

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

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Servicing & Technology

November 1997

Switching power supplies

Printed circuit board and parts handling

## Soldering and desoldering update



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# ELECTRONIC

Servicing & Technology

Volume 17, No. 11 November, 1997

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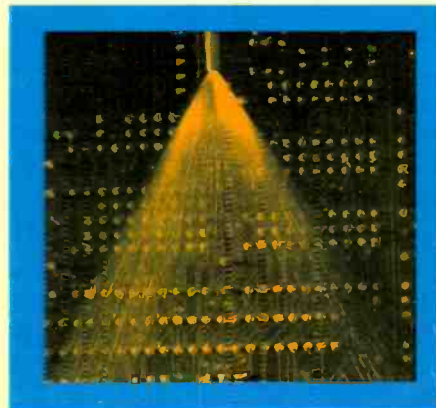
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### ON THE COVER

In most cases of repair of a consumer electronics product, the final steps in the process are removal of a component by desoldering, and soldering in a replacement. The decreasing size of components, accompanied by an increasing number of leads, makes this process increasingly difficult. The right soldering/desoldering tool can make it easier to get the job done. (Photo courtesy Den-On)

# Beauty is in the eye of the beholder

I was just reading an announcement in the Kansas City Star newspaper yesterday morning (Sunday, September 28) about a presentation that is to take place in this area soon. The speaker is some kind of computer expert. The topic of his speech will be computers in general, and the Internet in particular. It is pretty obvious from the tone of the announcement that the speech will be mainly negative. The article used terms like “overhyped”.

He complains that in Silicon Valley they teach computers to young children who should instead be learning how to get along with each other. He also says that he used to think that the great thing about the Internet was that there is was no media establishment, but now thinks that when information is free, what you get is worth very near zero.

Of course his arguments are valid. On the other hand, a computer is merely a tool. A very sophisticated tool. If we teach young children to form letters, to use pencil and paper, to read, to use books, to count, to add, subtract, to multiply, to divide, to tell time, to extract entertainment and information from television, at the same time as they are learning how to get along with each other, why shouldn't we be teaching them to use a computer. As long as there is balance, and the computer is not overemphasized, why shouldn't its existence as a useful and entertaining device be explored.

## Keep telling yourself, it is just a tool

Technological developments have always been controversial. One man's meat is another man's poison, so they say. Consider some of the other technological advancements that have changed our lives as profoundly in their own way as computers and the Internet are doing in theirs.

How about the automobile. In the early days of the automobile, it was a noisy, fast, smelly, unreliable mode of transportation, and a lot of people didn't like it. I can still remember when I was growing up in the middle to late 1940's that people sometimes would say “get a horse”, when a car went by.

But in the very early days, people positively distrusted those things. Some thought that humans would not be able to stand going faster than 15 miles an hour and would die if they drove faster than that. There were ordinances in some communities that required that automobiles driving at night stop and send up a flare every mile to warn people that they were coming. Look at automobiles now.

And how about electricity. When electricity was first introduced as a means to light homes, there were those who embraced the new technology, and those who denounced it as unnatural and evil. It made it possible for people to ignore the regular rhythm of the rising and setting of the sun. It made it possible for factories to work in 24 hour shifts. It still causes many, if not most, people to get less sleep than they should. But no one (well, maybe a few unbalanced individuals) would suggest that we pull the plug and go back to whale oil or coal oil or petroleum for lighting and steam as power.

## Television, too

Closer to home, for those of us who service television sets, television has come in for its share of denouncement. It is a vast wasteland, it has been said. And actually, I can't really disagree with that, although I spend more time than I should enjoying some of the waste. Some members of our community have said that some of the messages that TV pre-

sents viewers have a tendency to undermine our morals and our society. I really can't totally disagree with that, either.

However, that's a commentary on one of the uses, albeit the most prevalent use, of television. Television as a technology is pretty much neutral. It's a tool. It allows us to see what a camera on the planet Mars is aimed at, providing us with a better understanding of our universe. It allows us to be informed instantaneously if severe weather is threatening.

And in its better moments, even television entertainment can be enriching and uplifting as well as entertaining.

## It all depends on how the technology is used

It's a good thing for all of us who are involved in one way or another with technology to think about how useful it is, or is not. Even this magazine, and thousands of others like it, are the products of an advance in technology a few hundred years ago.

The invention of the printing press was a significant advance in technology that for the first time made information available to all humans, not just the elite.

The press itself is neutral. It's what people do with those presses that counts. What makes the difference is whether the press is used to publish *The Wall Street Journal*, *The Christian Scientist Monitor*, or *The National Inquirer*.

In spite of the many naysayers, from here it looks as though personal computers and related services, including the Internet, will thrive and continue to change the way we learn, buy and do business for some time to come.

*Nile Conrad Penam*

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2SB766	2SC1845	2SC2690	2SC3391
2SB817	2SC1906	2SC2705	2SC3393
2SB829	2SC1921	2SC2720	2SC3395
2SB851	2SC1923	2SC2735	2SC3399
2SB861	2SC1941	2SC2773	2SC3400
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2SC1114	2SC2063	2SC2979	2SC3460
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2SC1413	2SC2291	2SC3175	2SC3675
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2SC1417	2SC2310	2SC3180N	2SC3680
2SC1445	2SC2314	2SC3181	2SC3686
2SC1475	2SC2328	2SC3181N	2SC3688
2SC1507	2SC2336	2SC3182	2SC3711
2SC1509	2SC2344	2SC3198	2SC3729
2SC1583	2SC2362	2SC3203	2SC3731
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2SC1678	2SC2367	2SC3203	2SC3789
2SC1685	2SC2367	2SC3203	2SC3795
2SC1730	2SC2367	2SC3203	2SC3801
2SC1741	2SC2367	2SC3203	2SC3807
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### **Cordless phones continue torrid sales pace; fax machines also strong in first quarter**

Following a record-setting 1996 in which more than 20 million cordless telephones were sold to dealers, cordless sales continued to climb in the first quarter of 1997. According to statistics released by the Consumer Electronics Manufacturers Association (CEMA), over five and a half million cordless phones were shipped to dealers from January to March, representing a 32 percent increase from last year. Thanks to rapidly growing consumer demand for 900MHz models, dollar sales shot up 43 percent to \$342 million. The 900 MHz category constituted \$135 million of that total — a whopping 107 percent increase.

Despite the fact that 96 percent of U.S. households already own at least one corded telephone, the corded market remains steady. Manufacturers shipped over five million corded models to dealers in the first quarter, amounting to \$120 million in sales — down one percent.

Unit sales of telephone answering devices (TADs) were up slightly from last year, but price erosion led to a 10 percent decline in TAD dollar sales, to \$186 million. Cordless combination models showed the most success, ringing up \$118 million. Consumer fax machines sold particularly well in the first quarter, jumping 39 percent. With high-end models showing strength, dollar volume shot up 62 percent to \$328 million.

### **Closed captioning standards for digital television established**

The Consumer Electronics Manufacturers Association (CEMA) established closed captioning (CC) standards for digital television (DTV) to support the needs of caption service providers, CC decoder and encoder manufacturers, receiver manufacturers and signal processing equipment manufacturers.

Due to the increased capacity of the DTV bit stream over today's analog television signal, DTV CC will allow simultaneous transmission of captions in multiple languages and at multiple reading levels. Current analog CC can be transported at 960 bits per second (bps), while

DTV CC under the new standard, designated as EIA-708, will work at 9,600 bps - 10 times the analog capacity.

DTV CC will be more user friendly, imitating computer graphic windows. For example, the DTV standard boasts an increased screen resolution range of 720 or 1080 active scan lines, as opposed to 525 scan lines for analog TV. This added resolution provides more defined representations of character fonts and other CC objects. The heart of DTV CC display is the caption "window" which is identical to the window concept found in computer Graphical User Interfaces (GUI). Windows placed on the DTV screen have caption text placed within them. The windows and text have a variety of color, size and other attributes assigned by the standard.

The CEMA DTV CC standard provides a description of DTV CC specific data packets and structures; a specification of how DTV CC information is to be processed; a list of minimum implementation specifications for DTV receiver manufacturers; and a set of recommended practices for DTV encoder and decoder manufacturers.

### **Phase II of cable-ready compatibility standard passed**

Building on EIA-542, the standard that defines channel allocations for cable-ready TV services and products, the Consumer Electronics Manufacturers Association (CEMA) developed standard EIAIS-105.1, which specifies the interconnection method for attaching a basic cable decoder (a set-back box) to consumer equipment such as TVs or VCRs.

EIAIS-105.1 is the second step in a three-part process to establish a cable-ready interface as described by the Cable Act of 1992. The interface allows the receiver to provide a descrambled picture while supporting record-while-watching, sequential recording, picture-in-picture and other consumer electronics features. Equipment that supports the interface standard may be labeled "Cable Ready", which will signify to consumers the products that can operate seamlessly with their cable systems without compromising their TV's or VCR's features.

EIAIS-105.1 describes two connection ports between the decoder and the TV: an audio/video/control port which sends descrambled programming from the set-back box to the TV and controls commands both ways between them; and an IF port which provides the scrambled signal from the TV's own tuner to the descrambled box.

The new standard discusses the electrical and mechanical characteristics and the basic control components of the interface. Currently being processed, EIAIS-105.2 specifies the control protocol and commands between the two devices. The EIAIS-105.2 standard should be completed by the year-end.

The two documents, EIAIS-105.1 and EIAIS-105.2, describe the specifications needed for proper operation of simple systems. An advanced interface to support the basic cable-ready functions plus text over video (for such services as electronic program guides or other media like direct broadcasting systems), as well as home theater requirements, will be in the AVBus interface, another CEMA standard, which should be ready by the middle of the year 1998.

Cable operators, manufacturers and other interested parties can order EIAIS-105.1 by calling Global Engineering Documents: 800-854-7179 or at their web site at [www.global.ihs.com](http://www.global.ihs.com). Links to Global's site are provided on CEMA's web site, [www.cemacity.org](http://www.cemacity.org).

### **CEMA adds 100 new members, representing a broad cross section of the CE industry — from computing to mobile electronics**

The Consumer Electronics Manufacturers Association (CEMA) has announced that it has added 100 new members in 1997. Computer hardware and software companies joined with cellular, mobile electronics and accessories companies to round out CEMA's major recruitment effort.

CEMA has always represented leading edge technology companies," stated Gary Shapiro, CEMA's president. "When you see companies like Ademco Security Group, Funai Corp., Honeywell, Inc., Klipsch, Microsoft Corp., Mobile

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R232	B-4
R240	C-4
R331	D-3
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R335	D-1
R336	C-1
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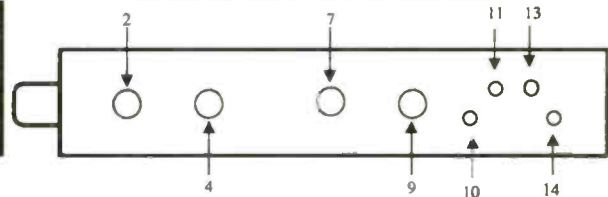
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- the easiest way to find those hard to locate surface-mount components

#1

### Tuner Information

- terminal guides show pin arrangements
- voltage charts gives exact readings by pin
- the best way to diagnose tuner problems

### TUNER TERMINAL GUIDE



### TUNER VOLTAGE CHART

Pin	VHF Low Band	VHF High Band	UHF Band
2 (TUNING VOLTAGE)	.8V	3.7V	6.4V
4 (AGC)	4.2V	4.2V	4.4V
7 (+9V)	8.9V	8.8V	8.9V
9 (IF OUT)	0V	0V	0V
10 (33V)	32.1V	32.2V	32.2V
11 (+5V)	5.0V	5.0V	5.0V
13 (CLK)	2.4V	2.4V	2.4V
14 (DATA)	2.8V	2.8V	2.8V

NOTE: VHF Low Band voltages taken on channel 2.  
NOTE: VHF High Band voltages taken on channel 7.  
NOTE: UHF Band voltages taken on channel 14.

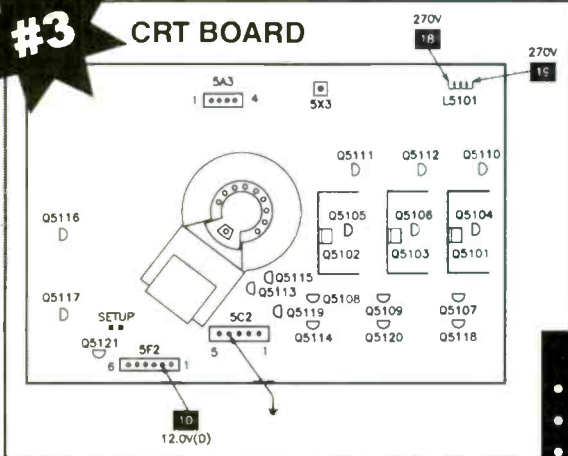
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### Placement Chart

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Authority, NCI/Nutech Communications and Wilson Audio Specialities joining CEMA — companies that cross multiple product categories — it is clear that we are on the right track. Our mission is straightforward, 'to grow the consumer electronics industry.' We have become more than a safe harbor for traditional CE manufacturers. Computers and cellular communications are now mainstream consumer electronics products and those manufacturers want to belong to the organization taking initiative to lead our industry. We welcome the leadership these new companies will bring to the organization and we appreciate their vote of confidence in CEMA."

By joining, CEMA companies have free access to detailed member designed market research, the proprietary nightly consumer research reports, product category research, comprehensive public relations initiatives, standards development efforts, consumer and product services initiatives, and a voice in the government and legal affairs efforts CEMA undertakes on behalf of its members and the entire consumer electronics industry. CEMA now has nearly 400 manufacturing companies as members.

### New standard helps safeguard DVD digital-to-analog copyrights

The Consumer Electronics Manufacturers Association (CEMA), working in tandem with manufacturers and software companies, created a new engineering standard, EIA/IS-702, which will guard the copyrights of DVD software developers in the analog world. With the standard in place, video programming providers will have greater control over their property and therefore be more likely to make a wider choice of DVD video software available to the public.

The copy generation management codes are embedded into the DVD software and tells the VCR or other recording device the copying rules. For example, DVD developers decide how many analog copies consumers can make from a piece of DVD software through their VCRs. Developers can decide to forbid any copies, allow just one copy or permit multiple copies of the software.

Working through line 21 and using the

Macrovision System already employed in many VHS cassettes, the vertical interval and color burst of copies is distorted, degrading the copy. With such inferior copies, unlawful copying of DVDs to VHS tape would be greatly reduced.

Manufacturers and other interested parties can order EIA/IS-702, the Copy Generation Management System (Analog) Standard, by calling Global Engineering Documents, tel: 800-854-7179 or contacting their website at [www.global.ihs.com](http://www.global.ihs.com). Links to Global's site are provided on CEMA's web site, [www.cemacity.org](http://www.cemacity.org).

CEMA is a sector of the Electronic Industries Association (EIA), the 73-year-old Arlington, Virginia-based trade association representing all facets of electronics manufacturing. CEMA represents U.S. manufacturers of audio, video, accessories, mobile electronics, communication equipment information products and multimedia products. ■

## ES&T Calendar

TeleCon XVII (ABC/Applied Business teleCommunications)  
November 5-7, 1997  
510-606-5150

'98 International Consumer Electronics Show  
January 8-11, 1998  
Las Vegas, NV  
703-907-7600

The Consumer Electronics Future  
January 12-14, 1998  
Las Vegas, NV  
703-907-7660

Home Automation Show & Conference  
February 25-27, 1998  
Orlando, FL  
203-840-5482

NESDA 48th/ISCET 28th/NIAS 6th Annual  
August 10-15, 1998  
Kissimmee, FL  
817-921-9061

PCS 98  
September 23-25, 1998  
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PCS 99  
September 22-24, 1999  
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# ELECTRONIC

Servicing & Technology

**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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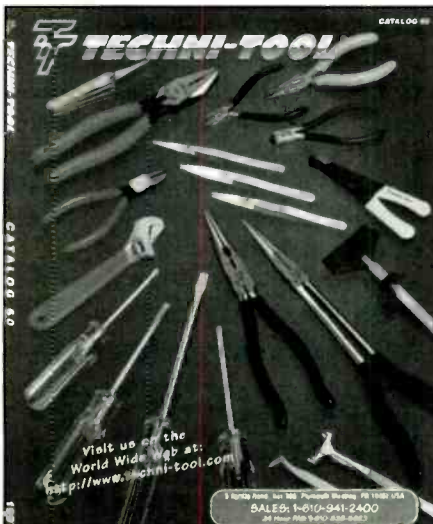
### New catalog

Herman Electronics announces the release of their new catalog. The catalog contains items for the service industry including: tools, test equipment, parts and accessories, chemicals, power products, technicians aids and more. Herman is now a premiere Fluke distributor.

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### Tool catalog

Techni-Tool's 1997 color catalog includes a selection of hard-to-find tools, tool kits, production aids, test equipment and computer accessories. The full-color catalog is filled with more than 16,000 items from over 650 manufacturers. Included are products from electro-mechanical and assembly devices to electronic and telecommunications tools, pro-



duction tools to custom tool kits and biomedical-related tools to field service tool kits. Other items include a full line of items for aerospace production, computer maintenance and surface mount technology, plus a line of ESD, static control and cleanroom items.

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### Consumer electronics engineering standards catalog published

The Consumer Electronics Manufacturers Association (CEMA) published its first engineering standards catalog that specializes in consumer electronics products. These standards have been created by EIZ/CEMA and its members on various products such as camcorders, televisions, loudspeakers, etc. With these standards, manufacturers can better ensure the safety and accuracy of the products that they manufacture and their operation with other devices.

These standards have been available from Global Engineering Documents, but have never been offered in an easy-to-read, easy-to-access format that solely focuses on consumer electronics. Also, for the first time, CEMA is offering sets of standards for similar products for further cost savings.

For example, the loudspeaker set contains standards for recommended safety practices, power ratings, mounting dimensions, spiders and testing. The loudspeaker package price is \$95 — a 30 percent cost savings if all five standards were purchased separately.

The catalog is available in electronic form via CEMA's website at [www.cemacity.org/works](http://www.cemacity.org/works).

To order EIA/CEMA standards, call Global Engineering Documents at 1-800-854-7179 or visit their website at [www.global.ihs.com](http://www.global.ihs.com). EIA/CEMA members receive a further 25 percent discount.

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### E-mail discussion group

AnaTek Corporation has launched an internet email discussion group for electronic service and repair professionals. Named ELREPAIR-L, the group is dedicated to the discussion of issues and questions that are important to those profes-

sionals. Typical topics include specific diagnostic problems, test equipment, component and documentation sources and service/repair procedures.

Many of the members of the group are "super technicians" who are willing to share their experience and knowledge with other professionals. The group has an international flavor with members from the U.S., Canada, Europe, Central America and South America

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### Catalog of fiber optic test equipment and training programs

Fotec has released a catalog covering all their test equipment for fiber optics and the "Fiber U" fiber optic training programs. Included is the new "FOtest'R" line of low cost power meters for troubleshooting fiber optic systems. The new Fiber U "Correspondence Courses" are described in the Fiber U section also.

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### Tools/kits/cases

The latest full-color Jensen Catalog is now available.

Among the latest items are two newly designed Jensen Kits; an aircraft pre-flight/preventative maintenance kit and an electronic equipment service kit; a number of recently released scopes and meters; two multi-purpose tools; and sets of ESD safe screwdrivers with static dissipative handles.

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# Printed circuit board and parts handling

by the ES&T Staff

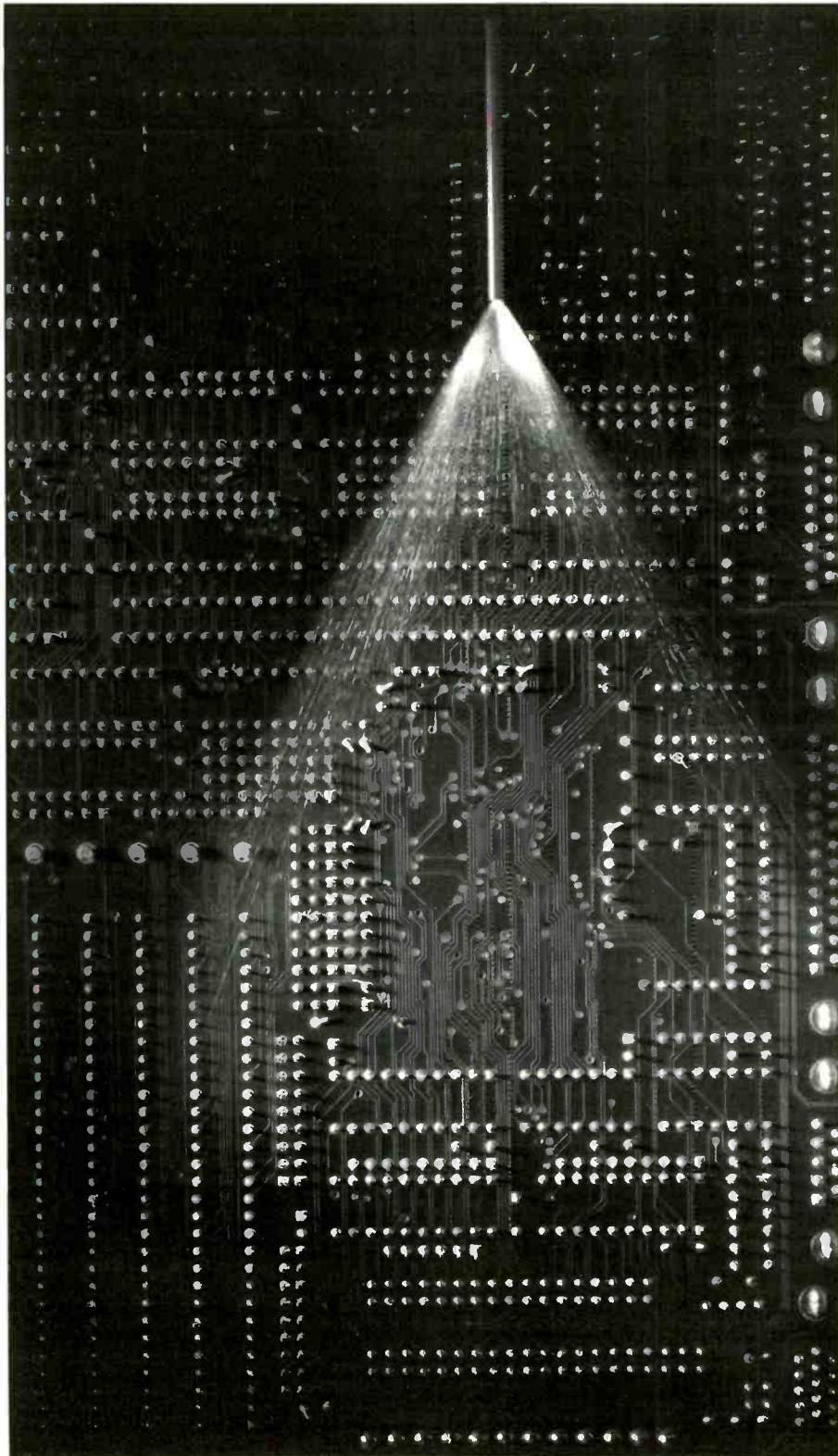


Photo courtesy Chemtronics

Service of a consumer electronics product consists of a number of steps. Of course the steps may differ from product to product and from problem to problem, but generally the steps include determination of the symptoms by communicating with the product's owner, verification of the symptom by direct observation, preliminary diagnosis of the cause of the symptom, visual inspection of the suspected circuits, isolation of the symptom to a single circuit or group of circuits, and identification and replacement of the faulty components.

Some of the key steps in the service process involve handling of the printed circuit board and the components. Because many of the components and printed circuit boards in consumer electronics products are susceptible to damage from a number of sources: physical damage, chemical damage, ESD damage, it is important to handle all of the internal workings of a product carefully in order to avoid damage and assure a successful repair.

## Avoid physical damage

Printed circuit boards are reasonably strong and can stand a certain amount of handling, but it's still important to exercise care. Generally, the larger the board, the more susceptible it is to being damaged, simply because it is easier to flex a larger board, and thus possibly cause damage. Moreover, printed circuit boards on which a large, heavy, object, such as a transformer, is mounted, may be damaged if a technician tries to pick it up by the end opposite the heavy object.

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*“Over time it's easy to lose the sense of the importance of observing proper procedures when handling pc boards and parts. When that happens, the technician becomes careless.”*

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***“When handling just about any piece of electronics equipment these days, you should use a grounded mat and a grounding wrist strap. It also wouldn't hurt to make sure that everything on or near the test bench is static safe.”***

It is important when handling PC boards to avoid flexing them. If a board is flexed, even if the board itself doesn't show any signs of damage, the delicate circuit traces may be damaged. Such damage may be very difficult to detect.

#### **ESD considerations**

Many of today's tiny semiconductor devices: diodes, transistors, integrated circuits, are manufactured using materials and designs that leave them very susceptible to damage from electrostatic discharge (ESD). For example, in some ICs, the metallic films may be far thinner than a human hair. If a static electric discharge passes through one of these devices, even a discharge that the person handling the device doesn't feel, could damage or destroy the device.

If you should destroy a device in this

manner, not only will it cost you money to replace it, but it might waste a great deal of time when diagnosing the problem. Let's say that you had already checked out the device and found it to be operating properly. Even though it's now destroyed, you still believe it to be good. You'll most likely check every other possible cause of the new problem, and only as a last resort check this device again.

When handling just about any piece of electronics equipment these days, you should use a grounded mat and a grounding wrist strap. It also wouldn't hurt to make sure that everything on or near the test bench is static safe.

#### **Be careful of chemicals**

There was a time when you didn't have to worry too much about the chemicals you used for cleaning when it came to

their effect on the inner workings of a TV, VCR, or other consumer electronics device. You just got a can of Freon and squirted a little on the product and then wiped wherever you wanted to clean up.

Nowadays, because of environmental considerations, Freon is no longer available. Now you must choose from a selection of cleaners, etc., available from a host of chemical manufacturers. Most of these products are quite safe when used on materials for which they were formulated, and when used according to the directions on the label.

But you should never take anything for granted. Never spray or swab a chemical on a surface without reading the directions that come with it. Some chemicals will attack certain materials, and could leave you with a mess on your hands.

#### **Devices for pc board handling**

There are few things more frustrating than trying to remove a tiny surface mount device from a faulty printed circuit board and have the board at the wrong angle causing it to slip around the surface of the bench. It's so much easier to work

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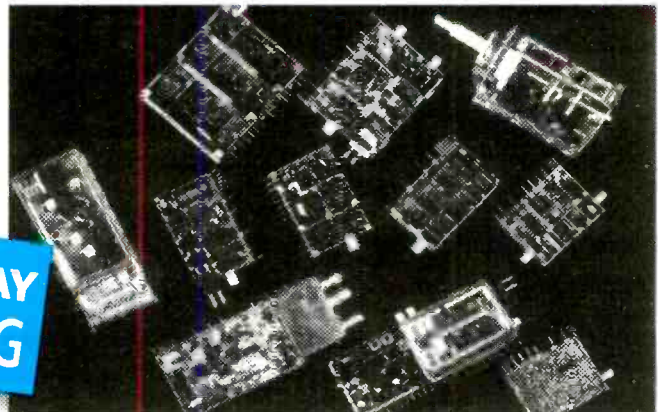
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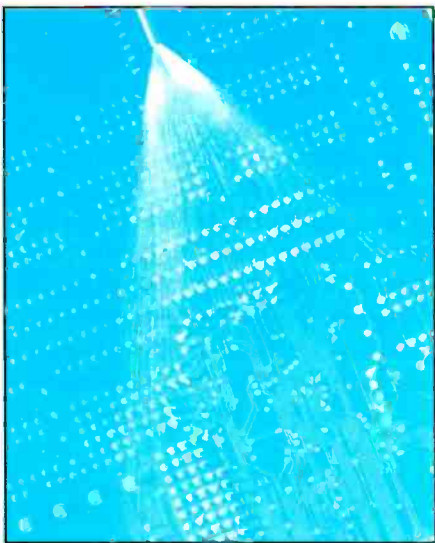
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if the board is held securely and in such a manner that you can adjust it to any angle that you need to work on it.

A number of manufacturers make holders into which you can clamp a circuit board and adjust it to any angle you like. They're not inexpensive, but they can certainly save a technician some time each time he has to solder/desolder a component on a circuit board. That time saved,

*"...many of the components and printed circuit boards in consumer electronics products are susceptible to damage from a number of sources: physical damage, chemical damage, ESD damage..."*

in the aggregate over the years, can add up to far more than the cost of the holder. And if it saves one board damaged, one circuit trace severed, that alone could be enough to pay for it.

#### Parts handling, too

Proper handling of parts is even more critical than the handling of assembled pc boards when it comes to ESD considerations. Once in the circuit board, sensitive components may enjoy a certain amount of protection from ESD because their pins are connected into the circuit (don't count on it, though), but individual components are highly susceptible to ESD damage.

For starters, ESD sensitive components should be handled as little as possible. They should be kept in whatever packaging they came in until the technician is ready to install them into the circuit, and then they should be touched only by

someone who is properly grounded with a wrist strap, and in an area in which static-safe procedures are practiced.

#### Avoiding complacency

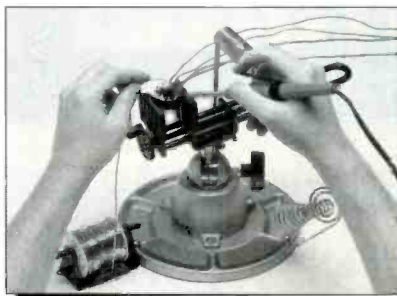
Over time it's easy to lose the sense of the importance of observing proper procedures when handling pc boards and parts. When that happens, the technician becomes careless and may forget one day to put on his wrist strap. He may be lucky. It may be a humid summer day, the kind of day on which static doesn't build up. On the other hand, he might not be lucky and destroy one or several expensive ICs.

Proper handling procedures are important, and with the incorporation of static sensitive devices and pc boards with super-fine traces into more and more consumer electronic products, it becomes increasingly important to consistently handle these devices with great care. ■

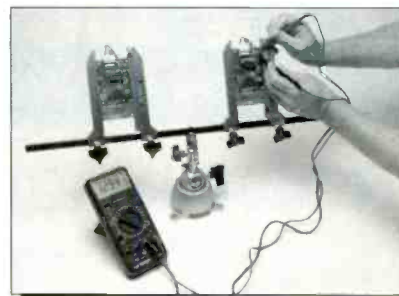
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**Component Identifier and Source Book, By Victor Meeldijk, PROMPT Publications, 384 Pages, \$24.95**

The *Component Identifier and Source Book* was written for the electronics engineer, technician or electronics enthusiast who has to identify a component from a part number on a schematic diagram or locate a manufacturer from a logo. This book is a useful tool for anyone who wants to make the process of identifying and locating components easier and faster.

This guide will help you cross reference component types to manufacturers, and also contains sections that cross reference trade names, abbreviations, and part number prefixes to the manufacturer. Listings of worldwide manufacturing and sales office addresses are also provided, and there is also a special listing of manufacturers who provide replacement devices and vendors who specialize in stocking and locating discontinued devices.

Sections in the *Component Identifier and Source Book* include: Logos for manufacturer identification; Cross references of abbreviated manufacturer names to the proper manufacturer name; Component prefixes and part number types for identifying parts from schematics and parts listings; Cross references to new manufacturers from mergers and acquisitions; Nationwide manufacturer offices; Worldwide addresses; Product locator listing; Manufacturers and distributors of obsolete parts; And much more.

PROMPT Publications, 2647 Waterfront Parkway E. Drive, Indianapolis, IN 46214

**Electronic Circuit Guidebook, Volume 3: Op Amps, By Joseph J. Carr, PROMPT Publications, 290 Pages, \$24.95**

The operational amplifier (op amp) is the most commonly used linear IC amplifier in the world. The range of applications for the op amp is large. It has become a mainstay of audio, communications, TV, broadcasting, instrumentation, control and measurement circuits.

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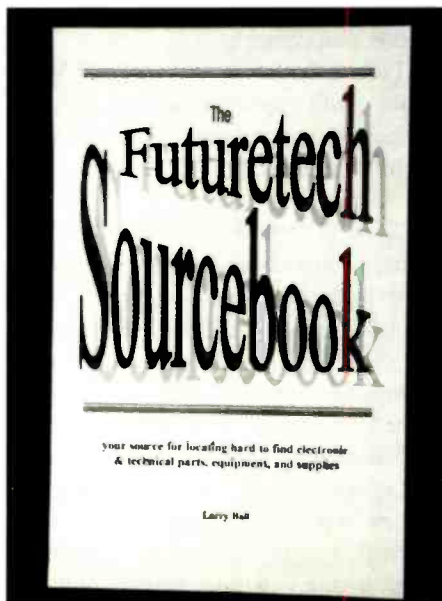
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**The Futuretech Sourcebook, By Larry Ball, Futuretech, 63 pages, \$11.95**

Locating parts and equipment is a perpetual problem for both electronics professionals and hobbyists. This innovative directory of 147 electronics and technical vendors makes that problem easier to handle. The book contains 394 common, as well as extremely uncommon categories in both table and index format.

The book's tables contain most of the product lines of 108 mail order vendors in 215 categories. That's where you'll find common items such as transistors, resistors, capacitors, and oscilloscopes. The table's organization makes it easy to compare the product lines of various companies to find what you're looking for. It can easily eliminate the need to place orders with multiple vendors to obtain the parts for your next project.

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Futuretech, PO Box 6291, Gulf Breeze, FL 32561

**Howard W. Sams & Company Computer Monitor Troubleshooting and Repair, PROMPT Publications, By Joseph Desposito and Kevin Garabedian, 336 Pages, \$29.95**

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John Iovine is an avid electronics hobbyist and author of many electronics books and magazine articles.

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# Power protection

by the ES&T Staff

Some years ago when I was working for a different company, I was sitting in my cubicle when all of a sudden the lights went off. From the cubicle next door I heard the editor of another magazine shout: "Damn!" or something like that. It wasn't a terribly serious problem, but we had experienced a power outage, and Janet, who had been working for quite some time to find an opening for her editorial, had just typed it in, and then lost it when the power failed. It was only a few sentences, but she was not able to recapture that particular phrasing, of which she had been quite proud.

That's one of the problems that can befall electrically operated equipment; when the power fails, they are no longer able to operate.

## Incorrect voltages

But power failures aren't the only things that can cause problems with electrically operated (and especially electronic) equipment. Anything that causes the voltage delivered to a piece of equipment to vary significantly from the specified supply voltage can cause problems of varying intensity. For example, a prolonged voltage reduction can cause a motor-operated product to operate at reduced efficiency. In extreme cases, motors subjected to reduced voltage can overheat and burn out. Excessive voltage can be equally harmful to equipment.

## Spikes and surges

If lightning strikes near a power line, it can generate a huge voltage spike, in the thousands of volts, that can damage or destroy any electrically-operated equipment connected to that line. To a lesser extent, motors turning on and off can generate spikes that may be conducted to any piece of electrical equipment connected

to the line. Such a spike might not cause damage to the circuitry, but if the affected piece of equipment is a computer, data could be corrupted, causing problems that might mystify the operator.

## Protecting electrical equipment

Here are a few suggestions for protecting electrical equipment from spikes, surges or even complete loss of power.

- Use a UPS or surge suppressor product to protect all ac-operated equipment, including TVs and VCRs.

- Make sure that outlets are properly wired. If possible, choose a UPS or surge suppressor that features a site wiring fault indicator that will warn of improper building wiring, including lack of a ground.

- Plug all power protection and/or system equipment line cords in at the same service branch. This means that power to all equipment is controlled by the same fuse or circuit breaker.

- Protect all telephone ports for modems, fax machines, answering machines, etc., from damage due to nearby lightning with appropriate spike/surge suppression devices.

- Protect the RF video input of TVs or VCRs with appropriate suppression devices on signal wires from antennas, satellite antennas, or CATV.

## Surge suppressor ratings

Surge suppressors are rated according to the amount of protection they provide. Read the package and any instructions that come with the device to determine how useful the product is. Here are some of the characteristics you will encounter.

- **Joule rating:** One joule is equal to one watt-second. In other words, a joule is a unit of work or energy (power times time). It is equal to the work done by a force of one newton when its point of

application is moved through a distance of one meter. In the case of a surge suppressor, the joule rating is a measure of the amount of electrical energy that the device can withstand without being damaged. The higher the joule rating, the more protection you have, no matter what kind of equipment you are protecting.

- **UL listing:** Underwriters Laboratory (UL) tests for consumer safety and product performance. Surge protectors are tested under strict UL guidelines and listed accordingly. The UL listing is an indication of how many volts a surge protector will let through when a strong power surge occurs. The lower the UL rating, the better the surge protector performs when hit with a power surge. The lowest rating that UL tests reflect is 330V.

- **EMI/RFI filtering:** Whenever there is a spike on a power line, electromagnetic interference (EMI) and radio frequency interference (RFI) are generated. These phenomena can cause loss or corruption of data. Check to see that whatever unit you plan to buy provides protection from EMI/RFI.

- **Three-line protection:** A voltage surge or spike on the power line may be imposed on any of the lines: hot, neutral or ground. Check to see if a suppressor will protect your electronic equipment against all incoming and outgoing power surges on all three lines: hot to neutral, neutral to ground, and hot to ground.

- **Connected equipment warranty:** Some manufacturers of power protection devices offer a warranty that provides coverage for the surge protector as well as for the equipment you plug into it.

## Shopper's guide to surge protection

This information was gleaned from the website of a rural power provider. If you purchase plug-in surge protection equip-

ment from a vendor other than a power utility, you should keep these factors in mind.

- When it comes to surge protection devices, don't go for the lowest priced unit. As a general rule, a good plug-in surge protector will cost at least \$30 to \$70 dollars.

- If you are trying to protect a computer connected to a modem, make sure any surge protection device you buy has telephone line protection capabilities.

- If you are trying to protect a television that is hooked up to coaxial cables for cable TV service or digital satellite service, make sure the device has coaxial line protection capabilities.

- Look for a UL listing of 1449. This is the category under which UL tests surge protectors. If you purchase a device that has a differently numbered UL listing, you may be buying a device that was tested only as a wiring device, like any other plug strip, and not as a surge suppressor.

- Clamping voltage should be no higher than 330V.

- Make sure that any device you buy protects the line to ground, the line to neutral, and the neutral to ground (L-G, L-N, N-G).

- It may be hard to find out, but try to determine if the surge protector you are buying uses thermally-fused MOVs (metal oxide varistors).

- Make sure that any device you buy has an indicator light or an audible alarm that lets you know if the suppressor is not functioning correctly or is improperly grounded. Surge protectors with alarms are especially useful if the device is hidden behind furniture or equipment.

- Computer networks have special surge protection needs. Contact a computer network specialist for advice concerning surge protection for networks.

### No (physical) harm done

As it turns out, Janet's computer was protected by a surge suppressor, as were all the other computers in the building. So the only thing lost that day were her words. And if she had had a UPS, she wouldn't even have lost those. Today's sensitive electronics devices, office equipment as well as consumer electronics devices, really should be protected from damage that might be caused when the occasional power surge occurs. ■



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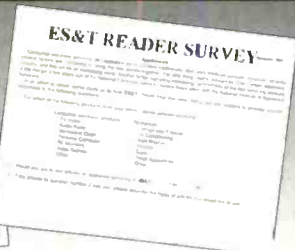
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# Soldering and desoldering update

by the ES&T Staff

**S**oldering consists of heating two pieces of metal that are touching and introducing an alloy that melts at a relatively low temperature in order to join the metals together. Soldering is used in a number of trades and industries. For example, plumbers use solder to join pipes, jewelers use solder to make jewelry and electronics manufacturers use solder to connect components to printed circuit boards, or to otherwise make circuit connections among components.

Each pursuit has its own objectives in terms of what a good solder joint consists of. In the case of jewelry, the jeweler is looking for a strong mechanical joint that also looks attractive. The plumber is looking for a strong mechanical joint that will not leak. Only in the case of electrical/electronic construction is it important to have a strong mechanical joint, but also a joint that conducts electricity well.

## Repair of electrical solder joints

In years past, solder joints in electronic equipment joined elements that were quite rugged. For example, point-to-point wiring in a TV set joined wires to wiring terminals, or, for example, vacuum tube sockets. The wires were relatively heavy, the terminals were physically robust, and any of these soldered joints could stand a lot of heat. In fact, in some cases where a wire was soldered to a heavy metal piece it was sometimes difficult to get enough heat, even with a 100W soldering gun, to melt the solder.

If a technician happened to cause damage to one of these interconnecting wires, it was simplicity itself to measure it, cut a new piece of wire with the same color insulation and replace it.

How things have changed. Nowadays, the printed circuit traces that have replaced the wiring is almost vanishingly thin. The components that make up the circuitry on the circuit board are tiny, fragile, and susceptible to ESD and high temperatures. These days, consumer electronics technicians have to have the manual dexterity of a jeweler.

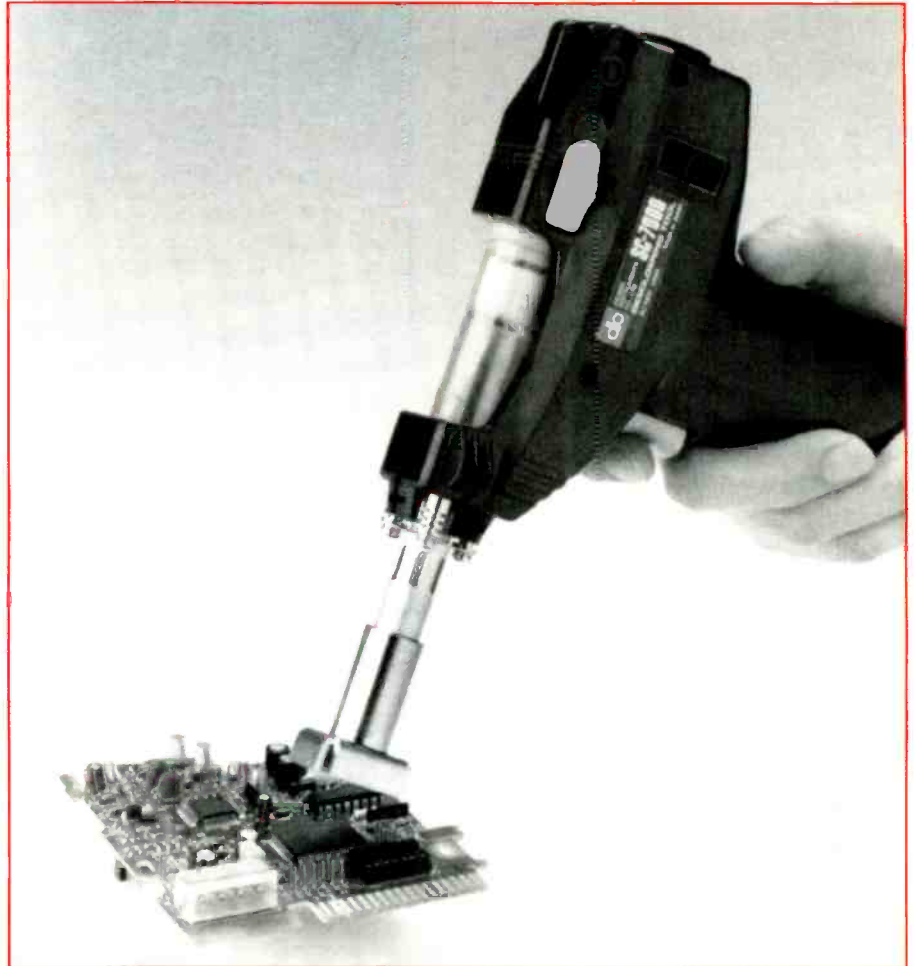


Photo courtesy DEN-ON

The fact that soldering has become high-tech, and very important in servicing, is testified to by the number of companies whose sole business is training technicians to solder. Some companies have training on site, while other companies will go to the customer's site. There is even a company that manufactures dummy components so that a technician can learn to solder/desolder with inexpensive artificial components before working on the real thing.

## Soldering/desoldering equipment options

Fortunately, companies that manufacture soldering and desoldering equipment

have developed a number of products to help service technicians remove soldered components and solder in replacements. The manufacturer of each type of product will, of course, tell you that their product is the best. However, the best soldering/desoldering device for any technician is the one that works the best for him.

## Soldering irons

Today, a broad selection of soldering irons is available to technicians. Notably absent from this selection is the old 100W soldering gun that was at one time so popular. Today such a dinosaur would destroy components, wiring traces, and possibly the printed circuit board.



Soldering irons that are currently available include, fine soldering pencils that deliver only a few watts of tightly controlled heat to the soldering tip. Some of these units use resistance heating to provide the heat to the iron's tip. Other units use rf current to heat the tip and provide the temperature control needed.

One advantage of soldering irons is that the heat needed to melt the solder is delivered only to the solder joint that is to be soldered or desoldered. Another is that they are generally inexpensive.

One disadvantage of the traditional soldering iron is that it can only heat one joint at a time. In order to deliver heat to all pins of various multiple-pin ICs, the iron has to be fitted with special tips, which increases the cost of this system. Additionally, if the technician does not exercise proper care, he may damage circuit traces or soldering pads on the PC board, and he may even cause damage to the replacement device being soldered in.

### Hot air

Hot air soldering devices have certain advantages over soldering irons. By moving the hot air nozzle back and forth across several pins at one time it is possible to heat all pins on one side of a multiple pin IC. This makes it possible to lift that side away from the board and do the same thing to the other side. Actually, in some cases with a hot air system, it is possible to heat all pins on all sides of the IC, thus simplifying its removal, and reducing the possibility of causing damage to the circuit board and/or its traces.

A disadvantage of hot air soldering is that the nozzle may deliver hot air to devices that the technician did not wish to heat.

### Solder removal

In most cases, at some point in the repair process, the technician will have to remove some solder from the board. If the technician is using a desoldering process that doesn't heat all pins at one time, he may need to use desoldering braid or a solder sucker in order to remove all of the solder so that he can subsequently lift the component free. Or, if the technician is using a desoldering process that heats all pins at the same time, he may be able to lift the component free while the solder is molten, then go back later with a solder

sucker or braid and remove the solder.

The decision about whether to use a solder sucker or desoldering braid really depends on the preference and pocket-book of the technician or service center. As long as the technique removes enough solder to reliably eliminate solder bridges between pins, and doesn't cause physical or ESD damage to the circuit board or sur-

rounding components, the technician can make his choice.

### Low melting alloy

Today, another process is available for removing solder; a low-melting alloy. In this process, the technician adds flux to the joint or joints to be desoldered, then heats the joint and introduces solder wire

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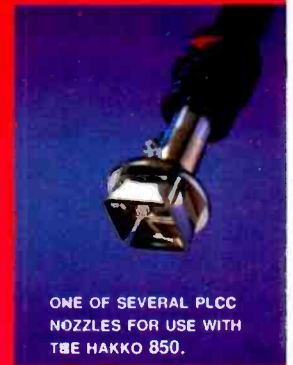
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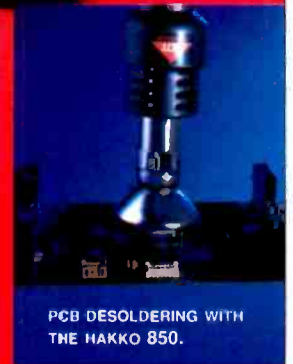
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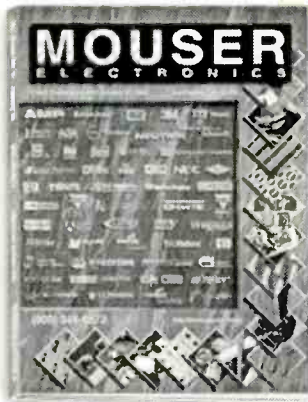
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that consists of an alloy that melts at a considerably lower temperature than standard electronic solder.

Because the melting temperature of this alloy remains low, even after it has melted and mixed with the existing solder, the solder remains molten for a while, even after the source of heat has been removed, the technician can simply take a cotton tipped swab and scrape the solder ball away from the joint and slide it off the board, and then lift the component free. The technician can then go back and use desoldering braid or a solder sucker in conjunction with a soldering iron or hot air soldering tool to complete the clean up of the solder from the circuit board.

Desoldering using this method can be enhanced by heating the entire board to a temperature below the melting point of standard electronic solder, then using the low-melting solder technique. Because the board is at a temperature below the melting point of standard solder, but above the melting temperature of the low-melting solder, the technician has more than enough time to complete the desoldering of the component.

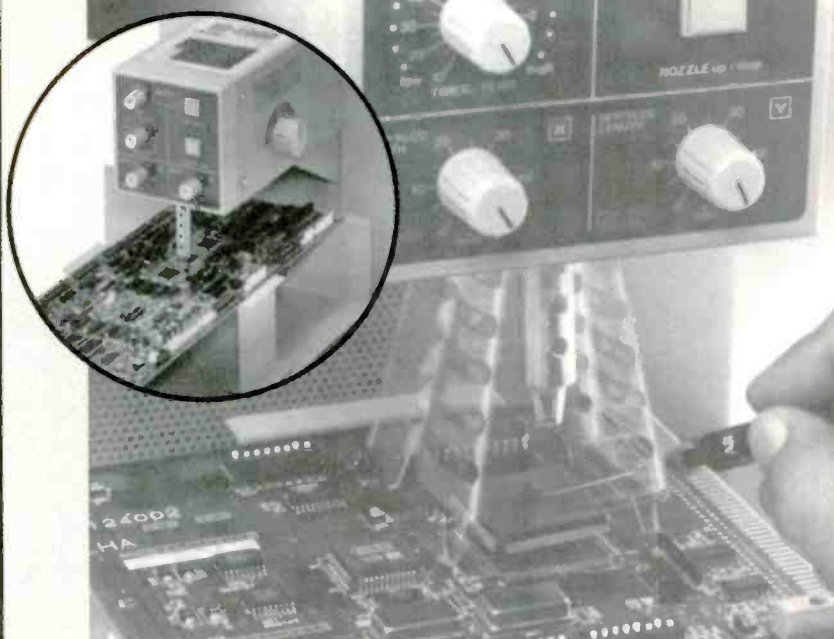


### Meeting the challenges

As electronics technology continues to change the way in which components are manufactured and interconnected, manufacturers of soldering and desoldering equipment will continue to develop the tools necessary to rework and repair the products made from them. It will be a challenge for technicians to keep abreast of soldering technology, and for the technical press, such as this magazine, to continue to report on that technology. ■

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# Switching power supplies: Representative examples

by Bob Rose

In a previous article on servicing switching power supplies, I suggested a five-step approach to servicing these "little demons." The approach involves asking and answering five questions: Is there B+; is there start-up voltage; is there drive/oscillation; is there output (secondary voltages); is there regulation? My thesis is that by dealing with these questions, you quickly get into the circuit that's causing the problem. Once there, the fix becomes relatively easy.

Actually, the very *first* thing to do is to visually inspect the power supply. Look at the bottom of the pc board. Notice any burned spots or missing traces. Before I developed this important first step, I worked on one of these power supplies for more than thirty minutes and could find nothing wrong. The problem was a burned trace. Carefully inspect the components on the top of the pc board. Are any burned or blown apart? A good visual inspection will save you time.

Following is a description of my approach using some popular switching power supplies that are used in current sets. I will point out components that fail often and suggest parts kits that make the repair (we hope) a little easier. As you work through these supplies, ask yourself these five questions. I think you will see that finding the answers to these questions will make things a little simpler.

## The RCA CTC 177/87 chassis

In my opinion, the power supplies in RCA's newer televisions are among the most reliable on the market (Figure 1). But like anything electronic, they do fail. When you encounter one of these power supplies that is not working, first check for raw B+ at pin 11 of U4104. If it is not present, you have a blown fuse or open 15W resistor. Naturally, you will repair the raw B+ supply first.

If B+ is present, check pin 4. Chances

are this is the source of your problem. R4104 is a 1.5M $\Omega$ , 1/4W resistor which supplies start-up voltage and current. It has a history of failure and may in fact be the only component damaged by a power surge or lightning storm.

If U4104 is shorted, check the horizontal output transformer (HOT) and CR4106. If either one is shorted, the new integrated circuit will be destroyed when you apply ac. Thompson says an open R4129 (off pin 5) will also cause the regulator chip to be destroyed. I have never had it happen, but I always check the resistor (100 $\Omega$ ) just to be safe.

Before you return the repaired set to the customer, be safe and resolder U4101 and T4101. These power supplies have failed merely because of insufficient solder.

## Samsung switching supply

Samsung manufactures a VCR it sells under its own name and vends to RCA/GE and Toshiba and, I think, to others. There are lots of VCRs out there that use this or a very similar supply, and the power supplies do fail. Figure 2 is a schematic of the supply.

The power supply can be tested without a load (connected to the VCR). You will need a variable isolation transformer, a scope, and a DMM. Before you start, locate both grounds. I usually use the negative lead of C05 for hot ground and the case itself for cold ground.

First a note about an "odd" set of symptoms. The supply may appear to be dead. When you check B+ at the collector of Q1, you have about 165V but no oscillation. Or, the display may be on and the VCR will power up. When you insert a tape, the VCR shuts off.

When you encounter this set of symptoms, before you do anything else, replace C09. This capacitor is used to kick-start Q1 into oscillation. In most instances C09 is a 22 $\mu$ F, 16V non-polarized capacitor. In a few supplies, the cap will be polarized.

If you order by the RCA number, you will get both. Since I encounter mostly

Samsung kit	
Q1	2SC4418 (upgrade)
Q2	KSC3203
D01	PS104R (not high failure)
D02, D03	1N4148
IC1	4N35 or PC817
IC2	TL431
R14	100 $\Omega$
ZD5	UZP18B (1N4746)
ZD6	UPZ43B (1N4755)

**Table 1.** This is a list of the components for the replacement kit used in servicing the switching power supply in the Samsung-manufactured sets covered in this article.

non-polarized caps, I order them by the dozen. If you choose to do the same, get the best quality cap you can get. Whatever you do, remember C09 is a high failure component.

If there is no B+, the fuse will more than likely be blown, in which case Q1 will be shorted. If you replace Q1, replace Q2 at the same time. In about fifty percent of cases, replacement of these components will repair the supply.

To check if the unit has been restored to normal operation, plug the power supply into the isolation transformer and slowly increase the voltage from zero while you monitor the output. A short-cut to this procedure is to monitor the voltage on the ever-six volt line.

If you measure an output voltage, increase the input voltage slowly. The voltage on the ever-six volt line should *never* exceed six volts. It may increase to, say 7V, but it should drop back to 6V or less. If it continues to increase, disconnect ac power because if you continue you will damage other components.

If the voltage starts to rise but does not reach 6V, something is loading it down (or there is a regulation problem). Shut the supply off. If you continue to increase the voltage, you will damage Q1 and possibly Q2. Incidentally, the supply should begin to oscillate at about 25Vac.

Rose is an independent consumer electronics business owner and technician.



### Funai kit

Q01	2SC4418 (an upgrade)
Q02	2SC4402
D05	EG01/ERA1804
D06, D14	SEM519
IC01	PC817
IC02	TL431

**Table 2.** This is a list of the components for the replacement kit used in servicing the switching power supply in the Funai-manufactured sets covered in this article.

I have found that if replacing Q1 and Q2 does not solve the problem, routine replacement of a kit of parts is in order, because several other components will have been damaged. Samsung sells the kit under the part number ST-17. Some distributors carry these kits. If you prefer, you can assemble your own kits for servicing these power supplies. See Table 1 for a bill of materials for the kit.

As you service more of these sets, let your experience be your guide. I find that in the case of lightning, the quickest repair is to replace the listed parts. When you have replaced the parts, check the power supply as I have indicated. Another good rule of thumb is to check every solid-state component in the secondary, either before or after you install the parts. Such a strat-

egy might save you money, and the investment in time is small.

### Zenith's switching power supply

Figure 3 is a schematic of a power supply Zenith has been using for several years. It is still in service. My shop sees a lot of Zeniths, and many of them use this supply or a variation thereof. Zenith's 9-911, 9-1130, 9-1335, etc., are examples of TV's using just such a set-up.

In this supply, RX3404 draws an initial turn-on current into the base of the switching IC. The initial pulse turns the switching transistor on, and switching begins. Base drive is drawn from the winding of TX3404. DX3407 rectifies the ac, creating a positive-going wave form that drives the base of the transistor inside ICX3431.

When the voltage at the emitter (pin 5) reaches 0.7V, QX3401 turns on and shunts base drive to ground and turns the switching transistor off. When this voltage drops below 0.7V, QX3401 turns off, and the cycle begins again. The power supply works best when pin 1 of ICX3431 is at -41V. The supply adjusts frequency and/or pulse width to keep pin 1 of this integrated circuit at -41V.

When you encounter one of these power supplies that has failed, be sure to check all the diodes and resistors in the primary circuit. Components that are fre-

### Service procedure recommended by Funai

1. Connect the unit to an isolation transformer and slowly increase voltage as you monitor the current. If the VCR draws too much current, turn the supply off and do the following (remember, the power supply has a 1.6A fuse).

a. Check for a short circuit: Q01, Q02, D12, D13, D15 through D17, D05, D06. Remember to replace resistors R13 and R14 if necessary.

b. You might have a short circuit in the VCR. Disconnect the diodes to 40V, 12V and 5V supplies and measure the resistance. If the resistance is low, that is the line with the short.

2. Check whether there is B+ at the collector of the switching transistor (I would have replaced this one first). If there is no B+, check the obvious components and find out why they failed. If Q01 is shorted, check R8-10 and R14-14. It is often necessary to remove components in order to check them.

3. With the primary dc working, check for secondary 5V. If there is no 5V, Funai states the obvious: it is because Q01 is not turning on and the tech needs to go to number One. A quick way to confirm that the supply is in fact working is to check the 5V line first.

4. Check for remaining voltages.

5. If the transformer makes a high squealing sound, and/or the waveform on the collector of Q01 is abnormal, likely causes are C07, R12, R16, C08 and R15.

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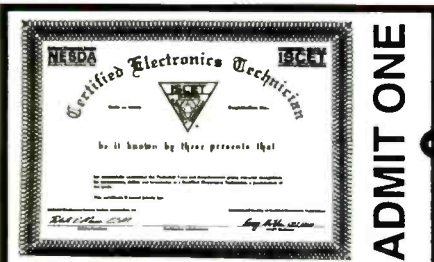
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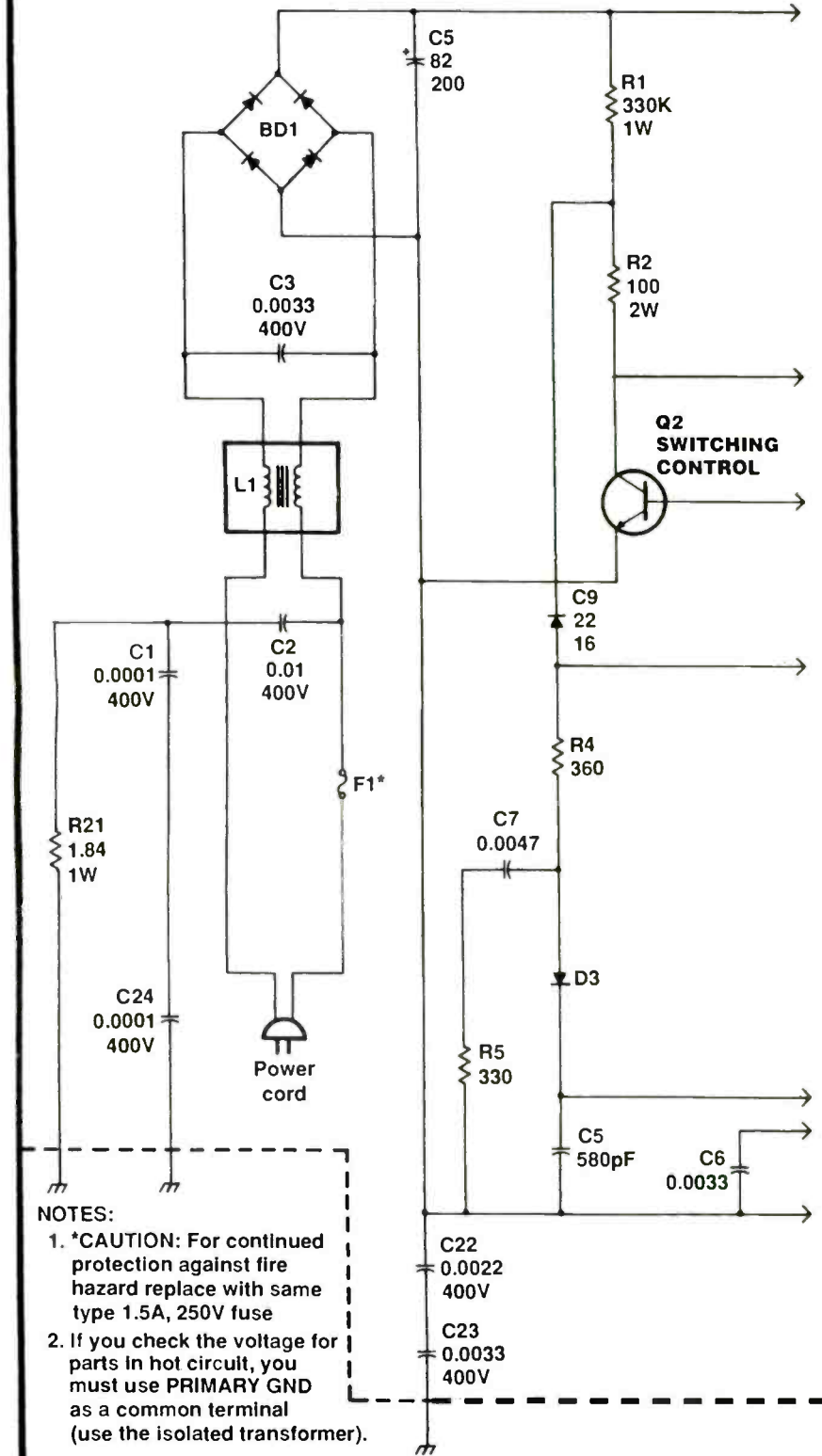


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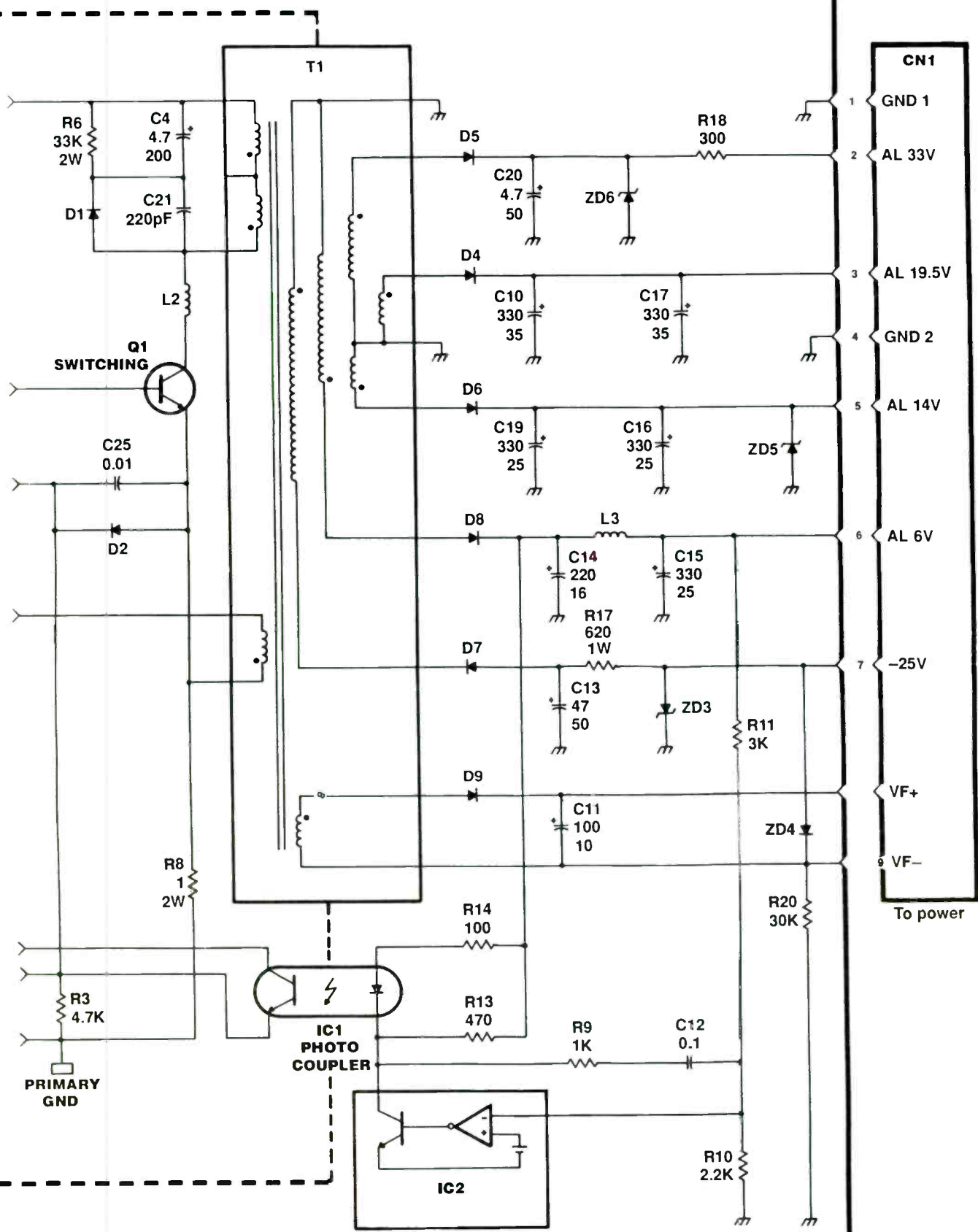
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- NOTES:
- \*CAUTION: For continued protection against fire hazard replace with same type 1.5A, 250V fuse
  - If you check the voltage for parts in hot circuit, you must use PRIMARY GND as a common terminal (use the isolated transformer).

Figure 2. This power supply is found in a number of brands and models of VCR manufactured by Samsung.



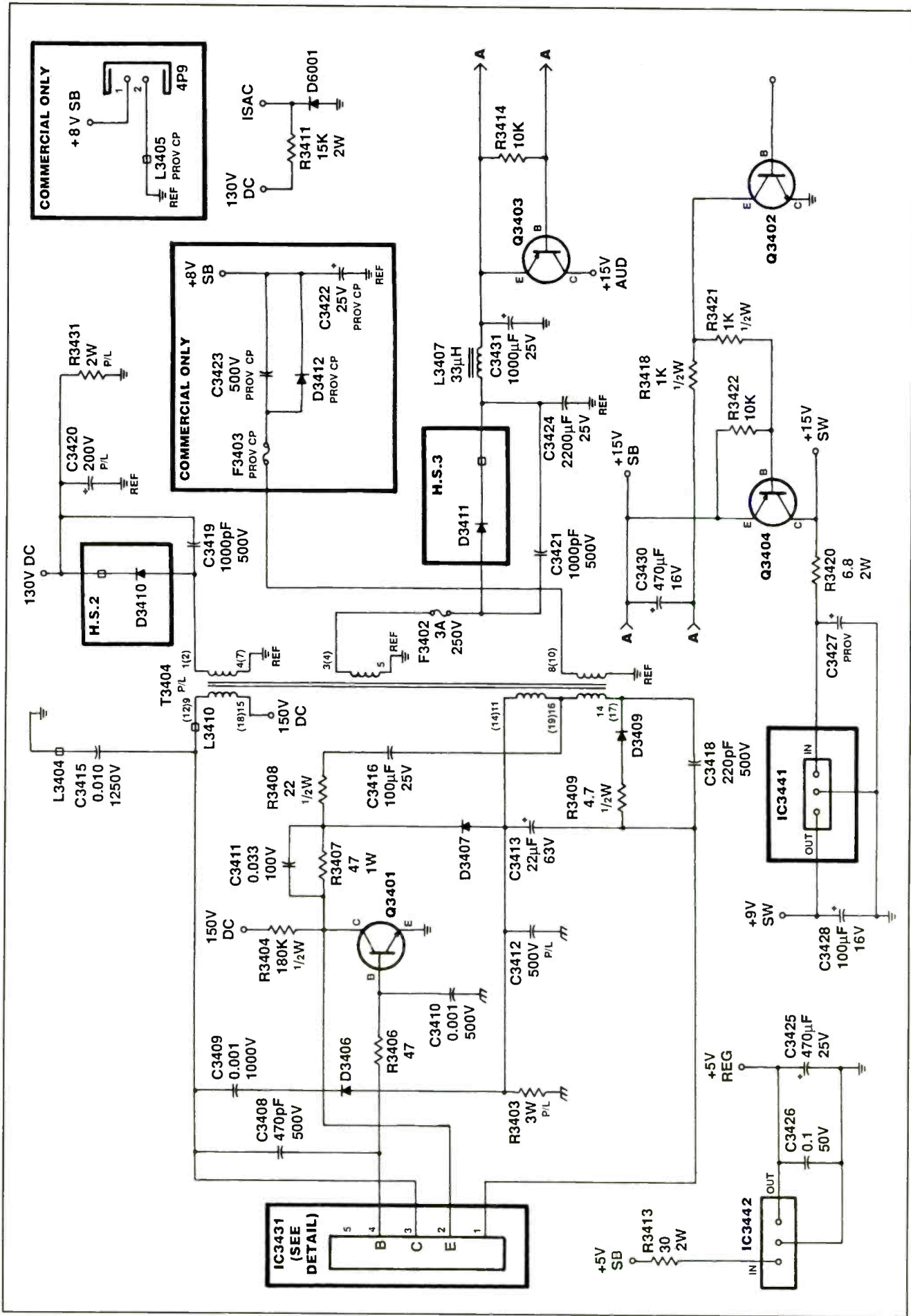


Figure 3. This supply has been used by Zenith for a number of years, and is still in service.





**MAIN 3/3**

Part No.	Position
1001	P-1
1002	P-1
TRANSISTORS	
001	O-2
002	O-2
053	O-2
054	O-2
055	O-1
058	O-1

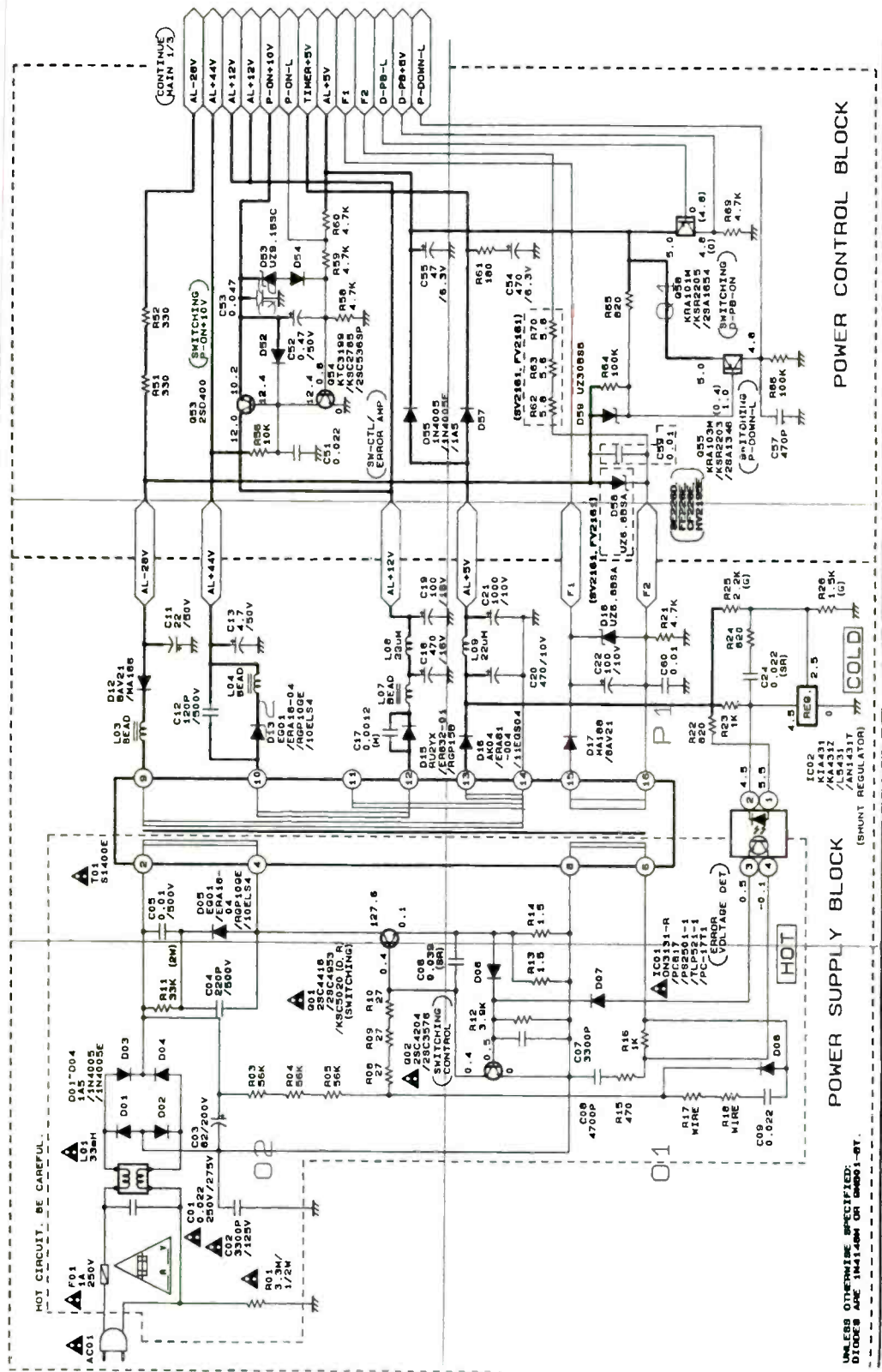
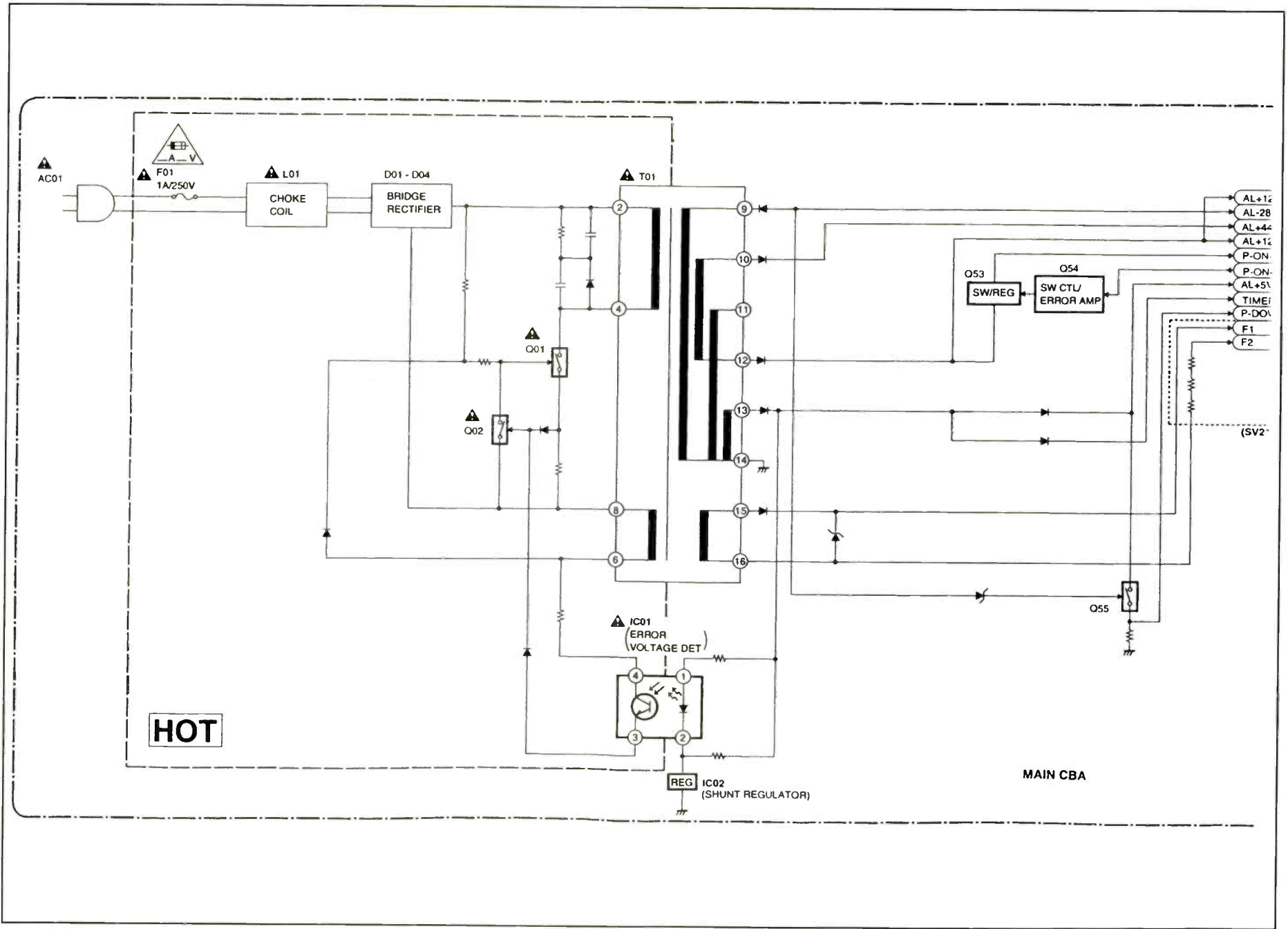


Figure 4. This power supply is by Funai, and is found in a number of other brands.



(Continued on page 37)

Figure 5. This is the block diagram of the Funai power supply in Figure 4.

## Switching Power (from page 24)

quently found to be the cause of failure in these supplies are RX3407 (47 $\Omega$ ), RX3406 (47 $\Omega$ ), DX3407, QX3401, and ICX3431. Generic replacement components will work when replacing the diodes, but use only the exact Zenith replacement part for QX3401. Generic replacements are available for ICX3431 and QX3401 from distributors.

Power surges and lightning frequently do mortal harm to these types of power supplies. A defective CRT will also take these supplies out. The CX3405 (the filter capacitor, 220 $\mu$ F to 330 $\mu$ F, 200V) can also cause failure. The big problem here is high equivalent series resistance (ESR), not loss of capacitance. Therefore, I routinely replace the filter capacitor. Most of the time, replacement of the fuse, the filter capacitor, QX3401, and ICX3431 help with the repair.

Once the repair has been completed let the TV operate for several minutes. Feel the heat sink on which the regulator is mounted. It should be just barely warm. If it is hot, check components in the secondary and in the horizontal deflection. The problem could be the flyback, the CRT, or a defective capacitor in one of the secondary circuits.

### A switching power supply by Funai

The power supply in Figure 4 (block diagram in Figure 5) is by Funai and is found in quite a few other brands: Symphonic, Magnavox, Sylvania, Philco, and Crosley, to name a few. It is, therefore, quite popular. This little fellow can be difficult to fix. It has quite a few components, most of which are small (some are SMDs), and the VCR has to be disassembled to get to the supply.

The repair procedure recommended by the manufacturer is shown in the sidebar. After repairing a number of these little beasts, I can recommend a kit of parts that will in most instances put the supply in good working order. You can order the kit from several vendors. If you prefer to assemble your own kit, the list of parts for these Funai VCR's is listed in Table 2.

In most instances, the parts contained in the kit will get the VCR up and running. But there are other times when nothing seems to work. I sometimes believe that consumer electronic devices

will get you any way they can, and these power supplies deserve that reputation. Therefore, it is a good idea to take the time to check all components.

I use an analog meter to check the solid state devices because the newer DMM's will not always detect a slightly leaky pn junction. My trusty battery-operated VOM on, say, the R x 1000 scale will detect a leaky junction that my new DMM will not. I use the DMM to check resistors.

I remember spending an hour on one of

these little jewels and getting nowhere. I finally decided to check some 1/8W resistors that looked good. Guess what? Two of them were open (R09 and R10). You won't invest much time when you check the components, and the time you invest just might save you time in the end.

If these suggestions are helpful, let me know. I have several other power supplies I can discuss, among them Panasonic's GL7, GL8, etc. I appreciate your suggestions and feedback. ■

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November 1997 *Electronic Servicing & Technology* 37

# Understanding the bipolar transistor: Part II

by Steven Jay Babbert

Understanding the bipolar transistor: Part I, published in November 1996, explained some of the physical mechanisms involved in transistor action. Part II will begin looking at how transistors behave and interact with other devices in electronic circuits. Some of the circuits most commonly encountered by consumer electronics technicians will be used as examples.

## A voltage-controlled resistor

In simple terms, a bipolar junction transistor (BJT) can be thought of as a voltage-controlled variable resistor. The "resistance" is between the emitter and collector, and the base voltage controls its value. Actually, BJTs are current-controlled devices; a small base current enables a much larger (typically close to 100 times larger) current to flow between the emitter and collector.

The base current combines with the collector current to become part of the emitter current. However, for a given amount of base current there is a corresponding emitter-to-base voltage drop. It is convenient to describe transistor action in terms of this voltage.

With no base voltage or "bias" the emitter-to-collector resistance is maximum

and can be considered infinite: no current will flow. This condition is known as cutoff. In an NPN device, as the base bias approaches 0.5V with respect to the emitter, the resistance drops and conduction begins (Figure 1). Very small increases in the base voltage result in large increases in conductance. At a base voltage of about 0.8V the resistance has dropped to its minimum value and maximum current flows. This condition is known as saturation. For a PNP transistor the base voltage will be negative with respect to the emitter. Notice that the curve has a linear portion between around 0.6V and 0.7V. It will be shown later that amplifiers rely on this characteristic for distortion-free operation.

## Basic configurations

There are three basic configurations from which the more complex circuits are derived. These are the common-base, the common-emitter and the common-collector. Table 1 compares some of their characteristics. The common element (the element shared in common by the input and the output) is shown grounded for simplicity. In most cases it won't be tied directly to ground (Figure 2).

In the common-base circuit, the input signal is applied to the emitter and the output is taken from the collector. Load resistor,  $R_L$ , is in series with the collector supply voltage,  $V_{CC}$ . The emitter input has a low resistance because the e-b junction is forward biased and the emitter current is high. The output resistance is high because the c-b junction is reverse biased. In both cases, the internal resistance is between the given element and the base.

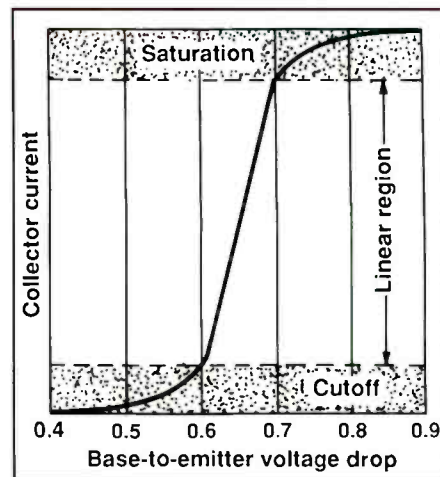


Figure 1. As the base-to-emitter voltage is increased, the collector-to-emitter resistance is reduced, causing the current to increase.

The common-base circuit is seldom used. It has no current gain from input to output because the collector current must be lower than the emitter current. The voltage gain can be high. The main advantage of this circuit is its thermal stability. The reason for the thermal stability of this

ply voltage,  $V_{CC}$ . The emitter input has a low resistance because the e-b junction is forward biased and the emitter current is high. The output resistance is high because the c-b junction is reverse biased. In both cases, the internal resistance is between the given element and the base.

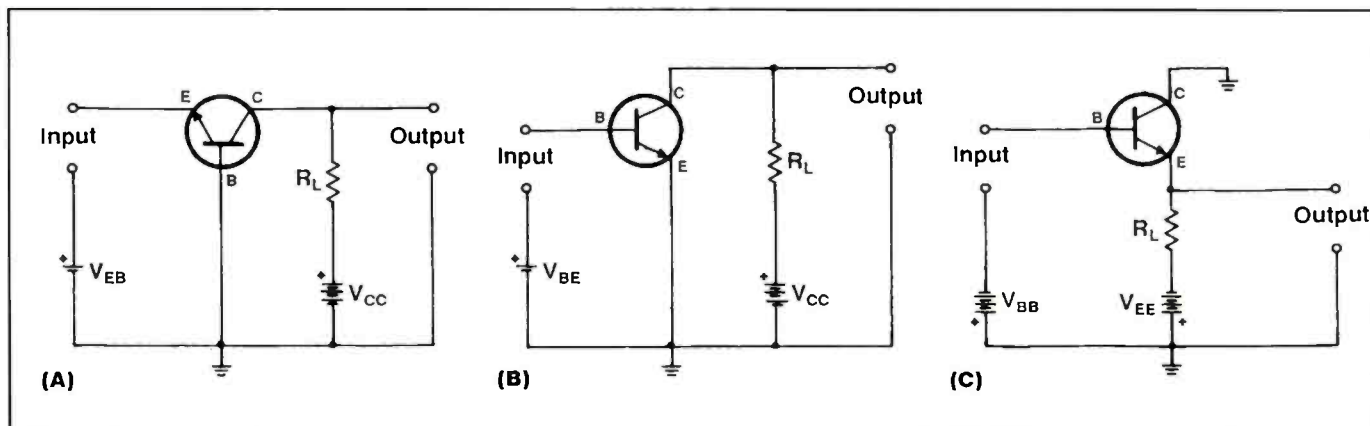


Figure 2. A, B and C show the common-base, common-emitter and common-collector circuits. The common-emitter is the most popular.

## Characteristics of Basic Configurations

Characteristic	Common Base (CB)	Common Emitter (CE)	Common Collector (CC)
Input Element	Emitter	Base	Base
Output Element	Collector	Collector	Emitter
Advantage	Stability	High Gain	High Input Resistance
Phase Inversion	No	Yes	No
Input Resistance*	20Ω	100Ω	150kΩ
Output Resistance*	1MΩ	50kΩ	80Ω

\* These values are typical for small-signal transistors with an emitter current of 1.5mA.

**Table 1.** The characteristic of a transistor circuit will depend on the configuration in which the transistor is connected.

circuit is that reverse leakage current from the collector to the base will not enter the input circuit where it would be amplified (the base is grounded).

In the common-emitter circuit, the input signal is applied to the base and the emitter is the common element. Since the base current is smaller than the emitter current, the input resistance is higher than that of the common-base circuit. The output signal is taken from the collector across the load resistor.

This circuit has a high current gain because the collector current is higher than the base current. Because of the higher input resistance these circuits can be cascaded (output of one stage drives the input of the next) without loading effects. The voltage gain is the same as for the common-base circuit.

The common-emitter circuit is the most popular for amplifier circuits because it

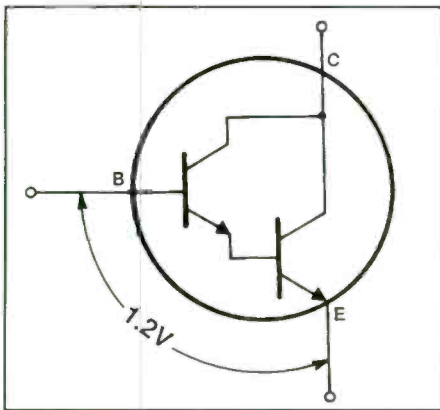
has the best combination of current gain and voltage gain which translates to good power gain. The disadvantage of this circuit is that reverse leakage current, collector to base, is amplified. A unique feature of the common-emitter circuit is that it reverses the phase of the signal from input to output. When the input signal at the base increases the forward bias, the collector voltage decreases due to the voltage drop across the load resistor.

In the common-collector circuit, the input signal is applied to the base and the output is taken from across the load resistor in the emitter circuit. This configuration has a very high input resistance and a low output resistance, unlike the other circuits. There is no voltage gain in this circuit because of the negative feedback from the load resistor. The voltage drop across this resistor when the transistor conducts raises the emitter voltage,

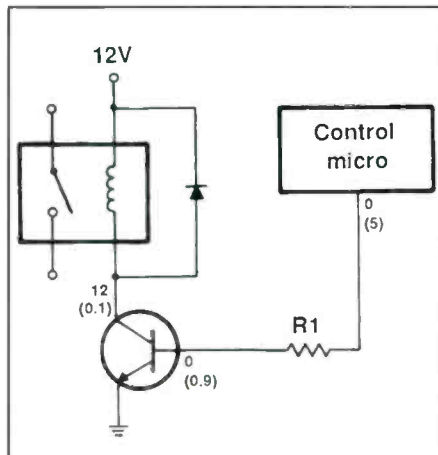
reducing the base-to-emitter bias voltage.

The common-collector circuit is often called an emitter-follower because there is no phase reversal the phase of the output signal at the emitter is the same as that of the input signal. This circuit is usually used for impedance matching when coupling a high-impedance source to a low-impedance load. This circuit also provides isolation between two circuits.

A special case of the emitter-follower is the Darlington pair. It comprises two emitter followers connected in cascade. The two stages are often integrated on a



**Figure 3.** The Darlington pair is a special case of the emitter follower. The signal for the base of the second transistor is taken from the emitter of the first. The unit as a whole can still be used in a common-emitter configuration. The base voltage will read about twice as high as a regular transistor with respect to the emitter because of the double e-b drop.



**Figure 4.** In this low-side driver, a voltage of zero at the base causes the transistor to act as a high resistance device, thus blocking current. When the controller's "power-on" pin goes high (5V), the transistor saturates providing a current path to ground for the relay.

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single die having three leads. The Darlington pair has a higher input resistance and a much higher current-gain than a single stage (Figure 3). Darlington pairs are often found in switching circuits, regulators and amplifiers.

### The electronic switch

The simplest transistor circuit is the electronic switch. A good example is the power-on relay driver found in many TV chassis. Since the control IC can't source or sink sufficient current to drive the relay directly, the transistor is used as an interface. The collector is tied through the load (the relay coil) to the supply voltage which is typically 12V. Without base drive voltage the transistor acts as an open switch (Figure 4).

When the "power" pin of the controller goes high, the base receives bias voltage via R1. The collector-to-emitter resistance drops to a low value pulling the low end of the coil to ground energizing the relay which powers up the chassis. When the transistor is turned off, there is a "kick" produced by the inductance of the coil which tries to keep current flowing through the transistor. The "kick-back" or "snubber" diode protects the transistor by shunting the pulse around the coil.

In this type of switch, a high base current is used to ensure the lowest possible resistance between emitter and collector. If the base drive is sufficient the collector voltage will drop to about 0.1V with respect to the emitter. This seems impossible; a measurement like this would normally lead a technician to suspect a short.

When transistors have excessive base drive current the c-b junction, which is normally reverse biased, becomes forward biased, and normal transistor action collapses. This is an extreme case of current saturation. The low value of the collector-to-emitter voltage results because the c-b voltage drop subtracts from the voltage e-b drop (Figure 5).

When the transistor switch is connected at the low-potential side of the load as in the example just given, it is referred to as a low-side driver. Transistors are also used as high-side drivers by connecting them into the high-potential side of the load. In this case a PNP transistor device is used and will be turned on when the base is pulled low (Figure 6).

Transistor switches are used to drive a variety of devices such as motors, sole-

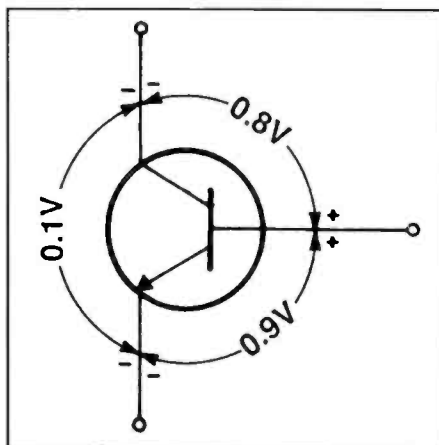


Figure 5. Excessive base drive causes normal transistor action to collapse. The c-b junction becomes forward biased resulting in a very low collector-to-emitter voltage drop.

noids and lamps. In some cases they are used to energize an entire circuit by placing them in the supply bus. An example of this is the bias oscillator in a VCR which is only running during record. Even LEDs are usually driven by transistors because their forward current, though normally only between 10mA and 20mA, is still too high for many control ICs.

### Digital transistors

While most electronic switches are designed around general purpose transistors, there is a device designed specifically for switching known as the "digital transistor," so named because they are usually driven by logic "high" and "low" signals. This is nothing more than a small-signal transistor with two internal resistors (Figure 7). The base resistor eliminates the need for an external current-limiting resistor in the base circuit. The resistor between the emitter and base acts to pull the voltage at the base toward the voltage at the emitter when the base drive is removed ensuring a solid turn-off. Typical values for the internal resistors are 10K $\Omega$ , 22K $\Omega$  and 47K $\Omega$ .

One of the first places these devices appeared was as an interface between TV tuners and their control circuits. In some TV tuners, the VHF high-band, low-band or UHF band is selected by applying 12V to the BH, BL or BU pins as needed. Digital transistors are connected between these pins and ground. The controller turns the transistors on or off by pulling the bases high or low using logic levels of 5V and 0V respectively.

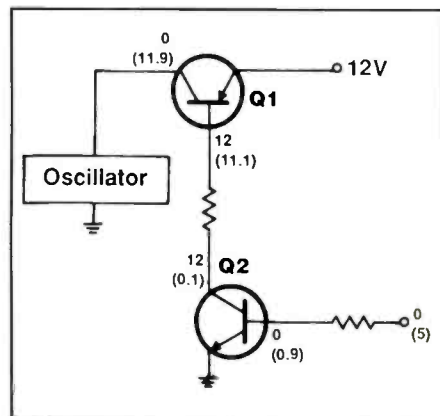


Figure 6. In this example, high side driver Q1, a PNP transistor, will be on when the voltage at its base is pulled low. When the base of Q2 is pulled up from 0V to 5V it will conduct pulling down the base of Q1.

Since digital transistors are often used in a common-emitter configuration which inverts the signal, they are sometimes depicted as inverters in schematics. Notice the resemblance to the standard logic symbol for the inverter (Figure 8). NPN devices show the "bubble" at the output while in PNP devices it is shown at the input. Most cross-reference guides will show the internal diagram which can be helpful when troubleshooting. The junctions can't be tested individually with a DMM because of the series base resistor, but most conventional transistor testers will give reliable results. These devices rarely fail because of the low power levels involved.

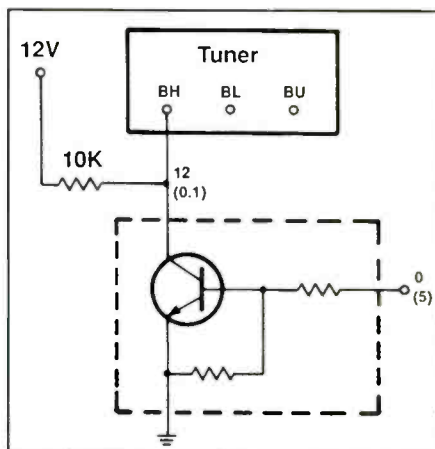
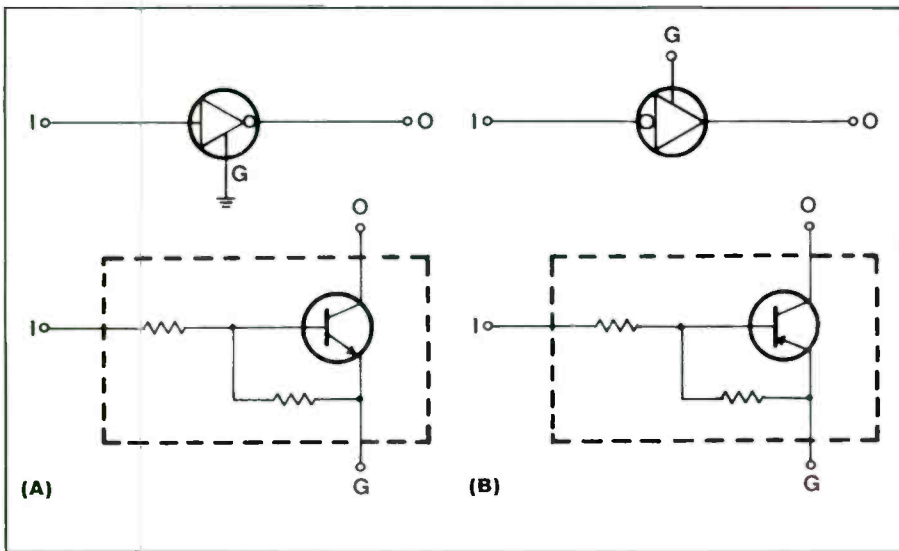


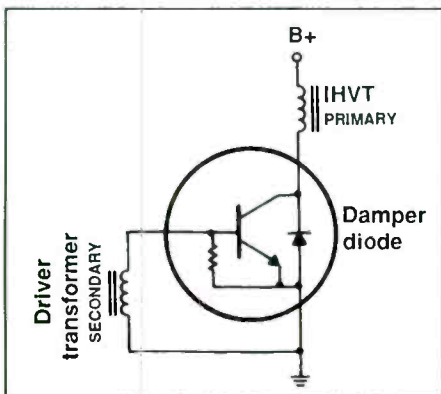
Figure 7. In some TVs, digital transistors are used as band selector switches. When the transistor is off the BH pin on the tuner is pulled up to 12V by a resistor. A logic "high" of 5V on the base will turn the transistor on pulling the BH pin close to ground. Similar circuits are used for the BL and BU pins.



**Figure 8.** Since digital transistors are usually used in a common-emitter configuration, which inverts the signal, they are sometimes labelled as inverters. The schematic symbol for these transistors resembles that of the standard logic inverter. The pins are often designated input, output and ground. For PNP devices the ground is typically connected to a 5V supply.

### The horizontal output switch

The horizontal output transistor used in TVs and computer monitors is another example of an electronic switch. The device is connected in a common-emitter configuration as a low-side driver with the primary of the flyback transformer or IHVT as its collector load (Figure 9). The high-side of the primary is connected to the regulated supply line which is typically around 120V. The device is driven alternately between saturation and cutoff by the base drive signal converting the dc voltage into ac. The ac is stepped up by the secondary winding to create the high-voltage for the CRT. The horizontal yoke is also connected to the collector of the horizontal output transistor and shapes the ac waveform for a linear horizontal scan.



**Figure 9.** The H.O.T. is another example of a transistor switch. It is alternately driven from saturation to cutoff by the base drive signal.

In most newer chassis, the horizontal output transistor contains an internal damper diode or "body diode" as well as a resistor tied from base to emitter with a typical value of 50Ω. The damper diode provides a return path for the yoke current during a portion of the horizontal

cycle and reduces stress on the transistor from reverse voltage kickback. The resistor acts to pull down the base for a rapid turn-off at the negative transition of the base drive pulse. This minimizes the period between saturation and cutoff when the transistor dissipates excess power in the form of heat.

If a horizontal output transistor is tested in-circuit with a DMM, the e-b junction will appear shorted due to the low resistance of the driver transformer secondary which is in parallel. Out of circuit the e-b junction will appear shorted or leaky if it contains the internal base resistor. If a resistance check shows around 50Ω then it is usually safe to assume that there is a resistor rather than a short. A short will generally be closer to zero ohms. A damper diode from collector to emitter will also show a normal diode-drop with a DMM. Many transistor testers will reliably test these devices in or out of circuit. Most cross-reference guides will show the internal breakdown of any device in question.

Future articles we will describe circuits that use bipolar transistors biased to operate in their linear region. ■

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# Where are they now? Part 2

by Victor Meeldijk

If you did not know Horn & Hardart, the former automaton company, changed its name to Hanover Direct, Dime and Anchor Savings banks merged to become Dime Bancorp, or Procter and Gamble merged White Cloud tissue into the Charmin brand, how would you find them? Mergers, acquisitions, bankruptcies and name changes make it difficult to locate companies or product brands. 1994 saw the top five merger specialists alone account for 553 acquisitions worth over \$330 billion dollars. In this article we help you locate companies or products you may be trying to find.

In February 1993, we listed various companies letting you know if they had been purchased, merged or ceased operation. Here are some more companies, or product lines, you may be looking for and were not able to find.

In addition to the information presented below, various reference works track company affiliations, and many are available in your local public library. Two of the books you may find are the *Directory of Corporate Affiliations, U.S. Public Companies*, and *Who Owns Whom*, by National Register Publishing, Reed Reference Publishing Company, 121 Chanlon Road, New Providence, NJ 07974, and Dunn and Bradstreet, America's Corporate Families and International Affiliates.

## Here's where they are now

### A

- Acumos (Foster City, CA), a manufacturer of graphics controller ICs, became a subsidiary of Cirrus Logic in April 1992.
- Aero M, a manufacturer of ac voltage capacitors for motor start circuits and computer grade capacitors, was purchased by Aerovox Inc. in March 1993.
- Ahead Technology Corporation (Los Gatos, CA), a manufacturer of magnetic heads for computer disk drives, was acquired by Precision Echo, Inc. (Santa Clara, CA) a wholly-owned subsidiary of Diagnostic/Retrieval Systems, Inc. in late 1994.
- Airpax is now known as Philips Technologies, a North American Philips Company, Woods Road, Box 520, Cambridge, MD 21613, 410-228-4600, Fax: 410-228-8910.
- Aldus Corporation (Seattle, WA), the creator of Pagemaker software, merged with desktop publishing firm Adobe Systems, Inc. (Mountain View, CA), the originator of the PostScript printing language.
- Allen Bradley potentiometer division was bought by Clarostat (Dover NH) which is now part of Hawker Siddeley (more on this below under Clarostat).
- Allied Telesis, Inc. (ATI), an ethernet vendor located in Mountain View, CA, changed its name to Allied Telesyn International Corporation, in late 1994.
- Amber, Montreal Canada, a manufacturer of audio test

instruments was acquired by Neutrik AG, Lakewood, NJ, in 1993.

- Amelco Semiconductor Co., became Teledyne Components and is now known as TelCom Semiconductor, Inc.
- American Instruments Company was acquired by Jewell Electrical Instruments, Manchester NH, in 1990.
- Ammon Instruments Company was acquired by Jewell Electrical Instruments, Manchester NH, in 1982.
- Applied Magnetics Corporation (AMC), Santa Maria, CA, a manufacturer of tape heads was purchased by Seagate Technology, Inc. in late 1994.
- Archive Corporation, a tape drive manufacturer, was purchased by Conner Peripherals, Inc. in 1993.
- Assembly Technologies was sold by General Signal to Kulicke & Soffa, Willow Grove PA.
- Astrio Corporation, a surface mount assembly maker, was acquired by Altron Systems, Corp. in June 1994.
- AT&T Microelectronics Connector Systems business (excluding fiber optic connectors) in Lee's Summit MO was purchased by Hicks, Muse and Co. and merged into Berg Electronics (and is known as MAC II (trademark) Fiber-Optic Connector Systems).
- Automatic Connector Company (Commack, NY), which filed for bankruptcy in March 1992, had some of its assets purchased by Speciality Connector Company (Franklin, IN).
- AVX (Myrtle Beach, CA), a manufacturer of passive components (notably capacitors) was purchased by Kyocera (originally called the Kyoto Ceramics Company) in 1989. The company is still known by the AVX name.

### B

- Ballantine Laboratories, a test equipment manufacturer, was acquired from Electro Scientific Industries in 1991 and moved to Cedar Knolls, NJ from Boonton NJ (201-984-1900, Fax: 201-984-1479).
- Barneyscan Corporation (San Leandro CA), a manufacturer of desktop color imaging scanners and software for electronic publishing/graphics arts, was acquired by PixelCraft, Inc. of El Segundo, CA (which is a subsidiary of Xerox Corporation).
- Base2 Systems, Inc. a supplier of voice and data communications ICs was acquired by Brooktree Corp. in late 1992.
- Beckman Industrial Corporation's instrumentation products (manufacturer of handheld digital multimeters and test equipment) was sold to Wavetek Corp. Instrumentation Division (San Diego, CA) in early 1993.
- Benchmark Technologies, UK, see DuPont Pixel.
- Bendix Flight Systems, Bendix Guidance Systems and Bendix Test Systems were reorganized by Allied-Signal Aerospace in 1992 into Bendix Guidance and Control Systems.
- BH Components, Ltd. an aluminum electrolytic capacitor manufacturer in Weymouth England was purchased by Aerovox Inc. in March 1993.
- Bicc-Vero, a manufacturer of backplanes, cardcages, enclo-

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tures and electronics packaging, was acquired from the United Kingdom BICC Group in April 1994 by a management buy-out team. The company is now known as Vero Electronics, Ltd. The office in the U.S. is in Hamden CT, 1-800-242-2863, 203-288-8001.

- Biomation Corporation, a logic analyzer company, was acquired by Embedded Performance Inc. (EPI) of Santa Clara, CA.

- Boonton Electronics Corp., manufacturer of RF and microwave test equipment, moved to Parsippany NJ in late 1994.

- Broadband Technologies, inc., Research Triangle Park NC, a manufacturer of fiber-in-the-loop equipment was acquired by Amp., Inc. (Harrisburg, PA).

- Bruno Power Supplies, became Hughes Power Supplies Corporation and was then acquired by Signal Technology in mid 1994. The company now operates as part of the power management line of ST Keltec, Fort Walton Beach, FL.

- BT&D Technologies, a manufacturer of fiber optic materials (formed by BT, British Telecom and DuPont), was acquired by Hewlett Packard. It is part of the Optical Communications Division of Hewlett Packard Components Group.

- BTR (British Tire & Rubber) plc's Hawker Fusegear Group, a supplier of electrical fuses, fusegear and connector products, was purchased by Cooper Industries, Inc. in 1993.

- Buchanan products, wire termination components such as terminal blocks, are available from Amerace Electronic Components, Punta Gorda, FL.



- Caloric Corp. was consolidated into the Amana Refrigeration Inc. line by its parent Raytheon Co. and all products now carry the Amana name.

- Cambridge Thermonics Corporation (CAMBION), and Hollingsworth, were part of Midland Ross which became part of Interconnection Products, Inc. (IPI). While the American IPI is no longer in business (since late 1991), the United Kingdom division of the company, Interconnection Products, LTD., Castleton, Sheffield England S30-2WR, Tel: 011 44 433 621555, Fax: 011 44 433 621290) is still operating.

- The Carborundum Company product line of Globar Non-Inductive Bulk Ceramic Resistors was purchased by Cesiwid, Inc. Niagra Falls, NY, in 1993. Cesiwid also purchased the Maxcap line of double layer capacitors.

- Centralab, the manufacturer of pushbuttons, toggle switches, rocker switches, keyswitches and potentiometers was known as CRL Components, Inc. for a while and then closed on August 31, 1992. The rotary switch line was sold to Electroswitch, Raleigh NC, in January 1992. The illuminated pushbutton switches was transferred to a sister company, Dialight Corporation of Manasquan, N.J. ITT Shadow, Eden Prairie MN, offers switches that may be compatible with CRL units (note: ITT Shadow, ITT Sealectro and ITT Jeanrenaud were consolidated into ITT Canon in mid 1994). CIA General de Electronica (CGE) S.A. based in Azacaptzalco Mexico purchased the pushbutton and dome switch lines at auction and has a sales office in Fort Dodge, Iowa (using CRL's old phone number). Some former CRL distributors may carry the CGE line.

- Checklogic Systems, Inc. (San Jose, CA), a vendor of automatic test pattern generation and design for testability tools, was acquired by Mentor Graphics Corporation in late 1993.

- Cherokee Data Systems (Longmont, CO), a manufacturer of optical disk drives, is now known as MountainGate Data Systems, Inc., Reno NV, 808-556-0222

- Chronologic Simulation, Los Altos CA, the supplier of the trademarked Verilog EDA digital simulator, was acquired by Viewlogic Systems, Inc., Marlboro MA in mid 1994.

- Cipher Data Products assets was purchased from Conner Peripherals, Inc. by Overland Data, Inc. of San Diego. Cipher Data products was owned by Archive Corporation which was purchased by Conner Peripherals, Inc. in 1993.

- Cirrus Computers (a manufacturer of gate level logic simulators), of England, was purchased by GenRad in 1982. GenRad's electronic design automation business was spun off into an independent company called Veda Design Automation in May 1994.

- Comdisco Systems, an electronic system design automation company was acquired by Cadence Design Systems, San Jose, CA in 1993. It is now known as the Alta Group.

- CP Claire type LA, LB and LC relays, and hook and switch lines, were acquired by CII (Communications Instruments, Inc.) in February 1993. CII also sells products previously manufactured by Pacific Scientific Corp.'s Sigma Relay Division and North American Philips's Airpax Relay Division.

- Clarostat Manufacturing Company, Inc., was founded in 1921 in Brooklyn NY and later moved to Dover NH. It and Senisys (Sensor Integrated Systems) were purchased from Hawker Siddeley Group plc by British Tire and Rubber Industries N.A. in 1991 and were merged together in September 1992. Clarostat/Senisys distributor orders can be placed through the 1600 W. Plano Texas office, 800-448-2900, 214-422-1844, Fax: 214-423-4661 (OEM, Original Equipment Manufacturers orders can be placed in the El Paso Texas office). The combined company is now known as Clarostat Sensors and Controls.

- Clifton Precision, a division of Litton, which manufactured motors, resolvers and controllers, was consolidated with Litton Poly-Scientific, Blakburg, VA.

- CMC Video Operations Company, a video head refurbisher and manufacturer of degaussers, was purchased by Diagnostic Retrieval Systems, Inc. in December 1993, and relocated within their Precision Echo Division in Santa Clara, CA.

- Connectron Inc., a Laurence NJ manufacturer of terminal blocks, merged into the USD Products Chicago IL facility in early 1994.

- Coors Components, was purchased by Microsemi Corporation (in Santa Ana CA 714-979-8220, in Broomfield CO 303-469-2161).

- Crystal Semiconductor (Austin, TX), a manufacturer of mixed signal ICs, became a subsidiary of Cirrus Logic in October 1991.

- CTI, or Circuit Technology Inc., a manufacturer of hybrid circuits including MIL-STD-1553 and MIL-STD-1760 devices, became Marconi Electronic Devices, Circuit Technology Inc. IC Division and is now known as GEC Plessey Semiconductors, Marconi Circuit Technology Corporation. They are still located in Farmingdale NY.

- CLSI (VHDL, VHSIC Hardware Description Language, products) was acquired by Compass Design Automation, San Jose, CA.

- Relay manufacturer CP Clare was acquired by Theta-J in 1989 and continues to operate under its own name.

## D

- Data (Systems) Storage Technology (Broomfield, CO), a developer of error-correction technology for hard disk drives, was acquired by Cirrus Logic in January 1990.

- Datatape, was sold by Kodak to Delta Tango in 1994.

- DBX, Inc. (a manufacturer of audio equipment), of Newton MA is now AKG Acoustics, Inc., San Leandro, CA.

- DEC sold its mass storage business (thin film head, disk drive, solid state disk and digital-linear tape operations) to Quantum Corporation, Milpitas, CA in 1994.

- Digital Equipment Corporation's multichip module plant in Cupertino CA was purchased in 1992 and is now known as Micromodule Systems, Inc.

- Digital Research, the force behind the CP/M operating system for PCs in the late 1970s, was sold to Novell in 1991.

- Digitran, a keyboard manufacturer can be found under its parent company XCEL Corp, Ontario CA, 909-391-4321

- Dowty Custom Electronics, Inc. was renamed Nexus Custom Electronics, Inc. (in Brandon VT in the U.S.) after the Dowty Group, PLC (England) was acquired by Tube Industries, PLC (in 1992) and Cray Electronics then bought the information Technology Division. Nexus Custom Electronics, Inc., does circuit board assembly, testing and system integration.

- Drytek, a manufacturer of plasma etching and stripping equipment was acquired by General Signal Corp. in 1986 and has since been merged into Lam Research Corporation, Fremont, CA.

- DuPont Connector Systems was purchased by a private investment firm (Hicks, Muse and Co.) in March 1993, and is again known by its former name Berg Electronics, Inc. The company has relocated from Wilmington Delaware to Harrisburg PA, where it operated prior to being acquired by DuPont.

- DuPont Pixel, a subsidiary of the DuPont Corporation is now 3DLabs, Inc., based in San Jose, CA, after a management buyout by its original founders in early 1994. This company provides hardware and software for 3D graphics applications.

- Dynamotion Inc., a manufacturer of pc board manufacturing equipment, was acquired by Cybernetic Products, Inc. in late 1992.

## E

- The component division of EAC/JMAR is now known as Advacom, in Teterboro, NJ.

- The Eaton Corporation line of RFI/EMI injection probes and current probes is now manufactured by Tegam Inc. Madison OH.

- Edge Technology Inc. is now known as Micron Computer.

- EEsos Inc. was acquired by Hewlett-Packard in late 1993. It was a developer of computer-aided engineering (CAE) software (for the design of high frequency systems, circuits and devices). The company was merged into Hewlett-Packard High Frequency Design Software Operation.

- EG&G Frequency Products, Inc. (a manufacturer of crystals and crystal oscillators) is now known as Frequency Products Corporation, still located in Cincinnati, OH.

- ELCO, a connector manufacturer, was purchased from Gulf and Western by Kyocera (originally called the Kyoto Ceramics Company) in 1989. The company is still known by the ELCO name.

- Electronic Arrays (EA logo) is now NEC Microelectronics.

- ELF Atochem Sensors, Inc. (Valley Forge, PA), a manufacturer of piezoelectric and pyroelectric polymer transducers was acquired by Amp. Inc. (Harrisburg, PA) in 1993. The existing plant remains in Valley Forge, PA.

- Elographics, in Oak Ridge TN, changed its name to Elo Touchsystems in early 1994.

- Emerald Computers, Inc. (Beverton, IL) a pioneer in integrating flat panel technology, was acquired by Carroll Touch, Inc. in early 1994.

- ESC, a division of connector supplier G&H Technology, Inc. (part of Penn Central Corp.) in Cammarillo, CA was purchased by First Lexington Group in March 1993. It is now known as ESC Technologies, Inc. and is located in Hawthorne, CA (where it was formerly located before being purchased by Penn Central Corp. in 1989).

- ETC, a manufacturer of crimp connectors is now Molex-ETC, Pinellas Park, FL.

- The mass storage division of Everex Systems, Inc. (Everex MSD, located in Fremont, CA), was sold to Exabyte Corporation in early 1993. This division manufactures quarter-inch cartridge tape drives for computers (such as the DC-2000).

- Expertest (automatic test equipment products) was purchased by Sunrise Test Systems, Sunnyvale, CA.

- The industrial battery division of Exide Corporation was acquired by Yuasa Battery Company Ltd. in 1991 and is now known as Yuasa Exide, Inc.

- Exzec Inc. (Evanston, IL) a guided acoustic wave touch screen manufacturer, was acquired by Carroll Touch, Inc. in early 1994.

## F

- Fairchild Industries Sentry Division, a manufacturer of automatic test equipment (ATE), was acquired by Schlumberger Ltd. in early 1979.

- The diode product line of FEI Microwave, Inc. (55 Charles Lindbergh Blvd, Suite A, Mitchell Field, NY 11553, 516-794-4500, was sold to M/A-Com Semiconductor Division, Burlington Semiconductor Operations, Burlington, MA.

- John Fluke Manufacturing Co. changed its name in late 1993 to the Fluke Corporation (and the stock exchange symbol is FLK).

- Ford Aerospace was purchased by Loral Corporation in 1990.

- Fordam Radio, an importer and mail order distributor with catalogs also under Scope Electronics and B.P. Electronics, went bankrupt in 1993 and is no longer in operation.

- Forval America Inc.'s modem division was purchased by IMC, Intelligent Modem Corp. of Sandy UT.

- Four-Phase Systems, Inc., Cupertino, CA, was acquired by Motorola, Inc. in 1982.

## G

- Gates Energy Products, Inc. nickel-based rechargeable battery division was sold to Eveready Battery Company in March 1993. The sealed lead batteries (such as Cyclon, Monobloc and Genesis) are now sold by Hawker Energy.
- Gates Radio Co. was the first electronics purchase made by the Harris Corp. in 1956, when Harris was manufacturing printing equipment.
- Geleco Electronics, Ltd. of Canada RF Systems was purchased by LBA Technology, Inc. of Greenville NC in early 1993 and assets and inventory was moved to the LBA Greenville NC manufacturing facility.
- General Cable was acquired by Wassal (London, England), in May 1994.
- General Instrument Optoelectronics, formerly Monsanto Optoelectronics (manufacturer of the MAN prefix LED displays), is now Quality Technologies in Sunnyvale CA.
- Glolite Manufacturing Co. Pauls Valley OK, a manufacturer of neon lamp products, was purchased by Chicago Miniature Lamp, Inc. in 1993.
- The Go Corporation was purchased by AT&T. This pen based software vendor was merged with PDA-maker Eo.
- Gordos products (solid state relays, etc.) are manufactured by the Crouzet Corporation, Carrollton, TX.
- The Aluminum Slide Group of Grant Hardware Co. was acquired by the Jonathan Manufacturing Corp. Fullerton, CA.
- Grumman Corp. was purchased by Northrop Corporation in 1994 and is now known as Northrup-Grumman.
- GTE Sylvania display business was merged into Display Technologies, Inc. of Elgin, IL. (which is owned by Corcoran partners, Chicago, IL). The GTE North American lighting business was purchased by OSRAM GmH and is now known as OSRAM Sylvania, Inc. The GTE connector business was sold to Siemens AG in 1992.

## H

- HaL Computer ownership was acquired by Fujitsu in late 1993 after Fujitsu purchased all the outstanding stock in the privately held company.
- Hamlin LCD's is now known as Standish LCD, a Division of Standish Industries, Inc., W7514 Highway V, Lake Mills, WI.
- Harris Microwave Semiconductor, Inc. HMS, in Milpitas, CA, a manufacturer of GaAs microwave semiconductors (FET's and MMIC's) was sold to Samsung Electronics Company, Ltd. (SEC) in May 1993. The transition was completed on June 15, 1993. The company, now called Samsung Microwave Semiconductor, Inc. and is still located in Milpitas California.
- H.H. Smith Company is now part of NT-T (National Teletronics) Inc., Meadville, PA.
- Honeywell Defense Communications and Production Division is now an independent company known as Group Technologies Corporation, located in Tampa FL.
- Honeywell's Keyboard Division, with headquarters in El Paso TX and manufacturing facilities in Las Cruces, NM and Juarez, Mexico was purchased by Key Tronic Corporation in May 1993.
- Honeywell Semiconductors (SSED division) is now SPT, Signal Processing Technologies (a member of the TOKO Group), Colorado Springs, CO.

- Honeywell Test Instruments Division, is now known as Metrum and is still located in Denver CO.
- Hughes Interconnect Systems Division (a connector manufacturer), a unit of GM Hughes Aircraft was purchased by the Packard Electric Division of General Motors Corp. in April 1993. The company is now known as Packard/Hughes and is still located in Irvine, CA.
- Hughes Power Supplies, see Bruno Power Supplies, above.

## I

- IBM Federal Systems Company (Bethesda, MD) was purchased by the Loral Corporation in December 1993 and is now known as Loral Federal Systems Company. IBM Technology Products is now known as IBM Microelectronics, in Fishkill NY.
- IBM sold its US copier business, based in Charlotte NC, to the Eastman Kodak Co. in April 1988.
- IC Designs, Inc. of Kirkland, WA a manufacturer of frequency synthesis IC's (clock generators) and ASSP programmable clock oscillator chips was acquired by Cypress Semiconductor Corporation in late 1993.
- Imaging Systems International, manufacturer of automated imaging systems, was purchased by Thermo Instrument Systems, Inc. in 1994, and combined into their Nicolet Instrument Corp. subsidiary to form Nicolet Imaging Systems, Inc. in Madison WI.
- Inova Microelectronics Corp (Santa Clara, CA), a manufacturer of static RAMs, declared chapter 11 bankruptcy in 1991 and ceased production of their microcircuits.
- Intaq, Inc. a printed circuit board manufacturer was purchased by Mitron Corp. and was incorporated into Mitron in Oregon.
- Intech/Advanced Analog (Santa Clara, CA) was acquired by Lambda Electronics, Inc. in June 1994 and is now known as Lambda Advanced Analog.
- The Intel programmable logic line (5CXXX, 5ACXXX, iFXXX, 85CXXX, and iPLD devices such as the 22V10) was acquired by the Altera Corporation on October 1, 1994. Intel sold its SatisFaction line of data/fax modem boards to Pure Data, Ltd. in late 1994.
- Interactive Systems Corporation, a Kodak subsidiary located in Naperville Illinois and specializing in the Unix systems marketplace, was purchased by SHL Systemhouse, Inc. in April 1993.
- International Microelectronic Products, Inc. of San Jose, CA, (a manufacturer of IC's such as single chip read channel IC's for hard disk drives), is now known as IMP, INC.
- Israel's Microelectronics Ltd. line of high power multilayer ceramic capacitors, porcelain and variable capacitors is represented in the U.S. by the North American Capacitor Company (NACC) and is marketed as Mallory/Microelectronics.

## K

- The Kemet Electronics Corp. line of film capacitors (polycarbonate and parylene capacitors (with the parylene film capacitors now discontinued)) was purchased by Component Research, Santa Monica CA in May 1991.
- Kiertron Transistors was purchased and is known as PPC Products Corporation, Riviera Beach, FL.



- Leasametric an electronic equipment rental, leasing, sales and service company was purchased by GE and is now GE Rental/Lease, a GE Capital Company, Atlanta, GA, 1-800-GE-RENTS.

- Logic Modeling Corporation (LMC) of Beaverton OR, a supplier of software and hardware simulation models, was purchased by Synopsys, Inc. In 1994 Synopsys, Inc. acquired Cadis GmbH (Aachen, Germany), a provider of block diagram entry and high level simulation tools for DSP (Digital Signal Processing) design. In 1993 Synopsys Inc. acquired Compiled Designs GmbH of Munich Germany, a manufacturer of VHDL simulation, synthesis and other EDA tools.

- LTV corporations missile unit was purchased by Loral Corporation in 1992.

- Lundy Computer Graphics, Glen Head NY, ceased operations in 1991.

- Lundy Financial Systems division, Charlotte NC, assets were purchased by Recognition Equipment, Inc. of Dallas TX in March 1992.



- Magnecraft Electric closed its Northbrook, IL headquarters and moved into the manufacturing facility it bought from Nytronics in Darlington, SC.

- Elements of Magnavox Electronic Systems Co.'s commercial GPS positioning and navigation systems business (the marine and land based GPS products, high accuracy GPS systems and the ACC-Q-POINT FM broadcasting DGPS network but not including the commercial satellite communications business group) was purchased by Leica Inc. (Leica Geodesy Business Unit in Switzerland). The company is now in Torrance CA.

- Marcon America Corp., Vernon Hills, IL, a manufacturer of capacitors, changed its name to Toshiba Marcon Electronics America Corp.

- Marconi Electronic Devices is now known as GEC Plessey.

- Mark Eyelet, Inc., was an autonomous subsidiary of AMP, Inc. but was integrated into the company in 1993.

- Mass Memory Technology, Inc., founded in 1989, is now known as WaferDrive Corporation.

- MCE Semiconductors, Inc., West Palm Beach, FL, declared bankruptcy in mid 1993 and is no longer in operation.

- McKenzie Technology (a manufacturer of IC sockets, etc.), was purchased by Berg Electronics in August 1994.

- Mesa Systems Corp., a manufacturer of computer platforms, is now known as North Atlantic Industries Systems Division (NAI Systems).

- Meta Design Semiconductor (MDS) sold the ULC (Universal Logic Conversion) to Matra MHS in late 1992.

- Micron Semiconductor Inc. sold its military components group to Austin Semiconductor, Inc. (Austin, Texas) in March 1993.

- Microdot's Interconnect Systems Division was purchased by Uni-Star Industries in May 1994.

- Microtran, Valley Stream, NY, became a division of the Tamura Corporation in 1994.

- Microwave Laboratories, Inc., Raleigh NC, a manufacturer of traveling wave tubes ceased operations in 1994.

- Midtex, a manufacturer of various types of relays, voltage

sensors, meter interface modules, and cycle timers, was purchased by Communications Instruments Inc. in March 1993.

- Miltech Co. a Monsey NY manufacturer of thin film capacitors was purchased by American Technical Ceramics of Huntington Station NY in late 1993.

- MIPS computer Systems was purchased by Silicon Graphics, Inc.

- Model Technology, a VHDL simulation company, was acquired by Mentor Graphics in late 1994.

- Monsanto Optoelectronics (manufacturer of the MAN prefix LED displays), which became General Instrument Optoelectronics is now Quality Technologies in Sunnyvale CA 408-720-1440.

- Mostek, was acquired by Thomson in 1986. The company is now known as SGS-Thomson.

- Motorola Display Systems is now Display Technologies, Inc. in Elgin, IL (owned by Corcoran Partners, Chicago, IL).

- MuRata Erie North America changed its name to MuRata Electronics North America in early 1994. MuRata Manufacturing Co. Ltd. (Kyoto, Japan) had acquired Erie Technological Products, Ltd. in 1981.



- The assets of NCI Systems Division of Noise Com, Inc., developer of microwave subsystems such as transmitters, receivers, synthesizers and RF Modems, was acquired by Communications Techniques, Inc.

- NCR, purchased by AT&T in 1991 is now known as AT&T Global information Solutions.

- Northern Telecom Ltd. optical cable and fiber business in Saskatoon, Canada was purchased by Siercor Corporation in May 1994 (the purchase announcement made December 15, 1993) and was renamed Siercor Corporation, Canadian Cable Plant.

- Northgate Computer ceased operations in the summer of 1994.



- Omaton, Inc., Richardson, TX, a PC based EDA company manufacturing Schema design tools, was acquired by ACCEL Technologies, Inc., San Diego, CA. in early 1994.

- ONYX Graphics, a manufacturer of imaging printers, software and scanners for PostScript applications, was acquired by Raster Graphics, Sunnyvale CA in mid 1994.

- Oracle Industries video generator product line was acquired in May 1991 by Javelin Electronics.



- Pacific Communications Sciences (San Diego, CA), a company involved in wireless communications technology, became a subsidiary of Cirrus Logic in February 1993.

- Papst Motoren GmbH & Co. was acquired by EBM Electrobau Mullfingen GmbH & Co. in 1992 but the two continue to operate separately.

- Philips Communication Systems Division, with operations in the Netherlands and Germany, was sold to Siemens AG.

- Philips Electronics North America Corp. sold their tantalum capacitor line to Vishay in June 1993. (This division was formed in April 1989 when Amperex and Mepco/Centralab were merged together.)

• Philips Test and Measurement (of Philips Electronics NV of Eindhoven, the Netherlands), whose products were distributed in North America by John Fluke Manufacturing Co. (Everett, WA) was acquired by Fluke.

• Philips Industrial Electronics Deutschland GmbH, in Kassel Germany, a sensor manufacturer, was acquired by ENVEC GmbH in April 1993.

• Pico Power, Inc. (San Jose, CA), a manufacturer of 80X86 chip sets, became a wholly owned subsidiary of Cirrus Logic in August 1994.

• Pie Design Systems and Quickturn Systems merged in June 1993 to form Quickturn Design Systems. The company is now headquartered in Mountain View CA, 415-967-3300.

• Pixel Semiconductor (Plano, TX), a manufacturer of video imaging ICs, became a subsidiary of Cirrus Logic in June 1991.

• Plessey plc was purchased by GEC in 1989 and is now known as GEC Plessey.

• Pollenex Corp. (Chicago) was acquired by Rival Manufacturing Co. (Kansas City) from the New York investment firm Odyssey Partners.

• Potter Operations of Pulse Engineering (Wesson, MI) a manufacturer of EMI filters and power distribution products, was acquired by Potter Production Corporation in mid 1994.

• Precision Metal Products Terminals Division (PMP) was acquired by Elpakco, Inc. of Lowell MA in late 1993.

• Projection Display Products Operation (PDPO) of GE Aerospace, located in Syracuse NY was sold to Martin Marietta in 1993 and then was sold to nView of Newport News VA in late 1993.

• Prometrix Corporation, a manufacturer of wafer inspection and inspection equipment merged with, and is now known as, Tencor Instruments, Mountain View, CA.

• Protech, Inc. Irvine, CA, sold its service oriented circuit board diagnostic and schematic generation systems to UltraTest International, Inc. (UTI), San Jose, CA.

## Q

• Qualitron, Dallas TX, a power supply manufacturer was purchased by Powercube, Billerica, MA, in 1990.

• The Quasar division of Motorola, a manufacturer of television sets, was sold to Matsushita in 1974.

• Quattro Pro, a spreadsheet/database manager program was sold by Borland International (Scotts Valley, CA) to Novell (Provo, UT) in 1994.

## R

• R&B Enterprises (West Conshohocken, PA) sold the marketing and manufacturing rights to their line of pulse generators to The Electro-Mechanics Co. (EMCO), Austin, TX., in 1994.

• R-Byte, Inc. a 4mm DAT storage vendor, was acquired by Exabyte Corporation (Boulder CO) in 1992.

• R. Scott Associates (Raleigh, NC), a modem software company, became a subsidiary of Cirrus Logic in December 1991.

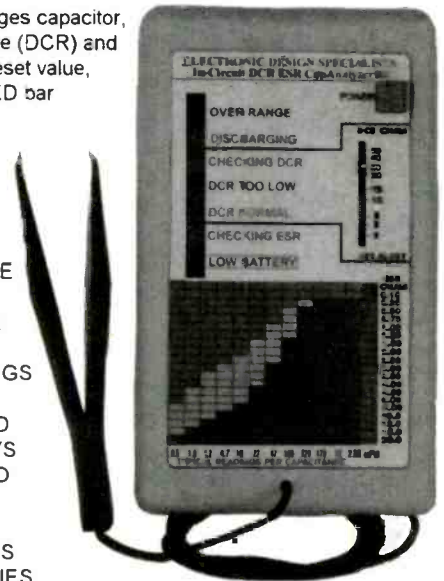
• Racal-Redac, an electronic design automation provider (pc board CAD tools), was acquired by Zuken, Inc. (Tokyo Japan) in June 1994, and is now known as Zuken-Redac.

• Raytheon Company microwave power tube business was purchased by Litton Electronics Devices Division in March 1993.

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- RCA Laboratories, established in 1942 became Sarnoff Laboratories (after the merger of General Electric and RCA in 1987), and is a subsidiary of SRI International (Menlo park. CA).

- Redwood Design Automation, an electronic system design company, was acquired by Cadence Design Systems, Inc. in mid 1994.

- Republic Telecom Systems (Boulder, CO), a company specializing in compressed voice and data technology, was purchased by Netrix Corporation in January 1994 and is now known as Netrix Telecom Systems Corp.

- Ross Technology, formerly a subsidiary of Cypress Semiconductor (with products marketed under the Cypress Semiconductor name) was purchased by Fujitsu Ltd. in 1993.



- The Schlumberger Industries Transducer Div. was sold to its management and is now known as Solartron Metrology, a division of Solartron Industries, Inc. The Schlumberger Communications Test Division (CTD) (which includes the Radio Communications Test Equipment business in Germany and the Telecommunications Test equipment business in France) was sold to Wavetek in late 1994.

- SEEQ Technology, Inc. sold its E2PROM (electrically erasable programmable read-only memory) line to Atmel Corp. in February 1994.

- Senisys (Sensor Integrated Systems) was merged with Clarostat Manufacturing Co. Inc. and is now known as Clarostat Sensors and Controls (see Clarostat above).

- SGS Microelettronica SPA of Italy and Thomson SA of France merged in 1987 to become SGS-Thomson Microelectronics NV. SGS or Societe Generale Semiconductor was formed in 1987 when Telectro (formerly a division of Olivetti now a division of Alcatel) decided to enter the semiconductor market.

- Sherwood Enterprises (Longmont, CO) purchased by its management in May 1994.

- Shinwa of America, Inc. (175 Olde Half Day Rd., Suite 100, Lincolnshire, IL 60069, 708-793-1600, Fax: 708-793-1603) sold the printer service, ribbons and parts to Bigston Corp. U.S.A., (Printer Dept.) Elk Grove Village, IL. This change became effective March 11, 1993. Sales of new Shinwa printers is still handled through Shinwa Of America, Inc.

- The Siemens division that manufactured rectifiers was purchased by Coors and became Coors Components and in late 1987 was purchased by Microsemi (see Coors Components, above). Siemens Gammasonics, Inc. (Hoffman Estates, IL), a unit of Siemens Medical Systems, became Loral Medical Imaging Systems in late 1994.

- Silicon General Inc. is now known as Linfinity Microelectronics, Inc. still located in Garden Grove, CA.

- Silvar-Lisco, an IC CAD (physical design) software company is now known as Silicon Valley Research (SVR) the original name of the company when it was founded in 1979.

- Socket Express, was purchased by Berg Electronics in January 1994.

- Sohio, Maxcap (tm) double layer capacitors, now manufactured by CESIWID, Inc., see Carborundum.

- Sorensen, a power supply manufacturer, was sold by Raytheon to the Elgar Corporation in February 1994. Their toll

free number remains the same, 1-800-525-2024, the Fax number for sales and applications, now in San Diego CA, is 1-619-458- 0237.

- Spectra Diode Laboratories, a manufacturer of visible laser diodes, CW linear arrays, and fiber coupled laser diodes, is now known as SDL, Inc.

- Spectrum Technology, Inc. a manufacturer of hybrid oscillators, was purchased by Oak Industries Inc. and consolidated into Oak's Frequency Control Group in Mt. Holly Springs PA.

- Sprague Technologies, Inc. after selling off the semiconductor, resistor, and capacitor lines is now known as STI Group Inc. Sprague Technologies solid tantalum capacitor line and the U.S. thick film network business was sold to Vishay Intertechnology in 1992. In late 1992, United Chemi-Con Inc. acquired the Sprague aluminum capacitor facility in Lansing, NC. The manufacturing location of the aluminum capacitors remains unchanged and the original Sprague part numbers have been retained. Capacitors as of December 1992 are marked Nippon Chemi-Con. The Sprague film capacitors (named Orange Drop in 1959) are made in the same manufacturing facility as they always were but it is now known (since 1985) as SB Electronics Inc. (SBE). The plant is located at 131 South Main Street, Barre VT 05641-4854, 802- 476-4146, Fax: 802-476-4149. This company also manufactures the 192 Pacer line (since 1992), originally made at this plant but transferred by Sprague to the Longwood FL facility (now known as Dearborne Electronics). Sprague Electric Semiconductors (formerly Solid State Scientific) is now known as Allegro Microsystems, Inc. (in MA). The 4000 series CMOS parts are now available from R&E International in PA. The Sprague filter and magnetics group, Fil-Mag was sold to the French company Fery Electronics, Inc. in 1990 and was known as FEE Fil-Mag. It was acquired by Technitrol in 1994 and is now known as Fil-Mag, Inc. a Technitrol Company.

- Square D Infrared Measurement Division of Niles Illinois, was purchased by Fairey Group plc. The division formerly known as Square D IMD is now known as IRCon, Inc. This company, a manufacturer of infrared noncontact thermometers, is still located in Niles IL.

- ST-Semicon, a manufacturer of semiconductors formerly in Bloomington IN, is no longer in business.

- Star Semiconductor, a manufacturer of digital signal processor (DSP) IC's, was acquired by Logic Devices, Inc. (Sunnyvale, CA) in May 1995.

- Stevens-Arnold's dc to ac electromechanical chopper line was sold to Duplicon, Inc. in 1987.

- Switched Reluctance Drives, Ltd. (SRDL), Leeds England was acquired by Emerson Electric Company, St. Louis, in late 1994.

- Syrelec products are manufactured by the Crouzet Corporation, Carrolltown, TX.



- Tag Semiconductors (of Zurich), a manufacturer of thyristors and triacs, was purchased from Raytheon Co. by SGS-Thomson Microelectronics in March 1993. The sales office in Boston MA was merged with the Boston office of SGS-Thomson.

- Tandy Manufacturing became TE Electronics in 1993 (200

Taylor St., Suite 100, Ft. Worth, TX 761022, Fax 817-878-4887). The computer manufacturing subsidiary was then sold to AST Research, Inc. (headquarters in Irvine, CA) in May 1993.

- Tallgrass Technologies, Corporation, a manufacturer of tape storage drives, located in Lenexa, KS, was sold to Exabyte Corporation in early 1993.

- Task Technologies, Inc. (Rochester, NY) was acquired by InterChip Systems, Inc., also a designer of MCM modules, in late 1994.

- Tektronix Inc. monolithic IC operation, which was part of the Tektronics Components Corporation, was sold to Maxim Integrated Products of Sunnyvale CA in early 1994. The avionics display unit (Wilsonville, OR) was sold to Planar Systems, Beaverton, OR.

- Teledyne Components was sold in late 1993 to a group of its high level managers. It is now called TelCom Semiconductor, Inc.

- Teledyne Electronic Systems (Northridge, CA) was sold to Litton Industries in late 1994.

- Texas Microsystems, Inc., a manufacturer of ruggedized PC's for industrial applications, was purchased by Sequoia Systems, Inc. in late 1994.

- Texel, a manufacturer of CD-ROM drives is now known as Plextor.

- Times Fiber Communications Inc., a manufacturer of coaxial cable and related products, was acquired by Amphenol Corp. in late 1992. They were previously sister companies when both were owned by LPL Technologies Inc. until Amphenol became a separate public company.

- TLA Technology Inc. was acquired by Schlumberger Ltd. in late 1993. This manufacturer of handlers, burn-in board loaders/unloaders and lead inspection systems) was incorporated into the Schlumberger ATE Division.

- Tri-Tec Engineering and Mold-Con was purchased by the Harbor subsidiary of Berg Electronics in March 1994. Harbor Electronics, Hazleton, PA, a manufacturer of cable assemblies and wire-harnesses, was acquired in 1993.

- Tricon, a manufacturer of multi-air turn dielectric trimmer capacitors was purchased by Sprague-Goodman Electronics, Inc. located in Garden City, NY in March 1993.

- TRW LSI Products, Inc. was sold to Raytheon Semiconductor in late 1992 and now operates as Raytheon Semiconductor-La Jolla.

## U

- Unimar Corporation, a manufacturer of magnetic components, was purchased by Unipower Corp. Unimar and Unipower were once part of Computer Products, Inc. and became separate companies in 1988. Unimar is located at Unipower's Pompano Beach facility.

- Unisys Defense Systems, McLean VA (Unisys is the company formed after Sperry and Burroughs merged), was renamed Paramax Systems Corporation (the name of the Sperry organization in Canada) in 1992. In 1993 the company became the Unisys Governmental Systems Group, still headquartered in McLean VA.

- The Unimax division (Wallingford, CT) of C&K Components, Inc was consolidated into the Clayton Division in Clayton NC and is now known as the Clayton/Unimax Division.

## V

- Varian Associates solar cell and power receiver operations was purchased by VS Corporation in 1991.

- The software program Ventura Publisher, was acquired from Xerox Corporation by Corel Corporation, Ottawa Canada, in 1993.

- Vesatest, Inc., a test equipment manufacturer for non-volatile memories, was purchased by Hewlett-Packard in late 1994.

- Video Display Corporation, of Tucker GA, was purchased by Richardson Electronics, Ltd. of LaFox, IL in late 1993.

- Viking was acquired by Wire-Pro in July 1994.

- Viking Laboratories, a testing laboratory, was acquired by F.W. Bell, Inc. in 1993 and merged with Continental Testing Laboratories. The new company is known as Continental-Viking Labs.

- Vitramon, a manufacturer of multi-layer ceramic capacitors, was acquired by the Vishay Company in late 1994.

## W

- WESCO (West Coast Electrical Manufacturing Company), a manufacturer of military and commercial AC/DC solenoids, formerly located in Paramount CA was purchased by Communications Instruments Inc. in March 1993. It is now located in Fairview NC.

- Westinghouse transformer product lines, including the ASL Dry type Power Center Transformers, were sold to ABB (Asea Brown Boveri) Power Transmission and Distribution Company, Inc.

- West-Cap Arizona's film capacitor business was purchased by Vishay Intertechnology, Inc. in December 1990 and then resold to Component Research Co., Santa Monica, CA in January 1991.

- Westinghouse sold its distribution and control products line to Cutler Hammer in 1994.

- Word Perfect Corporation was acquired by Novell (Provo, UT) in 1994.

## Z

- Zenith Electronics Corp., Glenview IL sold the monochrome display business (in late 1993) to Corcoran Partners of Chicago, IL who merged it into Display Technologies, Inc. in Elgin, IL.

- ZyLAB, Inc. (Buffalo Grove IL), an image/text retrieval vendor, and Progressive technologies (Gaithersburg, MD) a Federal OCR (optical character recognition) and document integrator merged in mid 1994. The new company is called ZyCO International.

## Distributors

Many distributors also merged, such as: In 1979 Arrow Electronics (headquartered in Melville, NY) bought the assets of Cramer Electronics and later bought Kierulff Electronics in 1987. Arrow now also owns Schweber, Anthem Electronics, Inc., Gates F/A Distributing, Megachip SA (Paris, France), Capstone Electronics, Zeus Electronics and Lex Electronics.

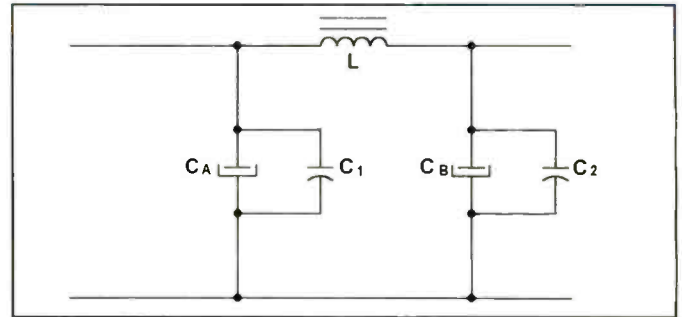
Avnet Electronic Marketing Group, encompasses Avnet EMG in Europe and Hamilton Hallmark in the U.S. (previously known as Hamilton Avnet) owns various component distributors including Penstock, Pioneer-Standard Electronics, Inc., All-American Semiconductor, Inc., Hamilton, Hallmark, Brownell Electro, Allied, and Adelsy (Milan, Italy). ■

# Test Your Electronics Knowledge

## Difficult measurement questions

by J. A. Sam Wilson

1. Which of the following is a higher frequency on the electromagnetic spectrum?  
A. Blue  
B. Red
2. The cgs (centimeter, gram, second) system of measurement has been replaced by the \_\_\_\_\_ system.
3. 25,000 gigahertz = \_\_\_\_\_ terahertz.
4. How many siemens are there in  $10\Omega$ ?
5. A polar diagram shows \_\_\_\_\_ vs. \_\_\_\_\_.
6. Expressed in powers of 10, how many picofarads are there in one microfarad? \_\_\_\_\_
7. What is the rating for energy storage devices that also applies to tuned circuits? \_\_\_\_\_
8. What is the name of the bridge circuit used to accurately measure the inductance of an inductor with a high Q? \_\_\_\_\_
9. What is the name of the bridge circuit that can accurately



**Figure 1.** Are the bypass capacitors,  $C_1$  and  $C_2$ , in this power supply filter used to increase the capacitance of the electrolytic capacitors ( $C_A$  and  $C_B$ )?

- measure very low resistance values? (For example, one picohm) \_\_\_\_\_
10. Is the following statement correct? The bypass capacitors -  $C_1$  and  $C_2$  - in the power supply filter of Figure 1 are used to increase the capacitance of the electrolytic capacitors ( $C_A$  and  $C_B$ ).

★ **BONUS QUESTION:** The band of frequencies within 18 gigahertz to 27 gigahertz is called the \_\_\_\_\_ band. (20 points)  
(Answers on page 56)

Wilson is the electronics theory consultant for ES&T.



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## Oscilloscope accessories

B&K Precisions has expanded its test instrument accessory line, adding several IEC-1010-compliant oscilloscope probes, cable sets and adapters for use with the company's products.

Offered in slim-line, monolithic designs, two new high performance oscilloscope probes are available, ranging from 150MHz to 250MHz, low capacitance with input impedances of 1M $\Omega$  or 10M $\Omega$  (1X/10X). Sets include comfortable, pen-style probe assembly with IEC1010-compliant insulated BNC connector, interchangeable tips, and sprung-hook clip. In addition, high voltage 2KV, 4KV and 15KV oscilloscope probes feature 100x and 1000X attenuation, up to 500M $\Omega$ /3pF input impedance, 5MHz to 200MHz bandwidth.

Cable Assemblies include a new, color-coded, 5-cable set, each assembly provided on 2-meter extra flexible cable, with insulated BNC connector. The assemblies are IEC1010 compliant. Individual and paired cables are also available in red and black, industry standard styles, including a BNC male-to-stacking plugs model. New adapters offered with the accessory group include an IEC1010-compliant BNC male-to-dual banana jack.

Circle (104) on Reply Card

## Computer monitor distribution amplifier

The ACM company introduces the first of a new product line, the DA-1 computer monitor distribution amplifier.

This is a tool for the computer monitor service market which will help a technician better evaluate the quality and efficiency of the repaired monitor (up to ten monitors per unit may be connected). Monitors may be put aside on shelves

connected to this distribution amplifier and a video signal source.

Features include: 200MHz Video bandwidth, 19" Rack mountable enclosure, fast acting op-amps for motion video and changing scan frequencies, all cables are included (ten 10' VGA cables), multiple units may be stacked and looped.

Circle (105) on Reply Card

## Process calibrator multimeter

Extech announces its handheld CMM-15 process calibrator multimeter with large dual display simultaneous source and measure functions for current, voltage, and frequency combined with full true rms multimeter functions.

The unit provides a precision constant voltage and current calibration source with 0.03% accuracy and a wide range frequency (square wave) source with adjustable amplitude, pulse width, and duty cycle. Current ( $\pm 23$ mA) and voltage ( $\pm 1.5$ V,  $\pm 15$ V) outputs are bipolar for constant current output for loads up to 500 $\Omega$ . A programmable 16 step memory is available for continuous, ramp, or step output.

Multimeter functions include dc mA, ac mA, dc V, ac V, ac+dc, temperature, and frequency measurements with 1 $\mu$ V or 1 $\mu$ A resolution and 0.06% basic dc V



accuracy plus duty cycle, pulse width, resistance, continuity, and diode. There is a 1ms peak hold for glitch capture, auto hold, data hold, 20 measurements/second bargraph response, and auto power off.

Circle (106) on Reply Card

## Oscilloscope meter

Fluke Corporation announces the new multifunction industrial ScopeMeter 123 test tool, handheld instrument that integrates oscilloscope, multimeter and "paperless" recorder functions for troubleshooting machinery, instrumentation, and control and power systems. The test tool is small in size (2.5 lbs) and features "connect and view" simplicity.

When the ScopeMeter 123 test tool is used to check several testpoints, the user will always get a stable waveform on the display. No matter what the signal looks like, all signal detail will be revealed, including spikes, noise, and even complex waveforms used in motor drives.

Circle (107) on Reply Card

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# What Do You Know About Electronics?

by J. A. Sam Wilson

The 1997 *ES&T Buyers' Guide* brought me more mail than I ever got for any WDYKAE? since it started early in the 1980's! I will respond to all of the writers at once because I don't have enough allotted space to print the letters.

First, let's talk about the equation for the four-terminal network equivalent circuit. For the benefit of new readers, I said that any resistive four-terminal network comprised of linear, bilateral circuit elements can be replaced by a four-terminal 'T' network if three of the four possible resistance measurements are made on the circuit in question. (I used resistors to simplify the calculations, but the theory also applies to capacitors, inductors, and any RLC network.) The possible measurements are: (Figure 1)

Input resistance with output terminals open -  $R_{AB}$

Input resistance with output terminals shorted -  $R'_{AB}$

Output resistance with input terminals open -  $R_{CD}$

Output resistance with input terminals shorted -  $R'_{CD}$

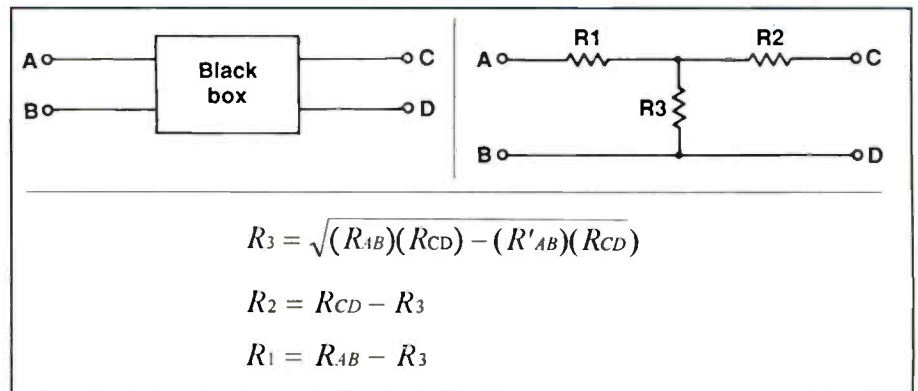
The equations were printed with an error: the prime for  $R'_{AB}$  was omitted. In the next issue I tried to correct the error. In that case I derived the equation (step-by-step) and again the prime was omitted in the final equation.

In that second attempt I saved the print-out and I know it was sent in correctly. What happened? I believe I know.

I do my equations on the equation editor of Word Perfect. It prints the equations correctly. I think the printer for the *ES&T* article cannot print a prime (') under the radical because it would cause the overbar of the radical to run through the prime. (On the Word Perfect printout the overbar is lifted above the prime.)

This time I have printed the equations by hand and I'll ask the editor to print my hand-written copy as Figure 1.

Many, many thanks to the readers who sent professional letters about the "typo". I'm sure I saved those letters but they are somewhere in about 50 boxes that were



**Figure 1.** A four terminal network such as the one at the top left, if it consists of only resistors, can be replaced by an equivalent "T" circuit, such as the one at the top right. The values of  $R_1$ ,  $R_2$  and  $R_3$  are calculated as shown in these equations.

packed for the move to my (permanent) office.

## About transformers

The second set of letters were written regarding my discussion of transformers. In every case except one, the letters were professionally written. The criticisms were polite, and, I want to thank those readers for their letters.

I think the best way to answer the criticisms is to start by reprinting exactly what I said. The text in the sidebar is taken directly from the WDYKAE? article in the *Buyers' Guide*.

What is wrong with the calculations in the sidebar, and in my original article, is that you cannot use the equation setting voltage and current ratios in the way it was used to get a secondary current of  $1/2A$  if the primary-side voltage is held constant. However, I should not have said that it was incorrect to use the equation:

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

I should have said that it is important to use care in applying the equation.

Let's derive that equation. That will give us insight into how it is to be used.

The Law of the Conservation of Energy applied to a transformer requires that the power in the primary must equal the power in the secondary. So,

$$V_P \times I_P = V_S \times I_S + \text{transformer losses}$$

Power transformers often have efficiencies above 98%, so we will disregard

the transformer losses. Therefore, the equation becomes:

$$V_P \times I_P = V_S \times I_S$$

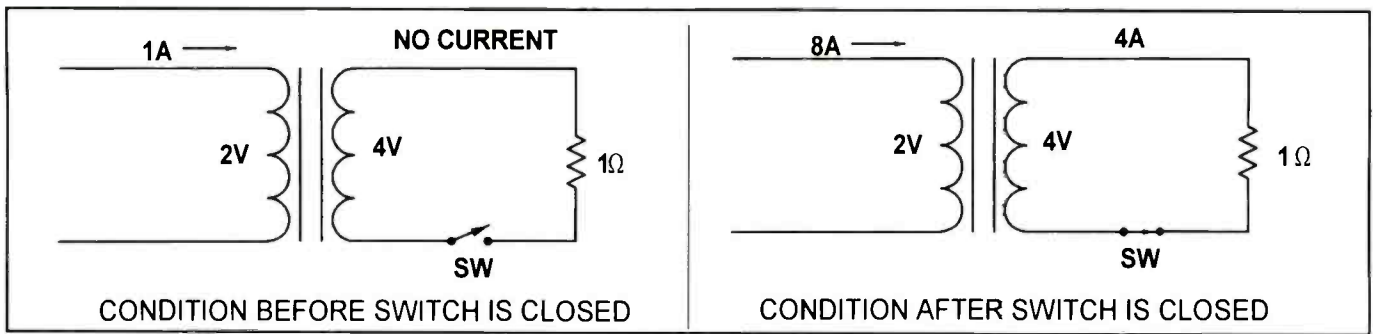
That equation tells you the conditions that are always present when a transformer has a primary and secondary current and voltage. You cannot fiddle with it and change the Conservation Law! If you divide both sides of the equation by  $V_S$ , and, divide both sides of the equation by  $I_P$  you get the equation of ratios:

$$V_P/V_S = I_S/I_P$$

That equation is for the conditions that exist in a transformer when there is a primary power and secondary power. The secondary power is equal to  $V_S \times I_S$  and that is determined by the primary power. In one sense you can consider that the transformer delivers power from one circuit to another.

Some readers wrote that the primary current would be so high that the transformer would melt down to a paper weight. Some other readers said there would be a power gain in the transformer. (The above equation shows that there is no power gain.)

Let's use that equation of ratios to calculate the current in the primary winding. First, we are going to hold the voltage across the primary to a constant 2Vac. That constant voltage is supplied by a constant-voltage source. Remember that the voltage ratio is the same as the turns ratio which is equal to 2:4 (or, 1:2) in our



**Figure 2.** Disregarding transformer losses, the equation for conservation of power from primary to secondary in a transformer is  $V_P \times I_P = V_S \times I_S$ . In this circuit, if the primary voltage is held constant by the use of a constant voltage source, then when the switch in the secondary circuit is closed, the primary current will have to increase to 8A in order for that equation to be true.

problem. The secondary current in our problem was determined to be 4A. By substitution into the equation:

$$\begin{aligned} V_P I_P &= V_S I_S \\ 2 \times I_P &= 4 \times 4 \\ I_P &= 8A \end{aligned}$$

Check: 16W in the primary circuit = 16W in the secondary circuit. See Figure 2. That isn't anywhere near a melt-down current. Since it is based upon equal powers in the primary and secondary circuits there is no power gain! See Figure 2 again.

### Reflected resistance

Many readers who wrote in used the "reflected resistance as if it was a reflected resistor. They used  $P = I^2 R$ , using reflected resistance for R.

However, when the 4Ω resistor is connected across the secondary there is an ac current in the secondary circuit. That ac current flows through the secondary winding causing an expanding and contracting magnetic field that cuts through the primary winding and induces a voltage across the primary. Lenz' law states that an induced voltage must always have a polarity that opposes the voltage that created it. Therefore, the voltage induced in the primary winding of the transformer is opposite in polarity to the original primary voltage polarity.

In other words, the opposing induced voltage is subtracted from the original primary voltage. It is as if a resistor was connected in series with the primary winding to reduce the primary current! That is the meaning of reflected resistance.

Now consider this important point: since we are holding the primary voltage at a constant 2Vac, the primary current *must* rise in order to preserve the law of the conservation of energy. Looking back from the secondary winding, in essence

we see a step-down transformer. When you have a step-down transformer, the current in the secondary is stepped up. That is evident by the 8A in the primary as shown in Figure 2.

But what if you don't have a regulated 2V applied across the primary winding? In that case, if you want to maintain 4V and 1A in the secondary circuit, you will have to increase the voltage across the primary to 4V. That 4V applied, minus the reflected induced voltage of 2V, will give a resultant of 2V across the primary, and we're back to Figure 2.

Observe that the reflected 2V drops the primary voltage from 4V to 2V. It is as if a resistance of 1/4Ω was connected into the primary causing a reduction of the primary voltage by 2V.

$$(V = IR = 8A \times 1/4\Omega = 2V).$$

There isn't any resistor in series with the primary winding. You can't multiply that resistance by the primary voltage to get the primary power.

Stop and think about this - did you ever take a new power transformer out of a box and find a warning tag tied to the secondary winding that says: *Warning - do not connect a low-value of resistance across the secondary winding.*

Stop and think about this: If you took the transformer in our example apart, you would not find a color coded resistor connected in series with the transformer primary winding. The reflected resistance works as if a resistor was connected in series with the primary winding.

There is a transformer test called the "Transformer Secondary Short-Circuit Test". That is a test to determine transformer losses. In that test the secondary winding is short-circuited and measurements are made on the transformer primary. I'm going to write about that test in a future WDYKAE? ■

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

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

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

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

$$I_S = \frac{V_P I_P}{V_S} = \frac{1 \times 1}{2} = \frac{1}{2} A$$

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

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

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

$$V_S = \text{turns ratio} \times V_P = \frac{2}{1} \times 2 = 4V$$

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

$$I = \frac{V}{R} = \frac{4}{1} = 4A$$

What is wrong here? By using the ratio equation we determined that the current was 1/2A in the secondary circuit, but, Ω's law gives us a current of 4A in the secondary circuit.

# Tips for good customer relations: 99 nifty customer service nuggets

by Bill Weiss

“The FBI is bugging my TV!” an elderly customer tearfully complains as she presents her TV for service. What do you do? It’s called “customer service.”

For electronics servicers, wrangling with warranty procedures, battling back-orders and ruminating over repeat failures are but a few of the daily detours we must face. So who has time for all this customer service stuff?

If you plan to be among the new millennium’s top servicers, the answer is you. According to the Bureau of Labor Statistics, by the year 2005, service and retail trade industries will dominate the projected 17 million new jobs. Customer service will be of paramount importance. With this in mind, national, regional and state electronics trade organizations name “customer goodwill and confidence” among their top priorities.

Whether you consider customer service little more than “hand holding, or want to improve already sound customer service techniques, these “99 Nifty Nuggets” will pave the way to long-term customer loyalty and service success.

## Counter intelligence

- 1) Provide a VCR demo center at your front counter.
- 2) Make sure to clear your counter for the next customer.
- 3) List accessories on your work order and claim check.
- 4) Confirm accessory returns at pick-up.
- 5) Never smoke at the counter.
- 6) Offer treats or novelty toys to customers’ children.
- 7) Offer to copy customers’ paperwork.
- 8) While assisting a customer, acknowledge subsequent customers as they enter.

9) Ask for counter assistance if wait times exceed two minutes.

10) Keep a list of manufacturers’ customer relations (CR) numbers near your counter, even brands you don’t service. Offering them enhances your image as a helpful service center.

11) Keep personal pets away from the front counter.

12) Provide itemized receipts.

13) Gladly comply with counter demonstration requests.

14) Professionally present all repairs at your front counter. Fine restaurants earn top reputations and prices by “presenting,” not simply serving, food to their patrons. Likewise, you should “present” repaired products to your customers. Offer your appreciation as you carefully place products on the counter, cabinets clean, cords tightly wrapped, brochures or flyers neatly arranged on the item.

15) Unless asked, never clean products at the counter. Nicotine sludge oozing down a customer’s television screen might prove embarrassing.

16) Showcase your high-tech image with equipment installed where the customer can see it.

17) Keep junk PC board and VCR mechanisms available as visual aids. When a customer questions a repair cost, wow them with complex examples.

18) At carry-in, note product blemishes on your work order and claim check.

19) Verbally state your guarantee to the customer during pickup.

20) Compliment customers’ children. Parents will beam and the kids will focus on you, not your fragile displays.

21) If asked, demonstrate programming features at the counter. Today’s multi-featured remotes and on-screen menus bewilder seasoned professionals; imagine your customer’s frustration.

22) Accept major credit cards. Credit

provides convenience and increases high-end estimate approvals.

23) Look busy, even when you’re not. Reading or eating at the front counter emphasizes business downtimes.

24) Never reprimand staff when you are at the counter.

25) Be there during posted hours.

26) Designate a lost and found area near your counter.

27) Install batteries instead of just selling them over the counter.

28) Designate a parts and accessory pickup shelf to minimize misplaced items.

29) Keep ample small change available to avoid embarrassing shortages.

## Flyers, fixes and freebies

30) Include your “products serviced” flyer with every repair.

31) Offer a free (inexpensive) surge suppressor with surge-related repairs.

32) Offer a senior citizen’s discount.

33) Minimize hook-up-related calls by including connection diagrams with all VCR repairs.

34) When errant calls bring customers in for incomplete units or orders, offer free delivery.

35) When customers call with “reset” problems (shut-downs solved by key presses or unplugging the unit), explain how to perform the reset. If successful, your honesty will pay future dividends; if not, you’ve earned immediate trust.

## Remote possibilities

36) Give free batteries with remote transmitter purchases.

37) Demonstrate to the customer how to use new remotes.

38) Remind customers to bring remotes to eliminate unpleasant return trips.

## Lobbying efforts

39) Clearly differentiate your lobby

Weiss is an independent electronics service technician

from your shop area to eliminate customer intrusions.

40) Keep the lobby of your service center clean and uncluttered.

41) If you allow smoking in your lobby, pedestal ash trays eliminate unsightly countertop trays.

42) When offering while-you-wait service, provide comfortable seating and a TV or magazines to help pass the time and minimize update requests.

43) Display awards, trade association certificates and thank you letters from past customers in your lobby.

44) Pipe soft music into your lobby area. Supermarkets profit from the stress-relieving ploy. Why shouldn't you?

45) When customers flood your lobby, keep mental track of who's next.

46) Avoid stacking customers' product in your lobby. Stacking can signal potential damage to products.

#### Reservice survival

47) Give a free blank tape with repeat VCR failures.

48) Apologize for the inconvenience, even when operator error on the part of the owner causes reservice.

49) Shake hands with reservice customers. Welcome these opportunities to prove your guarantee's worth.

#### Winning words

50) Substitute "You'll need to" for the more commanding "You'll have to."

51) Eliminate expletives. Profanity is not only unprofessional and unpleasant, it could bring law suits.

52) Rather than blurting "We don't service those," when confronted with product you don't service, say, "I'm sorry, but we're not authorized to service this product. Let me get you a number to call."

53) Never speak negatively about a customer's product, even notoriously inferior items. This attacks the customer's personal choices.

54) Never attack your competition's work or reputation. Professionals soar on expertise; incompetents sink to put-downs and innuendo.

55) Leave detailed answering machine

messages. Details will minimize the need for follow-up calls.

56) Mirror customers' words when discussing symptoms. Repeating their words proves that you're listening and will increase accuracy.

57) Avoid the "Yes I did" and "No I didn't" traps. When customers insist you said something, rather than argue, apologize for any misunderstanding and ask how you can right the situation.

58) Assure "no problem found" customers that diagnostic fees apply if problems occur during your guarantee period.

59) Use a uniform telephone answering "script." Providing only your company name when answering the phone accomplishes little. A well-rehearsed script, such as, "Good morning This is Joe, at XYZ Electronics service, how may I help you?" accomplishes three goals: "Good morning," followed by a brief pause, establishes contact and allows your customer time to focus; stating your name and company tells them they've reached the right place and are dealing with a "real" person; "How may I help you?" shows your willingness to help.

60) Turn incoming wrong numbers into mini-ads, by saying, "I understand, but if you ever need VCR or camcorder service, call XYZ Electronics at this number." This humorous approach has earned new customers for my service center.

61) When stumped by unfamiliar features, ask to see your customer's owner's manual. Explain that instruction on their "cutting-edge" product hasn't reached you yet. Say, "Let's learn together." They'll appreciate your dedication as well as your honesty.

62) Don't bowl customers over with techno-babble. Explain the service in simple language.

63) On slightly-out-of-warranty repairs, diffuse premature failure complaints with CR numbers.

#### Phone favorites

64) Return promised phone calls. When updates are unavailable by that 2:00 P.M. deadline, call anyway. Most

customers will understand and appreciate your vigilance.

65) On no-problem-found units, call customers for details that might help you spot intermittents.

66) Offer your fax number when customers forgot key documentation.

67) When you are unavailable to accept calls, your staff should take messages and assure customers that you will return their call. This will prevent the customer from calling back unnecessarily.

68) Post your phone number and hours prominently on your front door. Early arrivals will know when to return and the number to call for information.

69) To speed approvals and completion calls, get both the customer's home and work phone number (with extension and contact name).

70) Document numbers dialed, names, times and other pertinent info on all estimate and completion calls. This derails "Why didn't you call?" problems.

71) On declined repairs, offer immediate disposal while still on the phone. Mail a postage-paid disposal card, and discard the unit only after the signed card returns.

72) Don't wrap calling customers with warranty red tape. Remind warranty customers to bring receipts or accommodation letters. Explain the process.

73) Visually check stock before calling estimates or accessory pick-ups.

#### Money motives

74) Offer recently unemployed customers payment schedules, while you hold their product.

75) Charge diagnostic fees. Reasonable customers expect to pay for your time. You can't maintain quality service by giving away expertise.

76) Offer "added-fee" or "priority" same- or next-day service. Harried executives will gladly pay premium prices when computers or other key equipment fails at inopportune times.

77) Maintain a consistent pricing policy. Seat-of-your-pants pricing can bring substantial loss and, in these consumer-conscious times, hidden cameras spreading your picture all over the evening news.



78) Don't balk at refunds. Rather than being signs of failure, refunds are often a way to cut down on losses and salvage customer relations.

#### Assorted stuff

79) Know how to direct customers to the nearest bank or cash machine.

80) If a customer's car dies outside of your shop, offer the phone book or direct them to a nearby mechanic. Offering tools or personal assistance could bring lawsuits if injury or damage occurs.

81) If accessories are lost while in your store, apologize and offer replacements.

82) Gladly supply customer relation telephone numbers to customers expressing negative feelings about manufacturers or products.

83) Respect customers' decisions to decline repairs. Today's declined may be

tomorrow's \$1,000 big screen repair.

84) Don't toy with time. Offering speedy service may lure repairs, but when Saturday's graduation passes without that promised camcorder you and your service center will be labelled incompetent.

85) Avoid "basket case" repairs. Except for insurance claim situations, never accept a shattered, water-logged or bullet-riddled product for service.

86) Maintain an uncluttered shop area. Impress, don't repulse, customers.

87) Computerize your operation. Computerized job and parts tracking speeds repairs and minimizes telephone hold time for customers.

#### First and Lasting impressions

88) Jot customers' names on claim

checks to help personalize greetings when the item is picked up.

89) Greeting all customers with a smile.

90) Help carry product to and from cars.

91) Offer to staple paperwork together.

92) Use the customer's name when saying goodbye, it's on the invoice.

93) Know the path to your door. Maps and knowledge of key landmarks can help you guide customers to your store.

94) Shave every day. Poor personal maintenance signals poor product maintenance as well.

95) Keep mints handy to assure fresh breath when greeting customers.

96) Clean the exterior of all completed repairs. A dirty cabinet spells lax service.

97) Bag all completed VCRs, camcorders, and other small components. Bagging of the product looks professional, keeps product clean and minimizes demonstration requests.

98) Keep a spare shirt available, should yours become soiled or torn.

99) Assume that all customer complaints are valid.

#### That brings us to our FBI lady

Not long ago, an elderly woman believed the FBI had bugged her 19 inch TV. She asked me to investigate. "I know they're listening to me," she said. "I sometimes hear them talking inside my TV."

Naturally, I doubted the FBI scenario; I also doubted she dragged her set across town just for a visit. After assuring her that the voices were probably interference, I promised to evaluate her TV and alleviate her fears. Of course, my evaluation revealed no problem. And a follow-up call to her son confirmed what I had suspected: CB radio interference. The woman had mistaken a neighbor's CB babble for official FBI chatter.

My willingness to listen earned her family's business. Your willingness to embrace customer service as an ally and not an albatross will carry your service center into the new millennium. ■

## Test Your Electronics Knowledge

### Answers to test

(from page 50)

1. A - (Remember that blue light is scattered out by the atmosphere in a red sunset.)

2. MKS - Meter, Kilogram, Second

3.  $\frac{1 \times 10^{12}}{25,000 \times 10^9} = 0.04$

4.  $R = 1/R$  (siemens), so,  $10\Omega = 1/10$  (siemens) = 0.1 siemens

5. magnitude vs. direction

6.  $\frac{1 \times 10^{-6}}{1 \times 10^{-12}} = 10^{+6}$



7. Q (by definition)

8. Hay Bridge

9. Kelvin Bridge

10. Not correct. The rolled construction of electrolytic capacitors creates inductance, so they cannot bypass high-frequency noise and spikes. Capacitors  $C_1$  and  $C_2$  have planar construction with no inductance. So, they are used to bypass noise and spikes.

Answer to the Bonus Question: K band



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( ( **34,000 REPAIR TECH-TIPS** ) ) As promised, another 2,000 daily repairs have been added to our database this update. Included are the tenacious **Eprom repairs** of our industry. **WE ARE TECHNICIANS! TEST our FULL DATABASE** of repairs in **CD FORMAT, DOS or WINDOWS** for **ONE WEEK in YOUR SERVICE CENTER** for \$20.00. If satisfied, you may join our membership for an additional \$330.00. Our membership price has been the same for the past 8 years and will remain the same in the future. **"FREE"** 48 Page member magazine **"THE TIP INFORMER"**, **"FREE"** Emergency tech-assist telephone line, **"FREE"** FCC-ID Cross-Reference Manual, **"FREE"** Service Center Forms, **Semi-annual** updates with **2,000 new repairs** in four - 3" Paper Manuals or Computer, **CD, DOS or True Windows.** You may enter your own repairs, edit or tag any report or press one key and printout selected or all repairs on a particular Model or Chassis or FCC ID No. **"GET TO THE BOTTOM LINE PROFITABLY"** CALL and speak to a service center owner and technician **ED Erickson, NESDA MEMBER** and past president of the (**PROFESSIONAL ELECTRONICS ASSN. OF SOUTH FLORIDA**). You and your technicians will be glad you did! Today, labor is your largest expense. **800-474-3588** or 954-349-2455, **TV-Man Tech-Tips, Inc.** 2082 Augusta, Weston, Florida 33326.

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Heath vector scope (new), \$90.00. HP pulse generator. \$75.00. Conar radio signal tracer, \$20.00, radio color bar generator, \$35.00. Radio Shack 12V 21/2A supply, \$15.00 *Contact: Leonard Duschchuk, 561-871-5831.*

Tektronix oscilloscope, type 453 50MHz dual trace with manual and probe. \$450.00 plus shipping. *Contact: John Brouzakis, 412-482-3072.*

Sencore FC51 1GHz frequency counter. \$350.00. B&K CMOS tester. \$35.00. Both in mint condition. *Contact: Boulevard TV & VCR Service, 610-446-4519.*

VCR test equipment, \$500.00. Beltron 8080A picture tube check system, \$700.00. Microwave oven test equipment, \$500.00. Bird wattmeter model 4431-W/7 elements, \$675.00. All new. *Contact: Martin E. Wiedenbeck, 716-434-7395.*

Sencore TVA92. \$1200.00. VA62 with NT64 and VC63 test accessories. \$1250.00 or both for \$2450.00 or best offer. Will pay shipping. *Contact: Steve, 814-455-8741, 814-459-0591 or e-mail at: yogeshvara@juno.com.*

Sencore CR70 CRT restorer with '97 setup book and all adapters. Very good condition. \$695.00. *Contact: Dick, TV Workshop, 301-439-5333.*

Hickok signal generator 615. Sencore color generator G141. Photofact 1-1709. *Contact: Ann Bichanich, 15 1/2W. Lake Street, Chisholm, MN 55719.*

Sencore CR70, PR570, LC102, TVA92, and VG91, \$4800.00 total. All have original boxes and manuals. Like new! *Contact: Annie, 520-718-0220.*

B&K model 520B transistor tester with leads and manual. \$125.00. *Contact: Bob Kramer, 919 Grove Street, Aurora, IL 60505, 630-898-8946.*

Books on VCR repair by well-known authors, John Lenk, Robert Goodman, and Gordon McComb. All for \$50.00 plus \$5.00 shipping. All mint condition. Magnavox and NAP paper manuals from 1980's and 1990's. *Contact: Maurer Radio-Television Service, 717-272-2481.*

Sam's Photofact, 1655-1919; miscellaneous AR books. TV service manuals 1950's, \$150.00 for all. *Contact: Ross Opfer, 30030 West 84th Street, Desoto, KS 66018, 913-583-1839.*

Conar model 230 signal tracer. \$40.00. Heath model 10-18 lab scope. \$40.00. Heath model SG 72A audio generator. \$45.00. Heath Model 1M-38 AC VTVM. \$35.00. EMC model 502 RF signal generator. \$30.00. Measurements model 560FM mobile radio RF signal generator, \$150.00. *Contact: B.J. Jett, 205-638-2144.*

Sencore CVA94 and VR940, used twice, \$2000.00. With cables and manuals. Will pay shipping. *Contact: Gordon Wilmont, 12 Putnam Road, Hyde Park, NY 12538, 914-229-0478 between 9AM - 5PM EDT M-Th.*

Sencore SC3100 "Auto-Tracker" 100MHz waveform/circuit analyzer, \$2450.00. Sencore SG30 AM/FM stereo analyzer. \$1780.00, PA-81 audio power analyzer. \$1450.00. All brand new in box. *Contact: Jim, 888-532-8007 (toll-free), Fax 707-259-8010.*

Sencore SG80, new never used. \$1800.00. PA81, like new \$1400.00. Telonic AM/FM sweep generator, \$250.00. analog precision MV/thermocouple calibrator, \$1000.00, OBO. *Contact: 913-467-8431, 913-467-3921.*

## WANTED

16LP4A or 16ZP4 picture tube. Can be new, used or rebuilt. *Contact: Harold Mathews, 612-457-6907.*

Quadraphonic equipment, 4-channel audio scope (Pioneer SD-1100, JVC MM-4), Audio or spectrum analyzer, Precise 111M or Hickok tube tester. *Contact: 612-869-4963.*

Sylvania TV model CX0176W flyback transformer model 00361878-0002. EIZ 232 type B, and 90044 LIT3 152. JVC receiver model R-S33 service manual. *Contact: Todd McLaughlin, 16189 Snyder Road, S. Russell, OH 44023, Phone/Fax 440-338-3429.*

High voltage block 173494. RCA/Hitachi projection PMR450 CTC132D, used okay. Blue gun SD186B 873835505. Sony projection KpPP-41DS2. Used okay or will sell our red, green, chassis. *Contact: Excel TV, 3798 W. 79th Street, Chicago, IL 60652, 773-585-0760, Fax 773-585-1304.*

ESR meter by Creative Electronics. Hickok model 225 meter movements or complete meter. *Contact: Harold Klotze, 773 Midland Avenue, Ravenna, OH 44266, 330-297-1155.*

Panasonic camcorder model PV-520D schematic for loading motor/control circuitry. Will pay for copy and shipping. *Contact: Steve Zweifach, 9018 Greylock Street, Alexandria, VA 22308, 703-780-6708.*

Fisher big screen model PT-810, part DY0061XHA, red/blue deflection yoke. Will pay \$80.00 for new, \$50.00 for used, plus shipping. *Contact: Paul, Marshfield TV and Electronics, 417-859-2525.*

Mitsubishi 35-inch TV model CS-3505R. Part number 334P167809. New or used OK. Must be reasonably priced. *Contact: Walter Beers, 9159 Manderson Street, Omaha, NE 68134, 402-572-6870.*

Canon calculator schematic and/or operators manual, model 161. Late 60's, possibly early 70's. Willing to pay really big bucks. *Contact: Donald Dupre, 401-737-7118 or 401-886-3910. E-mail: dgd@cherry-semi.com.*

Fisher VCR model FVH980, need service information. No longer available from manufacturer. Any terms buy, borrow, copy and return. Can be paper or fiche. *Contact: Jim's Sparetime Repair, 65 Vassar Road, Poughkeepsie, NY 12603, 914-462-1674.*

Hewlett Packard HP1220A power transformer and or scope for parts. *Contact: Lorne, 403-320-1996, Lethbridge, Alberta, Canada.*

Quadraphonic equipment, records, turntables, cartridges, test discs, literature, audio scopes. Pioneer SD-1100, JVC, CBS, etc. Audio analyzers. Precise 111M or Hickok tube tester, tubes. *Contact: 612-869-4963.*

JVC VCR model HR-D620V need photocopy of just the power supply schematic. Magnavox CD player schematic model CDB465, photocopy okay. *Contact: Jim Budd, 1008 5th Avenue NW, Austin, MN 55912, 507-433-4316, after 5PM.*

APIA Digital Universal Electronic test set schematic for digital readout model, voltmeter/ohmmeter model, and power supply model. *Contact: A.R. Vickery, The Music Shop, 548 Main Street, Torrington, CT 06790-3796.*

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