THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

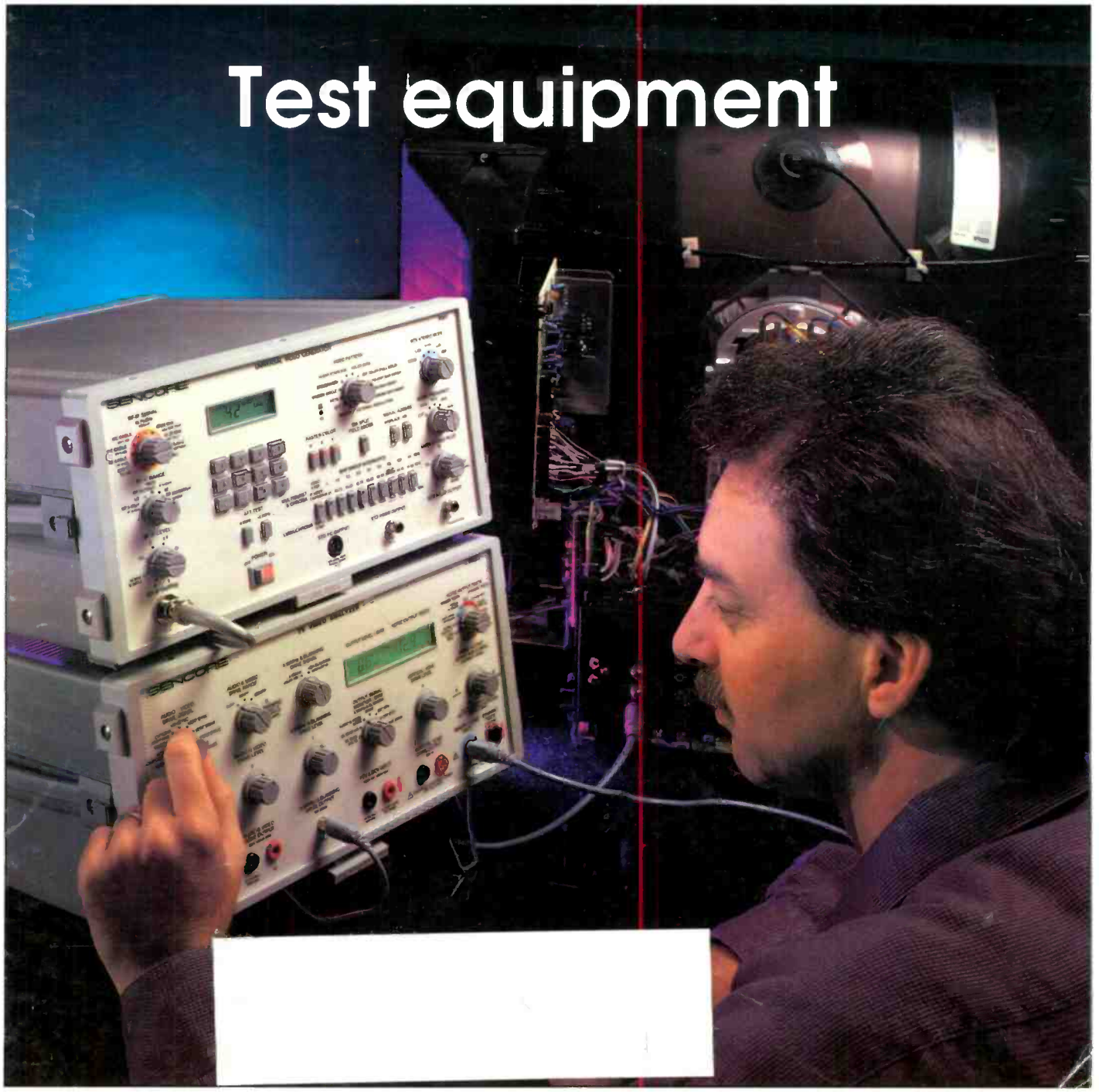
ELECTRONIC™

Servicing & Technology

December 1993/$3.00

Regulator burnouts

Replacement parts/servicing information sourcebook



What's Up?
VCRs, TVs, And Profits!

VCRs Remain The Number One Product To Service Among Top Electronic Service Centers!

Field seminar trainers are reporting that in excess of 98% of service centers are now maintaining a high volume of VCR and/or camcorder service activity. Also, recent EIA statistics show that VCR/camcorder sales are continuing to show high sales and thus high service potential.

However, many technicians still report that they are having difficulty with isolating head defects, separating servo electrical and mechanical problems, and troubleshooting color and luminance circuits. This is in part due to the fact that most defects are mechanical and the technician isn't familiar with the electronics.

One company has designed a test instrument to help the VCR technician better make a profit on all VCR repairs. In fact, it's the only VCR analyzer on the market, and it's only from Sencore.

One Test Instrument Company Remains The Technician's Choice For Innovation And Time Saving/Profit Adding Tests!

Again this year Sencore has proven to be the technician's choice for test instruments. From NESDA surveys of test equipment preference to technical support of the service industry, Sencore remains on top.

Sencore is number one because of the dedication of the entire factory toward their customer's success. This is evident in Sencore's new product innovations and toll-free access to the entire company. Sencore is the leader in American made instruments, and can be reached at **1-800-SENCORE (736-2673)** anytime you have test instrument or industry related questions.

Sencore's New "Tech Choice System" Instruments Have Proven Themselves As The Leading Instruments For The Service Industry. You Should Try Them For Yourself!

Improved TV Circuits Prompt Better Analyzing Techniques To Be Used By Service Centers!

Most TV manufacturers are now using switch mode power supplies, microprocessors, digital tuning, and other video processing circuits to produce a clear crisp picture. These newer circuits are providing new features and components that make the job of the technician even more challenging.

Couple the new features with the prices offered by many retailers, and the servicer must now find a way to determine if the TV is profitable for him to service. Successful servicers are welcoming the changes to video by meeting these challenges with new estimating techniques and new ways to pinpoint the defects.

Recently introduced test instruments are now allowing service centers to isolate TV defects, troubleshoot start-up/shutdown problems and test expensive components. And some of the tests are even being done with the TV turned off.

Again, only one company is standing strong with the servicer, and has introduced solutions to modern TV servicing challenges - Sencore.

Circle (32) on Reply Card

Call 1-800-SENCORE For Free Technical Servicing Information And To See How Sencore Instruments Can Be Put To Work On Your Bench!

SENCORE

3200 Sencore Drive, Sioux Falls, SD 57107
Phone (605) 339-0100 FAX (605) 339-0317

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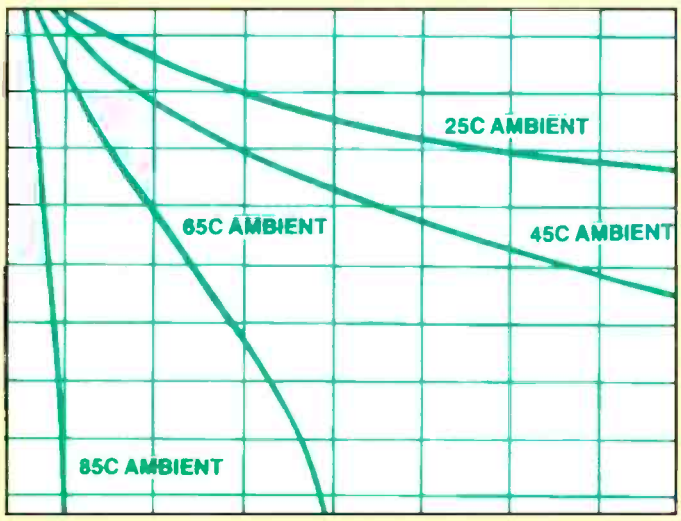

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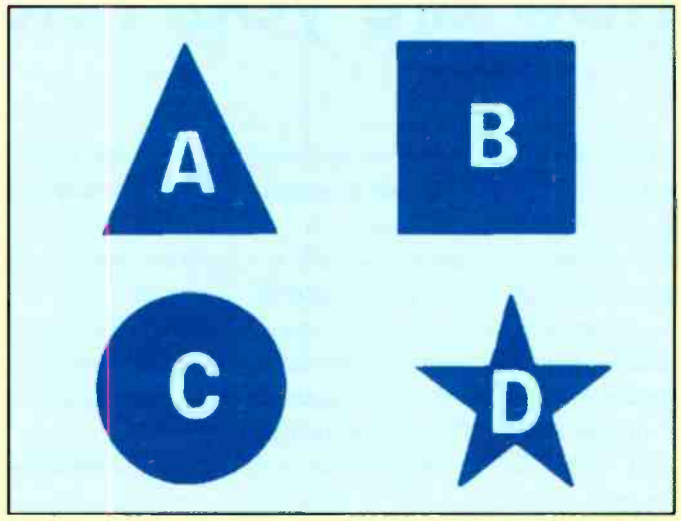

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SPECIAL ADVERTISING SUPPLEMENT

FEATURES

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ON THE COVER

Every profession in which the function of practitioners is to determine why the product or organism is malfunctioning and to take steps to correct the problem requires some kind of test equipment. The medical profession uses thermometers, stethoscopes, blood pressure cuffs, X-rays. The mechanic has his timing light, engine analyzer, feeler gauges. For the consumer electronics servicing technician, the test devices of choice include oscilloscopes, multimeters, signal generators, gauges, and power supplies. (Photo courtesy of Sencore).

ELECTRONIC Servicing & Technology

How are your references?

Once again it's time for us to present you with the updated "Replacement parts/servicing information sourcebook." As any service technician knows, it's frequently difficult to find the manufacturers of consumer electronics. They change address, they have a low profile in the marketplace, they sell in this country for a while and then pull out of the market.

All of that doesn't cut much ice when the customer brings in one of these sets to your service center. They want to get it fixed. So where are you going to find the manual you need to service the product, and the replacement parts.

The listings in this issue are the most up to date we have ever presented. The staff researched several other listings in the field to determine if these listings were current. Where there were questions, we called and verified the information with the company directly. There are no doubt still a few addresses and telephone numbers that aren't current, but most are. If readers find errors in these listings, please call or write and let us know which information is not correct, how you know it is incorrect, and what the correct information is, if you know it.

Help us expand these listings

The most serious limitation of these listings is that they are not complete. We know they are not, and would like to make them more complete if we can. Readers can help us. If you are familiar with one or more companies that aren't listed here, and you think they should be listed, please write to us and tell us. If you only know the name, provide us with that. On the other hand, if you know any other information; address, telephone number, products manufactured, etc., include that too.

Or if you have a product in for service and you don't recognize the brand name or have any idea who made it, call or write, and we'll try to get that information for you, and for inclusion in future listings. But please provide us with every bit of information that you can about the product: the product type (TV, VCR, camcorder, cordless phone, etc.), UL listing number if there is one, FCC ID number if there is one, screen size in the case of a TV, the store and the city and state where the product was purchased, etc.

Try to get some of the references

We know that this annual sourcebook is useful to most of our readers. They tell us that it is. However, because of the limitations of the magazine size, and our personnel and financial resources, this guide simply cannot contain all of the information that a service center needs to locate product manufacturers or a distributor of that important replacement part.

For that reason, we strongly recommend that you amass as many references as you possibly can. They take up space. They cost some money. But they can save you a lot of time, which translates to cost savings to you, and less aggravation to your customers.

As just one example, just recently a reader called me looking for a source of a replacement of a component. The defective part was an IC with the name Sanken on it. He told me he had been looking for the part for six months. He had been unable to locate Sanken.

I opened my copy of the Electronic Industry Telephone Directory to the Company Name and Telephone Number listing and in about a minute found the name Sanken. I gave that reader the number and wished him luck. I also asked him to please call me back to let me know if I had helped.

He called me back in less than five minutes. He had reached the Sanken company in the United States. They had the exact part he needed. His six months of searching were over. That's not an unusual situation. Many service centers spend hours, days, weeks and months trying to find a source of a replacement part. When you consider the cost in terms of productive time wasted, disappointed customers, telephone toll charges, the cost of a modest reference shelf of manufacturers and suppliers that will help you save all of that is small indeed.

Try Readers' Exchange

Unfortunately, no matter how many references you have available, sometimes the part or information just isn't there. For example, in checking to update addresses and telephone numbers in the manufacturer list in this issue, I called Audio Parts in California. As it turns out, the information I had for them was still correct.

However, when I asked them if they still had stocks of parts for Bohsei, they said that they had run out. I asked them if they knew if any other distributor had any Bohsei parts and they said no. You may recall that Bohsei is an offshore TV manufacturer that sold TVs in the U.S. for a while and then pulled out of this market. Audio Parts had bought Bohsei's stock of parts in the U.S. and distributed them while they lasted.

Once there's no longer an official stock of parts or service literature for a manufacturer's products, the only thing servicers can do is to ask other servicers for help. If you have exhausted all other sources, you might try writing in to Readers' Exchange in ES&T. Sometimes another reader will have a schematic diagram that he will be willing to copy and send. Or if miracles still happen, someone might even have that IC you're looking for. It happens. It's rare, but it happens.

Nils Conrad Persson

Electrical Connections

KEEPING THEM CLEAN AND TROUBLE FREE

By David Reel

A common problem, inherent to all audio, video and computer equipment, is distortion due to intermittent connections. This can take the form of crackling noises when operating volume controls, radio frequency interference, snowy video images, errors in data transmission and countless other symptoms. It can occur at any connector junction in the signal path, from the input source to the output, regardless of the quality of the equipment.

When connector surfaces are exposed to dust, smoke, soot, and other solids suspended in the atmosphere, non-metallic films can form, inhibiting conductivity. Oxidation is the most common reaction that causes metal-oxide formation. Salt-laden air in coastal areas corrodes most metals, forming chloride films that also inhibit conductivity.

While the household user of electrical and electronic equipment may be able to cope with such problems for short periods of time, one can realize the critical nature of even minor trouble when it affects pro audio/video, computer, industrial, high-tech or aerospace equipment.

Some film deposits are effectively removed with "wash-type" contact cleaners such as TF solvent, alcohol or other solvents. Oxides and sulfides, however, become an integral part of the metal surface and cannot be removed with these ordinary cleaners.

Gold-plated surfaces are especially vulnerable to whiskering of base metals to the surface (dendrite corrosion) due to the gold's soft and porous nature. Once exposed, base metals oxidize, resulting in unwanted resistance that impedes electrical performance. Since gold-plated surfaces are thinly coated, they are susceptable to scratching & abrasion, further exposing the base metals.

Having tried virtually every "contact cleaner" on the market, I have found ProGold, by Caig Laboratories, to be the most effective. Not only does it clean connector surfaces, it provides longer lasting protection from future contamination than the other products I've tried.

I've found it to be effective on both stationary and moving contacts as well as connectors with similar or dissimilar metals. This is extremely important, since different brand connectors may be made with different materials.

In our facility, we've found it to be an indispensible product for a variety of applications from manufacturing to service.

Whether or not ProGold will make your audio/video components perform better I cannot say for sure, but it will definitely improve the performance and reliability of the connectors and eliminate the headaches of troubleshooting intermittent connections. Hence, it is often referred to as the "electronic aspirin." For information contact Caig Laboratories, Dept M6, 16744 W. Bernardo Dr., San Diego, CA 92127, (619) 451-1799, FAX (619) 451-2799.

Reel is chief engineer of an electronic manufacturing facility in Northern California.

Class action suit demands California return $150 million

Senior California state officials, Kathleen Brown, Treasurer, Gray Davis, Controller, and Thomas W. Hayes, Director of Finance, are being sued in a $150 million class action suit filed by the California State Electronics Association (CSEA) and a private company, Malibu Video Systems. The class action suit claims that the state government illegally transferred money to be placed in "special funds" into the General Fund. These "special funds" were established by law, and the money that goes into them is to be used only to govern the business and professions they control and to protect the consumers who use the services of the licensees.

The class action suit claims that, under California's Budget Act of 1992, the legislature illegally authorized the state government to transfer money from the "special funds" into the General Fund to be used to pay off some of the State's general obligations. The amount that has or will be illegally transferred in 1993 is approximately $150 million, and the Plaintiffs want it returned to the "special funds."

According to Richard I. Fine, attorney for the Plaintiffs, "This class action suit affects all Californians, because the state government has taken registration and licensing fees of over 50 California businesses and professions, from accountants to veterinarians, specifically collected to protect consumers, and used this money collected illegally. We will prove in the suits filed in California State Court and the United States District Court in Los Angeles that taking money out of the 'special funds' to be used for other than its designated purpose violates the California and United States Constitutions."

Included among the consumer groups that will be affected by the Plaintiffs' class action suit are those who use the services of physicians and health professionals, dentists, automobile repair shops, pharmacists, bankers, barbers and cosmetologists, real-estate brokers and sales agents, collection agencies, contractors, dry cleaners, funeral directors, engineers, architects, pest control companies, and tax preparers.

The president of CSEA, Eloy Fierro, added, "In the past, our association, which represents electronic, appliance and computer repair and service people, never complained about paying the yearly registration fee. We knew the money was used to maintain high standards in our industry. Like everyone else, our members also paid their state income taxes so that the government could provide the public its other services."

Stanley G. Auerbach and Norbert Bactowski, owners of Malibu Video Systems, echoed Fierro when they commented that it's not right when the State requires us to pay a fee to govern our industry and provide consumer protection, then uses the money to pay off its deficit. It would be like our charging customers a sales tax and then using it to pay off a car loan.

Fine concluded, "After the filing of the suit, the State of California has not attempted to take the money from the Special Funds in its 1993 Budget."

Safety standard for antenna rotators

Underwriters Laboratories Inc. (UL) is proposing the updated standard for Safety for Antenna Rotators, UL 150, for recognition as an American National Standard.

UL 150 covers antenna rotators intended for household and commercial use on supply circuits in accordance with the National Electrical Code. An antenna rotator generally consists of a mast-mounted motorized drive unit that rotates the antenna and an indoor-located user-operated control unit that delivers operating power and direction signals to the drive unit. The power used to drive the motor is derived from a Class 2 circuit.

UL 150 does not cover systems that use a stationary antenna and change or rotate the receiving pattern by electronic or switching means.

The standard is a revised version of ANSI/UL 150-1989, which is presently recognized as an American National Standard. UL is seeking review and comment from interested individuals and organizations to help develop a consensus upon which continued recognition of UL 150 by the American National Standards Institute (ANSI) can be based. ANSI is a clearinghouse for information on standards and coordinates development of national consensus standards through voluntary action.

Anyone interested should contact Bernadette Folan at UL, 333 Pfingsten Rd., Northbrook, IL 60062-2096, (708) 272-8800 Ext. 42764, and request a free copy of UL 150-NR. Participation will be by correspondence. Those interested should request their copy now so that all comments can be considered in time to meet the ANSI deadline for this standard.

Separate components lead audio market in June

Sales of separate components led the way in the audio market in June 1993, according to statistics released by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Sales of audio products rose three percent in June to $550 million. All four major audio product categories posted positive growth during the first half of this year, the first such occurrence for the audio market on record.

June marked the first time since April 1991 that sales of separate components led the audio market. Dollar sales of separates like CD players, speakers, and amplifiers grew 21 percent in June 1993 over June 1992. This increase, which was the largest in the audio market since February 1989, pushed the separates category into the black for the first six months of this year with a two percent gain.

"The growing interest and demand in home theater components, specifically audio-video receivers and speaker systems, has helped renew the growth and vitality of the audio market," says Kerry McCammon, Vice President of Pioneer Home Electronics Marketing.

Receivers, with sales of $220 million, and speakers with $157 million in sales, were the leading products within the separates category during the first half of this year, rising 26 and 11 percent, respectively. Among CD players, carousel types ended the first half of this year with sales of $98 million, a two percent gain over the same period last year, buoyed by a strong June performance.

Sales of aftermarket autosound products rose for the fifth consecutive month in June, and grew for the seventeenth time in the last year and a half. CD players spurred aftermarket autosound growth in the first half of 1993, with single play

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ELECTRONIC
Servicing & Technology

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units and CD changers combining to post growth of nearly 40 percent on dollar volume of $196 million. In-dash removable CD players with amplifiers were the most popular type of autosound CD unit in the first half of this year with sales of $86 million, up 62 percent over the same period last year. Sales of CD changers also grew 62 percent during the first half of 1993, to $69 million.

Audio systems recorded average monthly growth of 13 percent during the first six months of this year. Dollar sales of rack systems totaled $242 million through June, down 12 percent from a year ago. Compact systems fared better, with a 34 percent increase in dollar sales.

Portable audio sales were relatively flat during the first half of this year, rising one percent. CD players were the primary movers within the category. Dollar sales of portable CD players reached $148 million through June, up 17 percent. CD boomboxes gained 21 percent with sales of $319 million.

FCC selects ETA to administer commercial examinations

The Electronics Technicians Association, Int'l., Inc. has been informed by the Federal Communications Commission that it has been selected to administer examinations for commercial FCC licenses. Individuals must have an FCC license to operate radios aboard commercial ships; certain coastal stations; aircraft and Civil Air Patrol stations; AM, FM or TV broadcast stations; experimental broadcast, and low power stations; or international fixed public radiotelephone or radiotelegraph stations.

An FCC license is also required to repair and maintain ship radio and radar stations; coast stations of all classes; hand carried units that communicate with ships and coast stations on marine frequencies; radio stations aboard all types of aircraft; portable and fixed aeronautical ground stations; AM, FM and TV broadcast stations; experimental and auxiliary broadcast stations and international radiotelephone and telegraph stations.

In its Report & Order of April 7, 1993, the Commission issued a Public Notice to announce that the Commission would accept requests from entities that wanted to become COLEMs, or Commercial Operator License Examination Managers. Multiple organizations were selected from the sixty requests received during the 25-day period for filing.

FCC examinations have previously been administered only by the Government. The purpose in privatizing the examination process is to relieve the Commission of the testing burden, to improve the content and timeliness of the examination questions and to increase the opportunities for individuals to take exams. FCC licenses will continue to be issued by the Commission. The examination process will be handled by outside entities such as ETA-I.

The Electronics Technicians Association, Int'l. is a not-for-profit Indiana corporation, based in Greencastle, Indiana. ETA has operated an international testing program for electronics technicians since 1978. Examination sites are located at over 230 educational institutions. U.S. military facilities administer the Certified Electronics Technician examinations through base education offices. The CET program recognizes the skills, education and abilities of technicians in all phases of electronics, including consumer, industrial, computer, biomedical, communications, satellite and RF signal distribution (cable TV and private cable). It is partially because of this experience that ETA-I has been chosen to administer the FCC examinations.

Implementation of the ETA testing process for FCC examinations will take place very shortly, in order to accommodate individuals who have been waiting to obtain their licenses. To receive further information regarding the sites and dates for examinations, write to: ETA, 602 N. Jackson, Greencastle, IN 46135. Call 317-653-8262.

Manufacturing and service industries develop standardized claims filing requirements

In a move that will greatly reduce the administrative time and money currently spent on filing claims forms, the consumer electronics industry and the product servicing industry have developed standardized warranty claim filing requirements for consumer electronics products. Currently, most manufacturers have different claims requirements.

The 10-page booklet, "Consumer Electronics Warranty Claim Filing Requirements," is the result of the efforts of the Electronic Industries Association's Consumer Electronics Group (EIA/CEG), the National Electronics Service Dealers Association (NESDA) and the National Appliance Retail Dealers Association (NARDA).

In 1991 the EIA/CEG Product Services Committee named a special subcommittee to create standardized requirements with the intention of reducing the administrative burden placed on servicers and providing adequate audit and quality information to manufacturers. The subcommittee comprised two ad-hoc committees representing manufacturers and servicers respectively.

Thomson Consumer Electronics' Jay Franklin chaired the manufacturers' ad hoc committee, his counterpart representing the servicers was Jack Hopson, First Electronics Service in Omaha, NE.

"A majority of manufacturers have agreed to start using the standardized requirements decided on by our subcommittee," said Franklin. "It is a tribute to both industries that, once a problem has been identified, we work together to reach a solution which is beneficial to everyone."

Hopson added, "These new requirements will certainly reduce the hardship that has been placed on the service providers in the past. Having one set way of filing claims accepted by all manufacturers will expedite filing time, reduce the number of misfiled and returned claims and will facilitate the software development for processing claims."

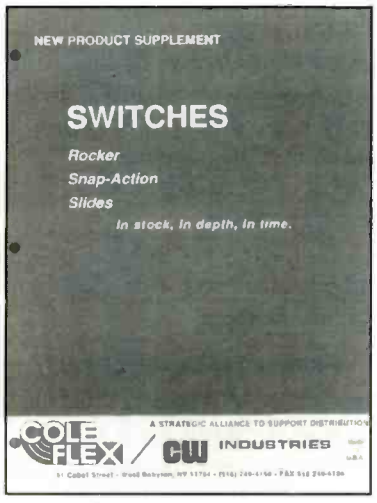
In 1991 the subcommittee released "Quick Reference Guide: Customer Complaint/Repair Codes," a listing of customer complaints and product symptoms given a four-digit code and a list of repair actions with a four-digit code.

For individual copies of "Consumer Electronics Warranty Claim Filing Requirements" or "Customer Complaint/Repair Codes," send $3 (each) and your request to EIA/CEG, Dept. 287, Washington, DC 20055.

Literature

Switch catalog

Now available from Cole-Flex, is a catalog featuring a line of switches which includes snap-action, miniature rockers (illuminated and non-illuminated) and slides. All the switches are manufactured in the United States by CW Industries, and are suited for use in motor driven devices, test equipment, instrumentation, appliances, auto/marine



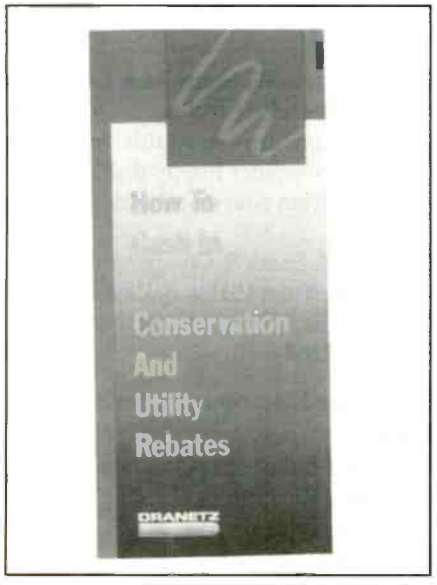
accessories, RV/emergency vehicles, telecommunications, computers and peripheral equipment. Most of the switches are rated UL/CSA and some international VDE specifications.

Circle (70) on Reply Card

Booklet on energy conservation and utility rebates

Dranetz Technologies, Inc., is offering a 20-page, full-color booklet, "How To Cash In On Energy Conservation and Utility Rebates."

This booklet not only identifies the areas where you can conserve energy and save money on your electric bill but also describes how to take advantage of the rebates and incentives offered by utilities for your conservation efforts.



A variety of opportunities are available from electric utilities, through their demand side management (DSM) programs, that provide cash incentives for the installation of energy efficient devices and for participation in energy conservation programs that lower electric demand.

The booklet addresses key topics like: demand side management, rebate incentives, return on investment, retrofit, payback time factor, energy efficient equipment, and the value of monitoring. Ex- amples of what other companies have done in these areas, including the resultant dollar savings and payback period, are also provided.

Circle (71) on Reply Card

Application note describes how to accurately measure ESD current waveforms

Application Note 165 from KeyTek Instrument Corp. provides information regarding the measurement of ESD current waveforms. Such measurements are used to verify that ESD test equipment meets the requirements of ESD test standards such as IEC 801-2, or the draft ANSI C63.16. The ESD event has several aspects that make it extremely difficult to measure ESD currents with accuracy. Since the ESD test standards themselves contain few details about how to make the measurements, significant errors can result. Application Note 165 describes the sources of possible measurement errors, and methods to reduce those errors.

As the mandatory European Community requirement for ESD testing approaches, and with the increasing move toward ISO 9000 quality certifications, it is anticipated that regular measurement and calibration of ESD test equipment will become much more rigorous than in the past. Application Note 165 provides important information to aid in responding to these trends.

Circle (72) on Reply Card

Cost survey

The NARDA/NASD 1993 "Cost of Doing Business Survey Report" covering fiscal 1992 has just been published, it was announced by NARDA president, J. Con Maloney, Cowboy Maloney's Electric City, Jackson, MS. Copies of the 75-page report are available to association members for $75 and to non-members for $150.

"We're really excited by this report," Maloney said. "This is the first time we've ever gone outside to a professional financial consulting firm to do our annual cost survey. It's a whole new generation of financial surveys for our industry and the most comprehensive study ever published for our members."

The report reveals balance sheet ratios, margins and business costs for appliance, electronics and furniture sales and service dealers by sales volume in six product categories. It also reports these categories by geographic region and shows general business characteristics such as number and type of employees, sales per square foot, sales per employee, inventory turns, etc. Another section reports the same results for the highest profit dealers in the report.

Ed Knodle, NARDA executive director, in announcing the report's publication to members, pointed out that members who participated in the survey were more profitable at the pre-tax level than the overall industry in 1992. He noted that Robert Morris Associates, in its industry study, found that the retailers selling appliances and electronics reported an average pre-tax profit of 1.2%. The same average for NARDA members was 1.43%.

Circle (73) on Reply Card

Application research information

Ferrofluidics Corporation's FerroSound Program, a customer partnership featuring engineering design assistance and education, announces the availability of a new application note, "Application of Ferrofluids to Woofers." It features information techniques, material interactions, dispensing methods and ferrofluid types.

Ferrofluid is said to increase power handling and reliability, reduce distortion and power compression effects, smooth frequency response and improve transient response. These substances have been used for over twenty years in a wide variety of speakers including high fidelity and autosound. More recent is the application of ferrofluid for use in woofers. In this application note, the fluids and their effects on woofer performance is discussed.

Circle (74) on Reply Card

Replacement parts/servicing information sourcebook

By The ES&T Staff

A customer has just walked into your service center and placed a Bohsei TV set on your counter. That company no longer imports products into the U.S., and it's not at all clear that any service literature or replacement components are available, but this is a valued customer and you don't want to make her unhappy. Where are you going to find the service literature? And if you do manage to determine the cause of the problem, where are you going to go to find the replacement parts.

Another customer brings in a VCR that was private branded for a major retail chain. That company is now out of business. Again, this is a good customer and you don't want to lose him. How can you determine who actually made the product so you can maybe find a service manual for a similar product made by the same manufacturer and obtain some replacement parts.

Locating servicing information and obtaining replacement parts are the two toughest problems faced by consumer electronic servicing technicians.

There are several factors that make it difficult for service centers to locate sources of service literature and replacement parts. Here are a few of those factors:

- Companies move, and after a set amount of time the post office doesn't forward mail.
- Some companies are small and have a very low profile in the marketplace, so they're just hard to locate.
- Many private brands of consumer products have little or no support.
- An offshore manufacturer may sell and support products in the U.S. for a period of time and then leave the market. In some cases these companies will have sold their stocks of replacement parts to a distributor in the U.S., but how do you know who?
- Some companies don't wish to have independent service companies service their products, so they refuse to provide service literature and replacement parts to the independent.

We have ways to help you find them

Each year in the December issue, we publish a replacement parts and servicing information sourcebook that provides service companies with several tools to help them overcome these problems. We do it annually because there are so many changes within a twelve month period that the list is largely out of date by the time a year has gone by.

This sourcebook contains the following sections that should be helpful to any service center in finding service literature and replacement components:

- A list of recommended references.
- A list of FCC (Federal Communications Commission) ID number prefixes that identifies the manufacturer of any product so labeled.
- A sidebar on how to use the FCC public access system to look up the manufacturer of a product on which you have found an FCC ID number.
- A list of UL (Underwriters' Laboratories) ID numbers.
- A completely revised and up-to-date list of manufacturers with addresses and telephone numbers.

Finding replacement parts

Here's a list of references that are useful in tracking down the manufacturers. We think that every electronics servicing facility should have them:

Consumer Electronics Replacement Parts Source Book
Consumer Electronics Group,
Electronic Industries Association
PO Box 19100
Washington, DC 20036
Include $1.00 for postage and handling

Electronic Industry Telephone Directory
(Or some equivalent)
Harris Publishing Company
2057-2 Aurora Rd.
Twinsburg, OH 44087-1999
This will cost around $50.00 (Or you might be able to get a copy free from your distributor.)

The Howard W. Sams and Company Annual Photofact Index
(This document is available in printed form and computer floppy disk)
Available from your distributor, or directly from
Howard W. Sams & Company
2647 Waterfront Parkway East Drive
Indianapolis, IN 46214-2041
800-428-7267

Consumer Electronics Show (CES) Directory
Electronic Industries Association
Consumer Electronics Group
2001 Pennsylvania Ave, N.W.
Washington, DC 20006-1813

The FCC public-access information system

Every VCR, personal computer, microwave oven and cordless phone sold in the United States must bear an FCC identification number because they are considered to be potential generators of radio-frequency interference. This number identifies which company manufactured the unit. If you have one of these products in your shop for service and can't identify the manufacturer, you can contact the FCC through its public-access system and find out.

There are two ways to get this information: via voice telephone or via computer and modem by contacting the public-access bulletin board. The FCC prefers to have people use direct computer-to-computer contact.

To contact the FCC bulletin board, you must have a computer and a modem capable of 300 baud or 1200 baud. The number to call, in Maryland (just outside of Washington, D.C.), is 301-725-1072. This is a toll call. Dialing this number at any time should get you in direct contact with the bulletin board.

Once you have made contact, the computer screen will tell you how much time you have and provide you with a menu of items to choose from. When ES&T dialed up the bulletin board in October, once we accessed the bulletin board the following screen information appeared:

"P A L"

1—Access Equipment Authorization Database

2—Definitions - Terms/Codes used in Application Records

3—Applying for an Equipment Authorization (1/92)

4—Other Commission Activities and Procedures (8/92)

5—Laboratory Operational Information

6—Public Notices (8/92)

7—Bulletins / Measurement Procedures (5/92)

8—Rulemakings (8/92)

9—Help

a—Information Hotline (7/92)

b—ADVISORY COMMITTEE ON ADVANCED TELEVISION SERVICE

c—Processing Speed of Service (10/92)

d—Test Sites on File per Sec 2.948 (10/92)

0—Exit PAL

Enter your selection:

Pressing the number 1 on the keyboard brought up the following information on the screen:

Equipment Authorization Database

Form 731: Until Form 731 is revised the March 1988 and July 1989 editions may continue to be used. The OMB expiration dates shown on the forms do not affect public use. Availability of the revised Form 731 will be announced here and by public notice. est: 7/92

1—Equipment Authorization Application Status

2—Applicant/grantee Names and Addresses by Code

0—Exit this Menu

Enter your selection: Enter Grantee Code (CR to end):

At this point, it was only necessary to enter the three character alpha or alphanumeric code, and the name, address and telephone number of the manufacturer identified by that code appeared. For example, entering the three letter ID aaa and pressing the ENTER key brought up this information on the screen:

AAA Code A Phone Corporation
PO Box 5656 Portland, OR
97228 USA

The system gives you eight minutes at a time, and you can enter as many codes and gather as much information as you can in that time period. If your software allows you to download information, you can download all of this information to your computer's disk for future reference.

The other method of obtaining this information is to call 301-725-1585, Monday through Thursday between 2:00 and 4:30 p.m. and ask to be connected to the status desk. The individual who answers will relay your question to the bulletin board via a computer terminal and will then relay the information to you.

Obviously, if you have a computer and a modem, it makes far more sense to contact the computer directly. You'll cut out the middle man and, of course, you can contact the computer any time.

The CES directory includes over 1,000 manufacturers, brand names, products and key personnel. The best way to get a copy of this directory is to attend the Consumer Electronics Show in Las Vegas, Thursday January 6 through Saturday January 9 1994, or Chicago, Thursday June 23 through Saturday June 26 1994. It comes with the price of attendance. For further information about CES, write to the address above, or call 202-457-8700.

If you can't get to the show, limited numbers of copies of the directory will be available from the above address. Limited quantities of the CES Show directory will be available at a reduced price to ES&T readers who send in the coupon in this issue. Quantities are limited, but the EIA/CEG will fill as many orders as possible.

A VCR model number and parts reference

Another invaluable reference is published by the International Society of Certified Electronics Technicians (ISCET): a VCR model number and parts cross reference. The Fourth Edition of the VCR Model Number and Parts Cross Reference is available in both disc and book format from ISCET.

This reference has been expanded to include over 1300 new parts and more than 360 new models. The new edition is available in both a 320-page document for $36.00, or on disk for IBM PC AT/XT and compatibles for $69.95. According to ISCET, the cross-reference represents an immediate cost saving for technicians who are able to use parts and service literature presently in inventory, and therefore avoid inadvertently purchasing duplicate manuals.

The disk software allows users to search by manufacturer for model numbers and descriptions of part numbers. A parts editing sequence gives an on-screen view of all substitutes for the part entered. An added advantage of the disk format is that it allows the user to update files by adding model and parts cross references of future models. The program requires

FCC ID numbers			
Code Prefix	**Manufacturer**	AGV	Montgomery Ward
A3D	NEC	AHA	RCA
A3L	Samsung	AIH	Litton Microwave Cooking Products
A7R	Orion	AIX	Sylvania
AAL	Phone Mate	AJU	GE
AAO	Radio Shack	AK8	Sony
AAY	Midland International Corporation	AKC	Superscope Inc
ABL	Hitachi	AKE	Marantz Co Inc
ABW	JC Penney	ALA	Wells Gardner Electronics Corporation
ABY	Motorola	ALI	Kenwood USA Corporation
ACA	Yorx Electronics	ANV	Capetronic Int'l Corporation
ACB	Phonotronics	API	Harman Kardon Inc
ACJ	Matsushita	ARR	AOC Int'l of America Inc
ADF	Carterfone	ASH	Akai
ADT	Funai	ASI	Victor Company of Japan
AES	Uniden	ATA	Sharp
AEZ	Sanyo	ATO	Zenith Electronics Corporation
AFA	Fisher	ATP	Advent Corporation
AFL	Sharp	BEJ	Goldstar
AFR	Curtis Mathes	BGB	Mitsubishi
AGI	Toshiba	BOU	Philips
		E0Z	Shintom
		C5F	Daewoo

Figure 1. Every VCR, personal computer, cordless telephone and microwave oven must carry an FCC ID number. The first three characters of that ID uniquely identify the manufacturer of the product. This is a listing of manufacturer vs FCC ID number prefix, alphanumerically by code.

DOS 2.1 or higher.

The ISCET VCR Model Number and Parts Cross Reference on paper or disk may be ordered from ISCET, 2708 W. Berry Street, Ft. Worth, TX 76109; 817-921-9101. If you order, be sure to include $3.00 for postage and handling.

This two-part reference will help any servicing organization that services VCRs to cross reference among different brands made by the same manufacturer. Part 1 of this reference will allow the user to determine when he has a product in for servicing, if it's possible that it's identical, or almost, to a product for which he already

FCC ID numbers		Motorola	ABY
Manufacturer	**First 3 Characters of FCC ID**	NEC	A3D
		Orion	A7R
Advent Corporation	ATP	Philips	BOU
Akai	ASH	Phone Mate	AAL
AOC Int'l of America Inc	ARR	Phonotronics	ACB
Capetronic Int'l Corporation	ANV	Radio Shack	AAO
Carterfone	ADF	RCA	AHA
Curtis Mathes	AFR	Samsung	A3L
Fisher	AFA	Sanyo	AEZ
Funai	ADT	Sharp	AFL
GE	AJU	Sharp	ATA
Goldstar	BEJ	Shintom	E0Z
Harman Kardon Inc	API	Sony	AK8
Hitachi	ABL	Superscope Inc	AKC
JC Penney	ABW	Sylvania	AIX
Kenwood USA Corporation	ALI	Toshiba	AGI
Litton Microwave Cooking Products	AIH	Uniden	AES
Marantz Co Inc	AKE	Victor Company of Japan	ASI
Matsushita	ACJ	Wells Gardner Electronics Corporation	ALA
Midland International Corporation	AAY	Yorx Electronics	ACA
Mitsubishi	BGB	Zenith Electronics Corporation	ATO
Montgomery Ward	AGV		

Figure 2. To make it easier for readers who may be interested in locating the FCC ID prefix of a particular manufacturer, here is the same information presented in Figure 1, alphabetically by manufacturer name.

UL listing number to VCR manufacturer (Unofficial)

UL Number	Manufacturer	Brand Names
146C	Goldstar	
153L	NEC	
16M4	Samsung	Supra, Multitech, Unitech, Tote Vision, Cybrex, GE, RCA Sears
174Y	Toshiba	Sears
238Z	Hitachi	RCA, GE, Penny, Pentax
270C	Sony	
277C	JVC	
282B	Sharp	
289X	Emerson	
333Z	Symphonic	Teac, KTO, Realistic, Multitech, Funai, Porta Video, Dynatech, TMK
336H	RCA	
347H	NAP	
43K3	Kawasho	
403Y	Fisher/Sanyo	Realistic, Sears
436L	Quasar	
439F	JVC	Zenith, Kenwood, Sansui
444H	Zenith	
44L6	TMK	Emerson, Lloyds, Broksonic
504F	Sharp	Wards, KMC
51K8	Portavideo	
536Y	Mitsubishi	Emerson, Video Concepts, MGA
540B	GE	
570F	Sony	Zenith
623J	Sampo	
628E	Samsung	MTC, ToteVision
679F	Panasonic	RCA, GE, Magnavox, Quasar, Canon Philco
723L	Sanyo	
727H	Hitachi	
74K6	Funai	
781Y	NEC	Dumont, Video Concepts, Vector, Sears
828B	Panasonic	Olympus
843T	Magnavox	
86B0	Goldstar	Realistic, JC Penny, Tote Vision, Shinton, Sears, Memorex
873G	Mitsubishi	
41K4	Portland	

Figure 3. The UL listing number on a consumer electronics product identifies the manufacturer who made it. Here's a partial listing of UL numbers vs manufacturer.

has a service manual. Part 2 of the reference cross references parts, so that if you can't find a part number for a product you are servicing, you may find that you have it on hand under a different part number for another manufacturer's product.

Identifying a manufacturer from the FCC ID number

Almost all consumer-electronics products, at least any that have to be plugged in to the power outlet or that might generate electromagnetic interference, carry clues as to who the manufacturer is. One of these numbers appears on every VCR and computer, and any other product that might generate electromagnetic interference. It's the FCC identification number. Armed with this number, a technician may call or write the FCC:

Federal Communications Commission
1919 M Street, NW
Washington, D.C. 20463

Just give the ID number and ask for the name and address of the manufacturer. A partial cross-reference list of manufacturer name vs FCC ID numbers is provided in Figure 1. Figure 2 is the same information in alphabetical order by manufacturer name.

Identification using the UL manufacturer's code number

Another source of manufacturer identification information is the Underwriters Laboratories code number. The manufacturer of every product that is submitted to UL for certification is assigned a unique code number that identifies the manufacturer. Figure 3 is a partial list of UL numbers and the manufacturers they represent.

Locating the manufacturers

It's not unusual for a servicing organization to have some difficulty finding the address and telephone number of a manufacturer from whom to order parts, even when the manufacturer is well known. Accompanying this article is a listing of manufacturers, gleaned from the Consumer Electronics Replacement Parts

Sourcebook, the NESDA Professional Electronics Yearbook, ES&T reader correspondence, many telephone calls by the ES&T staff, and other sources.

Information sources close to home

Those of you who are located in a city that has a good library system have a ready source of information available free. For example, the ES&T staff regularly call the local library for information. References that they have available include the Thomas Catalog, a brand-name reference book, and others. And they're always pleased to receive a call for this kind of information. It's what they're there for. Try giving the reference librarian in your local library a call next time you have a question about who makes what brand of TV or VCR, or similar questions.

Replacement parts source

Acoustic Research (AR)
330 Turnpike Street
Canton, MA 02021
617-821-2300
Fax: 617-784-4102

Adcom Service Corporation
11 Elkins Road
East Brunswick, NJ 08816
908-390-1130
Fax: 908-390-9152

AIWA America Inc.
800 Corporate Drive
Mahwah, NJ 07430
201-512-3600
Fax: 201-512-3705

Akai American, Ltd. - See Mitsubishi

Alpine Electronics of America, Inc.
PO Box 2859
Torrance, CA 90509
310-326-8000
800-421-2284
Fax: 310-533-0369

Altec Lansing Consumer Products
Routes 6 and 209
Milford, PA 18337
717-296-4434
800-258-3288 (ext PA)
Fax: 717-296-2213

AmPro Corporation
(Replacement parts for Kloss Novabeam and Videobeam)
5 Wheeling Ave.
Woburn, MA 01801
Sales: 617-932-4800
Fax: 617-932-8756

AOC International
311 Sinclair Frontage Rd.
Milpitas, CA 95035
408-956-1070
Fax: 408-956-1516

Apple Computer
20525 Mariani Ave.
Cupertino, CA 95014
408-996-1010
Fax: 408-996-0275

Aristo Computers Inc.
6700 SW 105th Ave., Suite 307
Beaverton, OR 97005
503-626-6333
800-3ARISTO

Atari Corp.
PO Box 3427
Sunnyvale, CA 94088-3427
Parts: 408-745-5501
Tech: 408-745-2466
Warr: 408-745-2367

Audio Technica U.S., Inc.
1221 Commerce Drive
Stow, OH 44224
216-686-2600
Fax: 216-688-3752

Audio Video Technologies Inc.
60 E. Ida
Antioch, IL 60002
708-395-6321

Audiovox Corp.
150 Marcus Drive
Hauppauge, NY 11788
516-231-7750
Fax: 516-434-3995

Barcus-Berry, Inc
5381 Production Drive
Huntington Beach, CA 92649
714-898-9211
800-854-6481

Blaupunkt
PO Box 4601
Carol Stream, IL 60197-4601
708-865-5200
Fax: 708-865-5209

BSR
C/O Warranty Central
8130 Remmett Ave.
Canoga Park, CA 91304
213-689-9188

Canon USA, Inc.
Service Division
One Canon Plaza
Lake Success, NY 11042
516-488-6700
Parts Center
100 Jamesburg Road
PO Box 1000
Jamesburg, NJ 08831
908-521-7000

Canton North America, Inc.
915 Washington Avenue South
Minneapolis, MN 55415-1245
612-333-1150
Fax: 612-338-8129

Capetronics USA Inc.
150 East 58th St., 29th Floor
New York, NY 10155-2998
212-832-1331

Casio Inc.
570 Mt. Pleasant Ave.
Dover, NJ 07801
201-361-5400
Fax: 201-361-3819

Channel Master
Industrial Park Drive
Smithfield, NC 27577
919-934-9711
Fax: 919-989-6951

Chinon America, Inc.
615 Hawaii Ave.
Torrance, CA 90503
310-533-0274
Fax: 310-533-0274

CIE American, Inc.
2515 McCabe Way
PO Box 19663
Irvine, CA 93713
714-833-8445
Fax: 714-757-4488

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* Student must have access to a personal computer system.

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Address: _____

Apt: _____

City: _____

State: _____ Zip: _____

Phone: (_____) _____

Age: _____

Return to: WAS004
World College
Lake Shores Plaza
5193 Shore Drive, Suite 113
Virginia Beach, VA 23455-2500

Citizen American Corp.
Subsidiary of Citizen Watch Co.
2450 Broadway, Suite 600
Santa Monica, CA 90411
310-453-0614
Fax: 310-453-2814

Clarion Corp. of America
661 W. Redondo Beach Blvd.
Gardena, CA 90247-4201
310-327-9100
800-821-6693
Fax: 310-327-1999

Columbia Data Products
851 W. Hwy 436, Suite 1061
Altamonte Springs, FL 32714
407-869-6700

Commodore International Ltd.
1200 Wilson Drive
West Chester, PA 19380
215-431-9100
Fax: 215-431-9465

COMPAQ Computer Corp.
20555 SH 249
Houston, TX 77070
713-370-0670
Fax: 713-374-1740

Connecticut Microcomputer
568 Danbury Road
New Milford, CT 06776
203-354-9395
Fax: 203-355-8258
800-426-2872

Craig Consumer Electronics
12845 Artesia Blvd.
Cerritos, CA 90701-5001
310-926-9944
Fax: 310-926-9269

Curtis Mathes Corp.
1 Curtis Mathes Pkwy
PO Box 2160
Athens, TX 75751
903-675-2292
Fax: 903-675-2843

Daewoo Electronics Corp. of America
100 Daewoo Place
Carlstadt, NJ 07072
201-935-8700
Fax: 201-935-6491

Dell Computer Corp.
9505 Arboretum Blvd.
Austin, TX 78759
Sales, Parts and Warranties:
800-426-5150
Service: 800-624-9896

Denon America, Inc.
222 New Road
Parsippany, NJ 07054
201-882-7490
Fax: 201-575-2532

Design Acoustics
An Audio-Technica Company
1225 Commerce Drive
Stow, OH 44224
216-686-2600
Fax: 216-688-3752

Eastman Kodak
343 State St.
Rochester, NY 14650
716-724-4000

Electronic Systems Products, Inc.
1301 Armstrong Drive
Titusville, FL 32780-7999
407-269-6680
Fax: 407-267-6211

Emerson Radio Corp.
One Emerson Lane
North Bergen, NJ 07047
~~201-854-6600~~
1-800-388-8333

Epson America, Inc.
20770 Madrona Ave.
Torrance, CA 90509-2842
310-782-0770
Fax: 310-782-5220

Fujitsu Ten Corp. of America
National Service Headquarters
19600 South Vermont St.
Torrance, CA 90502
800-423-8161

Funai USA Corporation
(Also Symphonic)
100 North Street
Teterboro, NJ 07608
201-288-2666
Fax: 201-288-0239

GE Appliances/Microwave Products Dept.
Appliance Park
Bldg. 41, Rm. 106
Louisville, KY 40225
502-452-3568

Gemini, Inc.
103 Mensing Way
Cannon Falls, MN 55009
507-263-3957

GoldStar Electronics Int'l, Inc.
201 James Record Rd.
Huntsville, AL 35824-0166
205-772-8860
Fax: 205-772-8987

Grundig/Lextronix Inc.
3520 Haven Ave., Unit L
Redwood City, CA 94063
415-361-1611
Fax: 415-361-1724

Harmon Kardon, Inc. - JBL
240 Crossways Park West
Woodbury, NY 11797
516-496-3400

Heath Company/
Heath-Zenith Consumer Products Group
PO Box 1288
455 Riverview Dr.
Benton Harbor, MI 49022
616-925-6000
Fax: 616-925-2898

Hewlett-Packard
3000 Hanover St.
Palo Alto, CA 94304
415-694-2000

Hitachi Home Electronics (America), Inc.
675 Old Peachtree Rd.
Suwanee, GA 30174
404-279-5600
Fax: 404-279-5692
Parts Center
401 West Artesia Blvd.
Compton, CA 90220
310-537-8383

INTV Corp.
3541 B Lomita Blvd.
Torrance, CA 90505
310-539-1940

International Jensen Inc.
25 Tri-State Int'l Ofc. Ctr., Ste 400
Lincolnshire, IL 60069
800-323-0221
Fax: 708-317-3826

JVC Service & Engineering Co. of America
Division of U.S. JVC Corp.
107 Little Falls Rd.
Fairfield, NJ 07004-2105
201-808-2100

Kawasho International
(Kawasho is no longer importing TV sets into the U.S., but some parts and service information is available from:)
Factory Service
PO Box 747
Buffalo, NY 14240
716-856-1612

Kawasho flybacks are also available from:
Electro Dynamics (General line distributor)
135 Eileen Way
Syosset, NY 11791
800-426-6423

Kaypro Corporation
4174 Sorrento Valley Blvd.
San Diego, CA 92121-1407
619-535-2155
Fax: 619-535-2170

Kenwood U.S.A., Corp.
PO Box 22745
Long Beach, Ca 90810-5745
310-639-9000
Fax: 310-609-2127

Kloss Video Corp.
See Ampro Corp.

KTV Inc.
205 Moonachie Road
Moonachie, NJ 07074
201-440-9090
Fax: 201-440-6557

Kyocera Electronics, Inc.
100 Randolph Rd.
Somerset, NJ 08875
908-560-0060

Lloyd's Electronics, Inc.
National Parts
6500 West Cortland St.
Chicago, IL 60635
312-889-8870
Fax: 312-889-6797

Luxman
Division of Alpine
19145 Gramercy Place
PO Box 2859
Torrance, CA 90509
310-326-8000
For non-account customers
Pacific Coast Parts Distributor
15024 Staff Court
Gardena, CA 90248
310-515-0207
Fax: 800-782-5747

Marantz USA
A Division of Bang & Olufsen of America, Inc.
1150 Feehanville Dr.
Mount Prospect, IL 60056
708-299-4000
Fax: 708-299-4004

Matsushita Services Co.
50 Meadowland Parkway
Secaucus, NJ 07094
201-348-7000 Manuals 206-395-7343
Fax: 201-348-7527

Mattel, Inc.
See INTV

Micro Palm Computers
13773-500 ICOT Blvd.
Clearwater, FL 34620
813-530-0128
Fax: 813-530-0738

Midland International Corporation
1690 North Topping
Kansas City, MO 64120
816-241-8500
800-MIDLAND

Mitsubishi Electronics America, Inc.
National Service Department
5757 Plaza Drive
PO Box 6007
Cypress, CA 90630-0007
714-220-2500

NAD (USA) Inc.
633 Granite Court
Pickering, Ontario
Canada L1W 3K1
416-831-6333
Fax: 416-831-6936
800-263-4641

NEC Technologies Inc.
Consumer Electronics and Computer Products Divisions
1255 Michael Drive
Wood Dale, IL 60191-1094
708-860-9500
Fax: 800-356-2415

Nikko
AVS Technologies
2100 Trans-Canada Highway South
Montreal, Quebec
Canada H9P-2N4
514-683-1771
Fax: 514-683-5307

Okidata
532 Fellowship Road
Mount Laurel, NJ 08054
609-235-2600
800-OKIDATA

Onkyo U.S.A. Corp.
200 Williams Drive
Ramsey, NJ 07446
201-825-7950
Fax: 201-934-1845

Ortofon, Inc.
65 East Bethpage Rd.
Plainview, NY 11803
516-454-6570
Fax: 516-454-6515

Penney, J.C.
National Parts Center
6840 Barton Road
Morrow, GA 30260
404-961-8408
800-933-7115

Philips Consumer Electronics Company
Philips Service Company
PO Box 555
401 Old Andrew Johnson Highway
Jefferson City, TN 37760
615-475-8869
Replacement Parts/Service Literature
800-851-8885
Fax: 800-535-3715

Pioneer Electronics Service, Inc.
1925 East Dominguez St.
PO Box 1760
Long Beach, CA 90801
~~310~~-746-6337 800
Fax: 310-816-0412
Tech 1-708-285-4550
2) Literature
3) Service
4) Parts

Proton
Proton Parts Department
5630 Cerritos Ave.
Cypress, CA 90630
714-952-6900
Fax: 714-952-4600

Radio Shack
Business Products Support Services
1600 One Tandy Center
Fort Worth, TX 76102
817-390-3011
Radio Shack Business Products Parts
812 E. Northside Dr.
Fort Worth, TX 76102
817-870-5695

Ricoh Corp.
3001 Orchard Pkwy.
San Jose, CA 95134
408-432-8800

Rotel of America
290 Larkin Street
Buffalo, NY 14220-8089
800-543-0471

Sampo Corporation of America
5550 Peachtree Industrial Blvd.
Norcross, GA 30071
404-449-6220
Fax: 404-447-1109

Samsung Electronics America, Inc.
Service Division
One Samsung Place
Ledgewood, NJ 07852
201-691-6200
Fax: 201-347-8650

Sansui Electronics Corp.
Parts Department
17150 South Margay Avenue
PO Box 4687
Carson, CA 90746
310-604-7300

Sanyo-Fisher (USA) Corp.
Consumer Electronics Sales Div.
21350 Lassen St.
Chatsworth, CA 91311
818-998-7322
For Service: SFS Corporation
1200 West Artesia Blvd.
Compton, CA 90220
310-537-5830 Ext. 712
Fax: 310-605-6699

Scott, H.H. Inc.
5601 Westside Ave.
North Bergen, NJ 07047
201-662-2000
Parts/Technical Literature:
H.H. Scott, Inc.
State Route 41 & County Rd. 100W
Princeton, IN 47670
800-695-0095
Fax: 812-386-6502
Tech. Serv.: 800-922-0738

Sears
Sears Tower
Chicago, IL 60684
~~312-875-5222~~
1-800-366-7278 Parts

Sharp Electronics Corp.
Sharp Plaza
PO Box 650
Mahwah, NJ 07430-2135
201-512-0055
Fax: 201-512-3456

Sherwood/Inkel Corporation
14830 Alondra Blvd.
La Mirada, CA 90638-5730
714-521-6100

Shintom West Corp. of America
20435 S. Western Ave.
Torrance, CA 90501
213-328-7200

Shure Brothers, Inc.
222 Hartrey Avenue
Evanston, IL 60202-3696
Service: 708-866-5732
Customer Service: 708-866-2553
Fax: 708-866-2279

Signet
4701 Hudson Drive
Stow, OH 44224
216-688-9400

Sony Corp. of America/
Sony Service Company NO TECH SERVICE
Sony Drive (T1-12)
Park Ridge, NJ 07656
201-930-1000

Sony National Parts Center
8281 N.W. 107th Terrace
PO Box 20407
Kansas City, MO 64153
816-891-7550

Soundcraftsmen, Inc.
2200 S. Ritchey St.
Santa Ana, CA 92705
714-556-6191
Fax: 714-662-0750

SDI Technologies
(Formerly Soundesign Corporation)
800 Federal Blvd.
Carteret, NJ 07008
908-855-0220
Fax: 908-855-0224

Sparkomatic Corporation
Routes 6 & 209
Milford, PA 18337
717-296-6444
800-233-8831 (Nationwide)
800-592-8891 (In PA)

Studer Revox America, Inc.
1425 Elm Hill Pike
Nashville, TN 37210
615-254-5651
Fax: 615-256-7619

Symphonic Corp.
(Also Funai)
100 North St.
Teterboro, NJ 07608
201-288-2606

Tandy Consumer Service Parts
7439 Airport Freeway
Ft. Worth, TX 76118
817-284-8691
800-243-1311
Fax: 817-284-1961

Tandy National Parts
900 East Northside Dr.
Ft. Worth, TX 76102
817-870-5600
800-442-2425

Tatung Company of America, Inc.
2850 El Presidio St.
Long Beach, CA 90810
310-637-2105
310-979-7055
Fax: 310-637-8484

TEAC Corporation of America
7733 Telegraph Rd.
Montebello, CA 90640
213-726-0303
Fax: 213-727-7656
Parts Orders: 213-726-0303
Fax for Parts Orders: 800-366-8868

Technics
See Matsushita

Teknika Electronics Corp.
A subsidiary of Fujitsu, Ltd.
Parts Department
353 Route 46 West
Fairfield, NJ 07004
201-575-0380
Fax: 201-575-7311

Teledyne
See Acoustic Research

Thomson Consumer Electronics
600 N. Sherman Drive
Indianapolis, IN 46201
317-267-5000

Thomson Consumer Electronics
Distributor and Special Products Division
2000 Clements Bridge Rd.
Deptford, NJ 08096
609-853-2241
For Servicing Literature:
TCE Publications
10003 Bunsen Way
Louisville, KY 40299
502-491-8110 Manuals

Toshiba America Consumer Products Inc.
National Parts Center
1420 Toshiba Dr.
Lebanon, TN 37087
615-449-2360
Fax: 615-444-7520
800-345-9785

Tote Vision
969 Thomas St.
Seattle, WA 98109
206-623-6000
Fax: 206-623-6609
Parts Fax: 206-343-9029

Unisonic Products Corp.
16 West 25th Street
New York, NY 10010
212-255-5400

Videonics
1370 Dell Ave.
Campbell, CA 95008
408-866-8300

V-M Corporation
The Voice of Music
305 Territorial
PO Box 426
Benton Harbor, MI 49023
616-925-8841

Wells-Gardner Electronics Corp.
2701 North Kildare Avenue
Chicago, IL 60639
312-252-8220

Yamaha Electronics Corp. USA
Parts Department
6660 Orangethorpe Ave.
Buena Park, CA 90620
714-522-9105
Fax Orders: 800-634-0355

Yorx Electronics Corp
405 Minnisink Rd.
Totowa, NJ 07512
201-256-0500

Zenith Data Systems
2150 East Lake Cook Road
Buffalo Grove, IL 60089
708-808-4584

Zenith Electronics Corp./Videotech Corp.
1900 North Austin Ave.
Chicago, IL 69639
312-745-2000
Service: 312-745-5151

X RCA Tech line
913-541-0402

Sources of replacement parts

By Victor Meeldijk

The problem of obsolete parts is growing as the rapid pace of technology development obsoletes even the most advanced products. The new product innovation cycle is only 3 to 4 years. The life cycle of parts for commercial products is about five to six years (down from a 10 year availability).

Contrast this to military system service life which is 20 minimum, about 30 years in the early 1990's and possibly stretching to 40 or 50 years because of defense budget reductions. Some of the reasons that components become obsolete are:

- The technology used to produce the part is obsolete (a new technology is used to produce most of the product line).
- The devices are only selling in low volume (thus the fabrication facility could be better utilized to produce a part that is more profitable for the company. If the commercial version of the part is no longer available, long term support of the military part is questionable.).
- To transfer from one wafer fabrication process to another is too costly.
- There are technical incompatibilities in transferring the process to other wafer fabrication lines.
- Corporate mergers cause product lines to be consolidated and redundant fabrication facilities are closed. (Equipment upgrades, and common testers for components may also cause components to become obsolete if it is considered too costly to manufacture the device with the new equipment, or to write test software for the new test systems).

Usually, if a part is going to be discontinued, manufacturers provide a 6 to 12 month time frame for final orders.

According to the Department of Defense in 1991, there were 40,000 IC designs that were vulnerable to obsolescence by 1997, with 19,600 parts sole sourced. In 1991, there were 10,496 parts discontinued, of which almost 6,000 were IC's and over 1,000 were discrete.

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

The military spends about $23 million dollars each year (per 1991 data) dealing with obsolete parts with more than 37% of the microcircuits used in key defense programs, currently in production, expected to experience sourcing problems in 2 to 3 years. In a military system the cost to redesign in a substitute component is estimated between $150,000 and $200,000.

Finding obsolescent parts

If you have to replace a part, or locate a source of supply for an existing device, there are organizations that track component availability, and issue notices of parts that are being discontinued. Various military and commercial organizations track component availability and help to locate obsolete components.

Some sources of obsolete parts are listed below. Aftermarket manufacturers plan for support of obsolete product for at least 10 years after the device is discontinued by the original manufacturer.

This information was current as of the date of writing of this article. Changes may have occurred since that time.

Organizations that track part obsolescense

The Navy manages a Microcircuit Obsolescence Management Program (MOM) that identifies devices (by types and package styles) that are being discontinued by integrated circuit manufacturers, and provides alternate sources of the devices where possible.

Naval Air Warfare Center
Aircraft Division- Indianapolis
6000 East 21st St.
Indianapolis, IN 46219-2189,
317-353-3768, or AV 369-3768
(remote computer bulletin board 317-351-4991, or DSN 369-4991).

Component Obsolescence notices are also distributed by GIDEP (the Government and Industry Data Exchange Program), through their DMSMS (Diminishing Manufacturing Sources and Material Shortages) Notices. Information on the GIDEP program is available from the following:

GIDEP Operations Center
PO Box 8000
Corona, CA 91718-8000

Obsolete parts, and new sources for components, are also tracked by the magazine Electronic Buyers' News (in the "Last Runs" column):

Electronic Buyers' News
CMP Publications, Inc.
600 Community Drive
Manhasset, NY 11030-3875
Subscriptions (address changes):
Electronic Buyers' News
PO Box 2020
Manhasset, N.Y. 11030-3875

Another organization that tracks obsolete parts is:

TacTech

Transition Analysis of Component Technology
22700 Savi Ranch Parkway
Yorba Linda, CA 92686
714-974-7676
Fax: 714-921-2715
This company offers the Defense/Aerospace industry an electronic military microcircuit information service.

Sources of obsolete components

This is a list of companies that manufacture devices discontinued by the original manufacturer:

Advanced Microelectronics
Center for Military Replacement Parts
Division of ITD (Institute for Technology Development)
1080 River Oaks Drive
Suite A-250
Jackson, MS 39208-8824
Mailing Address:
PO Box 55729
Jackson, MS 39296-5729
601-932-7620
Fax: 601-932-7621

An operating unit of the Institute for Technology Development (ITD), a private non-profit organization. The Center has engineering and manufacturing resources to replace, substitute, redesign or emulate a true form, fit and function replacement for integrated circuits, or circuit card assemblies.

American Power Devices
7 Andover Street
Andover, MA 01810
and:
69 Benett Street
Lynn, MA 01905
508-475-4074
Fax: 508-475-8997

This manufacturer, in business for over 24 years, produces industrial and military semiconductor devices. Included in their product line are stabistors and multichip devices that are direct replacementments for discontinued General Electric, Unitrode MPD series and Motorola MZ 2360 and 2361 series.

Calogic Corporation
237 Whitney Place
Freemont, CA 95439
510-656-2900
Fax: 510-651-1076, 3025

This company, which has been offering IC foundry service to various manufacturers for over eight years, has for the last two years been purchasing some obsolete lines from different manufacturers. They manufacture some of the parts discontinued by Topaz, Intersil and Siliconix.

General Transistor Corporation
216 W. Florence Ave.
Inglewood, CA 90301
310-673-8422
Fax: 310-672-2905

This company manufactures transistors discontinued by such manufacturers as RCA and Motorola, as well as second sourcing other available devices.

ISI- Ideal Semiconductor Inc.
46721 Freemont Blvd.
Fremont, CA 94538
510-226-7000
Fax 510-226-1564

This company, established in 1987, manufactures obsolete parts using wafers or tooling supplied by the original manufacturer. Devices can also be reversed engineered and emulated using standard cell devices. Microcircuits and semiconductors from a variety of original manufacturers, including AMD, Harris, National Semiconductor, IDT, Signetics, Quality, Samsung and Zytrex can be supplied.

ITAC Hybrid Technology
Division ITAC Systems Inc.
3121 Benton Street
Garland, TX 75042
214-494-3073
800-533-4822

This company manufactures high temperature (200C) operational amplifiers that can replace similar products discontinued by Burr-Brown Corporation.

Lansdale Semiconductor
2929 S. 48th St., Suite 2
Tempe, AZ 85282
602-438-0123
Fax: 602-438-0138

This company, which has been in business over 27 years, manufactures older technology products such as RTL, DTL, TTL and memory devices. Their product line includes devices formerly manufactured at the Signetics company closed bipolar wafer fabrication line in Orem, Utah.

Micrel Inc.
560 Oakmead Parkway
Sunnyvale, CA 94086
408-245-2500
Fax: 408-245-4175

This company has been processing wafers for mature and obsolete MOS technologies since 1978. The available devices include many CMOS and Metal Gate devices formerly manufactured by RCA and National Semiconductor.

R&E International, Inc.
210 Goddard Blvd., Suite 100
King of Prussia, PA 19406
800-253-7007
215-992-0727
Fax: 215-992-0734

This company, founded in 1987, manufactures, and has stock of, the CMOS SCL4000 series parts formerly manufactured by Solid State Scientific (S Cubed) and Sprague Semiconductor (now Allegro Microsystems, Inc.).

Rochester Electronics, Inc.
10 Malcolm Hoyt Drive
Newburyport MA 01950-4018
508-462-9332
Fax: 508-462-9512

Discontinued and custom packaged military and commercial semiconductors. This vendor, which has been in business over 9 years, has the facilities to custom package semiconductor dies and also manufactures discontinued parts from die masters. This aftermarket manufacturer is the authorized distributor for obsolete products from various original manufacturers including Texas Instruments and National Semiconductor.

Scorpion Semiconductor
2360 Qume Drive, Ste B
San Jose, CA 95131
408-944-6270, 6271
Fax: 408-944-6272

This company produces the full line of P-Channel Silicon gate MOS technology products formerly supplied by AMD (Advanced Micro Devices). They offer products and design services in N-Channel and CMOS process technology.

Solid State Electronics Corporation
18646 Parthenia Street
Northridge, CA 91324
818-993-8257 (voice and fax)

This company sources electromechanical choppers, used in precision dc amplifiers, voltmeters and servo motors. Devices available include stock from companies that have discontinued the parts (i.e., Airpax, Bristol, Stevens Arnold, Brown Converters, etc.) or are manufactured by companies under private labeling agreements.

Computer Science Laboratory
SRI International
333 Ravenswood Ave.
Menlo Park, CA 94025
415-859-3285
Fax: 415-859-2844

This company has a system called "GEM" or Generalized Emulation Microcircuits. This system, currently in the validation phase of the program, is a result of an R&D initiative by the Defense Logistics Agency and the Defense Electronics Supply Center with the guidance and support from the Weapons System Improvement Group within the Office of the Secretary of Defense.

The GEM system has the capability to produce IC devices that are form, fit and function equivalent to original devices at a quality level that satisfies testing in accordance with MIL-STD- 883C.

GEM is a flexible integrated manufacturing system capable of producing tested IC's within ten weeks from order and provides a source for otherwise non-available replacement IC's.

Sunset Silicon Products
Head Office:
38 Montvale Avenue
Stoneham, MA 02180
617-729-4439
Sales Office:
402A Ridgefield Circle
Clinton, MA 01510
508-365-6108
This company recreates the obsolete part functionally using either the original design process or by new design tools such as gate arrays (the parts are thus either emulated or recreated).

Companies that stock or locate obsolete material

In mid 1992, a new directory was published by Bruxer Publishing, Inc. and distributor CNC/Stamas Inc. of Medford, MA called the Component Exchange Directory. Excess and overstocked inventory from distributors and directory subscribers are listed in this book, making it useful not only for distributors, which the directory is geared towards, but also for purchasers needing hard to find material.

For further information contact Bruxner Publishing at 1-800-786- 9590.

A data base service where suppliers list their inventories (electrical, electronic, and mechanical) and capabilities is provided by ILS-Inventory Locator Service, Inc., a Ryder System Company, 3965 Mendenhall Road, Memphis TN 38115, 901- 794-4784, 800-233-3414, Fax: 901-794-1760. Suppliers worldwide list their inventories with this independent organization, including the quantity and condition (new, used or overhauled) of the part. There is also a listing by part number of companies that overhaul parts/equipment.

Some of the vendors listed may be able to help in providing Japanese parts that the U.S. divisions do not support, nor supply in this country.

A.C.P., Inc.
1310 East Edinger
Santa Ana, CA 92705
714-558-8822
800-347-3423
This company can supply current and hard to find/obsolete material (including IC's, semiconductors, capacitors, crystals, and diodes).

Act Electronics
Parts Department
2345 E. Anaheim Street
Long Beach, CA 90804
214-433-0475
Service manuals and repair parts for Grundig stereo equipment.

All Electronics Corp.
PO Box 567
Van Nuys, CA 91408
800-826-5432
818-904-0524
Fax:818-781-2653
Various surplus parts, including obsolete items.

America II Electronics
(Also known as A-1 Electronics)
13191 56th Court N. 107
Clearwater FL
800-736-4397
813-572-9933
Fax: 813-572-9944
Established in 1989, this company has an inventory of over 10 million IC's and concentrates on second source inventories and obsolete parts. They do deal with all types of parts, electrical, electromechanical, etc.

American Design IC Components
400 County Avenue
Secaucus, NJ 07094
201-601-8999
Fax: 201-601-8991
This company has a stock of many discontinued parts.

American Microsemiconductor, Inc.
133 Kings Rd.
Madison, NJ 07940
201-377-9566
Fax: 201-377-3078
Specializes in obsolete and hard to find Japanese and US parts. Has a network of suppliers to help in locating material.

Audio Parts Company
1070 South Orange Drive
Los Angeles, CA 90019
800-999-5559
213-933-8141
This specialty parts distributor has replacement parts for some items no longer available in the U.S. including Bohsei (TV sets), Garrard (turntables) and Wollensak (tape recorders).

Bally Micro
19 Hammond
Irvine, CA 92718
800-229-7690
714-581-7693
Fax: 714-581-7693
This worldwide distributor specializes in locating obsolete parts, and keeps a large inventory in stock, including parts from American (from Analog Devices to Zilog), Japanese and Korean suppliers (such as Fujitsu, Goldstar, Hitachi, Mitsubishi, Samsung and Toshiba).

Commodity Components Int'l.
75 Newburyport Turnpike
Ipswich, MA 01938
508-356-0020
Fax: 508-356-3633
This company, with its SEMI Search network can locate sources of discontinued or hard to find IC's and semiconductors all over the world.

Dataronics
237350 Blueberry Hill 12
Conroe, TX 77385
713-367-0562
Fax: 713-292-4914
This liquidator has a large quantity of parts, circuit boards and peripherals and can locate anything from microcircuits to platen knobs.

Defense Electronic Supply Center (DESC)
Attn: DESC-EAA
1507 Wilmington Pike
Dayton, Ohio 45444-5272
DESC stockpiles discontinued military (JAN S) parts for resale to original equipment manufacturers (OEM's) that have government contracts with NASA or the Air Force space division.

DERF Electronics Corporation
1 Biehn St.
New Rochelle, NY 10801
914-235-4600
Fax: 914-235-2138
In business since 1946, this company buys surplus material and may have obsolete parts in their inventory.

Dodd Electronics
PO Box 112
New York, NY
914-739-5700
Fax: 914-739-5854
Stocking distributor of obsolete and discontinued integrated circuits.

EDLIE Electronics
2700 Hemstead Turnpike
Levittown, NY 11756-1443
516-735-3330
800-645-4722
Various surplus parts including tubes and IC's.

Electronic Expediters, Inc.
14828 Calvert Street
Van Nuys, CA 91411
818-781-1910
Fax: 818-782-2488
This company has supplies of hard to find and obsolete parts.

Electronic Salvage Parts
2706 Middle Country Road
Centereach, NY 11720
Various surplus parts.

Electrospec
24 East Clinton Street
Dover, NJ 07801
201-361-6300
Fax: 201-361-7868
This company locates obsolete or hard to find wire, cable, tubing and electrical connectors.

General Components
927 Calle Negocio
San Clemente, CA 92672
800-944-3463
714-361-8800
Fax: 714-361-0062
In business since 1983, this company has a computerized parts search system (GEN-COM) that includes surplus inventory from OEM's worldwide, as well as distributor material.

H&R Enterprises
21521 Blythe Street
Canoga Park, CA 91307
818-703-8892
This company specializes in hard to find/obsolete IC's, transistors and diodes, both military and commercial parts.

HLK & Associates, Inc.
1305 SOM Center Road
Cleveland, OH 44124
800-222-3855
216-442-1444
Fax: 216-442-1412
This company specializes in finding hard to find or discontinued military and commercial parts.

Innovative Technology
Mailing Address:
1840 41st Ave.
Suite 102-280
Capitola, CA 95010
408-462-6547
Fax: 408-479-4818
This company buys excess OEM inventory and sells and locates hard to find parts such as DRAMS, SRAMS, TTL, Linear and Analog IC's and capacitors.

Institute for Technology Development
Advanced Microelectronics Division
Center for Military Replacement Parts
1 Research Blvd.
Starkville, MS 39759
601-325-2240
Fax: 601-325-8144
This organization assists military services and suppliers in finding obsolete and hard to find parts.

I.T.I. - Imminent Technologies, Inc.
22529 39th Ave. Southeast
Bothell, WA 98021
619-384-5001
Fax: 619-384-5003
This distributor specializes in locating hard to find parts including semiconductors, IC's and passive devices. They have been in business since 1990.

Jacques Ebert Associates, Inc.
44 School St.
Glen Cove, NY 11542
800-645-2666
516-671-6123
This company stocks and locates hard to find capacitors.

Jameco Electronics
1355 Shoreway Rd.
Belmont, CA 94002
415-592-8097
Fax: 415-592-2503
415-595-2664
May have some obsolete or hard to find parts in inventory, but occasionally has a flyer sale and disposes of the old material at reduced prices.

JPE-Jarrah Pacific Electronics
145 Willow St.
Bonita, CA 91902
800-326-5139
619-475-8430
Fax: 619-475-8438
This company specializes in hard to find semiconductors and IC's. They often sell to distributors and have sources in Southeast Asia and Europe and have a sister company in Australia.

JTM
2345 Collier Ct.
Simi Valley, CA 93065
805-527-9228
Fax:805-527-2710
Specializes in current, obsolete and hard to find devices from Western Digital, Faraday (Division of Western Digital), Chips and Technology, VLSI, Brooktree, and Paradise.

LJ Enterprises
2377 Yorktown St.
Oceanside, NY 11572
516-766-2304
Fax: 516-766-2348
With over 9 years of experience in the aerospace import and export fields, this company specializes in current and obsolete Japanese semiconductors, and passive components (for audio and video equipment). Besides their own inventory they have access to overseas components inventories.

Micro-C Corporation
11085 Sorrento Valley Ct.
San Diego, CA 92121
619-552-1213
Fax: 619-552-1219
Parts may be "Reconditioned" or pulled off of circuit assemblies.

Mission
7 Bendix
Irvine, CA 92718
714-859-1300
Fax: 714-859-4700
This company specializes in finding memory IC's including DRAM's, SRAM's and TTL and CPU modules.

Monarchy
380 Swift Ave.
Unit 21
South San Francisco, CA 94080
415-873-3055
800-922-7755
This company specialized in finding Memories, Static RAM's and EPROM's.

New England Circuit Sales, Inc.
292 Cabot St.
Beverly MA 01915
508-927-8250
Fax: 508-922-1341

This parts broker (independent distributor), established over 10 years ago, has a trademarked "Part/Find" system, a computerized database with over 3000 worldwide part inventories (including Japan, Taiwan and China). The database contains listings of parts from other part brokers, obsolete parts, company excess inventories, etc.

NOW Electronics
50 Gerald St.
PO Box 829
Huntington, NY 11743
516-351-8300
Fax:516-351-8354

This company makes lifetime buys and stocks obsolete parts. If devices are not in stock they use their computerized "Semi-Search" system to locate material from a worldwide network of part brokers, distributors and OEM's.

Performance Memory Products
(also Performance Electronics)
1565 Creek St., Suite 101
San Marcos, CA 92069
800-255-8607
619-471-5383
Fax: 619-471-9691

This company has discontinued and obsolete memory modules from various original manufacturers including TI, Fujitsu, OKI and NEC.

Prime Tech, Inc.
1210 Warsaw Rd.
Suite 900
Rosewell, GA 30076
404-594-8608
Fax: 404-594-8631

This company can supply European parts, ranging from electrical, electronic, electromechanical and mechanical items for different machines and equipment. They can also locate electronic controls/circuit boards for a variety of foreign made machines. In addition they are able to locate hard to find Japanese items through European distributors.

R.W. Electronics, Inc.
206 Andover St.
Andover, MA 01810
508-475-1303
Fax: 508-475-1461

This company, in business since 1981, specializes in global distribution and sourcing of such material as IC's, semiconductors, disk drives and computer peripherals.

TELTECH Research Corporation
Technical Knowledge Service
2850 Metro Dr.
Minneapolis, MN 55425-1566
612-829-9000
800-833-8330

This company offers a vendor locator service to source specialized parts, materials, equipment and services. They find emergency, or secondary sources of material and determine plant locations, order capacity, stock status and lead time. They also track technologies, patents and offer access to technical experts to answer questions.

Trans-World Electronics
15304 E. Valley Blvd.
City of Industry, CA 91748
800-822-1236

This company has parts and servicing information for Multitech, Dyna Tech, Spectrum, and HiTech brands.

Sources of vacuum tubes

The following listed companies are sources of vacuum tubes. Richardson is a manufacturer. The other sources listed stock or locate vacuum tubes.

Richardson Electronics Ltd.
3030 N. River Rd.
Franklin Park, IL 60131

A manufacturer of various types of tubes and power semiconductors.

Antique Electronic Supply
6221 South Maple Ave.
Tempe, AZ 85283
602-820-5411
Fax: 602-820-4643

Daily Elexs, Div. E
Box 5029
Compton, CA 90224
213-774-1255
Fax: 213-603-1348

Diers
4276-SC2 North 50th St.
Milwaukee, WI 53216-1313

EDLIE Electronics
2700 Hemstead Turnpike
Levittown, NY 11756-1443
516-735-3330
800-645-4722

Fair Radio Sales Co.
P.O. Box 1105
1016 E. Eureka St.
Lima, OH 45802
419-223-2196
419-227-6573

International Components Corp.
105 Maxess Rd.
Melville, NY 11747
516-293-1500
Fax: 516-293-4983

New Sensor Corporation
133 Fifth Ave.
New York, NY 10011
212-529-0466
800-633-5477
Fax: 212-529-0486
This company has tubes from worldwide sources (Russia, China, Yugoslavia, Germany, Czeckslovakia and the U.S.) and can burn-in and match tubes.

Steinmetz
7519 Maplewood Ave.
Hammond, IN 46324
This organization can supply lists of old and new tubes that can be supplied.

Tucker Electronics
1717 Reserve St.
Garland, TX 75042
800-527-4642
800-749-4642
214-340-0631
Has new and "pulls" (tubes removed from equipment) and surplus electronic test equipment.

Sources of generic replacement semiconductors
These companies provide cross reference guides to their replacement parts:

ECG Semiconductors
(Sylvania Electronic Components)
(a North American Philips Company)
Distributor and Special Markets Division
1025 Westminster Dr.
PO Box 3277
Williamsport, PA 17701
800-526-9354
ECG Canada Inc.
Electronic Components and Systems
8580 Darnley Rd.
Montreal, Quebec
Canada H4T 1M6

NTE-New Tone Electronics
44 Farrand St.
Bloomfield, NJ 07003
201-748-5089
212-732-1326
800-631-1250
Telex 333226
(Note: Cross references are available on computer disk.)

Thompson Consumer Electronics (RCA and GE)
Distributor and Special Products
2000 Clements Bridge Rd.
Deptford, NJ 08096-2088
609-853-2417
SK series replacement semiconductors and Japanese JEDEC/Generic replacement semiconductors.

World Wide Component Dist.
18 Stern Ave.
Springfield, NJ 07081
201-467-6264
Fax:201-467-8519
800-222-6268
Specializes in Japanese Semiconductors and generic replacement parts.

Circle (20) on Reply Card

Companies that sell electronic parts

ALL Electronics Corp.
PO Box 567
Van Nuys, CA 91408
800-826-5432
818-904-0524
Fax: 818-781-2653

Andrews Electronics
PO Box 914
Santa Clarita,CA 91380
805-257-7700

ASTI Magnetics Corp.
32 Piermont Rd.
Cresskill, NJ 07626
800-221-1828
84 S. Front St.
Bergenfield, NJ 07621
201-501-8900

Baldwin, Vance
2207 S. Andrews Ave.
Ft. Lauderdale, FL 33316

Bluefin Technologies
175 Commercial Way
Portsmouth, NH 03801
603-433-2223

Burks, PI
842 S. Seventh St.
Louisville, KY 40203

Circuit Specialists
PO Box 3047
Scottsdale AZ 85271-3047
800-528-1417
602-967-2539
602-966-0764 (warehouse)

CitiTRONIX Inc.
1641 Dielman Road
St. Louis, MO 63132
314-427-3420/800-846-2484

Consolidated Electronics
705 Watervliet Avenue
Dayton, Ohio 45420-2599
513-252-5662
800-543-3568
Fax: 513-252-4066
Telex: 288-229
Compuserve: 76057, 3347
Easylink: 62850013

Contact East
335 Willow Street South
PO Box 786
North Andover, MA 01845
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Fax: 508-688-7829

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2733 Carrier Avenue
City of Commerce, CA 90040
213-727-0054

DC Electronics
PO Box 3203
Scottsdale, AZ 85271-3202
602-945-7736(stock/price check)
800-423-0070 (order line)
Fax: 602-994-1704

Digi-Key Corporation
701 Brooks Avenue South
PO Box 677
Thief River Falls
MN 56701-0677/800-344-4539

Diversified Parts
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Portland, OR 97214

East Coast Transistor Parts, Inc.
2 Marlborough Road
West Hempstead, NY 11552
516-483-5742

EASY TECH, Inc.
2917 Bayview Drive
Fremont, CA 94538
800-582-4044
Fax: 1-800-582-1255

ECG
1025 Westminster Drive
PO Box 3277
Williamsport, PA 17701
717-323-4691
Fax: 800-346-6621
in Canada:

ECG Canada Inc.
Electronic Components
1928 St. Regis Boulevard
Dorval, Quebec H9P 1H6

EDLIE Electronics
2700 Hempstead Turnpike
Levittown, NY 11756-1443
516-735-3330
800-645-4772
Fax: 516-731-5125

Electronic Goldmine
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Scottsdale, AZ 85261
602-451-7454
Fax: 602-451-9495

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Emeryville, CA 94608
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718-375-2700

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Fairborn, Ohio 45324
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Fax: 513-878-1972
Telex: 6503531176 mci uw

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Unit J
Anaheim, CA 92806
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714-758-8602
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Fax: 714-758-8768

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Fax: 516-764-5747

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Southhampton, PA 18966
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Secaucus, NJ 07094

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718-934-4500

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Fax: 415-697-2890

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201-748-5089

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818-772-2700
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Greenpoint, NY 11222
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800-338-0531
Fax: 513-222-4644

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615-475-0317

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Whitewater, WI 51390
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Fort Worth, TX 76118
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So.Holland, IL 60473
708-333-4100

Video Display Corp.
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Tucker, GA 30084
404-938-2080

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Mitchell, SD 57301-7011
605-996-2233

Test your electronics knowledge

Do you remember what you read in ES&T?

By Sam Wilson

Are you keeping up with the technology? Readers of ES&T magazine are up to the minute!

Here are some questions about material that was published in the March, April, and May issues. You should do well on this test.

1. Which of the following is a disadvantage of the small white cards used to test infrared remote controls?

A. They are very expensive.

B. The light they emit is difficult to see.

2. This question refers to a statement in an article titled "The super tuner" by John Shepler. He says: "The AM band is capable of sounding just as good as FM." Question: Then why doesn't it?

3. According to Homer Davidson, in his article titled "All about transformers," the color code of the connecting wires to the primary of a power transformer is usually_____ or _____.

4. This question is based upon an article by Vaughn D. Martin titled "Unraveling the parts numbering maze." According to the author, the first and second leading manufacturers of linear ICs are_____ and _____.

5. Vaughn D. Martin had a second article in the April '93 issue. It was titled "The CD-ROM Primer—Part 1." In that article he said that—depending on the drive and how much of the disk is used—a CD-ROM can store data equivalent to _____ typewritten pages.

6. This question in Test Your Electronics Knowledge (April '93 issue) brought lots and lots of mail. (I changed the BCD number here.)

What is the decimal value of the following BCD number: 01010101?

7. In an article by Homer Davidson in the May '93 issue titled "Build this variable isolation ac power source," an isolation tranformer can be made from two _____ volt transformers.

8. According to ES&T Editor Conrad Persson in an article titled "Planning the Technician's Toolkit" (May '93 issue) the first question to be asked in toolkit stocking is _____.

9. The answer to this question was given in an article titled "Understanding TV horizontal_____circuits" by Glen Kropuenske (May '93 issue). In most horizontal output stages the output transistor's collector current splits two ways between _____and _____.

10. "Inspection, cleaning and lubrication of camcorders" was an article by the ES&T staff in the May '93 issue. It says to use an oiler to apply one or two drops of _____ oil to the specified components.

(Answers on page 42)

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

Selecting replacement electrolytic capacitors

By Ralph W. Muller

Many consumer electronics products contain electrolytic capacitors. These electrolytic capacitors may be standard components, or they may be constructed with any of a number of special characteristics: low ESR, low ESR at high frequencies, very high ripple current capacity and low dc leakage; to name a few. A modern electrolytic may feature only one of these special characteristics, or it may have a combination of any two or more special properties.

ESR stands for "equivalent series resistance." The ESR for a low-ESR electrolytic is approximately one-fourth that of a general-purpose electrolytic of equal capacitance and voltage. The ESR of a very-low-ESR electrolytic is approximately one-sixth that of a general purpose capacitor. Low impedance is similar to ESR, but is a more conservative rating than low ESR because it additionally considers the dynamic impedance of the entire electrolytic capacitor.

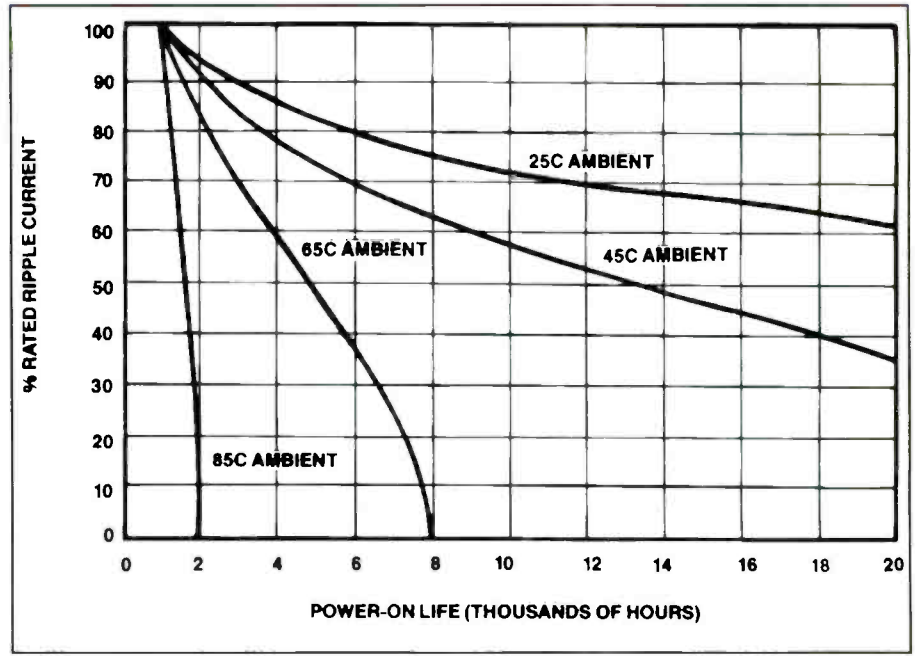


Figure 1. The operating life of an electrolytic capacitor depends on the temperature to which it is subjected. This temperature must be 30 degrees below its maximum temperature rating in order for it to operate reliably for five years during moderate use. If operated at 40 degrees below its maximum temperature, its lifetime would be 10 years. Other things being equal, your replacement must have at least the same maximum temperature rating as the defective part.

Ripple current and temperature rating

Ripple current capacity is a measure of how much ripple current can flow through the electrolytic capacitor's ESR without heating it beyond its maximum temperature limit. Low-ESR capacitors will generally have approximately twice as much ripple capacity as a general purpose electrolytic capacitor of equal capacitance and voltage. An electrolytic with very high ripple current capacity (which might also have low ESR) will have approximately four times the ripple current capacity of a general purpose electrolytic of equal capacitance and voltage.

The temperature rating of an electrolytic capacitor may be 85C, 105C or 130C. The primary cause of failure of these capacitors is heat, which causes the electrolyte to dry out. This heat is a combination of the ambient temperature of the equipment and the additional internal heat that is caused by the ripple current that flows through the capacitor's ESR.

Somewhat oversimplified, the temperature to which the electrolytic capacitor is subjected must be 30 degrees below its maximum temperature rating if it is to operate reliably for five years during moderate use. If an electrolytic capacitor operates at 40 degrees below its maximum temperature, its lifetime would be 10 years (see Figure 1). Everything else being equal, a replacement electrolytic capacitor must have at least the same maximum temperature rating as the defective part. Sometimes a manufacturer will choose a 105C general purpose electrolytic to tolerate the heat caused by high ripple currents, instead of installing an 85C electrolytic with low ESR and/or high ripple current capacity properties that would have operated cooler in the first place.

Dc leakage in an electrolytic can range from milliamps in a general purpose electrolytic down to microamps if it is either a low leakage electrolytic or a tantalum. Sometimes a manufacturer will use a low dc leakage electrolytic as a low-cost alternative to a tantalum if the circuit does not require any of the other special properties of a tantalum.

The importance of choosing the correct replacement

If the equipment manufacturer's service literature is not available, unless the technician has a vast library of each capacitor manufacturer's technical specifications with which to decode the markings on the electrolytic jacket, it is difficult to determine the properties of the defective capacitor in order to select an appropriate replacement. Do not use a high temperature rating, for example, 105C, that may be stamped on the elec-

(Continued on page 41)

Muller is service manager for an independant consumer electronics service center.

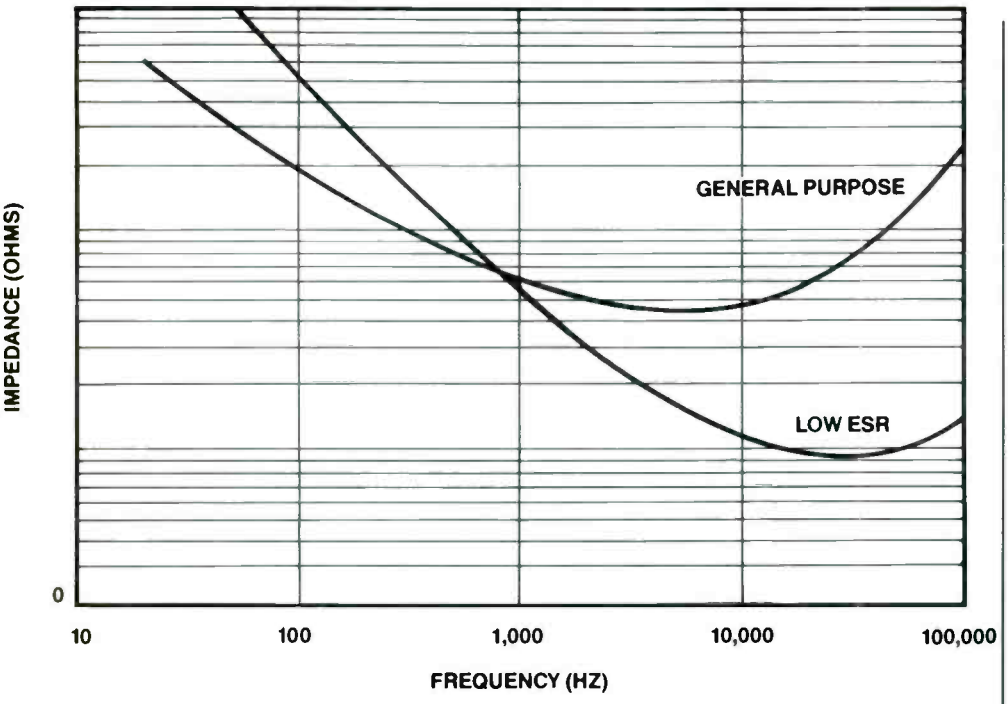


Figure 2. ESR is frequency dependent. If you viewed the frequency versus ESR graph chart of a low-ESR electrolytic you would find the ESR is biased so that the ESR is lower at high frequencies than it is at low frequencies.

trolytic jacket, to infer low ESR properties. A 105C temperature rating on an electrolytic capacitor does not necessarily mean that it is also a low ESR capacitor. Conversely, some 85C electrolytics are made with either low ESR properties and or high ripple current capacity.

If the equipment requires a low ESR and/or high ripple current capacity electrolytic, but the service center installs a general-purpose replacement, premature failure will result leaving the customer with exactly the same symptom for which the unit was serviced in the first place. Similarly, if the unit requires a low-dc-leakage electrolytic, but a standard-leakage replacement is used, the equipment will fail. This may not occur immediately, because the dc leakage of electrolytics degrades when heated.

Determining if the defective capacitor is low ESR

I have found that most of the time, the single most important quality for electrolytic filter capacitor replacement is a low ESR rating, because a low ESR electrolytic will also have twice the ripple current capacity of a general purpose capacitor. The technician should evaluate the circuit that requires a replacement capacitor to determine if a special electrolytic is called for.

For example, a switched mode power supply in a color TV or a VCR would generally require at least a low-ESR electrolytic, and a TV flyback secondary supply will often require a low ESR electrolytic. A computer color monitor will probably require a low-ESR-at-high-frequency capacitor because its horizontal frequency range can be as high as 33kHz, and its switched mode power supply can be three times greater in frequency than its horizontal oscillator.

But how are you to identify unknown defective electrolytics? In the case of a color TV flyback secondary or similar filtering circuits, use a scope and view the waveform. If the pulse prior to rectification has either a sharp rise time, or is a complex waveform of 30% or greater duty cycle, I use a low ESR electrolytic.

Another method that would determine if the unknown electrolytic had low ESR properties would require the use of an ESR meter and some detective work. Look for another electrolytic of approximately 5µF capacitance that has the same code marking as the defective part in the equipment under repair, and measure it with the ESR meter and note the reading. Now compare this ESR resistance reading with a known general purpose electrolytic of the same capacitance and voltage. If the ESR of the good electrolytic of

unknown properties is approximately one-fourth that of the general purpose electrolytic you are comparing it to, the unknown defective electrolytic is a low-ESR electrolytic.

To determine if the defective electrolytic was a high ripple current capacity device, install a general purpose replacement and allow the equipment to operate for five minutes. Now turn the device off and feel the temperature of the general-purpose replacement. Is it hot to the touch? If so, the circuit probably requires a high-ripple-current-capacity replacement.

When in doubt

If you are unable to determine either the ESR and/or ripple current properties of the defective electrolytic, there is nothing wrong with using a low-ESR electrolytic in either a filtering or decoupling application, even if the circuit only required a general purpose capacitor. Some low-ESR electrolytics, however, are manufactured with high dc leakage, and they would not be suitable in most signal coupling applications. I use the Panasonic HFS type, which is available from a nationally known vendor, as an all-purpose replacement, because it is readily available up to 63V and has low ESR and low dc leakage with above average ripple current capacity in a moderate case size.

There are times when you would not want to use a low-ESR electrolytic; for example, the coupling capacitor(s) in a vertical yoke circuit. The reason is that the vertical frequency is 60Hz and the ESR of a low-ESR electrolytic would be greater at 60Hz than the ESR of a general-purpose electrolytic. ESR is frequency dependent. If you viewed the frequency versus ESR graph chart of a low-ESR electrolytic you would find the ESR is biased or "tilted" to favor high frequencies at the expense of low frequencies (Figure 2).

Determining if the circuit needs a low-dc-leakage electrolytic is more difficult. Low-level coupling, R/C oscillators and feedback loops are some of the circuits that may require a low-dc-leakage replacement.

It is unwise to replace a defective tantalum with a low-leakage electrolytic, and certainly not with a general-purpose electrolytic. Tantalums are expensive to everyone including the equipment manufacturer. It is unlikely that the equipment manufacturer would have incurred the expense of a tantalum if the circuit did not require the many special properties that a tantalum has in addition to low dc leakage, for the device to work properly.

In an emergency, and if your application is either filtering or decoupling, you might install two general purpose capacitors of the same value and voltage in parallel as a replacement for a low ESR and/or high ripple current electrolytic. The advantage of this is that the combination of their general purpose ESR ratings will approach that of a single low-ESR unit, while their individual ripple current capacity will add and also approximate that of a high-ripple-current electrolytic. You will have to use care in using two capacitors in parallel, however, as the capacitance of the combination will be the sum of the capacitances of the individual components.

Which meter should you use

Although I have both an ESR meter and an electrolytic capacitance meter, I prefer to use the ESR meter for characterizing capacitors. The reason is that marginal electrolytics can be identified earlier with an ESR meter because the ESR will almost always increase out of tolerance before the electrolytic's capacitance will begin to decay. ■

Test your electronics knowledge

Answers to the quiz

(*from page 27*)

1. B. According to author Ricky Hall in the article titled "Build this Tester for Infrared Remote Controls" the answer is B (March '93 issue).

2. According to Shepler, up to now it has been because of the poor quality of AM receivers (March '93 issue).

3. Black or White (April '93 issue).

4. National Semiconductor and Motorola (April '93 issue).

5. 200,000 typewritten pages—That would make a stack over 20 feet high!

6. The BCD (Binary Coded Decimal) number is decoded by making four-bit groups: 0101 0101. Then, write the decimal equivalent for each group: 55.

7. The author shows an isolation transformer made with two 12V transformers.

8. What types of products will be serviced? The author suggests that you make a list.

9. The flyback and the yoke.

10. Sonic Slidas Oil.

Will Total Quality Management work for you?—Part 5

By John A. Ross

In Business Corner, for the past four months we have been looking at the management theory called Total Quality Management. In this installment, we'll talk about point 5 of the TQM concept propounded by W. Edwards Deming.

TQM Point 5

Improve constantly and forever the system of production and service.

Coupling the improvement of the total organization with the improvement of production and service are goals presented by nearly every management theory. Unfortunately, many businesses take a "short-term" attitude toward improvement. Since identifying short-term improvement does not require as much effort as is needed for the long-term approach, this attitude is understandable. Short-term improvements in the service arena may involve ideas such as improving timeliness or adding more hours to the work week.

All in all, working harder to achieve short-term goals may seem plausible. Yet, constant improvement is the key ingredient of Deming's point five. Improvement, in that context, includes innovation concerning existing processes, services, skill utilization and existing products. Instead of working harder, work smarter.

Making service calls more efficient

For a small electronics service business, constant improvement may include scheduling service calls by location. Another improvement that would enhance service call efficiency even more is to carry as many needed parts as possible in the service vehicle. For openers, the elimination of even small travel expenses should translate into more profits.

If you have the habit of repeatedly traveling from the service center to the job site and then back to the service center, take a minute to calculate the amount of time and gasoline expended while making unnecessary trips. Even if you can only eliminate a fraction of the "road time," the savings will accumulate.

The other advantages may be more intangible than the known benefits of money and time. As you concentrate on scheduling jobs by location and on carrying a supply of most-often-needed parts, your service operation will become more efficient. One consequence may be a reduction in your physical parts inventory. Any reliance on having the necessary parts on hand will increase awareness about the amount of money needed to maintain the inventory. As such, tracking the number of parts used for a given time period may become a necessity.

Tracking parts use and service experience

Several inexpensive microcomputer software database applications exist that allow the easy tracking of parts sales, but some of them may be useful for other purposes. For example, troubleshooting of commonly-occurring problems can be time consuming. But if you have readily available a database of those service procedures, you may be able to save time. By looking at scheduling, inventory, and the elimination of redundancy, you may find yourself evolving into a better manager. In an upcoming issue, we will discuss how to set up a database for the purpose of tracking.

Keeping employees happy and productive

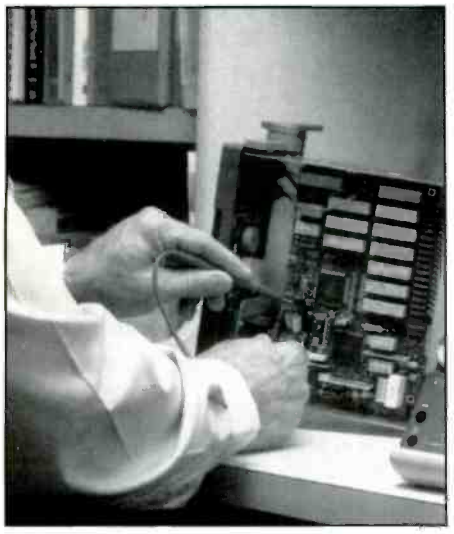
Constant improvement also takes us back to some earlier points presented by Deming. Point one told us that we need to build a constancy of purpose in regard to service improvement. Providing the type of consistent training outlined in the explanation of point one fits within the context of constant improvement. However, we can take this concept to a different level.

In most cases, higher salaries are not the only key to employee happiness. Indeed, employee responsibility and empowerment are often considered to have greater importance. For larger businesses, constant improvement also involves making sure that each task fits the skills of the assigned employee. In addition, those organizations should ensure that employees have the opportunity for personal growth. Employee dissatisfaction builds through the assignment of tasks that present no challenge or through a realization that their opinions count for little.

In point two, Deming advises that Total Quality Management must have the full commitment of upper-level managers. When we consider the concept of employee empowerment and that employees should have the opportunity for personal growth, the commitment and responsibilities of upper management become even more important. As such, managers and owners find that they are required to have a heightened awareness of changing employee skills and of day-to-day operations.

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

★ ★ ★ TEST EQUIPMENT SHOWCASE ★ ★ ★



The tasks performed by a technician in servicing a consumer electronics product usually follow a logical procedure. The technician begins by performing a thorough visual check to see if there are any obvious signs of the cause of the problem: things like burned resistors, charred circuit boards, loose connectors, cracked circuit board traces, broken switches, etc.

Once the technician has completed the visual check and made any corrections indicated, it's time to perform the operational check: plug the unit in, turn it on, and see if he can duplicate the symptom(s) described by the owner.

The test equipment

The steps described above are usually just the preliminaries. Serious servicing doesn't usually begin until the technician connects the test equipment to the suspected problem area and begins to take resistance readings, voltage readings, and observes waveforms on the oscilloscope. It's this sophisticated test equipment that really lets the technician know what's going on in the circuitry of the product.

Today's consumer electronics products are highly complex. In many cases, a consumer electronic product is far more than a product; it's an intricate system. Consider a VCR. The electromechanical portion of the system loads the tape and records or plays it. The electronic portion manipulates the video signal. The control section makes sure that all the other sections work properly together, and in addition senses conditions like the presence of moisture or end of tape and shuts down the system if there's danger of damage.

Because of this complexity of today's consumer electronics products, the test equipment used by the technician in performing diagnoses and repair must be sophisticated in order to accurately apprise the technician of the condition of the product. And because many of the products a technician faces today, like VCRs, CD players, and computer disk drives, are electromechanical, adequate diagnosis and repair may require sophisticated mechanical test equipment as well as electronic test equipment.

The value of a piece of test equipment to the technician depends on a number of factors. Here are a few:

- Ease of use
- Capability
- Accuracy
- Cost
- Support by the manufacturer
- Versatility

Buying a piece of test equipment

Often when a service center buys a piece of test equipment, the purchase is not carefully thought through enough. For example, it's decided that the service center needs a new oscilloscope, a little research is performed on the products available and their prices, and an oscilloscope is purchased.

Most purchases done in this manner turn out fine, but sometimes the organization learns to its chagrin that the unit just doesn't do the job. Sometimes the organization learns too late that the unit they just bought is overkill. You see some of those items listed in Readers' Exchange.

Just as with any purchase, the use to which the test equipment will be put should be thoroughly studied. The best approach would be to put together a checklist, and every technician who is likely to use the unit should be given an opportunity to participate in the decision. The example checklist questions are for an oscilloscope, but a similar checklist would be useful for any other piece of test equipment.

The checklist

- What testing products will be used?
- What bandwidth is needed?
- Single-channel, or two-channel?
- Is there a real need for waveform storage?
- Will this be used at the bench, or on site as well?
- Does it need to have readout of waveform parameters?
- Can this purchase be cost justified as a time and effort saver?

Getting acquainted with the suppliers

Because the decision to purchase a piece of test equipment is so pivotal, the more you know about the manufacturers or suppliers, the better informed your decision will be.

This special advertising section, "Test Equipment Showcase," was conceived as a way to help bring more information about test equipment providers to readers. Every advertiser in this section has been given additional space to tell readers something about that company, or to help readers understand the value and use of that company's products.

We invite you to read what these companies have to say about themselves and their products.

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Financing: We'll get you started with flexible investment terms to make your purchase easier, plus we can finance your investment at low rates with payments you can afford. Sencore's own financial division also serves as a highly reputable reference with other creditors.

Application Engineering: Once you've made your investment in Sencore test equipment, our job has just begun. If you need assistance using any of Sencore's instruments, our Application Engineers are just a toll-free phone call away. They're specially trained on the operation and uses of every item in the Sencore line. Our Application Engineers are dedicated to customers and helping solve problems—both before and after the sale.

Service: If your instrument should ever need service or recalibration, Sencore also services what we sell. Our factory service center backs your purchase with quality service that brings your instrument back to the same (or better) specifications as when new. Our top notch Service Department backs your equipment with three-day service, instrument loaners, and toll-free access for help servicing your own Sencore instruments if you choose.

Parts: Genuine original parts ensure your equipment is safe, accurate, and reliable. Our parts department ships orders within 48 hours guaranteeing maximum up-time and productivity from your Sencore test equipment.

Product Delivery: Most Sencore products are in stock and are shipped within 48 hours of receipt of your order-guaranteeing you maximum productivity right from the start. Overnight delivery is available for more immediate needs.

Buyer protection

30-Day Money Back Guarantee: Sencore's no-nonsense 30-day money-back guarantee assures you that you've made the right choice. Every Sencore instrument and accessory is covered by this guarantee of satisfaction. Simply stated:

"If you are not completely satisfied with any Sencore instrument, you may return it during the first 30 days and we'll give you a full refund, including freight, no questions asked."

You're always sure you've made the right decision when you say "yes" to a Sencore investment.

Product Warranty: Every Sencore instrument is warranted for one year against defects of any cause except acts of God and abusive use. During this warranty period, Sencore will correct any covered defect without charge for parts, labor, or recalibration.

Made Right Guarantee: We guarantee your Sencore instrument was "Made Right" or we will make it right without charge for parts and labor for as long as you own the instrument. This lifetime guarantee covers any defects caused by faulty design or workmanship errors. All parts and labor necessary to correct a workmanship defect covered by this guarantee will be at no charge to you. There will be a recalibration and handling charge if the instrument is no longer covered by Sencore's one year warranty.

Easy Ordering—Three WaysTo Contact Us

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1-800-SENCORE (736-2673)	1-605-339-0317	Sencore, Inc. 3200 Sencore Dr. Sioux Falls, SD 57107 (605)339-0100 Call 1-800-SENCORE (736-2673)

★ ★ ★ TEST EQUIPMENT SHOWCASE ★ ★ ★

MCM Electronics
650 Congress Park Drive
Centerville, OH 45459-4072
Phone: 800-543-4330
Fax: 513-434-6959

Best brands in the business

MCM Electronics is dedicated to developing the finest test equipment on the market. MCM offers name brand test equipment like Fluke, Leader, B&K and Hitachi because they are the recognized leaders in the electronic service industry.

A new name emerges

One name that is rapidly emerging as the top choice among service technicians is our own TENMA Test Equipment. Every TENMA product is engineered to exacting industry standards required to meet the needs of professionals on service, research and development, production, testing and training. Regardless of your measurement or test application, TENMA delivers reliable performance, accuracy, functional design and dependability. Known throughout the industry as "The World's Most Affordable Test Equipment," TENMA offers unsurpassed value across a broad range of products. Included are oscilloscopes, universal test center, monitor tester, spectrum analyzer, digital analog multimeters, DMMs or most pieces of test equipment for your service shop or truck.

Discover for yourself

MCM publishes two full-sized catalogs that are mailed each year. The latest issue introduced more than 1,400 new items with at least 30 pages devoted to test equipment. Not only does MCM have an extensive line of test equipment, but also stocks over 20,000 of the most commonly used replacement parts and components in the electronic industry. Sales flyers are mailed regularly which feature specially priced products. These flyers also keep the customers constantly informed of new items that are being added.

Superior customer service

MCM's sales staff are trained to answer all calls fast, friendly and efficiently. The sales representatives are professionals who are available on toll-free lines to provide immediate information on stock availability and pricing. They are available Monday through Friday, 7:00 a.m. to 8:00 p.m. EST, and Saturday 9:00 a.m. to 6:00 p.m. EST. Orders can be placed after hours with a national toll-free number, ensuring service 24 hours a day, seven days a week. MCM also provides highly-trained electronic technicians to answer customers product questions. With a separate toll-free "TechLine," customers receive prompt answers to their product questions by calling 1-800-824-Tech (8324).

Top-notch distribution facilities

As part of our on-going commitment to provide superior customer service, we have opened a second distribution center in Sparks, Nevada just outside Reno. This warehouse will service all customers nationally and get your orders to you fast! For more information and a free catalog, call 1-800-543-4330, in Dayton, OH call 434-0031.

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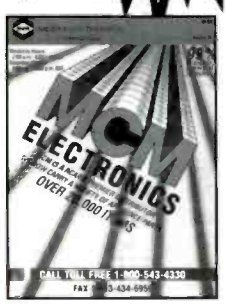

TENMA Monitor Tester

Finally an affordable monitor tester that compares to units costing hundreds of dollars more. Cash in on monitor repair profits with this full featured, compact and lightweight tester. Complete with 16 scan formats, test CGA, EGA, VGA, SVGA and more. Outputs include digital 9 pin, analog 9 pin and analog 15 pin. All this in a rugged extruded aluminum case measuring only 3¾" x 7¾" x 1½". Call now and start repairing monitors today!

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Unique "sidecar" design attaches directly to the TENMA Monitor Tester. This adaptor allows testing of MAC II and BNC type monitors. Includes mounting hardware.

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ES-75

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Fluke Corporation
P.O. Box 9090
Everett, WA 98206
Phone: 1-800-44-FLUKE
Fax: 206-356-5962

"Our customers have the right to get a little more than they thought they paid for," says John M. Fluke, Sr., the Founder of Fluke Corporation.

Fluke's mission is to be the world leader in compact, professional electronic test tools. For many customers, that means turning to Fluke for the world's highest quality handheld digital multimeters and accessories. For others, it means harnessing the power of a digital storage oscilloscope by using Fluke's revolutionary ScopeMeter test tool. And for others still, it means discovering new products and new areas of Fluke expertise, such as wireless data logging and LAN troubleshooting.

Regardless of the specific product and application involved, Fluke encourages its customers to look beyond basic specifications, and look at the total combination of features, functions and overall value represented by a product's design and care taken in its production. This concept is engineered into every Fluke product, and is best exemplified by looking at our handheld DMM family.

Proprietary circuit design and manufacturing facilities

Innovative instruments result when engineers design products to solve specific problems, using state-of-the-art design and manufacturing resources.

Integrated circuits developed in our Microcircuits laboratory have produced breakthrough performance features for handheld DMMs, such as dB, capacitance, frequency and duty cycle measurement, virtually invisible autoranging, a fast analog bar graph, and a Touch Hold function.

Human engineered with attention to detail

You may never notice the finer details built into our multimeters, but each has been thoughtfully created for your benefit. Like non-skid rubber feet, grooved sides and textured cases for surer grip, and careful attention to color selection to match the job.

No other DMM manufacturer we know of invests as much care in human engineering.

Environmentally tested for reliability

Reliability, especially under tough conditions, is more important than ever today. So, by the time Fluke DMMs are ready to be tossed in tool cases, they've undergone a rigorous testing and evaluation program.

Fluke DMMs are regarded by industry professionals as the toughest, most forgiving multimeters ever made.

Accessories for every purpose

A full-line of accessories extend the measurement capabilities of Fluke DMMs. This includes temperature probes that convert any DMM into a thermometer (thermocouple, semiconductor and infrared types are available), current clamps, high-voltage probes, high-frequency probes, test leads and carrying cases.

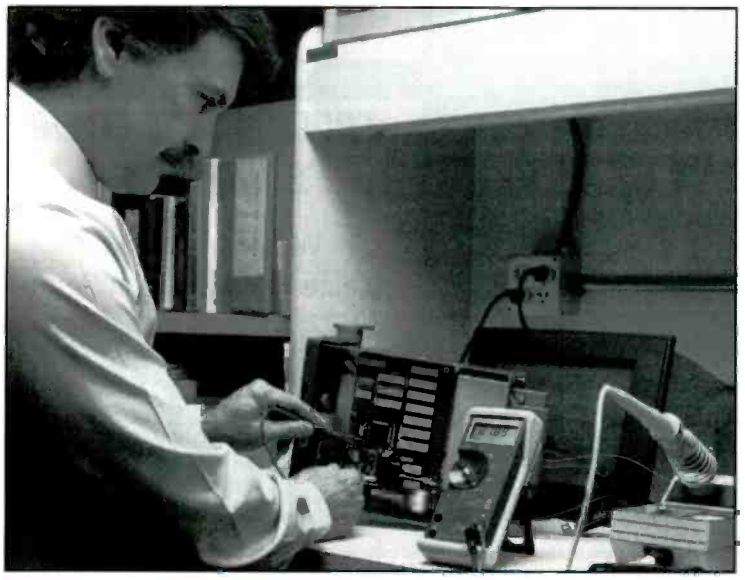
American quality recognized worldwide

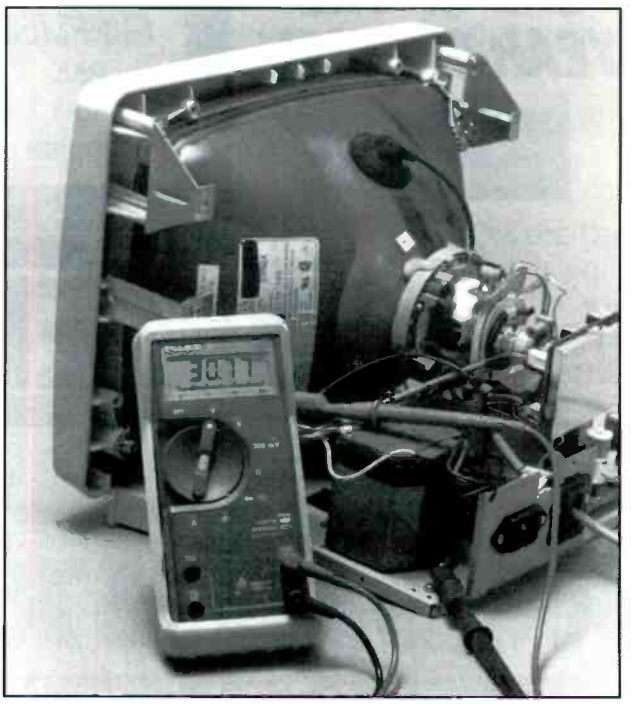
Design innovations and production efficiencies are essential to our commitment to manufacture the world's most capable multimeters . . . in the U.S.A. Fluke uses a variety of automated manufacturing processes, allowing us to offer you one of the highest quality multimeters available, at affordable prices, and backed by the finest warranty coverage in the business.

The Fluke multimeter. It's a product with a reputation to uphold. Built to meet your needs, and consistently exceed your expectations. An electronic tool you'll rely on for accurate measurements year after year.

For more information

For more information on Fluke multimeters, or any of our other professional test tools, call 1-800-44-FLUKE. Or write to: Fluke Corporation, P.O. Box 9090, Everett, WA 98206.





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Herman Electronics
1365 N.W. 23rd St.
Miami, FL 33142
Phone: 800-938-4376
Fax: 305-634-6247

Herman Electronics is a diverse, full-line distributor of everything in electronics—from original replacement parts to tools and test equipment. In business for more than 40 years, Herman has clearly established itself as a leader by providing quality products and superb customer service to all phases of the electronics industry.

Herman is quickly setting the standard by which all other distributors will be judged. At the helm of this effort are two young men, sons of one of the original founders—Jeffrey and David Wolf. We are taking the 40 years of foundation and applying modern and progressive philosophies to enhance our business and the service we provide.

The most dramatic change Herman has made is in the test equipment and tool product categories. The company is quickly establishing itself as stocking one of the largest and most diverse inventories of tools, test equipment, and solder supplies in the U.S. Huge inventories of XCELITE tools, Weller soldering equipment, and the highly regarded Hakko line of solder and desolder supplies are in place to serve you now! As far as test equipment, you name it we have it. Our well-stocked showroom has on display Beckman, Fluke, B&K, Goldstar, and Hitachi allowing us to ship the same day your order is placed.

Over the past 12 months, the company has made a major commitment to become one of the largest providers to the MRO industry with our tools, test equipment, and electronic supply needs. With the addition of product lines like Panduit, 3M, Amprobe, and countless more, Herman is able to provide immediate off-the-shelf service.

Herman sales representatives are well-trained and educated as we are required to attend weekly sales training meetings to keep us aware of the latest products and developments in the industry and ultimately to serve our customers better.

Herman Electronics is one of the largest original replacement parts and accessory distributors in the country and is factory authorized for Sony, RCA/GE, Panasonic, Samsung, Quasar, Technics, and Toshiba. We maintain huge inventories allowing us to provide two-day service to anywhere in the continental United States.

Herman Electronics makes ordering easy. Customer Service representatives are standing by to take your call. Dial toll-free (800) 938-4376 or Fax (305) 634-6247. If you're not sure as to what you need, ask to speak to an industrial sales representative who will be able to assist you. Out-of-state orders are shipped 2nd day air at no additional charge to ensure two-day service to you!

If you have not given Herman Electronics a try, please do so now! Experience, reliability, and service excellence is what we stand for. Put us to work for you.

SPECIAL ADVERTISING SUPPLEMENT

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Wavetek Corporation
9145 Balboa Ave.
San Diego, CA 92123
Phone: 800-854-2708; 619-279-2200

Wavetek Corporation designs, manufactures, and markets worldwide a broad range of electronic test and measurement instruments that are used for the design, evaluation, production, and maintenance of electronic devices and systems. Wavetek operations are tightly focused on well-defined segments of the diverse test and measurement marketplace with products specifically designed for particular applications. Recently, Wavetek extended its product line with the purchase of the Instrumentation Products Division of Beckman Industrial (BI) to include high-quality digital instruments for service test and measurement.

Wavetek has three operating divisions: Calibration Division, Communications Division, and Instruments Division. The Instruments Division offers a full-line of calibration products, test simulators, LAN cable test equipment, and digital multimeters.

Wavetek's calibration and test simulation instruments are widely used in research and manufacturing environments. A wide variety of precision voltage references, meter calibrators, arbitrary waveform generators, and function and pulse generators are available for customers to choose from.

The newest addition to the Wavetek family of calibrators is the Model 9000 Multifunction Calibrator. Model 9000 is designed to affordably and completely calibrate modern handheld DMMs.

For LAN cable system testing and EIA/TIA Category 5 certification, Wavetek leads the industry with the handheld LANTech®100. The LANTech cable testers accurately measure a variety of cable characteristics that are critical in a reliable LAN installation.

Wavetek's digital multimeters have an established reputation for quality and reliability. The comprehensive line offers a range of applications and features to fit the most demanding job requirements.

The Series 2000 provides engineers and technicians with highly versatile, professional-grade, handheld digital multimeters. The series offers a variety of standard DMM functions in addition to a frequency counter, capacitance meter, and intermittent and pulse detector. The extra large, 4-digit, LCD is backlit with fiber optics in Models 2020 and 2030. Model 2030 offers 0.1% accuracy, capacitance range from 100pF to 2000µF, a frequency counter range to 2MHz, and true RMS. The 2030 offers the most troubleshooting features available in a handheld instrument.

The XT series features specialized high-performance, full-function digital multimeters. Each measures not only voltage, current and resistance, but also offers additional functions important to troubleshoot the electronics you work with. The most versatile of the line, the DM27XT measures inductance from 1mH to 20H, frequency up to 20MHz, and capacitance from 1pF up to 2000µF.

A more compact series of meters is the XL Series. These compact, reliable, and rugged DMMs are available at low cost. They feature large LCD digits for easy viewing, and input warning beepers and safety test leads for user safety. All three models (DM5XL, DM10XL, and DM15XL) are designed to safely meet measurement requirements of the field service industry. The DM10XL features the Safety Tester™ to detect and display the presence of particular ac or dc voltage levels. The DM15XL offers a Logic Tester to detect and display the presence of TTL pulses up to 20MHz.

The CPM series provides clamp-on, true RMS power meters that combine many meters into one, easy-to-use handheld instrument for installing, maintaining, and monitoring electrical systems with linear and nonlinear loads.

Wavetek's CDM600 is a digital multiclamp for ac and dc current. Using advanced Hall-effect technology, it accurately measures ac and dc current up to 600 Amps without disturbing the wiring.

In addition to digital multimeters, Wavetek also supplies a wide variety of test leads and probes. Each digital multimeter comes with a standard lead or probe that is appropriate to the meter's most common applications.

Wavetek's test leads can be purchased individually or in kits. The multimeter test lead kits include high-quality silicone-insulated lead wires with one shrouded banana plug and one retractable shrouded banana plug, and two standard probe tips. The additional leads and probes included in each of the three kits vary for surface mount, general purpose, and electronic service applications. These kits come in a heavy-duty cordura case with plastic storage pockets.

Additional leads and probes are available for various application requirements. These leads are high-quality and can be used with any brand of meter. The lead tips are shrouded to protect the user from the dangers of exposed metal during testing. The silicon-insulated lead wires offer increased flexibility and high resistance to solder burns for the best performance and long life.

Wavetek's TC253 is a temperature converter which allows any multimeter to read temperatures from -50°C to 900°C (-32.4°F to 1652°F). A variety of measurement probes are available for this model including immersion, surface, air/gas, piercing tip, and more.

Wavetek also offers high-voltage probes and a radio frequency probe for use with multimeters. The RF241 is a radio frequency probe perfect for two-way communication applications. It is designed to operate with 10 or 22MΩ input digital multimeters.

To ensure that the equipment performs to specification over the life of the product, Wavetek offers its customers a variety of services. All Wavetek instruments are warranted against defects in workmanship and materials. The digital multimeters have standard warranties ranging from one to three years. On some of these, additional warranties for calibration and contamination are also included. Maintenance training courses are available and can be designed and customized to meet specific needs. Operator and maintenance manuals are available for all current products as well as many discontinued products. Product support is provided on all products by Wavetek's highly qualified team of customer support technicians. In most cases, product support is available seven to ten years following the discontinuation.

For over 20 years Wavetek has provided high-quality products and services to our customers. Wavetek has a strong commitment to customer satisfaction and offers customers expert technical support. Dedication to understanding our customers' needs in an industry of constant technological advancements, keeps Wavetek in the forefront of product development and innovation.

With headquarters in San Diego, California, Wavetek sells its products through a worldwide network of representatives, distributors, and dealers. For the distributor nearest you, call (800) 854-2708.

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Tentel
4475 Golden Foothill Parkway
El Durado Hills, CA 95762
Phone: 916-939-4005; 800-538-6894
Fax: 916-939-4114

A VCR contains rubber belts, wheels, idlers, gears, brakes and tension bands that are there to maintain the proper torques and tape tensions during the various loading, play, rewind, fast forward, and stop modes. All of these, plus the actual video head tips are subject to normal wear.

Every time the consumer plays a tape, these components stretch, wear, shift position, and are stressed. Contaminants and oxygen, in the air, cause many of these parts to age and break down even without use.

By the time a VCR requires service, several of these components are probably out of tolerance. Nine out of ten (90%) VCRs brought in for service have mechanical, rather than electronic, problems. When a customer brings in a VCR for service, the entire tape transport system should be checked.

Since many components in the transport are subject to wear during its use, once the immediate cause of the problem has been corrected, you should perform a thorough check of the other mechanical components to be sure that they too are in proper operating condition.

If you merely correct the immediate problem and return the VCR to its owner without a thorough check, there's an increasing risk that one or more mechanical components will soon either fail or cause erratic operation. The result of all this is a disgruntled and possibly lost customer, and either a callback that wastes time or, even worse the customer tosses the VCR in his closet and purchases a new one, carefully selecting a different VCR manufacturer. (It's the same for cars, if you get a "lemon" and the dealer can't fix it properly, the customer will typically change to a different manufacturer)!

That's why every VCR service should include a check, and adjustment if necessary, of tape guide heights, holdback tape tension, and numerous torques (including FF, REW, brakes and restoring torques). All of these checks and adjustments are specified in the service manuals of every manufacturer. You may also find it valuable to check the video head wear to see how many more hours of life the VCR owner can expect from them.

With the proper test equipment: torque, back tension gauge, reference plane, head protrusion gauge, etc., all of the tests and adjustments can be performed in just a few minutes.

A thorough test and adjustment will allow the service center to do it right the first time, and possibly collect a little more money for performing all the work that should be done anyway, plus you'll avoid disappointing the customer and avoid those dreaded callbacks.

And how much does it cost for all the required mechanical test equipment? More than? or less than? other necessary test equipment, such as a good scope. Actually much less than! $1100 to $1700 will buy all of the mechanical test equipment you need to perform all of the mechanical tests and adjustments shown in factory service manuals. The time you save in servicing VCRs more efficiently, performing higher quality repairs, and in avoiding the high cost of callbacks will easily pay for these products; providing the best VCR repair value for your hard earned money.

B&K Precision
6470 W. Cortland St.
Chicago, IL 60635
Phone: 312-889-1448
Fax: 312-794-9740

1994 will be B&K Precision's 40th year anniversary of selling test instrumentation. Through our 40-year history, B&K Precision has grown into an international organization and a leader in electronic product manufacturing. During the early years of the TV industry, many manufacturers provided TV sets. However, few provided test instruments to repair defects. About that time, Central Service, later to become one of the nations largest service centers, began developing their own test equipment to satisfy their needs to perform effective repairs. The demand for this test equipment from other TV service oranizations resulted in the birth of B&K Precision in 1954. Since the 1950s, many general purpose electronics instruments such as multimeters and oscilloscopes were added to the product line. TV and video test equipment still forms an important segment of the B&K Precision product line, but the greatly expanded line of instruments now serves a wide spectrum of other electronic servicing education, and manufacturing users. Today's product line consists of oscilloscopes, power supplies, multimeters, frequency counters, function generators, component testers, video and communication testers and low- cost ATE equipment. All B&K products are sold through its extensive distribution network. Over the past 40 years, B&K Precision has been dedicated to providing customers with innovative, value priced, quality driven products.

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Think of it as an army of test accessories. Banana clips, jacks, plunger and alligator clips, spade lugs and test prods are completely interchangeable to make fast, easy connections. Mueller offers test leads for every multimeter, hand-held and VOM on the market. They are versatile, adaptable and dependable, just like every Mueller interconnect.

Free! *Ask your local distributor for our new 72-page catalog with over 100 new products. Plus 1320 established items, all grouped by test application, or call 1-800-955-2629.*

Mueller

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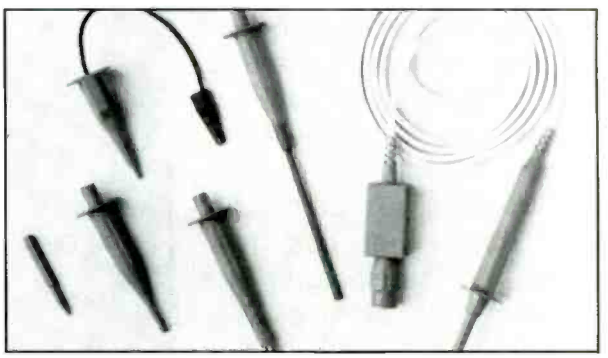
★ ★ ★ TEST EQUIPMENT SHOWCASE ★ ★ ★

Mueller
1583 East 31st Street
Cleveland, OH 44114
Ph: 216-771-5225/800-955-2629
Fax: 216-771-3068

Mueller Electric Company is the world's largest manufacturer of electrical and electronic test clips and insulators and a major supplier of test leads and products. These products serve a wide range of customer applications in manufacturing, design engineering and field service applications and include: Adapters-BNC and banana, banana plugs and jacks, BNC connectors, banana jacks and posts, clips and insulators, pluger-type test clips, general purpose test products and leads, insulated banana jacks, insulated interconnects, insulated test leads, products and accessories, Kelvin test assemblies, oscilloscope probes, and patch cords.



The scope of our products and manufacturing technologies have changed many times since 1908 when we first opened for business. While most customer requirements are addressed by our broad range of standard items, Mueller offers custom fabrication of interconnects with the following production capabilities: Metal fabrication, plating, spring fabrication, molding, and assembly.

Whether your requirements can be met by our broad range of standard products or by our custom fabrication capabilities, we invite you to call us for prompt attention to your test requirements.

Mueller develops new safety oscilloscope probe

Safety oscilloscope probes designed for safe operation to 1000V are now available from Mueller Electric Company. Standard probes are typically not designed for high-voltage applications and can expose users to electric shock during measurements when ground or shield connection of the test instrument is permitted to float.

Mueller safety probes feature fully-insulated plastic construction and finger guards that maintain a safe separation between fingers and metal tips to maximize safety procedures. The probes operate accurately within a band width range of 250MHz. A number of accessories are available for applications such as contacting recessed measuring points, connecting fine wire or IC pins, high-frequency applications, heavy-duty terminal connections and making other hard-to-reach point contacts.

SPECIAL ADVERTISING SUPPLEMENT

★ ★ ★ TEST EQUIPMENT SHOWCASE ★ ★ ★

Hameg Instruments, Inc.
1939 Plaza Real
Oceanside, CA 92056
Phone: 1-800-247-1241
Fax: 619-630-6507

SPECTRUM ANALYZER HM5005/5006

Hameg Instruments announces a new low-priced Spectrum Analyzer HM5005/HM5006 to be manufactured in their Oceanside, CA plant.

Hameg has been manufacturing and selling high-quality/reasonably-priced test instruments for over 30 years. Their German engineering continues to set new standards of quality and performance throughout the world.

The HM5005/HM5006 Spectrum Analyzer is the ideal instrument for analyzing signals of any kind within the frequency range of 0.5 to 500 MHz. Both models are equipped with a scanwidth selector allowing 50kHz/ div. through 50MHz/div. The higher resolution derived from this feature permits the analys s of narrow band signals in lower ranges.

An additional and very essential feature is the ability to determine amplitude levels of the displayed signals. The entire measurement area, including the switchable attenuators, covers the range of –100dBm to +10 dBm, whereby 80dB (10dB/div.) is within the display range of the CRT. Accurate level measurements can be performed in "Zero Scan" mode.

Both models are equipped with a 4-digit LED readout and can selectively display either Center or Marker Frequency. If Marker Frequency is selected, a dot is added on the screen to facilitate frequency determination.

The model HM5006 includes a Tracking Generator which allows frequency response measurements on external circuits. It is a frequency-synchronized signal source which is controlled by the spectrum analyzer with a frequency range of 100kHz to 500MHz. The output level is between –50dBm and +1dBm is 10dB steps and has a variable level control.

The Spectrum Analyzer is priced at $1,048 for the HM5005 version and $1,398 for the HM5006 version. These analyzers are easy-to-use, cover a large number of RF applications, and are ideal for field work, production and laboratory.

For more information, contact the HAMEG sales department at 1939 Plaza Real, Oceanside, CA 92056 at 1-800-247-1241. (Fax 619-630-6507).

SPECIAL ADVERTISING SUPPLEMENT

★ ★ ★ TEST EQUIPMENT SHOWCASE ★ ★ ★

Print Products International
8931 Brookville Rd.
Silver Spring, MD 20910
Phone: 800-638-2020
Fax: 800-545-0058

Print Products International is a premier distributor of equipment, tools and supplies for electronic maintenance and service. Print carries such lines as Pace desoldering, soldering and surface mount systems, Leader, Hitachi, B&K, Kenwood, Simpson, Beckman, Triplett, Global Specialties, and Hameg test equipment, as well as brand name tools for field service and depot repair.

Print lives up to its logo "we make ordering simple." With our friendly staff, toll-free phone and fax, huge inventory, and quick processing of orders, it is no wonder that Print has become the "source" for electronic test equipment.

Due to our huge buying power, Print is able to claim that we are the most competitively priced equipment distributor in the country. Print buys in large quantities, and passes these savings on to their customers. As our sales staff says, "If you didn't buy it at Print, you've paid too much!" Because of this buying power, Print sub-distributes equipment to other distributors.

Print accepts VISA, Mastercard, American Express, and COD orders. Open accounts are available to rated firms. Print will ship your order UPS Ground, UPS Blue, UPS Red, Federal Express, or whichever carrier you request. A 10-day trial is available on all equipment.

Remember, when you need test equipment—think Print! "We make ordering simple."

A toll-free phone 800-638-2020 and toll-free fax 800-545-0058 are available for your convenience. Please contact us for our free catalog.

SPECIAL ADVERTISING SUPPLEMENT

What Do You Know About Electronics?

More about graphical solutions

By Sam Wilson

Here is a safety micro quiz: which of the symbols in Figure 1 is for a fire extinguisher that can be used on electrical fires?

Use the wrong fire extenguisher and it could be Big Casino! The symbols in Figure 1 have been adopted by the National Fire Protection Association (NFPA). It would be a good idea to know all of them. Check your knowledge about this important subject at the end of this article.

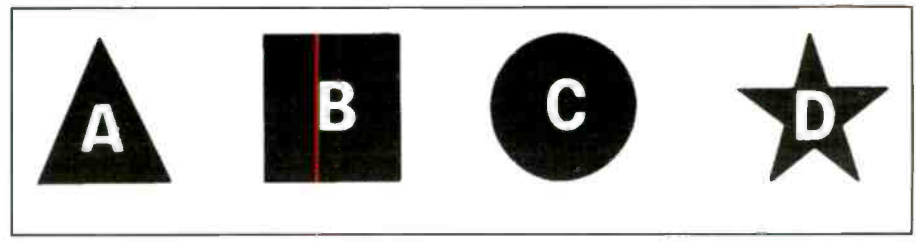


Figure 1.

Letters

I have organized the letters I get from readers into designated piles:

- Those I have answered.
- Those I still have to answer if I can ever find the time. (This pile is growing out of control.)
- Those I refuse to answer because they are insulting and not professional (They go into the wastebasket.)
- The letters I want to talk about now. They are the letters I have no idea how to answer. The quotes are taken from a few of those letters.

"Series and parallel tuned circuits are the same—period!"

"Regarding the equation dB = 20 Log V_2/V_1. I have used this equation for many years without ever having to correct for differences in impedance."

For some reason that last one reminds me to tell you that I have driven many different kinds of cars and many miles and I have never used the emergency brake in an emergency. I can't help but wonder if I'm like the person who wrote that last letter. Is there something that I really *should* know?

Here is one from Arizona that completely boggles my mind: "I read ES&T magazine but I never read your stuff. All you do is write about the things that technicians don't know about."

Wasn't it Argle D. Bargle who wrote a column about things everyone already knew about? Whatever happened to him?

This one is about an article I wrote in 1977 on how a laser works. "Technicians don't need to know anything about lasers. They will never be used in home entertainment equipment."

Here is one that applies to this month's subject—graphical solutions. It came a few years ago. "If you really knew how to do math you wouldn't need graphical solutions." The reader then proceded to work a problem I had solved graphically in WDYKAE? He made a mistake in his math solution!

Wire hardening and another million dollar idea

Readers of WDYKAE? know the name Ken Muncey. He is one of the two judges of the contest in which you were to solve an equation for time (t). The solution to that problem is given elsewhere in this month's column. He has been a technician in the military, a quality control inspector, and a quality spokesman for a toy company. He has a story for every occasion you can dream of.

Recently we were talking about test procedures. He had a story to tell. He told me about a test procedure for military tanks. The equipment was tested at nearly 500 amperes. A cable of stranded wires packaged in a sheath carried that current.

The cable was flexible until it carried the high current. When heavy current was flowing the cable became stiff as a board.

Think about this—each strand in the cable was carrying a very high current. Each was surrounded by a resulting magnetic field. Since the currents in all the strands were all flowing in the same direction their magnetic fields would repel each other. That forced the wires to repel each other and repel against the sheath.

Here's something else to think about—you can make a piece of stranded wire that is flexible until a current flows through it. I'm sure you can make one that works at a current a lot lower than 500 amperes.

Let your mind roll over some possible applications. Here is one example: a spring with a tension that varies with current.

Some day a WDYKAE? reader-turned-millionaire will write and say how he owes it all to a story he read in this issue.

Regarding your calculations

I have received a few letters saying that some of my calculations have been off—in the 9th, 10th, and 11th decimal place!

We have to make a few rules here. An answer cannot be more accurate than the number of digits in your multiplier, divisor, minuend, etc. I have been giving more digits in my answer to give you a chance to see how close you could come to that answer. I'm going to start rounding off to three digits.

Here is an example. Suppose you are working a problem that requires you to raise the value of π to the fourth power. We will assume this is part of a longer problem. Your answer is affected if you use 3.14 instead of the more accurate 3.14159265. Round the answer off to three digits.

(round off π to 3 places: $(3.14)^4 = 97.2$)

(do not round off π: $(3.14159265)^4 = 97.4$)

Now, before you write and ask for a problem where you have to find the fourth power of π, let me take care of that query right now. It will save a lot of postage.

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

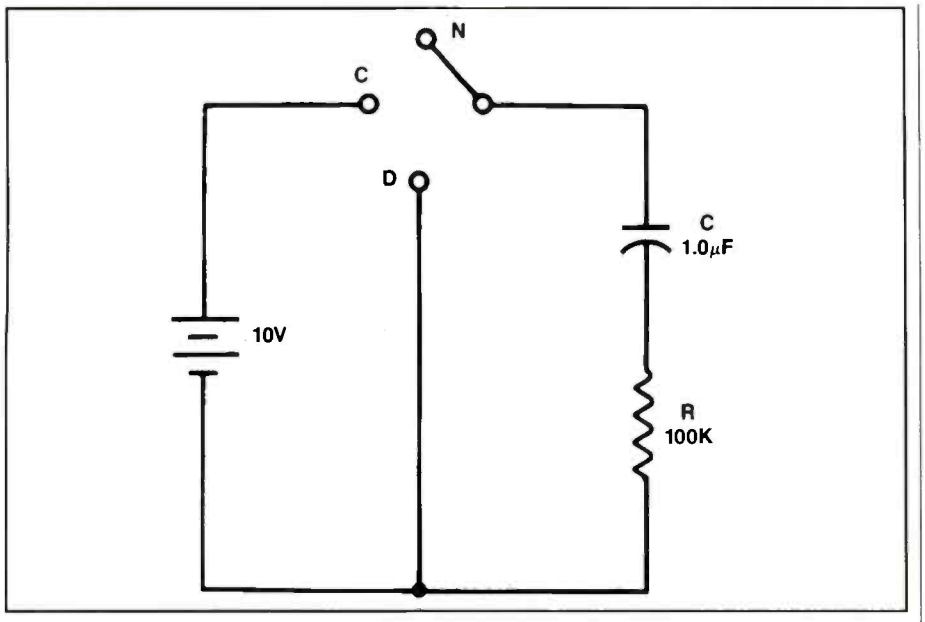


Figure 2.

Problem: What do you get when you raise π to the fourth power?

You didn't think I could do it, did you?

Solutions to last month's "second problem"

Here is the problem that was given:

How long does it take the capacitor in the circuit of Figure 2 to reach 5.5V after the switch is changed from position N to C? It was assumed the capacitor was uncharged before the switch was operated.

Let's do a simple graphical solution first. It is shown in Figure 3. All you have to do is find 5.5V on the (vertical) voltage axis. Go to the right until you get to the curve. Then move down until you get to the time (horizontal) axis. The answer is shown to be 0.08 seconds.

Now for the mathematical solution. Fasten your seat belts. There are two basic laws in algebra that say:

$\ln \in = 1$, and,

$\ln V^{\ln X} = X$

I have said this before and I think this is a good place to repeat it. If you want to become proficient in math take the time to learn the laws of math. Then, working a problem is a matter of applying the laws. I'm talking about applied math here.

Given: $V_C = V[1 - (\in^{-t/RC})]$

Where: $V_C = 5.5V$, $R = 100K$, $C = 1\mu F$, $V = 10V$

Therefore,

$5.5 = 10 - 10[\in^{-t/(100 \times 10^3)(1 \times 10^{-6})}]$

Observe that everything in this equation is known except t.

$4.5 = 10/(\in^{t/0.1})$

$4.5 (\in^{t/0.1}) = 10$

$(\in^{1/0.1}) = 10/4.5$

At this time, take the ln of both sides of the equation.

$\ln(\in^{1/0.1}) = \ln 2.22222222$

$t/0.1 = 0.7985077$

$t = 0.07985077$ (answer) That's about as close to 0.08 as you're going to get!

I'm not trying to turn this into a column

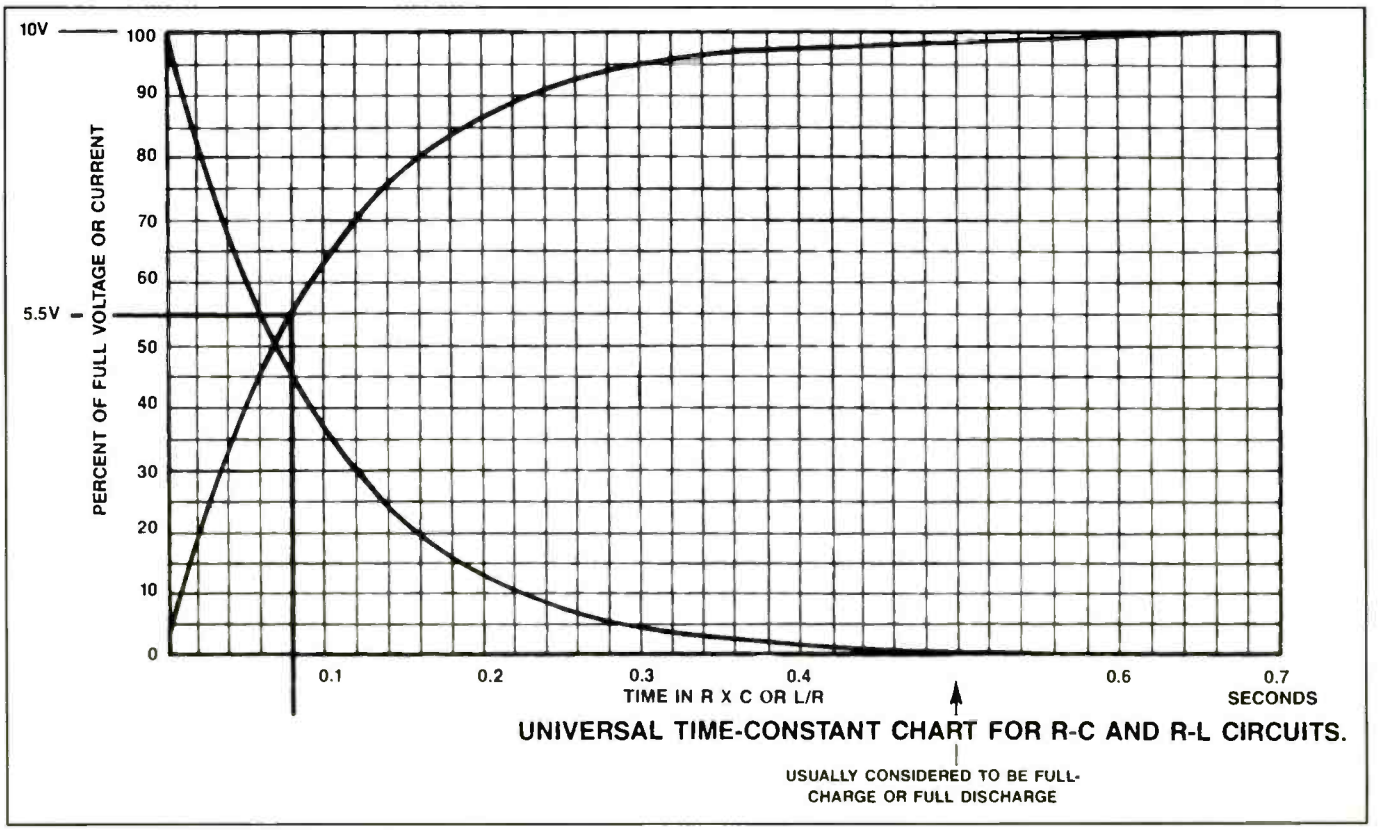


Figure 3.

titled "Mathematics for electronics." I tried that once and it went over like an iron dirigible. But, I think this problem proves my point that the graphical solution is sometimes much easier, sufficiently accurate, and easier to understand than the math solution.

I know that some readers do not like the math, and they will skip over the steps to find the bottom line. That still proves my point. Get out a ruler and measure the lines for the graphical solution. Then, measure the lines for the math solution. You will see that the graphical solution is easier.

For those dynamic readers who can't follow some of the math steps, but, who really want to know how the problem is worked—send a stamped, self-addressed envelope and I'll send the math solution with the steps broken down into more detail.

Finally, for those few die-hard readers who are getting ready to send a letter asking when it would be necessary to work a problem like this, the answer is simple. It occurs when you get a problem like the one just worked.

Answer to safety micro-quiz

The one marked "C" is for Class "C" fires. Class "C" fires occur in, or near, electrical equipment. *Do not use foam or water streams on these fires!* (A very fine spray may be used if there is no extinguisher available.) The reason for the caution is the possibility of a very severe shock. Electric current can flow up to the source of a foam or a water spray because they are electrical conductors. A very fine spray is not a very good electrical conductor so it is not likely to result in injury to the person directing it onto an electrical fire.

Here are the other classes of fires defined—

CLASS A: Oridinary combustibles such as paper, rags, wood, etc.

CLASS B: Flammable liquids such as gasoline, oil, paint, thinner, etc.

CLASS D: Combustible metals such as sodium, lithium, magnesium, etc. *Do not use any other type of extinguisher on this type of fire!!!*

You really need as much information as you can get on types of fires and fire-fighting equipment. The National Safety Council (425 North Michigan Ave., Chicago, IL 60611) has a booklet on this subject matter.

That is the latest address I could find.

Solution to the high crime rate problem

I know—it isn't electronics. However, I think you should consider my solution. The crime rate is based upon statistics and the statistics are based upon the number of arrests in a given time. For that reason, every time you add a policeman to the force the crime rate goes up. When a policeman retires the crime rate does down.

Obviously, you can completely eliminate the crime rate by eliminating the police force. (Why hasn't anyone come up with this simple solution before?) ■

Symptoms of CMOS battery failure—Part 3

By David Presnell

The past two installments of Computer Corner, in the October 1993 and the November 1993 issues, discussed CMOS RAM, and the battery used to maintain the information that is entered into this RAM to tell the BIOS how the computer is configured, and presented a case history of the author's experience with a failing CMOS battery. Also included was a description of how the author replaced the battery and got the system back up and running again.

This installment describes how to confirm that a problem is caused by CMOS battery failure, and, in general, how to install a new battery and restore the configuration information that was lost when the battery failed.

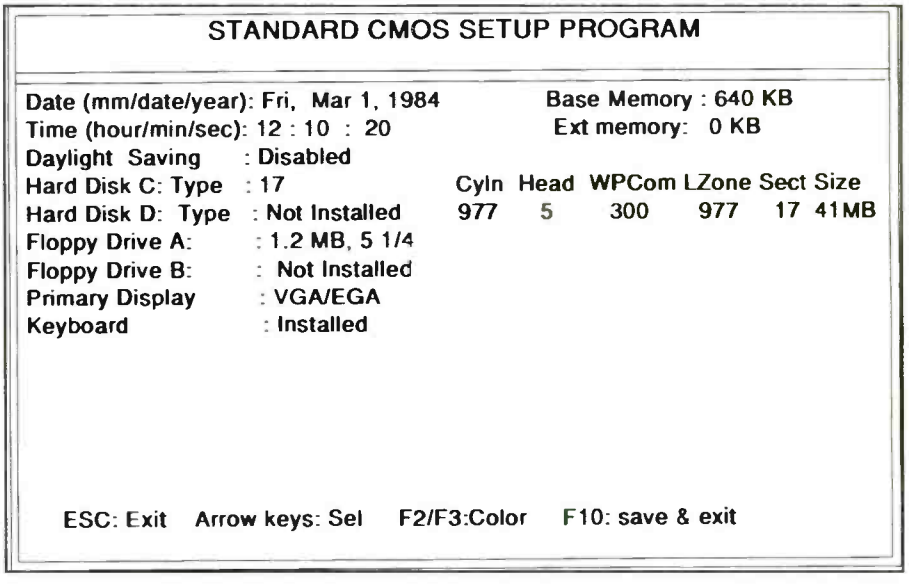


Figure 1. The software that allows the user to enter the system configuration information into the computer is called the Setup program

Symptoms of a CMOS battery failure

When the CMOS battery fails, the CMOS setup information located in CMOS RAM will be lost. The next time the computer is turned on, the computer will return to its burned-in BIOS default setup that generally includes a floppy drive and a monochrome monitor. In such a case the hard disk will not be recognized by the BIOS ROM or CPU. Moreover, if the system includes a VGA monitor or a second floppy drive for which the BIOS requires setup, the BIOS ROM will not recognize them either.

When the customer turns on the system with a dead CMOS battery, they will first assume that something is wrong with the hard drive and call you for service. An unrecognized hard drive is the most common problem, combined with the fact the system will be requesting the setup program on an attempted boot.

Another symptom of a dead CMOS battery on older AT systems (at power on) is that the monitor will respond with a 40-column display, (common as a burned in default before AT standards were set).

Most AT systems will show an on screen "BIOS ERROR" message and prompt you to press F1 to enter setup. Some systems will require you to press CTRL+ALT+ESC or CTRL+ALT+minus key or the DELETE key to enter the burned-in setup program. Some systems will take you directly to the setup screen upon power on.

If it's an original IBM AT, (and a few older clones), you may be instructed to "Run setup utility disk to continue." In this case you will need the manufacturers original "setup disk," (possibly called setup and diagnostics). To use, you should power down and install this disk in drive A: and power on the computer. Most setup disks are bootable. If this one is not, you will have to boot from a DOS disk of the correct version and run the setup disk from the A: prompt. Either way you should now have a CMOS or BIOS setup screen on the monitor.

What the setup screen says

Look over the setup screen. You may be looking at the final screen which shows you the date, time, disk type, monitor type, and other information (see Figure 1). You can use the arrow keys and Page Up/Page Down keys to move around and change setup on most modern setup screens. Current CMOS setup programs will start with a main menu. Select the one that says Standard CMOS Setup.

You will usually be given a warning screen asking you if you wish to continue. Follow on-screen instructions to continue to the final standard setup screen where you can make changes. Some may have F1 help available; use it. Look over each screen carefully before acting. It could save you a lot of starting over.

Once you have the final standard setup screen on your monitor, look at the date. It should be current (or very close to it). If it's an old date, possibly in the early 80's, then your CMOS battery is proba-

Presnell is owner of an independent computer servicing business and a freelance technical writer.

bly dead. You will also note "No hard disk installed." Other configuration data may be incorrect from the CMOS data table.

When finished, you usually have to press ESC to exit the program. You will return to the main menu (in modern programs) where you will be given the choice to save the new setup in CMOS RAM.

It's quite possible to come across an old upgraded system that will not even boot from the floppy drive. If you're not getting beeps or error codes to suggest otherwise, look for an installed lithium battery, possibly on an add-on card. This could be your culprit.

Making the repair

Power down the computer and using precautionary static sensitive handling procedures, locate the CMOS battery. If you can get to the contacts, take a dc voltage reading with the battery still in place. If the reading indicates the proper voltage, it's possible that the battery is good, but a trace is bad. Also, there may be a loose connection on one of the traces leading from the battery to the CMOS RAM sections.

Least likely, but still within the realm of possibility, a section of the CMOS RAM may be defective and possibly even the BIOS ROM chip itself. More likely than not, however, the battery will be low or dead. Determine the best way to remove the battery. Some are plugged in, some clipped in, and some are soldered in place.

Carefully note the location of all plugs, connectors, and jumpers. Also, note the orientation of the (+) and (-) leads of the battery. Installing a new one backwards can lead to more stress than you care to have, so look before you yank.

Finding a replacement battery

Once the battery is removed, try to determine its type or number. Some older batteries can be hard to find. Contact your parts supplier for a replacement. In a few rare cases, you may have to contact the manufacturer for a direct replacement.

In modern AT boards, you may have the choice of using either the onboard 3.6V battery, or (by changing a jumper setting), using an external plug in 6V battery pack. In other rare cases you may have no choice but to make your own battery pack and wire it to the motherboard.

If it gets that drastic, use care. You could easily make the motherboard useless. Generally, a motherboard is multilayered with traces on each layer. Too much heat from a soldering iron and the motherboard could be hopelessly gone. Also, always use static handling procedures when working on a computer motherboard. CMOS RAM chips are very susceptible to static damage.

Placing the computer back into operation

Once you have your new battery correctly installed, power up the computer with a boot disk (or setup disk if required) in drive A. Return to the CMOS setup screen. As a quick check, set the date and time; then exit (ESC) and save the new CMOS data as instructed on screen.

Shut down the system and boot with a DOS disk in drive A. Type date at the A: prompt. If your new battery installation is working as it should be, you now have the correct date showing. Try the time also. This should indicate that everything is working. Now go back to your BIOS setup screen and setup the hard disk type.

If you don't know the hard disk type

you may be able to refer to a hard disk reference manual or a hard disk database such as Diskbase (from Landmark Research) to find the information you need. The hard disk type numbers used by one BIOS chip manufacturer are not necessarily the same as the type numbers used by another manufacturer. Thus, type 30 from one manufacturer may be totally different than a type 30 from another manufacturer. You might also try contacting the hard disk or computer manufacturer for this information.

CMOS setup utility software

Another choice, and my favorite, is to use software programs designed to setup the CMOS for you. DOSUTILS is one such program available from Ontrack Computer Systems. DOSUTILS is a collection of diagnostic and hard disk utility programs designed for professional users. You can perform many procedures including data recovery with DOSUTILS. Every computer service technician should obtain a copy. Disk Manager also from Ontrack, is an excellent program to use to setup a new hard drive and to get an old one going again. There are many other excellent programs that will do this for you as well.

Be careful not to use just any AT setup disk with any computer. Often setup disks were designed to work with a specific brand of computer. You can, as I have done, fill the CMOS RAM with data that's so bad that the system locks up tight. So tight, in fact, that the only way to recover from this corrupted CMOS situation is to power down and remove the CMOS backup battery you just installed and allow the CMOS RAM to lose its data, then start all over.

Some manuals will suggest you remove the battery and short the motherboard battery post to quickly erase the RAM. The idea is to discharge the voltages remaining in the capacitors on the motherboard. I have done this in the past, but things can go wrong, especially if you forgot to power down. I suggest you remove the battery and go take a break. You probably at this point need it. In a few minutes the system will be ready for you to start all over.

If the computer you're working on requires a setup disk, try to obtain it from the customer. Otherwise, use Disk Manager, DOSUTILS, or an equivalent program. Run the program (Disk Manager, DOSUTILS, etc.) as instructed in the user's manual. If all goes well, you will have set up the standard BIOS data table and preserved it in CMOS RAM with the help of your newly installed CMOS backup battery.

Checking your work

Reboot from drive A, and return to your setup screen. Look to see if it shows a hard disk installed. Note the type (write it down). In fact, if all works well, record the BIOS hard disk information onto a small label and place directly on the case of the hard drive for future reference.

Now go to the A: prompt again. Type C:\ and press ENTER. You should now have a C:\ prompt. If you don't you may certainly have to contact the drive or computer manufacturer to get the setup information you need. Also, you will generally need to boot from the same DOS version that is located on the hard disk to make everything work.

At the C:\ prompt, type DIR and press enter. You should now see a listing of the customer's original files that were initially on the root directory of the hard drive.

As mentioned above, at some point you may get the message "Incorrect DOS version." If you do, the floppy disk you booted from is not compatible with the DOS version on the hard disk. If this occurs, try to obtain the original DOS disk from the customer. If they cannot find it, as usual, try a PC-DOS version rather than MS-DOS, or try an earlier version of either or both, around DOS VER. 3.2. It is possible that the hard disk was prepared with an operating system other than DOS, in which case you will have to obtain the original system and operation disk.

When done, try to boot from the hard disk. If the computer boots then your job is finished.

Next time

When nothing goes as it should, there are drastic measures you can try, but only as a last resort. Under no circumstances should you partition or format the disk drive. Also, there are some "tricks of the trade," including some other helpful software utilities. We will discuss some of them in our next, and final installment of this Computer Corner series. ■

Books

Troubleshooting and Repairing PC Drives and Memory Systems, by Stephen J. Bigelow, Windcrest Publishing, 304 pages, $22.95 paper, $34.95 hardcover.

This reference for computer technicians, students, and hobbyists offers professional and reliable, up-to-date troubleshooting and repair guidelines for all types of PC storage and memory devices. Bigelow shows how to repair or replace hard drives, backup drives, RAM ICs, SRAM and DRAM chips, floppy drives, CD-ROMs, expansion SIMMS, and FLASH cards.

Readers learn how data storage and memory equipment operates, and the importance of regular cleaning, maintenance, and alignment to the long, trouble-free life of drives and memory media.

PC Drives also covers new tools, test equipment, and diagnostic software and includes consolidated troubleshooting charts, vendor listings, glossary, and a schematic symbols chart.

Windcrest/McGraw-Hill, Blue Ridge Summit, PA 17294-0850

Color and Black & White Television, Theory and Servicing—Third Edition, by Alvin A. Liff and J.A. Sam Wilson, Regents Publishing, 592 pages, $50.00 hardcover.

This book is directed to those who wish to become troubleshooting television electronics technicians. It is written with the assumption that the reader has already completed courses in basic electronics and both AM and FM radio receivers. The treatment is essentially nonmathematical and is presented in an easy-to-read format.

The first chapter contains a description of what service entails, a list of test equipment required, and a list of basic troubleshooting procedures. Subsequent chapters cover the black and white TV system, color TV, the front end, AFT and remote control circuits, video IF amplifiers, AGC and noise canceling, TV sound, picture tubes and associated circuits, video amps, low-voltage power supplies, sync separators, deflection oscillators, vertical and horizontal deflections, color sync, color demodulators and videotape recorders.

The book contains many illustrations, including schematic diagrams of TV circuits with component values, which assist readers in understanding the theory of TV circuits and developing a solid troubleshooting technique.

Regents/Prentice-Hall, Englewood Cliffs, NJ 07632

Solvent Waste Reduction and Recycling: Practical Advice for Small Business, compiled and available by the Iowa Waste Reduction Center at the University of Northern Iowa, 56 pages, $10.00 paper.

This easy-to-read manual outlines practical reasons for reducing and recycling waste solvent, and contains chapters on good management and operating practices, process and material modifications, and recycling technologies.

Appendices include information on EPA requirements and regulations for solvent waste disposal, testing parameters, labels and manifests.

The Iowa Waste Reduction Center provides free, confidential, non-regulatory technical assistance to small businesses in reducing and managing their wastes: solid, hazardous, infectious, air emissions and waste water. The $10.00 book price covers printing costs.

For order information, contact the IWRC at 800-422-3109

Iowa Waste Reduction Center at the University of Northern Iowa
Cedar Falls, Iowa

Troubleshooting and Repairing Computer Printers, by Stephen J. Bigelow, Windcrest, 320 pages, 241 illus., $22.95 paper, $32.95 hardcover.

This book provides advanced maintenance and repair information for all types of printers in use today. With the help of many diagrams, photos and illustrations, Bigelow discusses each component in detail, describing how it works and how it interacts with the computer and other system components.

Step-by-step, Bigelow guides his readers and explains how to use test equipment such as multimeters, logic probes, and oscilloscopes to identify and repair or replace faulty printer components, such as print heads, parallel interfaces, the memory, main logic, paper transport systems, ribbon transport systems, linear and switching power supplies, serial interfaces, driver circuits, resistive, mechanical, and optical sensors, carriage transport systems, and more.

This book also describes malfunctions that result from hardware and software incompatibility rather than mechanical or electrical failure—and it includes a time- and money-saving focus on preventive maintenance.

TAB Books/McGraw-Hill, Blue Ridge Summit, PA 17294-085

EMF—Electromagnetic Fields: Scientific and Legal Aspects, by Edwin F. Froelich Esq., James D. Hamlin, Matiaf F. Travieso-Diaz, published by Shaw, Pittman, Potts & Trowbridge, 29 pages, $5.00 paper.

The Washington, D.C. law firm of Shaw, Pittman, Potts & Trowbridge recently announced that three of its attorneys have jointly authored a handbook entitled "*EMF—Electromagnetic Fields: Scientific and Legal Aspects*," which summarizes the present state of scientific knowledge regarding the effects of electromagnetic fields generated by electric currents as well as litigation and regulatory developments relating to EMFs.

The rise in public concern about potential health hazards from EMFs has resulted in increased regulatory and judicial attention to the matter. Electric utilities, appliance and electronic equipment manufacturers, real estate developers, health care providers, and employers utilizing computer and office equipment, are among the organizations that have been the subject of public concerns about EMF exposures. The handbook is intended to provide easy-to-understand information that is useful to those subject to EMF concerns.

Shaw, Pittman, Potts & Trowbridge, Washington, D.C. 20037-1128

Digital Oscilloscope Handbook, by C.G. Masi, Butterworth-Heinemann publishing, 250 pages, $34.95 hardcover.

This is a new comprehensive reference on the use of digital scopes as well as an introduction to digital oscilloscopes for experienced digital scope users seeking a deeper understanding of these instruments.

Starting at a level comprehensible to anyone with an electronics background, it covers everything from basic principles to a detailed look at the circuitry that makes digital scopes work. Its broad coverage includes offerings from all major vendors as well as most classes of applications.

The contents of the handbook included hardware fundamentals, digital oscilloscope circuitry, digital oscilloscope specifications, principles of operation, basic measurement principles, waveform mathematics, and data acquisition.

To order a copy, call toll-free 1-800-366-2665 or write: Butterworth-Heinemann, 80 Montvale Avenue, Stoneham, MA 02180.

Butterworth-Heinemann, Stoneham, MA 02180

Should you become a sound contractor?

By Ron Johnson

For the company that is willing to jump in with both feet, there is money to be made in sound contracting and intercom systems. On the other hand, trying to dabble with this stuff could be a quick way to put you into the red. Really, sound contracting is a business unto itself, with some unique problems and opportunities. But, if you have an interest and are willing to operate a bit differently than the average service organization, this area could be for you.

Look before you leap

As always there are several considerations you should look at before plunging in. Some of them are technical, some business oriented, all important if you expect to be successful.

To start with, sound contracting requires a heavy emphasis on sales. To do it right somebody has to be constantly selling. Your salesman not only sells service and installation, but also a complete line of professional products. He must be a good salesman: persuasive, articulate and knowledgeable about product, installation, service and estimating.

Your company has to acquire, and maintain, dealership status with several manufacturers or distributors of equipment. You must be equipped with the necessary tools and test equipment for installation work and have transportation and personnel to do the installation on the customer's premises.

Estimating and bidding

As in most contracting businesses, the salesman must be able to estimate and bid for contracts. This takes time, skill and attention to detail. Punch one wrong button on the calculator and your profit margin is gone. And one of the easiest mistakes to make is in cost accounting.

Often the salesman does a great estimate, sells the job, and sees it installed and operating, then moves on to sell the next one. But somebody has to add up what it really cost to do the job. Did the cost of materials come in within the cost he projected? Was the installation done within the expected time frame? In other words: did you really make any money on the job? It doesn't take many mistakes to eat up the profit margin in contracts like these. And if you don't do this kind of after-the-fact calculation, you won't know until it's too late.

Sound contracting is competitive, especially in recessionary times. Churches, schools and other institutions—some of your main markets—operate with tight budgets at the best of times. If you can't do the job within their budget, you're out of luck.

The people who have been in sound contracting for a while know how to bid, know what the pitfalls of certain jobs are, and know exactly what margin they need. The outfits who are new, experienced or just dabbling in the field tend to underbid, making it hard for the established companies to get enough work. They may go out of business within six months or a year but there always seems to be another one popping up to try their hand at it.

Everyone is an expert

Another aspect of sound contracting that makes it difficult is that everyone is an expert. There's always somebody around who claims he can do a better job than you for half the price. Usually this is the person who owns the biggest stereo system on the block and built a set of speakers out of two-by-fours and some paneling. He knows just enough to make himself dangerous to you, the customer and himself.

How do you establish credibility so you are noticed above this crowd? The only answer I can come up with is: *be careful*, the same as in any business. Do a good job, at a competitive price; give good service and steadily build a reputation. You can't go into sound contracting for the short term.

All this sounds pretty negative, but a healthy caution could save a lot of headaches later on. The other (positive) side of the coin is that you know how to run a business. You probably have personnel, some expertise, transportation, test equipment and some contacts in the field.

So, assuming you've decided to give sound contracting a try, what should you know to walk into it with your eyes open?

Well, first consider what I've mentioned so far. No matter how much you like working in this area, or how good you are at it, or even how many jobs you get, if you're not making a profit you won't last long. But we'll also assume you're past that hurdle.

Enhance your skills and knowledge

One of the most successful sound contractors I ever knew told me "knowledge is money"—but I didn't believe him. What he really meant was: "if your customer (and everybody else you talk to) thinks you have a lot of knowledge, it will make you money." He was one of those people who could talk circles around the customer and come away looking like the world's foremost expert.

Part of successful sales in this, and other technical fields, is convincing the customer that you are the best. You can do this by sounding knowledgeable. There is a catch to this, of course. It helps if you really are knowledgeable, especially in order to deliver the goods. Reputation is everything, and you're only as good as your last job.

Johnson is a journeyman electronics servicing technician and an instructor of technology at the Northern Alberta Institute of Technology in Edmonton, Alberta, Canada.

Read some good books

One starting point that I recommend is to obtain a copy of a book by Don and Carolyn Davis called "Sound System Engineering," put out by Howard W. Sams & Company. This is a standard in the industry, a textbook really, covering the basics of how sound works and how to make it work for you.

Even if you are somewhat knowledgeable about the whole area of sound, this book looks at it from the sound reinforcement angle rather than the hi-fi side of audio. It covers topics such as: audio systems, the decibel notation system, loudspeaker directivity and coverage, the acoustic environment, designing for acoustic gain, interfacing the electrical and acoustical systems, installing the sound system, and much more. If you read this, study it and understand it—you'll establish a good foundation to build on.

Another good book is called "Handbook on Estimating." It is geared specifically toward the sound contractor and covers topics such as: estimating and accounting, surveying the job, labor analysis, material costs, computing profit and overhead, and much more. It isn't a large book but it is very useful.

Know the equipment and your competitors

Next you have to get familiar with all (including your competitor's) major lines of commercial and professional sound equipment. You need to know the advantages and disadvantages of each, the features and comparative pricing. You also need to know who your local competitors are and their strengths and weaknesses.

After that you have to develop contacts in the industry: potential customers, sales reps, design and construction engineers and architects. You should subscribe to industry publications and join any local organizations that can further your cause.

Starting out

You can do a lot of preparations while carefully testing the waters for contracts. I recommend starting small. Maybe even volunteer your help for free at your church or at your child's school. They'll probably appreciate the help and you can get some practice in the skills that aren't part of what you do now. You can also "play" with the equipment and experiment to see what works the best.

Your next step might be to look for a small installation where the material and labor costs are easily controlled. Background music systems in restaurants or small grocery stores fall into this category. A tape deck or CD, a small background music amplifier, a couple of microphones, and some ceiling speakers can make up a typical small, grocery store system. One person should be able to install it in less than a day. Actually, systems like these can become some of your most profitable jobs in contracting. I've made more clear profit from a $2,500 background music system than on some of the $10,000 systems that take much more time to install.

Managing growth

As you build up skill, confidence and a good reputation you can move into larger systems. But remember: the larger the job, the more that can go wrong, both technically and from a business perspective. Try not to experiment on the systems where a large profit and your reputation are at stake. This is pretty difficult to accomplish because in sound contracting every system is unique and every acoustic environment is unique. Sometimes your best design will have to be modified to accommodate a particular aspect of the room or the customer's needs.

Finally, don't compromise on your components or the quality of your installation. It's sure to come back to haunt you. Every job becomes an example of your ability to deliver, even if the short cuts were your customer's ideas. Better to walk away from a contract that has a high risk of becoming a liability to your reputation than to leave behind an example that makes you look bad.

In a future issue, I'll take a look at the technical aspects of sound contracting. What makes it different than consumer audio and some of the pitfalls to avoid in installing commercial sound equipment.

New tool for working with composite video

Ultech Corporation has introduced the TV Trigger Mate—a new tool for working with composite video. The unit provides a stable trigger for oscilloscopes. It is able to sync on weak and copy protected video and is unaffected by VCR head switch noise. The product works with NTSC, PAL, & SECAM video.

The trigger offers individual line selection as well as combinations of four color fields (in NTSC there are four color fields differentiated by the phase of the color subcarrier). It can trigger on all fields, odd fields (1 & 3), even fields (2 & 4) or individual fields (1 & 4). It can trigger anywhere within a TV scan line in increments of 125nS with a maximum jitter of ±8nS.

A useful feature is its blinking marker signal available at the video output connector. The marker flashes a pixel on a TV or monitor that corresponds to the trigger point. The marker can provide coordinates of objects on the screen such as text boxes.

The device also provides horizontal, vertical, field, and composite sync from an incoming video signal. These outputs are available on rear panel BNC connectors or front panel probe terminals.

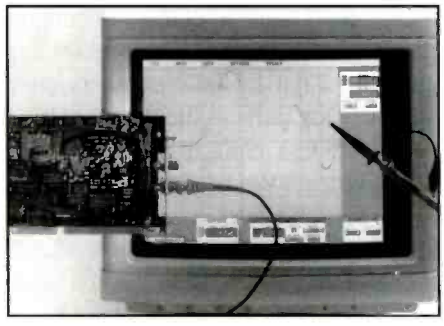
The accessory is useful for developing and testing video products in areas such as multimedia, TV receivers, VCRs, on-screen display systems, video editing equipment, teletext, closed captioning, cable and satellite TV, extended data services, and video compression.

Circle (85) on Reply Card

Oscilloscope cards for personal computers

The 420 and 430 series of oscilloscope cards from *PC Instruments* combine the features and performance of portable oscilloscopes with the convenience of the personal computer. The cards, which occupy one PC/AT expansion slot, provide 200 MHz bandwidth, 500 ps/div minimum timebase setting, and 200 gigasample/second equivalent sampling rate.

The single channel 420 series and the dual channel 430 series also provide seven voltage ranges, ac/dc coupling, dc offset and a probe compensation signal. Also included are 27 timebase settings



from 500ps/div to 200 ms/div, and an automatic trigger level algorithm to quickly establish a valid trigger level.

BenchCom software is included with every oscilloscope card and provides test engineers and systems integrators the tools necessary to integrate the scopes into their test environment. The software provides the ability to view and print the waveform, translate the waveform data file to an ASCII list or spreadsheet format, and control the oscilloscope card from DOS (Basic, C, C++, Pascal) and Windows applications. The command set utilized by the software is based on the SCPI standard. Also available is the optional BenchTop software, which provides a "point-and-click" graphics user interface with the ability to store and recall waveforms, store and recall test setups, and easily change settings without needing to learn the command syntax.

Circle (86) on Reply Card

Linear power supplies

American Reliance introduces five new models of power supply with power output ranging from 30W to 165W: the LPS series. Each model is controlled by an internal microprocessor and all data entry is performed via a front-panel keypad to simplify operations. The output voltage and current can be monitored by

the built-in LCD panel and an optional RS-232 interface allows remote talk and listen control. Other key features include a voltage/current step up/down function, power-off memory for voltage and current settings, output enable/disable, and an intelligent forced-fan cooling system (except the LPS-301).

The LPS series includes two models which are dual-range single-output designs rated at 30V/1A or 15V/2A for the LPS-301 and 30V/2A or 15V/4A for the LPS-302. The LPS-303 is a single-output unit rated at 90W with a voltage output of 30V and a current output of 3A. The LPS series also includes two triple-output models with two independently variable channels and a fixed-output channel: the LPS-304 offers two 30V/1A outputs along with a fixed 5V/2A output while the LPS-305 offers two 30V/2.5A outputs in addition to a 5V or 3.3V output at 3A.

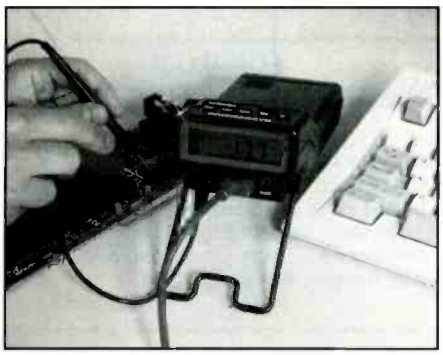
Circle (87) on Reply Card

Talking DMM/thermometer

A portable DMM/Thermometer from *Omega Engineering* speaks. A remote control voice annunciation feature reads measured parameters.

The "Smart Meter" is suited for applications in instrumentation, metrology, and product development laboratories or as a portable troubleshooting instrument. The meter is capable of measuring an extended range of electrical and temperature values while annunciating the readings in a choice of one of five languages.

The meter features basic 0.25% dc and 2% ac accuracy and reads true RMS ac voltages and currents. The electrical measurement capabilities include five ac/dc voltage autoranges from 400mV to 1000V, two ac/dc current ranges from 400mA to 4A and six resistance autoranges from 400Ω to 40MΩ. The temper-



ature measurement capabilities include twelve °C/°F ranges from -200C to +1372C (-328F to +2500F) with 0.1C resolution to +1000C.

Circle (88) on Reply Card

Desoldering braid

Philips ECG introduces a high-performance desoldering braid designed for quick and efficient solder removal.

The Zip Wick desoldering braid is the latest addition to the ECG electronic accessories product line which consists of

aerosol chemicals and solder products. Made of the finest copper braid, Zip Wick is fast, consistent, efficient and leaves 25% less residue than most other brands.

The new desoldering braid offers high thermal conductivity, fast capillary action, high surface area per square inch, and minimal potential heat shock. By using only pure type "R" rosin, the braid also conforms to the most stringent soldering standards specified in Mil-F-14265D Type "R". The series is available in four widths and three convenient lengths to meet desoldering needs from surface mount to large terminal devices.

Circle (89) on Reply Card

Eight-function multimeter

Extech Instruments introduces its $4^1/_2$ digit eight function multimeter. Monitor dc voltage in five ranges from 200mV to 1000V, ac voltage in five ranges from

200mV to 750V, dc current and ac current in five ranges from 200µA to 20A, and resistance in seven ranges from 20Ω to 20MΩ. Basic dc accuracy of 0.05%. Also includes audible continuity, diode, and transistor test. The large LCD readout reads up to 19,999 counts for resolution to 10µV, 0.1µA and 0.01Ω. Also indicates function, polarity, low battery and overload. Fuse protected. Comes complete with test leads, rubber protective holster, and 9V battery.

Circle (90) on Reply Card

Battery tester

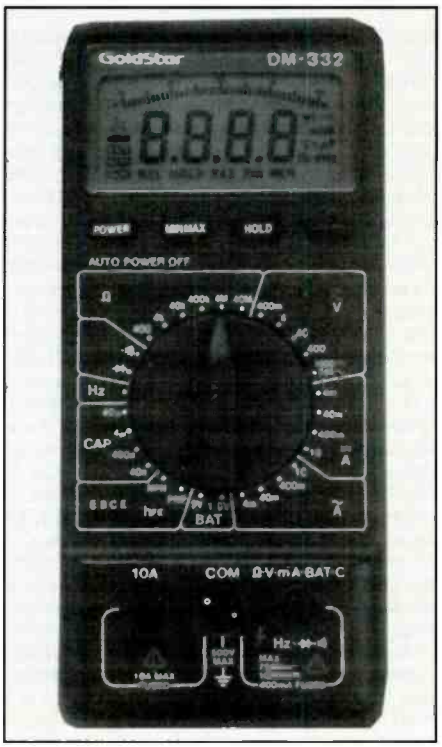
L-Com has introduced a battery tester, the DX20BT. It accepts any standard carbon-zinc, alkaline, mercury, silver oxide, lithium or nickel-cadmium battery. When the selector switch is set to the desired battery type, the meter will provide a true test of its condition with a load imposed.

This tester features permanent built-in test leads, an adjustable clamp to hold all types of button cells, dual contact buttons on the panel top to accept 9V batteries, a "neg" contact button to rest any size single cell so only the red test lead needs to be used, a switch to select nine different battery/voltage types, meter scales for regular, lithium and nickel cadmium cells.

Circle (91) on Reply Card

Seven DMM models

GoldStar announces seven new DMM models with the priorities of protection and reliability in mind. Models range with a variety of features: 3.5 or 3.75 digit displays, manual or autoranging, capacitance,



transistor check, frequency counters, min/max hold, relative, bargraph, etc.

The models DM-311 thru DM-334 all include 600V protection on the resistance, continuity, and diode check, 1000V dc/ac protection between COM. and Ground, mechanical 10A input jack restriction gate. This gate disables the 10A input jack until the proper selector switch position is selected.

Pulsing audible warning when test leads do not correspond with the proper selector switch position.

Circle (92) on Reply Card

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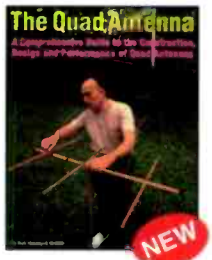

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This is a fast-paced video introduction to the fascinating world of ham radio. CQ's experts show how to select equipment and antennas; which bands to use; how to use repeater stations for improved VHF coverage; the importance of grounding and the basics of soldering. How to get the most out of your station, whether it's home-based, mobile or hand-held.

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Top DXers share their experience with equipment, antennas, operating skills, and QSLing. You'll see hams work rare DX around the world. If you're new to DXing, this video is for you! All this valuable information may well give you the competitive edge you need to master the exciting world of DXing.

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For the newcomer to contesting or an experienced veteran, this video is for you! You'll get advice and operating tips from some of contesting's most successful competitors, including Ken Wolff, K1EA, Dick Newell, AK1A, and CQ's own contest columnist, John Dorr, K1AR. Here's just a sample of what you'll see: what contesting's all about, explaining contest jargon, tips for beginners, how to compete from a small station, operating secrets from the "pros", live QSOs from world class stations, VHF/UHF contesting

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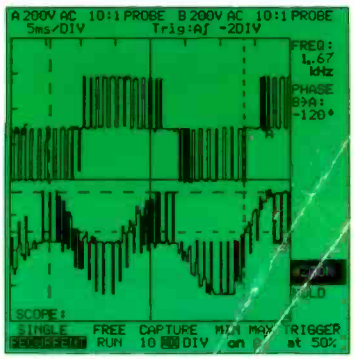
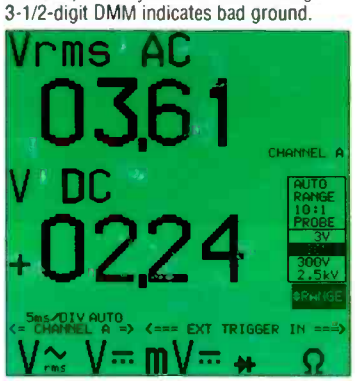
A DAY IN THE LIFE OF SCOPEMETER®.

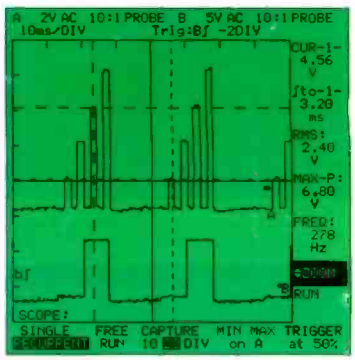
6:42 AM, Motor in #2 shaft overheating.
Dual channel shows incorrect drive signal.



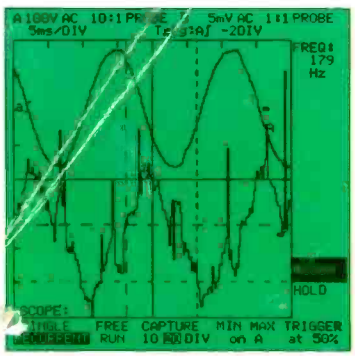
8:23 AM, Security Monitor not working.
3-1/2-digit DMM indicates bad ground.



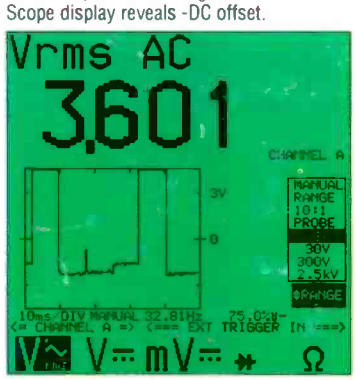
9:25 AM, Conveyor Stepper Control fails.
Cursors help find broken sync connection.



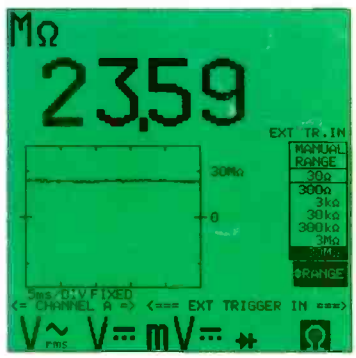
10:57 AM, Intermittent Auditorium lighting.
Waveform shows too much noise.



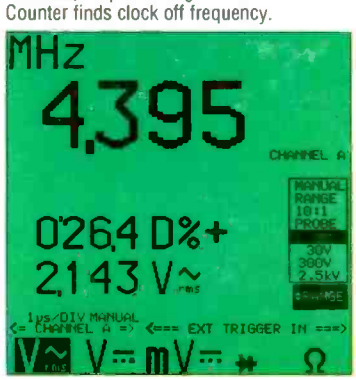
11:17 AM, 5V Control Signal is bad.
Scope display reveals -DC offset.



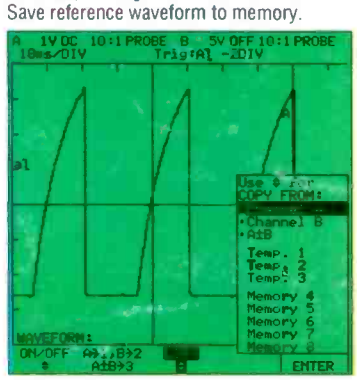
12:58 PM, Air Conditioner overheating.
Resistance shows corroded connection.



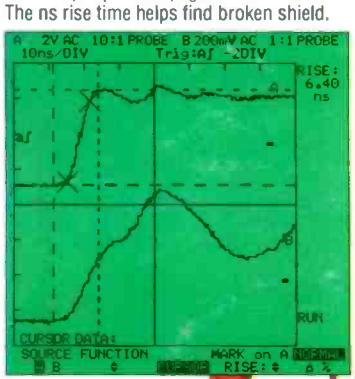
1:22 PM, Copier toning uneven.
Counter finds clock off frequency.



2:14 PM, Testing Power Inverter loads.
Save reference waveform to memory.



3:12 PM, Copier fails, again!
The ns rise time helps find broken shield.



4:05 PM, Salesman presents demo board.
25MS/s finds 40ns glitches.

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