THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

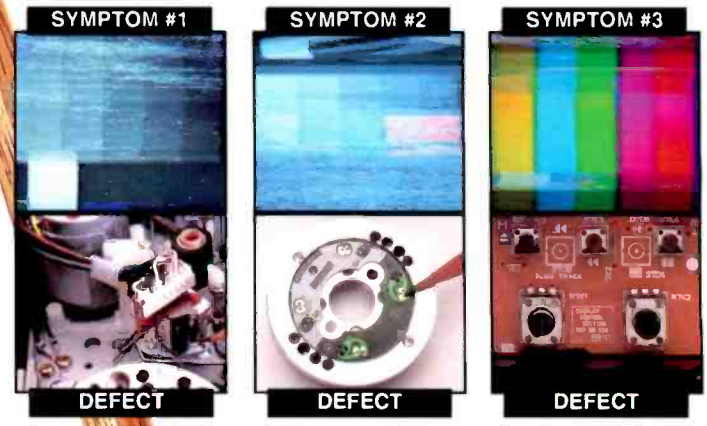
T.M.

FEBRUARY 1993/$3.00

Computer software for service center management

Where are they now? • On site servicing

Frustrated With Servicing The "Tough Dog" VCRs?



Are You Ready For Today's VCR Challenges?

You know the scenario all too well. A customer brings in a VCR for service with the simple complaint that the picture is noisy. But down deep in the pit of your stomach you wish it would be something else, maybe "It won't load a tape, or it won't rewind". You'd even wish the customer would have said "it plays for a few seconds and then stops".

But a noisy picture, that could be anything from a problem in the servos to bad video heads, or a tape path alignment problem, to a defect almost anywhere in the luminance circuits.

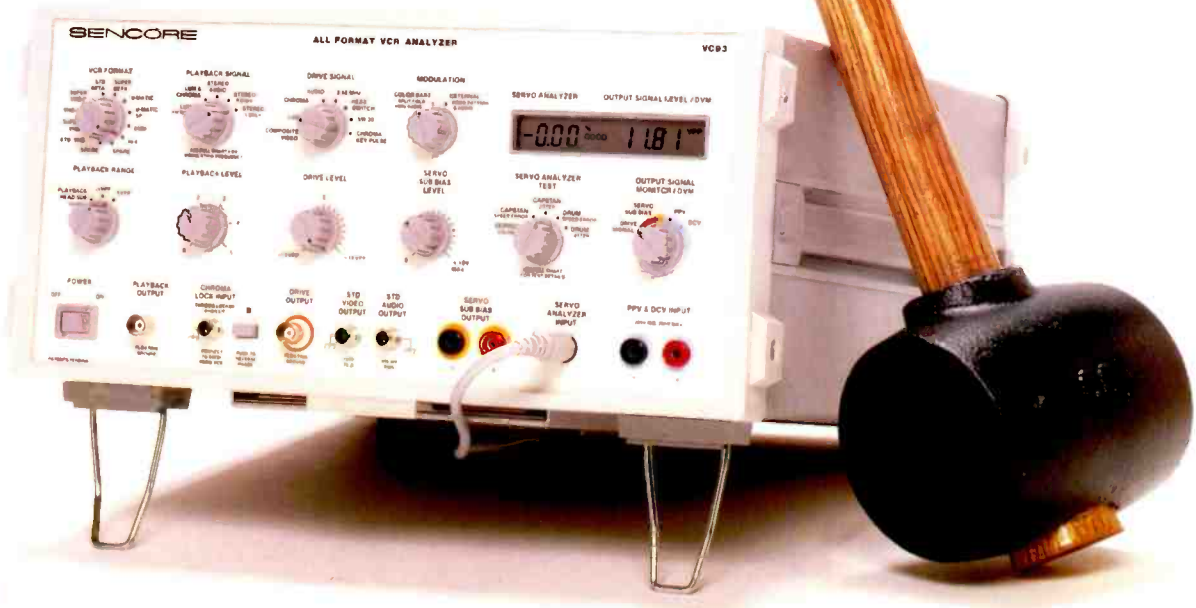
What do you do after you've carefully and thoroughly cleaned the heads - several times – only to find that the same symptom has not gone away?

What would you do next if you had one of these VCRs in your shop?

- Inspect the heads further?
- Check the servos?
- Give the customer a high estimate?
- Order new heads?
- Suspect a mechanical problem?
- Other?

Are you equipped to profitably service today's VCRs and camcorders? Sencore's new VC93 All Format VCR Analyzer answers the technical troubleshooting challenges you face when servicing VCR/camcorder playback and record circuits.

If you'd like to see exactly how the VC93 can help you troubleshoot the three symptoms above, call 1-800-SENCORE and ask for your FREE video tape demonstration.



VC93 All Format VCR Analyzer

TECH CHOICE SYSTEM

With the VC93 All Format VCR Analyzer...

Now, You Can Isolate Any Playback Or Record Problem In All VCRs, In Less Than Half The Time It Presently Takes!

- Equip your bench for servicing all consumer VCRs with the only all-format VCR analyzer.
- Eliminate guesswork with dynamic VCR head signal substitution for all consumer formats.
- Quickly isolate Hi-Fi stereo audio problems with exclusive Hi-Fi stereo head signal substitution.
- Pinpoint any luminance, chrominance, or audio problem with phase-locked analyzing signals.
- Automatic servo analyzer allows you to catch servo defects in a fraction of the time presently required - (patent pending)
- Built-in Split Field test pattern generator permits stand-alone operation.
- Additional test patterns and RF/IF troubleshooting capabilities are available when used in conjunction with the Sencore video analyzing system.
- Special troubleshooting features complete the VCR analyzing package:
  - Servo sub-bias supply
  - Standard video and audio line outputs
  - Autoranging DCV and PPV meter
  - Output signal monitor
- Expandable for future and increased applications.

Circle (95) on Reply Card

Call Your Area Representative At 1-800-SENCORE And Ask About How You Can Add $3 To $5 On Every VCR Repair

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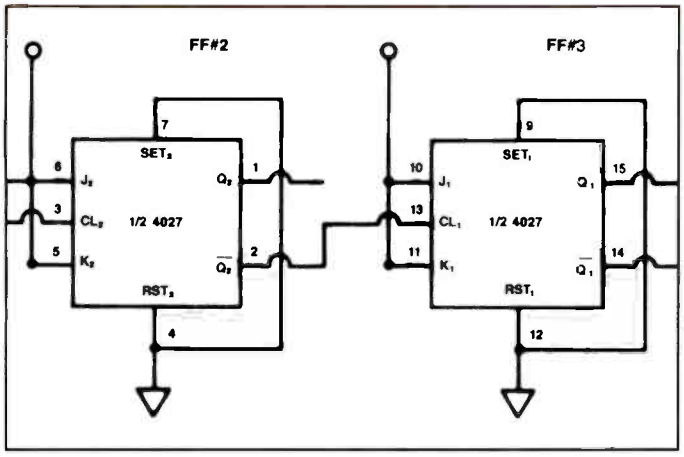
Volume 13, No. 2 February 1993



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FEATURES

DEPARTMENTS

ON THE COVER

Every consumer electronics service center has a great deal of administrative work: filling out forms, preparing claim checks, keeping track of the status of each product being serviced, making out the bills. An inexpensive personal computer with the right software can perform most of these tasks, freeing technicians and managers to perform their tasks more efficiently. *(Photo courtesy Sencore).*

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
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The computer as expert

The first computer built in the United States was used to compute trajectories for artillery. This information was computed, then arranged in tables so that the U.S. military knew how to aim its guns in order to hit a distant target.

This computer, ENIAC, for electronic numeric integrator and calculator, was programmed by expert mathematicians and their helpers, as the computations were being done, by rearranging wires that connected parts of the computer.

The computer was a huge affair, made up of vacuum tubes, consumed a great deal of electrical power, and because of the low reliability of tubes, it failed regularly.

But it did its job and it did assist the war effort.

Today, no doubt, a microcomputer could do the entire job much faster. And, in fact, no doubt, a microcomputer built into an artillery piece could instantaneously compute or look up a trajectory based on input data and set its own angle of fire. But then that would probably still be less sophisticated than the military weapons that currently exist.

As computers, which are now tiny, and which can now store their programs internally, increase in power, and memories continue to shrink in size and grow in capacity, computers and the software written for them, continue to become, increasingly, a part of our lives; frequently in ways in which their existence is not evident.

For example, most high end TVs, VCRs and camcorders have a microprocessor or two in them. The fax machines that over the past three or four years seem to have appeared everywhere would not be possible without microcomputers. The entire concept of compact disk requires computers to convert the music information to digital bits that are recorded on the disks, and to convert the bits on the disk back to music.

Compact disk interactive (CDI) is a method of recording text, voice, graphics and music on a compact disk in the form of digital bits. In some of these cases, the idea of software gets a bit murky. For example, in the case of CD there's software in ROM (read only memory) that directs the operation of the player, then there's the "software" on the disk that is converted to music in the case of CD, or text, music, etc., in the case of CDI.

Another place you'll find tiny computers and their software is in the cellular telephone.

And of course, all of those video games: Nintendo, Sega, Genesis, are nothing more than tiny computers that use the software contained in those game cartridges to create the pictures and sound that keep the kids entertained for hours on end.

As the power of computers continues to increase, the memory capacity continues to expand, the price of the hardware continues to decrease, and the sophistication of the software continues to increase, more and more tasks can be performed by computer.

We have reached the point where, in many cases, the cost of the computer hardware is no longer an issue. The cost of the computer is so low that it is an insignificant part of the overall cost of the product, and in many cases it's even less costly than the less versatile, less functional, hardware it replaces. The cost of much of the software is also becoming less.

Technology is at a point now that nearly every process that can be economically realized by a computer and the appropriate software is either being done by a computer or being studied for possible computerization.

With this level of computerization, there is hardly a consumer electronic service center that couldn't benefit from automating their operations. A powerful personal computer such as the 386 or 486 along with, say, 4 megabytes of memory and a hard disk drive capable of storing 100 megabytes or more of memory can be purchased for around $2,000. The software can be purchased for anywhere between a few hundred and a few thousand dollars.

And for the most part, the software has been written either by people who are service technicians or managers, or by software experts working closely with service technicians and managers. Because of this, much of the software is intuitive, and so requires little training to make it work.

And one thing that most users find out is that, on balance, using a computer to manage the business doesn't cost; it pays: in reduced paperwork, more efficient tracking of products through the service process, readily availability of service information such as technical tips.

In essence, computerization allows a company to benefit in several ways: applying a good software package, or a combination of software programs, is like hiring an expert manager, a file clerk, an experienced technician and more.

Today's computers are everything that first computer was not: small, energy efficient, reliable, affordable, simple to operate. And while that first computer required that the programmers be there at the site to do the programming, today's stored program computers allow that programming expertise to be recorded on a floppy disk and made available to anyone who wants to buy it.

Nils Conrad Persson

News

Field test of long distance HDTV broadcast

Zenith and AT&T demonstrated that digital high-definition television (HDTV) broadcasting can bring high-quality, snow-free, interference-free TV pictures to a broader service area than conventional TV broadcasts. In the first long-distance over-the-air field test of an all-digital HDTV signal, Zenith and AT&T conducted a broadcast from a TV station in Milwaukee 75 miles to Zenith's technical center in Glenview, Ill.

The late-night field test of the "Digital Spectrum Compatible" HDTV system, broadcast on Milwaukee Public Television Station WMVT Channel 36, was the first ever terrestrial broadcast of digital TV signals using low power over long distances. The test also showed that digital HDTV can provide high-quality, noise-free pictures even in the presence of interference from conventional TV signals on the same channel.

The primary broadcast service area (Grade B contour) for conventional analog TV signals on WMVT is 48 miles from the transmitter. The Glenview receiving site is on the far fringe reception area of the Milwaukee station, and even with an antenna tower atop the seven-story building, the conventional analog signals are very noisy or snowy.

Using less than one-tenth of the power used to transmit a full-power conventional analog TV signal, the test successfully transmitted and received digital signals - without noise, snow or ghosts. The test showed that the system's unique digital compression and transmission technologies can eliminate the so-called "cliff effect" a total and abrupt loss of the TV picture and sound that could be caused by errors in transmitted digital data at long distances from the transmitter.

The companies plan to share the field test data with the Federal Communications Commission's Advisory Committee on Advanced television Service and its HDTV Field Test Task Force.

Summit meeting held

A third summit meeting among members of the three national service associations consisting of the National Association of Service Dealers (NASD) a division of NARDA, the Professional Service Association (PSA), the National Electronic Service Dealers Association (NESDA), and several state organizations including the California State Electronics Association (CSEA), the Television Electronics Service Association (ESDA) of IL, the Independent Warranty Servicers (IWS), and the Appliance Service Dealers (ASD), was held in Chicago on October 4, 1992.

The industry Summit decided to form a permanent group called the "Service Industry Council" for the purpose of collecting information, identifying industry problems and finding possible solutions for those problems. This group will continue to meet on a regular basis to address the needs of the service industry.

The environmental committee report stated that as a result of indecision on the part of governmental agencies the mandated technician certification program has been abandoned. The resulting controversy that continues to grow in the ser

(Continued on page 62)

Literature

Demonstration package available for virtual instrument software

National Instruments announced today that a free demonstration package is available for the new LabVIEW for Windows graphical programming software. The demonstration package includes software and a guide that gives the user a comprehensive look at the software but does not require previous knowledge of it.

Based on the full-function version of LabVIEW, the demonstration package describes fundamental concepts, gives an overview of the system, and guides the user through hands-on examples. In the first section, the user learns about the product and explores a completed virtual instrument (VI) program. In the second section, the user builds a VI from scratch. The third section contains a variety of examples demonstrating how the software addresses different application needs. The last section also describes the GPIB, VXI, and Instrument Driver VI libraries for controlling over 115 GPIB, VXI, ad RS-232 instruments using the company's interface hardware; the Data Acquisition VI Library for controlling the company's PC plug-in data acquisition and signal conditioning hardware, and the Data Analysis Library for processing acquired data.

The demonstration package is available now on 3.5 in. high-density diskettes and requires a 386/33 PC with a 387 coprocessor (486 recommended) running Microsoft Windows Version 3.1, 8M memory, and VGA or Super VGA video adapter.

Power Protection catalog on disk

Available from Best Power Technology, Inc. is a new hypertext catalog on a disk that is free of charge. The full-color, interactive disk is a virtual encyclopedia of information on protecting computers and other sensitive electronics from power problems. Featuring an easy-to-use, "point and click" user interface, the catalog instantly responds to each user's information needs with more than two megabytes of helpful information. In addition to a complete description of the company's line of power protection products, the catalog includes a number of innovative features.

Unlike many computer-based "catalogs" this one features actual on-screen color product photography, so users can see the devices being described.

Many of the photographs and diagrams in the presentation are interactive; users can click on anything they see in the graphic to get more information on it. By clicking on a button, users can invoke a UPS Sizer. The program asks questions about the computer system the user wishes to protect, calculates total VA load and system growth, and makes specific product recommendations based on the criticality of the user's application The UPS Sizer can also be run as a stand-alone DOS application.

Interface handbook

A new handbook, IPC/92, describes Interference Phase Cancellation, a practical method for suppressing interference which occurs at the same frequency as the desired signal or which occurs so close to it that application of conventional filters is impractical.

IPC/92 summarizes the phase cancellation theory, describing six most common interference problems, 15 different examples, solutions and product instructions. Some areas discussed are co-channel reception, ghosting due to relfection, in-channel harmonic reception, wideband noise across low band channels, undesired adjacent FM carriers and microwave inband interference. The handbook also explains methods applicable to CATV and other broadband cable systems, interference to VHF-microwave receivers, interference to TVRO installations and interference to UHF/cellular paging.

Fume extractor brochure

Pace Inc. announces the release of the new Arm-Evac Fume Extraction brochure illustrating a wide variety of fume extraction systems to remove hazardous fumes from solder operations and other electronic assembly processes. This brochure also explains the benefits of local exhaust by removing harmful particulates and gases of the extraction system before they reach the worker's breathing zone.

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

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

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Computer software for service center management

By Conrad Persson

In just a few short years, the personal computer has revolutionized the operations of every kind of business. Not many years ago, if you went into your doctor's office, or any of a number of small businesses, when you gave them your name they went to a file cabinet and pulled out your records. Today they ask you for your telephone number, punch a few buttons on a computer keyboard and your record appears on a monitor screen.

Just a few years ago, a few visionary consumer electronics service centers revolutionized their administrative procedures by computerizing. They recognized that a personal computer, or a network of personal computers, would be perfect for taking care of all of the administrative tasks that are required in a service center. Since that time, more and more service centers have converted from the old cumbersome paper approach to entering information, tracking products through the servicing process, preparing parts orders, preparing invoices and billing, to a computerized system that does all these things but has the added advantage of allowing instant access to any of this information at any time from any place in the service center.

More than just service center management

Now service centers are turning over even more and more tasks to the computer. One example is the filing of service tips. Traditionally, many service centers have file drawers full of service tips. The personnel at the service center carefully document every service procedure they perform; the symptoms of a problem on a particular set and the nature of the trouble found. They file this information, along with tips they receive from manufacturers and other sources.

In the exceptionally well-managed service center, this information is properly filed and accessible when a product is being serviced. In the less well managed service center, sometimes the information desired can be found, and sometimes not. Even in the well managed service center, however, the process is cumbersome, and if one service technician has a particular tips file, it might not be available to another technician who needs it.

There are programs available now not only for storing and retrieving these tech tips, but they have hundreds or even thousands of symptoms and cures already in a data base. A service center that buys one of these programs can then add the problems they have encountered, along with the solutions, to this existing data base. By filing all of these service tips in a computer data base on a networked computer system, all the service tips, those developed in house as well as those provided by the program, are available readily to any technician at any time, using just a few keystrokes.

Diagnostics, too

While computers are helping service centers file and retrieve information, computers that require servicing are also providing service centers with a source of revenue. Many service centers have added personal computers to the list of products that they service. Unlike products such as TVs, VCRs, CD players, etc., computers can tell the servicer what's wrong, to a certain extent at least.

When a personal computer is exhibiting a problem, but some of the vital portions are still functioning, it's possible to put a disk into the computer that contains a software program that was written so that it exercises certain portions of the computer, and reports back if everything is working properly, or provides a report of the nature of the problem if a problem exists.

Here's a rundown of the software as we know it

Whether you've been computerized for the past five years, or plan to computerize next year, whether you have all your service tips on a computer or have been thinking about doing it, or whether you've been servicing computers for years or think you might get into it one of these days, this article is published here to provide you with some useful information. What follows is a description of some of the features of some of the software mentioned above, accompanied by a list of companies who offer this software for sale.

Service center management

Service center management software provides support for the servicing facility in just about every aspect of the business. With one of these packages, when a product is brought in for service you enter the customer's information and the nature of the complaint. If this is a repeat customer you may just have to type in his phone number, and the rest of the information is brought up automatically from the computer database.

Here's a rundown of some of the features of a software product that provides a broad range of service center management capability. Because software such as this can vary considerably in its usefulness, depending on the particular needs and management style of the managers, we recommend that before making a commitment to purchase such a system that you compare the features and ease of operation of several packages. Another important consideration, of course, is cost. The least expensive of these programs cost a few hundred dollars. The most expensive may cost several thousand dollars. As with any other product, the purchaser must weigh the product's features against the cost and determine which is best for a particular application.

To help you decide which one of these software packages would be best for you, many of the companies listed here offer a demonstration program that you can try out before you buy. Most of these demos contain all the features of the software product so you can determine if it will meet your needs. The only limitation of a demo package is in the record storage fea-

Persson is editor of **ES&T**.

ture. Typically, a demo will only let you store 10 or so transactions.

One manufacturer, BGI, will send a fully featured package as a demo for $14.50, on the understanding that the person who orders it will pay the remainder of the full list price if satisfied.

Job tracking/scheduling

As the customer's job information is entered into the system, the computer automatically creates a job ticket and stores the information. Now you can do several things:

- Easily handle customer phone inquiries. Just enter the customer's phone number or name and the job information appears on the screen.
- Instantly access a job's current status just by supplying the appropriate code number.
- Get detailed job status information.
- Maintain a complete history of each unit by serial number or by customer number.
- Call up a summary schedule that lets you see the whole day's schedule at a glance.
- Schedule on-site service by territory.
- Obtain a printout of both technician routing sheets and a management summary sheet.

Inventory management

The inventory program gives you the individual parts movement by the month, cross reference data, prices, quantity and a reorder report. By checking the movement record, you can adjust quantities ordered to make sure you have adequate inventory of parts without accumulating a large inventory of slow-moving parts. By coupling this information with manufacturer's shipping time, you can order replacement parts early enough to cut down on back orders.

Invoicing

With some programs, you may enter repair descriptions and labor pricing ahead of time. The information is then on record allowing you to automatically invoice by making number selections for repair descriptions and labor prices. In addition, this program segment allows you to print both customer and standard NESDA or NARDA invoices and to automatically print post cards informing customers of the status of their unit.

Codes and tables

User-defined codes and part pricing tables let you customize your system and speed up data entry. All the technician needs to do is to press a special key to see the list of possible code entries. They include codes for unit types, brands, manufacturers, technicians, status of jobs; e.g., parts on order or estimate, customer approval, return shipping method, sales taxes, vendors.

Forms and reports

A service management software system can save you time and money in several ways by doing much of the paperwork for you. First, a valuable technician will have to take less time away from repair work to do paperwork. Second, you only have to enter the customer data once. After that, the computer will automatically generate the information in the proper format to match your different forms. Finally, the various computer generated reports allow you to see where your money is going and how fast.

Some of the forms and reports that are available are: management reports, such as daily work in process report, work completed not picked up, technician unit report, technician productivity report, production detailing report, job tracking/scheduling. Also available are invoicing reports, warranty and service literature information and inventory management.

Yet more computer help

As powerful as these computer programs are, one thing is absent from their capabilities: input from and communication with the manufacturers. At least one system now includes communication with the manufacturers as part of their features: OASIS by KeyPrestige.

OASIS provides information from subscribing manufacturers to service centers. Once a manufacturer subscribes to this system, a manufacturer's specific data base is created and continually maintained, service centers can access this data and obtain information on claims, parts availability and pricing, technical bulletins and more, as authorized by the subscribing manufacturer. A service center that wishes to access this system only needs to have a PC and the appropriate communications software.

When the user connects with the central source mainframe, they instantly have access to all authorized information. The screens are all menu driven and easy to use, and on-line help is available, according to the company.

Current menu options

A user can make as many or as few inquiries as desired with each dial-up session. Status can be checked with one or several subscribers on the following items:

Claims - A user can inquire about the status of warranty claims. Included in this screen is all the necessary claims information. A window at the bottom of the screen will display any additional information that is applicable, including any reason for rejection or non-payment.

Parts - This screen will display part numbers, descriptions, availability and applicable prices.

Bulletins - This feature offers users technical information to assist in repairs. Users can order bulletins or print them in-house while on-line.

Future options

According to the manufacturer, options that will be added to the software in the future are parts ordering, electronic transmission of warranty claims, special announcements, and more.

A caveat

A service management system won't make your business run any smoother all by itself, any more than an oscilloscope will diagnose a problem in a product. It's a tool. You have to learn how to use it and teach other people in your business how to use it. And you have to use it consistently and correctly.

One other comment: these systems are probably not for every servicing facility. A low-end system, software only to run on your own PC may cost several hundred to over a thousand dollars. A high end system for a large shop, software or software and hardware, may cost several thousand dollars. On the other hand, if a shop is large enough to use one of these systems, and the people who will use it are dedicated enough to making it work, the benefits may well far outweigh the cost.

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Baltimore, MD 21234
410-668-9594
Fax: 410-661-3942

Circle (10) on Reply Card

Foothill TV & Electronics
(Sync Pulse 1)
7730 Foothill Rd.
Tyjunga, CA 91042
818-353-9595
Fax: 818-353-7016

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Fundamental Services
1546 Peaceful Lane N.
Clearwater, FL 34616
813-584-2610
Fax: 813-585-0021

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Ideal Computer Systems
1320 Second Ave., SE
Cedar Rapids, IA 52403
319-362-2662
Fax: 319-362-4305

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

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Magic Solutions, Inc.
180 Franklin Turnpike, 2nd Floor
Mahwah, NJ 07430
201-529-5533
Fax: 201-529-2955

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MCSS, Inc.
20975 Swenson Drive
Waukesha, WI 53186
414-798-8560
Fax: 414-798-8573

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Ogment Group
PO Box 781
Lafayette, CA 94549
510-284-7372
Message or Fax: 510-284-4142

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Premium Parts +
PO Box 28
Whitewater, WI 53190
800-558-9572
Fax: 414-473-4727

Circle (18) on Reply Card

Sencore
(Service Center Manager)
3200 Sencore Drive
Sioux Falls, SD 57107
800-736-2673 Ext. 238
Fax: 605-339-9374

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ServiceWare Corporation
2212 Gladwin Crescent, Unit D2
Ottawa, Ontario
Canada
K1B 4S6
613-521-7391
Fax: 613-521-7391

Circle (20) on Reply Card

NESDA
(Service Control System II)
2708 W. Berry Street
Ft. Worth, TX 76109
817-921-9061
Fax: 817-921-3741

Circle (21) on Reply Card

Service Management Software
931 Sunset Blvd.
West Columbia, SC 29169
800-756-7035
Fax: 803-791-8521

Circle (22) on Reply Card

Service Systems International, Ltd.
8717 West 110th Street, Suite 600
Overland Park, KS 66210
913-661-0190
800-826-4351
Fax: 913-661-0220

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Sidon Data Systems
18007 South Mitchell
Irvine, CA 92714
714-553-1131
Fax: 714-553-1133

Circle (24) on Reply Card

Soft-Serve, Inc.
757 North 22nd St.
Mesa, AZ 85213
Phone/Fax: 602-835-2243

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Service Tips programs

AnaTek Corporation
(Computer monitors)
PO Box 1200
4 Limbo Lane
Amherst, NH 03031
800-999-0304
603-673-4342
Fax: 603-673-5374

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FixFinder
TCE Publications
10003 Bunsen Way
Louisville, KY 40299
502-491-8110

Circle (27) on Reply Card

High Tech Electronics
1623 Aviation Blvd.
Redondo Beach, CA 90278
310-379-2026
800-289-3001
Fax: 310-379-9608

Circle (28) on Reply Card

Higher Intelligence Software, Inc.
60 Farmington Lane
Melville, NY 11747
Phone/Fax: 516-643-7740
This company also offers custom software for the service industry.

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Diagnostics/utilities

Fessenden Technologies
116 N. 3rd Street
Ozark, MO 65721
417-485-2501
Fax: 417-485-3133

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Gibson Research Corp.
35 Journey
Aliso Viejo, CA 92656
714-362-8800
Fax: 714-362-8808

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Micro 2000, Inc.
1100 E. Broadway, Third Floor
Glendale, CA 91205
818-547-0125
Fax: 818-547-0397

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7730 Foothill Blvd.
Tujunga, CA 91042
818-353-9595
Fax: 818-353-7016

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Track Mate
Diagnostics and disk drive maintenance
5305 East Shore Drive
Conyers, GA 30208
800-486-5707
Fax: 404-922-8044

Circle (34) on Reply Card

Windsor Technologies, Inc.
130 Alto Street
San Rafael, CA 94901
415-456-2200
Fax: 415-456-2244

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On-line systems

Technical Information Procurement System
(Online computer system for tech tips)
PO Box 1681
Forest Park, GA 30051-1681
Phone/Fax: 404-968-3715
System Phone: 404-968-6600 E-7-1

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Servicing consumer electronics on site

By Homer L. Davidson

Servicing of consumer electronics products in the home has become largely a thing of the past. Modern TV sets and other consumer electronics products are so sophisticated that most service procedures require tools, test equipment and information that are only available in the well-equipped service center. Moreover, a large proportion of those products are small enough and light enough that they can be brought into the service center by the customer.

However, some products can still be serviced economically on site if not more than two trips are required to finish the job, and payment is collected before the technician leaves the site. Payment arrangements should be made when the call is booked in. Of course, if the customer has been with you for years, it's another story.

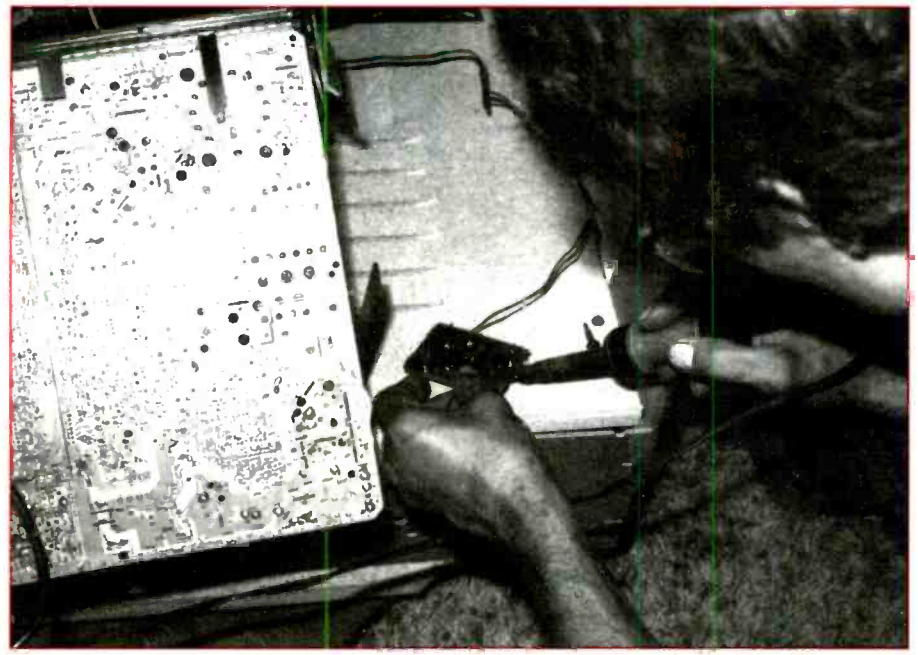


Figure 1. Minor service can be completed on site. Here a technician is replacing defective diodes in an RCA CTC140 chassis.

Logging in the call

The service center employee who logs in calls for on site service should be trained to ask for specific information that will be helpful to the technician who will perform the on site service. What specific information to ask will be determined by the individual service manager, but the following represents some of the information that will be helpful to the technician for any on site service call:

- What is the brand and model and type of product?
- What is the screen size?
- Is it a console, table model, portable, projection set?
- What are the symptoms?
- How long has the problem existed?
- Has the set been moved or disconnected recently?
- Have you had any problems with the power system, or did the problem begin just after a thunderstorm?

If the questions reveal that it is a portable or other small product, the telephone person might be instructed to tell the customer that he or she can save a trip charge by bringing the unit in.

Scheduling on site service

In a small service center where a technician does both bench servicing and on site service, it should be determined what time of day is best for the technician to make on site calls. I prefer the afternoon, since the mind should be bright and clear in the morning to tackle those tough jobs. Larger service centers may have outside technicians who take calls all day long. A regular servicing route may take certain sections of town or country on given days.

How many house calls can be made in a day? Owners of some large service centers say 8 or 10 calls a day is necessary for a decent profit. But in the case of a small service center, the technician can only take the morning or afternoon for calls, while the other half is reserved for bench time.

I have made many on site service calls, each of them different from the others. In some cases I was able to perform the service on the spot. In other cases it was necessary to return the product to the service center so that it could be serviced on the bench. The following narratives of some

Davidson is a TV servicing consultant for ES&T.

of my experiences may give other readers some insights into on site servicing.

Call 1 - Old faithful

One RCA XL100 console TV that I was called out to service exhibited two unrelated symptoms. The main problem was that, intermittently, the set refused to operate. According to the owner, sometimes when the set was inoperative rapping on the side of the cabinet would cause it to begin working. The other symptom was that the remote worked sometimes, and refused to work on other occasions.

Mr. Jones had been giving the cabinet a rap with his cane or a swift kick for days. Now the TV set would remain silent for longer hours, and sometimes would not respond at all when rapped. After setting for several hours, it might start up again when either the switch on the set was pressed, or when the on/off button on the remote unit was pressed.

Our experience with this particular XL100 chassis was that this type of tuner control problem was fairly common on sets that were 10 or 12 years old. This chassis has a slanted push button assembly with tuner control module in one piece. In fact, "old faithful" (CTC92W) frequently developed symptoms caused by cold solder joints

I removed the back cover and dropped the tuner-control assembly down. Turning the assembly over provided easy access to the PC wiring and component contacts within the tuner. As I had done in the case of several other XL100 chassis in the past, I resoldered the outside and ground connections, as well as all the connections at the bottom half of the entire area.

After re soldering these joints with a soldering gun and rosin core solder, I turned the set on. It operated perfectly. I flexed and carefully tapped on the tuner assembly to see if I could make the symptom return. The chassis never missed a beat. I returned the intermittent remote control transmitter to the service center to be serviced at the bench.

Call 2 - A horizontal white line

This was one of those exceptions to the rule that a portable set should be brought into the shop by the customer. Mrs. Smith, the owner of this portable set, is confined to a wheelchair.

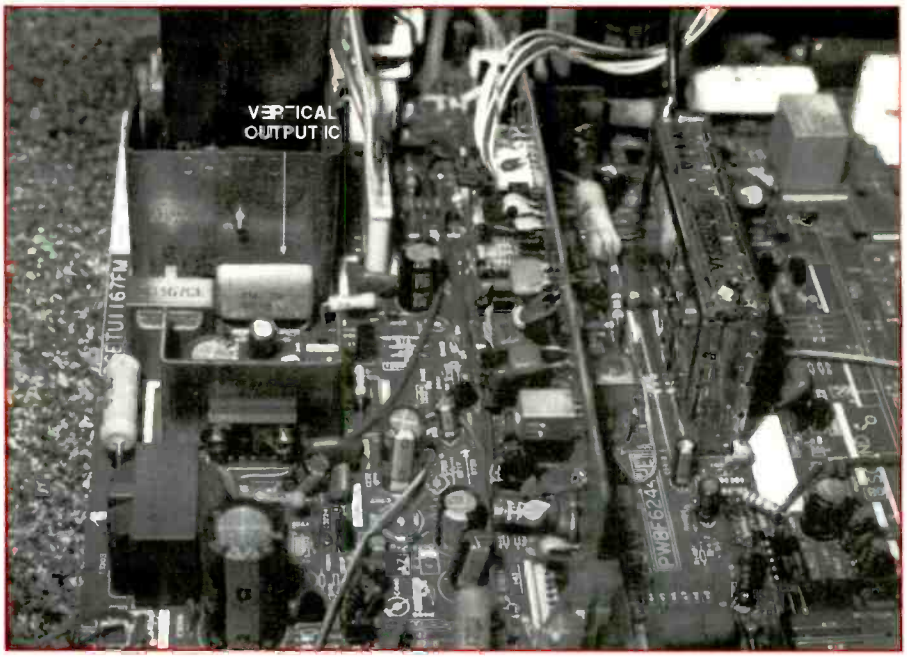


Figure 2. The defective vertical deflection IC (X0238CE) in a Sharp 19SB60R model was replaced with a TCE SK7653 universal replacement.

The only thing that showed on the screen of this Sharp 19SB60R portable was a horizontal white line. Mrs. Smith had been listening to the sound with no picture for several weeks.

Because the screen showed only a horizontal white line, I quickly concluded that the problem had to be a defect somewhere in the vertical section.

Rather than just picking up the set and bringing it into the service center, I decided that as long as I had made the trip to the house, I might as well attempt to service it on site. After removing the antenna cables and VCR connections, and pushing the pet dog aside, I removed the plastic back cover. I turned the set on and turned the brightness control up as far as it would go. There was only a white line. The sound was good, but there was no vertical sweep.

I examined the fairly new Sharp chassis, trying to locate the vertical output cir-

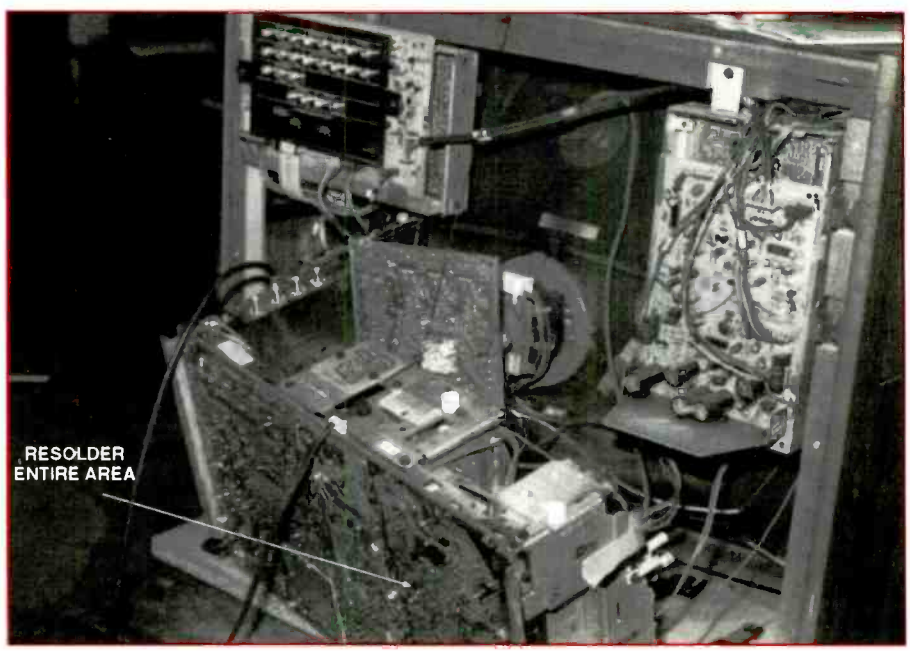


Figure 3 Soldering all terminal connections under the flyback area solved the intermittent condition in this RCA FM2722T model.

cuits. Since the chassis was only two or three years old, I assumed that the vertical oscillator or count down circuits must be in a large IC. No doubt the vertical output must be on a separate heat sink.

Sure enough, the vertical output component was located at the outside edge of the chassis on a separate heat sink (Figure 2). I was fairly confident that this IC must be defective and the cause of the symptom.

I looked up the X0238CE vertical IC in the TCE solid-state replacement guide. The SK7653 was listed as a replacement for the X0238CE vertical IC. When I called the service center and asked for this part, the parts clerk went to look for it. A short while later, the service center called back that this part was not in stock, but the local distributor had it in stock.

After picking up the replacement IC, I quickly installed it and turned on the set, holding my breath. I breathed a sigh of relief when the picture appeared. Adjusting a few controls placed the color picture back to normal. I sure lucked out on this one.

Call 3 - Intermittent RCA FM2722

I was having breakfast at a small restaurant when one of the regular waitresses told me that she was having trouble with her TV set. She was one of three sisters who worked here. She gave me their new home address and told me that her sister, Sarah, would be home all day. So I was able to make the call at my convenience.

Sarah complained that the set would go off, sometimes sound was there and sometimes not, with a black screen. At other times, the FM2722T table model would run all day and half the night.

When I first turned the set on, the picture and sound were normal. The TV set played perfectly for five minutes and then went out. When I turned the cabinet around to get at the back cover, the picture and sound reappeared. Loose connections, no doubt.

After removing the back cover I pushed around on the flyback's shield, the picture and sound would come and go. After removing two chassis end screws, I was able to turn the chassis up for easy viewing (Figure 3).

Flexing the PC board under the flyback caused the picture and sound to come and go. This naturally suggested cold solder joints or other connection problems. After I resoldered all the solder joints in that area and turned the set back on, the picture had returned to normal.

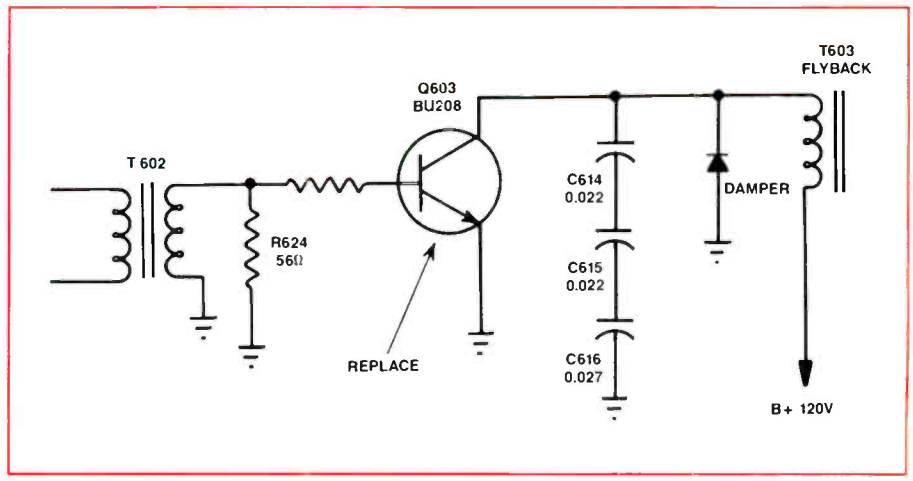


Figure 4. The leaky BU208 horizontal output transistor was replaced with a GE-38 universal replacement.

Call 4 - Dead set

The next call was on a KMart KS-1976 model. There was a great deal of dust gathered over each component. Because the set was completely dead, I suspected a blown fuse, or low voltage or horizontal output problems.

I replaced the 4A ac line fuse, but the chassis remained dead. I located another fuse in the B+ circuit (1.25A) and replaced it. The chassis still remained dead. This fuse was right alongside the flyback transformer.

A quick voltage test at the B+ fuse indicated no voltage at this point. No doubt a defective diode or switch was at fault. A continuity check from the line voltage fuse to the bridge rectifier circuits revealed an open circuit condition. When I closely examined the area around the fuse and bridge rectifier, I noted a large white 10W resistor standing upright. A resistance check showed that this resistor was open. I replaced R701 with a 5Ω, 10W resistor. When I turned the set on, the B+ fuse blew. I removed the spent fuse and made some resistance tests on the related circuitry.

A quick resistance check on one side of the B+ fuse clip indicated a voltage

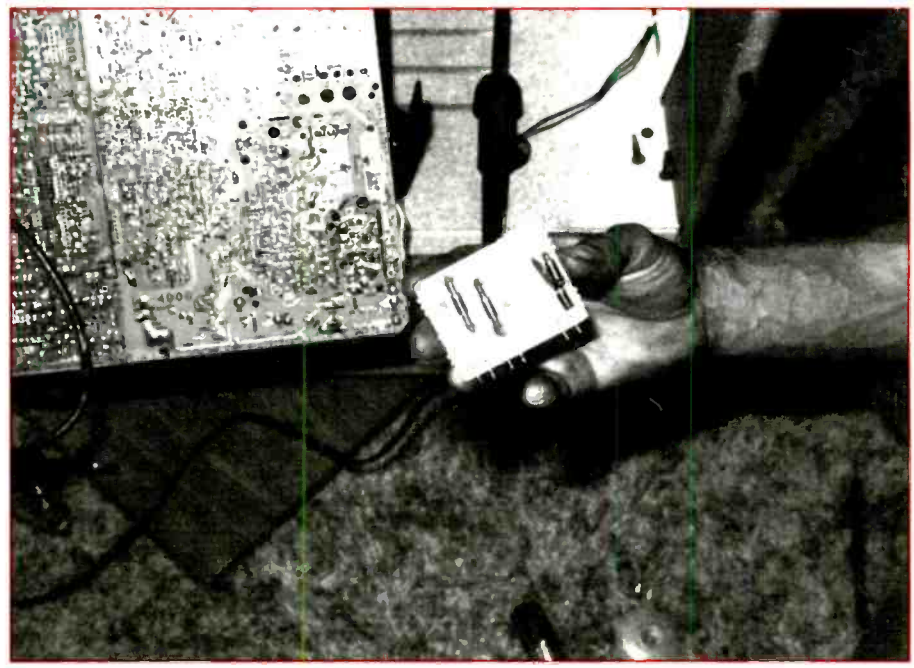


Figure 5. Resoldering all three diode connections upon a SIP diode board solved the intermittent off/on problem in this RCA CTC140-SN chassis.

discharge through the DMM. When I placed the test probe on the other fuse clip, I read a low resistance, under 200Ω. The cause of this low resistance could be a leaky output transistor, since this circuit feeds the flyback transformer primary winding.

Sure enough, the horizontal output transistor had a leakage of 0.13Ω to chassis ground. The horizontal output transistor was located on a separate heat sink bolted to the metal chassis. I removed Q603 from the circuit to determine if the transistor was leaky, or if the problem was the diode. Testing the transistor out of the circuit, with the DMM, indicated leakage between collector (metal) and emitter terminal.

To determine if the damper diode and flyback winding were normal, I made a resistance check from the collector socket to ground. There was no leakage here (Figure 4). A quick continuity check from the base terminal to chassis read around 27Ω. A resistance test from the emitter terminal to chassis ground indicated a direct short. This was normal.

I called the service center and the parts clerk determined that the faulty transistor, Q603, could be replaced with a GE-38 replacement. As luck would have it, there were two on the truck. Replacing the horizontal output transistor, two fuses and a 10W resistor restored the set to operation. Just in time for lunch.

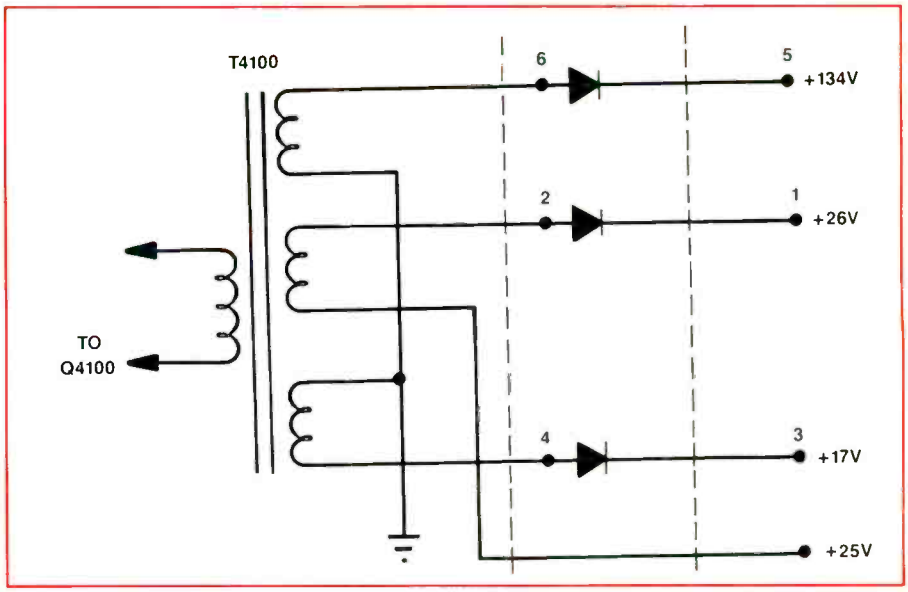


Figure 6. Solder each diode terminal to correct the intermittent off/on problem.

Call 5 - Intermittent off/on

In this 27-inch RCA console, the picture and sound would sometimes pop off and then back on, or the set would sometimes just quit. Sometimes the set would operate all night long. Usually, the CTC140-S2 chassis would always come on, with or without the remote control unit, and after running for several hours may pop off.

We had observed this problem in several of these same chassis in the past. In the first case we encountered, we brought the set into the service center. Careful diagnosis revealed that the problem was caused by bad solder joints on the SIP diode board. The problem was corrected by resoldering these joints. Now when we encounter these symptoms on one of these sets, we can go right to the circuitry that's causing the problem and correct the problem. No need to bring the set to the service center.

The CTC140 chassis must be pulled out to get at the SIP diode board (Figure 5). Six soldered pins under the chassis must be released to remove the small diode board. Carefully examine the soldered ends of each diode for cracks in the solder joint. Thoroughly solder each diode connection, by adding new solder to each terminal (Figure 6). But , don't let on to

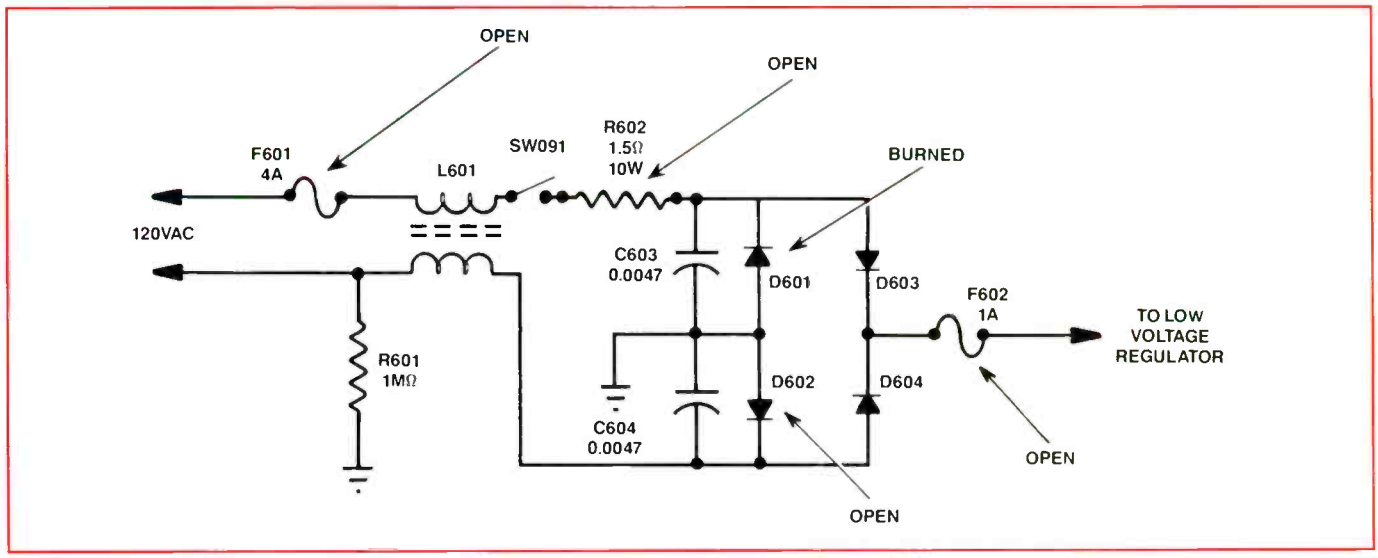


Figure 7. When this Curtis Mathes CM81 console was subjected to a higher than normal line voltage, several components in the low voltage circuit were damaged. In addition, several sections of the PC wiring were burned.

the customer how easy it was to fix the set; let him think you are a genius for repairing this large TV set in a total of 30 minutes.

Call 6 - AC line problems

Although the next call was only 1-1/2 miles north of town in the same area, the problem turned out to be quite different. Since yesterday's rain storm, every electrical appliance in the house was damaged. A large tree branch had fallen over the power lines to the house. Somehow this caused a higher than normal voltage to be placed upon all equipment that was operating at the time.

Mr. Smith, the homeowner was watching TV when the storm hit. When the tree came crashing down on the power line, the TV set flashed and went out, the VCR went up in smoke, and the ceiling fan started spinning faster than normal. It continued to race until it was turned off.

Mr. Smith called the electrician at once. After the electrician had restored normal power, he checked all the electrically operated products in the house. Not only were the TV and VCR inoperative, the refrigerator would not come on, the stereo player was dead, and two small radios did not work.

Because the radios, stereo player and VCR were not turned on when the power surge hit, the damage to them must have been caused because their small power transformers were connected directly into the circuit with the ac switch on the secondary side.

A cursory examination of the Curtis Mathes CMC81 console TV set gave the impression that little damage had been done, so I replaced only the line and B+ fuse and then turned the set on. When I did so, a puff of smoke rose from the set. My first thought was that this might indicate the bridge diodes were damaged. Even the voltage isolation resistor (1.5Ω) was open (Figure 7).

If I had only pulled the chassis up and looked at the bottom PC wiring, several minutes could have been saved. There were at least three different strips of PC wiring ripped from the board, tied to chassis ground. This set had to go in for a complete estimate. It looks as though this power surge may call for a total TV replacement.

Conclusion

In order to be profitable, on site service should be completed in less than one hour. The on site technician must work efficiently and with great determination. Evaluate the symptoms with the screen and speaker before tearing into the chassis. Look for those simple problems that occur most of the time. If handy, take along the correct schematic.

Be polite, courteous, and always admire the customer's plants, hobbies, children, house flowers and dog. Don't forget to smile before collecting the service bill. You may be asked personally to come back the next the TV refuses to function.

Troubleshooting microwave oven high voltage circuits

By Homer L. Davidson

Servicing microwave ovens can be dangerous. Extreme caution must be exercised any time the technician works around ac power line voltages and dc voltages up to 4.5kV. Always remember that the power transformer, capacitor, rectifier and magnetron tube have high voltages on them when the microwave oven is operating (Figure 1).

Some manufacturers warn against taking any voltage tests within the high-voltage section. Of course, the TV technician works around picture tube voltages up to or over 35KV. But remember, the high voltage in the microwave oven is capable of delivering high-current as well, while the current that a TV set can deliver is limited. Extreme care must be used while servicing a microwave oven.

Before taking off the back cover, remove your wrist watch. Make sure that the oven is unplugged at all times when checking continuity and resistance and replacing components. Before making any tests, discharge the HV capacitor with insulated handle screwdrivers. Remember, you can be severely shocked or killed if the high-voltage capacitor is not discharged.

WARNING! Before attempting any service, or any time the cabinet has been removed, the microwave oven should be unplugged and the high-voltage capacitor discharged. Sometimes you may have to use two well-insulated screwdrivers if you cannot get one blade across both terminals. Again, any time the oven has been plugged into the power line, once you again turn it off, before you work on it, discharge the HV capacitor.

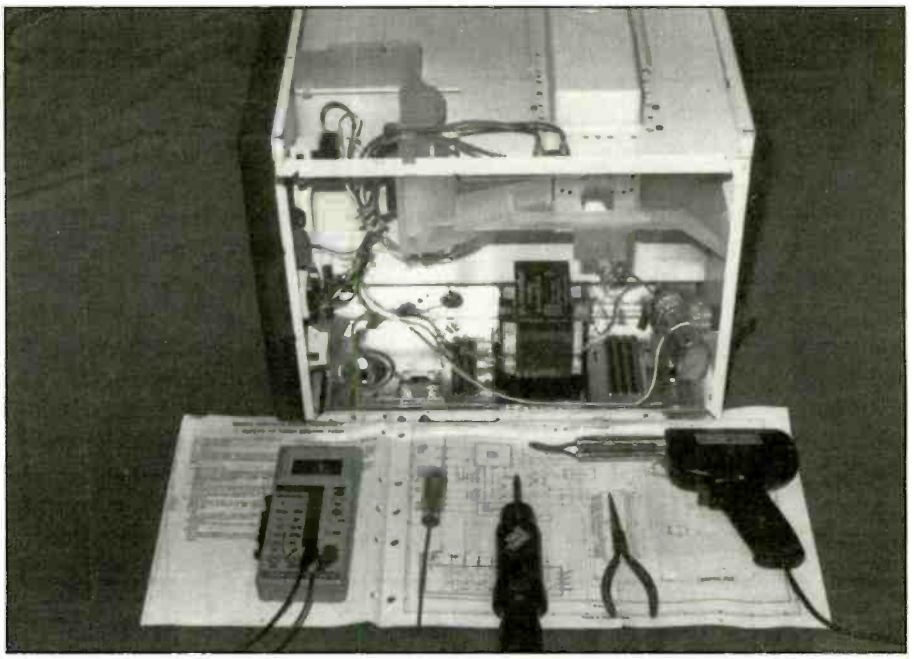


Figure 1. Do not touch anything: hands, tools, or test leads to the oven while operating.

Basic HV circuit

The high voltage circuit in a typical microwave oven operates on the voltage doubler principle. Ac voltage (120V) is applied to the primary winding of the HV transformer, which provides output of 2000V to 6000V peak voltage. The HV diode rectifies the high ac voltage to operate the magnetron tube from 1800Vdc to 4500Vdc (Figure 2).

The typical half cycle doubler circuit with capacitor and diode is connected in the secondary circuit of the HV transformer. Another transformer winding provides a filament voltage of 3.1Vac to

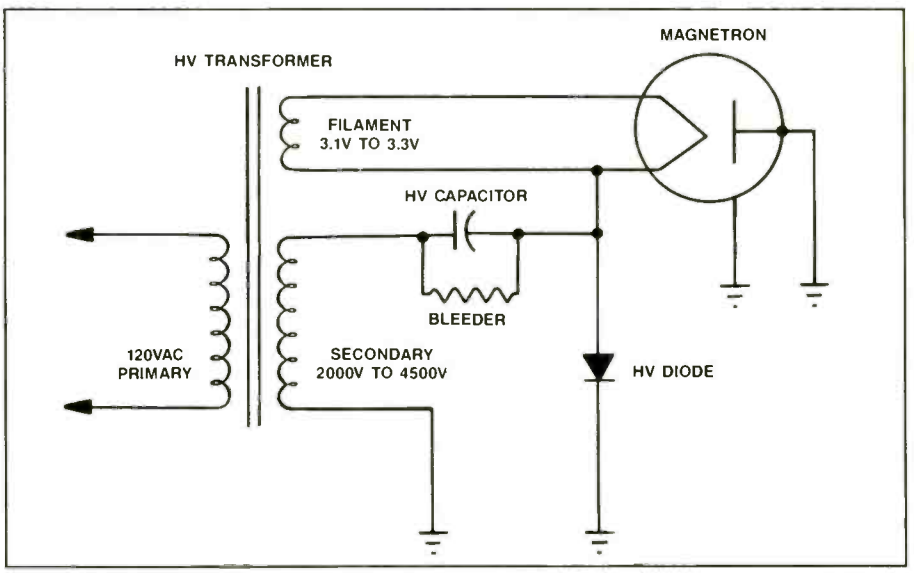


Figure 2. The basic high-voltage doubler circuit with transformer, high-voltage capacitor and diode.

Davidson is a TV servicing consultant for ES&T.

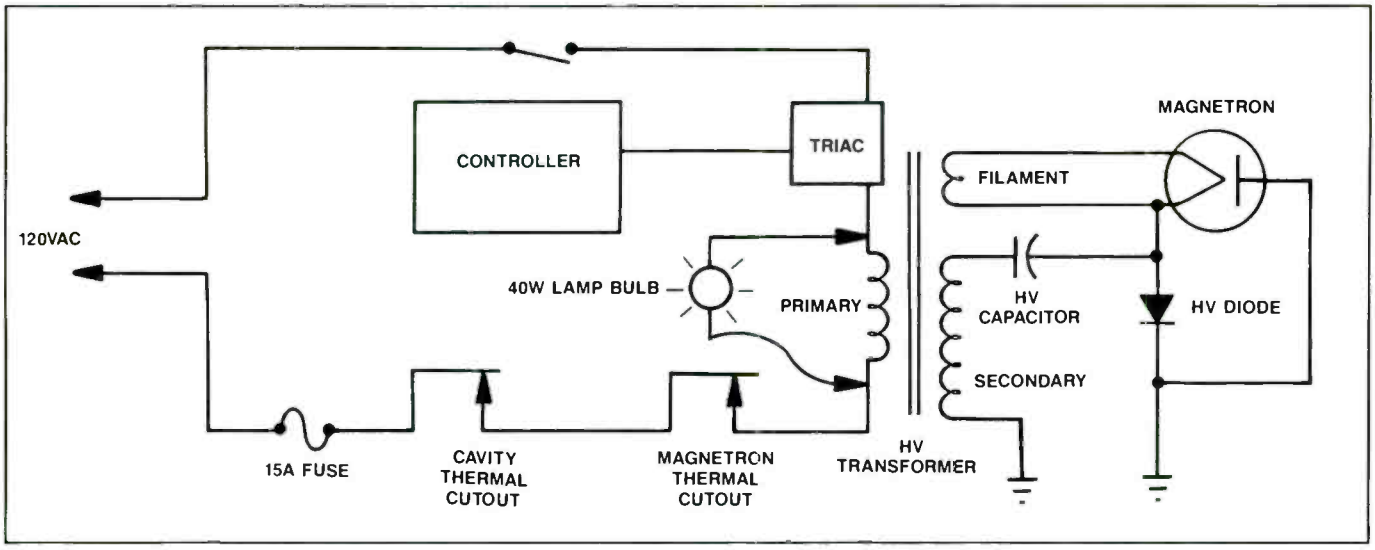


Figure 3. A 40W pigtail socket light bulb, or ac meter connected to the primary winding of the power transformer indicates if primary circuits are normal.

3.3Vac to the magnetron. Some ovens have suppression filter chokes and bypass capacitors to reduce radiated noise that would interfere with radios or TV sets. On most ovens you can tell if the magnetron is oscillating by looking for horizontal firing lines across the picture of the kitchen portable TV.

You may find a bleeder resistor of 9MΩ to 10MΩ across the high-voltage capacitor. When the oven is off, the HV capacitor is discharged in about 30 seconds. It's wise, however, to always discharge the capacitor by placing a short across it. Do not assume that the bleeder resistor will discharge the HV circuit.

HV circuit components

The HV circuit consists of the HV transformer, capacitor, diode and magnetron. A failure of any of these components may result in a blown fuse, no heat/no cooking, or intermittent cooking symptoms.

When 120Vac is applied to the primary winding of the HV transformer, high voltage developed by the secondary winding is applied to the voltage doubler circuit. The primary winding voltage may be applied via an oven or high voltage relay and triac assembly. You can monitor this primary voltage (120Vac) with a 40W pigtail light bulb socket or ac meter (Figure 3). If the meter registers 115Vac to 120Vac, or the light bulb is bright, you know the primary circuits of the oven are functioning.

Typical faults that cause the transformer to be defective are: an open primary or secondary winding, poor connections or shorted windings. When you suspect that the transformer is faulty, discharge the HV capacitor before checking continuity or resistance at the transformer terminals.

The primary resistance should be less than 2Ω (around 0.15Ω). The secondary winding may measure from 50Ω to 100Ω. The filament winding for the magnetron may read less than 1Ω (0.001Ω to 0.5Ω) with leads disconnected.

The high-voltage capacitor may open up or become leaky. A shorted high-voltage capacitor may blow the main fuse. To check this component, discharge the HV capacitor. Remove wires from both terminals. Set the ohmmeter to R X 10,000

Figure 4. Checking the high-voltage capacitor resistance test with a small DMM.

Figure 5. Do not use a small DMM or VOM to measure high voltage in the microwave oven. Use the DMM only for continuity and resistance measurements.

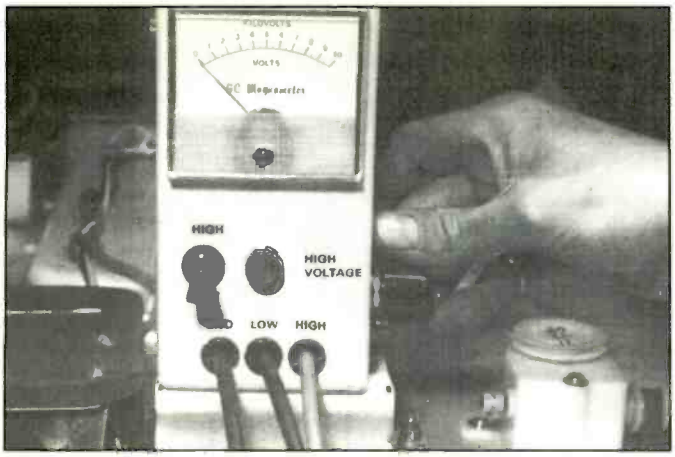


Figure 6. The original Magnameter was invented by Nick Parnello of Rockford, IL.

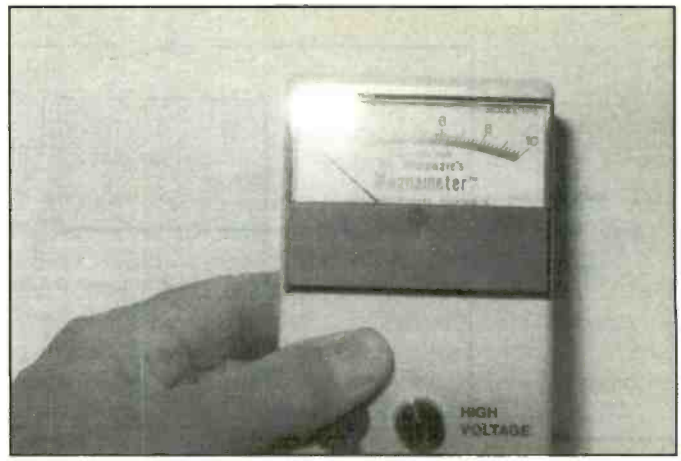


Figure 7. The Magnameter has a yellow area up to 2kV, a green area from 2kV to 4.5kV, and a red area from 4.5kV to 10kV.

scale (Figure 4). The meter needle should go up and slowly downward, then settle at infinite ohms. Now reverse the test leads. If the capacitor is normal, the meter indicator should go up and down as before. The meter should read infinite resistance for each terminal. Replace the capacitor if its resistance is below 10KΩ, or if the body becomes warm.

Usually, if the HV diode is defective, it becomes warm or leaky. Sometimes the HV diode becomes open. To evaluate the condition of the diode, start by discharging the HV capacitor. Set the ohmmeter to R X 10,000 scale. Apply test leads across the diode terminals. A normal HV diode should read infinite in one direction, and with test leads reversed, above 10KΩ. If the diode has a lower resistance or runs warm after the oven operates, it is defective. Replace it.

Magnetron tests

Typical magnetron defects are weak operation, or shorted, leaky or open filaments. Intermittent cooking may be caused by burned or poor filament connections, intermittent internal filaments, or a defective magnetron. An overloaded magnetron may operate intermittently because the thermal cutout alternately opens and closes the circuit. The defective magnetron may arc internally, around the metal gasket or between the antenna and the adjacent chassis, caused by a cracked glass antenna tube.

The defective magnetron may be checked by observing the symptoms when water is heated in the oven, or by

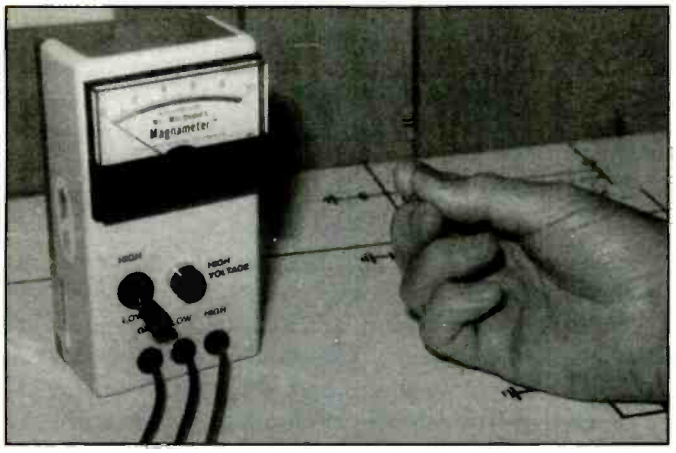


Figure 8. Disconnect the cathode terminal (+) of the HV diode in the oven and place the 10Ω resistor (furnished with tester) in series to chassis ground. You may find a 10Ω resistor in some ovens.

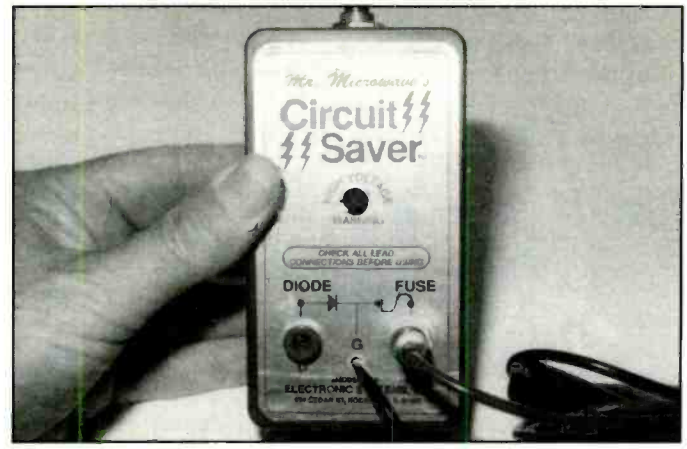


Figure 9. When the microwave oven keeps blowing the fuse, clip the Circuit Saver across the fuse holder and just reset the circuit breaker, instead of replacing those expensive chemical fuses each time.

making resistance and HV checks. Discharge the HV capacitor. Remove the HV terminal wires. Set the ohmmeter to R X 1. Place meter probes across the filament terminals with the filament wires disconnected. The meter should read less than 1Ω (0.02Ω to 0.035Ω).

Now set the meter to R X 10,000 and measure the resistance between each filament terminal and common ground. The meter should show infinite ohms at each terminal. If any lower resistance is measured, the magnetron or HV diode may be leaky. Disconnect one end of the HV diode and test again. A shorted diode may blow the 15A chemical fuse.

Dividing the circuits

The primary or low voltage circuits are found ahead of the primary winding of the power transformer. The HV circuits are known as the secondary circuits. Monitor the low voltage circuits with a pigtail 40W light bulb or ac voltmeter across the primary winding of the transformer. You may assume the low voltage circuits are working if the power line voltage is found at this point. Usually, ac voltage is applied to the winding through an oven relay contacts or triac component.

Resistance measurements

Critical resistance measurements of the HV components may reveal a defective component. Discharge the HV capacitor before making resistance measurements. A low resistance measurement from the filament of the magnetron or the top of the HV diode to chassis ground may indicate a leaky magnetron or diode. Disconnect one end of the diode and check the resistance of each component. A normal circuit will read infinite here, except in cases where the circuit features a 10MΩ resistor across the diode terminals.

Measure resistance or check continuity of the power transformer windings. If the HV winding is shorted, this resistance will be less than 50Ω and the transformer will run warm or red hot. Completely disconnect the HV winding. If the transformer runs too warm without a load, replace it.

A leaky or shorted magnetron may keep blowing the fuse or overheating. Higher than normal HV at the filament terminals may indicate open filaments within the tube. If you suspect this to be the case, discharge the HV capacitor, disconnect the filament from the circuit, and place test probes across the filament terminals. If the filament is intact, you should measure less than 1Ω.

Checking the high voltage

BE VERY CAREFUL IN TAKING HV TESTS WITHIN THE MICROWAVE OVEN. DO NOT ATTACH ANY TEST PROBES, OR TOUCH ANY CONNECTED TEST PROBES, WHILE THE OVEN IS OPERATING.

First, discharge the HV capacitor. Connect the test lead to the top side of the HV diode or magnetron filament terminals. Correct high-voltage measurement at the filament terminals of the magnetron may indicate the voltage-doubler circuits are normal. Remember, the positive side of the HV diode is at ground potential.

The high-voltage within the oven may be checked with a HV dc meter, high-voltage probe, or a Magnameter. The regular VTVM (found upon most TV service benches) with the high voltage probe will indicate if high voltage is present.

Do not hold the probe in your hands. Make sure that the probe is well insulated from the oven metal base, and that the ground wire is clipped to metal chassis. The Magnameter is a useful tester to check high voltage and current within the HV circuits.Do not attempt to use a small DMM or VOM to measure HV in the microwave ovens (Figure 5).

Meter damage

Since the second edition of my book, "Microwave Oven Repair" has been published, I have received letters from four different technicians with damaged test instruments. The first two instruments were a small VOM and DMM that were destroyed, while taking HV measurements. Most small VOMs or DMMs will not measure over 1000Vdc, and the lowest HV found in the microwave oven is above 1.5KV.

One technician had used a 3kVdc voltmeter in testing out several microwave ovens without any problems. The meter was damaged beyond repair when the HV diode was open, placing raw 3800Vac directly upon the dc meter terminals.

The fourth technician used an expensive bench DMM with a maximum 3000Vdc voltage measurement. He forgot to reconnect the ground end of the HV diode that he was testing earlier while making continuity tests. When the tester was connected for HV test, the meter went up in smoke. He returned the meter for factory repairs but in the end, had to replace it. The damage was just too exten-

sive for economical repair.

Be safe, use only a VTVM with HV probe or a Magnameter for HV tests within the microwave oven.

Magnameter tests

The Magnameter was primarily designed to check high voltage and current within the HV circuits. A correct negative voltage at the HV diode indicates that the HV circuits are normal. Simply flip the toggle switch to the low reading and measure the current pulled by the magnetron. No current measurement indicates the magnetron is open. Lower current than normal may indicate a low emission tube. Higher than normal current may indicate a leaky magnetron.

The new meter

The Magnameter is a specialized test instrument to speed up and simplify microwave oven repair. The new meter is a lot smaller in size and has a colored meter assembly (Figure 7). The shorting lever is not found upon the present meter.

The unit enables both high voltage and plate current measurement with one set up. When high voltage is present, on either "High" or "Low" position, the neon warning light is on. The test instrument has high-voltage test leads, with no metal knobs or switching actuators on the exterior unit.

All precautions for making measurements in microwave HV circuits still apply when you use any specialized meter. Don't get careless.

To test for high-voltage, connect ac power, set the toggle switch to high and insert a water load (usually 16 oz of water). Turn the oven on high setting and read the meter. If the meter only moves into the yellow area, suspect a shorted magnetron, shorted diode or HV capacitor, shorted or open high-voltage transformer, or open HV fuse.

Check for an open magnetron, open filament, defective filament transformer or open HV wire if the meter goes into the red area. The microwave is normal if the meter indicator is in the green area.

Turn the switch to Low to test the plate current. Most home type ovens should measure between 1.6V and 4.5V (160mA to 450mA). Commercial ovens register from 2.0V to 7.0V (200mA to 700mA) (Figure 8). Correct plate current, plate voltage and oven wattage for typical domestic and commercial ovens can be found in the instruction manual.

The Circuit Saver

The Circuit Saver is manufactured by the same firm to prevent replacing the chemical fuse when the oven keeps knocking out the fuse (Figure 9). To use this device, remove the blown fuse and plug the red banana plug into the fuse jack on the meter, and clip the meter across the fuse holder. The Circuit Saver can be reset each time if overload occurs.

The saver can save a lot of money in blown fuses while making microwave tests. The Circuit Saver also has an internal HV diode that can be clipped into the circuit, when you suspect that the problem is the HV diode.

Simply remove HV wire (anode end) from HV diode and connect the saver. If high voltage is present, the red HV light will come on.

The Magnameter and the Circuit Saver are available from:

Electronic Systems, Inc.
Microwave Division
624 Cedar Street
Rockford, IL 61102 ■

Where are they now?

By Victor Meeldijk

Many companies seemed to have disappeared due to mergers, acquisitions, name changes and bankruptcies. In this article we will tell you what happened to some of the companies you may be familiar with.

In the 1980's and 1990's, many companies merged, were acquired or went bankrupt, sometimes with the assets sold to other companies. According to industry statistics in 1992, in one typical month 1080 firms closed and 26,620 new businesses were incorporated. In this process, many original supplier names disappeared (remember when Datsun took the parent company name Nissan) making it hard to locate the company that might still make the parts.

(Electronic industry facts on companies, including assets and mergers, are compiled in the Electronic Industry Financial Directory, formerly called the Electronic News (EN) Fact Book and Directory, published yearly by Fairchild Books, 7 West 34th St., New York, N.Y.10001, 1-800-247-6622, 212-630-3880, Fax: 212-630-3868). Some of the changes that have occurred are:

ACUMOS was acquired by Cirrus Logic Inc.

The variable resistor lines manufactured by **Allen Bradley Company** were acquired by Clarostat Manufacturing Company. See Clarostat, below, for details on their merger.

American Switch Corporation, was bought by Mors Components, Inc., and is now known as MORS/ASC, Wakefield, MA.

AMI or American Microsystems was known as Gould-AMI up to the late 1980's when Gould Inc. sold AMI to Nippon Mining Company Ltd. of Japan.

Amperex and Mepco/Centralab merged on April 3, 1989 and on September 4, 1989 this company became known as Philips Components.

AT&T Microelectronics, DC wound capacitor line was purchased by Aerovox, Inc.

Ballentine Laboratories, a test equipment manufacturer, ceased operations in 1991.

Bowmar and NES meters are now manufactured by Weschler Instruments of Cleveland Ohio.

Cambridge Thermonics Corporation (CAMBION), and Hollingsworth, were part of Midland Ross which became part of Interconnection Products, Inc.(IPI). While the American IPI is no longer in business (since late 1991), the United Kingdom division of the company, Interconnection Products, LTD., Castleton, Sheffield England S30-2WR, is still operating. Their distributor in the U.S. is Pyttronic Industries, Inc. 1-800-251-2617, Fax: 1-215-855-5120. The Integrated Electronics Corporation in Denver CO is also dealing directly with the English company. Some of the IPI commercial connector lines may be available from Wearnes Technology Private, Ltd. which bought the assets of IPI (IPI was a subsidiary of Wearnes Technology, a unit of Singapore based Wearnes Brothers Ltd.). The Cinch Connector Division of Labinal Inc., in Elk Grove IL, purchased the MIL-C-5015FR, MIL-C-5015RR and MIL-C-28840 lines from IPI.. Interstate Connecting Components, Inc. in Moorestown NJ is still selling their remaining inventory of MIL-C-5015 and MIL-C-28840 connectors. Hollingsworth, the manufacturer of terminals is still operating in Florida.

Carol Touch Technologies is now Carol Touch, part of Amp. Inc. They are located at P.O. Box 1309, Round Rock, TX 78680.

Centralab, the manufacturer of pushbuttons, toggle switches, rocker switches, keyswitches and potentiometers was known as CRL Components, Inc. for a while and then closed on August 31, 1992. The rotary switch line was sold to Electroswitch, Weymouth MA, in January 1992. The illuminated pushbutton switches was transferred to a sister company, Dialight Corporation of Manasquan, N.J.. ITT Shadow, Eden Prairie MN, offers switches that may be compatible with CRL units.

Clairex Electronics of Mount Vernon N.Y. was acquired by OptoSwitch/Skan-A-Matic of McKinney Texas in 1992.

Clarostat Manufacturing Company and Senisys (Sensor Integrated Systems) were purchased from Hawker Siddeley Group by British Tire and Rubber Industries N.A. and were merged together in September 1992. Clarostat/Senisys distributor orders can be placed through the 1600 W.Plano Texas office, 800-448-2900, 214-422-1844, Fax: 214-423-4661. OEM, (Original Equipment Manufacturer) orders can be placed in the El Paso, Texas office.

CODI Semiconductor, Inc. ceased operations in 1991.

Cornell-Dubilier AC capacitor line and power products and filters were purchased, in late 1991, by Aerovox, Inc., North Dartmouth, MA.

Corning Electronics Resistors became Bradford Electronics, Inc. and is now part of Vishay.

Crystal Semiconductor was acquired by Cirrus Logic Inc.

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

Custom Arrays Corporation of Sunnyvale CA has adopted the name Interdesign. This company manufacturers the linear arrays in a technical alliance with Ferranti Interdesign before it was acquired by Plessy Semiconductors.

Edmac, a subsidiary of Rospatch became Flightline Electronics, and is still located in Fishers, NY.

EMC (Electronic Molding Corporation) sockets, test jacks and panel systems was acquired by Advanced Interconnections. 5 Energy Way, W. Warwick, RI 02893, 401-823-5200, FAX: 401-823- 8723.

Erie became part of MuRata and is now known as MuRata/Erie. In April 1992, MuRata Manufacturing Company of Japan sold its EMI filter line, manufactured in Canada, to Spectrum Control in Fairview Pa. MuRata continues to sell surface mount filters and ferrite products for computer, consumer and telecommunications applications in Smyrna GA.

Fairchild Semiconductor became part of the National Semiconductor.

Ferranti Interdesign. See Custom Arrays Corporation.

Gazelle Semiconductor, Gigabit Logic and TriQuint Semiconductor merged together and are now called TriQuint Semiconductor, Santa Clara CA.

GE, RCA and Intersil microcircuits, and MOV's (metal oxide varistors), for the OEM market are now available, from Harris Semiconductors, part of the Harris Corporation, Melbourne, Florida. The use of the Harris name superseded the other logos in December 1989.

GE and RCA semiconductors, for the consumer service market, are now Thompson Consumer Electronics.

General Instruments Microelectronics Division is now called Microchip Technology.

General Semiconductor, was sold by its parent company Square D, to General Instrument Corporation in 1992.

GenRad (formerly General Radio) test equipment line (consisting of standards, measurement bridges, noise meters, stroboscopes) is now Quadtech, Inc., Bolton Mass.

Groupe Bull sold two printer lines, the series 4000 and 5000 high speed printers, to Delphax Systems in Canton, MA in late 1991. Groupe Bull continues to service the printers for Delphax Systems (the manufacturer of the print engines used in the machines).

Hamlin, a manufacturer of LCD's is now known as Standish Industries, Hamlin LCD Division.

H.H. Smith Company is now part of NT-T (National Tel-Tronics) Inc., 632 Atch Street, Meadville, PA 16335, 814-724-6440, Fax: 814-333-1912 .

Honeywell Semiconductors are now available from SPT, Signal Processing Technologies (a member of the TOKO Group), 1510 Quail Lake Loop, Colorado Springs, CO 80906, 719-540-3900, Fax: 719-540-3970.

Hughes Aircraft Microelectronic Circuit Division sold the crystal filters and oscillators to Piezo technology, Inc. in Orlando Florida.

Hybrid Systems Corporation is now known as Sipex Corporation, and is still located in Billerica MA (508-667-8700).

The **IBM** laser printer line is now an independent company known as Lexmark International, Lexington KY.

INMOS was bought by what is now SGS Thompson, although it still exists as a separate company.

Inova, a manufacturer of static RAMs, declared Chapter 11 bankruptcy in 1991 and ceased production of microcircuits.

Integrated CMOS Systems, Inc. in San Jose, CA, changed its name to Vertex Semiconductor Corporation in 1990.

International CMOS Technology, Inc. was acquired by a group of creditors, after filing Chapter 11 of the Federal Bankruptcy Act in August 1991, and was renamed ICT Inc.

ITT sold their computer line and the ITT XTRA Computers are serviced by Alcatel Business Products, located in AZ, 800-528-1400, Technical Service: 800-528-6457, Sales/Accessories/Technical Manuals: 1-800-231-4075.

Keithly sold their hand held meter and temperature instrument line to Tegam, Inc., Madison OH.

In 1991, **Kodak** sold its line of 9V Ultralife Lithium batteries and the new company is now known as Ultralife Batteries, Inc. Kodak continues to sell their other lithium batteries.

Kulka, a manufacturer of terminal blocks/strips, formerly a North American Philips Company, in Mount Vernon N.Y., is now part of Marathon Special Products, Marathon Electric, 13300 Van Camp Road, Bowling Green, OH 43402, 419-352-8441, TWX: 810-499-2988, Fax: 419-352-0875.

Lambda Semiconductor parts are available from Semtech Corporation, Corpus Christi Facility, 121 International Blvd., Corpus Christi, TX 78406, 512-289-0403, Fax: 512-289-0472.

LSI, Avionics Systems Corporation of Lear Siegler, Inc. became SLI, Smiths Lear, Inc. part of Smiths Industries, 7-11 Vreeland Road, Florham Park, N.J. 07932, 201-822-1300.

In October 1992, **M/A-COM** sold their Radar Products Operation, microwave based high power control components military family, to Varian Associates, Inc. in Palo Alto CA.

Mallory Capacitors assets were purchased by North American Capacitor Co. 4760 Kentucky Ave., P.O. Box 1284, Indianapolis, IN 46206, 317-856-2430, Fax: 317-856-2500 .

Mepco became Mepco/Electra then Mepco/Centralab and then merged with Amperex on April 3, 1989 and became Philips Components, Airport Road, Mineral Wells, TX 76067.

MMI, Monolithic Memories, Inc. became part of AMD, Advanced Micro Devices, Inc. in August 1987.

Mostek Semiconductors was sold to United Technologies in 1979 and was later sold to Thompson-CSF. It is now part of SGS/Thompson Microelectronics, Inc (parts now have an "ST" logo). 1000 East Bell Road, Phoenix, AZ 85022, 602-867-6100.

Moxon Inc. manufacturer of Time Code Generators, became Kode, Inc. a division of Odetics, Inc. and is now known as Precision Time, a division of Odetics, Inc., 1515 South Manchester Avenue, Anaheim CA, 92802-2907, 714-730-6901.

Nova Devices, in 1969, became the Analog Devices Semiconductor division.

Nytronics inductor line is being distributed by Vishay Electronic Components (and is called Nytron). (Vishay Electronic Components is the parent company of TTI Inc., Angstrom Precision, Dale Electronics, Jeffers, Ohmtek, Techno, Ultronix and Vishay Resistors. The military relay lines of Struthers-Dunn and HiG were purchased by Schneider S.A of France (and can still be contacted through the pitman NJ location), who also purchased Square D. Struthers- Dunn commercial relays was acquired from the Nytronics Components Group by Magenecraft Electric Company in Northbrook, IL.

Optical Fiber Technologies (OFTI), of Westford MA was purchased by AMP in June 1992 and was merged into the AMP Electro-Optics Division.

Optima Division of Scientific Atlanta (manufacturer of enclosures) is now part of the Gichner Systems Group, is still located in Tucker GA.

Pixel Semiconductor was acquired by Cirrus Logic Inc. but still operates as a separate company.

Plessey, the division that manufactured special purpose computer boards is now Radstone Technology Corporation, 20 Craig Road, Montvale, N.J. 07645-1737, 201-391-2700, Fax: 201-391-2899

Plus Logic, a manufacturer of PLD's (programmable logic devices) was purchased by Xilinx.

PMI, Precision Monolithics Inc., a manufacturer of operational amplifiers, voltage followers, buffers, converters, multiplexers, etc., was acquired in 1990 by Analog Devices.

Power Control Devices, a manufacturer of oscillators/choppers, quartz crystals and amplifiers, discontinued operations in 1992. This company was formerly American Time Products a Division of Frequency Control Products, and prior to this a Bulova Electronics Division.

Prairie Tek, a disk drive manufacturer founded in 1986, closed in August 1991.

RCA test equipment was first sold to VIZ Instruments, which was later acquired by Kappa Networks, Inc. In 1990 they were again sold, to the Vector Group and are now called Vector-VIZ. They are located in Newburgh N.Y.

Renaissance GRX. See ZyMOS Corporation.

Rogers Corporation Circuit Components Division (best known for PGA and rail capacitors) was sold in April 1992 and is now known as CCI, Circuit Components, Inc., the company is still located in Arizona.

SFE Technologies ceased its San Fernando Capacitor Operations in 1991 and the EMI/RFI filter line was sold to Wems Electronics. The company is now called Wems Electronic Filter Group and is in Hawthorne CA.

Solid State Scientific, a semiconductor manufacturer, was acquired by Sprague Electric in 1984.

Souriau, Inc was puchased by Burndy Corporation. In Europe these connectors are marketed under the Framatome Connectors International (FCI) name. Framatome Connectors is the parent organization of Burndy, Jupiter, Souriau and Connectral.

Sprague Semiconductor is now Allegro Microsystems Inc., in MA.

Sprague Technologies solid tantalum capacitor line and the U.S. thick film network business was sold to Vishay Intertechnology in 1992. The 192P film/foil capacitor line was sold in 1992 to SB Electronics of Barre Vermont. Also in late 1992, United Chemi-Con Inc. acquired the Sprague aluminum capacitor facility in Lansing, North Carolina. The manufacturing location of the aluminum capacitors remains unchanged and the original Sprague part numbers have been retained. Capacitors as of December 1992 are marked Nippon Chemi-Con.

Standard Grigsby, a manufacturer of rotary switches, was acquired by Oak Switch (parent Oak Industries) in 1991. The new company is called Oak Grigsby, located in Sugar Grove, Illinois.

The **Tecktherm** thermally conductive insulation product line (series 1601 to 1605) was sold in 1992 and is now available from Bergquist (Minneapolis, MN) as part of their Sil-Pad product line.

Teledyne Philbrick Division of Teledyne Inc. is now known as Teledyne Components Division of Teledyne Inc..

Texas Instruments sold its business computer line (the 1500 family) to Hewlett Packard in June 1992. Hewlett Packard will continue to sell the 1500 line and can even use the TI logo. TI will continue to manufacture the line for Hewlett Packard at a

(Continued on page 45)

contract manufacturing plant in Austin. TI continues to manufacture a laptop line made by its peripherals group.

Times Fiber Communications, Inc., a manufacturer of coaxial cable and related products was acquired by Amphenol Corp. in late 1992.

TRW/UTC (United Transformer Corp.) Transformer became OPT/UTC, part of OPT Industries, Inc., 300 Red School Lane, Phillipsburg, N.J. 08865, 201-454-2600, Fax: 201-454-3172.

Unimax Switch is now C&K Unimax Unisys Defense Systems, Mclean VA (Unisys is the company formed after Sperry and Burroughs merged), was renamed Paramax Systems Corporation (the name of the Sperry organization in Canada).

Unisys Defense Systems, Mclean VA (Unisys is the company formed after Sperry and Burroughs merged), was renamed Paramax Systems Corporation (the name of the Sperry organization in Canada).

Unitrode sold its semiconductor products division (which makes discrete power semiconductors for industry and the military) to Microsemi Corporation in 1992. This division was renamed to Microsemi Watertown.

U.S. Elco Inc. in Santa Clara CA, a power supply manufacturer, changed its name to Cosel U.S.A. in May 1992.

Vitelec Corporation was acquired by Mosel Corporation. The new company is called Mosel-Vitelic Corp., San Jose, CA.

Ward Leonard Resistors was acquired by Charles T. Gamble Industries, Delanco NJ.

Ward Leonard Industrial Controls (Relays, Contactors, Rheostats) was acquired by Joslyn Clark Controls, Lancaster SC.

The **WCI Major Appliance Group**, which manufacturers such brands as Frigidaire, Tappan, White-Westinghouse, Gibson and Kelvinator, changed its name to the Frigidaire Company in 1991.

West-Cap Arizona, an inductor manufacturer, was purchased by Vishay Intertechnology, Inc. in 1990.

The **Xceed** line of add-in computer video boards, cache cards and SIMM modules (for Macintosh and HP Laserjet printers) was sold by Micron Technology in 1992 to P.G. Design Electronics. This business which was operated as Micron's Enhancement products division is a division of P.G. Design based in Richmond Michigan and operating under the name Xceed Technologies.

ZyMOS Corporation, a manufacturer of PC Chip Sets, Graphics Chips and ASIC (application specific IC's) and Renaissance GRX, a manufacturer of graphics cards for PC workstations merged in 1991 and the new company is known as Appian Technology, Inc. in Sunnyvale CA.

Power supply mergers

The power supply industry saw many mergers and consolidations, including:

AC/DC, PowerTec, Semiconductor Circuits, Inc., and Brandenburg Power Supplies and ASTEC are now ASTEC America, Inc. 401 Jones Road (the old AC/DC address), Oceanside, CA 92054, 619-757-1880, Fax: 619-439-4243.

CEAG Power Supplies became CEA Power Supplies, same location in LI, New York.

Cherokee International, Inc. was purchased by Core Industries, Inc.

Fincor, division of INCOM International, Inc. became Mid-Eastern Industries, Inc. and later became a division of Technology Dynamics, Inc., 100 School Street, Bergenfield, NJ, 201-385-0500.

Gould Power Supplies became Advance Power Supplies, Inc. and is now known as Farnell Advance Power, 426 S. Hanover St, Baltimore, MD 21202, 301-528-9120, Fax: 301-528-9116.

Jetta Power Systems, Inc. changed their name to ETA Power Systems, Inc. 2675 Junipero Ave., Signal Hill, CA 90806, 213-427-0095.

Magnapower, Inc. the power supply manufacturer, was purchased by Lambda, Inc.

Modupower Inc. of Santa Clara CA (a manufacturer of dc/dc converters, power supply modules and voltage regulators) assets were bought by Semtech Corp., Corpus Christi, TX in September 1992.

MPSI, Modular Power Systems, Inc assets were purchased by EG&G Almond Inc.

NJE Power Supplies are available from Electronic Measurements, Inc. in Neptune N.J., this company bought NJE in 1990.

Novatronics, the power supply manufacturer is now part of the Lambda Group, Lambda Novatronics, Inc., 305-942-5200, Fax: 305-783-4963.

Computer Products Inc., Power Products Division, which included Boschert, Stevens-Arnold and Asia-Pacific, Ltd. sold the switching power supply lines to Unipower, Pompano Beach FL. Technetics, Inc. a military power supply manufacturer, was also sold to a group of its senior managers.

Powertec Inc., the power supply manufacturer was purchased by Low and Bonar, of Scotland.

Venus Scientific, Inc., a manufacturer of high voltage power supplies, is now known as Ferranti Venus. ■

Successful Servicing
Diversification in servicing

By Ron C. Johnson

In an economy where businesses are struggling to find new ways to turn services into profits, diversification is one of the most viable options. This is certainly true in the field of electronics service. Technologies which used to be the domain of specialty service organizations are now fair game for more aggressive consumer electronics service centers.

Computers, printers, monitors and copiers are no longer considered the private realm of business service companies. Individuals use this kind of equipment as personal productivity tools, often working from home or out of a small office. If service is required, and they know their local consumer service center can do the job, the equipment finds its way there.

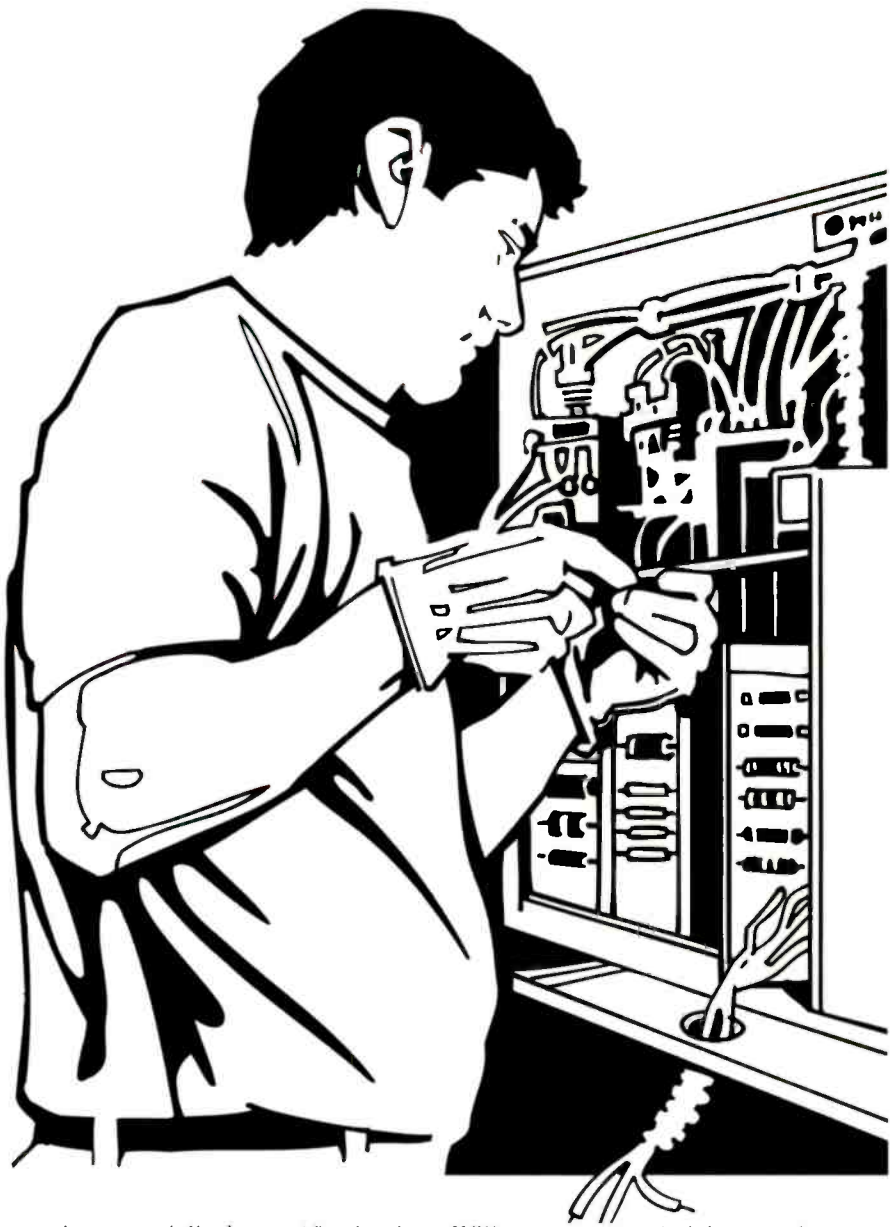
Aggressive business people would then ask, "What other areas of service can we move into?" As an electronic service technician, in business myself for several years, I asked myself that question innumerable times. Some of the areas I tried were quite successful while others were dismal failures, but each one was a learning experience. This article will list and describe some of those areas, their pros and cons, and give some ideas on how to approach them.

First considerations

Before listing some areas where service work could be obtained some consideration should be given to whether the investment of time, effort and money is worth the return. We all know that keeping busy doesn't always translate into making profits. Even large cash flows don't guarantee black ink, instead of red, in your bank account. It's the bottom line, after the expenses are deducted, that tells the story. Obviously, some careful study is required.

Look for service areas where the population of serviceable equipment is high.

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



Becoming a specialist in specific circuitry and equipment costs money in training, test equipment and experience. As technology is improved, equipment failures become less frequent. If there aren't enough units around to support the investment there will never be profits. More importantly, for long term growth, the population should be expanding.

Consider the level of training and the investment in test equipment required. Will you or your technicians need to travel somewhere for specialized training? Are your existing equipment and shop facilities adequate to the task? Is on-site service required as well as shop repairs? How large is the service region?

Profit potential also depends on related factors. Does this kind of work lend itself to service contracts or extended warranties? What will the average repair bill be? Are the sales of parts and supplies

a significant part of the picture? If so, what level of investment in parts is required? Who are your competitors and what is their status in the field?

If your analysis indicates a good opportunity for profits you may have a winner.

Some potential service opportunities

You are in business because you have the ability to provide certain services in your current field. Taking on new areas means transferring those skills and abilities to a new area. The following list and description may be helpful in determining if that transfer is workable.

Personal computer servicing

This is no surprise to anyone. Many service shops which have traditionally repaired home entertainment electronics, microwaves, etc. are already moving into this field. Personal computers have become a fixture in many households and the home office is very common. Fax machines, photocopiers, printers and PC's are becoming so closely integrated that they all fall into this category. In addition to the potential for sales of service contracts, supplies such as printer ribbons, paper, diskettes and laser printer refills can increase profitability.

Automotive test equipment

The automotive service industry has become highly dependent on sophisticated test equipment for battery testing, wheel balancing and alignment, and engine analysis. Since the environment is less than friendly to the test equipment, service on a regular basis is required.

This field, like many others, has moved steadily toward specialized computer equipment, which is quite reliable in itself. Much of this area's profitability comes from basic repairs to lead sets and connections between the vehicle and the analyzer.

For instance, a typical engine analyzer uses five or six sets of special cable harnesses with clips on one end and connectors on the other. In the shop environment these harnesses fail regularly. Sometimes they are cut or worn by moving parts under the hood of the vehicles, sometimes abused by the service mechanics who use them. Repair and/or replacement of cable sets is easy and profitable.

Engine analyzers also use sophisticated gas analyzers to analyze the vehicles' exhaust. Periodic cleaning, servicing and calibration of this equipment can bring in regular work.

Both engine analyzers and wheel alignment machines use software designed for specific automobiles. Every year new models come out with new requirements. The service shop representing the test equipment manufacturer has yearly opportunities to sell updated hardware and software needed to service the latest models.

While automotive test equipment is fairly specialized and requires extra training, some test equipment and a significant investment in parts, it can be very profitable. Moreover, it opens doors for related repair business such as timing lights, battery chargers and other small electronics related to the automotive field.

Supplies for the equipment, as well as supplies for the automotive shop (tools, materials, etc.) add to the total business. Representing specific brands can lead to the opportunity to branch out in non-related areas such as hoist installation and operational training, as well.

Industrial controls

There are countless small to medium sized businesses, manufacturers and industrial suppliers who struggle with electronic equipment failures. These companies cannot justify their own electronic service personnel on staff but could use the services of one on a periodic basis.

This also applies to small electrical maintenance companies. Their main function is to service the electrical equipment in commercial and small industrial plants. Often they are confronted with electronics equipment that they are not equipped to handle. An ongoing working relationship with companies such as these can create in-shop work.

While this kind of work can be varied and, consequently, difficult to effect repairs quickly, high charges can be justified. Who else will do it for them? Unfortunately, this kind of work can also be sporadic, but in some situations good profits are possible.

Agricultural electronics

It might be easy to overlook this area unless you have some contacts or a background in farming. Agriculture is no longer a simple folksy way of life. Successful farming involves the use of complicated machinery that uses electronics to monitor its operational status and to maximize its efficiency.

While this area is very specialized and requires a good understanding of the field, there is a vast market of seeder monitors, grain loss monitors, shaft monitors, etc., which need repairs regularly. The company that can set up an efficient system for receiving, repairing and shipping agricultural monitors can build a profitable sideline.

Agricultural applications are expanding and, for the company with the ability to design and manufacture original equipment, the possibilities are endless. Many times these applications are not 'high-tech' as much as they are very application specific.

Manufacturing a simple but practical item, (and marketing it through the same agri-dealerships that you are doing service for), can be lucrative.

Sound contracting

Sound contracting is a multi-faceted area of electronics. It can include sales, (bidding, quoting, in-store, etc.), service, (on-site and in-shop), and installation. The field ranges from small intercom, paging, background music, drive-through systems in restaurants, stores and offices, on up through public address systems in churches and schools, and even into large auditorium and sports field systems.

Since these are all largely contracted, the difficulties here lie in being able to accurately bid each project and then tightly control the costs when the job is done. Large cash flows are often associated with this kind of business and it can be a 'boom-and-bust' situation, with 'dry' periods interspersed with frantic efforts to complete all work on schedule.

My experience in this area led me to believe that several small contracts, with reasonable profit margins, were far superior to one or two large systems installations. Usually the large jobs attracted much more interest from competitors and the profit margins were 'shaved' to almost nothing (even less than nothing if a mistake in estimating occurred).

In addition, designing larger sound systems is difficult due to the variations in room acoustics and other factors. Ensuring customer satisfaction is equally difficult. The positive side is that smaller systems can be easily installed with a minimum of tools and expertise, for rea-

sonable profits. Working relationships with restaurant and retail chains can result in repeat work.

Security systems

Some similarities exist between sound system contracting and security system contracting. Some installation techniques and equipment are similar and often bidding for jobs is required. Both an advantage and disadvantage of security system contracting is that monitoring is required.

Security system monitoring involves the relatively high, up- front cost of setting up a system to monitor the security systems installed, but once it is in place, the customer pays regular monthly fees to have their system monitored. As with sound systems, a high degree of expertise is required to design reliable and effective systems.

Print shops and newspapers

As the use of personal computers continues to grow the distinction between desktop publishing and professional publishing becomes blurred. Still, the larger print shops and newspapers use more sophisticated systems for typesetting, printing and other applications.

Some manufacturers of this equipment will contract a local company to do service rather than keep a local service representative in the area. I also have had some success with providing 'third party' service when the manufacturers' service rates and response time were unsatisfactory to the customer.

Teaching

One side benefit of making yourself knowledgeable about a subject is that you can communicate the same information to others. It's not only who you know, but what you know. If you are able to stand up and talk to a group of people who are interested in a particular subject there will often be money to be made.

One way in which this occurs is when you sell a piece of equipment that requires specialized knowledge to operate it. Automotive test equipment is one example. The mechanics using the equipment need to know how to use it to make money for themselves. I have known a few trainers who make their living traveling around doing seminars on a single piece of equipment.

Community college evening courses are another opportunity. In addition to being paid to teach a course you can develop good public relations for your company in the process.

Full time work as an instructor at a technical school (as I do) is another, albeit full-time, way of making money from your technical knowledge and expertise. It isn't uncommon for instructors to make their living in the classroom while operating a business during their evenings, weekends and holidays.

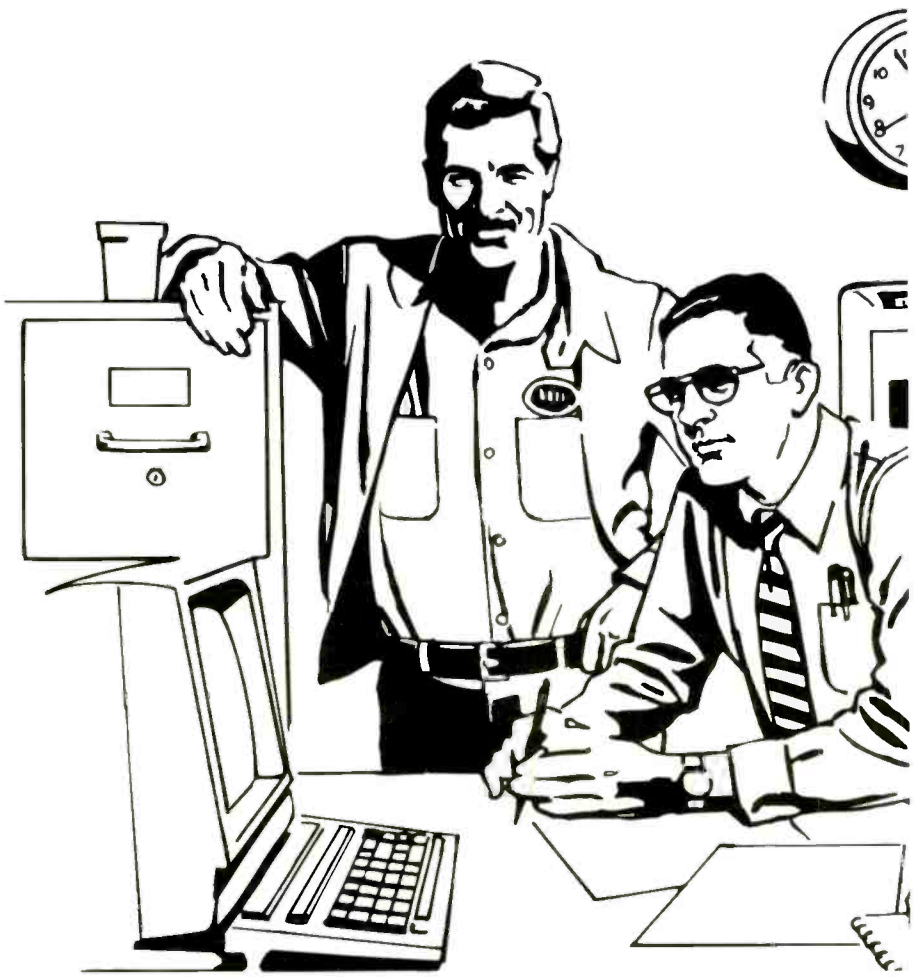
Writing

As I said, it's often what you know that can produce a profit. Writing for technical and trade magazines and journals, newspapers, advertisers and for educational publications are all valid ways of using your expertise.

Your experience is unique. You have undoubtedly unraveled technical problems which are different than those that have been faced by anyone else. Why not use those experiences to help out others in your field of work? They'll gladly buy a magazine to share your knowledge. Again, sharing this kind of information not only benefits you personally but is good public relations for your company.

The key to making money writing technical articles is to write clearly and simply. Write letters to the magazines you think would be interested in your material and ask for writers' guidelines. You can also suggest some topics you could write about. They will usually be glad to respond with information on their requirements. Above all, follow these guidelines as closely as possible. This will maximize your chances of selling your material.

Even during good economic times business can be a challenge. But economies change, markets change, and technologies change. We have to take a dynamic approach to long range planning. The business that determines to stick with the success formula it used in "the good old days" may be writing its own death certificate. After considering the alternatives—only a few of which I've mentioned here—the business that broadens its income base may be the one that is still around in years to come. ■



Test your electronics knowledge

By Sam Wilson

1. The highest decimal number that can be represented by eight binary bits is

A. 256
B. 257

2. An integrated circuit has a pin designated as NOT CS. The signal to this pin is delivered on the

A. data bus
B. address bus
C. control bus

3. Evaluate the following

192_{10} = _____ 16

4. In a non-regulated power supply, better regulation occurs with

A. a capacitor input filter
B. a choke input filter

5. In the equation for magnetism, $\mu = B/H$. μ is the permeability. B is the flux density in lines/in^2, and H is the magnetizing force in ampere turns per inch. The unit of measurement for μ is

A. Gauss per square inch
B. Maxwells
C. Games
D. (none of the above choices is correct.)

6. An unregulated power supply has an M-derived LC filter. Is it is replaced by a constant-k filter the cutoff curve will

A. be sharper (that is, steeper).
B. not be as sharp (that is, not as steep).

7. An SCR is turned on by a

A. gate voltage
B. gate current

8. Is the following statement correct?

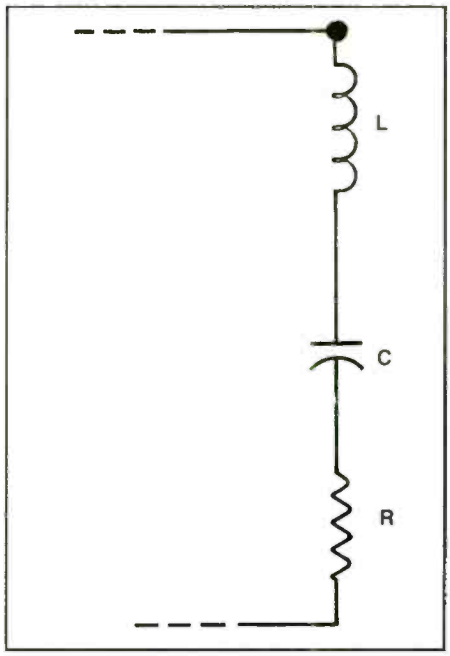


Figure A

"In the series-tuned circuit of Figure A the resistance has some effect on the resonant frequency."

A. The statement is correct
B. The statement is NOT correct

9. A VU meter measures

A. the average voltage value of a waveform
B. the RMS current value of a waveform
C. the peak voltage value of a waveform

10. A certain publication lists an h_{FE} of 110 for a transistor. Which of the following is correct?

A. The value must be wrong because h_{FE} cannot exceed 100.
B. Because of the value given it should be called h_{FB}
C. (Both choices are correct).
D. (Neither choice is correct).

(Answers on page 62)

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

Video Update: Setting VCR head switching

By the ES&T Staff

This article is based on Tech Tip 108 from Sencore. All artwork is courtesy of Sencore.

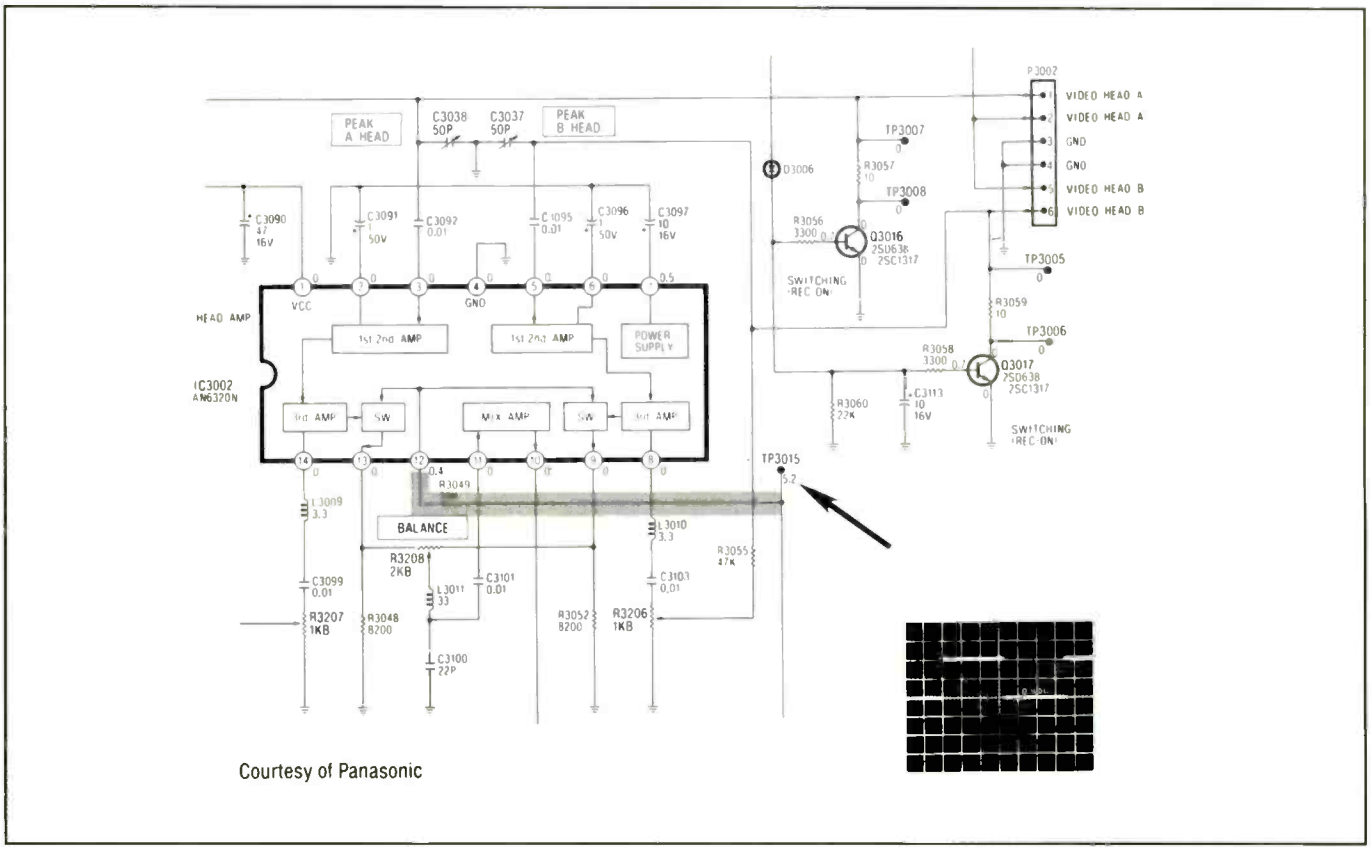
VCR technicians have a need to know how to set the head- switching signals in VCRs. Another name for this adjustment is the "PG Shifter" control. This article, based on Sencore Tech Tip 108, explains this adjustment in detail.

We will start by explaining how the head switching adjustment affects VCR performance. We will then explain two ways to adjust the circuits using the oscilloscope. The first method is based on using the scope in a conventional manner, manually counting sync pulses. The second method assumes that the oscilloscope available is one of the newer more sophisticated scopes with a delta time function.

The delta time method can also be used for any other VCR adjustment that needs a time delay between two signals, such as the tracking-fix (sometimes called tracking preset) adjustment and the timing of the hi-fi heads in VHS tape decks.

Why head switching needs adjustment

Before we explore how to set the head-switching signal, lets consider what it does. Every VCR uses a pair of video heads when playing a tape at normal speed. Even decks with 3, 4 or 5 video heads use the heads two at a time. (See Figure 1.).



Courtesy of Panasonic

Figure 1. The head switcher uses a 30Hz square wave from the servo circuits to turn off the amplifiers of the head which is not contacting the tape.

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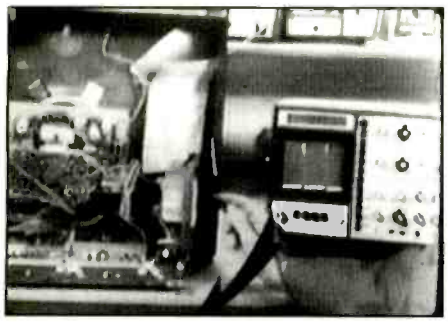


Figure 2. Noise appears in the picture at the point where the VCR switches from one video head to the other. The switching adjustment keeps this noise close to the bottom of the screen, so that it is not annoying.

TP	ADJ.	MODE	INPUT
TP2005 TP3001	R2023	SP PLAY	
TAPE	M. EQ.	SPEC.	
ALIGNMENT TAPE Color Bars	OSCILLO-SCOPE	T = 6 ± 1 H	

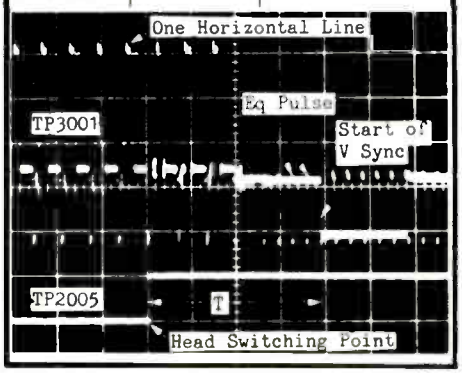


Figure 3. This is a typical manufacturer's head-switching instruction. Use the service literature to determine the test points and adjustments to use for the adjustment.

A 30Hz square wave from the servo circuits controls an electronic switch at the head amplifier output. The switch selects the amplifier for the head which is in contact with the tape and turns off the channel for the head which is on the opposite side of the drum. If the second head was not turned off it would add noise to the playback signal.

Noise appears in the video signal when the switching takes place.(See Figure 2.). You can see this noise by adjusting the vertical hold control to display the sync interval on a TV connected to the VCR. The switching noise is a horizontal tear in the picture a few horizontal lines above the black sync bar.

The head switching circuits change the timing of the switching signal with reference to vertical sync. Switching should take place a few lines before vertical blanking to place the noise in the bottom 3 lines of the picture. Since most TVs are overscanned (the vertical deflection is slightly larger than the CRT screen), switching is invisible, because it happens while the electron beam is below the screen. If the circuits switch too early, the noise moves up into the visible part of the picture. If the circuits switch too late, the noise occurs during the sync pulse, causing poor vertical stability.

Now that you understand how the adjustment affects the circuits, you should have a better understanding of why the timing must be correct. This understanding should also help understand the alignment procedures. Now let's see how to adjust the pulse timing. We will start with the conventional oscilloscope method.

Adjusting head switching by counting pulses

The first thing you need to do is locate the test points and the controls that affect the head switching. The service literature for the VCR you are servicing is the best source of this information. The service literature also tells you how many adjustments the VCR contains. (See FIgure 3.).

Depending on the VCR, it may have one, two, or three adjustments. Most 2-head VCRs have only one control. VCRs with four (or more) video heads may have two playback adjustments. If so, you will need a test tape recorded at the fastest tape speed (SP or Beta I) to adjust one control, and a tape recorded at the slowest speed (EP or Beta III) to adjust the other. Some early VCRs also have a third adjustment in the recording circuits.

The instructions will usually tell you to adjust the control until the switching square wave is 6.5 horizontal lines ahead of vertical sync. If you are counting pulses to make this adjustment, remember that you must count *every other* pulse through the blanking interval if your test tape has interlaced sync. This happens because the vertical blanking pulses contain equalizing pulses at twice the rate of the horizontal sync pulses.

If your tape has non-interlaced sync, it may not contain equalizing pulses, so you must count *every* pulse. You can avoid the question of whether to skip pulses by remembering that the blanking interval is always three horizontal lines wide. Count 3.5 horizontal lines from the start of blanking instead of 6.5 lines from sync. This lets you use the same procedure, whether or not your signal contains equalizing pulses.

Using a dual-trace scope with delta time capability

If your scope has two input channels and a delta time capability, you can use it to help you adjust the head switching, and avoid counting of pulses. Refer to the VCR manufacturer's service literature to find the needed test points and adjustment locations. Then, use the following procedures to make each head switching adjustment using the oscilloscope screen. Figure 4 shows the sequences of steps for this procedure for one manufacturer's waveform analyzer.

1. Connect the Channel A probe to the VCR video output and the Channel B probe to the test point with the head-switching square wave signal.

2. Set the scope's TRIGGER SOURCE switch to the "Channel B" position (to trigger from the square wave) and the TRIGGER MODE switch to "AUTO." The TRIGGER POLARITY switch lets you select the rising or falling transition, depending on which one you want to use.

3. Set the TIMEBASE-FREQ switch to the 1msec position (check the HORIZ POSITION control to confirm that it's in the correct position for a non-expanded trace).

4. Press the A&B (dual trace) selector button and adjust the inputs and triggering circuit until the two traces are locked in on the scope face.

5. Place the VCR into the record or playback mode, depending on the manufacturer's alignment instructions.

6. With the trace positioned to start at the left side of the CRT, adjust the horizontal vernier control (the small knob in the center of the TIMEBASE-FREQ control) until you see two vertical sync puls-

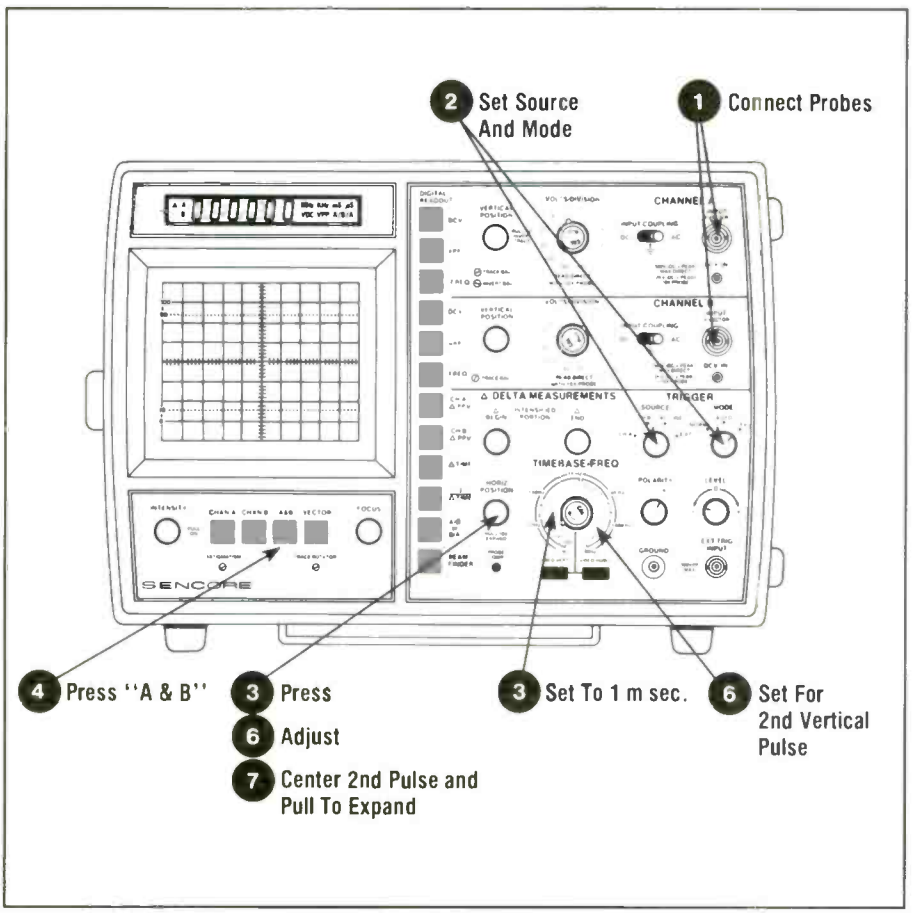


Figure 4. This drawing shows the sequence of steps that a technician would use to display the head-switching signal on the Sencore Waveform Analyzer.

es on the channel A trace - one at the left edge and the second one near the right edge of the screen. (Channel B should show a square wave transition near the second sync pulse.)

7. Adjust the HORIZONTAL POSITION control until the right hand vertical sync pulse (and square wave transition) is in the center of the screen. Set the HORIZ POSITION control to the correct position to expand the waveforms by ten times.

8. Carefully watch the trace as you adjust the control. Start by adjusting the timing until the square wave just touches the vertical sync pulse. Then move the transition to the beginning of vertical blanking. Finally, move the transitions 3.5 horizontal lines before blanking (which is the same as 6.5 lines ahead of vertical sync).

9. Some people prefer to add channel A to channel B by manipulating the appropriate controls. This makes it easier to compare the timing of the two signals. When added, the square wave causes a step to appear in the video waveform.

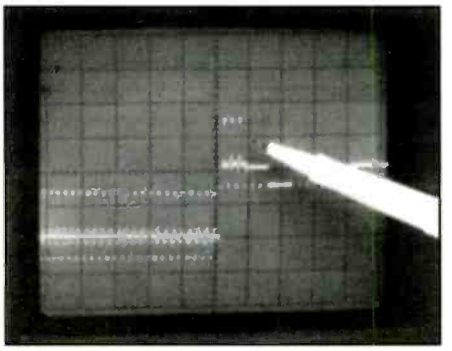


Figure 5. Setting the oscilloscope up so that Channel A and Channel B are added together results in a display that shows a jog at the point where the heads switch.

LINES	MICROSECONDS
6	381
6.5	413
7	444

Figure 6. The number of microseconds that correspond to typical head-switching specifications.

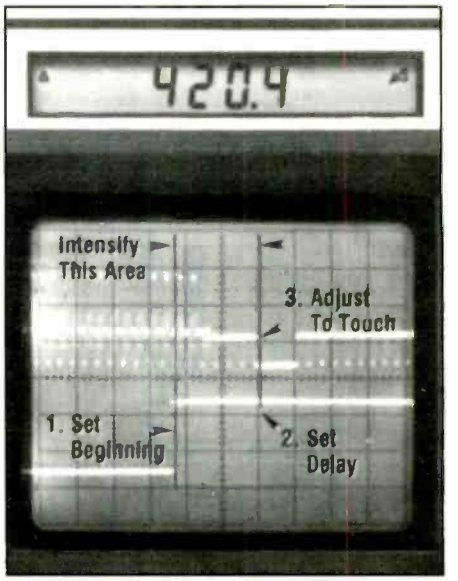


Figure 7. Use the delta time function, if your oscilloscope has this feature, to preset the time needed between signal, and then adjust the circuits until the signals touch the intensified area of the waveform.

Adjust the head-switching control until the step is 3.5 horizontal lines ahead of the vertical blanking (see Figure 5).

Using delta time to adjust head switching

If your oscilloscope has a delta time function, you can use it to eliminate the need to count pulses. You preset the delta begin and delta end controls until the digital readout shows the correct time, and then adjust the head switch control until the sync pulse touches the highlighted area of the waveform.

To use the delta time function, you need to know how many microseconds to leave between the square wave and the sync pulse. Simply multiply the lines specified by the time for one horizontal line: 63.5µsec. Your servicing instructions may use one of three delays: 6, 6.5 or 7 horizontal lines. Figure 6 shows the calculated values for each delay.

Lock the waveforms onto the CRT by following the previous steps 1 through 7. Then, choose the delta time function and set the interval so that the interval begins just to the left of the sync pulse, and ends to the right of the transition, such that the readout shows the correct time interval. Finally, adjust the head-switch control until the vertical sync pulse just touches the end of the time interval.

To use the delta time feature to set head switching: (See Figure 7.)

1. Follow steps 1 through 7 from above to display the two signals on the scope face.

2. Make whatever adjustments are necessary on the oscilloscope so that you can easily see the area of waveform that is of interest.

3. Select as the beginning of the time interval the square wave transition in channel B.

4. Select the end of the desired interval such that the digital or on-screen readout shows the correct time for the waveform (for example, 413µsec for a 6.5 line delay. Don't be too fussy in this setting since the circuits only need to be adjusted within 30µsec of the ideal amount.

5. Adjust the VCR head-switch control until the beginning of the vertical sync pulse just touches the end of the selected time interval.

You can use a similar procedure any time you need to set a time delay between the signals at two test points. ■

Troubleshooting Tip

Unit: JVC HRD-310U VCR

Submitted by:

Ken Dias
Service Manager
Videofix
Scarborough, Ontario, Canada

Symptom: The picture produced when a tape was played on this VCR was clear for about four inches at the top half of the screen, but there was nothing but noise on the rest of the screen. All functions of the VCR worked properly. The tracking control had no effect on the problem. The picture contained no color.

My first step in servicing this unit was to determine the extent of the problem. To determine if the tuner was ok, I selected VCR from the TV/VCR selector and changed channels. The picture was perfect, which showed that there was no problem in the tuner.

Because the problem occurred during playback, my first suspicion was that there might be some malfunction in the record/playback transport mechanism, so I performed a thorough inspection here. I noted that both the supply and playback rollers had seized. I replaced both rollers, and operated the unit, expecting to find that the problem had been eliminated. There was no noticeable improvement.

Next, suspecting that the problem was in the video circuit, I used the oscilloscope to observe waveforms at the pins of IC201, the video IC. The frequency of one waveform was erratic, so I checked the connections between the IC and the crystal. I found a cold solder joint and resoldered it, but the improvement was only slight.

Not knowing what else the problem could possibly be, I ordered a new upper video head drum assembly. After installing the new unit I played a known-good tape in the VCR. Again, no improvement.

I now started checking waveforms and taking voltage measurements at various points. It occurred to me during this procedure that I had omitted the preamp IC in my initial troubleshooting procedure. This time I observed waveforms at all pins of this IC. The waveforms at all pins of the IC were exactly according to the specifications, except for the waveform at pin 17, the 30Hz head switching signal. There seemed to be no question that the problem had to be in this IC. Replacing this IC cured the problem.

If I had thought this service procedure through more thoroughly as I went through my initial troubleshooting procedure, I would have realized that the problem couldn't have been caused by a video head problem. As has been mentioned before in a number of publications, including **ES&T**, if any part of the playback picture is clear, the problem is not the video heads. Also, hindsight reveals that the defect could have been narrowed down to the playback (and not the record) circuit, if I had simply recorded a tape on the defective VCR and played it back on a known good VCR.

*In our January issue of **ES&T**, we ran a troubleshooting tip which was not given a name or make. The unit was a Mitsubishi TV model CS-1347R and was submitted by A. Camus, Queens, NY.* ■

What do you know about electronics?

More on the AM radio detector for IR remotes

By Sam Wilson, CET

Here is some very valuable information from Paul R. Dedrick of North Carolina. He explains why the infrared remote control signal for consumer products can be picked up by an AM receiver.

Dear Sam: I am writing in response to your "What Do You Know About Electronics?" column in the July 1992 issue of **ES&T.** Until recently, I was employed as a Technical Writer/Trainer. I taught classes in all consumer products to authorized repair facility technicians. What follows is the reasoning behind the AM radio test to detect the presence of infrared remote control signals. An additional test will be given.

To begin, most infrared remotes operate by using a counted down fundamental frequency to generate a clock for data pulses which provide the different functions for the product to operate remotely. What is this fundamental frequency? Well, it usually is (you guessed it) 455KHz. Most remotes use a ceramic resonator to generate this frequency.

Often this delicate resonator has very thin leads which, when the remote is abused (i.e., dropped) the ceramic resonator becomes detached from the circuit. This can be determined by shaking the remote unit gently. If you hear a rattling sound, the resonator is usually loose! In this case, the remote can generally be repaired using a universal 455KHz resonator available from most Radio Shack stores.

If the resonator is not loose inside the remote, it may still be damaged, so you check it by operating the remote in close proximity to an AM radio. This tells if the remote is operating on frequency, by generating the buzz in the radio speaker.

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

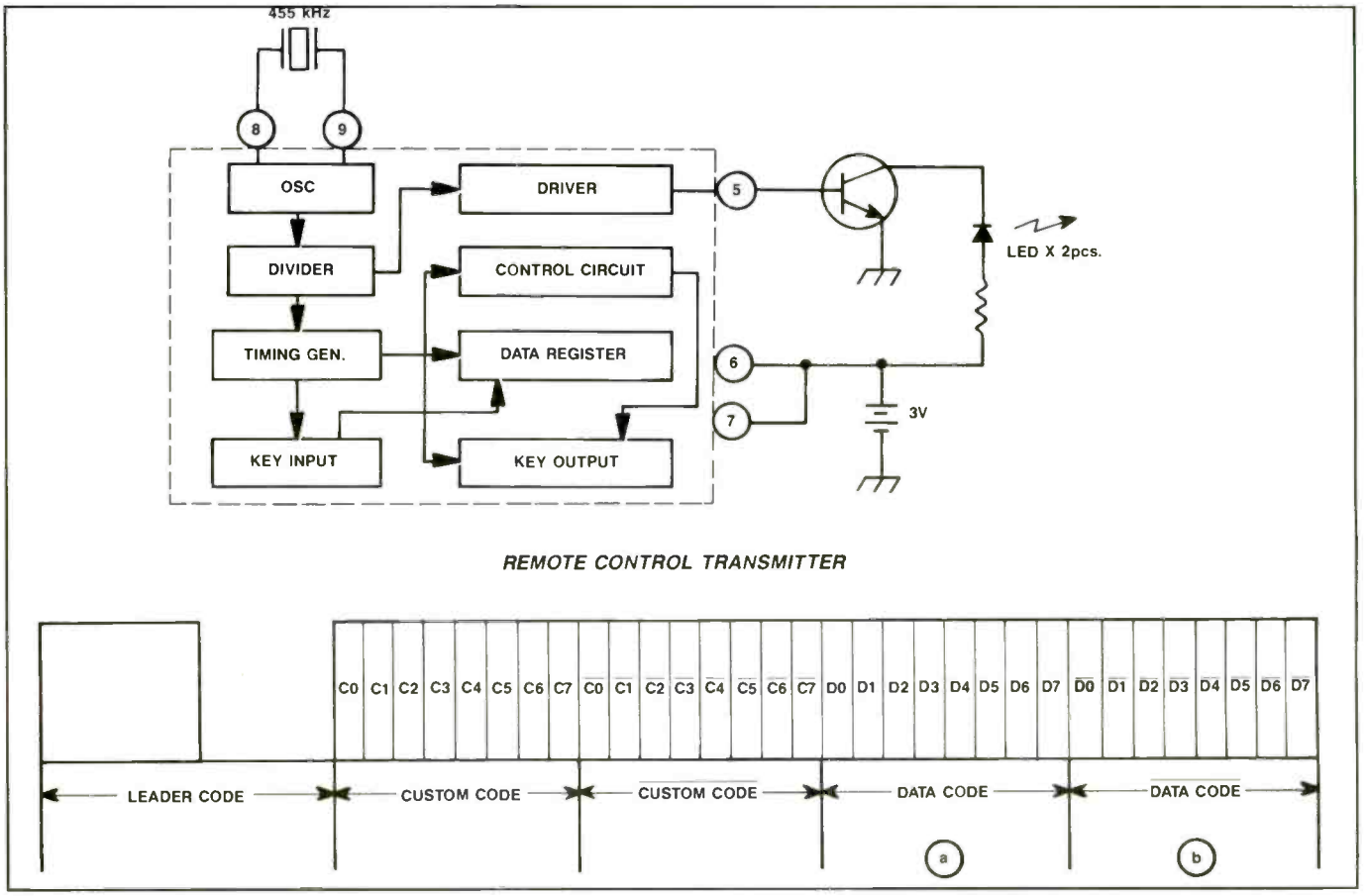
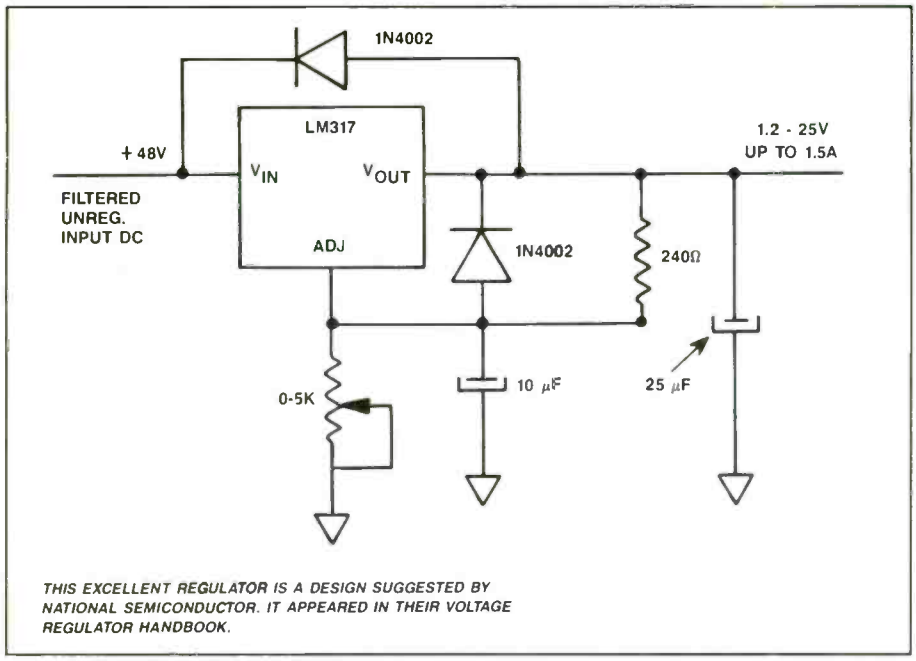


Figure 1.



THIS EXCELLENT REGULATOR IS A DESIGN SUGGESTED BY NATIONAL SEMICONDUCTOR. IT APPEARED IN THEIR VOLTAGE REGULATOR HANDBOOK.

Figure 2.

To fully test the remote for proper operation, use an infrared detector card, available from most mail-order parts sources, manufacturers, Sencore, or Radio Shack. If the remote is on frequency, and putting out infrared pulses, there is a 99% chance that it is a good remote!

Also, I would be interested in receiving an author package for writing articles for your fine publication."

Seven years ago, as a high school electronics teacher, I used articles from **ES&T** and your TYEK tests to enrich my curriculum in my classes. The magazine is an invaluable aid to the continuing educational needs of the industry. I find it very informative and helpful in my efforts to keep current.

Figure 1 shows a schematic diagram from one of the training manuals I wrote, which shows a typical remote control transmitter construction.

The transmitter is an infrared type, which offers up to 32 remote control functions. The transmitted signal is composed of four different codes, Custom Code, Inverse Custom Code, Data Code, and Inverse Data Code. Each code consists of eight bits. One single transmission consists of a combination of 32 bits.

Besides the four codes, there is a Leader code included in the transmission signal. It is made up of a 9ms carrier wave and 4.5ms off-wave. This is transmitted prior to the other codes. The Leader code is used to allow the microcomputer to differentiate the remote control signal from other control signals in terms of the time relation among them. The other four codes that follow the leader are applied to the microcomputer, which reduces them each to a 1 or 0 pulse. This is performed in accordance with PPM (Pulse Position Modulation) system. The pulses "a" and "b" are used in 32 different combinations of 1 and 0.

Sincerely,
Paul R. Dedrick, CET
Secretary, North Carolina Electronics Association

Sam Says - Observe from this information that the signal from the IR (infrared) remote control is pulsed. That is what makes it possible to inject the i-f signal into the AM radio and hear the signal in the radio speaker. A pulsed signal is rich in odd harmonics. As you know, a 455kHz sinewave signal could not produce any output sound in the receiver since it is the job of the "second" detector to remove a 455kHz carrier.

The AM radio signal tells you that the pulses are being generated but it doesn't tell you anything about the condition of the infrared LED.

The test with the infrared detector card - suggested by Mr. Dedrick sounds like it will give more reliable information.

I will be glad to consider any additional information on troubleshooting by our readers.

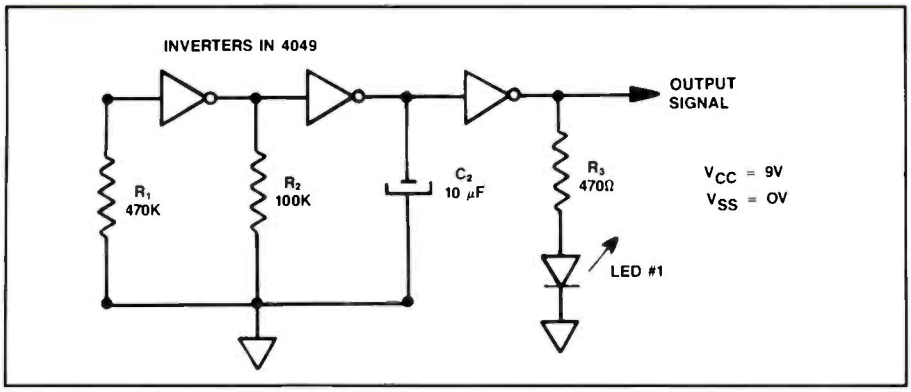


Figure 3A.

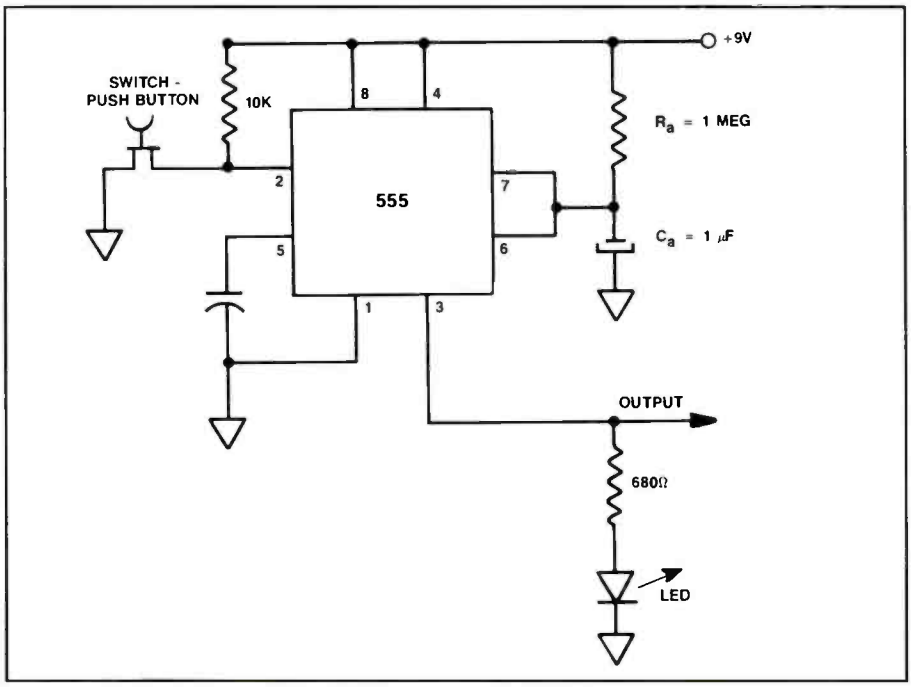


Figure 3B.

Many, many thanks to Mr. Dedrick for the letter.

Circuits for building the microprocessor

In the last issue I said I was going to give an experiment using an off-the-shelf memory. I don't quite get that far in this issue. The reason is that there are some circuits external to the memory that must be built before we can use it. Some of those circuits are given in this issue. In the next issue the memory circuit will be assembled.

Keep in mind where we are going with this series of experiments. My contention has been that a microprocessor and a computer are both memory controllers. That is why I have spent some space in previous issues on the most popular memories used in µP and computer systems. Starting with this issue I am going to give a series of experiments in which the major circuits in a microprocessor are built on plug-in boards. We will perform the same operations as the µP would do to get the same result.

Many technicians have told me they can best understand theory by hands-on work with devices. I have to admit I do not understand how that works. It doesn't work for me.

I have spent a lot of time doing hands-on experiments that didn't give me my time's worth. In other words, there was a lot of constructing, measuring and trou-

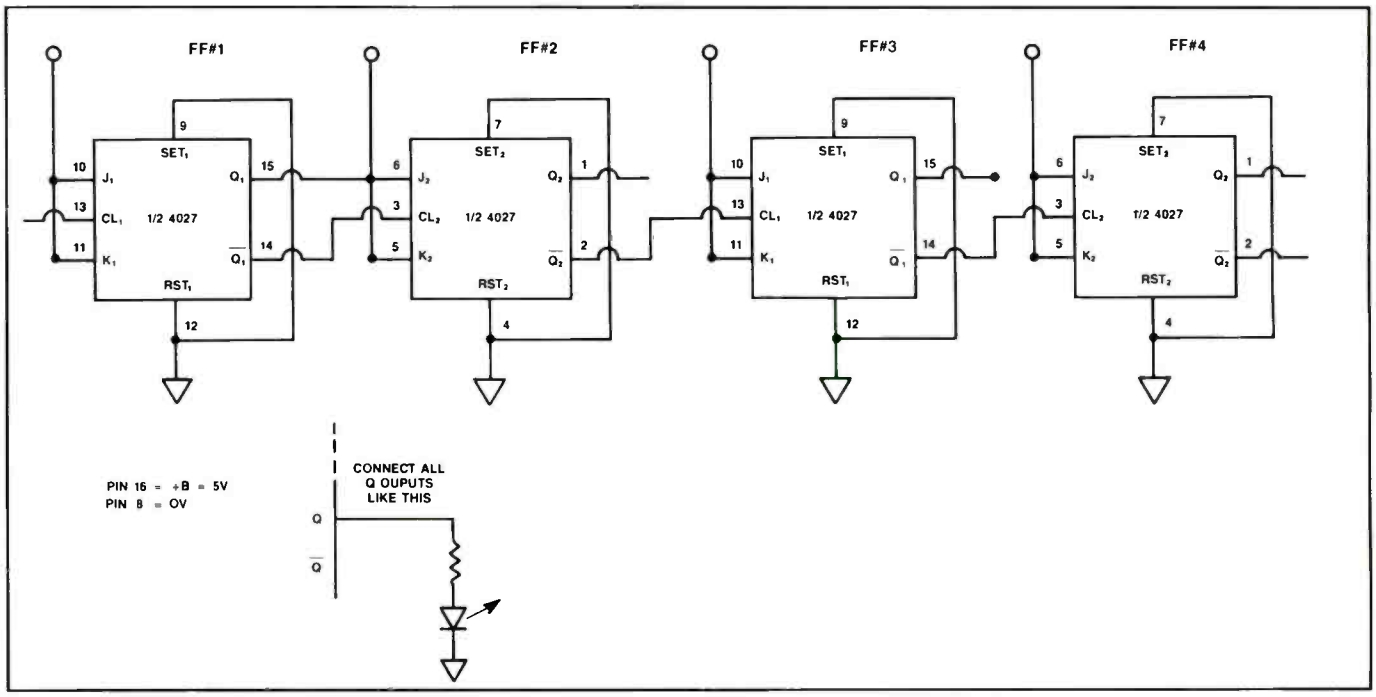


Figure 3C.

bleshooting just to "learn" one single piece of information that I could have read in a half page of typed material. I just don't understand trading 6 hours of wiring and pushing buttons for a minute of reading time.

Well, that's my concept. I know from experience that something can be true whether I understand it or not. So, to give those technicians the hands-on they need, I give µP experiments.

When a microprocessor is built with individual integrated circuits instead of on a single integrated circuit chip it is called a bit slice. So, basically, we are going to build a bit slice on plug-in boards. However, when we get all of the circuits assembled we will NOT be able to hook all of them together to get the bit slice.

The reason you can't put them together is that the timing of the various operations is very critical. So critical, in fact, that a microsecond difference in the arrival of pulses can make the system fail. However, when we have finished with the experiments we will have built the complete bit slice. If you are not into hands-on experimenting, read the experiments anyway. The basics of µP operation are explained in the theory writeups.

Memory experiment

To demonstrate how the µP operates a Random Access Memory (RAM) you will write a telephone number into the memory, then, read the memory to get the number back.

I chose CMOS integrated circuits because I thought it would be convenient for the reader to operate the circuits with a 9V battery. However, the memory I chose got hotter than a $2.00 pistol on 9V, so, I changed to a +5V regulated supply. If you don't have a regulated +5V, build the one shown in Figure 2. It is useful for many other things besides these experiments.

Figure 3 shows three circuits to be built to engage the memory.

Figure 3(a) shows the circuit for our clock generator. It produces the timing pulses for all of the µP experiments. Computers are often evaluated by their clock frequency. Ours will generate about one clock cycle each second, usually written as 1Hz. That is somewhat slower that the 25MHz frequency of some desk-top computers.

Mechanical switches and relay contacts have a habit of bouncing a few times when they are closed. Those bounces are interpreted by logic circuitry as being combinations of ones and zeros. That really messes up the operation. To get around that problem there are two circuits available to us. One is the bounceless switch (not shown). It is made with cross-coupled gates.

Instead of a bounceless switch, we will use the 555 one-shot circuit of Figure 3(b). It is usually called a monostable circuit. When a trigger is received from the switch, the output goes through a complete ON-OFF cycle before it can be triggered again. During that cycle the switch that provides the trigger can bounce and bounce but that will not affect the single-pulse output of the 555.

The monostable circuit (or, the bounceless switch) is needed so we can operate the system one step at a time. That is called single-stepping. More on that in the next issue.

The circuit of Figure 3(c) is sometime called "divide-by-16." It can be used as a binary counter to produce a binary count from 0000 to 1111. It will be needed to step our way through the program stored in our memory rows and to keep track of where we are in a program. So, it is our program counter.

Remember, the circuits of Figure 3 are used by the µP to operate the memory. To test the circuits, first connect the output of the monostable circuit to the input of the counter (CL1 of the first flip flop). Each time you momentarily switch the trigger input of the 555 monostable you get one output pulse. The output is shown by LED #1. It should be on for a short period of time after you operate the switch.

With each single step the counter should advance to a binary count from 0000 to 1111. The count may not start with 0000. You should advance the counts until the 0000 is displayed, then, start the count by single-stepping with the monostable circuit. Assuming the single stepping works, remove the 555 output to CL1 and connect the clock output to that point. The counter should automatically produce the complete range of counts when you single-step the clock pulses. ■

Books

The Winn L. Rosch Hardware Bible, Second Edition, By Winn L. Rosch, Prentice Hall Computer Publishing, 700 pages, $29.95.

With this newly revised and expanded edition, users gain hands-on expertise about mother boards and modems and everything in-between. This book puts users in the position to control processors, ports, peripherals, and more. This book also delivers the very latest developments in portables and laptops, as well as easy-to-follow instructions for PC, PC compatible, and PS/2 maintenance, expansion, and troubleshooting. Users also benefit from illustrations and diagrams that clarify how things work.

Prentice Hall Computer Publishing, 11711 N. College Ave., Suite 140 Carmel, IN 46032

Tube Substitution Handbook, By William Smith and Barry Buchanan, Howard W. Sams & Company, 154 pages, $16.95.

The Tube Substitution Handbook is a reference tool for antique radio buffs, ham operators, collectors of vintage ham radio equipment, marine operators, microwave repair technicians, TV and radio technicians, and any do-it-yourselfers with an interest in tubes and tube replacement.

The handbook features over 30,000 tubes and tube substitutions.

Howard W. Sams & Company 2647 Waterfront Parkway East Drive, Indianapolis, IN 46214

Hot ICs for the electronics hobbyist, By Stan Gibilisco, TAB Books, 464 pages, 400 illus, $19.95.

The hardest thing about building electronic circuits for fun is trying to find designs that are relatively simple and inexpensive, yet still useful for real working applications. Hot ICs for the Electronics Hobbyist solves that problem by bringing together, in one easy-to-use volume, the best low-cost circuit designs for experimenters. This collection of circuits ranges from simple power converters and function generators to practical ICs for video, audio, sound effects, alarm, timer and filter devices. Many of the circuits shown are new - straight from the drawing boards of major manufacturers - and have never been published anywhere before. Each includes a discussion of terms and parameters, a pinout diagram, suggested uses, and other important data, and the appendices contain a complete listing of distributors. Stan Gibilisco is an electronics engineer and a full-time science and technical writer. He is best known as the author of the International Encyclopedia of Integrated Circuits, 2nd Edition and co-author of the Encyclopedia of Electronics, 2nd Edition

TAB Books, Blue Ridge Summit, PA 17294

Power Supplies: Projects for the Hobbyist and Technician, By Kevin Etter, Howard W. Sams and Company, 96 pages, $10.95.

Power supplies, the sources of energy for all electronic equipment, are basic considerations in all electronic design and construction. This book guides you from the fundamentals of power supply components and their functions to the design and construction of power supply systems. Useful in many home workshop and technical construction projects, this book will prove invaluable to the interested do-it yourselfer or the seasoned technical professional. Contents include: basic sources of dc and ac power, unregulated power supply systems, linear power supply projects, switching power supply systems and projects, measurements, calibration, and troubleshooting and much more.

Howard W. Sams & Company, 2647 Waterfront Parkway East Drive, Indianapolis, IN 46214.

Speakers for Your Home and Automobile: How to Build and Enjoy a Quality Audio System, By Gordon McComb, Alvis J. Evans, and Eric J. Evans, Howard W. Sams & Company, 164 pages, $19.95.

This book will show any do-it-yourselfer or technician the hows and whys of building quality speaker systems for home and automobile. With easy-to-understand instructions and clearly illustrated examples, the authors explain the construction of home speaker systems and automotive speaker installations. Contents include: how speakers work, including the science behind the system, enclosures and their effects on sound quality, speaker types and design factors, construction of speakers for specific areas and purposes, finishing touches that add a professional look to your construction, project plans for both home and automobile installations, design equation and conversion charts, complete glossary to audio and speaker system terminology.

Howard W. Sams & Company, 2647 Waterfront Parkway East Drive, Indianapolis, IN 46214.

The Modern Converter Ciruit Encyclopedia, By Rudolf Graf, TAB Books, 192 pages, 300 illus, $12.95.

In this volume, readers will find 300 ready-to-use converter circuit designs reflecting the latest engineering principles and practices. The author includes only the best in converter technology, featuring unaltered circuits from the most respected electronics manufacturers and publications.

Analog-to-digital, ac-to-dc, frequency-to-voltage, capacitance-to-pulse width, triangle-to-sine wave - every kind of converter circuit is illustrated here, with explanations of how they work and how they can be used. Original sources are cited, for readers who want additional information on a particular circuit, and according to the publisher, all entries have been tested to ensure accuracy.

TAB Books, Blue Ridge Summit, PA 17294

Making Sense of Sound: The Basics of Audio Theory and Technology, By Alvis Evans, Howard W. Sams & Company, 112 pages, $10.95.

A lot of questions get answered in Making Sense of Sound: The Basics of Audio Theory and Technology. How is sound electronically reproduced? What are pitch, fidelity, and distortion? How do today's electronics components work together to produce quality sound? These are just some of the topics discussed in this clearly illustrated text that teaches you the basics of audio theory and their relationship to today's audio technology. Other topics include stereo components - how they function separately and as a system, distortion and system noise, recording and playback, combinations of video and audio technology, complete glossary and index plus much more.

Howard W. Sams & Compnay, 2647 Waterfront Parkway East Drive, Indianapolis, IN 46214.

Digital compact cassette

By John Shepler

Just when you thought digital audio tape was the medium of the future, here comes digital compact cassette (DCC). DCC is an invention of N.V. Philips, the company that also invented the audio cassette nearly 30 years ago. It doesn't replace the cassette the way CD's replaced vinyl discs. Instead, it extends the cassette into the digital age.

You may be surprised to know that the cassette was originally intended for low fidelity applications such as dictation. The small size and easy portability, however, made it just too attractive as a replacement for open reel tape to pass by. Over the decades, better quality transports, new tape formulations, and noise reduction techniques like Dolby and dbx have allowed audio cassettes to flourish as a music medium. Now, digital compact cassettes will allow consumers to keep playing their present stock of prerecorded cassettes while using much higher digital recordings for new material.

A digital compact cassette is about the same size as an analog cassette. It is flatter, though and has a metal shutter to protect the tape, much like a 3.5 inch floppy disk. Another difference is that the tape reels are accessible from only one side, so the tape deck must take care of reversing the tape movement.

DCC tape decks will play both digital and analog cassettes. They'll only record the new digital cassette, though. This dual playback is made possible by a new linear recording technique that uses 8 digital thin-film heads to record the audio bit stream lengthwise on the tape. Remember that DAT works like a VCR, using a rotating head to record in helical stripes across the tape.

Linear recording at the low speeds used by cassettes requires both the 8 channels of digital information plus a data compression technique called PASC or Precision Adaptive Sub-band Coding. This is a digital signal processing technique that compresses the data by taking into account which sounds are masked by other sounds and thus, don't need to be recorded anyway. PASC can reduce the required digital capacity by over 75%, with minimal impairment of the sound quality.

Sound quality of DCC decks will be similar to DAT and compact disc. Frequency response is 5Hz to 22kHz with a dynamic range of 108dB. In a sense, the consumer is getting the audio quality of CD with the recording capability of DAT, plus the ability to still play all those existing analog cassettes. It's an excellent compromise.

Philips is side-stepping lawsuits with the music industry by building the Serial Copy Management System or SCMS into the DCC chips. SCMS is a technique to prevent bootleggers from copying and recopying digital tapes, which lose none of their audio quality when copied.

In addition to the audio features already mentioned, DCC also has the ability to record digital data at 400 characters per second. This will enable recording studios to include song titles, artists, and even music lyrics or other information that can be displayed on the tape deck. The data can also be used as codes, so the consumer can program the deck to skip or repeat songs and even pick the order in which the songs play.

The first DCC units, like any new technology, are more expensive than traditional cassette decks. They're priced more like DAT recorders than CD players or cassette record/play decks. The new cassettes are also priced five to ten times the cost of standard cassettes.

This should change over the next few years. Philips is planning to introduce a variety of machines including smaller portable DCC record/play units and car stereo DCCs. Philips is also licensing the technology world-wide. This will help reduce costs by increasing manufacturing volumes. The stationary DCC head mechanism is also expected to be less expensive to produce than the rotating DAT and VCR mechanisms.

Recording companies have agreed to support the introduction of the new medium. Within the next year, hundreds of prerecorded digital compact cassettes should be available in music stores.

Since DCC is being promoted as a consumer electronics advance, warranty service and repair opportunities should start presenting themselves shortly. If DCC does flourish as anticipated, the service centers positioned to take advantage of this technology will surely benefit. ■

Shepler is an engineering manager and broadcast consultant. He has more than twenty years experience in all phases of electronics.

News (from page 3)

Field test of long distance HDTV broadcast

Zenith and AT&T demonstrated that digital high-definition television (HDTV) broadcasting can bring high-quality, snow-free, interference-free TV pictures to a broader service area than conventional TV broadcasts. In the first long-distance over-the-air field test of an all-digital HDTV signal, Zenith and AT&T conducted a broadcast from a TV station in Milwaukee 75 miles to Zenith's technical center in Glenview, Ill.

The late-night field test of the "Digital Spectrum Compatible" HDTV system, broadcast on Milwaukee Public Television Station WMVT Channel 36, was the first ever terrestrial broadcast of digital TV signals using low power over long distances. The test also showed that digital HDTV can provide high-quality, noise-free pictures even in the presence of interference from conventional TV signals on the same channel.

The primary broadcast service area (Grade B contour) for conventional analog TV signals on WMVT is 48 miles from the transmitter. The Glenview receiving site is on the far fringe reception area of the Milwaukee station, and even with an antenna tower atop the seven-story building, the conventional analog signals are very noisy or snowy.

Using less than one-tenth of the power used to transmit a full-power conventional analog TV signal, the test successfully transmitted and received digital signals - without noise, snow or ghosts. The test showed that the system's unique digital compression and transmission technologies can eliminate the so-called "cliff effect" a total and abrupt loss of the TV picture and sound that could be caused by errors in transmitted digital data at long distances from the transmitter.

The companies plan to share the field test data with the Federal Communications Commission's Advisory Committee on Advanced television Service and its HDTV Field Test Task Force.

Summit meeting held

A third summit meeting among members of the three national service associations consisting of the National Association of Service Dealers (NASD) a division of NARDA, the Professional Service Association (PSA), the National Electronic Service Dealers Association (NESDA), and several state organizations including the California State Electronics Association (CSEA), the Television Electronics Service Association (ESDA) of IL, the Independent Warranty Servicers (IWS), and the Appliance Service Dealers (ASD), was held in Chicago on October 4, 1992.

The industry Summit decided to form a permanent group called the "Service Industry Council" for the purpose of collecting information, identifying industry problems and finding possible solutions for those problems. This group will continue to meet on a regular basis to address the needs of the service industry.

The environmental committee report stated that as a result of indecision on the part of governmental agencies the mandated technician certification program has been abandoned. The resulting controversy that continues to grow in the ser

Test your electronics knowledge

ANSWERS TO TEST

(from page 49)

1. A - The value is computed by raising 2 to the eigth power. $2^8 = 256$

2. C - NOT CS means NOT CHIP SELECT. It measn that the integrated circuit is selected by a logic 0 on the control bus.

3. C - $192_{10} = CO_{16}$

4. B - The disadvantage of a choke-input filter is that its use results in a lower output voltage.

5. D - There are no units of measurement for permeability.

6. B - The M-derived filter has the sharper cutoff

7. B - It is the gate current that operates the SCR - even though a gate voltage is used to produce that voltage.

8. B - Although the effect is not great, the series resistance DOES influence the resonant frequency.

9. C - Compared to a dB meter, the VU meter has a higher degree of damping. It is used to monitor audio signals.

10. D - The parameter h_{FE} is sometimes called the dc Beta. It is equal to the collector current divided by the base current. A value of 110 is reasonable.

Z-axis adhesive film new concept in electronics interconnection

3M's new Z-axis adhesive film is an innovative concept for connecting flexible printed circuits and tape automated bonding (TAB) tape to printed circuit boards, glass substrates, and other flex type products. The 5303R Z-axis adhesive film (ZAF) has a thermoset adhesive that contains randomly dispersed, subminiature conductive particles. Conductivity can occur only in the Z axis (through the film) and not along the plane of the film.

The ZAF is heat tacked to the conductive pads of a flex or TAB circuit. The circuit with the applied ZAF is aligned with the conductive traces on a substrate (glass, printed circuit boards, or flex circuit). Heat and pressure is applied to the TAB or flex circuit, causing the ZAF to melt, flow, and cross link.

The thermoset adhesive has a higher coefficient of thermal expansion than the conductive particles. When cooled under pressure, the adhesive has little tendency to yield, so the conductive particles are forced onto the conductive pads of the circuits. This results in a stable electrical connection between the flex or TAB circuit and substrate pads.

The result is a long-term interconnect with environmental stability. The ZAF creates a repairable bond, which gives the user an opportunity to rework defective interconnects and thus extend component utilization. The ZAF also has excellent creep resistance over a wide range of temperatures allowing for stable electrical performance.

The ZAF has economic and environmental advantages. It has a lead-free formulation, so is an alternative to lead-based solder. Also, no flux is required, eliminating the cost of chemicals and disposal. The dry film construction avoids many volatile components associated with solder processes. ■

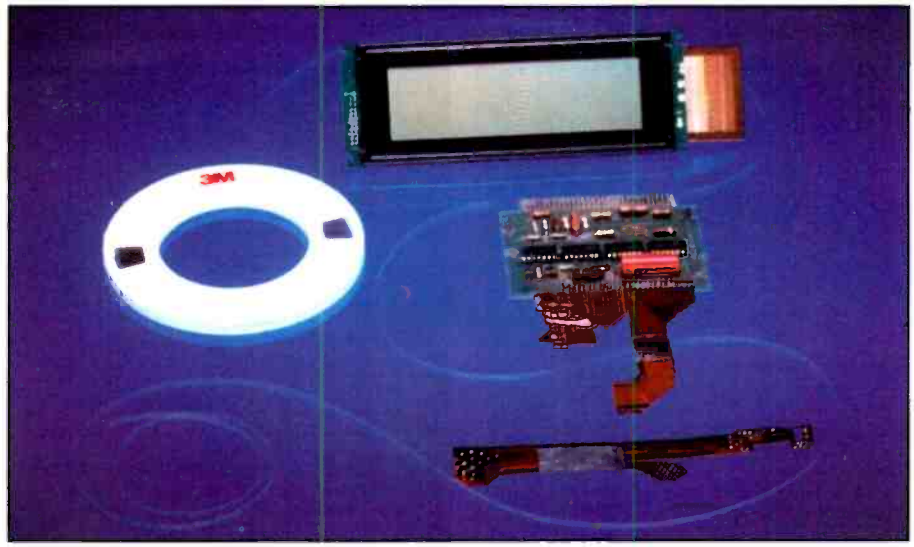
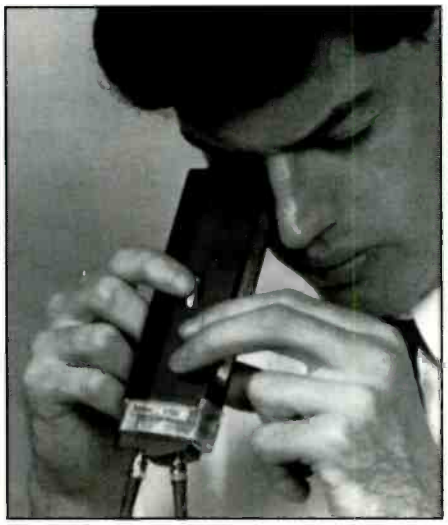


Figure 1. 3M's Z-Axis Adhesive Film (ZAF) is a new concept in connecting flexible printed circuits and Tape Automated Bonding (TAB) circuits to printed circuit boards, glass substrates, and other flex circuits.

Magnification light for inspection work

Waldmann Lighting Co. announces its newest magnification light, the "Focus 7 Plus." This task light is designed to meet a wide range of close up inspection needs at any workstation. The (6.5" x 4.25") 3-diopter lens gives an undistorted, broad field of view, reducing eye fatigue and improving productivity. The thirteen inch focal distance makes assembly with soldering equipment or hand tool easy. To increase functionality, there are two optional "ADD-X" lenses to increase magnification up to 7 or 15 diopters. The light uses the new generation 13W compact fluorescent lamp which provides as much light as a 60W incandescent, but with 78% less energy consumption and heat. The lamp will last 10,000 hours.

Circle (80) on Reply Card



Fiber optic microscope

Fotec has introduced a new multipurpose fiber optic test tool that can be used to test fiber optic cables and connectors for common problems. The model V400 acts as a 3-way microscope and FOtracer. As a microscope, the unit can view fiber optic connectors three ways. In the direct mode, it allows seeing how well the fiber fits in the connector and if there are any large scratches in the polished surface. While in the direct mode, it can also illuminate the core of the fiber, an excellent way to find cracks in the fiber introduced during polishing. The third mode, angle viewing, emphasizes polish irregularities, providing the best test to how well the connector has been polished. One can even confirm "PC" convex polishing in this mode. The device even offers zoom capability, with a 60X to 100X range. It is compatible with many common fiber optic connectors.

Circle (81) on Reply Card

Static control grounding cord extends reach

Employees wearing static control wrist bands can now have greater mobility with *3M's* new 2243 lightweight heavy-duty extension grounding cord. The cord plugs into any manufacturer's single conductor wrist strap grounding cord to provide an additional seven feet of reach. The grounding cord has a standard 0.175-inch banana jack on one end and a connection for a standard 0.175-inch banana plug on the other. It is constructed of a single bundle of tensile conductors and reinforced with strong synthetic fibers for durability without additional weight. The five-foot cord has an extended length of seven feet.

Circle (82) on Reply Card

Service business management software

Sencore claims that their new Service Center Manager software is the fastest, most complete customized, and easy-to-use business management program on the market. This program is designed specifically to help manage all aspects of a service industry and is flexible enough for a one person operation, and powerful enough to run 20-employee service center. The product is field-tested and market-proven to help service centers remain competitive in today's high technology and narrow margin environment. The product comes with a complete software package and configuration guide to help you get started. Each software package comes with toll-free support to answer questions anytime.

Circle (83) on Reply Card

Integrated service management software package

Developed by two service technicians for their own 7 man service shop, TECH SERVE is a comprehensive, fully integrated, Novell compatible, multi-station, user friendly software system, according to the selling company Premium Parts +. The software is an easy to understand and operate tool that will assist in maintaining a greater level of control over your business. It will increase profitability by making more efficient use of non productive time. A useful feature in this package is a secondary database that maintains the price that manufacturers are reimbursing the service technician for on the warranty work that is performed. The product tracks customers units, technician's productivity for the day and month, tracks cost and price of part installed for each claim and creates NARDA warranty claims, and allows you to create a summary report of claims submitted, and more.

Circle (84) on Reply Card

LAN physical layer tester

Beckman Industrial has introduced LANTech LT-10, a handheld LAN physical layer tester. The tester is designed for certifying all UTP and STP twisted pair, coaxial and telephone style wiring, 10BASE-T, Ethernet, ArcNet, and Token Ring networks. The unit is simple to operate for LAN technicians of any level according to the manufacturer, providing one-button access to commonly used test functions. In the Autotest Mode, a single keystroke starts an all-in-one, comprehensive series of tests that completes in less than 30 seconds. Test results can be stored internally, downloaded to a portable PC, or output to an optional portable printer. Up to 100 test results can be internally stored.

Circle (85) on Reply Card

Fume extraction kit

ARM-EVAC Fume Extractor kit from *Pace* removes hazardous and irrating fumes from the workplace. Fumes are extracted by way of a universal extractor arm into a self-contained air filtration system. An integral 3-stage filter collects hazardous particulates and gases. The cleaner air can be recirculated back into the work environment. The kit is fully portable, and the central unit is only 13"x13"x19". It features the central filtration unit, extraction arm, suction tube, flexible hose and an easy-to-assemble bench mounting bracket. An optional mobile stand is also available.

Circle (86) on Reply Card

Updated 1992 integrated circuits library

The revised 1992 D.A.T.A DIGEST Integrated Circuits library from *D.A.T.A. Business Publishing* has increased by 12%, or more than 32,200 components, over the earlier 1992 editions. Among the five product-specific digests - digital, interface, linear, memory and microprocessors - the most significant growth has been in Memory, with over 15,000 new devices, and Interface, with over 6,500 new devices. Sections included in each Integrated Circuits D.A.T.A. DIGEST are:

- Function, generic and part number indexes
- Technical sections
- Appendixes including package and pin drawings, device pinouts, suggested replacements, manufacturer directory, distributor/sales offices and electronics associations.

Circle (87) on Reply Card

Newest version diagnostic software

DiagSoft, Inc. announces the newest version of *QZPlus, 4.7.* New features include: Identification of the latest technologies, upgraded component tests, enhanced system information reporting, new and enhanced system utilities, new virus detection and remote control software included. In addition the software includes essential LAN features that simplify networked PC support and much more.

Circle (88) on Reply Card

Printer assembly repair video

Diversified TechniGraphics, Inc. (DTI) has released a fusing assembly repair video computer peripheral repair facilities. The video and accompanying manual, accurately show how to efficiently and effectively repair the Canon SX fusing assembly. Over half of all desktop laser printers on the market use the Canon SX engine, according to the company. This video shows time-saving repair techniques, guiding the viewer through the complex assembly leading to successful rebuilding the first try, says the company.

Circle (89) on Reply Card

Readers Exchange

FOR SALE

Camcorder repair. 500 page book. Troubleshooting and repairing camcorder topics by Homer L. Davidson. Also VHS tape Laymans guide to minor camcorder repair by electronix. Both hardly used, sell together or individually. Make offer. *Call Jackson VCR 205-643-5906.*

B&K oscilloscope 30MHz dual trace $300.00. Sencore VA48 make offer. *Rob Francella, 518-286-0710.*

Sencore VC-63, best offer over $275. Will take a Sencore SCR250, in partial trade. *Mike's Repair Service, 410-272-4984.*

Deviation meter $175.00, B&K CMOS IC tester $175.00, Cordless phone antennas, Leader Dot Generator $45.00. *Ask for Ralph Bianco at 215-446-4519.*

Heathkit RF signal generator model IG-102 with manual and test lead. Good condition. $50.00 plus shipping. RCA service manuals (1955-1961) (1967-1968) $7.50 each or all 3 for $20.00 plus shipping. *412-483 3072 ask for John.*

630 original TV service manuals. Hitachi, Panasonic, Sharp, Mitsubishi, NAP , Quasar, Teknica. $1.00 each, minimum 20, or $400 for all. Also 159 Sams books: 3 citizen band, 52 transistor radio, 6 tape recorder and 98 modular Hi-Fi books. $4.00 each, min 10, or $300.00 for all. List available. *Bob Neilson 602-855-5400.*

Sencore video test equipment. VA62 video analyzer, VC 93 VCR tester $1600.00 and SC 61 waveform analyzer $1750.00 or take all for $2900.00 *Cliff Deese 10497 Highway 17N. Myrtle Beach, SC 29572 or call (803) 272-2607.*

22 - YA + SYA + CO adapters. $20.00. Shipping 26 AR + Tekfax. 1 MHF $10.00 and shipping. *E. Andrews Jr. PO Box 91. Exeter, RI 02822.*

Sencore equipment VA62, SG165. Other brands also. Make offer Call *Ed Slagle at 615-926-1346.*

B&K model 490 CRT restorer/analyzer. Purchased new July 92. Adapters included. $750.00. Taking $300 loss. Sams Photofacts 2922-2977. 56 sets for $150. Will consider trading for computer. *Ernst Prater, PO Box 598. Hurley, VA 24620. 703-566-2265.*

Sams Photofacts, 2215-2305. New, in original (opened) mailing cartons. $225.00 plus shipping. Also looking for TSM's. *Robert Morrison, 231 Perkins St. Havelock, NC 28532 (919) 444-1660.*

WANTED

Need service manual or schematic for RCA VCR model VFT-650. Will buy outright or will copy and return. *Hugo Oliver 518-827-6138.*

Schematic and parts list for Simpson Models 260 and 260 series SP. Simpson company will not supply, as per request. These are VOMs. *Robert M. Dykeman, 912 Lock St., Phoenix, NY 13135.*

Jackson roll chart info for model 715 and 648A tube tester particularly old tubes. *Robert Christie, 2885 Beltine N.E., Grand Rapids, MI 49505.*

Hitachi monitor CM-1481 service manual, B&K #470 CRT checker adapter socket CR-42, Panasonic flyback #14712F. *Ed Herbert, 410 N. Third St., Minersville, PA 17954.*

Technical information on servicing a KLH model 510 portable Hi-Fi component system, specifically a capstan assy. Also info on an AKAI GX226-II reel-reel no control pnl functions. *Eugene Wolfe, 1855 S. Barton D., Augusta, GA 30906 or 706-560-0441.*

Flyback transformer, used but still good, for TV Sears model 14077 ch. C-984-20150. *G. Gautier 218 Ballantyne, Chicoutimi Quebec, Canada G7J 2L7.*

Photofacts and specialized books: AR, CB, HTP, MHF, SD, TR, TSM, VCR. *A.G. Tannenbaum, P.O. Box 110, E. Rockaway, NY 11518. 516-887-0057.*

Safety relay for Pioneer receiver SX-780. P/N ASR-020 or ASR-032. Power transformer or complete power supply for Samsung VCR model VR 4700L. *Parini VCR, John Parini 717-288-6141.*

Schematic and IC for Daytron VCR model VCR-42DBU IC# DBL 324 (DAE WOO). *Northern Technical Services, Joe, 715-356-6004.*

Tentel gauge, alignment tapes, Leader video generator, Sencore VC-93, VA62, etc. in good condition. *McGregor TV Service, 360, Jefferson Ave, Texarkana, AR 75502. 501-773-6488.*

Magnavox IC 612187-1, Quasar flyback TLF 6122F1, Samsung flyback KF 74525. *Blasig TV 203-242-4015.*

Variable isolated ac supply metered. Prefer Sencore Powerite. *Vance Payburn, 2718 Homestead Madison, WI 53711. 608-274-3002.*

Service/operation manual for Conn strobe tuner, tube type. *James Zikes, 9016 West 117 Terrace, O.P. KS 66210.*

Instruction manual and schematic for RCA RF signal generator model WR-50B. *Robert Blackwell, 2925 R1665 Ave. Baltimore, MD 21216. 410-362-6678.*

Schematic or service information for Apple disk drive model A2M0003. Will pay for copy. *W. Moulis P.O. Box 282, Poynette, WI 53955.*

Schematic for Silvertone Model - F- 31778. Audio output Xfmr and speaker for Zephyr model RN-7 radio. *John Phipps, 1412 Navaho Trail, St. Charles, MO, 63304.*

Cassette holding/loading tray assy for JVC VCR model HR-D200U, and for Llyod's VCR model L823. Service manuals or copies for JVC VCR's model HR-D670U and D680U. *J. Powell, 4237C FCN, McGuire AFB, NJ 08641. 609-723-1103.*

Classified

Classified advertising is available by the word or per column inch.
By-the word. $1.65 per word, per Insertion, pre-paid Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 addltional. No agency discounts are allowed for classified advertising by the word. Contact Emily Kreutz at 516-681-2922 to place your classified ad (by-the-word). Mastercard, VISA, American Express are accepted for phone or mail orders. Or send your order, materials and payment to **Emily Kreutz, 76 North Broadway, Hicksville, NY 11801.**
Per column Inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising please contact Jonathan C. Kummer at 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

FOR SALE

TV CASE HISTORIES: Booklet with 1, 750+ histories. Satisfaction assured. Only $35 (first-class shipping add $1.50). Mike's Repair Service, P.O. Box 217 Aberdeen Proving Ground, MD 21005. Same mailing address 29 years. Send SASE for samples.

REPAIR MANAGEMENT SOFTWARE: for IBM PC's. Repair tracking, inventory, reports, billing, maillist, more. Demo disk $15. CAHILL ELECTRONICS, PO Box 568, Kingston, NH 03848. 603-642-4292

SENCORE TF46: Transistor Tester, $285.00; Sencore CG25, $50.00; Startek Frequency Counter, $50.00; Eico Flyback Tester, $50.00. Eico H.V. Probe, $25.00. 607-988-9000 Weekends and Nights.

COMPLETE SENCORE VIDEO TEST BENCH for sale. VA62A, VC93, SC61, CM2000, PR57, and CR70. New with all cables, manuals, and original cartons. Make Offer. *Chris Eichman, 215-270-5749.*

VHS-VCR Repair Solution Sets I, II, III IV, V, VI, VII. Each contains 150 symptoms and cures, updated cross reference chart, free assistance. $11.95 each, all seven $69.95. Schematics available. Visa/MC. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530.

TELEPHONE LINE SIMULATORS. An absolute must for every repair shop. Two stamps for details. **JECTECH,** 13962 Olde Post, Pickerington, OH 34147.

THE ONLY ANSWER TO REPAIRING ELECTRONICS PROFITABLY (this should have been done years ago) **GET SMART!** Someone somewhere has already repaired your next repair **YOUR TOP TECHNICIAN,** who's training you have paid for **JUST LEFT TODAY! YOU'RE THE BOSS** and now you have to put on your old rusty technician's cap. **TODAY YOUR BANK** sent you three NSF checks your customers so graciously gave you, and you don't have time to chase them down to collect, **THEY LEFT TOWN. IT'S TAKING YOU LONGER** to assess the repairs and your customers are now coming to collect their units. You promised to give them a **FREE** estimate, but you just realized you don't have a schematic or time to do it. **NOW YOU ARE DOING NIGHT REPAIRS** because during store hours the phone rings off the hook with nuisance questions about setting VCR clocks and you have parts to order, bills to pay and service literature to file. **CIRCUIT CITY JUST MOVED IN** and your wife say's there's no money in repairs **FRIEND!! YOU DEFINITELY HAVE AN EMERGENCY!!** 10,000 repairs 1987 through 1992 with annual updates. References available on request. **I CAN ASSURE YOU THESE TECH-TIPS ARE NOT DUSTY OLD REPAIRS YOU'LL NEVER SEE.** Other programs don't even come close to comparing. **CALL NOW (305) 474-2677 FOR A "FREE" DEMONSTRATION DISK OR PAPER FORMAT** or mail request to **TV-MAN SALES & SERVICE, 8614 SR-84, FT. LAUDERDALE, FL 33324**

LARGEST SELECTION of original TV & VCR IC's and transistors. Lowest Prices. Call or write for free catalog. **PRELCO ELECTRONICS,** 605 Chestnut Street, Union, NJ 07083, 908-851-8600.

CONSUMER ELECTRONICS SALES & SERVICE: Busy one or two man shop on main business district. Well established with low overhead. Excellent opportunity for VCR technician. Located on Mississippi River in Northern Illinois. 815-589-3010.

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5 1/4" IBM compatible disks, 1,000 VCR, Printout $83, Disks $72. 5,400 TV, Printout $135, Disks $113 (Harddrive). Add to or quick scan by chassis, model and stage. Two solutions pays for it. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903.

TV-VCR SHOPS: Now fix those tough dogs! A package of over 2800 fixes on disk. ASCII or data for popular data bases. (PFS, QA, etc.) One fix could pay for all. Only $99.95. TECHDAT, 212 Earth Row, Waynesville, MO 65583. To order call 1-800-280-2100. VISA & Mastercard Accepted.

REDUCED 85%. Diehl Mark 111 $79, Diehl Mark V Horizontal circuit tester $199. New. Conductive coating for remote control keypads $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629, 608-233-9741.

HELP WANTED

TECHNICIAN NEEDED: If you have long term experience in servicing all brands of projection TV's or camcorders. Please send your resume to: Service Manager, 6601 West Bethany Home Road, Suite 4, Glendale, AZ 85301. Experience required. Salary DOE.

WANTED

WANT TO BUY small electronic servicing business. Prefer Western or Southern United States. Call Mike 1-510-783-3648 or Joe 1-918-682-4781.

BUSINESS OPPORTUNITIES

ESTABLISHED CONSUMER ELECTRONICS sales and service business, located in the beautiful mountains of North Central Idaho, where fishing and hunting is just outside our back door 208-983-0429.

MOVE TO SUNNY SOUTH FLORIDA: Owner retiring. Fully staffed in largest growth area of Ft. Lauderdale. Established 12 years, no competition. Authorized 15 major brands. 100 percent computerized. Simple to operate business. Owner financing available. Call for details 305-474-3588.

Manufacturers Parts and Literature Directory

This monthly section is sponsored by manufacturers to help you find the parts and technical literature needed to service their equipment. Call them for replacement parts or for the name of their nearest distibutor.

Hitachi Home Electronics 401 W. Artesia Blvd. Compton, CA 90220 800-HITACHI	**Mitsubishi Electronics America** 5757 Plaza Drive Cypress, CA 90630 800-553-7278 fax 800-825-6655	**NEC Tehcnologies** 1255 Michael Drive Wood Dale, IL 60191 800-366-3632
Panasonic 50 Meadowlands Parkway Secaucus, NJ 07094 800 545-2672	**Philips ECG** 1025 Westminister Drive Williamsport, PA 17701 800-526-9354 fax 800-346-6621	**Quasar** 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672
Technics 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672	**Thomson Consumer Electronics** 2000 Clements Bridge Road Deptford, NJ 08096 800-257-7946 fax 800-524-1498	**Zenith Electronics Corp.** 1900 N. Austin Avenue Chicago, IL 60634 312-745-2000

Call Jonathan Kummer at 516-681-2922 to reserve space in this special section.

Advertiser's Index

We'd like to see your company listed here too. Contact Jonathan C. Kummer to work out an advertising program tailored to suit your needs.

SALES OFFICE
Phone: (516) 681-2922
FAX: (516) 681-2926

Jonathan C. Kummer
Advertising Manager

Emily Kreutz
Sales Assistant

4,000 ECG® Semis In Master Guide Replace 262,000.

ECG212Q

Guide references 262,000 parts for industrial MRO, commercial, entertainment equipment. ECG Semiconductors—industry's most comprehensive line of universal replacement components and accessories for over a quarter century.

At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (76) on Reply Card

ECG® Capacitance Meter Reads 0.1pF To 20,000 μF With 0.5% Accuracy.

CX-920

A portable, battery-powered meter with bench-top performance; 3.5 digit, half-inch high LCD. Rugged construction, input protected, carrying case—all for **$79.95.** One year warranty.

At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (77) on Reply Card

45 ECG® Ni-Cad Batteries Fit Camcorders, Cordless Phones And More.

Rechargeable replacement batteries and packs for cordless phones and camcorders cover 99 brands, 1,000 part numbers. Power for memory backup, radio-controlled model vehicles, too. Ask for catalog. At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (78) on Reply Card

Replacement Work On VCRs Is Easy With ECG® Parts, Catalog.

New from Philips ECG: VCR modulators for many popular brands, more opto sensing devices, additional idler wheels/assemblies and belt kits. Pinch rollers, idler components, and scores of belts complete the selection. At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (79) on Reply Card

Multi-Choice.

Whether you're doing first-level troubleshooting or component-level diagnosis, Fluke meters offer you one of the widest choice of capabilities and price ranges in the industry. Choices ranging from the basic Fluke 12 with auto function V-Chek™ and Continuity Capture™. To the classic Fluke 77 with Auto Touch Hold® and current measurements.

Fluke 77
The classic
Multimeter
$169.00

To the advanced Fluke 83 with Min/Max/Average recording, Frequency, Duty Cycle and Input Alert™. Plus a full line of quality accessories to extend those capabilities even further. No matter which Fluke meter you choose, you can count on precise, reliable, consistent performance year in and year out. Plus, strong customer support and product warranties that measure up to any in the industry. Make the choice that gives you the most choices.

Fluke 83
Full-featured
Multimeter
$255.00

Look to Fluke for the tools you need to get the job done right.

See your Fluke distributor, or call 1-800-87-FLUKE for a catalog and the name of the distributor nearest you.

Fluke 12
Auto-function
Multimeter
$89.95

FLUKE 12	FLUKE 77	FLUKE 83
The Fluke meters listed above feature DC/AC voltage, resistance, audible continuity and diode test.		
Capacitance measurements	Auto Touch Hold®	Auto Touch Hold®and Relative modes
V Chek™ (auto function)	Current measurements	Current measurements
Min/Max Record with Relative Time Stamp	Analog/Digital display	Analog/Digital display
Two-year warranty	Three-year warranty	Three-year warranty
Continuity Capture™	Yellow holster with Flex Stand™	Yellow holster with Flex Stand™
Basic accuracy 0.9%	Basic accuracy 0.3%	Input Alert™
		Capacitance measurements
		Frequency and Duty Cycle
		Min/Max/Avg. Recording
		Basic Accuracy 0.3%

John Fluke Mfg. Co., Inc.
P. O. Box 9090, Everett, WA 98206
For more information call:
(416) 890-7600 from Canada
(206) 356-5500 from other countries

FLUKE®

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