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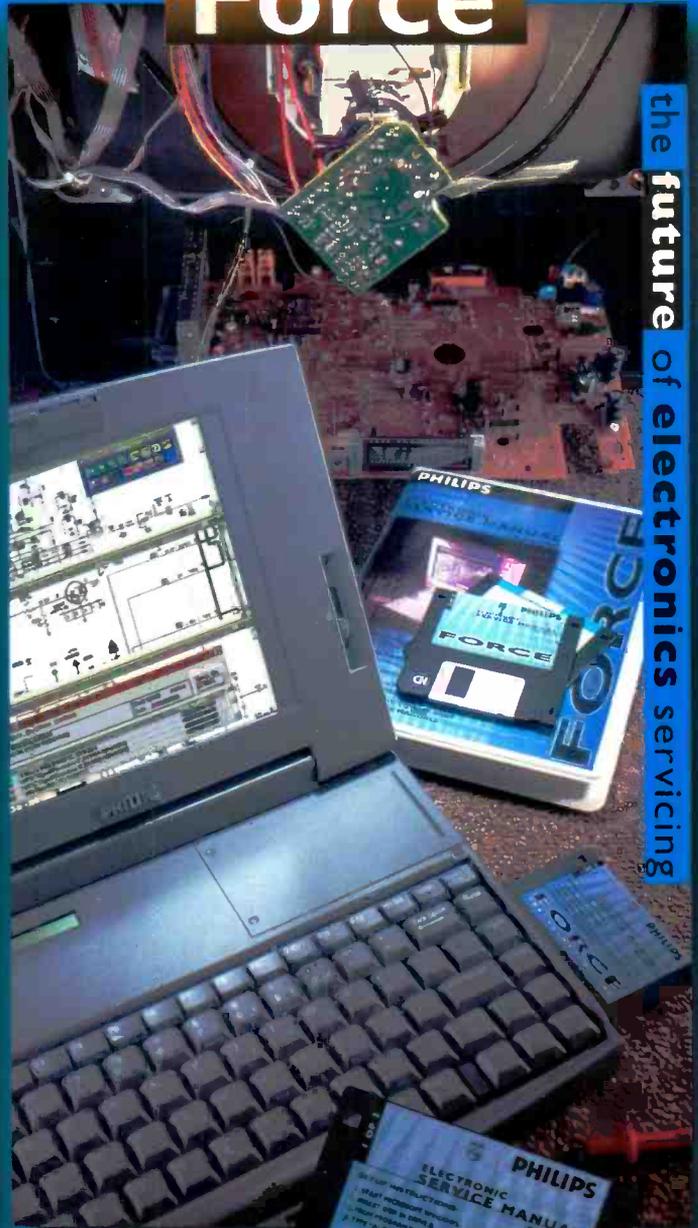
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Servicing & Technology

Volume 17, No. 4 April 1997

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By The ES&T Staff

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The purpose of this article is to shed some practical light on the general subject of noise and noise tests in electronic systems.

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A distributorship is the place where the service center buys the products; replacement parts, consumables, test equipment and other materials that it needs to complete a repair and get the product back to the customer. This showcase is written by distributors, and features descriptions on what their business is about. Use this showcase to help you make a knowledgeable decision when it comes to picking a distributor.

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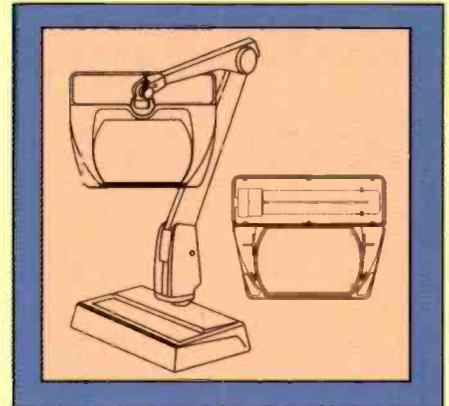
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ON THE COVER

How do you find a distributor who can provide the products you need, when you need them, reasonably priced and without charging outrageous shipping charges? Call or write to several and ask. One way to get started is to peruse the Distributors' Showcase in this issue. (Photo courtesy of Thomson Consumer Electronics.)

National Technicians Day

Congratulations to all technicians on National Technicians Day, April 22. For more information on what that's all about, take a look at the news item in this issue titled "Electronic technicians cited."

Technicians are the highly trained individuals who keep the high-tech products that the developed world has come to depend on operating. And technicians definitely deserve recognition.

Actually, most people hold technicians in quite high regard anyway. After all, technicians can repair their TVs, VCRs, camcorders, microwave ovens and any other complex product that consumers find hard to even operate. In fact, in the last couple of years, a survey showed that the average person has considerable regard for the competence of technicians.

Do you ever wonder, then, why it is that consumer electronics servicing, while respected in general, seems to come in for a disproportionate share of disrespect. You know what I mean. How often do we see the local TV consumer advocate reporter do a report on consumer electronics service "ripoffs."

You're familiar with the script. You've seen it many times before. The station rigs a TV or a VCR, or whatever, with a fault, maybe just a blown fuse, and brings it in to several service centers. Of course, a number of the service centers can't resist the temptation to pad the bill just a little, or even rob the customer blind.

Well, we all hate those crooks who give the majority of service centers a bad name. And it's helpful to consumers to have them exposed in reports like this. The reporters often do try to be even handed. They may tell the audience that many of the businesses to which they brought in the "defective" product found the problem quickly and repaired it reasonably. The effect of the program, however, is to instill mistrust in an entire industry.

And it doesn't help that occasionally the reporters give especially high marks to a service center that has found that "it's only a fuse," and says "no charge." Those

guys are heroes, says the reporter.

Well, when was the last time you walked into your doctor's office because you had a minor temperature or ache or pain, and he examined you and said "just a minor infection. Here's some aspirin. No charge." That's what I thought.

If a service center takes in a product, makes out paperwork, performs a diagnosis on a product, even if there's nothing wrong with it, they should receive payment. Every time. They're professional, and their time is worth money.

If you think about it, other professions are guilty of far worse excesses and don't seem to suffer the stigma that consumer electronics sometimes does. For example, Reader's Digest recently published a scathing report on some dentists who charge not ten or twenty dollars too much, but tens of thousands of dollars for restorations, crowns, etc. Per patient. Yet most people hold dentists in high regard.

There have been scandals in the medical profession, the legal profession, stock brokers, auto rental companies. The list goes on and on. And yet, most people continue to hold those professions and businesses in at least relatively high regard. Why? It's at least in part because they act professional and businesslike. They wear suits, or uniforms, they have businesslike places of business. And because they act professional and businesslike, we treat them as such.

Many consumer electronics service centers conduct business in a very professional way. And they know what it's like to be treated with respect. Unfortunately, many service centers project an image that is less than professional.

As we celebrate National Technicians Day, we should all resolve to do whatever it takes to become more professional, to project a more professional image, and work together to enhance the image of consumer electronics service in the eyes of the public.

Nile Conrad Penam

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

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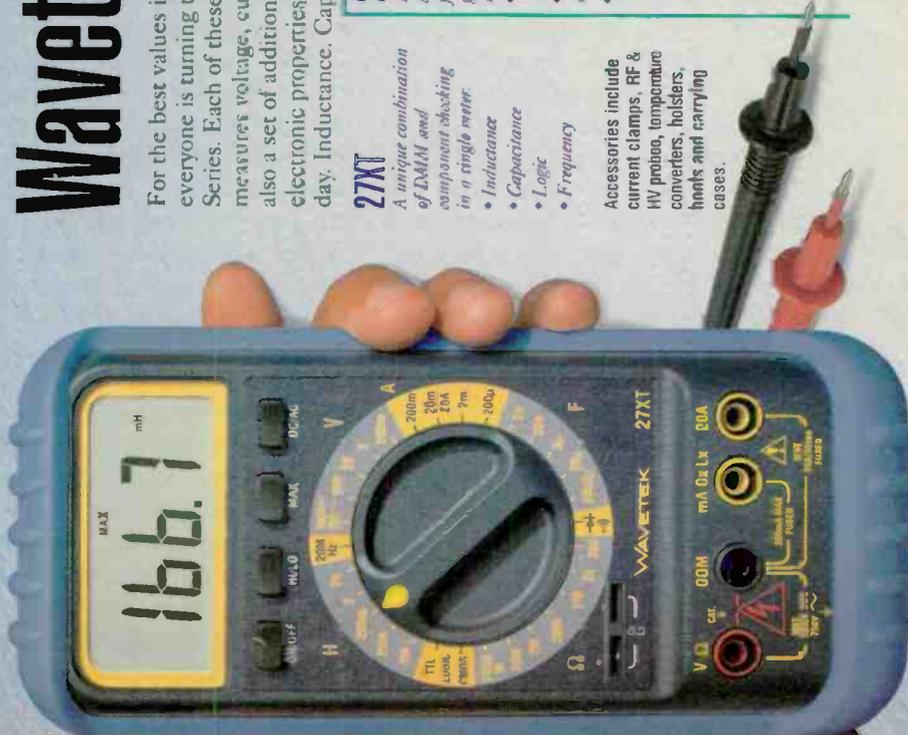
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Electronics technicians cited

Electronics Technicians will receive recognition on April 22, 1997, with the celebration of National Technicians Day. This day recognizes the high standards of performance and excellence maintained by professional technicians. The Certified Electronics Technician (CET) program, now in its 32nd year of recognizing the professional capabilities of electronics technicians, is overseen by the International Society of Certified Electronics Technicians (ISCET).

National Technicians Day, April 22, 1997, has been set aside as a National Testing Day for certification. Many of the volunteer corps of ISCET test administrators are planning to use "T-Day" to encourage electronics and appliance technicians to demonstrate their expertise by taking the Certified Electronics Technician, Certified Appliance Technician, or any one of a number of Federal Communication Commission (FCC) exams.

By the end of 1996, over 42,000 electronics technicians and nearly 200 appliance technicians has been certified through ISCET in all 50 states, and in 37 territories and foreign countries.

Certification is now offered in the consumer, audio, video, industrial, communication, computer, radar, and medical electronics fields plus the appliance program. Added this year for the first time are exam endorsements, which are technology specific additions for technicians who already hold Journeyman CET certificates. The first endorsements approved are VCR and Camera, Camcorder and 8mm. Future endorsement examinations will include Computer Monitors, Audio Systems, Cellular Radio, Computer Networking, and Industrial Robots.

Each year, over 6,000 exams are taken by technicians, but only about 40% pass. The demanding criteria for certification require technicians to be knowledgeable in both fundamental electronics and the more advanced theory applicable to their specialty fields. Appliance technicians are required to know electrical circuits and components, refrigeration systems, laundry, cooking, and dishwashing

equipment, and have a basic knowledge of microwave cooking.

In addition to the CET and CAT exams, ISCET Test Administrators proctored about 1,200 examinations for FCC Licenses including General Radiotelephone, Radiotelegraph, GMDSS Operator and Maintainer, and Radar.

For more information on ISCET and the CET program, contact ISCET Headquarters, 2708 W. Berry, Fort Worth, TX 76109. 817-921-9101, Fax: 800-946-0201 or 817-921-0142, or send E-mail to: iscetFW@aol.com.

CEMA survey shows increased consumer interest in RDS features

A recent survey by the Consumer Electronics Manufacturers Association (CEMA) shows that consumers think the safety features that a Radio Data System (RDS) car radio offers are highly desirable. In an identical telephone survey given to 400 randomly chosen consumers in the state of Florida and to 400 randomly chosen consumers from around the country, almost half of the consumers surveyed were interested in receiving the Emergency Broadcast System alert and automatic traffic and emergency news with an RDS car radio.

RDS provides a digitally encoded stream of information that FM broadcasters "piggyback" on their normal radio signals. That stream of information enables a wide range of new capabilities for the conventional home and car radio. RDS radios allow listeners to see the call letters of the station; tune by program format (e.g. top 40, sports, country, etc.); view song titles and artist names; and hear traffic emergency alerts automatically among other features.

Automatic searching for format and favorite stations were top choices among respondents. One-third were interested in the Program Type Category (PTY) feature that allows RDS radio to search for radio stations by format, and one-fourth were interested in the Alternate Frequency (AF) feature that permits automatic re-tuning of the radio to the next strongest signal carrying the same program when traveling in fringe reception

areas. For example, National Public Radio (NPR) could be received throughout the country without having to retune the radio during travel.

The survey was formulated by EIA Market Research Staff and fielded by the Verity Group of Fullerton, CA during the month of March 1996. All results have a margin error of +/-4 percentage points.

The Consumer Electronics Manufacturers Association (CEMA) is a sector of the Electronic Industries Association (EIA), the 72-year-old Arlington, Virginia-based trade association representing all facets of electronics manufacturing. CEMA is the new name of EIA's Consumer Electronics Group (CEG).

Video sales finish 1996 with a flourish; projection TVs, VCRs and camcorders set all-time records

Led by large-screen televisions - both direct-view and projection models - sales of most consumer video products showed renewed strength in December, the Consumer Electronics Manufacturers Association (CEMA) reported today.

More impressively, the industry closed out 1996 with record-breaking unit sales totals in three major categories: projection television, videocassette recorders and camcorders. Overall, more than 44 million pieces of video hardware were sold to U.S. dealers last year.

Reflecting the growing popularity of home theater, sales of direct-view TVs measuring 30 inches and larger jumped 22 percent in 1996, while those 25 inches and above advanced 6 percent. At the same time, projection TVs grew 8 percent to 887,000 units. December sales of direct-view TVs increased 12 percent, as compared with December 1995.

Reacting to the December and year-end results, Guy Johnson, senior vice president of Thomson Consumer Electronics, said that it is a measure of our industry's strength that in an otherwise undistinguished year, we managed to set a host of new sales records. And with a number of innovations on the way, including new digital products, there is every reason to be upbeat about the video future.

(Continued on page 68)

it's Sunday 3 a.m.

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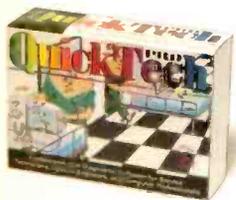
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Computer software for service center management

By the ES&T Staff

Whether they own a computer or not, every service center has a database of some kind. For some service centers, the database may be a filing cabinet in which there's a file folder for every customer who has used their services during the past several years. The folders, usually arranged in alphabetical order by the customer's last

name, might contain a customer contact sheet with name, address, telephone number and possibly some other information such as age, preferences, types of consumer electronics products owned, etc.

In other service centers, some of that information might be distilled into a 3 by 5 card file that contains only customer name, address and telephone number and

a brief notation to provide service center personnel with a few details about the customers. Still other service centers may use something like a Rolodex file.

Forms, forms, forms

Most service centers need another database of sorts. When a customer brings in

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a product for service, some kind of tracking form is attached to the product so that its owner can be readily determined and perhaps the owner's description of the symptoms might be included, the customer is issued a claim check, and a form is generated for the customer service staff so that they can keep track of it.

The problems with manual databases

There are a number of problems with manual databases. For one, every time a new form or portion thereof is generated, the information has to be manually entered again. Of course, carbon copies can improve this situation, but carbons tend to be messy and they're not always easy to read. Moreover, any time a procedure is completed on the product, from initial diagnosis to ordering of parts, to completion of service and performing of the operational tests, no one in the service center will be aware of the status of the product except the technician. That is unless an elaborate, and perhaps cumbersome, procedure has been established such that each location reports to a central location each time there is a change in status.

If such a procedure does not exist in a given service center, then any time a cus-

tomers call in to determine the status of repair of his product, the customer service person has to check with the technician, via intercom or in person, thus disrupting the flow of the work of both the technician and the customer service function.

There is a better way

Many service centers still reject computers. They simply feel that computers are an unnecessary product that they would have to learn about and pay good money for, for no reason. After all, they can continue to do things the old fashioned, manual, way. And of course they can. But a computer can certainly make all of that work of writing out paperwork, retrieving data and generating reports a whole lot easier.

In fact, service management software is possibly the best argument for a service center to buy a computer. And the best thing about the software out today is that it really doesn't require that the user know anything about computers. They simply have to learn how to use the software.

But even that statement is somewhat misleading. Many, if not most, of the service center management software packages available use methods and proce-

dures that make using them as simple, or even more so, than using their paper equivalent. And they make all of the paperwork chores associated with consumer electronics service so much easier than doing the same things on paper.

Tracking a set

Here's a typical transaction using one type of software on a networked system. A customer walks in with a VCR. The customer service person asks if the customer has done business with the service center before. If the answer is no, the counter person asks for and keys in name, address and telephone number, etc. If the customer has done business there before, the customer service person asks for the customer's telephone number and key that number in. The data for that person; name, address, telephone number, etc., will appear on the screen.

At this point the information on the set: brand, model number, chassis number, screen size, complaint, etc. is then keyed in. Any other pertinent data such as the amount of deposit and the promised completion date are also entered.

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claim check and inventory tag to be attached to the set. If the system has the capability, these documents may be bar coded for simplified data entry when the status of the set is updated.

During the service process, pertinent update information is entered into the computer network; such things as the name of the technician assigned to the product, trouble found, parts that need to

be ordered, location of the set if it has to be temporarily stored, etc.

If the customer calls to ask about the progress of the VCR, customer service only has to enter the individual's tele-

phone number into the computer and the appropriate information appears on the screen, as if by magic.

When the repair is complete, the total labor and parts, as well as any miscellaneous materials charges are entered into the computer, the invoice is prepared, and the owner of the product is notified.

Sharing information

Depending on the particular software package, the service center may be able to do a lot of other things with the information available. If, for example, the replacement parts and service information inventory are also on the network, when the service technician needs to select the service information he checks the computer to see where it is. If another technician is already using it, that information will be displayed. If the service literature is on file, when the technician takes it out of storage he makes the appropriate entry and every one in the service center knows where that literature is.

If the technician uses a part from inventory to perform this repair, the inventory is updated to show the new correct number of parts, and if the stocking level has reached the reorded trigger point, the part

can be placed on order.

Other features

If the software is properly equipped, all of the financial information can be accessed and brought into the accounting system, without the need to re-enter the data. If the program has an electronic filing option, the appropriate warranty information can be transmitted directly, electronically to the manufacturer.

Which one?

Service management software programs range in price from a few hundred dollars to several thousand dollars. It's impossible without a thorough study to determine which one is the best for a particular service center. The one with the largest price tag is not necessarily the most full-featured or useful. The only way to determine which would be the best for your purposes would be to try several that seem to be in line with your needs and find out which one will do the job.

Most service management software companies offer demo programs, some of which are actually fully featured versions, but limit the number of records that can be entered to ten or twenty. Experimenting with several of these demos will give

you a chance to determine if one of them will work for your service center.

Be sure to try all of the features and make sure it will do everything you need it to do. One service center owner with whom we've spoken has a wonderfully useful program for managing his service center, but it won't interface with his accounting system, so every month his clerical personnel have to manually transport all or part of the financial data to the accounting system. That's an unfortunate waste of time when it really should be possible to achieve that interface with another program.

Look at our list

The accompanying box contains a listing of all of the companies that we know of who offer service management software. The listing is as up to date as we could possibly make it. ■

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Seeing the light

By The ES&T Staff

Lighting is one of those things that most of us take for granted, yet it's one of the most important things in our lives. If the day is bright and sunny, it usually buoys our spirits. Given a dreary day, on the other hand, most of us can't help but feel down in the dumps.

In fact, light is so important to humans, that some people when the weather is dark, are afflicted by a malady called seasonal affective disorder (SAD), in which they become depressed. The only known remedy is to sit in bright lights for up to an hour at a time to straighten out whatever it is in their bodies that requires light.

Seeing

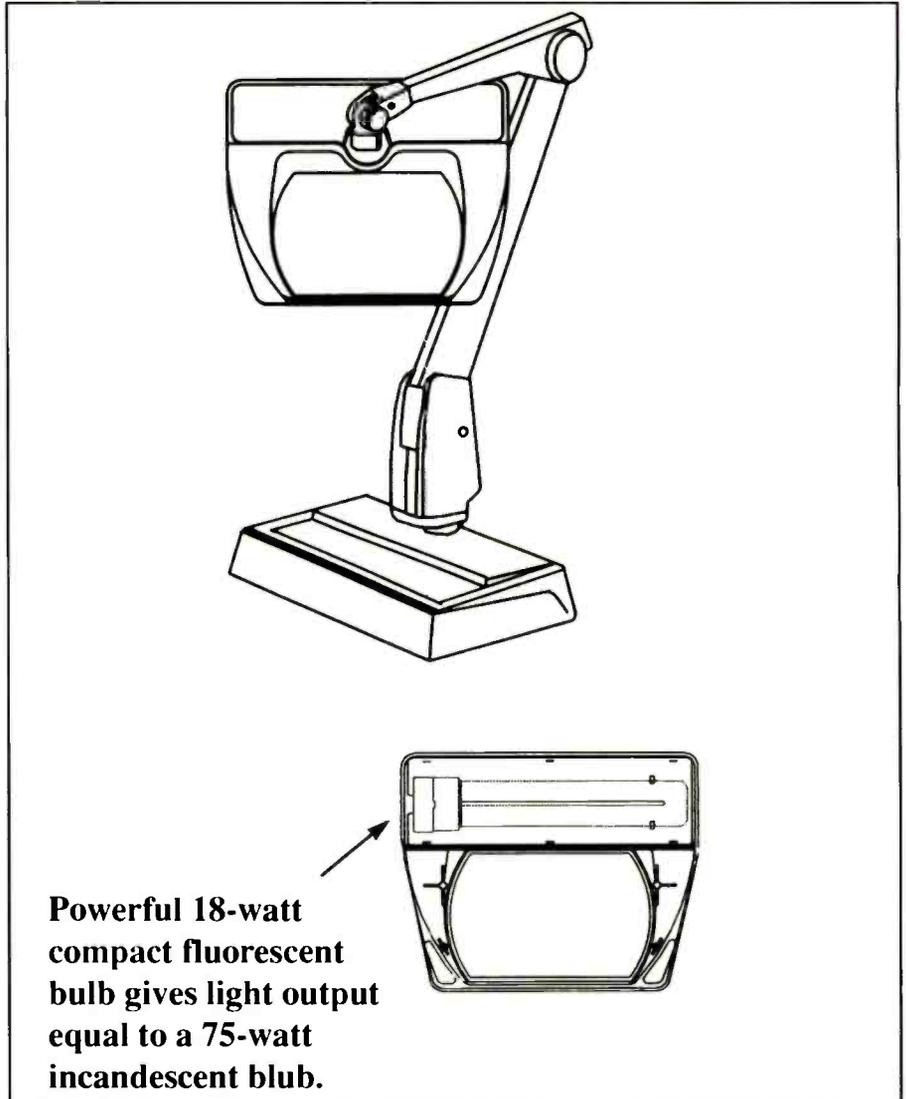
But in addition to being so important, in general, to humans, it's also, of course, very important when we perform any kind of task, whether it be reading, tying flies, building a piece of furniture, sewing or trying to solder or desolder a surface-mount component.

Imagine trying to do any of those tasks in total darkness. Of course, it's impossible. Now imagine trying to do any one of those tasks in bright sunlight. That would be blinding and painful. Somewhere between the two extremes there's a proper amount of light for performing any of those difficult visual tasks.

Task lighting

Of course, it might be possible to provide enough light for any task by installing enough ceiling mounted light fixtures. But there would have to be a lot of lights, at a fairly high brightness level. That would mean that the cost of installing those lights would be quite high. And the cost of electricity to operate them would be prohibitive. And you'd probably wind up with unacceptable shadows on the work anyway.

The answer to obtaining proper lighting levels in the service center is to use a combination of good ambient light with additional task lighting at each work station. Task lighting refers to any light source designed specifically to direct light onto some task performed by a per-



Powerful 18-watt compact fluorescent bulb gives light output equal to a 75-watt incandescent bulb.

son or machine. Task lighting can increase productivity improve viewing comfort, give greater control of individual lighting levels and save energy.

Task lighting and productivity

A recent study by the American Society of Interior Designers found that poor lighting and eyestrain are the most frequent office worker complaints. We must be comfortable to maintain productivity over the course of a day. There are already enough demands and distractions that compete for our energy and concentration. Straining to see should not be one of them. Seeing should be effortless and

automatic. We spend a great deal of time and money trying to make ourselves more comfortable so that we can be more efficient and productive. Yet frequently, we neglect a simple and inexpensive solution: a task light.

Advantages of an adjustable-arm task light

A good way to provide task lighting is to use a light with an adjustable arm for personal control. This allows the user to adjust the level of light for individual viewing comfort.

People's postures change during the day. Our tasks vary to some degree. If we

have windows, light in the room changes from morning to evening. In response to these changing conditions, we need to be able to adjust the lighting levels directed on our work in order to maintain maximum performance. Task lighting allows us to correctly position the angle of light to eliminate glare and veiling reflections.

Magnification

Is it a good idea to have task lighting, even if the work station is provided with magnification? The answer to that is yes. Magnification is only half of the solution for achieving good vision. Proper lighting is of equal importance. Take an extreme example. How much good would magnification do in the dark? Not much. The benefits derived from visual aids such as magnifiers and prescription glasses are entirely dependent upon the lighting conditions in which they are used. Proper task lighting allows us to get the maximum benefit from a visual aid, and may even allow for reduced magnification. Increasing the amount of light (brightness) directed onto a task will help compensate for small print size or poor contrast. Examples of poor contrast include faded print on white paper, or dark print on a dark background.

The older we get, the more light we need

It's unfortunate, but true, the older we get, the more light we need to see. Research indicates that people in their 60's need 80% more light for reading than people in their 20's. This increased need for light is due to a number of biological facts in the aging process.

For example, the muscle in the eye called the iris, expands and contracts to control the amount of light entering our eye. As with all our muscles, the iris loses some of its flexibility in the aging process, and doesn't open as wide. Therefore, more light is needed to compensate for the reduced ability of the iris to open wide.

Energy and economic considerations

Instead of trying to maintain proper lighting levels on desktops from overhead fixtures, task lights can do a better job while using less energy. A task light using the new 13W compact fluorescent lamp will consume far less energy than a typical overhead lighting fixture. A work environment can maintain lower levels of

Common diopter/power relationships: diopters / 4 = power

Diopter	Power	% Bigger than Object	Focal Length in Inches
3	0.75X	75%	13
5	1.25X	125%	8
8	2.00X	200%	5
11	2.75X	275%	3.75
13	3.25X	325%	3
16	4.00X	400%	2.5

Figure 1. The relationships between diopters, power, apparent size of the object magnified and focal length of the lens are shown here.



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overhead lighting by illuminating desks with energy-efficient task lights. In addition, maintenance and bulb replacement costs are less with task lighting.

Experts tell us that with the use of energy-efficient lighting technologies, we can reduce electrical use for lighting by 50 percent. This reduction would save over \$20 billion annually and decrease power plant pollutants by millions of tons.

Illuminated magnification?

Illuminated magnification is the combination of a magnifying lens with a light source. There is a wide variety in the type and quality of both the magnifying lens and light source. Magnifying lenses come in numerous sizes and powers, with some having less distortion than others. Light sources range from poor quality penlight types to those designed to provide the best illumination for the magnifying lens.

Proper lighting is as important as magnification in achieving good viewing. A magnifying lens would be useless in the dark, so increasing light levels results in better vision. The better the quality of light used with a magnifying lens, the less magnification is needed. When less mag-

nification power is required, you can see a larger area under the lens. You also have more working distance between the lens and the object you are examining.

I get by now—why would I need an illuminated magnifier?

You are able to get by, but that's not good enough. It is frustrating to have difficulty seeing details or to quit activities because you cannot see well enough. Proper lighting plus magnification helps you see the small details. You can read and work for longer periods with less eye-strain and fatigue. You may be less drowsy because you don't have to concentrate so hard on trying to see. Activities can be fun again!

Will I need my glasses with an illuminated magnifier? Absolutely!

An illuminated magnifier is not a substitute for your glasses. It is another tool to help you see better. In most cases, the additional light and magnification provide a tremendous boost to your glasses. Some vision problems can be helped more than others. However, there are some serious vision problems that will not improve with more light and magnification. The only way to find out how much your vision will be helped from an illuminated magnifier is to try one.

Why is hands-free viewing easier?

It is much easier to have both hands free to grasp an object and not worry about holding a magnifier or light. When using an illuminated magnifier mounted on an adjustable-arm, you are able to hold a fully spread newspaper with both hands. When your task requires working with both hands, it is essential that the magnifier be mounted on an adjustable-arm for hands-free viewing.

What is the price of an illuminated magnifier?

The price varies depending upon the type of light, magnification, and mounting options. The most popular models and options cost about the same as a good pair of prescription eye glasses.

What is a diopter?

Diopter refers to the curvature of a lens. As the diopter increases, the lens becomes thicker and the curvature greater. As the curvature increases, light rays are redirected to fill a greater portion of the per-

son's retina which makes the object look bigger. Higher diopter lenses have greater magnification power.

What is power?

Power refers to how much larger an object is made to look through a magnifying lens. Power is typically indicated by an X; such as 2X or 4X. The relationship between diopters and power is: diopters divided by 4 equals power. For example, an 8 diopter lens would make an object look two times bigger, over and above what the unaided eye already sees (8 diopters / 4 = 2X power). See Figure 1 for the relationship between diopters and power.

What is focal length?

Focal length is the distance from the center of a lens to the point where the light rays converge and the object is in optimal focus (focal point). This is also known as the working distance of the lens. Focal length is important when the task requires using tools with the object being viewed. Because focal length of a lens decreases as power increases, there is less room to perform work on an object under higher power magnification lenses.

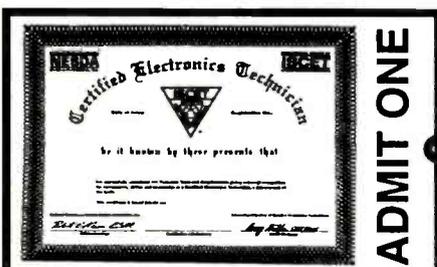
What is field of view?

The field of view is the size of the magnified area that is in focus under the lens. The field of view decreases as power increases. More powerful lenses make small details look big, but less of the total object is visible. There is a trade-off for the person who must decide between the size of the field of view and the amount of magnification (see below).

Good lighting helps keep workers happy

The information above on providing enough light to perform tasks adequately is certainly important. But ambient light provided by ceiling fixtures, wall sconces, etc., are also important. Service centers tend to be pretty much gray with a smattering of browns and other dull colors of the products waiting to be serviced. Anything the service manager can do to improve the lighting and brighten up the surroundings are sure to result in happier technicians and better productivity.

This article was adapted from technical information provided by Dazor Lighting (<http://www.dazor.com>) ■



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What Do You Know About Electronics?

Lightning, batteries and some startling numbers

By J.A. Sam Wilson

Here comes the summer, and therefore, here come the tornados. Right? Well, not exactly. In some parts of the lower 48 states tornados can occur at any time of the year, summer or winter. (Florida is an example.)

Some number of years ago the National Electronics Associations (NEA) distributed literature that explained ways of detecting tornados by watching the television screen. It was a member benefit.

Maybe this is a good place to stop and remind you that both ISCET and ETA are worth joining. There are many, many benefits. Before you write and tell me you don't have enough money to join both, let me say this: Quit smoking! That will save you the money you need to join both ISCET AND ETA!

Anyway, I am going to reprint the tornado thing here.

Protecting yourself from lightning

Tornados are spawned by severe thunderstorms, and they are only one of the thunderstorm hazards. Lightning is the worst killer. Stay indoors and away from electrical appliances while the storm is overhead. If lightning catches you outside, keep yourself lower than, and at a considerable distance from, the nearest high, conductive object.

I'm going to stop here and repeat some good advice I've put in this column before. *Don't lie flat on the ground!* Doing so will ground all of your body. Get down on the heels of your hands and your knees only. Stretch out as far as you can, that reduces the parts of the body that are grounded. While you are in that position you might throw in a little prayer for additional protection.

Wilson is the electronics theory consultant for ES&T.

TYPE	TERMINAL VOLTAGE	AMPERE-HOUR CAPACITY (MAX)	COST OF CELL SIZE D
Leclanche (Carbon Zinc)	1.53V	0.3 ah	\$0.26
Nickel Cadmium	1.5V	10.2 ah	\$2.27
Mercury	1.35V	10.0 ah	\$0.72
Alkaline	1.52V	2.5 ah	\$0.58

Table 1. Voltage, Ampere Hour and cost ratings of various cells.

Thunderstorms may cause flash floods. Be careful where you take shelter.

Watches and warnings and detecting tornados

During thunderstorm season, the weather bureau may issue one of the following bulletins:

Tornado watch: conditions are right for tornados to develop.

Tornado warning: a tornado has been detected; take shelter.

Here is how you can adjust your TV to detect a tornado:

- warm up your TV set and tune for channel 13. Darken your screen to almost black. (Use your brightness control.)
- turn to channel 2 and leave the volume control down (unless you have a broadcaster on that channel).

Your tornado detector is now in operation. As a storm approaches, lightning will produce momentary white bands of varying widths across the screen. A tornado within 15 to 20 miles will produce

a totally white screen (color on color TV). Should this occur, turn off your TV set and take your portable radio. Go to a storm shelter at once.

Don't depend on the power company; run your house on dry cells

Some years ago I wrote and distributed (at my cost) a monthly publication called "Technical Notebook". Recently I ran across a back issue with this article and I am passing it on to you. Since it was written for the March 1976 issue, the costs and prices are out of date, but the message is clear, nevertheless.

If your electric bills have been out of sight you may be in the market for another source of electricity. I've calculated the cost of converting over to dry cells as a possible alternative. Gray Brandon, CET of REM Electronics gave me the price of the batteries. The May 1963 issue of Electronic Products magazine supplied the kilowatt-hour and the voltage values.

Not taken into consideration was the

TYPE	KILOWATT-HOUR RATING
Leclanche (Carbon Zinc)	0.000459 KWH
Nickel Cadmium	0.0153 KWH
Mercury	0.0135 KWH
Alkaline	0.0038 KWH

Table 2. These Kilowatt-Hour ratings for various cells were calculated from Table 1.

cost (and power loss) of the required inverters needed to convert the dc to ac. Not all equipment in the home is ac operated, so the cost of the inverters depends on your particular situation.

Table 1 shows the ratings of various types of dry cells.

The ampere-hour capacity multiplied by the terminal voltage gives the volt-ampere-hour rating which is the same as the Watt-hour rating. Dividing the product by 1000 gives the kilowatt-hour rating:

KILOWATT-HOUR RATING =

$$\frac{V_{\text{TERMINAL}} \times \text{Ahr CAPACITY}}{1000}$$

Using the values in Table 1, the values in Table 2 were obtained.

The cost per kilowatt-hour is obtained when you divide the cost of the cell by the kilowatt-hour rating.

$$\text{Cents per KWH} = \frac{\text{cost of cell (cents)}}{\text{KWH rating of the cell}}$$

Using in Tables 1 and 2, the following was obtained (See Table 3):

TYPE	COST IN CENTS PER KILOWATT HOUR	COSTS IN DOLLARS PER KILOWATT HOUR*
Leclanche (Carbon Zinc)	56,644.88	\$566.45
Nickel Cadmium	14, 836.60	\$148.37
Mercury	5,333.33	\$53.33
Alkaline	15,263.18	\$152.63

* Divide cost in cents per kilowatt hour by 100

Table 3. The dollar cost per KWHr for various types of cells.

To find the cost of operating your house for a month on dry cells, use the following equation:

$$\text{Cost per month} = \text{Number of KWH used} \times \frac{\text{Dollar cost}}{\text{KWH}}$$

You get the number of KWH used from your electric bill, and, you get the dollar cost per kilowatt-hour from Table 3.

As an example, at my house I used 1347 kilowatt-hours of electricity in one month. Table 4 shows the cost of operating my house for that month.

I couldn't make up my mind which way to go. The mercury cell was cheaper, but there was the problem of disposing of all of those cells without fouling up the environment. Nickel-cadmium looked like a good deal until I realized that the terminal voltage drops to 1.2V almost as soon as current is drawn. That would mean a higher initial cost.

There was also the job of replacing the cells as they are used up.

The series-parallel arrangement needed to get 120V, 15A would mean the extra cost of diodes to keep current from one bank from flowing into another bank.

There is no advantage here between using a primary type of battery (can't be recharged) or a secondary type (can be recharged but there would be no place to plug in the many, many chargers). Of course, trying to operate the chargers by using cells to operate the chargers is a lost cause. It would be a lot like trying to borrow your way out of debt.

Ohio Edison charged me \$42.26 for that month. I decided to pay it.

The size of atoms

There are about 2.5 centimeters in an inch. A cubic centimeter of pure Germanium semiconductor has in the order of 44,000,000,000,000,000,000,000 (4.4 x 10²²) atoms. That's 44 thousand million million million atoms. If that doesn't boggle your mind your mind just isn't boggleable.

Now think about this: A lightly-doped germanium block has a resistance of 10Ω. It has only about 1.7 x 10¹² free electrons, and, 3.68 x 10¹⁴ holes. In other words, it has only about 1/15 as many free electrons as the undoped version. Does it make sense to believe that the current

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TYPE	KWH	DOLLARS PER KWH	COST OF ELECTRIC BILL PAST MONTH USING DRY CELLS
Leclanche (Carbon Zinc)	1347	\$566.45	\$763,008.15
Nickel Cadium	1347	\$148.37	\$199,854.39
Mercury	1347	\$53.33	\$71,835.51
Alkaline	1347	\$152.63	\$205,592.61

Table 4. If you used 1347 KWHrs, as I did one month, this would be your cost to do so using various types of batteries.

through P-type germanium conducts electricity by electron flow?

Some students don't want to deal with the idea of hole flow. It's really simply a concept. Have you ever tried playing with one of those games in which you have a square with fifteen numbered small sliding squares and one hole, or a place where there's no square. The object is to get all of the squares in numerical order. Every time you slide a square to a new position, the "hole" moves. In a P-type semiconductor, electrons move from hole to hole, much like the movement of the "hole" in the game. Effectively, the "holes" move, even though it's really electrons in the material moving from hole to hole.

Some very old ideas

Did you know that the first commercial diodes were available in 1924? They were invented originally for use in railway crossings. Also, the first UJT was manufactured in 1953.

$$\text{rms sine-wave voltage} = \frac{V_{\text{MAX}}}{\pi}$$

$$\text{Average sine-wave voltage} = \frac{V_{\text{MAX}}}{\sqrt{2}}$$

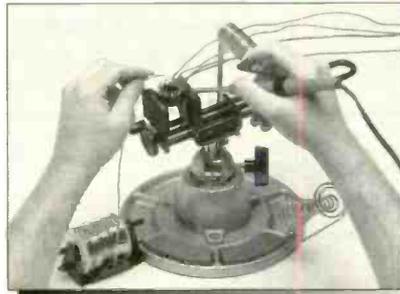
Calculator Accuracy

The RMS value of a sine wave voltage is about 0.707 times the peak value. If you need a really accurate value, use the peak voltage divided by π . The average value is usually given as 0.636 times the peak value. If you need a more accurate value, use the peak value divided by the square-root of 2 (approximately 1.414).

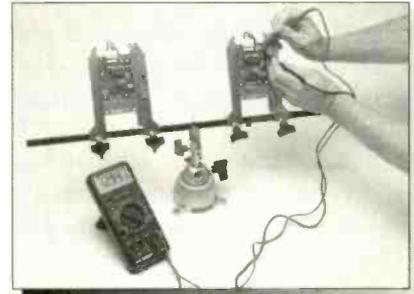
And, here is the last word for this month's WDYK: The bubble in a bubble memory is not a bubble. It is actually a cylindrical region that has a magnetic field in the opposite direction of its surrounding material. It looks like a bubble from the top. Bubble memories are harder to manufacture (read that more expensive) so, you probably would only see them as replacements. ■

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Convergence

By Hulon Forrester

For some reason, many trade schools feel that teaching CRT (cathode ray tube) technology is about as useful as teaching receiving tube theory. They have been predicting the demise of the CRT since before 1960. The CRT is actually older than the receiving tube, having been invented in 1897, whereas Lee deForest patented the triode in 1907, which began the radio era.

The transistor has replaced most of the receiving tubes, but there are certain applications in which the tube works better. Therefore a receiving tube market still thrives. A transistor is totally unforgiving. If it experiences a momentary overload it will be destroyed. A tube can survive a momentary overload many times, which is ideal in certain applications.

The CRT has some similarities to a receiving tube in that it has a cathode, a grid, a screen and an anode. In addition, the CRT has a focus element and the electron flow from the cathode is directed by magnetic or electrostatic deflection to pinpoint an area on a screen.

The CRT is the most economical and most reliable method of producing an image on screens that vary in size from less than 1" to 45" or more. The CRT inspired the creation of all other screen types. Its only disadvantages are its weight and power requirements. The flat panel LCD screen is more applicable in areas where space and weight are a major factor, but the CRT still excels in brightness, picture quality and longevity.

If a superior method of producing a picture on a screen were invented today, it would take forty or fifty years to replace the CRT, and many would still be in operation even then.

The future

The future for the CRT is still bright. The new digital TV format will call for a revised shape in CRT design, but it will not demand more standards than have already been met by the CRT in other applications. The new digital system will

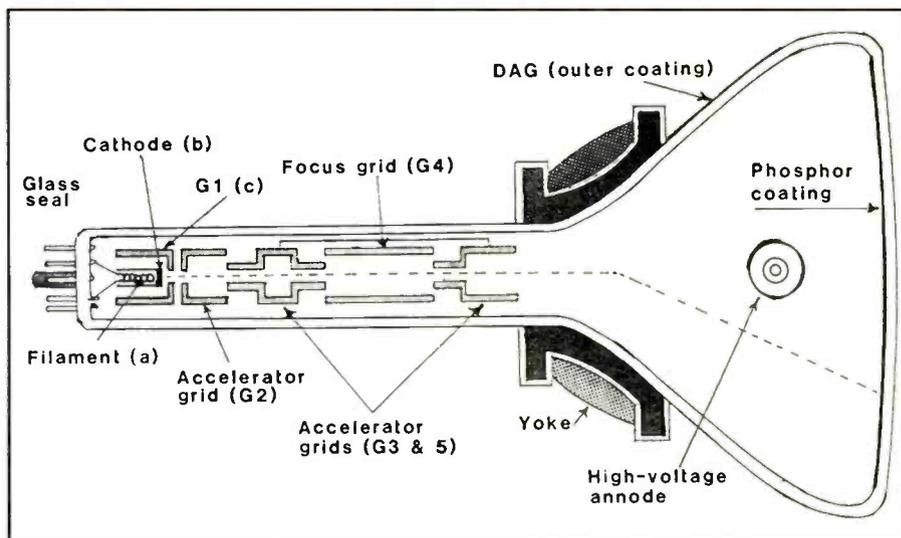


Figure 1. The cathode ray tubes in television sets use magnetic deflection (a yoke mounted on the outside of the tube) to deflect the electron beam(s), creating the picture on the face of tube (screen).

use a 9 by 16 screen ratio, which will allow a complete panoramic picture to fill the screen. The picture will also be composed of about twice as many lines. This will produce near 35mm picture quality.

Each year more and more CRTs are produced. It is estimated that the industry will

manufacture some 300,000,000 CRTs in the year 2000. There is already a shortage of high X-ray absorbing glass which protects the viewer from harmful radiation, but the industry will find a way to overcome the shortage.

Once the component manufacturer

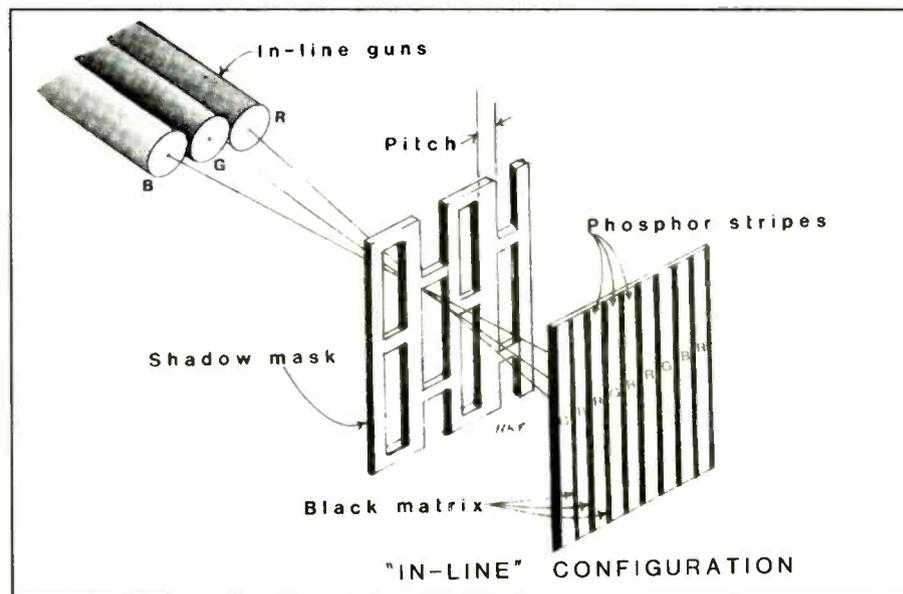


Figure 2. In a color CRT, the three individual electron guns must work as a team in order to produce a color picture. Each gun illuminates one of the three color phosphors on the CRT face. The failure of any one of the guns is easily recognized and is the most common cause of CRT failure. There are several types of color guns and screens, but the in-line tube is the only one considered here.

Forrester is a CRT consultant.

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PC Servicing – (PCS)

Color TV Technology & Servicing – (CTV)

Computer Monitor Servicing – (MON)

VCR Technology & Servicing – (VCR)

Microprocessor/PC Servicing – (UPC)

1997 Technician Workshop Schedule

WORKSHOP	CITY/STATE	DATE
MON	Walnut, CA	4/22/97
PCS	Salt Lake City, UT	5/20/97
MON	Lewiston, ID	5/29/97
CTV	Walnut, CA	6/3/97
MON	Salt Lake City, UT	6/10/97
PCS	Beloit, KS	6/11/97
VCR	Los Angeles, CA	6/16/97
CTV	W. Palm Beach, FL	6/23/97
VCR	Bremerton, WA	7/7/97
VCR	Tampa, FL	7/7/97
MON	River Grove, IL	7/14/97
MON	Walnut, CA	7/23/97
PCS	Gresham, OR	8/5/97
MON	California	8/19/97
PCS	California	9/17/97
PCS	California	9/22/97
CTV	Tampa, FL	10/7/97
CTV	River Grove, IL	10/13/97
CTV	Walnut, CA	11/11/97

1997 Educator Workshop Schedule

UPC	Norman, OK	6/2/97
UPC	Shelby, OH	6/9/97
PCS	Raleigh, NC	6/23/97
PCS	Lexington, KY	6/25/97
PCS	Lincoln, RI	6/30/97
UPC	Virginia Beach, VA	7/21/97
PCS	Springfield, MO	7/23/97
VCR	North Little Rock, AR	7/28/97
PCS	Logan, UT	8/11/97
VCR	Sylmar, CA	8/11/97

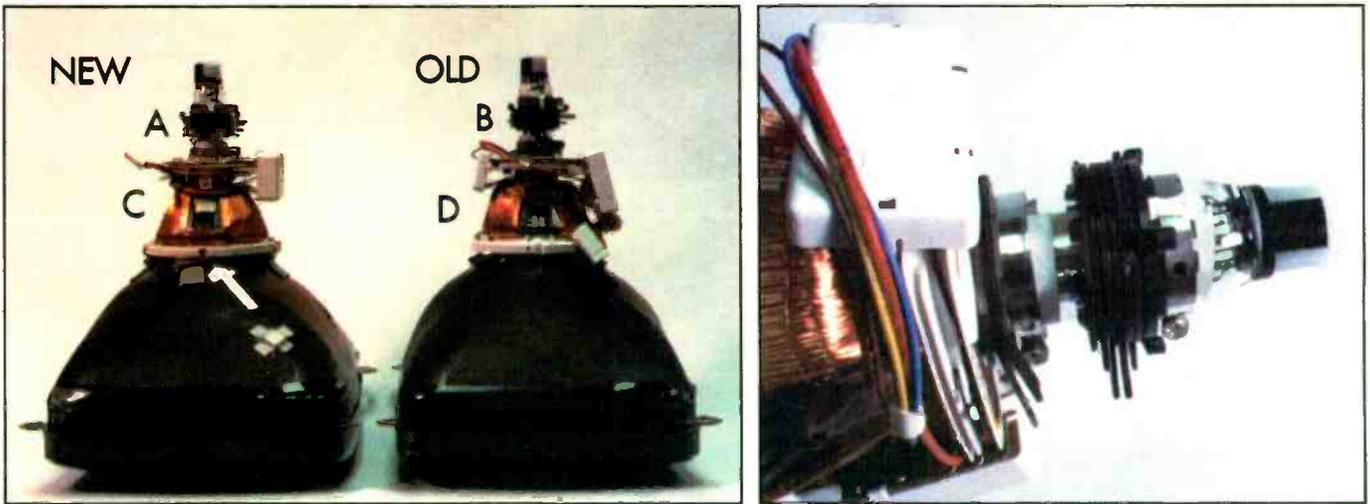


Figure 3. In this photo, a new tube without a yoke is sitting beside an old tube that has a yoke. The old yoke must be removed from the OLD CRT and mounted on the new tube. "A" and "B" are the convergence magnet assemblies (CMA).

uses all of the CRTs furnished by the new CRT manufacturer, new replacement tubes are almost never available. The only source of replacement CRTs are from the recycler. That is why old CRTs have value. It is important therefore that you carefully choose your CRT source of supply. Warranties vary, but a well remanufactured CRT will last as long as a new one. The recycling industry has grown in volume and quality.

They're everywhere

If you plan to make electronic service your vocation, you will find the CRT in

every facet of the industry. Whenever a screen is needed it is usually a CRT. It is to your advantage to know as much as you can about it. If you know how to use your old yoke and have a good understanding of the CRT, you can repair more monitors, TV sets, medical equipment, RADAR and computers faster and at lower cost as well.

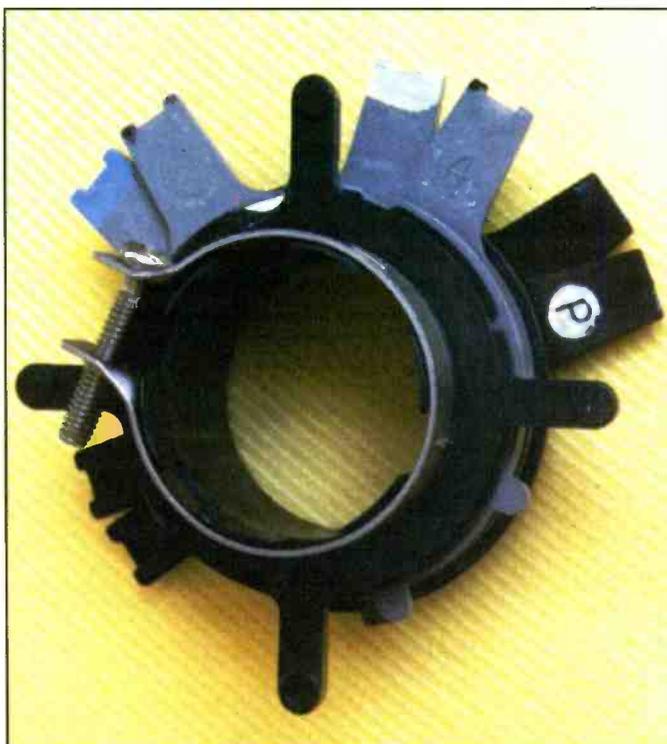
Most importantly, since hundreds of monitors use the same tube but different yokes, your inventory will be more flexible and economical. It's like limiting what you drive to cars with automatic transmissions only. Being able to drive a 5-speed and an automatic can resolve

your transportation problems in a more efficient manner.

The deflection circuits

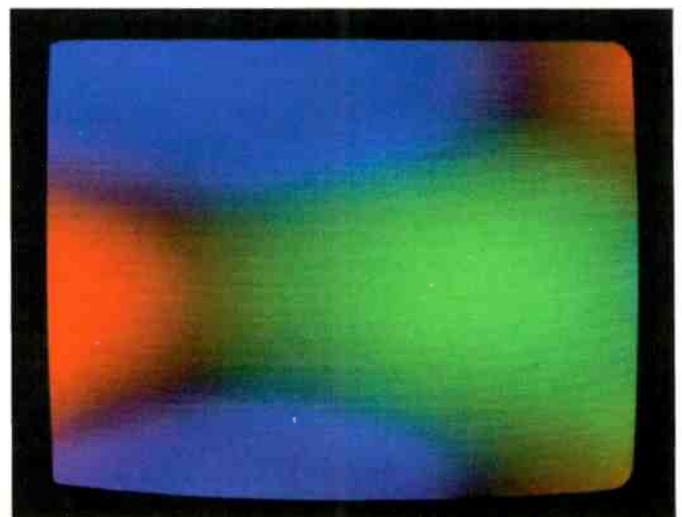
Any component with a CRT, regardless of its application, depends on a group of circuits whose cumulative performance produces an image on the screen. There are two basic types of deflection, but our primary concern here is magnetic deflection (a yoke) as in the monochrome tube as shown in Figure 1.

The filament heats the cathode which emits electrons. The quantity of electrons is controlled by G1, the grid. Usually, you



← **Figure 4.** Note that the "lock" on this yoke has four tabs and the others only two each. Turning the lock counterclockwise allows you to move the tabs easier. You may have to break loose a paint-like substance before you can move the tabs. This substance was used to prevent moving the tabs accidentally after the last convergence.

Figure 5. With the yoke back against the CMA, and the red and blue screen controls turned down your screen might look like this. ↓



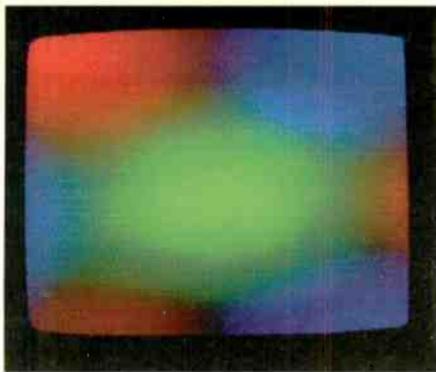


Figure 6. Use the purity tabs to center the green "blob."

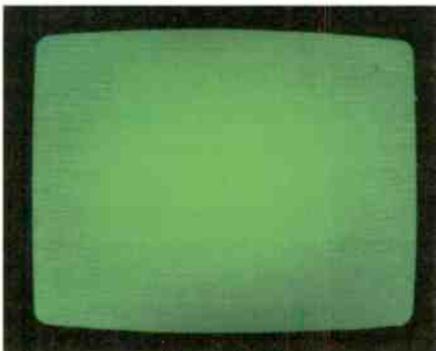


Figure 7. Slide the yoke all the way forward, then ease it back just far enough to have a full green screen. There should be no discoloration of the green on the entire screen. Turn the yoke to level the raster and adjust the height and width control for a full screen. Tighten the "C" clamp on the yoke.

will find the brightness control is tied to G1 and the signal is fed to the cathode. The electron flow is accelerated by a series of grids with higher voltages, G2, G3, and G5. The focus anode (or grid) G4, does what its name implies: focuses the beam on the screen. The color of the screen depends on the color of the phosphor it is coated with. The yoke has two windings, vertical and horizontal for image height and width.

As shown in Figure 2, a color tube has three guns which must work as a team in order to produce a color picture. Each gun illuminates one of the three color phosphors on the CRT face. The failure of any one of the guns is easily recognized and is the most common cause of CRT failure. There are several types of color guns and screens, but the in-line tube is the only one considered here.

Transferring the yoke

When a yoke is transferred from an old tube to a new one, getting the yoke to work isn't the problem. The problem is getting the beams to work together to pro-

duce sharp, true color. This is called convergence. An engineer at Video Display Corporation confirmed to me that this seems to be one of the least understood but most important areas to learn.

Many of you reading this may think much of this as repetitious or too basic. No matter how well you know CRTs, it doesn't hurt to review theory once in a while. On the other hand, looking at the basics from another point of view engenders even better understanding.

Remember, we are talking about in-line color CRTs only. Delta color tubes are a different breed. They use a different method of convergence and the procedure is more complex. Oddly enough, the sharpest possible image is produced by a high resolution delta CRT. Nevertheless, because convergence is less demanding for an in line tube, remarkable images may be possible because it is possible to achieve better convergence.

Becoming familiar with the parts

In Figure 3 a new tube is sitting beside an old tube. Before we attempt the trans-

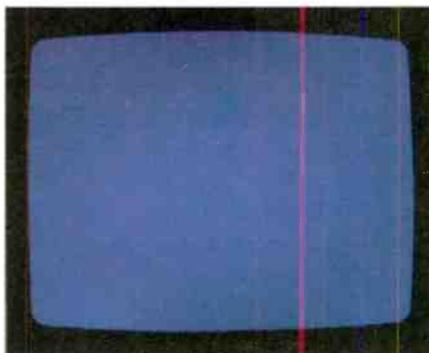


Figure 8. Turn down the green gun and turn up the blue. The screen should be solid blue.

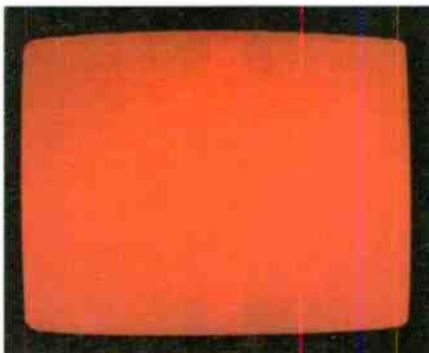


Figure 9. Turn down the blue gun and turn up the red. The screen should be solid red. If the screen was pure green, blue and red with the green, blue and red guns turned up, respectively, the screen is said to have color "purity."

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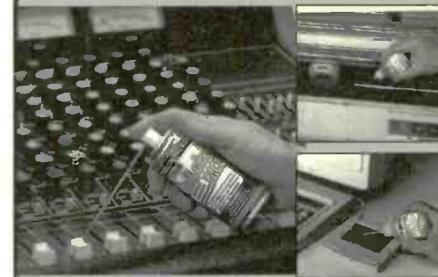
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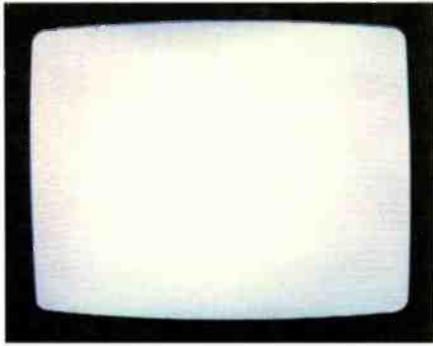


Figure 10. With the brightness control still on mid range without a video signal, turn the red blue and green screen controls up or down until you have a white center screen as shown here. You may or may not have some discoloration around the sides, but if the center is solid white, you're on your way to good convergence.

fer old yoke to the new tube, let us consider the nomenclature.

"A" and "B" are the convergence magnet assemblies (CMA). Note the close-up view in Figure 4. You will note that the "lock" has four tabs and the others only two each. Turning the lock counterclockwise allows you to move the tabs easier, but a paint-like substance may have to be broken loose first. Using this substance prevents accidental movement of the tabs after the last convergence.

"C" and "D" are the yokes. Under each yoke are usually three and sometimes four rubber wedges. They play an important part in convergence also.

A closer look at the yoke

First let us take a moment to look at the yoke. The yoke has two windings: verti-

cal and horizontal. The vertical winding has a higher dc resistance in ohms than the horizontal winding because of the differences in sweep frequencies; the vertical sweep operates at a lower frequency than the horizontal.

Sometimes, though it is not always recommended, the yoke that comes with the new tube will work in the TV in which you're installing the new tube, but, (1) the plug is different and needs to be changed, and (2) the windings are not identical but sometimes close enough to work. If all you have to do is change the plug, adjust the horizontal and vertical size, this extra work of swapping yokes and convergence isn't necessary!

In most instances the colors of the wires from each winding are the same. If the colors are not the same, and you connect the wires wrong, all you will get is an upside-down picture or a picture with the letters backward. All you have to do to correct the problem is to reverse the wires.

To determine if it is possible to use the new yoke that comes with the replacement picture tube, simply measure the resistance of each winding. If the resistance is within +/- 10% of its counterpart, do a trial installation, even though you have to change the plug. If the new tube works with the new yoke, you don't need to reconverge the CRT at all! You've saved yourself some time.

Assuming there is no similarity in the yoke windings, we will now take a detailed look at changing the yoke from the old CRT to the new one. When discon-

necting your old tube don't forget to discharge your HV by shorting the CRT HV terminal to ground. As in every procedure, "practice makes perfect". After a few times, you'll wonder why you looked at this procedure with apprehension.

Exchanging yokes

Of course, if there is no yoke or magnet assembly on the new tube, you will use all of the old parts. Otherwise, proceed as described in the following.

First, you will have to remove the convergence magnet assemblies. It is important to return the new magnet assembly as close to the spot where it came from as possible. This will make convergence easier. Mark the neck of the new tube, remove the new magnet assembly and keep it to put back on the new CRT.

Remove the new yoke by loosening the neck clamp and sliding a knife between the wedges and the tube. Remove the wedges from the yoke by holding the yoke in one hand and using a circular twisting action of the wedge with the other. Be careful not to damage either yoke; you may need the unused one another time. Save the wedges for use in the last steps of the convergence.

Use the same procedure on the old tube, but keep the yoke and put aside the magnet assembly. place the old yoke on the new tube and replace the new magnet assembly in the position you had previously marked. Tighten the "C" clamp of the magnet assembly.

Now install the new tube into the mon-

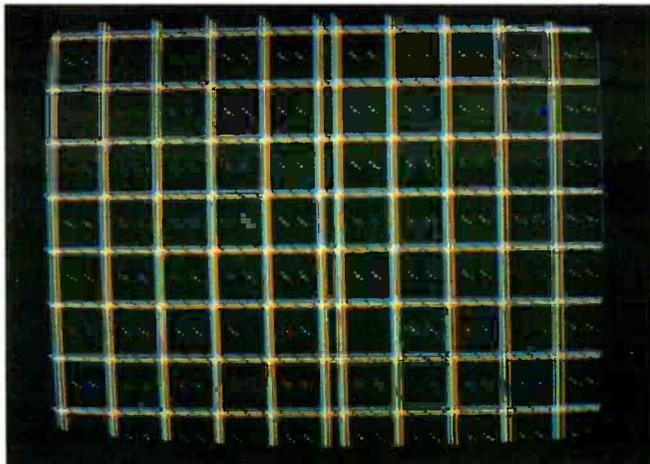


Figure 11. From a cross hatch generator or a computer signal, put a signal similar to this on the screen with several vertical and horizontal lines. You probably have green, red and blue somewhat parallel lines in both the vertical and horizontal planes. Adjust the CMA tabs marked with 4 or YELLOW to superimpose red on top of blue in the center of the screen both horizontally and vertically.

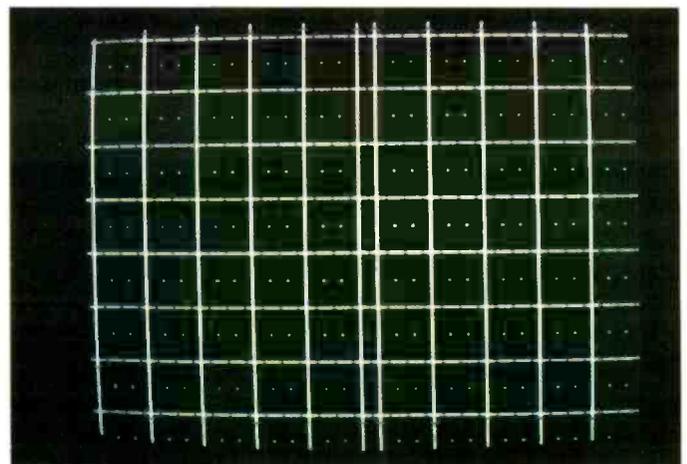


Figure 12. Adjust the yoke as described in the text so that you have only white lines on the screen.

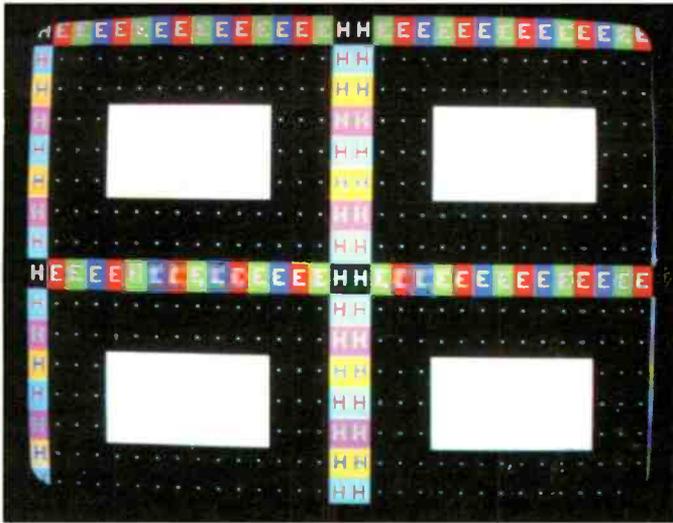


Figure 13. This is an example of a well-converged CRT with one type of pattern from a signal generator on the screen face.

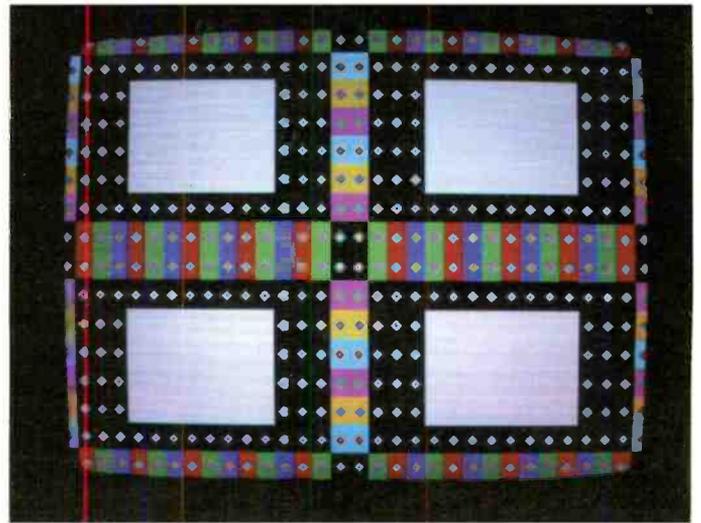


Figure 14. The clarity of this pattern shows that the CRT has been properly converged.

itor. Connect your HV lead, base plug and don't forget to plug in your yoke (turning the unit on without vertical and horizontal sweep is the quickest way to damage the CRT) and connect your ground leads. Turn the unit on, check for a raster, and focus for a sharp scan. At this point, let the unit warm up for at least 20 minutes, then slide the yoke all the way back to the CMA for the first purity adjustment.

Purity adjustments

At this point, use a degausser or turn the monitor off for ten minutes so the automatic degausser will do it for you, then turn the unit back on. Now adjust G2. With a cross hatch pattern, turn G2 just far enough to blank out any background and focus for best resolution. (This is important because any future changes in focus will change resolution). On the CMA you will find a thick ring that has four tabs 90 degrees apart. That is your tab lock (Figure 4). Turn the lock so the convergence tabs will turn snugly, but stay where you leave them. As mentioned before, it may be necessary to break loose some glue/paint. The purity tabs are the front or rear pair marked "P", 2 or RED.

Turn the brightness control to mid-range and contrast to full. With the screen controls, turn down the red and blue screens. Adjust the green screen to a moderately bright level. With the yoke back against the CMA, your screen could appear as shown in Figure 5. Use the purity tabs to center the green "blob" as shown in Figure 6. Slide the yoke all of the way forward, then ease it back just far enough to have a full green screen, (Figure 7).

There should be no discoloration of the green on the entire screen. Turn the yoke to level the raster and adjust the height and width control for a full screen. Tighten the "C" clamp on the yoke.

Turn down the green gun and turn up the blue. You should have a solid blue. (Figure 8). Repeat for red (Figure 9). If you have a solid red, green and blue screen as in Figures 7, 8 and 9, you now have achieved "purity". It is sometimes necessary to repeat the purity procedure for optimum results.

Convergence

With the brightness control still on mid range without a video signal, turn the red blue and green screen controls up or down until you have a white center screen (Figure 10). You may or may not have some discoloration around the sides, but if the center is solid white, you have the beginnings of proper convergence.

From a cross hatch generator or a computer signal, put a signal similar to Figure 11 on the screen with several vertical and horizontal lines. You probably have green, red and blue somewhat parallel lines in both the vertical and horizontal planes. Adjust the CMA tabs marked with 4 or YELLOW to superimpose red on top of blue in the center of the screen both horizontally and vertically.

The CMA tabs marked with 6 or BLUE will move the converged red and blue lines on top of the green line. Note: The green is stationary. Readjustment of the 4 or YELLOW and the 6 or BLUE tabs may be necessary to get perfectly white lines across the center of the screen. Turn the

lock ring to hold the CMA tabs in place. Now the objective is to get white lines on the sides both horizontally and vertically.

Tilt the yoke toward the 12 or 6 o'clock position to converge the red and blue vertical lines at the top and bottom of the raster. Insert a wedge as necessary to maintain this new yoke position.

Next, tilt the yoke toward the 3 or 9 o'clock position to converge the red and blue vertical lines at the sides of the raster. Insert two wedges 120 degrees apart to maintain this new yoke tilt position. You may have to repeat these steps until you get only white lines as in Figure 12. When convergence is complete, glue the wedges in place with silicon cement or a glue gun, making sure the yoke clamp is tight.

With no signal, you should have a solid white screen. You may readjust the red, green and blue controls in order to get the best white. Turn the brightness down just below the point of visibility. Now put one or two color patterns on the monitor and look at your handiwork. It's always a good idea to check your focus one last time. Figures 13 and 14 are good examples of a well converged CRT.

In spite of your efforts, convergence may not meet your specifications in the corners. This can be improved by sliding strip magnets between the CRT and the yoke; then gluing them in place. It may take several magnets to get to the point where you have perfect convergence.

Congratulations, you're finished with the convergence procedure. ■

(This information was supplied with the assistance of the Engineering Department at Video Display Corporation, Tucker, GA.)

A distributorship is the place where the service center buys the products; replacement parts, consumables (solder, wire, chemicals, etc.) test equipment and other materials that it needs to complete a repair and get the product back to the customer. Distributors share some characteristics in common with other types of stores. Some distributors just do a better job than others.

For example, some distributors offer depth and breadth of product line. In other words, they have replacement parts for most, or all, of the major brands. Not only that, they even stock some of the hardest to obtain replacement parts for those brands. They offer a wide selection of brands and types of test equipment, consumables, etc. Their mission is to provide as much assistance as they possibly can to their clients, consumer electronics servicing professionals.

Other distributors may be newer to the business, and, until they grow, offer fewer replacement parts and other products. Other distributors may simply never wish to expand their product lines. On the other hand, they may offer better prices, greater convenience, or other incentives to make dealing with them more attractive. As long as the service center dealing with these distributors is aware of any limitations or shortcomings, one of these distributors may be just the one they need.

Consider these variables

Most people are careful shoppers when it comes to buying consumer goods. It pays to shop just as carefully when choosing a distributor.

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

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

Some important questions to ask

Some of these questions may not seem important, but from what we have learned from some of our readers, they are very important. For example, we learned from one of our readers that one mail order company that he dealt with

made a regular practice of charging unnecessarily high shipping charges.

Another practice that some distributors indulge in is to hold shipment of products for some time after the purchaser's check has cleared. This gives the distributor a nice little interest-free loan between the time the check clears and the time he decides to ship the merchandise. This is not necessary. Some companies ship the product immediately after receiving an order.

One other thing to keep in mind is that some distributors charge a restocking fee even when they were responsible for shipping the incorrect product.

Check this showcase

The purpose of this distributors' showcase is to provide the distributors who advertise in the magazine with additional space to give readers information about their companies. We hope you will take this opportunity to learn a little more about these companies so that you will have a better understanding of their capabilities and practices.

Let the buyer beware

Most replacement parts distributors are hard-working, well-organized, ethical companies, who will make every effort to help you obtain the correct replacement for a faulty component. Some are less ethical in their practices. It's not always easy to locate the good ones and avoid the ones that will give you problems.

When you're considering ordering products from a new distributor, it might be wise to start out with a small order and see what kind of treatment you get. If the service is good, you might gradually increase the size of your order and build up a close working relationship.

If the service you receive from the distributor is not what you'd like, try someone else. It's your business that will suffer if you don't get what you order when you need it, or if you're hit with exorbitant freight charges that you have to pass along to your customer. ■

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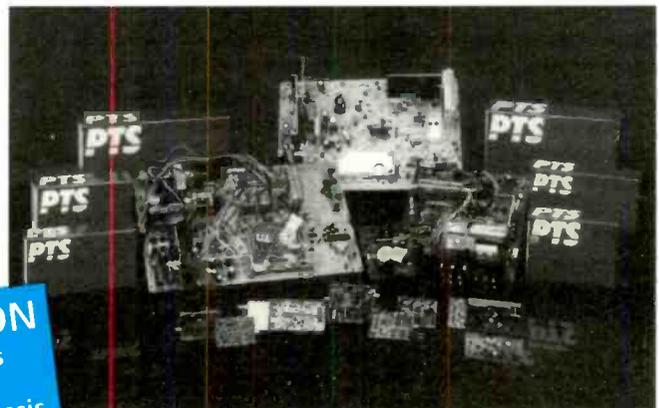
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PTS knows what it takes to make it in today's rapidly changing electronics industry. Over the years PTS has gained the confidence of service professionals and manufacturers by providing a level of service unsurpassed in the industry. PTS provides quality replacement TV Tuners, Chassis, Mainboards, and Modules for most major manufacturers. Brands such as Zenith, RCA and Philips are in stock for immediate shipment.

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TELEVISION
Mainboards
Tuners
Complete Chassis

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Dalbani Corporation

4225 N.W. 72nd Avenue
Miami, FL 33166
Phone: 1-800-325-2264
Fax: 305-594-6588

Dalbani Corporation is a national and international distributor of high quality test equipment, electronics components and parts servicing the wholesale, retail and manufacturing industry.

Since finding the parts you need should not be a major task, Dalbani Corporation maintains a huge stock of the most popular parts as well as those parts that are hard to find. Our extensive inventory of over 30,000 different items reflects our commitment to our customers anticipating their needs and offering the lowest prices available for the best quality merchandise.

Dalbani Corporation keeps customers informed of the latest introductions of new items by publishing two full line catalogs per year including catalog supplements, seasonal brochures, and notifications of sales promotions and specials. The mul-

tilingual Sales Department coupled with the state-of-the-art computerized order processing, enables Dalbani Corporation to offer prompt and efficient service to benefit the customers: Monday through Friday 9:00 A.M to 7:00 P.M. Eastern Time. A toll-free number (1-800-DALBANI/1-800-325-2264) for the U.S.A. is available, in addition to a 24-hour fax line (305-594-6588).

Dalbani Corporation offers many shipping options (UPS Red, Blue, Orange & Ground, FedEx, etc.). Orders received by 2:00 P.M. Eastern Time will be shipped the same day, and most other orders are shipped within 24-hours. CODs, company checks and cash, and most major credit cards (Visa, Mastercard, Amex, & Discover) are accepted. There is a \$20.00 minimum order.

Our Customer Service Department is



Free catalog (248 Pages) With Your First Order.

available to help answer customer's product related questions during normal business hours.

Dalbani Corporation will meet your company's needs: wholesale, retail and manufacturing. ■

POCKET SIZE DIGITAL MULTIMETER

- 3 1/2 digits LCD with a max reading of 1999
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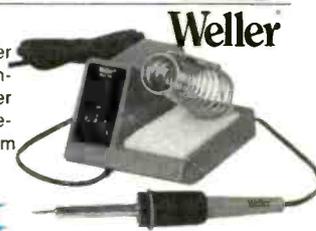
\$19.50

Weller WLC100 Soldering Station

- Ideal for the professional, serious hobbyist, or kit builder who demands higher performance than usual of a standard iron, but without the high cost
- Variable power control (5-40W) • 40W pencil iron and ST# interchangeable tip • Replaceable heating element • Cushioned foam grip • Safety guard iron holder • On/of switch with "power-on" indicator light

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- This small amplifier is constructed around the TDA2003 IC, capable of delivering 4 Wrms at 4 Ohms. The IC is completely thermally and short-circuit protected. A conventional direct current can be connected as supply. Signal power output: 7W/4 Ohm - RMS output: 3.5 W/4 Ohm and 2W/8 Ohm - Total harmonic distortion: 0.05% (1W/1 KHz) - Frequency response 20 Hz to 20 KHz (-3dB) - Signal/noise ratio: 86dB (A Weighted) - Input sensitivity: 40 mV / 150 KOhm - Overload and short-circuit protected - Supply Voltage: 15 VDC (8 to 18VDC possible) / 0.5A - Dimensions: 55mm x 35mm

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(Windows Version)

- Contains over 9300 VCR/2100 TV problems, along with practical repair suggestions for each one
- Save you hours of unproductive diagnostic time
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VCR Order N° 83-0125 TV Order N° 83-0130

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- Optima-5s

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Order N° 46-2755

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Order N° 50-425 Manuf # OS-9100P
100MHz 2-CH DUAL TRACE

NEWLY DESIGNED REALTIME OSCILLOSCOPES

GENERAL: The Goldstar's new realtime oscilloscopes are designed with various function including ALT-Trigging function, and also designed to meet low cost requirements from the field of school and hobbyists.

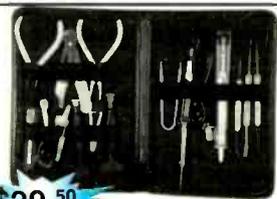
- Features:** • 6" large size high luminance CRT • ALT. Trigging function (Vert Mode) • Adoption of SMT for high performance and reliability • TV sync. separation and hold-off circuit useful in video signal observation • Sweep magnification(x10) • DC to 100MHz, 2CH dual trace. • Wider than specified frequency response • Signal delay with line useful for observation of signal start point • Auto focusing according to the change of intensity • Drift compensation circuit employed in vertical amplifier for low drift. • Jitterless and high trigger sensitivity • DIM. : 320mm(W) x 140mm(H) x 430mm(D) • Weight : 8.5Kg, Power Supply: 120V/220V/240V 50/60Hz
- Specifications:** Vertical deflection: • Band width -DC(10Hz) to 100MHz, Dc(10Hz) to 20MHz(2mV Range) • Deflection factor: 2mV to 5V/div in 11 calibrated steps of 1-2-5 sequence • Rise time: 3.5ns or less
- Horizontal deflection:** • Time Base A: 0.1µs/ div to 0.2s/ div in 20 calibrated steps of 1-2-5 sequence • Time Base B: 0.1µs/ div to 10µs/ div in 7 calibrated steps of 1-2-5 sequence

17 ITEMS IN A ZIPPER CASE

- Kit contains:** • IC Remover • Soldering Iron, UL Listed • Desoldering Pump • 2 ICs Inserters • Long Nose pliers • Insulated wire cutters and stripper • Anti-Static Wrist Strap • Tube of Solder (11" X 71/2" X 11/4")

Order N° 50-845

\$29.50



Parts Express

**340 E. First Street
Dayton, OH 45402-1257
Phone: 800-338-0531
Fax: 513-937-4644**

Parts Express is a full line distributor of electronic parts, tools, test equipment, and accessories geared toward the consumer electronics industry and the technical hobbyist. In business since 1986, Parts Express has quickly established itself as a leader in the industry by consistently providing quality products, first rate customer service, low prices, and toll-free technical support.

Parts Express stocks an impressive array of CATV and VCR repair parts, tools, semiconductors, test equipment, chemicals, computer accessories, adhesives, telephone products, educational materials, pro sound equipment, raw loudspeaker drivers for home, car, and home

theater applications, crossover parts, specialized connectors, batteries, cellular accessories, and a huge selection of wire and cable. Parts Express stocks over 15,000 items and strives to continually expand its product line to offer the customer a wide and diverse selection of sometimes hard to find products and accessories. Some of the items stocked are from names like 3M, Fluke, Tripplett, Littelfuse, Klein, Goldstar, Mueller, Electro-Voice, Catamount, NTE, Motorola, Pioneer, Eminence, Pyle, Pyramid, Celestion, Audax, Vifa, Morel, Monster Cable, Sherwood, Dynamat, Ultimate, Kester, Neutrik, Augat, Cambridge, GC Electronics, Tech Spray,

Rite Off, Caig, GB, Lisle, Phoenix Gold, Easypower, Mag-Lite, Weller/Ungar, Panavise, Carol, Ferrofluidics, and many more. All of these products are stocked and ready for immediate shipment (most orders shipped within 24 hours).

The sales department at Parts Express prides itself on offering fast, friendly, dependable service and complete customer satisfaction. The phone representatives can provide information about current pricing and availability and the technical support staff is happy to provide answers on a wide variety of questions. Orders can be placed 8:00 A.M. - 8:00 P.M. ET Monday through Friday, and 9:00 A.M. - 5:00 P.M. ET on Saturday.

Each year Parts Express produces a full line catalog, showcasing the complete product offering plus detailed descriptions and specifications. This catalog is supplemented with numerous sales flyers during the year, offering special bargains and hot deals. For more information or to request a free 244 page full line catalog, please call 1-800-338-0531. ■

Parts Express™

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244 PAGE
CATALOG**

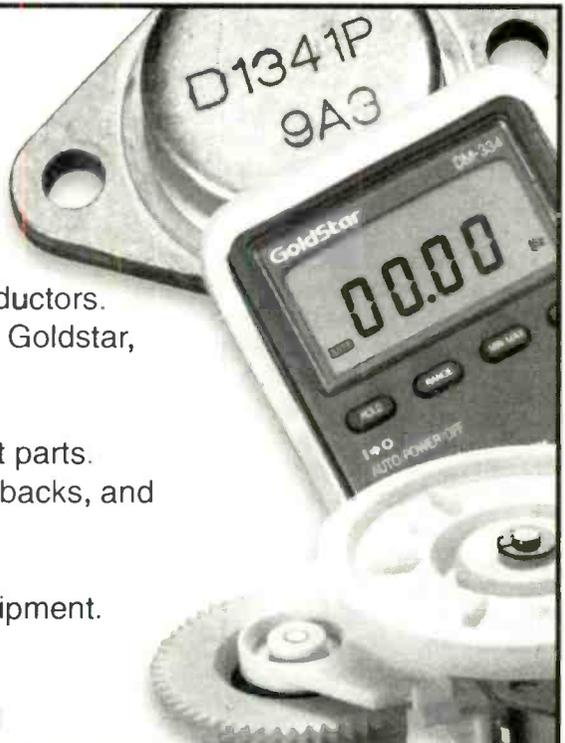


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Parts Express 340 E. First St. Dayton, Ohio 45402-1257 Phone: 513-222-0173 Fax: 513-222-4644



CitiTronix, Inc/Panson Electronics

America's one call source for brand name electronic parts and accessories®

CitiTronix/Panson's affiliation is based on 90 years of combined parts distribution experience. Serving North America's servicers and customers by distributing high quality exact replacement parts and accessories for most major consumer electronic manufacturers.

In January, 1994 CitiTronix, Inc. and Panson Electronics formed an alliance which operates under the name CitiTronix/Panson.

Benefits for you from this alliance are:

- More product lines—by combining resources the alliance offers more lines than ever.

- More Inventory—With multiple warehouse facilities the "in-stock" parts inventories are larger than ever.

- Faster shipping—Multiple warehouse facilities allows your order to be filled and shipped from the most efficient location.

- State-of-the-Art/Computerized Phone System—allowing for immediate access to the customer service department, research help desk, fax and Dial-In/On-Line access (P.A.R.T.S.®).

The company maintains an experienced staff dedicated to serving you and providing exact replacement parts for your servicing needs. Parts research is provided via the On-Line system, or by calling 1-800-846-2484. This research includes helping you determine the correct parts and recommending alternates when parts are no longer available. A large collection of manufacturer's literature, microfiche and computer data is maintained for the sole purpose of assisting you.

The company maintains a state-of-the-art computerized telephone system, Fax, and one-line computer system for communicating with you. The remote customer access system (P.A.R.T.S.®) is continually updated and provides research capabilities as well as access to the complete combined company inventories.

Warehouses are located in Pine Brook, New Jersey, St. Louis, Missouri and the Chicago area.

In 1994 JCPenney named CitiTronix/Panson as their exclusive authorized repair parts distributor.

Both CitiTronix, Inc. and Panson Electronics are long-time parts distributors and have interesting histories.

CitiTronix was founded on June 1, 1936 and was called City Refrigeration Company. It began as a service company servicing washers, dryers, ranges and refrigeration products.

A dramatic change came to CitiTronix in 1977 when the first electronic lines were added to the existing appliance lines. Following are the brands of exact replacement parts offered:

- Sony
- Philips, Magnavox, Sylvania, Philco
- Matsushita (Panasonic, Quasar, Technics)
- Sanyo & Fisher
- Thomson Consumer Electronics (RCA Premier, GE, ProScan)
- Kenwood
- JC Penney

On January 8, 1988, the name City Refrigeration Co., Inc. was changed to CitiTronix, Inc. and a 13,800 sq. ft. facility was established.

Panson Electronics was established in 1965 as a supplier of electronic repair parts and was authorized as the first Panasonic repair parts distributor in the U.S.

Responding to the ongoing changes and needs of the consumer and repair industry, Panson began expanding its services so that today it distributes exact replacement parts for such well-known electronics products as:

- Sharp
- Hitachi
- JVC
- Zenith
- Thomson Consumer Electronics (RCA Premier, GE, ProScan)

- Matsushita (Panasonic, Quasar, Technics)
- JC Penney

In August 1993, Panson relocated from Greenpoint, NY to the present 20,000 sq. ft. facility in Pine Brook, NJ in order to provide the fastest parts delivery available.

CitiTronix/Panson features:

- A consistent high level of service.
- A knowledgeable customer service department that is available from 8:00 AM to 4:30 PM CST.

- Free freight on back orders.

- On-line remote access system with extensive data base, parts price/availability, model number to part number research, open order status and order entry (P.A.R.T.S.®).

- Open line of credit available.

- Daily open order and shipped order reporting.

- Outside sales—calling on regional accounts.

- Monthly specials.

- One stop shopping for major and secondary brand parts support.

- Line item ID to servicer's work order number.

- Exact replacement parts, kits and accessories.

- Warranty Pricing.

- Same Day Shipping on in stock orders.

- Toll-Free ordering phone and fax numbers.

The CitiTronix/Panson Corporation will provide to you a total service which is greater than the sum of the services provided by the individual companies. America's one call source for brand name electronic parts and accessories®

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- State-of-the-art Distribution Process



RCA

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Quasar JCPenney  **FISHER**

SONY KENWOOD **SANYO**

SYLVANIA  **PROSCAN**

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Technics

SHARP

ZENITH

PROSCAN

JVC

Technics



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the revolutionary low temperature patented Chip Quik® kit; 3) Replace the SMD using the Zephytronics™ AirPencil and Quik Stick™ No Clean Rework Paste. This system is so amazing we've developed a demonstration video so you can see it and *believe* it (see ad below).

Throughout our many years of serving the electronics industry, PRB's goal has always been to put our customers first. Our in-house staff of professionals works hard to provide the best possible products and superior service.

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expanded our HR® line of flybacks to include over 30 newly developed transformers for brand names such as Goldstar, RCA, and Sony. Since HR® is ISO-9001 certified, PRB Line guarantees the quality of their flybacks. We are looking forward to continued growth in this line.

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Contact your local PRB Line distributor, or for a list of distributors in your area, call 1-414-473-2151. We're also on the Internet at www.prbline.com or e-mail us at info@prbline.com.

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Chip Quik® SMD Bench Rework System



P/N: ABC-1 & ZT-1
Zephytronics™ Adjustable Board Cradle & AirBath
"Best New Product Award" *SMT Magazine*



P/N: ZT-2
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Non-contact pinpoint soldering



Contact your local PRB Line distributor or call 414-473-2151 for details on these and other PRB Line products

Andrews Electronics

PO Box 914

Santa Clarita, CA 91380-9014

Phone: 800-289-0300

Fax: 800-289-0301

Andrews Electronics is housed in 50,000 square feet of warehousing and office space. Miles of shelving are arranged for immediate identification and easy accessibility for over 250,000 different parts that we carry.

Maintaining an inventory of this size has been the cornerstone of our success as the O.E.M. parts distribution industry leader. It provides us with an average first pass fill rate of above 90% and makes us the largest supplier in America for the manufacturers that we represent. Our fill rate is calculated on not only everything that is ordered but also on every call or fax that we receive for availability, even if it isn't ordered! Our dealer order desk has 32 available sales representatives to handle all of your ordering needs.

We've built our reputation on a very simple philosophy....service. Not very fancy, but very effective. Our constant growth attests to it. You see, all of our policies that have been developed over the years have been based on that one simple thought: "How may we better serve the industry?" How about:

- 14 major brands to save you time, frustration, and money with "one-stop shopping."
- Orders placed before 2:30 PST are routinely shipped the same day.
- A freight program that offers free and discounted shipping.
- No minimum orders or handling charges.
- Automatic backorder reports with ETA's mailed bi-weekly.
- A fast, highly-efficient research department, second to none.
- A program that converts make/model descriptions to part numbers instantly for the majority of research requests.
- 24-hour toll-free phone and fax order lines.
- Over 80 full-time employees waiting to serve your needs.

Our already outstanding freight program has been drastically improved! The minimum qualifying amount has been cut in half and the 2 day air discount has been almost doubled! Even if an order is below the minimum, we'll ship it blue label at the 3 day select rate! With this type of shipping program, we're a lot closer than you might think.

In case you've heard this elsewhere before, now's the time to let us prove it to

you. By investing a mere two minutes of your time, you can discover what thousands of others have: that there is a difference. When you place your next order with

your local supplier, check the availability of all the items. Then call or fax Andrews and check our stock levels. We believe you'll be pleasantly surprised! Wouldn't getting those extra units repaired a week or two sooner be good for your reputation? Sure it would! And we can help! After all is said and done, it is performance that counts. We know that your ability to perform your job depends on how well we perform ours. Our regular office hours are from 8:15 to 4:45 PST and we're closed for lunch between 12:00 and 12:30. When you think of electronic parts...think of Andrews. ■

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Philips Software Development

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Fax: 423-475-0071**

Software Development is a new department in Philips. We grew out of an effort to create the best electronic service manual program possible. From this effort we have embraced the goal to **"Develop the most user friendly software products for the service industry"**.

We were the first to develop a parts cross reference program covering all 250,000 of our parts with substitutes, prices, dud allowance, and availability. It was in this project that we started to develop methods to reduce the size of our data which makes it practical to load on a hard drive.

Our next big effort was to take all of our TV/PTV models going back to 1985 and put them into a program that allows fast access to any component in those sets with a link back to the pricing program. This combination was very fast and powerful, allowing access to all parts including hand units by typing the model number. Substitutions, price, and availability are then only a keystroke away.

In 1994 we began to research how we could create an electronic service manual. We insisted that it meet certain criteria:

1. An electronic service manual program had to be FAST in order to bring up diagrams and move through them without delay.

2. It had to be COMPATIBLE with all other manufacturers. In order to prevent servicers from having to have multiple systems, our program is designed to be flexible to accommodate any manufacturers service manual data.

3. The most challenging and important is that our program had to OVERCOME EVERY COMPLAINT we could imagine concerning the use of paper manuals.

Overcoming every complaint was the most difficult. There are so many problems and as we talked to technicians the list grew even longer. This is a short list of problems to overcome:

- Manuals get lost on the bench under other manuals as they do not get refilled.
- Tracing signals through a manual is

too time consuming and difficult.

- Finding any information in a manual takes too long.
- The diagrams are printed too small for most people.
- It takes too long to order and receive a manual when it is needed.
- Paper manual files take up too much floor space in the shop.
- Paper manuals take up too much bench space when opened to view the diagram.
- Keeping paper manuals updated in a timely manner is difficult.
- In most cases paper manuals lack a history of known fixes and troubleshooting techniques.
- Paper manuals cost too much.
- Every company makes their manual in a different style.

We have listened to every one of these complaints and designed FORCE to overcome these and so many more. The program was initially called SmartMan. Regrettably there was a trademark already issued for that name so we have changed the name to FORCE (FOR Consumer Electronics).

We have designed FORCE to make every manual available to every technician. It includes HotSpot signal tracing to quickly jump from one diagram to another. Location information for components, circuits, diagram name, and all Known Faults are included. We can deliver our manuals via the Internet as well as update it at any time. We allow you to make notes about any fix you find. We are also soliciting consumer electronics companies wishing to make manuals in this style to join us.

We designed our program, FORCE, to be user friendly and can improve productivity so much that every technician will soon have his own computer. We see productivity improving by 10% to 30%, depending on the technician's use and the kind of jobs done. It costs only 2% of that productivity improvement to put a computer in the hands of every tech.

CD-ROMs have been considered to be



the only way to go with a program like this. A CD-ROM style would make the manuals too large for Internet delivery. Most of our manuals are under one floppy disk in size. If our manuals required a CD-ROM, we would not be able to easily deliver them by Internet and only one technician could access a manual at a time. Updating would have been much more difficult and adding your own information, impossible.

The FUTURE of FORCE is growth and expansion. We are going to add many more features:

- The ability to annotate a diagram with your notes.
- Cause voltage measurements to appear on-screen and remain there while you diagnose a problem.
- Draw or write on a diagram, save it and FAX it to a help line.
- Link via modem to any compatible help line to exchange ideas on a repair.
- Tie to any company's service programs and record the results.
- Allow NARDA claims to be generated and electronically filed right from the job.

There are more features being planned and we expect technicians will be making suggestions that will turn into even more new features.

The Software Development Department hopes to overcome years of everyone doing their own thing. We stand ready to help any company that wants to join a unified standard for the industry. We want to overcome the last complaint about paper manuals and finally produce manuals that are easy and **intuitive** to use. FORCE is designed to do just that. ■

Philips Service Company

**PO Box 555
401 E. Old Andrew Johnson Highway
Jefferson City, TN 37760
Phone: 800-851-8885
Fax: 800-535-3715**

Rated #1 in the Industry

Philips Service Company surveys its Authorized Servicers throughout the country to ask them to rate our service among the service of the top ten consumer electronic manufacturers. All manufacturers are rated in seven service-related categories as well as an overall rating. The Philips Service Company has consistently achieved a #1 rating in all categories, including the category of Service Parts Support.

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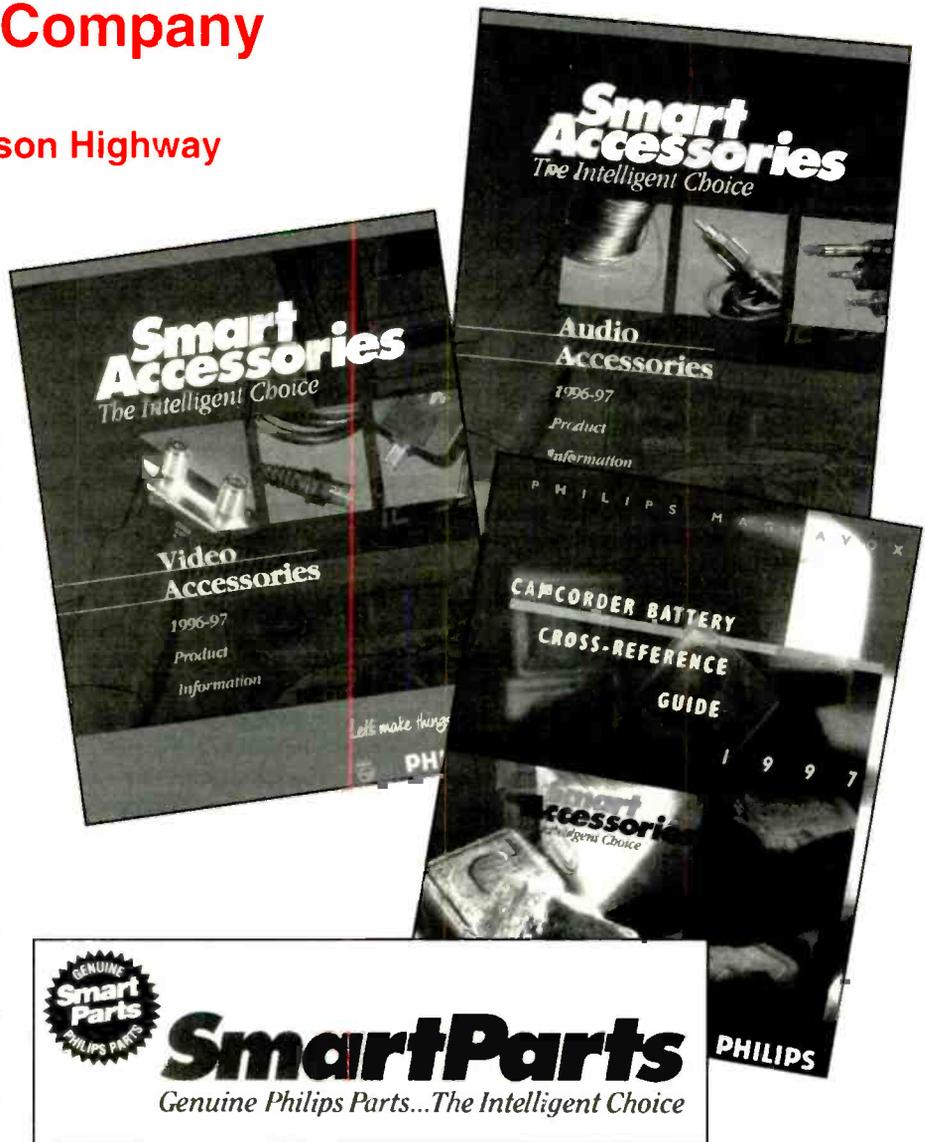
Courteous and knowledgeable phone representatives are available Monday through Friday, 8:00 a.m. - 8:00 p.m. EST and Saturdays from 8:00 a.m. to 5:00 p.m. EST and are ready to take your order or assist you with on-line pricing and availability information. A toll free fax is also available 24-hours a day, 7 days a week for customers to fax their orders. A confirmation of your order can be returned upon request indicating the order number and item availability.

No Hassle Return Policy

In our continued effort to be easy to do business with Philips offers a 30-day No Hassle Return policy. The details of this policy are provided on the back of your packing slip, and enable the servicer to maximize this turnaround time of customer repairs and estimates by allowing the return of new parts within 30-days of purchase with *No Hassle*.

Customer Service Department

Servicers are encouraged to contact our Customer Service Department if they experience any problems with their orders, parts returns, or account. Associates are trained to resolve most problems while you are on the phone. The Customer



Service Department can be reached through the Parts and Accessories ordering number 1-800-851-8885.

Teleserve Department

Our Teleserve Department consists of knowledgeable representatives working to keep you informed of new items and special promotions that are available for you to offer to your customers. Representatives are continuously finding new avenues of reaching our customer base such as outbound calling and group faxing.

Making Things Better

Reduced Pricing

In our effort to continually *make things better*, Philips Service Company reduced its parts pricing in late 1996. This repre-

sented a reduction in price from 2%-23% for many of our popular items, such as tuners, remotes, and transformers.

Same Day Shipping - Two-day Delivery

Philips continues to achieve same day shipment of orders received by 6:00 p.m. EST. Your orders will be delivered within 2 working days anywhere within the United States. Free shipping for all set warranty replacement parts.

Inventory Availability

Philips prides itself on inventory availability, measuring its orderfill percentage to ensure that it consistently meets 95% or better. All of this is to allow our servicer to provide the best service support to their customer.

I.C.M. Components

1226 Third Street Promenade, Suite 206
 Santa Monica, CA 90401, U.S.A.
 Phone: 310-260-1444, 800-748-6232
 Fax: 310-451-8727

I.C.M. Components is an importer and distributor of high quality computer monitor flybacks, computer monitor testers, schematics and service manuals. Flybacks for televisions are also available.

Offering the highest level of service, I.C.M. processes and ships most orders the same day from an inventory of over 600 different types of flybacks and 750 different types of schematics/service manuals. There are no minimum orders and most major credit cards are accepted.

Helping the repair technician is I.C.M.'s top priority. In addition to schematics and service manuals, we offer several types of software designed to assist the tech. One such software program is our Tech-Tip Repair Program for Windows that we sell for \$199.95 plus S&H; the program contains over 1,400 Monitor, CPU, and

Power Supply failures listed by symptom and solution. The program is updated once a month and upgrades can be purchased for a small charge plus S&H. As a bonus, the FCC-ID Database program described below is included at no extra charge with the new WINDOWS Tech Tips program (a \$50.00 value if purchased separately).

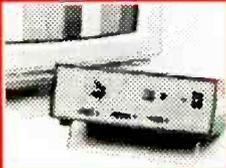
To help identify who made the different brands of monitors, I.C.M. offers a FCC-ID software program for \$50.00. The FCC-ID database contains over 60 pages of monitor manufacturers names and addresses. The software is easy to install and operate; no long instruction texts are ever required. With so many off-brands of monitors being sold now, this program is a must to easily identify the O.E.M.

Our line of Computer Monitor Testers

are affordable and easy to operate. Starting at only \$129.00 plus S&H our testers can test most of the IBM compatible monitors including MDA, CGA, EGA, VGA, SVGA. There is no need to use a computer or to change video cards; the ease of operation, reliability and low price has made our testers a very popular choice with repair depots that already own the top names in testing equipment. For 1997 we have introduced two new testers that will test Apple Mac monitors in addition to the IBM compatibles; one of the new models is also capable to test up to five different IBM compatible monitors simultaneously for long term burn-in. A new TV tester is now also available; price and specifications on all testers are available upon request.

I.C.M. sales people are dedicated to complete customer satisfaction. Our staff is knowledgeable, dependable and friendly. To obtain the latest availability and pricing call our toll-free telephone line between 7:30AM - 5:00 PM (Pacific) Monday through Friday. During off hours and days use our voice mail to leave detailed parts request information; all calls will be promptly returned with price and availability.

YOUR MONITOR & TV FLYBACK SOURCE



MT802 MONITOR TESTER

Can be used to quickly and easily trouble-shoot, test and align IBM compatible and Macintosh computer monitors.



MT803 MONITOR TESTER

Same functions as the MT802, plus can test up to 5 IBM compatible monitors simultaneously.



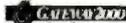
TELEVISION TESTER

ATTENTION SERVICE PROFESSIONALS!

If You Fix Monitors:



- Highest Quality Replacement Flybacks
- Fully Guaranteed Flybacks
- Prompt Reply To Your Parts Requests
- Courteous & Efficient Service
- Competitive Pricing



NEC Macintosh

ZENITH WANG

HEWLETT PACKARD COMPAQ

AT&T IBM

GoldStar

SAMSUNG

PACKARD BELL

DELL

F.C.C.-I.D. DATABASE PROGRAM \$50.00

On 1.44 disk to help you identify who manufactured the monitor you are trying to repair. Program contains over 60 pages of manufacturers names and addresses.

SCHEMATICS

For over 700 monitors/terminals. Call us with the make, model and F.C.C.-I.D. number of the monitors you need schematics for.

TECHTIP REPAIR PROGRAM FOR WINDOWS® \$199.95

Lists over 1000 monitor, CPU & power supply failures by symptom & solution. • BONUS!! • Included at no additional cost is our F.C.C.-I.D. DATABASE program (\$50.00 Value).
© MICROSOFT CORP

800-748-6232



Call 800-748-6232
 310-260-1444
 FAX 310-451-8727



ALL BRAND NAMES LISTED ARE REGISTERED TRADEMARKS OF THEIR RESPECTIVE COMPANIES

Circle (67) on Reply Card

Herman Electronics

**7350 Herman Way
Miami, FL 33122
Phone: 800-938-4376
Fax: 800-938-4377**

Herman Electronics is a diverse and multi-faceted full-line distributor of everything in electronics, committed to offering only the best in original replacement parts, tools, test equipment, cable, connectors, chemicals, and most importantly, customer service to their customers. In business for over 40 years and having recently moved to their new state-of-the-art corporate offices and distribution facility, Herman Electronics has clearly established itself as one of the leaders in the industry by providing only quality products and superb customer service to all facets of the electronics industry.

The heartbeat of the company lies in the OEM parts department. While serving the industry for over 3 decades, Herman has many of the major OEM parts lines enabling them to provide more efficient and cost effective service to you, their

valued customer. The company prides itself on being a SINGLE source to the service trade.

Herman Electronics is one of the largest original replacement parts and accessory distributors in the country and is factory authorized for SONY, PANASONIC, THOMSON-Premier (RCA-GE-PROSCAN), SAMSUNG, QUASAR, ONKYO, TECHNICS, TOSHIBA, and KENWOOD. Stocking one of the largest and most comprehensive parts inventories in the country enables the company to fill over 80% of their orders from their inventory and guarantees SAME DAY shipment of all in-stock orders placed before 4:30 P.M. (EST).

Herman Electronics provides a variety of customer support services as a result of their commitment to customer service excellence. They have several professional customer service representatives

to serve all your needs from 8:30 A.M. to 6:00 P.M. (EST) Monday thru Friday.

The company prides itself on being accommodating to its customers in order to provide complete customer satisfaction. "We realize there are many good distributors throughout the country," says Jeffrey A. Wolf, President and son of one of the company's founders. "It is our job to be better by taking that extra step in giving our customers professional, personalized service. This industry has quickly become service driven and therefore it is our focus and dedication to maintain a standard of excellence in customer service. As the year 2000 rapidly approaches we must continue to develop innovative ideas and fresh approaches to meet and exceed the demands that lie ahead." And the company is doing just that. On-line computer services, 24 hour electronic ordering, EDI, on-line parts research just to name a few. To accommodate the west coast and after hours requests, Herman has an electronic telephone and fax ordering system available 24 hours a day, seven days a week.

If you haven't given Herman Electronics a try, please do so now. Call to request their monthly specials and experience the true HERMAN ADVANTAGE where with ONE call you can get it all! ■



IF YOU NEED IT... WE HAVE IT!

HERMAN ELECTRONICS

Phone: 800•938•4376

Fax Order Line: 800•938•4377

ORIGINAL REPLACEMENT PARTS & ACCESSORIES

SONY KENWOOD Panasonic RCA

GE GO.VIDEO TOSHIBA Technics

Quasar ONKYO SAMSUNG ELECTRONICS PROSCAN

* PREMIER DISTRIBUTOR

THE HERMAN ADVANTAGE

- All In-Stock Orders Placed Before 4:00 PM EST Are Shipped the Same Day.
- FREE or DISCOUNTED Air Freight Program
- RAPID RESPONSE to All Research Requests.
- PROFESSIONAL Customer Service Representatives to Serve Your Every Need.
- CONSOLIDATE YOUR BUYING and purchase all the major lines from ONE SOURCE.
- NO MINIMUM ORDER.

Test Equipment, Tools, Soldering Equipment, Chemicals, and Service Accessories

BK PRECISION GoldStar FLUKE HAKKO
Chemtronics HITACHI KENWOOD LEADER
WAVETEK GC 3M Weller Xcelite



7350 HERMAN WAY, MIAMI, FL 33122
Internet E-Mail Address: hermanelec@aol.com



Web Page: <http://gateintl.com/hermanelec>

Thomson Consumer Electronics

7225 Winton Drive, INH 915
Indianapolis, IN 46268
Phone: 317-415-2568
Fax: 317-587-9647

Thomson Consumer Electronics believes that you should have a choice. We realize that you rely on our genuine replacement parts not only during the required warranty period, but also when you want the highest level of quality and performance available. We also realize that not every estimate you give can be converted to a repair using original parts. That's our difference, we give you the choice!

Original Parts

RCA and GE genuine replacement parts provide today's service professional with the reliability they need when completing in-warranty repairs. And they are delivered to you by parts distributors who provide an outstanding level of service. In fact, our most recent survey of the service industry continues to show that three out of four servicers believe that no other manufacturer provided a consistently better parts fulfillment system than the Thomson Consumer Electronics' parts distributors.

Thomson Premier Distributors can fill your warranty part orders either off their shelves on all in-stock products, or by placing a Direct Drop Shipment (DDS) order via computer directly into the TCE national parts depot. Either way, you receive the part you need to complete the repair quickly and you get the highest possible fill rate for warranty parts to service RCA, GE and ProScan products. This computer link also allows the Premier Distributor access to all the information needed to provide you with the high level of service you require in today's fast paced business.

SK Series Universal Parts

You know that lower estimates equal more repairs and more business for you. To help you turn more of those COD estimates into repairs, Thomson continues to broaden its line of SK Series Universal Products. These quality parts let you reduce the repair estimate by lowering your replacement parts cost, and that's good news for you!

Thomson is so serious about the universal parts business that we have put our money where our mouth is! In January we placed a "reward" on your replacement video head business. TCE offered a \$2.50 rebate on every SK Series replacement video head that you used 1/1/97-3/31/97. Your response has been so great that we are now upping the ante! TCE is very pleased to announce the extension of the Reward Program on video heads as well as the addition of a reward on two other product groups! TCE will offer a \$2.50 reward on every SK Series replacement video head, SK Series flyback transformer and SK Series laser pick up that you purchase from a participating distributor between 4/1/97 and 6/30/97. Video heads, flybacks and laser pick ups all at a \$2.50 savings. What could possibly be better?

SK Series Universal Products cover a wide range of high wear, high usage parts. Whether you need video heads, flyback transformers, video replacement parts, belts, tires, pinch rollers, laser pickups, RF modulators, exact semiconductors, servicer aids and more, you can look to SK Series First.

TCE Literature

Thomson also provides a number of publications which makes finding the right part for the repair even easier. Our latest "SK Series Product Guide" (Catalog #201) serves as a quick reference tool to the SK Series Universal Product line. Photographs, text and graphic illustrations all help guide you to the right stock number very quickly and easily.

In addition to TCE's comprehensive service data, the "Television Components Quick Reference Guide" contains key part numbers for recent RCA, GE and ProScan chassis. It's ideal for the technician on the road. It folds to fit in your pocket. The Quick Reference Guide also contains a section dedicated to the EPROM's associated with chassis CTC168 through CTC187.

Another hard copy publication is the TCE "Source Book" which contains a wide

variety of information. The extensive main section contains VCR/Camcorder Key Items, with a look-up by brand and model. Also included is a complete Camcorder Battery cross-reference along with information on TCE tools and fixtures by model number, flameproof resistors, IC protectors, and axial lead zener diodes.

And there is of course, our well known and widely accepted "OEM Remote Control" book. This book is printed once a year and no one that repairs TCE products should be without one!

These publications are available from your Authorized Thomson Parts Distributor. For the "SK Series Product Guide" order publication 1J1226, for the "Quick Reference Guide" order publication 1J9548, for the "VCR/Camcorder Source Book" order publication number 1J9780 and for the "Remote Control" book order 1F5790.

Accessories and Components Business

The Thomson Consumer Electronics, Accessories and Components Business provides service from a 358,000 square foot facility located in Deptford, New Jersey. All business functions—customer service, sales and marketing, quality assurance, product analysis, administrative departments and warehousing operate under one roof. Some parts are stocked in satellite warehouse facilities in El Paso, TX, Asheville, NC and Indianapolis, IN.

A full line of RCA brand Consumer Electronics Accessories is marketed from this facility as well. The business is managed by Jack Nick, Vice President. Thomson Consumer Electronics corporate headquarters is in Indianapolis.

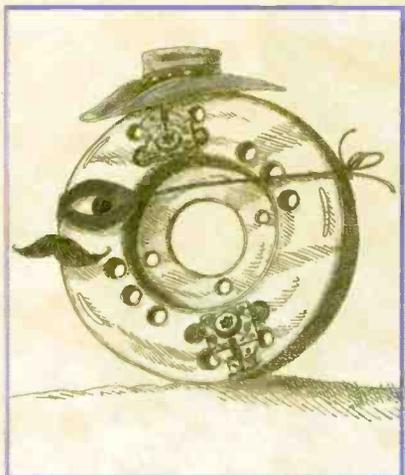
One Call Is All You Need To Make

Whether you need original RCA and GE parts or SK Series products, your Thomson distributor is your one stop source. A single call to a Thomson Distributor gives you the choice you deserve, making your business more profitable. To locate a nearby Thomson Authorized Distributor simply call (800) 338-1900 today. ■

WANTED

Your Universal Replacement Part Business

THE SK SERIES GANG



"CURLEY"

Video Head



"TEX"

Laser Pickup



"SLIM"

Flyback Transformer

\$250
per unit
REWARD

All you have to do is purchase any SK Series video head, laser pickup, or flyback between April 1 and June 30, 1997, fill out a redemption form and send it along with the numbered box top and your invoice. Simple as that. Some restrictions apply. Void where prohibited by law. See your participating authorized Thomson Consumer Electronics distributor for details.

See Your Participating Authorized
Thomson Consumer Electronics
Distributor For Details.

SK
Series

Philips ECG

PO Box 967
Greeneville, TN 37744-0967
Phone: 423-636-5693
Fax: 800-346-6621

Leading the Industry to Success

Philips ECG has stood the test of time and reliability by building upon a tradition of providing the highest quality products, most reliable customer service, technical support and consistent availability in the industry. This long-term focus on quality and service first has made the ECG brand a standard by which others are compared. ECG has also earned ISO-9002 registration, so very important in today's competitive environment. ECG products are distributed through a nationwide network of leading Electronic parts distributors and major catalog houses.

Over 31 Years of Universal Replacements

In 1966, the ECG Semiconductor Replacement Line was introduced, and a year later the company introduced its first replacement guide with 23 types cross referencing to 2,700 industrial part numbers. Thirty one years and 17 editions later, the ECG Master Replacement Guide now crosses nearly 4,000 devices to over 294,000 industry part numbers. Throughout this time, ECG has continually offered the broadest available line of universal replacement semiconductors to the commercial, industrial OEM/MRO, computer, entertainment, and communications industries. Philips ECG pioneered the concept of universal replacement semiconductors to provide customers an opportunity to reduce redundant inventories and the number of suppliers they must deal with. The ECG semiconductor line replaces more industrial part numbers than any other line.

Philips ECG - Our Product Lines Keep Growing

In addition to ECG's wide range of universal replacement semiconductors such as transistors, IC's, rectifiers, diodes and opto devices, just to name a few, ECG recently introduced a line



of generic semiconductors. The ECG brand has become the recognized industry leader in universal replacement relay's, as well. The ECG relay cross reference guide crosses over 58,700 industry part numbers, covering 210 different brands, to 700 ECG types. Other Philips ECG product lines include a totally revamped line of environmentally friendly chemicals, a line of top quality digital & analog multimeters, scope & logic probes, an excellent capacitance meter, etc., an extensive line of flame proof resistors, flybacks for TV's and monitors, and wide selection of multi-outlet surge suppressor strips. ECG also has a top quality antenna rotator and cable converter. These lines are continuously monitored and updated to ensure that Philips ECG customers receive the latest in state-of-the-art technology.

Save Money With Less Parts

Philips ECG is dedicated to helping our customers improve their bottom line. Our products save distributors and service technicians money by helping them enjoy the benefits of a broader parts coverage with less inventory and at a substantial savings. When our customers succeed, we succeed.

The First Name in Replacement

From its inception in 1966 to its leadership role in the semiconductor replacement industry, the ECG brand has continued to stand the test of time by providing the highest quality, reliability, and customer service.

Ask your ECG distributor today or call 1-800-526-9354 for the name of the distributor nearest you. ■

VERSATILITY.



SEE US AT
EDS LAS
VEGAS BOOTH
#6102D

ECG.Solving replacement problems.

ECG products help you reduce inventory by increasing their uses. Our devices support so many brands that you're always ready when you need to replace.

With extensive parts lines, we make hard-to-find replacements easy-to-find. The ECG Semiconductors Master Replacement Guide features over 4,000 devices which replace 294,000 part numbers. Our Relay Guide lists over 700 relays/accessories and cross-references over 58,700 part numbers. These guides are the time-tested industry standard.

Versatility means you have what you need when you need it—without overstocking your inventories. ECG provides long-lasting solutions to your replacement problems.

In addition to semiconductors, relays, and relay accessories, we carry antenna rotators, cable converters, chemicals, cube timers, flameproof resistors, flyback transformers, input/output modules, multimeters, proximity switches, rechargeable batteries, surge suppressors, test equipment, TV accessories, VCR tools/parts, and wiring accessories.



When it's time to replace, the industry calls ECG, because it fits and it works.

For ECG distributor information, call 1-800-526-9354.

Philips ECG is ISO-9002 registered.

Circle (119) on Reply Card

ECG Products

A Division of Philips Electronics North America Corp.



PHILIPS

Matsushita Services Company

20421 84th Avenue South
 Kent, Washington 98021
 Phone: 800-833-9626
 Fax: 800-237-9080

For 35 years, the Panasonic, Quasar, and Technics brand names have appeared throughout American homes and industries. In that time, our company's commitment to total customer satisfaction has manifested itself in many ways. Our approach to post sales support has evolved to include programs that encompass qualitative human resource training, as well as ones that stress the development of automated processes that allow us to offer timely, accurate solutions to our end users' service needs.

The engine behind MSC's ability to ensure timely repairs is our ability to deliver parts, accessories, and service literature to our network of factory service centers, independent servicers, and dealers in timely manner. We are now seeing the results of over a decade of continued investment in the modernization of our facilities. The primary point of support for all replacement parts and service literature is the National Parts Center in Kent, Washington. From here, and with further support from sales & marketing staff and field staff throughout our U.S. regions, we handle a wide variety of inquiries and fill just about any request made of us.

Customer Contact

Generally, the first line of customer support is provided by our order offices located in Kent, Washington. This office handles a wide variety of customer calls ranging from simple parts orders to requests to do research on unique model numbers. Currently, the order office handles an average of 1,400 calls a day just for taking orders, as well as take an average of 250 calls from customers requesting such things as estimated shipping time, return authorizations, processing credits, and special orders. Also, the office receives over 500 faxes daily. In addition to all of this, we offer retail customers toll-free phone and fax numbers to call and order literature, parts, or any of our comprehensive line of accessories.

One of our recent changes was the consolidations of our Kent, WA and Suwanee,

GA order offices. The single order office allows us to process customer orders more quickly and efficiently. In order to further improve our level of service, we've made significant investments in phone management systems to improve our efficiency. Data gathered from these systems will graphically depict work load volume, peak times, and average call length on a daily basis, and give management a true picture of where additional improvements are needed.

Our staff includes representatives which reach out to the field as well. Regional parts accessory representatives call on distributors, independent servicers, dealers, and even end users, to assess their needs. With a comprehensive portfolio of sales programs and promotional items, they are able to keep in touch with the ever changing needs of all, and make the necessary recommendations to our market developmental personnel.

Our commitment doesn't stop with our internal efforts. We also maintain a network of over 40 authorized independent parts and accessory distributors who are well positioned to support our wide range of customers in various markets throughout the country.

Parts and Service Literature Distribution

Once we've established what our customer needs, we have to get it to them. That's the job of over 80 employees that staff our parts and service literature warehouse in Kent. The building is a quarter mile long, and encompasses 228,000 square feet, which houses over 125,000 line items and 3 1/2 million pieces.

The warehouse day begins at 6:00 A.M. There are nearly 2,000 parts orders being processed at any given time. In order to manage such an overwhelming task, procedures have been created that allow us to meet our goal of having all orders shipped within 24 hours. By the end of the day, the facility will have shipped approximately 3,000 parts and literature orders, which consist of over 10,000 line items,

and over 40,000 pieces!

Through the use of bar coding, and a RF (radio frequency) based receiving system, we are able to reduce the turn around time for receiving and stocking, making goods available to the customer even sooner.

We are in the process of completing our investment in the modernization of our warehouse operations. This will include the expanded use of RF and bar codes throughout the facility, conveyors, carousels and a new software system. Designed to create a paperless environment, this comprehensive, state of the art installation will enable us to provide faster, error free service to our customers as well as positioning Matsushita for the next decade.

Finally, in our effort to be earth friendly, the warehouse has been a leader in the effort to recycle. It all started five years ago when we began to use biodegradable packing material. Today, we have a comprehensive program to recycle all paper, cardboard, aluminum cans, and pallets. We make an effort to purchase recycled product when it is available. In recognition of our efforts, we were designated a "distinguished Business in the Green" by King Country.

The Future

There will be a continued emphasis on expansion of our customers' ability to go "on line" with MSC, not just for order entry and order inquiry, but also for credit and return procedures.

Internally, with systems that our customers don't directly see, we move further into the information age. Not only do our purchasing agents continue to employ CD-ROM information systems, we are now on line with our factories in Japan for inquiry purposes, a capability we plan expand to selected aspects of our market. The use of bar coding will continue to expand.

Our goal for the future is customer satisfaction, not just for our direct customer, but anyone who comes in contact with Panasonic, Technics, or Quasar. ■

Matsushita Original Replacement Parts and Accessories

A Guarantee of Quality

Nothing less than total satisfaction is expected by today's customers. The only way to live up to this standard is by using Matsushita Original Replacement Parts and Accessories. The source of this quality is Matsushita Services Company and your Authorized Replacement Parts Distributor. Consult the list below, or call **1-800-545-2672** for the location nearest you.

CALIFORNIA

Andrews Electronics (C/V/M/A) * 25158 Avenue Stanford, Santa Clarita 91355 * 800-289-0300 * FAX 800-289-0301
AVAC Corp. (V) * 3746 Bradview Dr., Sacramento 95827 * 916-361-7491 * FAX: 916-361-5480
Cass Electronics (C/V/M/A) * 801 Seventh Ave., Oakland 94606 * 510-839-2493 or 800-289-0300 (outside 510) * FAX 510-465-5927
E and K Parts, Inc. (C/V/M/A) * 2115 Westwood Blvd., Los Angeles 90025 * 800-331-8263 or 310-475-6848 * FAX 800-826-0890 or 310-474-0846
Pacific Coast Parts (C/V/M/A) * 15024 Staff Court, Gardena 92048 * 800-421-5080 * FAX 800-782-5747
Star For Parts (V) * 10727 Commerce Way, Suite B, Fontana 92335 * 909-428-1404 * FAX 909-428-3213
Blakeman Wholesale (V) * 1800 E. Walnut St., Fullerton 92631 * 714-680-6800 * FAX 714-680-8700

COLORADO

Star For Parts (V) * 2350 Arapahoe St., Denver 80205 * 303-296-2117 * FAX 303-296-2120

CONNECTICUT

Signal Electronics Supply, Inc. (C/M/A) * 589 New Park Ave., West Hartford 06110 * 860-233-8551 * FAX 860-233-8554

FLORIDA

Herman Electronics (C/V/M/A) * 7350 N.W. 35th Terrace, Miami 33122 * 800-938-4376 * 305-477-0063 * FAX 800-938-4377 * 305-477-8087
Layco, Inc. (C/V/M/A) * 501 South Main St., Crestview 32536 * 904-682-0321 * FAX 904-682-8820
Vance Baldwin (C/M/A) * 2701 West McNab Road, Pompano Beach, 33069 * 800-432-8542 or 954-969-1811 * FAX 800-552-1431 or 954-969-0226
Vance Baldwin (C/M/A) * 1801 NE 2nd Ave., Miami 33132 * 305-379-4794 * FAX 305-373-8855
Vance Baldwin (C/V/M/A) * 1007 N. Himes Ave., Tampa 33607 * 800-299-1007 * FAX 813-870-1088

GEORGIA

Buckeye Vacuum Cleaner (V) * 2870 Plant Atkinson Rd., Smyrna 30080 * 404-351-7300 * FAX 404-351-7307
Wholesale Industrial (C/M/A) * 5925 Peachtree Corners East, Norcross 30071 * 770-447-8436 * FAX 770-447-1078

ILLINOIS

B-B & W, Inc. (C/V/M) * 2137 S Euclid Ave., Berwyn 60402 708-749-1710 * FAX 708-749-0325
Hesco, Inc. (V) * 6633 North Milwaukee Ave., Niles 60714 * 847-647-6700 * FAX 847-647-0534
Joseph Electronics, Inc. (C/M/A) * 8830 N. Milwaukee Ave., Niles 60714 * 847-297-4208 * FAX 847-297-6923
Union Electronic Dist. (C/V/M/A) * 311 E. Corning Road, Beecher, IL 60401 * 800-648-6657 or 708-946-9500 * FAX 800-43-UNION or 708-946-9200

INDIANA

Electronic Service Parts (C/V/M) * 2901 E. Washington St., Indianapolis 46201 * 317-269-1527 * FAX 800-899-1220

KANSAS

G & A Distributors, Inc. (C/V/M/A) * 635 N. Hydraulic St., Wichita 67214 * 800-247-1439 or 316-262-3707 * FAX 316-262-6494

MARYLAND

Tritronics (C/V/M/A) * 1306 Continental Dr., Abingdon 21009-2334 * 410-676-7300 * FAX 800-888-FAXD

MASSACHUSETTS

Signal Electronics Supply, Inc. (C) * 484 Worthington St., Springfield 01105 * 413-739-3893 * FAX 413-739-3895
Tee Vee Supply Co. (C/V/M/A) * 407 R Mystic Avenue, P.O. Box 649, Medford 02155 * 617-395-9440 * FAX 413-739-3895

MICHIGAN

G. M. Popkey Co. (C/V/M/A) * 5000 W. Greenbrooke Dr. S.E., Grand Rapids 49512 * 800-444-3920 or 616-698-2390 * FAX 616-698-0794
Remcor Electronics (C/V/M/A) * 10670 W. Nine Mile Rd., Oak Park 48237 * 810-541-5666 * FAX 810-398-1016

MINNESOTA

AVAC Corporation (V) * 666 University Ave., St. Paul 55104 * 612-222-0763 * FAX 612-224-2674
Ness Electronics, Inc. (C/V/M/A) * 441 Stinson Blvd. NE, Minneapolis 55413 * 612-623-9505 * FAX 612-623-9540

MISSOURI

Cititronix, Inc. (C/V/M/A) * 1641 Dielman Rd., St. Louis 63132 * 314-427-3420 or 800-846-2484 * FAX 314-427-3360
Tacony Corp. (V) * 1760 Gilsinn Lane, Fenton 63026 * 314-349-3000 * FAX 314-349-2333

NEVADA

MCM Electronics (C/V/M/A) * 495 East Parr Blvd., Reno 89512 * 800-543-4330 * FAX 513-434-6959 (OH)

NEW JERSEY

AVAC Corp. (V) * 66 Ethel Rd., Edison 08818 * 908-287-3300 * FAX 908-287-3331
Panson Electronics (C/V/M/A) * I-80 and New Maple Ave., P.O. Box 2003, Pine Brook 07058 * 800-255-5229 or 201-244-2400 * FAX 800-332-3922

NEW YORK

Dale Electronics (C/V/M/A) * 7 E. 20th St., New York City 10003 * 212-475-1124 * FAX 212-475-1963
Fox International, Inc. (C/V/M/A) * 241-A Central Ave., Farmingdale 11735 * 516-694-1354 or 800-321-6993 * FAX 516-694-0595
Radio Equipment Corp. (C/A) * 196 Vulcan St., Buffalo 14207 * 716-874-2690 * FAX 716-874-2698
Star For Parts (V) * 250 Rabro Drive East, Hauppauge 11788-0255 * 800-525-6046 * FAX 516-348-7160

OHIO

Fox International, Inc. (C/V/M/A) * 23600 Aurora Rd., Bedford Heights 44146 * 216-439-8500 * FAX 800-445-7991

MCM Electronics (C/V/M/A) * 650 Congress Park Drive, Centerville 45459-4072 * 937-434-0031 or 800-543-4330 * FAX 937-434-6959

OREGON

Diversified Parts (C/V/M/A) * 2114 S.E. 9th Ave., Portland 97214-4615 * 800-338-6342 * FAX 800-962-0602
Northwest Wholesale (V) * 426 NE Davis St., Portland 97232 * 800-234-8227 or 503-232-7114 * FAX 503-232-7115

PENNSYLVANIA

CRS Electronics (C/M) * 818 Brownsville Rd., Pittsburgh 15210 * 412-431-7700 * FAX 412-431-5666
Steel City Vacuum Co., Inc. (V) * 919 Penn Ave., Pittsburgh 15221 * 800-822-1199 or 412-731-0300 * FAX 412-731-3205

TENNESSEE

AVAC Corp. (V) * 236-B Space Park South Dr., Nashville 37211 * 615-834-8800 * FAX 615-831-1051
Electrotex, Inc. (C/V/M/A) * 6122 Macon Rd., Memphis 38134 * 901-383-9300 * FAX 901-388-0258
Shields Electronics Supply, Inc. (C/V/M/A) * 4722 Middlebrook Pike, Knoxville 37921 * 423-588-2421 * FAX 615-588-3431

TEXAS

Electrotex, Inc. (C/V/M/A) * 813 Morrow, Austin 78757 * 512-454-0318 * FAX 512-454-0859
Electrotex, Inc. (C/V/M/A) * 555 S. 23rd St., Beaumont 77707 * 409-842-3456 * FAX 409-842-5262
Electrotex, Inc. (C/V/M/A) * 1410 Crescent, Corpus Christi 78412 * 512-993-9697 * FAX 512-993-9699
Electrotex, Inc. (C/V/M/A) * 2300 Richmond Ave., Houston 77098-3299 * 713-526-3456 * Fax 713-639-6400
Electrotex, Inc. (C/V/M/A) * 1200 W. Hildebrand, San Antonio * 78201 * 210-735-9271 * FAX 210-737-2642
Fox International (C/V/M) * 752 So. Sherman, Richardson 75081 * 800-321-6993 or 214-439-8500 * FAX 800-445-7991
Interstate Electric Co. (C/V/M/A) * 11292 Leo Lane, Dallas 75229 * 214-247-1567 or 800-527-4029 * FAX 214-247-2137
VCP International, Inc. (V) * 2285 Merritt Dr., Garland 75040 * 214-271-7474 * FAX 214-278-5981

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G. M. Popkey Company (C/V/M/A) * 2035 Larsen Ave., Green Bay 54307-2237 * 414-497-0400 * FAX 414-497-4894
G. M. Popkey Company (C/V/M/A) * 2355 S. Calhoun Rd., New Berlin 53151 * 414-786-5887 * FAX 414-786-9031

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Fax: 800-RNJ-FAX1

RNJ Electronics, Inc. is now entering its 17th year as a full-line discount distributor, servicing the TV, VCR, computer, stereo, and microwave repair industries. In addition, RNJ Electronics is a leading supplier of background sound products including PA amplifiers, microphones, speakers, wire, etc. RNJ is also your source for all home theater products including Dolby Pro-logic receivers, in wall speakers, subwoofers, center channel speakers, as well as Decora volume controls. RNJ electronics can now fill your DSS satellite needs including both the basic and deluxe systems. The company has also become a leading distributor in an industry experiencing tremendous growth: the security industry, stocking products such as cameras, monitors, sequential switchers, quad splitters, multiplexers, lenses, modulators, etc.

The company publishes a semi-annu-

al, 136-page catalog containing thousands of items all at discounted prices. Product categories in our catalog include test equipment by B&K Precision, EMCO, Global Specialties, Fluke, Wavetek, and AVCOM. In addition, the company also stocks a full line of audio video and antenna accessories, universal remotes, TV and VCR wall mounts, mobile carts, service chemicals, an extensive line of VCR parts, camcorder accessories, TV and monitor flybacks, Japanese semi-conductors, microwave oven parts, educational kits, tools and soldering equipment and computer accessories. RNJ is also one of the largest stocking distributors of Panasonic cable converters.

RNJ Electronics prides itself on its ability to stay current with the ever changing needs of its customers. Customer service is a top priority for the company. All orders are processed in a timely manner with



shipping via UPS. The company has added additional phone lines as well as an 800 fax line.

The company offers volume discounts for large orders. It also ships all over the world. RNJ Electronics, Inc. can meet all of your needs. Call toll free and see. ■

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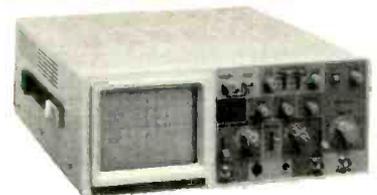
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MCM Electronics, Your Source For Service Parts and Accessories

For over 20 years, MCM has been a leading supplier to the electronics service industry. Stocked is a wide variety of original OEM and generic repair parts used in all aspects of consumer electronics repair. As authorized distributors for RCA/GE, Panasonic, Technics, Quasar and now ECG, Philips and Maganavox, we have the exact replacement items you need. For the bench, we stock a broad selection of tools and technician aids from trusted names like Chemtronics, Tech Spray, Caig, Xcelite, Crescent, Klein, Weller, Ungar and Hakko. Not to mention test equipment from Tenma, Fluke, B&K Precision, Hitachi, Sencore, Leader, Trip-lett, Simpson and Tektronix.

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MCM publishes two full-sized catalogs annually. The latest issue boasts over 6500 new products, and features over 100 pages devoted solely to semiconductors, repair parts and accessories. In all, MCM stocks over 35,000 items essential to the service industry. Sales flyers are mailed regularly featuring specially priced items and new product additions keeping the customers up to date on the latest available products.

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Howard W. Sams & Company is proud to be celebrating 50 years as the nation's leading technical publisher. Since its inception in 1946, Sams has seen its product offerings expand and diversify, so that today, Sams boasts the most complete lineup of technical documentation, services, and publications found anywhere.

Over 50 years ago, Howard Sams was the first company to recognize that the increasing popularity of home entertainment electronics meant a corresponding demand for reliable service documentation. This insight gave birth to the first PHOTOFACT®, which presented concise technical information to help service technicians repair specific makes and models of radios. Televisions soon were added to the product line, followed by computer equipment and then VCRs, further enhancing Sams' ability to provide complete, consistent, high-quality repair information to service technicians.

Today, Howard Sams is the nation's largest provider of after-market service data for the television and VCR repair industry in the form of the PHOTOFACT® and VCRfacts® subscription services, as well as through electronics distributors. Research shows that 95 percent of the companies providing after-market repair service for color televisions use Sams technical data.

While PHOTOFACT® provided the foundation for Howard Sams' rise to the top of the technical publishing industry, it is only a portion of what the company publishes today. Sams currently offers a complete line of service products, distributor catalogs, technical books, copy service, and custom manuals for a wide range of clients.

Another major part of the Sams technical products line, PROMPT® Publications has grown to become one

of the top technical imprints in the nation and one of Sams' brightest stars. Concentrating its efforts on technical books designed both for the novice and the experienced electronics technician, PROMPT® published over 60 books in its first five years, with another 30 scheduled to go to press this year. Among the upcoming titles yet to be released are *Electronic Projects for the 21st Century*, *Desktop Digital Video*, *Home Security Projects Book*, and *Howard W. Sams Computer Monitor Troubleshooting and Repair*.

Each and every PROMPT® book provides a clear understanding of the principles involved in the installation, maintenance, and performance of electronic devices that have become such a large part of our everyday lives. Some of PROMPT's most recent best-selling titles include *The Component Identifier and Source Book*, *Howard W. Sams Complete VCR Troubleshooting and Repair*, and *Optoelectronics*.

Sams' photocopy service is another element of the company's business that provides invaluable information to its customers. With a library of hundreds of manufacturers covering a wide range of product lines and thousands of models, Sams can provide service documentation on most any product, including TVs, VCRs, FAX machines, computers, microwave ovens, antique radios, plus much more.

Howard Sams experienced another historic growth year in 1995 as it was acquired by Bell Atlantic Directory Graphics, a member of the Bell Atlantic family. The acquisition was a result of a successful strategic teaming agreement that started in 1994, when BADG and Sams began working together to develop DATAHOST® an industry-leading on-line catalog delivery system.

The teaming agreement demonstrat-

ed that Directory Graphics' technological skills combined with Sams' content-rich database and technical catalog expertise would lead to next-generation business-to-business information products for both print and electronic delivery. Presently, Sams' five-million item database is being converted to a relational database platform, coined DATAHOST®. The information contained in DATAHOST® can be extracted from the database and delivered to distributor customers through not only traditional print catalogs and niche catalogs, but also CD-ROMs and electronic on-line applications.

The growth of 1995 was followed by even more expansion in 1996. Howard Sams created an on-line presence at www.hwsams.com. By visiting this site, guests are treated to complete title summaries for PROMPT® books, as well as an entirely searchable version of the Annual Index. The site also features an interactive demonstration of the DATAHOST® cataloging system. In addition to the Web site, Sams added three national sales offices in 1996. National headquarters remain in Indianapolis, IN, with sales offices now located in California, Florida, and Pennsylvania.

Since its very creation, Howard W. Sams & Company has been setting the standard by which every other technical publisher is judged. Many have tried, but few have succeeded in matching the level of quality and customer satisfaction that Sams provides with every one of its products. Sams is now taking its half-century of technical expertise into the next generation, once again forging the path that other publishers will try to follow.

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"The On Time Electronic Distributor" is our motto at MAT Electronics and we have proudly served the electronic repair industry for over ten years. Over the past several years, MAT Electronics has strived to constantly improve their product lines, customer service and competitive pricing.

MAT Electronics has two locations to better serve our customers—our original location in Pennsylvania and our newest location in Las Vegas, Nevada. The growth of MAT Electronics has been due to the following: quality product, competitive prices and fast reliable service. The company's products are used by manufacturers, engineers, hospitals, technical training schools, hobbyists, and technicians.

MAT Electronics stocks an extensive line of flybacks (TV and monitor), Japanese semiconductors, capacitor and MATV accessories. Recently, MAT Electronics has started to distribute original

parts from Hitachi, NEC, Panasonic and Sony at very competitive pricing. The company publishes an easy-to-read 116-page catalog filled with thousands of inventoried items, which can be accessed immediately on their state-of-the-art computer system.

MAT Electronics is always current with market trends in the repair industry—always emphasizing what is new in electronic parts and components—for VCRs, TVs, computer monitors, stereos, microwaves and surveillance equipment. MAT Electronics sources its products from around the world as well as domestically to offer the best product at a true savings.

MAT Electronics is proud to be a prominent distributor in the surveillance industry and is authorized Sony, Philips, Pro-video distributor.

MAT Electronics takes great pride in its ability to accommodate the various needs

of all their valued customers—both in the U.S. and worldwide. The company normally ships orders within 24-hours of receipt of your order, but UPS red and blue label service is also available to ensure even faster delivery service if necessary.

The company takes pride in our friendly and knowledgeable telephone operators on both coasts, who are waiting to take your phone call and deal courteously with any questions you may have about any electronic part. If you don't see it in the catalog—just ask for it.

MAT Electronics takes the risk out of ordering from a catalog, offering a 90-day 100% guarantee on all purchases. Large volume discounts are also available. The company's toll-free lines are open weekdays 8:30 A.M. to 7 P.M. EST, and Saturdays from 8:30 A.M. EST until 2:00 P.M. The toll-free FAX number is available 24 hours a day. ■

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164113 RCA Idler Original	\$1.89ea (10 min)	2SC1172B	\$2.50ea (10 min)	154-074E	\$19.95ea	4.7M/250V	Radial \$.45ea (10 min)
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613-022-2534 Sanyo/Fisher Gear	\$.29ea (10 min)	2SD1397	\$1.99ea (10 min)	2434651	\$24.95ea	10M/160V	Radial \$.55ea (10 min)
199347 RCA Belt Kit	\$1.99ea	2SD1398	\$1.99ea (10 min)	3214003	\$24.50ea	10M/250V	Radial \$.65ea (10 min)
VTK-1 Video Tool Kit	\$29.95ea	2SD1426	\$1.99ea (10 min)	043220011	\$26.50ea	10M/350V	Radial \$.75ea (10 min)
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Over the past several years, SBS Direct has built a name for itself in the electronics service industry as a leader in total store automation systems.

It's star product, Store-Trak®, was developed by people who worked in the retail and service sectors of the electronics industry. They saw the need for a PC-based system that would manage most, if not all, aspects of small-to-medium sized businesses. The product they envisioned would provide easy-to-learn and easy-to-implement solutions in the ever-changing business environment. Their vision resulted in the development of Store-Trak®. With more than 1,000 systems shipped to date, SBS's customers can attest to the time and money they have saved with Store-Trak®, not to mention the profes-

sional image they project to their customers with the computer-printed work orders and invoices.

Store-Trak® is easily installed and most customers find they are comfortable with the system in about a week. Upgrades and enhancements are provided every 9-12 months based on customer feedback and suggestions. The system is very intuitive and based on the work flow in your service business. It's a system that thinks the way you do!

SBS Direct's efforts are totally dedicated to the support and enhancement of Store-Trak®. Selling, maintaining and upgrading software for managing the electronics service industry is not a sideline at SBS; it is all that SBS does. And they do it very well, judging by what their cus-

tomers have to say about them. Their fully trained and qualified staff is available during normal business hours and is always ready to assist you with any questions you may have.

The current version of Store-Trak® software is available now. A number of attractive financing options for up to twelve months are available to you. If you don't presently own a computer, SBS has complete, turnkey systems (printer included), pre-loaded and ready to go right out of the box. Just think, within 7-10 business days, you can begin to gain better control over your business. If you have a need for a low cost PC for your technician's workbench, call them. They have high-powered, reasonably priced PC's available as well. In short, SBS works very hard at earning, and keeping, you as a satisfied customer.

Does saving time and money sound good to you? Would you like to be more productive and profitable? Would you like to project a more positive, professional image to your customers? If you would, a call to SBS at 1-800-603-9000 would be a great first step. ■



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Abingdon, MD 21009
Phone: 800-638-3328
Fax: 800-888-3293



Tritronics, Inc. a family owned and operated business, is poised to launch into the twenty-first century with the opening of its website, www.tritronicsinc.com. The site is currently interactive to request free literature and catalogs, and to leave a message requesting price and availability. A response will be sent by 5:00 pm the same day.

Future plans for the website include on-line ordering; live price and availability searches by model and/or part number; the ability to download the information; and hot links with NESDA, ATT and key providers of EDI in our industry.

Our goal at Tritronics is to make it as easy and efficient as possible to place orders. EFFICIENCY is great, but how can we save our customers' time and money? Tritronics offers toll-free pricing

and availability for common parts by description and by part number. Our headquarters can be reached at (800) 638-3328 and our Florida branch at (800) 365-8030. The order desk is staffed by an experienced sales force. We also offer toll-free fax numbers for pricing and availability, headquarters (800) 888-FAXD and Florida (800) 999-FAXD. Faxed in research is usually returned in four hours.

Many of our customers are looking for ways to cut costs and Tritronics is committed to helping the service industry do so. Tritronics, a stocking distributor for B&K Precision Instruments, consistently sells test equipment below the published dealer price. Our newest catalog has more pages of products and cross-references, and now includes test and soldering equipment, optical pick-ups and many

new products. Please call (800) 638-3328 if you have not received our latest edition. If you are located in the Southeast, please call (800) 365-8030.

Tritronics has full staffed research and sales departments that are knowledgeable. The majority of the staff has been with Tritronics for a minimum of three years. Orders received by 4:00 pm EST are shipped the same day. Tritronics averages an overall 85% fill rate on initial shipments. We also offer an on-line ordering system called DRAGNET. It is available to all servicers, operates with Procomm Plus and a free software package from Tritronics.

Tritronics, Inc. has a branch located in Miami at 1952 NW 93rd Avenue. The branch manager, Doug Maris, has recently created a counter area with about 1,500 square feet of tools, service aids, accessories, antenna/DSS supplies and parts. If you are in the area, stop by for a visit. The branch is located within minutes of Miami's International Airport.

In our travels to the various industry meetings, Tritronics officers often have the pleasure of meeting other people who work their business with family members. The Tritronics family looks forward to serving your business now and in the future.



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Circle (81) on Reply Card



Instrument selection guide

A comprehensive Selection Guide and Data Pack for application-specific testing solutions is now available from Fieldpiece Instruments. The new, full-color guide features a complete selection of kits and accessories for HVAC, electrical, and electronic applications, including the versatile Fieldpiece Model HS26 "Stick" DMMs, and is available free of charge.

This easy-to-use data pack highlights the complete line of the company's heavy duty DMMs and accessories and features the interchangeable accessory heads which measure most parameters needed by field service technicians.

Test kits are also covered in the selection guide and offer field service and plant technicians complete test solutions and convenience for most applications. Data sheets in the pack provide detailed specifications on the HB74 Heavy-Duty DMMs, Test Lead Sets, Thermocouple accessories and Fieldpack Kits.

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Sencore publishes new Sencore news

Sencore, Inc. has announced that Sencore News #177 is published and now available through the company's Area Sales Engineers. Sencore News #177 introduces the new CR7000 "BEAM-RITE" CRT Analyzer & Restorer. The all-new CR7000 "BEAM-RITE" provides servicers with fast accurate methods of testing and restoring CRTs. The tests and safe restoration techniques add confidence and security to your CRT testing, according to the company.

The Sencore News is a technical publication printed six times a year designed to help electronic servicers (owners or operators) with informative articles and troubleshooting tips in each issue.

Circle (106) on Reply Card

Electronic component

Mouser Electronics announces the publication of their newest electronic component catalog. This 340 page purchasing manual is newly updated and offers over 68,000 products from more than 125 of today's leading electronics manufacturers. The catalog features new products from 3M, Amp, NEC, SGS-Thomson, Rectron, Teccor, E-Switch, BI Technologies and other electronic leaders.

These products complement the company's established line of electronic components from companies such as AMP, 3M, SGS-Thomson, NEC, Amphenol, Mallory, Rohm, Spectrol, Thomson-Passive and many more. A guide for both buyers and engineers, this catalog provides complete specification drawings and guaranteed prices.

Circle (107) on Reply Card

Wire processing equipment

The Eraser Company, Inc. announces its all new 136-page full color catalog of wire processing equipment.

The company manufactures a complete range of wire and tubing cutters, wire and cable strippers, twisters, dereelers, coaxial cable strippers, Fybrglass industrial brushes and infrared tubing shrinkers.

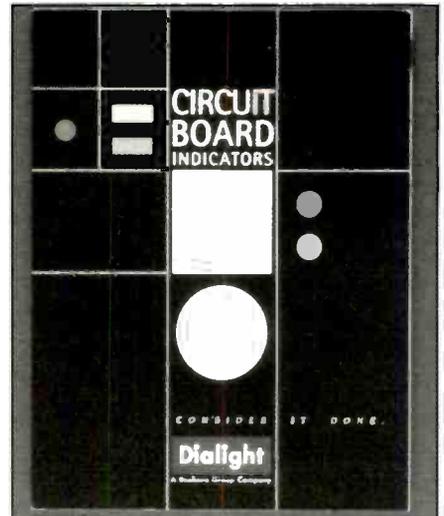
In the new catalog, last updated two years ago, there are a number of new products, including a variable speed wire and tubing cutter, air-operated cable cutter and air-operated cable stripper, an automatic wire twister for twisting together pre-connected wires, and much more.

In addition, information on Eraser's products can be found on two Internet sites on the World Wide Web. They are <http://www.rapid-response.com>, and <http://www.thomasregister.com>.

Circle (108) on Reply Card

LED databook

Dialight Corporation's Electronic Products Group has issued a new edition of its circuit board indicator databook. It con-



tains specifications for more than 1,000 LED Products, among them 30 new offerings including orange and blue LEDs. Covered are circuit board indicators, surface mount devices and light pipes, and discrete LEDs. Also provided are a product selector guide, part number index, application notes, and glossary of terms.

Circle (109) on Reply Card

Tool/tool kit catalog

Techni-Tool's 1997 catalog includes a selection of hard-to-find tools, production aids, test equipment and computer accessories. This 264-page, catalog lists more than 16,000 items from over 650 manufacturers, including electromechanical and assembly devices, electronic and telecommunication tools, production tools, custom tool kits, bio-medical-related tools and field service tool kits.

Circle (110) on Reply Card

Power monitor

A new four-page, color brochure describes BMI's two product lines: (1) the PQNode family of power monitors that form a networked system controlled by computer, and (2) portable instruments including harmonics analyzers, self-contained power monitors with user-interface, and single-phase computer-controlled instruments.

The brochure also describes additional software capabilities including report writing, notification of events, and information exchange using the Internet.

The company now also has a web site at <http://www.electrotek.com/bmi/>.

Circle (111) on Reply Card

Noise tests and measurements

By Alvin G. Sydnor

Noise is usually considered to be random sound waves with little or no periodicity. This does not completely define noise, for there are certain "noises" that are associated with certain commonplace events such as a gate opening, floor creaking, motor hum and foot steps on a hard surface.

The fact that amplifiers and receivers can be sources of "noise" is well known. This type of noise offends the ear as a hiss, rushing sound, or roar (in extreme cases). Any experienced technician has at some time given thought to noise reduction, but few have bothered to inquire into the nature of internal noise or appreciated the importance of noise measurements. The purpose of this article is to shed some practical light on the general subject of noise and noise tests in electronic systems.

Reference sound pressure

Early experimenters dealing with noise subjected a group of young men with good hearing to a 1,000Hz tone from a source positioned one meter (39.37 inches) from the ear. During this test, the tone was turned off and on, and at the same time the sound level was lowered, eventually arriving at the lowest sound pressure that the subject could hear. This level, which was found to be highly reproducible, was defined as the reference sound pressure. This level, called 0dB, is defined as one tenth of a bel. It is a dimensionless quantity, equal to the logarithm of the ratio of two quantities.

$$dB = K \log Q_2/Q_1 \quad K = \text{constant}$$

Thus 0dB sound pressure level (SPL) is equal to a dynamic pressure change of 2.9×10^{-9} lbs/in², or, in international units, 2×10^{-4} μ bar. Using this as the base reference, all sound measurements are scaled from this point.

Sydnor is a retired consumer electronics servicing technician.

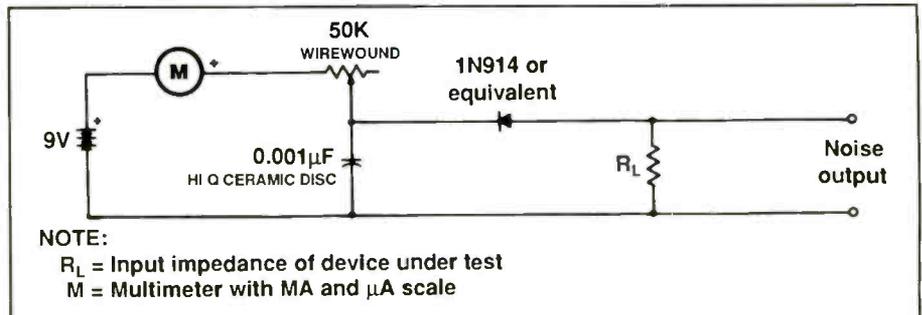


Figure 1. This simple silicon diode noise generator generates useful noise at frequencies up to several thousand MHz.

Significance of noise level

Aside from its obvious disturbing features, noise level is extremely important in the design and improvement of high-gain electronic systems. The unavoidable presence of noise in a sensitive system, such as an amplifier or receiver, puts a practical limit on the weakest signal that can be handled. Signals having amplitudes less than that of the noise generated within the system are masked by noise, while those of the same amplitude must compete unfavorably. Thus the amount of internal noise limits the usable sensitivity of a receiver or the usable voltage gain of an amplifier.

Similarly, the amount of usable gain that may be obtained with a preamplifier depends upon the inherent noise level of the preamplifier. Providing considerable voltage gain, a preamplifier offers overall improvement in the performance of the system ahead of which it is operated if it improves, or keeps constant (in some cases), the amount of noise with respect to the amount of signal in the system.

For determining the relationship between noise and signal and also to express the improvement that might be expected from boosters and preamplifiers, our yardstick is the ratio of signal amplitude to noise amplitude, which is called the signal-to-noise ratio.

If the output signal measured at the speaker terminals of an amplifier is 4V

and the voltage due to noise alone in the absence of the signal is 4mV, the signal-to-noise ratio is $4/0.004 = 1000$ to 1. The amount of noise in a system is expressed as its *noise figure* in so many dB. This may be considered as the dB ratio between the signal-to-noise ratio of an ideal system and the signal-to-noise ratio of the practical system being tested.

The nature of noise

Electrical noise has the characteristic of being unpitched, or non-periodic. In audio systems, it is usually harsh to the ear. This feature distinguishes noise from other types of interference, such as hum, oscillation and spurious modulation. Noise voltage is spurious and is considered to be composed of large numbers of narrow pulses of different amplitudes which occur at random frequencies. Impulse noise is characterized as ignition interference which consists of separately recognizable sharp pulses, while random noise is composed of rapidly successive pulses which often overlap.

Electrical noise arises from several sources and is typed according to these origins. The principal types are discussed here in the following text.

External origin

The external origin includes all noise impulses that arise outside of the electronic system. Some examples are static, ei-

ther natural or man-made, cosmic hiss, etc. Such impulses are picked up by receiving antennas, or unshielded or poorly shielded input circuitry. Generally, very little control of these noises is possible, with respect to the signal amplitude, once they enter the electronic system. Their elimination is achieved efficiently only at the points of their origin. Man has little or no control over natural and cosmic sources of noise.

Thermal noise

All audio technicians have at some time or other run into thermal noise problems. We have heard it as hiss in high gain and otherwise quiet amplifiers. Interstation noise in an FM broadcast receiver is an example of such noise. Thermal noise is often called white noise, Gaussian noise or Johnson noise.

The waveform of thermal noise never repeats itself exactly, it is random in nature and it has no period, therefore if the waveform is analyzed it will be found that frequency components occur equally or are of equal magnitude across the bandwidth of the noise source. In other words, the power spectrum of a thermal noise source is flat with frequency. Also, we will notice that instantaneous peaks of various heights occur. If measurements are taken over a long period, all magnitudes can be recorded. The distribution or frequency of occurrence of the several peak values follows a normal, or Gaussian, distribution.

The last point brings up an interesting observation. In a simple sinewave the peak value of the voltage is related to the RMS value by the factor of 1.414, or 3dB. If thermal noise is analyzed, it can be shown mathematically that peak amplitudes greater than the RMS value by a factor of four occur less than 0.01 percent of the time. Thus the peak-to-RMS ratio of thermal noise is usually considered to be 4:1 or 12dB. Thus an amplifier designed to amplify thermal noise will have a power handling capability 9dB less than when handling sine-wave signals. It should be noted that this figure is quite close to the usual 10dB "headroom" which is the standard practice in well-designed audio systems.

Quantifying thermal noise

It was J.B. Johnson in 1928 who estab-

lished quantitative values for thermal noise. His findings show that Noise Figure is directly proportional to temperature and bandwidth. It is proportional also to the resistive component of the impedance across which the noise voltage is developed, but R is often constant in a given system. You can expect an electronic system to be noisier when heated; and if it is a wide-band device, it will be noisier than a sharply-tuned system.

The latter is obvious, since a wide-band system allows more of the random noise frequencies to pass through. Don't expect a wide-band untuned TV booster to give a signal that is as free of snow as that of a sharply-tuned, or single channel, booster.

As an analogy, consider that the successful reproduction of audible noise requires efficient transmission throughout the audio frequency spectrum. For this reason, the jingling of keys or similar sounds are often used for quick qualitative testing of audio systems.

The noise level due to thermal agitation is expressed by a complex mathematical equation which says that if R, the resistive component of the impedance across which the thermal agitation voltage is developed, is plotted against frequency, a peaked curve will be obtained. If we compute the area under that curve between the pass-band limits and then multiply this area by four times the temperature of the resistive component, the result is the square of the voltage.

The energy resulting from thermal agitation voltages across a resistance is distributed throughout the frequency spectrum from zero to many MHz. It is interesting to note that it is the actual bandwidth and not the position of this band within the spectrum that determines the thermal agitation voltage level.

Resistor noise

Noise voltages are proportional to the current flow, and are generated in carbon resistors as a result of fluctuation in contact resistance between adjacent carbon granules. It is for this reason that carbon resistors are not used in the critical positions of the input or other sensitive sections of any electronic system. So far, we can see that noise is inherent in electronic systems, and that its nature is that of random voltage pulses distributed

throughout the frequency spectrum and arising from various sources.

Practical considerations

Our discussion up to this point has defined noise, and described the phenomena responsible for its generation and the factors upon which it is dependent. Our concern now is to see how this fits into the practical consideration of electronic systems, and how to use it as a tool. In the following discussions, several illustrative examples will be given that are purely hypothetical, although entirely logical. The figures do not apply to any particular existing amplifier or system.

Example 1

An amplifier has a voltage gain of 100. At its output terminals (high-impedance loaded), a 0.2V signal is measured. The noise output voltage is 2mV (0.002V). This is a signal-to-noise ratio of 100:1.

It is desired to increase the gain of the system to 1000 by means of a preamplifier having a voltage gain of 10. The available preamplifier has a signal-to-noise ratio of 50, which is twice as bad as that of the main amplifier. Thus, the signal is amplified 100 times, and the main amplifier output becomes 20V. But twice the noise voltage is also amplified 100 times, and this becomes 0.4V. Now, the signal-to-noise ratio is 50:1. Although we have succeeded in increasing the gain, we also have more noise to contend with.

If the preamplifier had the same signal-to-noise ratio as the main amplifier, the required boost of 10X would be obtained at no increase in noise.

Example 2

Signal-to-noise ratios of 100 to 1 or better are desirable in TV receivers to insure snow-free pictures. A certain TV receiver is operated in a fringe area, so a booster is required. With this set operating below its agc threshold, a signal of 1,000,000 μ V is measured at the picture tube. The noise voltage at the same point is 100,000mV. Here we have a signal-to-noise ratio of 10:1 or 20dB.

One booster available for the purpose has a gain of 10X and has a noise figure of 20dB; the same as that of the set. This combination of booster and receiver gives a picture tube signal voltage of



10,000,000 μ V and a noise voltage of 1,000,000 μ V. The signal-to-noise ratio remains 10:1, so greater sensitivity has been obtained without increasing the noise level. But neither is the noise ratio improved. The result is increased gain but no improvement in the picture.

Example 3

A second booster is available that will provide a voltage gain of 10X, but its noise figure is 26dB. This additional 6dB over the noise figure of the receiver means that twice as much noise voltage is generated. Therefore, this booster would increase the signal to 10,000,000 μ V, as the first one would, but the noise is increased to 2,000,000 μ V. Now the desired gain has been obtained with a worse signal-to-noise ratio which is 5:1, certainly conducive to snow.

Example 4

A third booster has 10X gain with a signal to noise ratio of 40dB. This change of 20dB in the noise figure means that only half as much noise is generated by the third booster as by the receiver. This lower noise level is amplified in the set along with the signal, so that now the output signal voltage is 10,000,000 μ V, as required, with an improved noise level. Thus giving us improved sensitivity along with improved picture quality.

Noise testing

It is not an easy task to measure the signal-to-noise ratio of a receiver with ordinary methods. It is difficult to observe and measure the random voltage, except with an oscilloscope, and even then care is required in making the measurements and evaluating the data.

When the noise is of a relatively continuous nature, a keyed or warbled signal from a microvolt-calibrated rf signal generator may be employed. The generator is connected to the receiver by appropriate impedance networks. The signal amplitude is adjusted to a level just barely audible in the presence of the background noise. This level is in μ V, read at the generator output, which can be assumed to correspond approximately to the receiver noise level. When making such measurements, care must be taken to prevent

hum or stray signal voltages from being included in the noise measurements.

Noise diode

Some years ago, there were special diode tube noise generators being used for the determination of the noise figure of amplifiers and audio systems. In the tube, "shot-noise" energy due to ac components of the fluctuating diode plate current was proportional to the average dc current. For a given current, the noise is maximum when the plate collects all of the electrons emitted by the filament. When this condition is met, the emission is said to be temperature limited. Within a frequency band the RMS current in a temperature-limited diode tube is:

$$i = \sqrt{3.18 \times 10^{-19} I \Delta f}$$

where i is the rms fluctuating current expressed in amperes, I is the diode dc plate current expressed in amperes, and Δf is the frequency band in which the noise is measured.

The temperature-limited diode may be used to check the noise characteristics of amplifiers and receivers. When operated with sufficient plate voltage to saturate the emission, the random rf noise (hiss) generated by the diode is wide-band and constant. Its level can be adjusted by varying the filament voltage. The noise output is proportional to the dc plate current, which can easily be read.

With the diode tube operated as a source of known noise power, the amplifier under test is operated first with its input terminated and its noise output (PA) observed with a relative-power meter. Then the diode noise output power (PN) is fed into the amplifier and increased to the point where the amplifier power output doubles. At this point, PA = PN.

When the diode generator circuit is matched to the amplifier input, the noise figure of the system can be calculated from $F = 0.211R$, where I is the diode dc plate current (mA) and R is the amplifier input impedance (ohms). F also equals $10 \log(0.021R)$, in dB.

Crystal diode noise generator

Since temperature-limited diode vacuum tubes are almost impossible to obtain,

their cost is prohibitive, and their requirements in filament-controlling power supplies are stringent, the experimenter and service technician interested in making noise tests will prefer a less critical device. For this purpose, a noise generator using a silicon diode is recommended. Germanium diodes are not satisfactory for this purpose.

A simple silicon diode noise generator is shown in Figure 1. The circuit generates useful noise up to several thousand MHz.

The 50k Ω potentiometer is the noise output control. The dc current meter will be an aid in setting the exact values of the diode reverse current. The noise generator's output can be connected to the antenna terminals or the input terminals of the amplifier under test. When the unit under test does not provide a dc return path, a resistance, R , equal or close to the input impedance of the unit under test, must be placed across the noise generator's output terminals as shown.

Comparative tests may be made in the following manner:

1. Switch off the avc and bfo as well as any other automatic control circuit of the unit under test.
2. Set the gain controls in the desired positions for the test.
3. Connect the noise generator to the device under test as explained above.
4. Connect an output meter, preferably one that reads audio power directly, to the output terminals of the unit under test and note the noise reading.
5. Switch on the noise generator and increase its output until the output meter (receiver or amplifier) reads twice the first power reading (or if a voltmeter is used, 1.4 times the first voltage reading, or a 3dB change).
6. The dc meter or potentiometer setting in the noise generator now indicates relative noise. A low current reading indicates low noise level, and vice versa, as does a low setting of the 50k Ω potentiometer.

Please keep in mind that the test device and results you will obtain here will differ from those published by manufacturers under the auspices of the new IHF (Institute of High Fidelity) standards. Manufacturers use much more sophisticated test methods and equipment. ■

Test Your Electronics Knowledge

A mixed bag By J.A. Sam Wilson

1. What is the value of $(\text{Log}^1)\text{Log } 6$?
2. Here is the definition: "The range through which the measured signal can be varied without initiating response." What is the term?
3. Is the following statement correct? You should align the i.f. stage of a superheterodyne radio receiver for maximum output at the speaker.
4. Is the following advice correct? Assume that you have an analog VOM. You should wipe the glass front frequently with a clean cotton cloth.
5. Temperatures of -459.67F and -273.15C are defined as _____.
6. Assuming there is no dc component, the ratio of the peak voltage to the rms voltage of a waveform is called the _____.
7. If you take the cosine of the phase angle between the voltage across a load impedance and the current through that load impedance you will get the _____.
8. When using J-K flip-flops to count from 0000 to 1111, which of the following places a greater demand on the power supply?
A. Asynchronous counting.
B. Synchronous counting.
9. In this question we are asking about power in a circuit as defined by scientists. The product of the rms voltage and rms current in a circuit gives the value of
A. rms power.
B. Average power.
C. Peak power.
10. What is the name of the device used for measuring an electric charge?

Wilson is the electronics theory consultant for ES&T.

(Answers on page 68)

ES&T Calendar

Major Appliance Servicers Convention and Trade show
April 3-4, 1997
Orlando, FL
800-743-0455

CES Mobile Electronics - The 12-Volt Educational Forum
April 4-6, 1997
Atlanta, GA
703-907-7674

EIF '97
Electronic Industries Forum of New England
May 6-8, 1997
World Trade Exhibition Center
Boston MA
800-322-9332
e-mail: summitexh@aol.com

Electronic Distribution Show
May 13-15, 1997
Las Vegas NV
Sponsored by EIA/CG (Components Group)
703-907-7547

Support Systems Expo
May 14-15, 1997
Boston, MA
207-846-0600

Spring Comdex/CES Orlando
May 23-25, 1997
Orlando, FL
703-907-7600

Spring CES '97 co-located with COMDEX/Spring WINDOWS WORLD
June 2-5, 1997
Atlanta, GA
703-907-7674

CES Habitech '97 - The Home Systems Trade & Training Show
June 24-26, 1997
Dallas, TX
703-907-7674

NESDA 47th/ISCET 27th/ and NIAS 5th Annual National Professional Service Convention and Trade Show
August 4-9, 1997
Las Vegas, NV
817-921-9061

CTIA Breakaway '97
September 18-20, 1997
San Diego, CA
702-268-1818 ext. 310

CES Mexico
October 8-10, 1997
Mexico City Mexico
Sponsored by EIA/CEMA
703-907-7620

Networks Expo Dallas/Windows World
October 29-31, 1997
Dallas, TX
201-346-1400, ext. 145



Test Your Electronics Knowledge

Answers to the Quiz

(from page 67)

1. 6 - This is an important rule in basic electronics: "the inverse logarithm of the logarithm of a number is the number."

2. The statement is the definition of the term "Dead Band" according to the IEEE dictionary.

3. The statement is not correct. The i.f. stage should be aligned for maximum *bandwidth*. In order to do that you need a sweep generator. Can anyone afford to take the time to do that on an AM radio?

4. Not correct! Rubbing cotton over glass can create static charges that ruin the accuracy of the meter (until the charge dissipates). Consult the manufacturer's literature.

5. Absolute zero. They are calculated values. They have never been produced.

6. Crest Factor - by definition

7. Power Factor - by definition

8. B - with synchronous counting all flip-flops change at the same time.

9. B. In the world of science and engineering and math there is no such thing as rms power. It only exists in the mind of sales people. Peak power is $V_{MAX} \times I_{MAX}$ in a purely resistive circuit.

10. Electroscopes. In its simplest form it is made with gold leaf draped over a wire. Very sensitive electroscopes are made today with MOSFETs.

During 1996, more than 25 million televisions - direct-view, projection and TV/VCR combinations - were sold in the United States, equal to one in every four TV households. Of that total, 22.4 million were direct-view TVs and 2.2 million were color TV/VCR combinations.

As for the record-breaking categories, projection TV was propelled to new heights by a 17 percent gain in December. The new annual record was set despite a 10 percent decline in shipments of models 49 inches and under. Units with 50-inch screens and larger enjoyed 21 percent growth to 587,000 units.

VCRs surpassed the 14 million mark with sales of more than 14.6 million units. Stereo VCRs generated most of that growth, increasing 38 percent in 1996 and accounting for 46 percent of sales.

Camcorders also posted an all-time record with unit sales topping 3.6 million, a 2 percent improvement over calendar 1995. The compact formats—8mm and VHS-C—represented 87 percent of all camcorder sales last year.

On the negative side of the ledger, color TV/VCR combinations declined fractionally last year, while sales of laserdisc players fell nearly 40 percent.

National Certification Council (NCC) goes international (ICAC)

The National Certification Council approved a name change which more aptly characterizes the world wide applicability of this accreditation council. Concerned over a perceived country limitation, with the word National, the new name adopted is The International Certification Accreditation Council (ICAC).

In accordance with the by-laws approved by Charter members of the organization, four officers and nine of twelve authorized Directors were elected to leadership positions of the ICAC. The four top officers elected were; Jay Warmke, Executive Director of BISCO (President); Carrie Giannakos, Executive Director of NASA (Vice President); John Holmberg, Executive Director of NARTE (Secretary); and Carl Brown, Vice President of PSA (Treasurer).

The council has been formed in response to a growing flood of credential

programs in the technical and professional disciplines. While most of these programs are well designed and of tremendous benefit to their respective industries, the need for an objective body to evaluate the programs against standard criteria has increased along with our reliance on these credentials.

Acknowledging that ICAC members would retain their autonomy as separate and distinct organizations, ICAC's stated mission is to create a medium by which developed and developing certification programs could be evaluated, accredited as appropriate and counseled so as to promote the highest certification standards possible. Further, the ICAC serving as the official representation of certification programs of council members, would maintain a centralized organization for concerted action upon any matter affecting certification standards.

The ICAC, as an advisory and accrediting body would also promote the sharing of technical know-how, encourage cooperative action and interaction among its members, advance the professional interest and foster the practice of ethical principles among member organizations.

While the initial organization membership is comprised of non-profit and not-for-profit associations, the ICAC is open to and welcomes all who are interested in the creation and the sustaining of credible and worthy certification programs.

Charter organization member associations which have been instrumental in forming the ICAC are BICSI (A Telecommunications Association), CFESA (Commercial Food Equipment Service Association), ETA-I (Electronics Technicians Association International), NAC/SA (North American Computer Service Association), NARTE (National Association of Radio Telecommunications Engineers), NASA (National Appliance Service Association), PSA (Professional Service Association), SDA (Satellite Dealers Association), and USA (United Servicers Association).

The next meeting for this organization is scheduled to be held on June 15, 1997 at Berea College, KY.

For additional information contact Ron Sawyer, ICAC Director at 518-237-7777 or fax at 518-237-0418.

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Funai symphonic color TV/VCR model 13TVCR MKIII diagram. Radio Shack Portavision, 7 inch b/w TV/AM/FM cat 16-245. Daewoo 25 inch color TV, model DTQ 2605FL. *Contact: Gloria Flores, Apenines 633, Pio. Nuevo, Puerto Rico 00920.*

Need source for n.O.S. NOVAR (not miniature 9 pin tube sockets). *Contact: John Phipps, 1412 Navaho Trail, St. Charles, MI 63304.*

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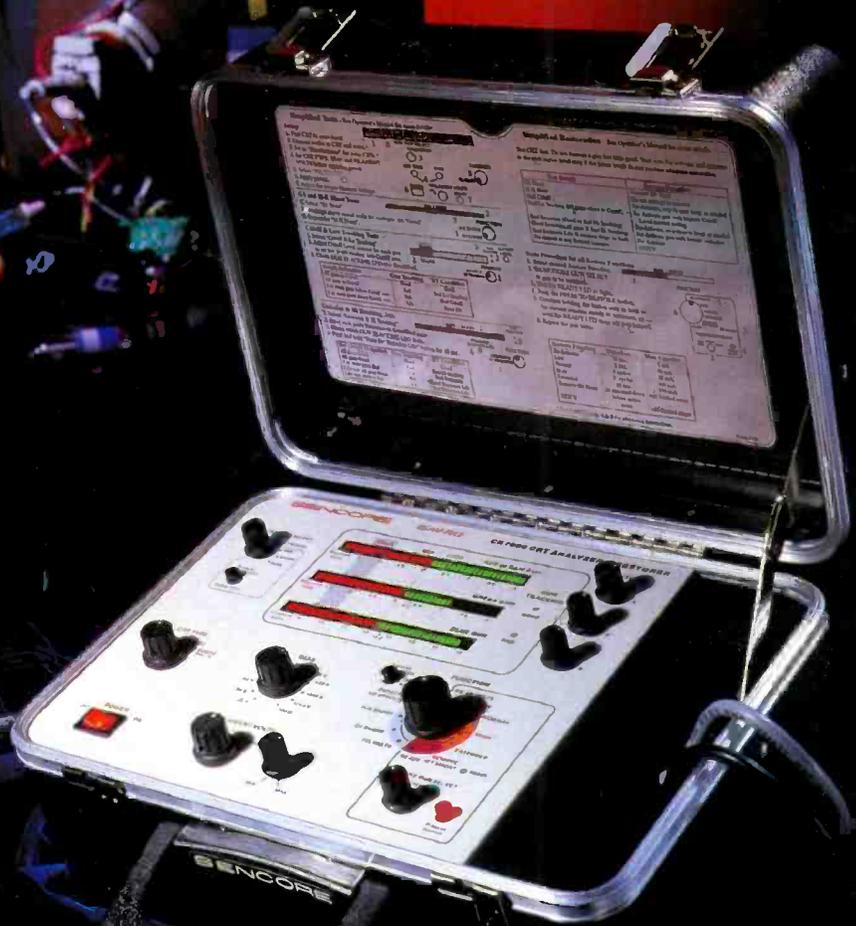
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