135
317-653-4301
Fax 317-653-8262

Seco Industries
6909 E. Washington Blvd.
Montebello, CA 90640
213-726-9721
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Schematic or any factory literature associated with EICO vacuum tube receiver, Model #2536. *B. Pagano, 53 W. 11th St., #2W, New York, NY 10011. 917-278-7236.*

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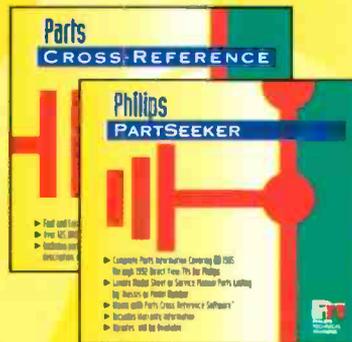
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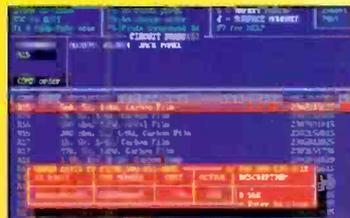


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