THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

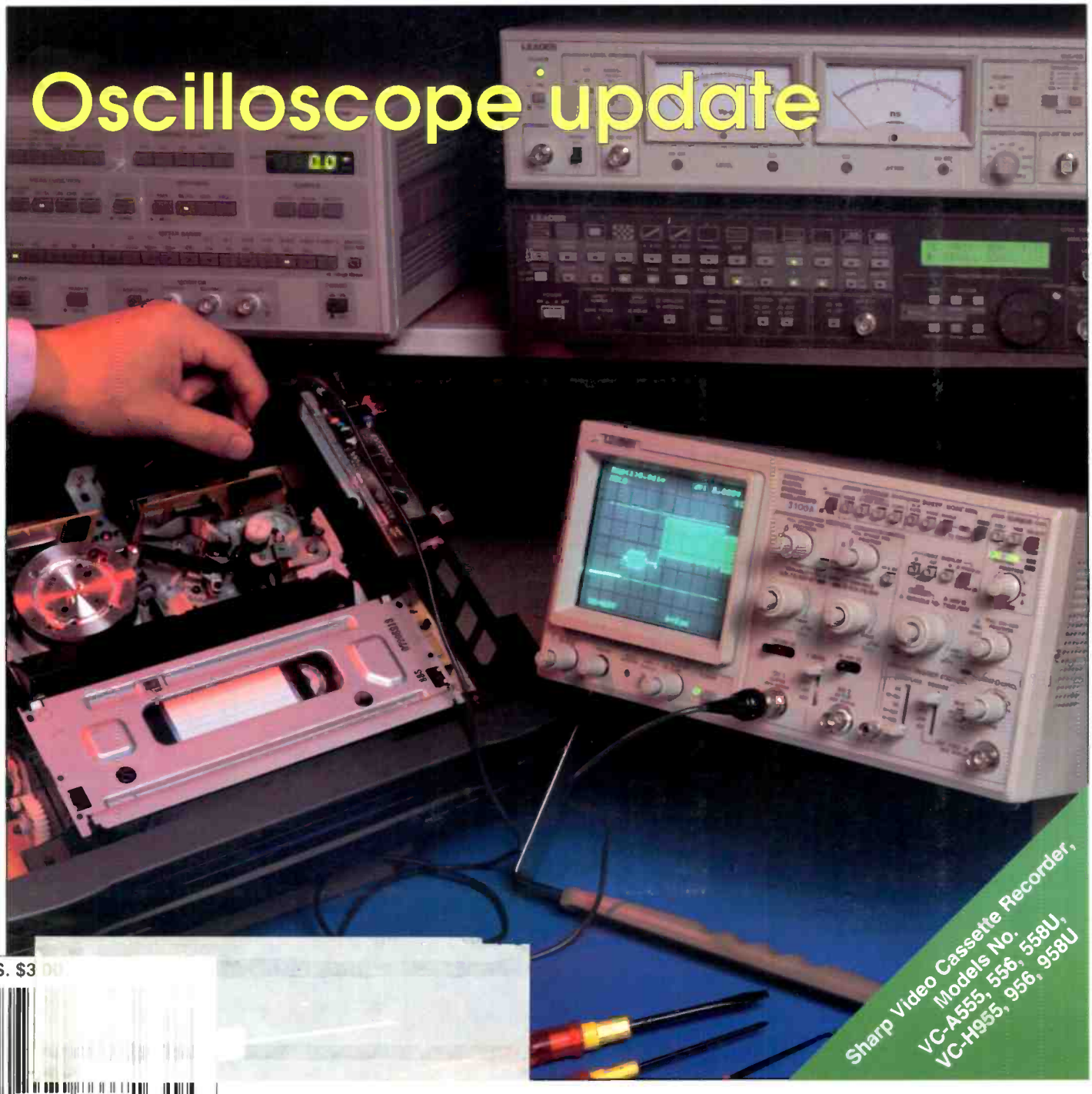
ELECTRONIC Servicing & Technology

T.M.

September 1996

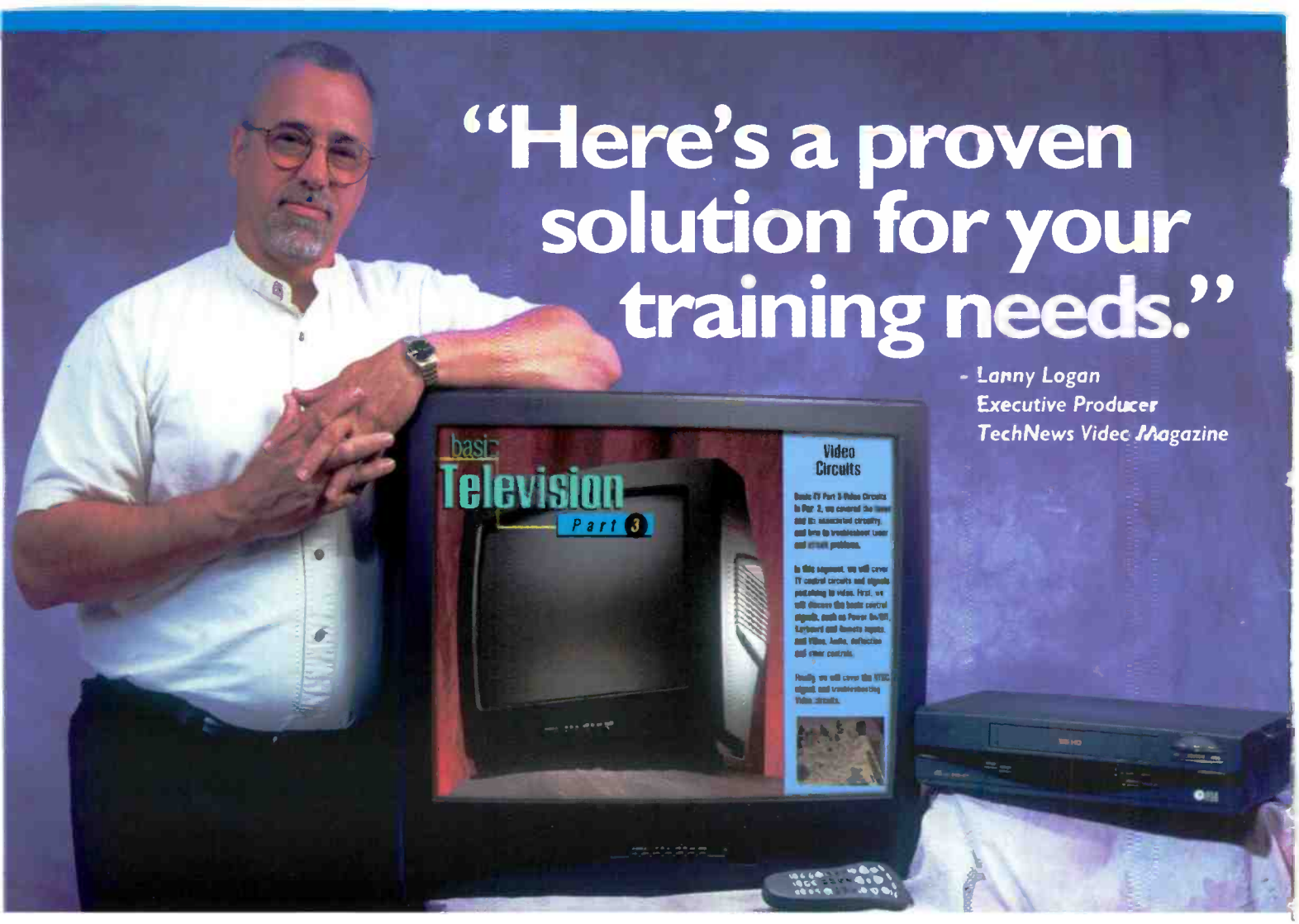
Multimeter update

New consumer electronics technology



U.S. $3

0 74470 86667 1



"And you know, a better trained technician can increase your income!" Developed in response to servicer requests, TechNews offers 60+ minutes of technical information on a quarterly basis. Your technicians can keep up-to-date on the latest field developments. The easy-to-follow video format is popular with servicers across the country.

Here's what they're saying about TechNews:

"Great concept for Technical Training."
- John Tubby, Florida

"The "Y" chassis was excellent; it's the sort of thing that's best done on video."
- Sequoia Electronics Service, California

"We have techs in training who really need basic TV– the basic TV section was very good!"
- Jack's TV Service, Michigan

TechNews demonstrates proven methods for detecting and correcting problems servicers face every day. With TechNews, you can stay current on the latest trends, learn about time-saving techniques, and find out about valuable resources.

Order TechNews and receive:

- Four videotapes over the next year
- Answers to your questions from our Tech Advisors
- Troubleshooting tips
- Basic TV theory
- The best methods for servicing specific products
- Information on use of service test equipment
- Free Tip-O-Dex cards

Order your TechNews video subscription today! Only $69.95 plus tax.

Just call 423-475-0044
or write: Philips Technical Training,
P.O. Box 555, Jefferson City, TN 37760

MAC5901 896

Philips Consumer Electronics Company
A Division of Philips Electronics North America Corp.

PHILIPS

Circle (113) on Reply Card

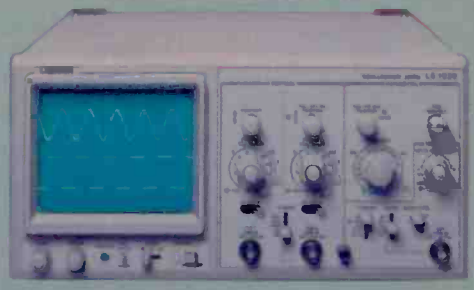
You Shouldn't Have To Mortgage Your Business To Get The Tools Of The Trade!

The difference between success and failure is strictly determined by your bottom line. The service center that can best contain their costs while providing excellent service at affordable repair rates will survive these tough times and eventually succeed. Providing affordable and reasonable repair rates to your customers is ultimately determined by the costs of your operation. Leader Instruments Corporation has been providing the worldwide electronics production and service markets with high quality, high reliability instruments at affordable prices. Listed below you will find a small sample of our products — loaded with features at prices you can afford. Call 1 800 645-5104 (in NY State call 1 516 231-6900) for a copy of our full line catalog.

$1,995 Model 8104 100-MHz 3-Channel CRT Readout Oscilloscope

Loaded with features, the Model 8104 boasts 100-MHz bandwidth with cursors and CRT readout of all critical waveform parameters for ease-of-use. 1 mV/div sensitivity, 3-channel operation, extensive video triggering and dual timebase are standard. All 3 channels can be monitored simultaneously along with their second timebase and the difference (CH1-CH2) can also be displayed — providing 8-trace display capabilities for extensive troubleshooting. The Model 8103, priced at $1,760, includes all of the features of the 8104 except for CRT readout.

$525 LS 1020 20-MHz 2-Channel Oscilloscope



Developed specifically for the electronics production and service industries, the LS 1020 is equipped with features typically found only on higher bandwidth scopes. It is ideal for use on the audio bench, and can be used as a second scope for video troubleshooting as well. The unit is equipped with TV-V and TV-H coupling, has a 5 mV/div sensitivity (0.5 mV/div with X10 on), and includes both CHOP and ALT vertical mode functions. Rugged and reliable, the LS 1020 provides service professionals with an affordable choice without compromising features or quality.

$395 LTC-905 Semiconductor Curve Tracer

STOP REPLACING GOOD PARTS!

Use this handy semiconductor curve tracer with any oscilloscope (must be equipped with X-Y mode) and test transistors, triacs, UJTs, SCRs, FETs, MOSFETs, as well as zener, signal and rectifier diodes. The LTC-905 will measure (both in and out of circuit) gain (beta), cutoff, leakage and output admittance. Affordably priced and full featured, the LTC-905 is a "must have" for any serious repair center.

Starting at $345 700 Series Digital Display Power Supplies

A wide variety of power supplies are available from Leader. The 700 Series single output digital display power supplies can be operated in constant voltage or constant current modes. Digital readout of voltage and current is provided. Triple output power supplies are also available from Leader. For a detailed listing of our DC power supplies call 1 800 645-5104 (in NY State call 1 516 231-6900.)

LEADER
FOR PROFESSIONALS WHO KNOW THE DIFFERENCE

1 800 645-5104 IN NY STATE CALL 1 516 231-6900

Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, New York 11788
Regional Offices: Chicago, Dallas, Los Angeles, Atlanta. In Canada call Omnitronix Ltd., 905 828-6221

Circle (84) For Product Information
Circle (85) For Product Information & Demonstration

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

Volume 16, No. 9 September 1996

Contents

FEATURES

12 Oscilloscope update: Using the oscilloscope to determine the cause of hot output transistors
By Homer Davidson
Output transistors in the most recent television sets seem to experience the most problems with overheating. This article explains how a servicer can troubleshoot this problem by using an oscilloscope.

21 Multimeter update: What those meter accuracy figures mean
By Lamarr Ritchie
Most meter manufacturers provide specifications that tell the user how accurate readings may be expected to be. This article is a rundown of what those numbers mean.

23 New consumer electronics technology
By The ES&T Staff
It is amazing how many new electronic products are introduced each year. But what is even more amazing is the fact that there is still a lot of product innovation yet to come, and that means that every consumer electronic technician has to be prepared to service them. This article takes a look at what new technology has been introduced this year.

28 Companies on the network
By Victor Meeldjick
This article provides Internet, E-Mail and BBS addresses of some component distributors.

42 How to design and build a POST code reader: Part 3
By Harvey Schwertly
The third part of this three part article provides details on the function design and construction of a POST code reader card.

DEPARTMENTS

6 Editorial

10 News

31 Profax

48 ES&T Calendar of Events

49 Test Your Electronics Knowledge

50 Business Corner
Try value pricing to increase your profit

54 Literature

55 Books

56 What Do You Know About Electronics?
Visual Modulation

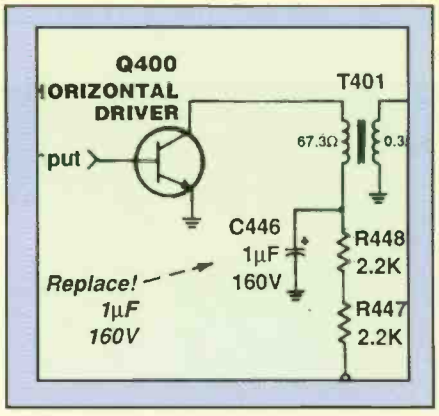
58 Photofact

59 Products

64 Classified

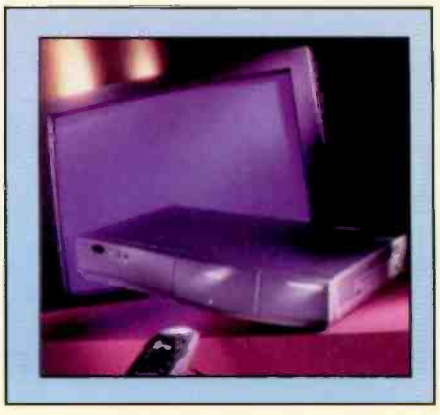
65 Readers' Exchange

66 Advertisers' Index



page 12

page 21



page 23

ON THE COVER

The oscilloscope is one of the most useful pieces of test equipment to the service technician. It allows him to compare waveforms actually observed at test points in a product being serviced with those published by the manufacturer in the service literature, and from that comparison, draw conclusions as to the nature of the problem. (Photo courtesy Leader)

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.

EDITORIAL
Nils Conrad Persson, *Editor*
(Internet e-mail: cpersedit@aol.com)
Kirstie A. Wickham, *Associate Editor*
(Internet e-mail: kirstieest@aol.com)
Richard S. Moseson, NW2L, *On-Line Coordinator*

CONSULTING EDITORS
Homer L.Davidson, *TV Servicing Consultant*
Victor Meeldijk, *Components Consultant*
John E. Shepler, *Audio Consultant*
Sam Wilson, *Electronics Theory Consultant*

PRODUCTION
Elizabeth Ryan, *Art Director*
Barbara McGowan, *Associate Art Director*
Edmond Pesonen, *Electronic Composition Mgr.*
Dorothy Kehrwieder, *Production Manager*
Emily Kreutz, *Assistant Production Manager*
Pat Le Blanc, *Phototypographer*

BUSINESS
Richard A. Ross, *Publisher*
Diane G. Klusner, *Associate Publisher*
(Internet e-mail: dianekest@aol.com)
John Dorr, *General Manager*
Frank V. Fuzia, *Controller*
Simon Schatzmann, *Circulation Director*
Catherine Ross, *Circulation Manager*
Melissa Nitschke, *Operations Manager*
Jean Sawchuk, *Data Processing*
Denise Pyne, *Customer Service*

SALES OFFICE
Electronic Servicing & Technology
76 N. Broadway, Hicksville, NY 11801
516-681-2922; FAX 516-681-2926
Diane G. Klusner, *Director of Advertising*
Emily Kreutz, *Sales Assistant*

EDITORIAL CORRESPONDENCE:
P.O. Box 12487
Overland Park, KS 66212
913-492-4857

National Electronics Service
NESDA
Dealers Association, Inc.
Member, Electronic Servicing Dealers Association

Electronic Servicing & Technology (ISSN 0278-9922) is published 13 times a year by CQ Communications, Inc. 76 N. Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. Second class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year $24.75, two years $45. Foreign countries—one year $30.75, two years $57. Allow six weeks for delivery of first issue and for change of address. Printed in the United States of America.

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

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

Technology and obsolescence

In this issue of ES&T you'll find an article about some of the new technology that's being unveiled by the manufacturers this year. For example, already, or soon to be, on the market are TVs that provide access to the Internet, devices that can eliminate TV ghosts, the digital versatile disk (DVD), capable of providing around two hours of movie with hi-fi surround sound on a CD-sized disk, and a few other assorted technologically advanced products.

Products such as these are exciting to consumers. For example, no doubt there are millions of households in the U.S. that have heard reports on the wonders that await them on the Internet, and yet, because they don't have a personal computer in the home, access to that technology has been denied them. The TV sets being introduced into the market will make the Internet available to anyone who can afford to spend an extra $300 when they buy their next TV. And the DVD has the potential to become something that the video disc promised but never quite became, at least not in widespread use, a signal source for movies at home as well as a source of high fidelity stereo music for the stereo system.

The good news in all this for consumer-electronics service companies is that all of these new technologically advanced products represent potential business. Despite the fact that these products represent the cutting edge of technology, they aren't perfect: many of them will need service at some time.

Of course this will require that any service company that wants to service these products become familiar with their capabilities and mode of operation. Now that TVs are capable of connecting to the Internet, which means that they have computers in them, any service technician who plans to service them will have to possess a package of skills that includes TV, computers and peripherals, an understanding, at least a rudimentary one, of the Internet, and telephone access and communications. Whew.

New technology accelerates obsolescence

Another effect of all the new consumer electronics technology that has been snowballing for the last couple of decades is the acceleration of obsolescence. Every time a new product sporting the advantages of advanced technology is introduced, older products become less attractive, and when they begin to show the signs of age, or fail, the owners are more likely to be thinking of replacement rather than repair.

Moreover, products are now being built using components that were specially designed by that manufacturer, rather than being based on a common pool of readily available components, such as back in the good old vacuum tube days. That means that the pipeline of replacement components has to carry an increasing diversity of parts. Because demand for any specialized parts is limited to products from a single manufacturer, as the products age and many owners simply replace them, the demand for replacement parts for these products becomes smaller, so that component manufacturers no longer find it profitable to continue making them. These parts then become NLA: no longer available.

As an example of this, a reader called recently asking if I knew of any source where he could obtain an IHVT for an 11-year-old TV set of Japanese manufacture. He had tried several distributors but had gotten the same answer, "that part is NLA." Yes the set is 11 years old, well past the point that manufacturers consider to be the useful life of a product. But this servicer is frustrated that a set that was otherwise operating fine now has to be tossed out to further clog some landfill when, if he could obtain a $50.00 part he could restore it to operation for a few more years.

I suggested that he send an item to us for the Reader's Exchange portion of the magazine, that perhaps some other service center has one of these IHVTs on hand that they'd be delighted to have removed from their inventory.

This brings up an important point, however. As the service business becomes more difficult for a number of reasons such as decreasing prices for the product, increasing product reliability, increasing diversity of products, and more, it becomes ever more important for servicers to work together and to consider other servicers as colleagues rather than competitors. All servicers are possible sources of information or even NLA parts. If you don't belong to a professional association, perhaps you should join one. If you haven't talked to your friendly competition in a while, perhaps you should give them a call.

Keeping up with technology is a challenge, and so is dealing with its fallout, but over the years servicers have learned to handle it, and by working together, will continue to prevail in the future.

Nils Conrad Persson

Sometimes There's No Substitute For The Genuine Article...

As a member of today's professional electronics repair industry, we realize that you rely on our genuine replacement parts not only during the required warranty period, but also when you want the highest level of quality and performance.

RCA
PROSCAN
GE

Genuine Replacement *Parts*

Thomson Consumer Electronics' Authorized Parts Distributors can provide you with the replacement part which meets original specifications for RCA, GE and ProScan brand products.

Not only is Thomson a leader in producing quality Home Consumer Electronic products, but our most recent survey of the service industry shows the majority of you believe that **no other manufacturer** provided a consistently better parts fulfillment system than Thomson. We thank you very much.

As a result, quality parts and quality service combine to protect your reputation with your customers. Is anything more important to you?

Sometimes There is

SK *Series* **UNIVERSAL** *Parts*

We also realize that not every estimate can be converted to a repair using original parts, especially VCRs. Our growing line of low cost, high quality SK Series universal parts can help you convert more of those jobs and increase your profits. Whether you need video heads, idlers, gears, pulleys, tires, belts, pinch rollers, laser pickups, tool kits or exact semiconductors, you can look to SK Series.

We have parts for Panasonic, JVC, Sony, Zenith, Magnavox and most other brands...and you can get all these parts with one call to your Authorized Thomson SK Series Parts Distributor. What could be easier or more convenient?

For more information on the SK Series line of universal parts contact your Thomson Parts Distributor.

THOMSON CONSUMER ELECTRONICS
2000 Clements Bridge Road Deptford, NJ 08096-2088

Circle (107) on Reply Card

Certified Satellite Installer course on Spacenet 3—weekly schedule announced

ELN 288 is the Course Number for the first ever C-Band college-credit training course for satellite installers and technicians. Instructor Gordon Koch, CET, of Mid Plains Community College in North Platte, NE has outlined the subject matter which will be included in the one-hour weekly classes which will appear in-the-clear on Spacenet 3, Channel 4 beginning August 23rd, 1996. The course will run 16 weeks, excluding November 29th (Thanksgiving break). Classes start at 7:30 PM CST Fridays.

Those with C-Band capability who wish to learn more about how direct satellite works and how to install and service this dynamic means of communications can watch the series for free, or, they may sign up with MPCC for the 1 credit-hour (20 contact hours) course. The cost to participate as a student, receiving worksheets and other communications, is $68 for out-of-state (NE) students. SDA needs to know that non-credit viewers are participating in order to prove the value of the program to NEB*SAT network officials. Readers viewing one or more sessions, please call 308-532-8740 (MPCC-Gordon Koch) to register as a free participant.

The course objective is to familiarize the student with: basic satellite communications; satellite receive systems; satellite receive installation; conventional roof-top antenna systems; antenna systems distribution; and troubleshooting.

Subject matter for the weekly classes is as follows: The Clarke Belt, Uplinks and Downlinks; dish construction, AZ-EL, prime focus, offset, flat arrays, focus and dish calculations; feedhorns, LNBFs, coaxial dual-band feeds, servos, LNBs, gain, operating voltages and troubleshooting; polarization, H/V and C/Ku switching, DSS and other offset DTH dishes; Basic installation, poles, burial, entrance, cable runs, safety; drive arms, sensors, motors, limit switches, brushes, gears, fuses; TVRO receivers, controls, back panel ports and signal levels; decoders, IRDs, digital concepts, signal requirements; small dish installation and aiming; rooftop antennas, cable TV, SMATV systems; troubleshooting; and examinations for those planning to become CSI's or CETs.

For those wishing to take the CSI exam, there is no course prerequisite. For those wishing to take the Journeyman CET exam, using the TVRO option, the Associate CET exam is one portion of the total CET test, required at the time the option is taken, or prior to.

To contact Mid Plains Community College to participate in the Spacenet 3 program, write to: MPCC, Gordon Koch, CET, 110 Halligan Dr., N. Platte, NE 69101, 308-532-8740, 308-532-8494 (fax).

To contact ETA and SDA regarding testing sites for CET or CSI examinations, call 317-653-4301, fax: 317-653-8262.

VCRs top retailers' video purchases for May

Overall video sales rose two percent in May, the first monthly gain since January, with more than 2.8 million video products shipped to dealers last month, according to the Consumer Electronics Manufacturers Association (CEMA). The gain came almost entirely from a 16 percent increase in shipments of VCR decks. Other categories, although slightly down in May, had their best showings of the year.

"Driven by a healthy appetite for home theater, industry sales of large-screen color TVs continue to grow, despite overall softness in the direct-view business so far this year," said William J. Sims, president of Zenith Sales Company. "Projection TV and large-screen direct-view remain strong and may get another boost from TV coverage of major events like the Olympics and the political conventions this summer. VCR sales were surprisingly strong in May, again reflecting growing interest in home theater as more consumers move to hi-fi VCRs to enhance their entertainment centers."

VCR sales sizzled in May, jumping 16 percent on sales of nearly 970,000 units. Stereo models accounted for a record high percent of sales in the month with volume of more than 440,000, up 79 percent from 1995. Monaural deck sales dropped 11 percent in May.

Color TV sales fell just two percent from May 1995, but were still off eight percent in the year-to-date. The strongest indication of a turnaround in direct-view sales was a two percent gain in May shipments of 19 and 20 inch sets. The two screen sizes combined to record shipments of just over 523,000.

Selling more than a quarter million units in the year-to-date, projection TVs bettered their flat April sales performance with a two percent gain in May. Sales of models 49 and smaller rebounded from poor April results to post a 10 percent gain in May. Sales of units 55 and larger rose 38 percent in the month.

TV/VCR combination sales fell a combined eight percent in May. Shipments of sets 13 inches and smaller were also down eight percent in May, while 19 inches and larger models dropped seven percent.

Camcorder sales fell eight percent in May on a sharp (36 percent) decline in shipments of full-size decks. Compact sales rose three percent in the month. More than one million camcorders have been sold to dealers so far this year.

Winners in electronics products servicing announced 1996 skills USA championships

The winners of the thirtieth annual Skills USA Championships in Electronic Products Servicing were announced Friday evening, June 28, at the Awards Session of the VICA National Leadership and Skills Conference. The Conference was held June 25–June 28, 1996, at the Municipal Auditorium and the H. Roe Bartle Hall in Kansas City, MO. Approximately 3,500 outstanding vocational students joined in the excitement of hands-on competition in fifty-seven different trade, technical, and leadership fields.

Working against the clock and each other, the participants proved their expertise in job skills for occupations such as electronics, technical drafting, precision machining, medical assisting and culinary arts. There were also competitions in leadership skills, such as extemporaneous speaking and conducting meetings by parliamentary procedures.

The Vocational Industrial Clubs of America (VICA) is the national organization for students in trade, industrial, technical and health occupations education. It sponsors the Skills USA Championships annually to recognize the

achievements of vocational students and to encourage them to strive for excellence and pride in their chosen occupations.

The contests are planned by technical committees made up of representatives of labor and management and are designed to test the skills needed for a successful entry-level performance in given occupational fields. Safety practices and procedures—an area of great concern to labor and management alike—are judged and graded and constitute a portion of a contestant's score.

The competition consists of three sections. Section I involves contestants to logically troubleshoot functional building blocks of electronics systems, using modern test equipment in the following areas: audio systems, power supplies, microprocessors, digital technology, and video systems. Section II activities evaluate the students' soldering and desoldering skills, and their workmanship and assembly techniques of constructing an electronics project. Section III is a written exam to test the contestant's understanding of safety procedures, electronic devices and concepts.

National committee members for the electronic products servicing contest are chairperson Walter Seymour, Consumer Electronics Manufacturing Association; co-chair Jerry Ganguzza, Sharp Electronics Corporation; Ed Mueller, Electronic Industries Association; Don Hatton, Consumer Electronics Manufacturing Association; Brian Ott; Rich Polak, Maxtec International Corporation; Mike Derosa, Sony Electronics, Inc.; James Carfi, Toshiba America, Inc; Elmer Poe, Electronic Industries Association; Tom Graff, Thomson Consumer Electronics; Emmanuel Henry, Matsushita Services Company; Chet Dunn, Philips Consumer Electronics; George Gonos, Leader; Martin Elmes, Consumer Electronics Manufacturing Association; Mel Gilson, Zenith Electronics.

The national technical committee is assisted by a national conference committee: chairperson Jim Lent, Fort Osage AVTS (MO); San Dixon, Cecil County School of Technology (MD); Gene Dudley, Alpert P. Brewer AVC (AL); James Hallis, Gibbonby Technical Center (VA); Mike Harrington, Grand River Technical School (MO); Ron Porterfield, Dinn State Technical College (MO).

Home theater manufacturers start off 1996 with positive retailer sales

Factory sales of home theater products rose six percent in the first quarter of 1996 due to the very strong performance of home theater audio products, according to the Consumer Electronics Manufacturers Association (CEMA). Sales for both audio and video products totaled $1.7 billion in the first three months of the year.

"The right audio components can take your regular movie watching experience into a whole new dimension—airplanes whiz by your ears and jungle noises come at you from all sides," said Laura Hendershot, CEO of Counterpoint, a CEMA member. "Home theater ownership is skyrocketing. Consumers want to bring the high quality movie experience into their own homes, and that takes both video and audio products."

Home theater audio sales jumped 33 percent in the first quarter to $191 million. Surround sound processing equipment, whether in the form of an A/V receiver or an amplifier, was up 23 percent on combined volume of $117 million. Home theater speaker sales rose by more than half to $74 million as more and more consumers upgraded their video components with additional speakers for true surround sound effects.

Home theater video equipment managed a three percent first quarter gain despite fierce price competition in the large screen direct-view TV market. Projection TV sales were up 14 percent and hi-fi VCR sales rose 10 percent on consistently strong sales. Stereo VCRs have been solid winners during the past year as consumers replace their mono models and look to VCRs that can take advantage of the great sound quality a home theater system brings. ■

Oscilloscope Update

Using the oscilloscope to determine the cause of hot output transistors

By Homer L.Davidson

Locating faulty components that cause the horizontal output transistor in a television set to run hot takes a great deal of patience and service time. Using the oscilloscope to observe waveforms in these critical circuits can help a great deal in isolating these problems.

After replacing a component in the horizontal section, you may find the output transistor operating hot. Most horizontal output transistors run warm, but not too hot to touch. Sometimes the output transistor seems to fail in a week or two. Output transistors in the most recent television sets seem to experience the most problems with overheating (Figure 1).

Hot output transistors

The most frequent causes of destruction of horizontal output transistors are defective flybacks, open damper diodes, improper drive voltages, and open safety capacitors. If there is no high voltage in the set, and you find that the output transistor is warm, suspect any one of these parts. A leaky or shorted deflection yoke or pin cushion transformer can destroy the horizontal output transistor. Insufficient drive at the base terminal can quickly damage the output transistor. Higher than normal voltage supplied to the output transistor can destroy it.

When the output transistor operates hot (some of these transistors end up with a collector to emitter short), suspect improper drive voltage, absence of base

Davidson is a TV servicing consultant for **ES&T**.

Horizontal circuits checklist

By checking and replacing the following components in the following order, the most difficult hot transistor symptom can be solved:

1. Check driver and output transistors for correct operating voltages.
2. Check for correct horizontal drive waveforms.
3. Test both transistors out of circuit.
4. Replace the horizontal output transistor with one of the manufacturer's exact replacement part number.
5. Solder all board terminal connections of the driver transformer.
6. Check the resistance of the driver transformer.
7. Replace resistors in series with the driver primary winding.
8. Replace electrolytic capacitor off of driver transformer voltage source.
9. Replace driver transformer.
10. Shunt electrolytic capacitors in the horizontal voltage sources.
11. Replace flyback transformer after all other parts are replaced and tested.
12. Hope and pray the new output transistor will operate cool after all tests and part replacement.

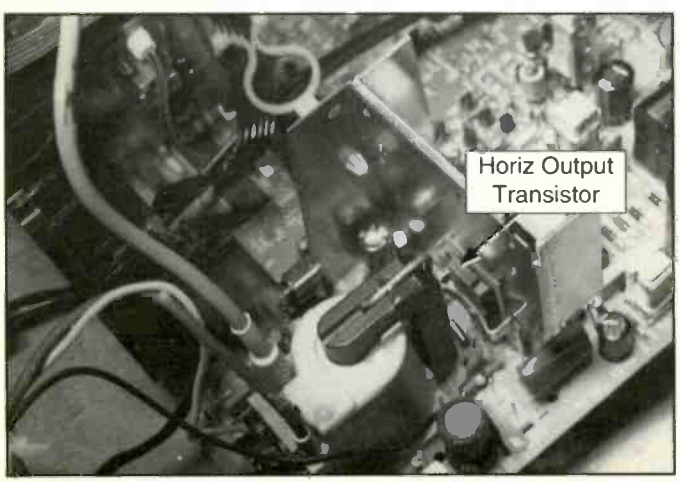


Figure 1. Check the horizontal output transistor after replacement to see if it's still operating hotter than normal.

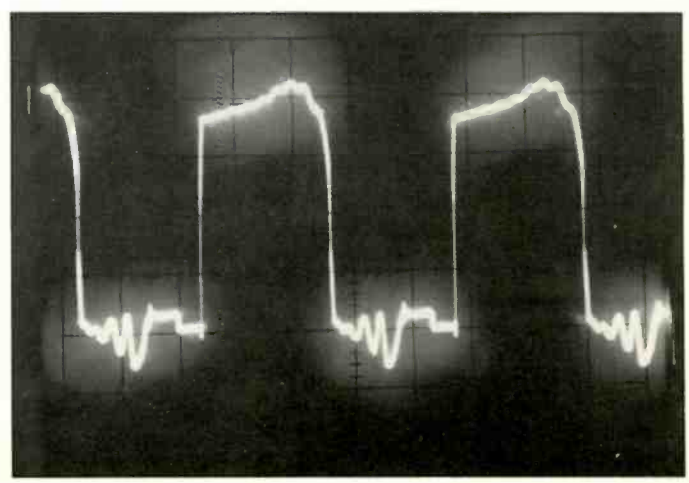


Figure 2. Check waveforms at the base and collector of the horizontal driver transistor, and at the base of the output transistor.

Model or Chassis	Waveform Voltage P-P	Base Voltage	Collector Voltage
Emerson MS1980R	14V p-p	-0.1V	123V
Emerson ECR2100	20V p-p	-0.1V	123V
Goldstar CMT2612	12.2V p-p	-0.5V	121V
Sharp 19SB60R	18V p-p	-0.5V	118V
Sears 504.42071850	10V p-p	0.02V	135V
RCA CTC146	14V p-p	-0.1V	139V

Figure 3. This list of base drive waveforms and base and collector voltage of the horizontal output transistor, taken at random from the service literature of a number of different television sets, gives an idea of the normal range.

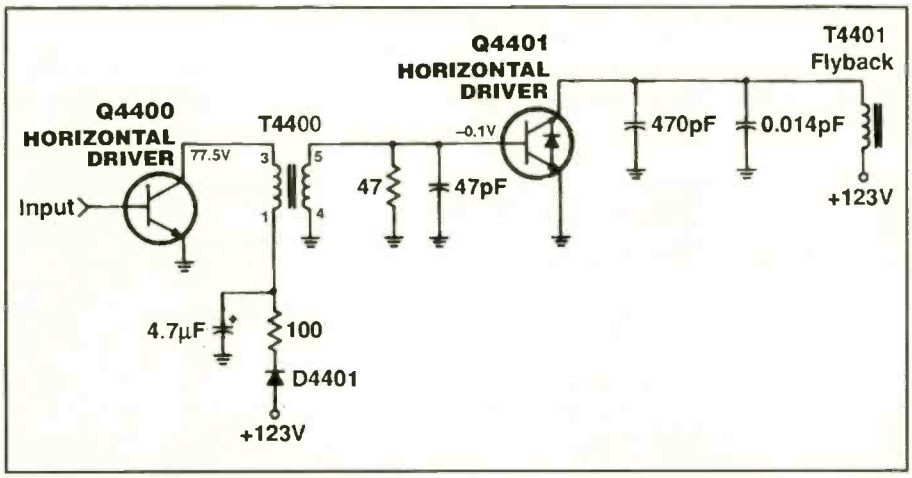


Figure 4. Check the output transistor and components for hot grounds when taking voltage, resistance and waveform tests.

waveform, a defective driver transformer, or poor transformer connections. Do not overlook the possibility that the problem may be caused by a dried up electrolyte, or a loss in capacitance of electrolytic capacitors in the drive circuits.

Your first step, however, should be to use the oscilloscope to observe the drive waveform and compare the waveform you observe to the drive waveform published in the service literature to see if it is of the correct shape and amplitude.

Correct voltage and waveforms

Any time there are problems with overheating horizontal output transistors, check the horizontal circuits to make sure

Model or Chassis Number	Primary Resistance	Secondary Resistance
RCA CTC166	3.6Ω	0.30Ω
RCA CTC167	2.4Ω	0.10Ω
Goldstar CMS54841N	84.5Ω	0.04Ω
Goldstar CMT2612	89.0Ω	0.08Ω
Sharp 19SB60R	122.0Ω	0.40Ω
Sanyo AVM255	69.8Ω	0.14Ω
Emerson MS250R	102.5Ω	0.33Ω
Toshiba CF317C	90.6Ω	0.50Ω
Quasar AEDC-148	75.0Ω	0.07Ω
Sears 564.42071850	64.1Ω	0.08Ω
Emerson ECR2100	67.3Ω	0.30Ω

Figure 5. A list of driver transformer primary resistance measurements taken at random from the service literature of a number of television sets.

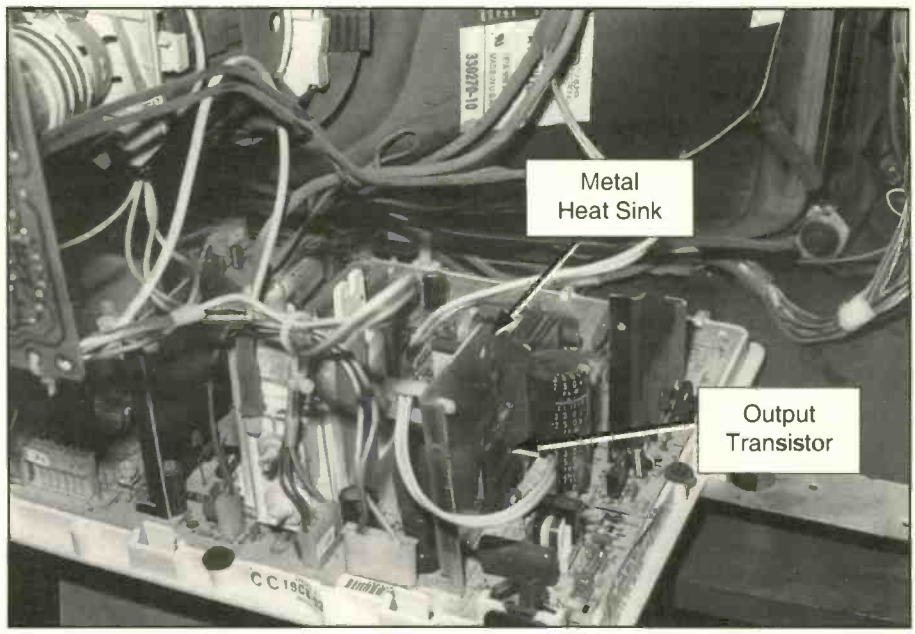


Figure 6. The horizontal output transistor is located on a separate heat sink.

that the operating voltages and waveforms are within specification. Scope each stage from the countdown or horizontal sweep IC to the horizontal output transistor. All waveforms should be clean and of the correct amplitude (Figure 2). Of course, without the manufacturer's service literature it may not be possible to make this comparison. One possible way around this is to compare waveforms from the faulty TV set to the waveforms that you observe in a similar, properly operating set from the same manufacturer.

Make careful measurements of the critical voltages on the horizontal driver and output transistor. The drive waveform to the output transistor averages between 10V and 20V, while the base voltage is very low; from –0.1V to –0.5V. Figure 3 lists the peak-to-peak value of the horizontal output transistor base drive voltage waveforms, and the base and collector voltages for a random selection of television sets.

Remember to make measurements in the horizontal circuits with respect to hot ground. If you measure the parameters with respect to the wrong ground, the voltage and resistance measurements will be incorrect. Compare the drive and output waveforms to those on the schematic.

Defective driver transformer

Defective horizontal drive transformers have caused symptoms such as intermittent operation, a dead set, and exces-

sively hot output transistors. When the drive voltage at the base terminal of the output transistor becomes low or nonexistent, the transistor will run extremely hot. The same excessive current that causes the transistor to run hot may cause damage to the flyback transformer. Of course as a result of the overheating the output transistor is damaged. Moreover, voltage and isolation resistors in the low voltage supply may become burned, changed in value, or open circuited (Figure 4).

If you have encountered problems in a television set such as intermittent operation, failure to start up, shut down after startup or complete absence of function (dead set), if voltage and waveform tests are inconclusive, solder all terminals of the driver transformer. Check the resistance of the transformer primary winding with the low ohm scale of the DMM and compare it to the schematic. Some schematic diagrams list the resistance of the driver transformer and others do not. Often, the primary winding will change in resistance if the drive transistor is leaky, or if the drive waveform at the base terminal is not correct.

The resistance of the secondary winding of a driver transformer very seldom changes, since it contains larger wires and carries less current. The resistance of the primary winding of the driver transformer varies greatly from manufacturer to manufacturer. Notice, for example, that the resistance of the primary winding of the driver transformer of an RCA CTC166 or an CTC167 chassis is quite low compared to those of other manufacturers (Figure 5). In some cases, simply replacing the driver transformer can cure a set with a hot output transistor.

Defective filter and bypass capacitors

An electrolytic capacitor that becomes reduced in capacitance or dries out can cause the horizontal output transistor to run hot. Horizontal pulling at the top of the picture can result from open bypass capacitors in the collector circuit of the driver transistor. Small electrolytic capacitors on the supply source of the primary winding can cause the output transistor to have a short life.

If the horizontal output transistor is running hot, use the oscilloscope to examine the drive waveform at the base of this transistor. Now observe the waveform of the power supply source at the primary winding of the horizontal output transformer. Noise and spikes on this waveform suggest a bad electrolytic capacitor.

After you have made careful note of these waveforms, shut the chassis down, tack solder a known good electrolytic capacitor in parallel with the suspected one and again observe the drive waveform. If this waveform changed significantly and the transistor ceases to run hot, replace the capacitor permanently. Also, use the oscilloscope to observe the supply voltage waveform at the primary of the transformer. The noise should now be gone.

The defective output transistor

There are many different components that can cause the output transistor to overheat and have a short life. The output transistor itself may be the cause of the problem. Replace the transistor if it is

Hot output

The horizontal output transistor in an inoperative Emerson ECR210 was found to be open. The replacement transistor ran warm, and burned out after only a few days of operation. I immediately checked the driver transformer board connections and resoldered them. The output transistor had been replaced before. The drive waveform upon the output base terminal of the output transistor was $19V_{PP}$ with 122V applied to the collector terminal, which was quite normal.

A check of the primary winding of driver transformer T401 with the DMM showed this resistance to be 57.1Ω (Figure 7). Even though this transformer tested fairly normal, I still suspected that it was the cause of the problem and ordered a new transformer. Even after the driver transformer was replaced, the output transistor was still operating hot. R448 and R449 tested normal. The voltage on the driver collector terminal was fairly close to normal.

I then began to suspect the flyback transformer, but as I mulled over the possible causes of the problem it occurred to me that the electrolytic bypass capacitor might be the cause of the problem. Since C446 was much easier to replace than the flyback, I tackled it first. After I replaced C446, the 2SD1555 transistor ran warm, but not hot.

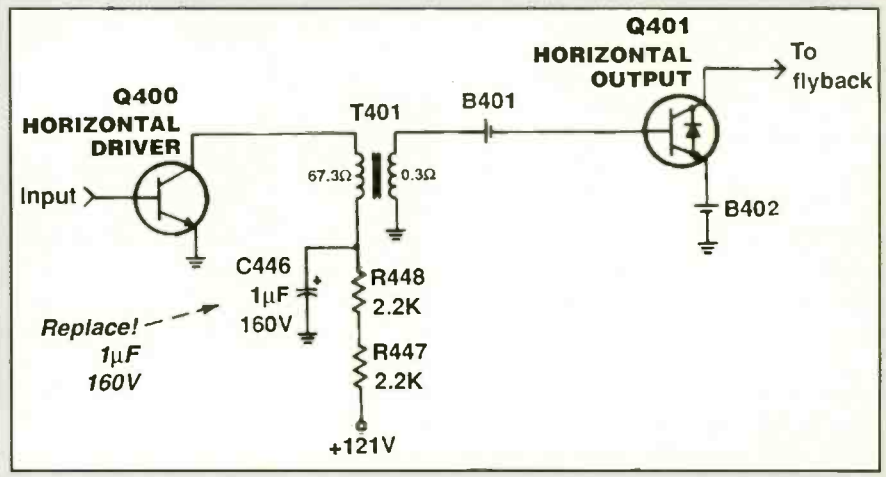


Figure 7. Replacing electrolytic capacitor C446 (1μF, 160V) in an Emerson 2100 TV set cured the problem of a hot output transistor (Q401).

leaky or damaged. Always test the transistor both in circuit and out of circuit to determine if it is open or leaky.

It's difficult to test for an open output transistor while it's connected in the circuit, since the secondary winding of the drive transformer is tied to common ground, and therefore is seen as a short circuit across the base/emitter junction. Notice that the damper diode is found inside the output transistor in the latest horizontal circuits. It is best to remove the output transistor and test the circuit.

Most horizontal output transistors can be replaced with universal replacements. You may find with the new vertical mounted output transistors, valuable service time and headaches can be avoided by simply replacing the output transistor with the exact part number (Figure 6). This is especially true when the transistor is operating hot after replacement.

Hot symptom problems

The horizontal output transistor may have a short life if the flyback is defective or the yoke assembly is leaky. Check the pin cushion transformer as a possible cause of output transistor damage. Disconnect the horizontal yoke winding (red wire) to determine if it's the cause of transistor overheating. If all other tests have failed to turn up the faulty component, as a last resort replace the flyback.

Most output transistors are damaged as

A NEW Generation of Scopes from HITACHI

HITACHI Color Note Book DSO for the Bench or Field

- Active Matrix Color Display
- Performance to 150 MHz/60 Ms
- Direct Hardcopy to Most Printers
- Built-in Waveform Analysis
- TV-H, TV-V and TV-Line trigger
- ***Advanced High End Performance Model Now Available***

New!

VC-5431 VIDEO OSCILLOSCOPE
Oscilloscope: 2 Ch, 50 MHz, 30 Ms/Sec
Vectorscope: NTSC Vectorscope
Waveform Monitor: NTSC Waveform Scale
Monitor: Full Color Display
PC Interface: RS232 / Centronics
Price: $3995.00

New!

	VC-5410	VC-5430	VC-5460	VC-5470
Bandwidth	20 MHz	50 MHz	150 MHz	150 MHz
Sample Rate	15 Ms/Sec	30 Ms/Sec	60 Ms/Sec	100 Ms/Sec
Memory	2KW/Ch	2KW/Ch	2KW/Ch	8KW/Ch
Waveform Memories	10	100	100	25
PC Interface	RS-232/ Centronics	RS-232/ Centronics	RS-232/ Centronics	RS-232/ Centronics
User Price	$1595.00	$2195.00	$2895.00	$3495.00

Hitachi's ***NEW*** Digital Storage Oscilloscopes make looking at all types of signals easier on the eyes and budget. These new DSO's allow you to meet hi-tech applications found in the lab, as well as one time and slow events. Well suited for the Bench or Field Technician.

HITACHI Affordable Deep Memory DSO

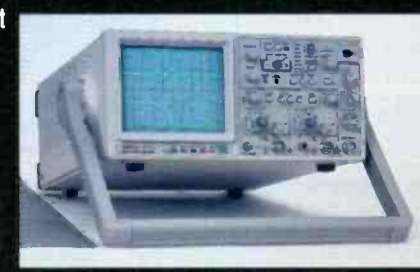
- 150 MHz/100 Ms on all Four Channels
- TV-H, TV-V and TV-Line Select
- PCMCIA Waveform Memory Support (up to 4 MB)
- RS-232 and IEEE 488 Support
- Built-in Thermal Printer

VC-7524	150 MHz/4 CH/2 MB	$ 7995
VC-7504	150 MHz/4 CH/8 KW	$ 5995
VC-7502	150 MHz/2 CH/8 KW	$ 4995

The ***NEW*** VC-7524. Now all users can afford the benefits of deep memory acquisition. From capturing an entire line of video, to viewing encoders, and slow changing events, the VC-7524 brings detail you could never see before.

Analog Plus Digital Performance

- Easy To Use Front Panel
- Performance to 100 MHz/100 Ms
- RS-232 Interface and Free PC Software
- Autosweep Setup
- 3 Year Warranty



The ***NEW*** RSO Series from Hitachi features 6 Models. Ideal for users with applications that require the flexibility of Analog and the Waveform Storage Capability of Digital. These instruments come standard with an RS-232 port for PC transfer.

	VC-6525	VC-6545	VC-6555	VC-6565
Channels	Dual CH			Quad CH
Bandwidth	50 MHz	100 MHz		
Sample Rate	20 Ms	40 Ms	100 Ms	100 Ms
Memory	2 KW Mem	4 KW Mem	8 KW Mem	4 KW Mem

With more than 25 models of Oscilloscopes and Logic Analyzers to choose from, Hitachi could not show them all to you on this page. However you can be assured that if you require Lab Performance, Portability, Analog plus Digital, or just solid Analog performance like our two channel 100 MHz V-1565. Hitachi can meet your quality expectations and your budget.

VC-3120 32 CH/100MHz $ 1995

Don't settle for less!

For more information or a demonstration on any Hitachi Oscilloscope contact...

HITACHI

HITACHI DENSHI, LTD.
HITACHI DENSHI AMERICA, LTD.
HITACHI DENSHI, LTD. (CANADA)
371 Van Ness Way, Suite 120
Torrance, CA 90501
(310) 328-6116 Fax: (310) 328-6252
(516) 921-7200 Fax: (516) 921-0993
Circle (120) on Reply Card

A short-lived RCA CTC140 chassis

A customer brought in an RCA CTC-140 TV set with the complaint that it had been operating intermittently for several days and now had no picture. The horizontal output transistor (Q4400) was found to be shorted between collector and emitter terminals. I replaced the output transistor with an exact manufacturer's replacement part. After the set had operated on the bench for several hours, the replacement transistor appeared to be excessively hot.

I used the oscilloscope to observe waveforms at the base terminal of Q4400 and horizontal driver transistor (Figure 8). By comparison to the waveforms published on the schematic diagram for this set, the amplitudes of both transistor waveforms were lower than normal. Voltage measurements at both collector terminals were lower than normal. I disconnected the set and resoldered all of the driver transformer terminals, but when I again applied power to the set there was no improvement in the situation.

A measurement of the resistance of the primary winding of the driver transformer showed that this resistance was within specification. To confirm that this winding resistance was normal I quickly checked the resistance of the primary winding of the driver transformer of another CTC140 set that was waiting for parts. The resistance of this other winding was within the same range.

I measured the voltage at the top and bottom of the primary winding of the driver transformer. The voltage drop across the winding was insignificant. When I measured the resistance of R4322 I found that it had increased significantly in resistance. After I replaced this 3.6KΩ resistor, the set operated perfectly, transistor Q4400 ran just slightly warm, and the oscilloscope trace of the drive waveform looked just like the one in the service literature.

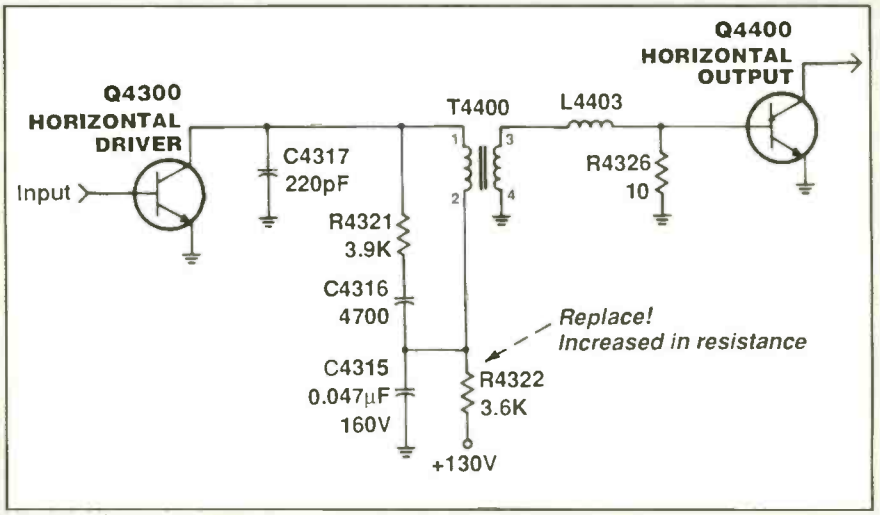


Figure 8. In this RCA CTC140 TV set, I checked R4322 and found that it had increased in resistance. Replacing it restored the set to normal operation.

Pulling raster—hot output

In one Sanyo A-2V-56000 set, the symptoms and diagnostic measurements pointed to a faulty horizontal output transistor. After I replaced the horizontal output transistor with a universal replacement, it ran hot, and the picture pulled at the top. I thought that the problems might be that the universal replacement might not have the same specifications as the original horizontal output transistor, Q302, so I installed a manufacturer's exact replacement. The problem remained (Figure 9).

The resistance of the driver transformer (T301) seemed normal. The collector terminal voltage of the horizontal driver transistor (Q301) had increased to 90.7V. The waveform at the base of Q302 was lower than normal.

I measured R330 (2.7KΩ) and found that its resistance had increased in value, so I replaced it. Additionally, suspecting that C323 was probably faulty as well, I replaced it with a 10µF, 160V, electrolytic capacitor.

With these changes, the horizontal output transistor felt cooler during operation and the collector voltage on Q301 was within specification. However, the horizontal pulling at the top of the picture remained.

When I shunted capacitor C321 (150pF) with a known-good capacitor, the picture returned to normal and the horizontal output transistor operated normally. The final step in servicing this set was to permanently replace C321.

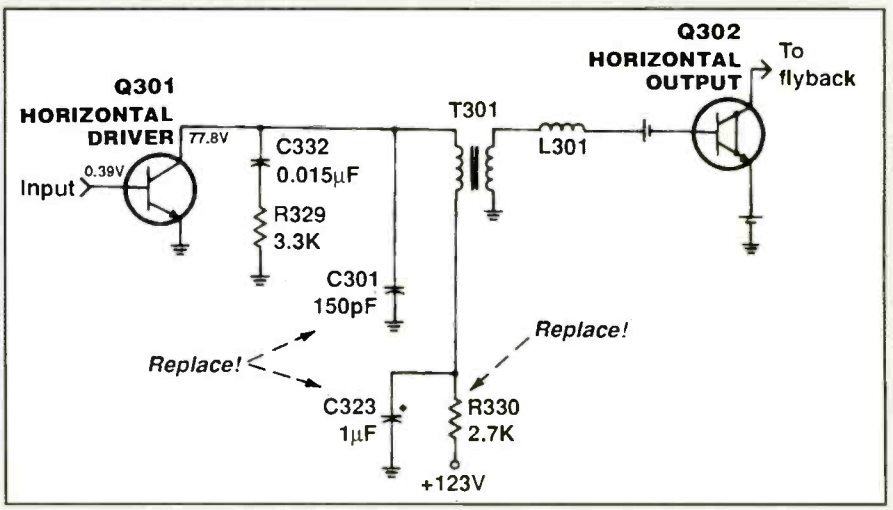


Figure 9. Capacitor C323 and resistor R330 were the culprits responsible for a hot Q302, and C301 (150pF) caused pulling at the top of the picture in a Sanyo TV.

Dead chassis—hot output

When I replaced the horizontal output transistor in a Sanyo PR-8000 chassis with a GE-38 universal replacement the transistor immediately began to run hot. Thinking that the problem might be a poor solder connection, I resoldered all of the driver transformer terminals. The resistance of the primary winding of T402 had reduced to 50.7Ω. It should be around 76Ω (Figure 10). I ordered a replacement driver transformer.

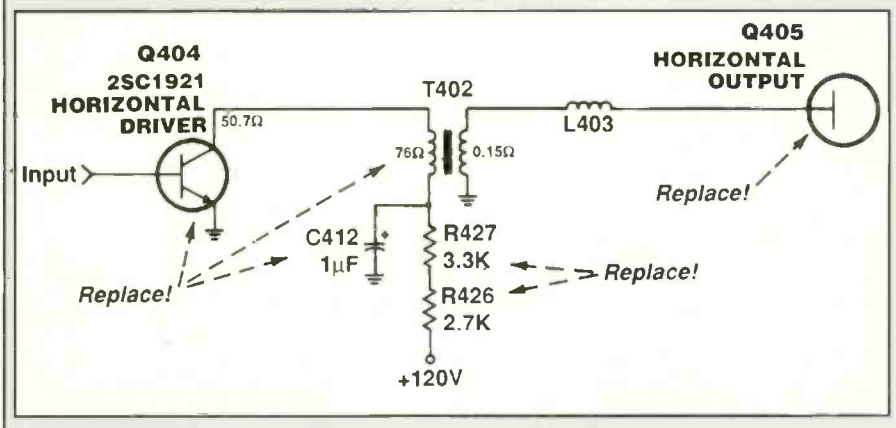


Figure 10. Replacing Q404, Q405, T402, C412, R427, solved the problem of overheating of Q405 in a Sanyo TV.

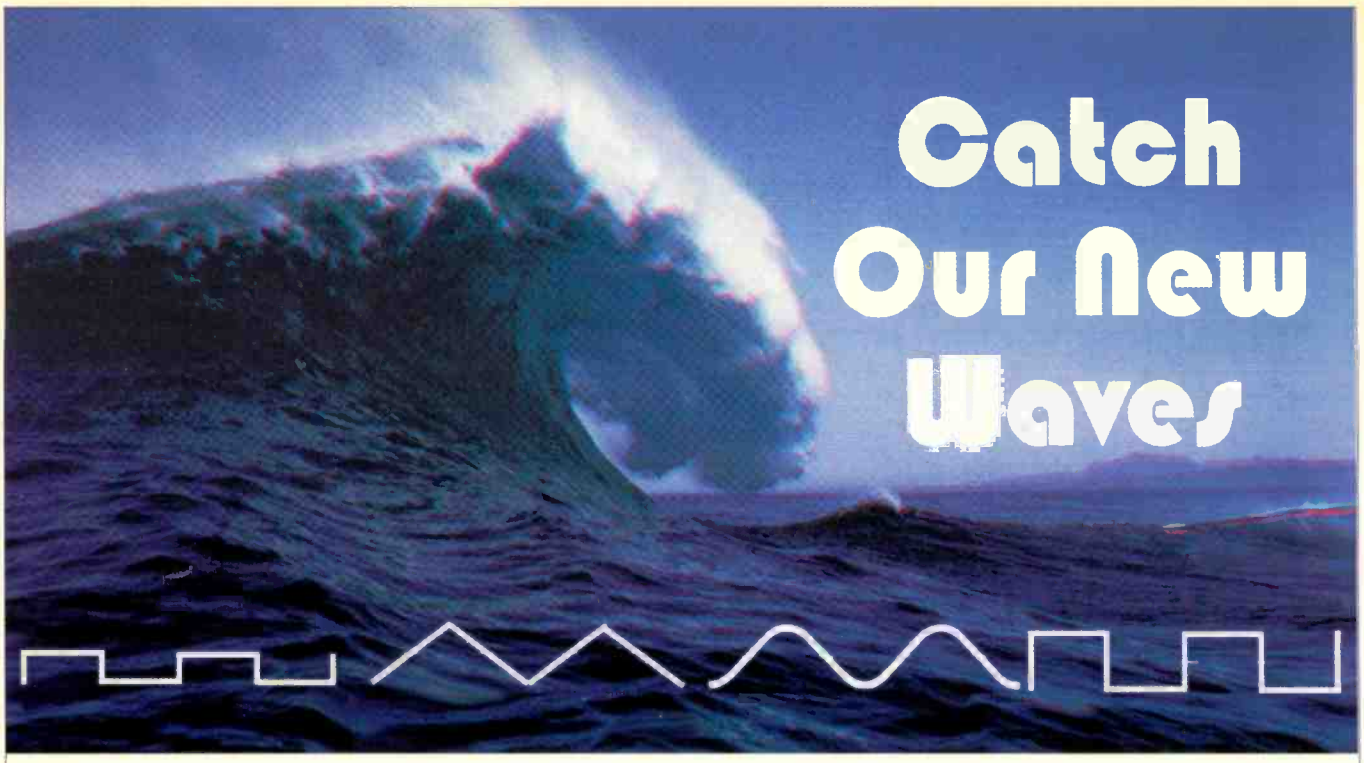
In the meantime, I replaced resistors R427 (3.3KΩ) and R426 (2.7KΩ) with 2W replacement resistors. I replaced capacitor C412 with a 1μF, 160V, electrolytic capacitor and Q404 with a universal replacement transistor. Even though all of these components were replaced, Q405 ran warm after several days of operation.

Sometimes to solve the problem of a hot output transistor, you have to replace all components within the horizontal driver collector circuits. That's what I did in this case.

a result of insufficient drive voltage. If the collector voltage of the driver transistor is higher than normal, the output transistor can be damaged.

In an Emerson 2550 set the horizontal output transformer was running hot. The overheating was caused by increased collector voltage on the driver transistor, which, in turn, was caused by a faulty C435 (1μF, 160V) capacitor.

An increase in resistance of the resistors in series with the primary winding of the driver transformer may cause overheating of the horizontal output transistor, thus shortening its life. A decrease in resistance of the driver primary winding is another cause of hot output transistors. ■



Function Generator Breakthrough!

Introducing all new B+K Function Generators offering wider frequency bandwidths at new value pricing. Beats the competition big time!

Product Features . .

- Proprietary integrated circuit doubles bandwidth for best performance and reliability.
- All the basic functions plus
  —Sine, Square and Triangle waves
  —TTL and CMOS outputs
  —Variable waveform symmetry
  —Variable DC offset.
- Made in the USA

PROUDLY MADE IN THE USA*

* Manufactured in USA from domestic and imported parts.

Bandwidth	Counter	TTL	CMOS	SWP.	AM/FM	Price	Model
2MHz		•	•			$229	4010
5MHz	•	•	•			$284	4011
10MHz	•	•	•	•		$369	4017
20MHz	•	•	•	•	•	$499	4040

Compare this price with those $1,200 units! ⇨

For the name of your nearest B+K distributor
Call 1-800-462-9832
8am-5pm, CST, weekdays

BK PRECISION®
MAXTEC INTERNATIONAL CORP.
Domestic and International Sales
6470 W. Cortland St., Chicago, IL 60635
Tel: 312-889-1448 • Fax: 312-794-9740
Canadian Sales: DCS Electronics, Ltd.
Tel: 905-683-4500 • Fax: 905-683-8074

Circle (116) on Reply Card

Multimeter Update

What those meter accuracy figures mean

By Lamarr Ritchie

A multimeter is generally the first piece of test equipment selected by a consumer electronics technician when he diagnoses a product that has become faulty. In many cases, checking a few critical voltages and resistances is all that it takes to pinpoint the cause of the problem. In other cases, the meter readings isolate a general area of the chassis, and tell the technician where to apply the oscilloscope, signal generator or other test equipment to complete the diagnosis.

For a lot of diagnostic procedures, the accuracy of the meter is not critical; the tech merely needs to know if the voltage is there and if so, if its value is within the ballpark. On other occasions, it's important to know what a voltage or resistance is. Meter manufacturers provide specifications that tell the user how accurate readings may be expected to be. Here's a rundown of what those numbers mean.

Meter accuracy

Multimeters are not perfect. We can expect some degree of inaccuracy even with digital multimeters, although they are built with precision components and most are calibrated. There are several factors that affect the accuracy of a multimeter. One is, of course, that the components from which it is made will have a certain tolerance and may vary within small limits. Most multimeters use transistors, diodes and other semiconductor devices in their circuits that are sensitive to temperature and other factors.

The accuracy of an analog meter is usually specified as a percentage of the full-scale deflection. The readings of a meter with a full-scale accuracy of ±2% will be within two percent of the indicated value, but only if the pointer is at or very near full deflection. For most readings, which would be less than full scale, the accuracy would be a little less.

Digital multimeter accuracy is also given as a percent, but since the accuracy also depends upon the number of digits in the display, this is usually given in a form such as ±0.2%, ±1 digit. The digital meter is usually capable of displaying 3 or 4 digits. Most often, the most significant digit can only be a 1. The digital display could then indicate from 0 to 1999. This type of meter display is referred to as a 3-1/2 digit display.

The number of digits in the display would dictate what ranges the meter would have. This display would probably have a 2K range for resistance, for example. When this range is selected, the meter could read resistance values from 0.001KΩ (1Ω) to 1.999KΩ (1999Ω).

If the actual resistance value were 1245.5Ω, the meter could read either 1.245KΩ or 1.246KΩ, providing the accuracy was this good with the other factors considered. This is why the ±1 digit is added to the accuracy figure.

Errors caused by the measurement process

Another source of error has to do with the measurement process itself, particularly voltage and current measurements. It is impossible to make any measurement in a circuit without affecting the circuit in some way. This means that by connecting the voltmeter across a component to measure its voltage, the meter itself will change the voltage to some extent, making a 100% accurate measurement impossible. The effect of the meter on the circuit it is being used to measure is referred to as voltmeter loading.

The voltmeter will require some current to produce an indication in the meter. This current will be supplied by the source of power for the device being measured. This added current will cause more voltage drop across the other circuit resistances resulting in a lower reading than the actual voltage. This loading effect is present in all meters, but the higher the voltmeter resistance, the less loading effect it would have.

The ideal voltmeter would have an infinite resistance, and would thus not load the circuit at all. For digital multimeters, the actual resistance of the voltmeter is called the input impedance. This is usually in the range of 1MΩ to 10MΩ. This is quite high, and for most measurements

Ritchie is an electronics instructor at Kentucky Tech, Hazard Campus.

the loading effect of the digital multimeter is negligible.

Analog meter sensitivity

The rating that gives this voltmeter loading effect is somewhat different for the analog VOM. The rating in analog meters that corresponds to input impedance in digital meters is "sensitivity", specified in ohms per volt. The reason that this specification is expressed this way has to do with the way the voltmeter section of the analog meter is made, using a d'Arsonval meter movement.

The higher the sensitivity rating the better. That is, a meter with a sensitivity of 100KΩ/V will have less voltmeter loading error than one with a sensitivity or 50KΩ/V. You should also remember that a sensitivity of 20KΩ/V is just about the minimum that will give reasonable accuracy for most electronics work.

Accuracy in current readings

Current measurements involve breaking the circuit and placing the meter in series with the circuit. As you can imagine, this also affects the current. The presence of the meter in the circuit will reduce the actual current somewhat because of the meter resistance. The ideal ammeter has a resistance of 0Ω. There are none that are actually 0Ω, but it will be quite low. The lower the ammeter resistance, the less it will affect the current and thus the more accurate the measurement will be.

Since the meter resistance is so low, you should see why you must never connect the meter across the circuit when measuring current. This would place nearly a short circuit across the circuit and may cause damage. Most meters do not give a rating for the resistance of the ammeter function, but have only smaller current ranges where the low meter resistance will not influence the reading.

Keeping the meter accurate

A little common sense will help keep meters reading accurately. The first step, of course, is to buy a quality product from a recognized name. Meters will take a considerable amount of abuse, and that abuse can affect readings. Avoid subjecting meters to excessive heat, or other extremes. The highest quality products are made to tolerate all kinds of environmental punishment, but, again, every injury takes its toll.

And it's a good idea once in a while to check one meter against the other. For example, take a few voltage and resistance readings with two meters. If they're in agreement for the most part, there's a good likelihood that they're both accurate. If they differ significantly, one of them is inaccurate. It would be a good idea to find out which one is inaccurate and either have it calibrated or replaced.

The multimeter is one of the handiest and most useful pieces of test equipment available to the technician, and for that reason it's important to take good care of it.

New consumer electronics technology

By The ES&T Staff

Digital technology along with constantly shrinking microminiaturization of circuits and components seems to make almost anything possible, and affordable, in consumer electronics. So many exciting new products have been developed in the past few years that it's hard to remember which of them came first: VCRs, camcorders, compact disc players, personal computers, and much more. It's amazing to think that all of these wonderful new devices are, to badly paraphrase Shakespeare, merely prologue. There's still a lot of product innovation yet to come for eager consumer electronics technicians to prepare to service.

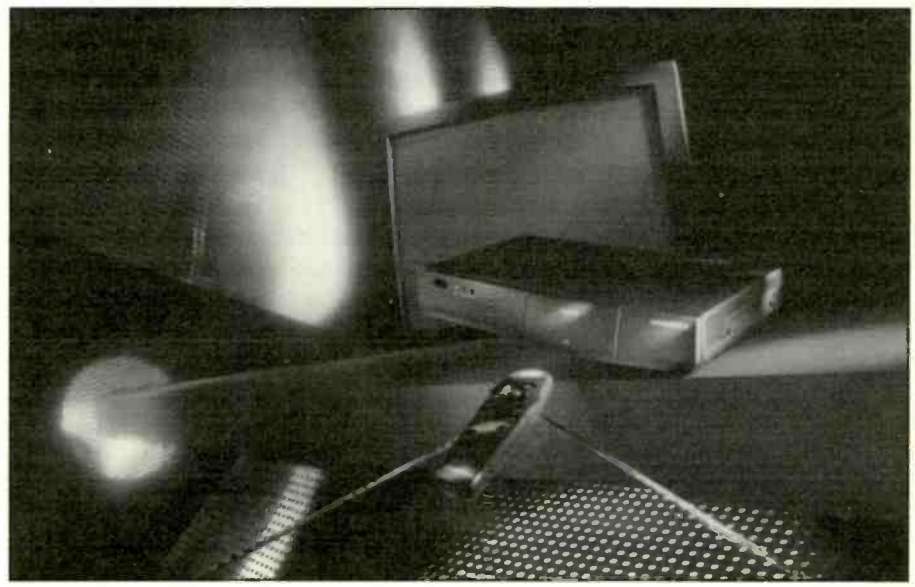


Figure 1. Television sets soon to hit the market will include circuitry that will allow people who don't own personal computers to access the Internet.

A TV that connects to the Internet

One example of late-breaking technology is a television that has the capability to connect to the Internet, and provides a number of other useful features. A number of consumer electronics manufacturers are in development of such a product, but one of the first actual products that has been announced is the UniView from Curtis Mathes. This system will allow millions of households to use their TVs to surf the Internet or use the on-screen program guide to search for movies or programs featuring specific subjects, stars or ratings. The Internet connection will be via a 28.8MBPS modem and full graphic web browser support.

Other features of the system are VCR programming, fax and e-mail capability. The technology also allows the telephone to be answered with the press of a button on the TV remote control, displaying the caller's name and telephone number automatically on screen as the phone rings. In addition, users can utilize one-touch telephone call-back and a built-in, executive style speaker phone for conference calls.

Moreover, the system allows parents to control what comes into their living rooms by enabling them to block objectionable channels, programs or individual episodes. All functions can be easily activated by a hand-held TV remote control.

"The Curtis Mathes UniView technology converts a television set from a passive viewing experience into a full-featured, interactive multimedia device," states Patrick A. Custer, Chairman/CEO of Curtis Mathes. "And yet, we have kept this technology easy to use for families and ordinary folks, not just engineers."

UniView set-top units can be used on any brand or model of TV and will be available in October. TVs incorporating the technology are expected to be available to consumers by this holiday season in 32", 35" and 50" models at additional cost over base models.

To go along with the new technology, the company offers the "Wireless SurfBoard," a wireless keyboard that will allow operation of the UniView system from up to 50 feet away without the necessity of aiming in a direct line of sight, which is required with infrared controls. The "SurfBoard" consists of a compact, 83-button keyboard and a mouse touch pad with dual mouse buttons and provides a high level of data integrity through its radio frequency wireless technology.

SmartCard TV, flat panel TV, HDTV, DVD and more

Philips Consumer Electronics Company has checked in with a number of technological innovations, including: SmartCard televisions, a multimedia access terminal, a ghost cancellation unit, flat panel and high definition televisions, a "smart" DVD (digital video disk) movie player, and a car navigation system.

The SmartCard television system will allow consumers to select the type of inte-

Figure 2. Ghost cancellation circuitry eliminates television ghosts, even where multipath reception is a fact of life.

CURRENT PRODUCTS and TECHNOLOGY

CONSUMER ELECTRONICS	COMMUNICATIONS	INFONETS/SERVICE	PERSONAL COMPUTERS
TV	Telephones	Internet	Desktops
Audio	TAD's	World Wide Web	Notebooks
Video	Cellular	America On-Line	Ethernal
Video Games	Pagers	Prodigy	Multimedia PC's
Home Theater	Modems	CompuServe	PDA's
Home Security	Caller ID	AT&T Imagination Net	Wave Table
DBS	Video Conferencing	Ardis	MPEG
	Alternating Voice/Data	Ram	Digital Cameras
		News Corp.	PCM/CIA

NEAR FUTURE PRODUCTS and TECHNOLOGY

CONSUMER ELECTRONICS	COMMUNICATIONS	INFONETS/SERVICE	PERSONAL COMPUTERS
Interactive	Screen Phones	Microsoft Network	Windows 95
2-way Wireless TV	Flex Pagers	Blockbuster	Intel P-6
DVD	ISDN	New Century Net	Voice Recognition
Digital TV/Video	HFC	Tele-TV	3-D Graphics
	SDV	Video on Demand	Home Networks
	ADSL	CDPD	CD-R
	Voice over Data	PCS	Home Media Net
	Cellular TDMA/CDMA	Electronic TV Guides	

Figure 3. This is the perception of one major consumer electronics manufacturer as to the state of consumer electronics technology today, and where it is headed.

gration and interactivity they want in a television. For example, viewers will be able to simultaneously access the Internet, receive telephone calls, watch TV, while also replacing the cumbersome VCR programming routines, with an elegant click drag and drop interface.

The company has perceived a need on the part of consumers to expand use of television with integrated products that provide entertainment, information and connectivity applications. The response was to develop a multimedia access tower (MAT) which will serve as the control center for consumer electronics and home peripherals. Along with MAT, Philips will offer a full range of consumer electronics peripherals with similar styling and common user interface. Scheduled for a first quarter 1997 launch, MAT will be preceded in the marketplace in the fourth quarter of this year by an Internet browser product with consumer electronics styling. This product is targeted at the 40 million households that do not own a personal computer because of cost.

For homes where television ghosts are a problem, available now is ImageLock, a device that eliminates ghosts on television screens and enhances picture quality. Currently 70 percent of the nation's broadcasters, whose signals reach 90 percent of viewers, are transmitting a ghost cancellation reference signal. Those viewers can purchase ImageLock and eliminate ghosting or multiple images on their television screen.

For an overall look at where Philips sees consumer electronics now and where they feel it is headed, see Figure 3.

READ ONLY		
Single Layer, Single Sided	DVD-5	4.7GB
Single Layer, Double Sided	DVD-10	9.4GB
Dual Layer, Single Sided	DVD-9	8.5GB
Dual Layer, Double Sided	DVD-18	17GB
RECORDABLE		
Write Once	Single Sided	3.6GB
DVD-R	Double Sided	7.6GB
Overwrite	Single Sided	2.6GB
DVD-RAM	Double Sided	5.2GB

Table 1. This is a complete list of numbers for the DVD systems.

HDTV

After nine years of development in this country, high-definition television (HDTV) is still a work in progress. It is, however, making progress. For example, at the annual convention of the National Association of Broadcasters (NAB) in Las Vegas in April, an HDTV signal was broadcast from a TV station to a TV system at the Las Vegas Convention Center. The system used was the HDTV system developed by the "Grand Alliance," consisting of AT&T, General Instrument, the Massachusetts Institute of Technology,

the David Sarnoff Research Center, Thomson Consumer Electronics, Philips Consumer Electronics and Zenith.

For a number of reasons, it will still be some time before this system is in use commercially in this country. For one thing, broadcasters have asked the U.S. government to provide them with a large segment of the radio frequency spectrum without cost so that they can develop the system without spending what they consider to be a prohibitive amount of money, over and above the high cost of purchasing HDTV broadcast equipment, for the additional frequency allocations that will be required. The stated intention is, once HDTV has been established they will turn unused spectrum back to the government to auction off.

Others believe that such a use of the frequency constitutes a giveaway to the broadcast industry, and that they should pay their own way in this venture. These decisions are yet to be made.

Moreover, at this moment the receivers with the advanced technology to receive the HDTV signals are still in the development stage and will not be available for several years.

One step in that development process has been made by two companies. Mitsubishi Electric Corp. and Lucent Technologies (AT&T's systems and technology businesses) have agreed to jointly develop a set of semiconductor chips that together will perform all of the functions needed for next-generation HDTV sets for the U.S. market.

The chip set will be used by Mitsubishi in its own planned HDTV receiver, and will be sold by both companies to other TV receiver manufacturers.

HDTV, also known as Advanced Television, or ATV, is a proposed new standard for television broadcasting that would replace the 45-year-old NTSC (National Television Standards Committee) standard in the U.S. with a digital technology that can offer movie-theater-quality picture and sound.

The Mitsubishi/Lucent chip set will receive HDTV broadcast signals, process them, and display them on a high definition screen all in compliance with specifications that the FCC recommended in May. The first samples of the chip set will be available in early 1998.

"We believe that we are the first two companies to announce plans to develop a complete HDTV chip set, and hope to be the first to bring HDTV silicon to market," said Jay Kshatri, manager of consumer video marketing in Lucent Technologies' Microelectronics Group. "By doing so, we hope to speed the introduction and acceptance of HDTV in the U.S."

"This chip set is an ambitious engineering undertaking, comprising approximately ten million transistors and associated circuitry," said Yoshiyuki Nakai, chief engineer, Microcomputer and ASIC Division of Mitsubishi.

The chip set will consist of five application-specific integrated circuits (ASICs):

- a demodulator, which separates the digital signals from the analog carrier wave on which they are transmitted;
- a demultiplexer, which separates the audio portion of a transmission from the video portion;
- an image decoder, which decompresses an encoded video signal;

Disk Diameter	120mm
Disk Thickness	1.2mm (2 x 0.6mm)
Track Pitch	0.74u
Laser Wavelength	650nm/635nm
Numerical Aperature	0.6
Error Correction	Read Solomon Product Code
Signal Modulation	8 to 16
File Management Structure	Micro UDF and/or ISO-9660

Table 2. This is an overview of the specifications of the DVD system.

• an audio decoder, which does the same for the audio portion of the transmission; and

• a display processor, which transforms decoded video signals to a number of display formats.

The demodulator and demultiplexer chips are being developed by Bell Laboratories, the research and development arm of Lucent Technologies; the image decoder will be developed by Mitsubishi with support from Bell Labs; and the audio decoder and display processor chips are being developed by Mitsubishi.

"By collaborating with Lucent, we can shorten the time it would take any one company to develop all five chips, and share the development costs," said Nakai. "In so doing, we hope to have sets in stores sooner, and with a lower price tag."

"We're combining Bell Labs' core competence in signal encoding and decoding, transmission and processing, with Mitsubishi's deep expertise in TV receiver system design, high definition display technology, and audio and display processing technology," added Kshatri.

Digital versatile disk

Digital versatile disk (DVD) is a new data (computer data, full motion video, audio) storage format. According to industry press information, it is expected to be available sometime in the third quarter of this year. Maybe it's in stores now.

In the early stages of developing this new format, there were actually two formats being developed: one called super density disk (SDD), the other called multimedia CD (MMCD). Rather than develop two separate formats, the principals in these developments decided to work together. They considered the needs of both the traditional consumer electronics industry (TV, audio, video) and the personal computer camp, and developed a set of specifications that would be usable in both systems.

The product that was born as a result of this cooperative approach is the digital versatile disc (DVD), a digital disk that is of exactly the same dimensions as an audio CD or a CD-ROM, but that can store 4.7GB (4.7 gigabytes, or 4.7×10^9 bytes) of data; seven times as much data as will fit on a CD.

The track pitch of the new disk is 0.74µm (0.74×10^{-6} meters), compared to 1.6µm for an audio CD or CD-ROM, or better than twice as dense. Because the information-containing pits at this density are necessarily smaller, it was necessary to decrease the wavelength (increase the frequency) of the laser pickup. The wavelength of the DVD laser is 650nm (650×10^{-9}m), compared to a wavelength of 750nm typical of CD lasers.

Both recordable and read-only

It is currently planned to have DVD systems available in both read-only and recordable configurations. Data density for the recordable versions will be less than that of the read-only version. The read-only system will be capable of data densities from a minimum of 4.7GB to 17GB The discs for the recordable system will feature data densities of 2.6GB to 7.6GB.

Average data transfer rate for either system is 4.69MB/S (4.69×10^6 bytes/second). See Table 1 for a complete rundown of the numbers for each of the systems.

The formats

Because of the large amount of data that can be stored on these disks, and the high rate of speed at which it can be read from the disc, this system can be used in consumer video systems. Discs recorded in the DVD-5 format, for example, will be capable of storing over two hours of

full-frame MPEG2 video (MPEG stands for motion picture experts group, and is a format for storing and retrieving video in digital form), with Dolby AC-3 digital surround sound. Picture resolution will be at 720x480 pixels. This resolution is better than the resolution offered by laser disc, which, in turn, is far better than VHS tape picture resolution.

For an overview of the specifications of the DVD system, look at Table 2.

The ac line as the home's information superhighway

A new family of products is being launched that delivers what the manufacturer says is the long-sought-after "holy grail" of home electronics; the ability to transmit voice, video, audio and data (V V A D) over a home's existing ac wiring.

The products, known as ezPhone, ezTV, ezAudio, ezCom and ezRemote rely on a proprietary new technology called Customer Premises Area Network (CPAN), that transforms the existing electrical wiring in any house into a high-tech transmission medium that can simultaneously carry V V A D, eliminating the need to wire a home. The products were created and are marketed by Elcom Technologies Corporation of Malvern, PA.

In effect, these products enable homeowners to place any brand, make or model of phones, TVs, stereos, computers, printers, and other electronic equipment virtually anywhere without stringing cables or fishing wires through walls.

The family of products consists of a palm-size transmitter and receiver that sends and receives signals over a home's electrical wiring. According to the manufacturer, the CPAN technology separates specific frequencies from other noise on the ac wire, a hurdle that has thwarted earlier attempts to use electrical wiring as an in-home information superhighway and entertainment pipeline.

As an example of the use of these products, a consumer can add a telephone extension where there is no telephone jack by plugging the telephone line into the ezPhone transmitter and then plugging the transmitter into an ac outlet. The telephone can then be connected into an ezPhone receiver plugged into an ac outlet at another location in the house.

The other products allow consumers to transmit TV, TV remote control, computer data (for example to a printer located remotely from the computer), and audio throughout the house without installing special wiring.

Dealing with new technology, greater complexity

For any technician, all of this new technology represents a challenge. The technician will now have to learn about it in order to service it. For on site technicians it represents even greater complexity. The likelihood of encountering an almost indecipherable maze of wires and connections given some of these new systems would seem to be very great.

It's now possible to find a home theater type of system that has connections to the cable or a dish antenna, connections to telephone system so that the family can order pay-per-view events, connections to the stereo, the computer, electronic games, and now, seemingly extraneous connections to the ac wiring. For the technician who has to disconnect such a TV from one of these systems and bring it into the service center, it would be a good idea to draw a good map so he'll know how it to put it back together later. ■

Companies on the network

By Victor Meeldijk

Articles and news items constantly refer to the Internet. With approximately 3.5 million CompuServe, 3.3 million America OnLine, Inc. and 2 million Prodigy network users, and an estimated 14,000 new subscribers each day, more and more companies are signing on to the Internet and opening up Web sites.

Estimates on worldwide Internet use range from 5 to 30 million users. There were more than 22,600 commercial web sites in February 1996, about 600 of these sites opened in one week in that month.

This article provides Internet, E-mail and BBS addresses of some component distributors. A future article will list some electronics manufacturers.

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

Lots of computer users

In 1945, Thomas J. Watson, Chairman of the Board for IBM said, "I think there is a world market for about 5 computers". Contrast this with the fact that in 1994 nearly 17 million computers were shipped, with more than half of them used to replace older units. There are 20 million computers worldwide and Intel Corporation has estimated that almost 30% of U.S. homes have a computer, with the percentage expected to rise to 50% by the end of the decade. More and more businesses are going on the network to take advantage of this market potential. With the listings provided below you can take advantage of the Internet too.

Component Suppliers/Distributors on the Internet

Advacom, Inc.
http://www.advacom.com

All American
info@allamericansemi.com
http://www.allamerican.com

America II Group, Inc.
(Also known as A-1 Electronics)
http://www.america2.com
This firm is an independent distributor.

American IC Exchange
(formerly Bally Micro)
E-mail: ictrader@aice.com

Avnet Corp
Electronic Marketing Group
http://www.avnet.com
Allied Electronics:
http://allied.avnet.com
Hamilton Hallmark:
http://www.tsc.hh.avnet.com/
http://www.hh.avnet.com
Avnet Industrial:
http://www.avnet-industrial,com/avind/
Avnet Supply:
http://www.avnet-supply,com/avsupply/
Time Electronics:
http://www.time.avnet.com

BCD Electro
E-mail: bcdelect@onramp.net
http://www.bdelectro.com/bcd
(purchases and resells surplus electronic components)

Bell Industries, Inc.
Electronic Distribution Group
http://bellind.com

Bell Microproducts
http://www.bellmicro.com/

BJM Electronics, ltd.
http://www.bjm.com

California Switch & Signal, Inc.
http://www.calswitch.com

Capsco
http://www.capsco@ix.netcom.com

Car-Go Battery Company
http://www.car-go.com

Carlton-Bates Company
http://www.connecti.com/cbates

Chip Express Corporation
email: moreinfo@Chipx.com
http://www.elron.net/chipx/
(laser programmable gate arrays for 24 hour prototypes)

Chip Supply, Inc.
75664-3074@COMPUSERVE.com
(a supplier of semiconductor die)

Classic Components Corporation
http://206.14.133.66

Connex Electronics Corporation
http://www.industry.net/connex

Cyber International
http://www.cyber~us.com

Daitron, Inc.
http://www.daitron.com

Dalis Electronics
http://www.dalis.com

Digi-Key
http://www.digikey.com

Electronic Equipment Company
http:/www.igc.net/eec

Electronics Marketing Corporation
http://www.smartpages.com/emc

Electronics unlimited
electun@ix.netcom.com

Electronix Corporation
http://www.electronix.com/elexcorp
E-mail: elexcorp@erinet.com
(service items and repair parts for TVs, VCRs, PCs, microwave ovens, etc.)

Eric Electronics
http://www.ericnet.com

Federated Purchaser
http://www.federatedpurchaser.com

Future
(FAI, Future Active Industrial Electronics)
http://www.future.ca/Future/future.html

Hawk Electronics, Inc.
http://www.hawkusa.com

HLK & Associates, Inc.
http://www.industry.net/hlk
(This company specializes in finding hard to find or discontinued military and commercial parts.)

Insight
http://www.ikn.com
http://www.memec.com

Jaco Electronics
http://www.jacoeoelectronics.com

Joseph Electronics
http://www.joseph@shoga.wwa.com

JTM
http://www.jtment.com
E-mail: jtm@jtment.com, jtm@earthlink.net, and jtm@west.net

Kiesub Electronic Supply
http://www.acoaccess.com

Leo Electronics, Inc.
http://www.excess.com
(This company buys and resells excess electronic components)

Marshall Industries
http://www.marshall.com/
E-mail: browsers@001.marshall.com

Masline Electronics, Inc.
http://www.masline.com

Milgray
rhyman@milgray.email.com

Mouser Electronics
http://www.mouser.com

NECX Direct
http://www.necx.com
(This company has listings for used computers)

Nemal Electronics International, Inc.
http://www.nemal.com

The Network Group
sales@netgroup.com

The New Tube Company
http://www.74131612

North Atlantic Components, Inc.
http://www.northatlantic.com

Nu Horizons Electronics Corporation
http://www.nuhorizons.com
E-mail: info@nuhorizons.com
sales@nuhorizons.com

Peters-deLaet, Inc.
http://www.pdel.com

Pioneer-Standard
http://www.pios.com
E-mail: pioneer@pios.com corporate@pios.com
(includes Pioneer Technologies)

Performance Memory Products
(also known as Performance Electronics)
http://www.memorywld.com/~memory/chips/index/html

Powell Electronics
http://www.powell.com

Power House Electronics, Inc.
http://www.powerhouseelec.com

Q Components
http://www.qcomponents.com

Reptron
http://www.reptron.com

Richardson Electronics, Ltd.
http://www.rell.com

RicheyCypress
http://www.richeyelec.com
(Note: also owns Deanco, Inc.)

RPC Electronics
http://www.radioparts.com

Sager Electronics
http://www.sager.com

Simcona Electronics Corporation
http://www.simcona.com

Standard Data Resources
http://www.sdrinc.com

Sterling
info@emali.sterlink.com

Tauber Electronics, Inc.
http://www.tauber.com

Vertex Technologies, Inc.
http://www.vertextech.com

Western Micro Technology, Inc.
http://www.westernmicro.com

Wyle Electronics
http://www.wyle.com
In addition to these distributors, there is a component information service called PartNet, that allows search by characteristics for mechanical and electronic components from numerous vendors simultaneously. the Web address is: http://part.net

Phone Number Directories
AT&T 800 number directory:
http://att.net/dir800/
NYNEX Yellow Pages:
http://www.nylp.com

How to design and build a POST code reader—Part 3

By Harvey K. Schwertly, CET

Note from the editor: The POST code reader described in this article and in the article in the June issue is a fairly rigorous project and we don't recommend that it be attempted except by those readers who are advanced circuit builders who are well-versed in computers and digital logic. We have published this article because it was felt that even if an individual does not choose to build the POST code reader circuit described, the material in the article provides an excellent introduction to POST codes and the devices that are used to read and display them, as well as an excellent introduction to programmable logic devices, which are frequently encountered nowadays during servicing of consumer electronics products.

Schwertly is a digital systems technician, designer and instructor.

This is the third part of a three part article that provides details on the function, design and construction of a POST code reader card. The first article covered the PC booting process, listed some of the other POST readers that are on the market and described designing a different PAL for decoding all of the DIAGNOSTIC POST ports on the PCs. The second segment covered programming a PAL (programmable array logic) chip to convert binary data from the personal computer data bus to hexadecimal numbers on a seven-segment display using the proLogic compiler from TI (Texas Instruments).

This installment will cover programming the PAL16R8 integrated circuit and construction of the POST code reader.

Writing the program

I wrote the program using a text editor. The data lines have been used in this man-

```
  File 1 HEX.PLD
  title(HEX TO 7 SEGMENT DRIVER)
  include p16r8;
  pin12.d= (!pin5 & !pin4 & !pin3 & pin2 # !pin5 & pin4 & !pin3 & !pin2
        # pin5 & !pin4 & pin3 & pin2 # pin5 & pin4 & !pin3 & pin2);
  pin13.d= (!pin5 & pin4 & !pin3 & pin2 # !pin5 & pin4 & pin3 & !pin2
        # pin5 & !pin4 & pin3 & pin2 # pin5 & pin4 & !pin3 & !pin2
        # pin5 & pin4 & pin3 & !pin2 # pin5 & pin4 & pin3 & pin2);
  pin14.d= (!pin5 & !pin4 & pin3 & !pin2 # pin5 & pin4 & !pin3 & !pin2
        # pin5 & pin4 & pin3 & !pin2 # pin5 & pin4 & pin3 & pin2);
  pin15.d= (!pin5 & !pin4 & !pin3 & pin2 # !pin5 & pin4 & !pin3 & !pin2
        # !pin5 & pin4 & pin3 & pin2 # pin5 & !pin4 & !pin3 & pin2
        # pin5 & !pin4 & pin3 & !pin2 # pin5 & pin4 & pin3 & pin2);
  pin16.d= (!pin5 & !pin4 & !pin3 & pin2 # !pin5 & !pin4 & pin3 & pin2
        #!pin5 & pin4 & !pin3 & !pin2 # !pin5 & pin4 & !pin3 & pin2
        #!pin5 & pin4 & pin3 & pin2 # pin5 & !pin4 & !pin3 & pin2);
  pin18.d= (!pin5 & !pin4 & !pin3 & pin2 # !pin5 & !pin4 & pin3 & !pin2
        # !pin5 & !pin4 & pin3 & pin2 # !pin5 & pin4 & pin3 & pin2
        # pin5 & pin4 & !pin3 & pin2);
  pin17.d= (!pin5 & !pin4 & !pin3 & !pin2 # !pin5 & !pin4 & !pin3 & pin2
        # !pin5 & pin4 & pin3 & pin2 # pin5 & pin4 & !pin3 & !pin2);
  test_vectors(
pin1 pin11 pin5 pin4 pin3 pin2 pin12 pin13 pin14 pin15 pin16 pin18 pin17;
C     1      X     X     X     X     Z      Z      Z      Z      Z      Z      Z      ;
C     0      0     0     0     0     H      H      H      H      H      H      L      ;
C     0      0     0     0     1     L      H      H      L      L      L      L      ;
C     0      0     0     1     0     H      H      L      H      H      L      H      ;
C     0      0     0     1     1     H      H      H      H      L      L      H      ;
C     0      0     1     0     0     L      H      H      L      L      H      H      ;
C     0      0     1     0     1     H      L      H      H      L      H      H      ;
C     0      0     1     1     0     H      L      H      H      H      H      H      ;
C     0      0     1     1     1     H      H      H      L      L      L      L      ;
C     0      1     0     0     0     H      H      H      H      H      H      H      ;
C     0      1     0     0     1     H      H      H      L      L      H      H      ;
C     0      1     0     1     0     H      H      H      L      H      H      H      ;
C     0      1     0     1     1     L      L      H      H      H      H      H      ;
C     0      1     1     0     0     H      L      L      H      H      H      L      ;
C     0      1     1     0     1     L      H      H      H      H      L      H      ;
C     0      1     1     1     0     H      L      L      H      H      H      H      ;
C     0      1     1     1     1     H      L      L      L      H      H      H      ;
  )
```

File 1. This is the HEX.PLD, the source file for programming the PAL16R8, written using a text editor, based on the truth table for a binary to seven-segment display converter, shown in Figure 1.

```
File 2 HEX.LST
proLogic Compiler
Texas Instruments V2.0
Copyright (C) 1991 Prologic Systems


F U N C T I O N S
─────────


pin12.d=
    !pin5 & !pin4 & !pin3 & pin2
    # !pin5 & pin4 & !pin3 & !pin2
    # pin5 & !pin4 & pin3 & pin2
    # pin5 & pin4 & !pin3 & pin2

pin13.d=
    !pin5 & pin4 & !pin3 & pin2
    # !pin5 & pin4 & pin3 & !pin2
    # pin5 & !pin4 & pin3 & pin2
    # pin5 & pin4 & !pin3 & !pin2
    # pin5 & pin4 & pin3 & !pin2
    # pin5 & pin4 & pin3 & pin2

pin14.d=
    !pin5 & !pin4 & pin3 & !pin2
    # pin5 & pin4 & !pin3 & !pin2
    # pin5 & pin4 & pin3 & !pin2
    # pin5 & pin4 & pin3 & pin2

pin15.d=
    !pin5 & !pin4 & !pin3 & pin2
    # !pin5 & pin4 & !pin3 & !pin2
    # !pin5 & pin4 & pin3 & pin2
    # pin5 & !pin4 & !pin3 & pin2
    # pin5 & !pin4 & pin3 & !pin2
    # pin5 & pin4 & pin3 & pin2

pin16.d=
    # !pin5 & !pin4 & !pin3 & pin2
    # !pin5 & !pin4 & pin3 & pin2
    # !pin5 & pin4 & !pin3 & !pin2
    # !pin5 & pin4 & !pin3 & pin2
    # !pin5 & pin4 & pin3 & pin2
    # pin5 & !pin4 & !pin3 & pin2

pin18.d=
     !pin5 & !pin4 & !pin3 & pin2
    # !pin5 & !pin4 & pin3 & !pin2
    # !pin5 & !pin4 & pin3 & pin2
    # !pin5 & pin4 & pin3 & pin2
    # pin5 & pin4 & !pin3 & pin2

pin17.d=
    # !pin5 & !pin4 & !pin3 & !pin2
    # !pin5 & !pin4 & !pin3 & pin2
    # !pin5 & pin4 & pin3 & pin2
    # pin5 & pin4 & !pin3 & !pin2
proLogic Compiler
Texas Instruments V2.0
Copyright (C) 1991 Prologic Systems


F U S E   P L O T
─────────

      HEX TO 7 SEGMENT DRIVER

p16r8 revision 89.2.11

                11 1111 1111 2222 2222 2233
    0123 4567 8901 2345 6789 0123 4567 8901

  0 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
  1 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
  2 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
  3 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +   pin19.d
  4 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
  5 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
  6 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
  7 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

  8 X-- -X- -X- -X- — — — —   +
  9 -X- X-- -X- -X- — — — —   +
 10 X-- X-- -X- -X- — — — —   +
 11 X-- X-- X-- -X- — — — —   +   pin18.d
 12 X-- -X- X-- X-- — — — —   +
 13 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 14 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 15 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

 16 -X- -X- -X- -X- — — — —   +
 17 X-- -X- -X- -X- — — — —   +
 18 X-- X-- X-- -X- — — — —   +
 19 -X- -X- X-- X-- — — — —   +   pin17.d
 20 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 21 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 22 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 23 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

 24 X-- -X- -X- -X- — — — —   +
 25 X-- X-- -X- -X- — — — —   +
 26 -X- -X- X-- -X- — — — —   +
 27 X-- -X- X-- -X- — — — —   +   pin16.d
 28 X-- X-- X-- -X- — — — —   +
 29 X-- -X- -X- X-- — — — —   +
 30 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 31 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

 32 X-- -X- -X- -X- — — — —   +
 33 -X- -X- X-- -X- — — — —   +
 34 X-- X-- X-- -X- — — — —   +
 35 X-- -X- -X- X-- — — — —   +   pin15.d
 36 -X- X-- -X- X-- — — — —   +
 37 X-- X-- X-- X-- — — — —   +
 38 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 39 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

 40 -X- X-- -X- -X- — — — —   +
 41 -X- -X- X-- X-- — — — —   +
 42 -X- X-- X-- X-- — — — —   +
 43 X-- X-- X-- X-- — — — —   +   pin14.d
 44 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 45 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 46 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 47 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

 48 X-- -X- X-- -X- — — — —   +
 49 -X- X-- X-- -X- — — — —   +
 50 X-- X-- -X- X-- — — — —   +
 51 -X- -X- X-- X-- — — — —   +   pin13.d
 52 -X- X-- X-- X-- — — — —   +
 53 X-- X-- X-- X-- — — — —   +
 54 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 55 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

 56 X-- -X- -X- -X- — — — —   +
 57 -X- -X- X-- -X- — — — —   +
 58 X-- X-- -X- X-- — — — —   +
 59 X-- -X- X-- X-- — — — —   +   pin12.d
 60 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 61 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 62 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +
 63 XXXX XXXX XXXX XXXX XXXX XXXX XXXX XXXX   +

    |  |  |  |  |  |  |  |  |  |  |  |  |  |
pin2 |  3 |  4 |  5 |  6 |  7 |  8 |  9 |
     |    |    |    |    |    |    |    |
   pin1   18   17   16   15   14   13   11

Legend:

  X  : Cell intact      (JEDEC 0)
  -  : Cell programmed (JEDEC 1)

X- : True input term, Complement register term
-X : Complement input term, True register term
XX : Any XX pair in a product term yields product term LOW.
  — : No input term (don't care). A product term comprised
      entirely of — yields product term HIGH.
```

File 2. This is the HEX.LST file output by the proLogic compiler, based on the input of the HEX.PLD file.

```
File 3 HEX.JED
proLogic Compiler
Texas Instruments V2.0
Copyright (C) 1991 Prologic Systems

      HEX TO 7 SEGMENT DRIVER

p16r8 revision 89.2.11

*N_csidp16r8
*QP20
*QV17
*QF2048
*F0
*L0256 01111011101110111111111111111111
*L0288 10110111101110111111111111111111
*L0320 01110111101110111111111111111111
*L0352 01110111101110111111111111111111
*L0384 01111011011101111111111111111111
*L0512 10111011101110111111111111111111
*L0544 01111011101110111111111111111111
*L0576 01110111011110111111111111111111
*L0608 10111011011101111111111111111111
*L0768 01111011101110111111111111111111
*L0800 01110111101110111111111111111111
*L0832 10111011011101111111111111111111
*L0864 01111011011110111111111111111111
*L0896 01110111011110111111111111111111
*L0928 01111011101101111111111111111111
*L1024 01111011101110111111111111111111
*L1056 10111011011101111111111111111111
*L1088 01110111011110111111111111111111
*L1120 01111011101101111111111111111111
*L1152 10110111101101111111111111111111
*L1184 01110111011101111111111111111111
*L1280 10110111101110111111111111111111
*L1312 10111011011101111111111111111111
*L1344 10110111011101111111111111111111
*L1376 01110111011101111111111111111111
*L1536 01111011011101111111111111111111
*L1568 10110111011101111111111111111111
*L1600 01110111101101111111111111111111
*L1632 10111011011101111111111111111111
*L1664 10110111011101111111111111111111
*L1696 01110111011101111111111111111111
*L1792 01111011101110111111111111111111
*L1824 10111011011101111111111111111111
*L1856 01110111101101111111111111111111
*L1888 01111011011101111111111111111111
*C8452
*V01 CXXXXNNNNNN1ZZZZZZZNN
*V02 C0000NNNNN0HHHHHLHNN
*V03 C1000NNNNN0LHHLLLLNN
*V04 C0100NNNNN0HHLHHHLNN
*V05 C1100NNNNN0HHHHLHLNN
*V06 C0010NNNNN0LHHLLHHNN
*V07 C1010NNNNN0HLHHLHHNN
*V08 C0110NNNNN0HLHHHHHNN
*V09 C1110NNNNN0HHHLLLLNN
*V10 C0001NNNNN0HHHHHHHNN
*V11 C1001NNNNN0HHHLLHHNN
*V12 C0101NNNNN0HHHLHHHNN
*V13 C1101NNNNN0LLHHHHHNN
*V14 C0011NNNNN0HLLHHLHNN
*V15 C1011NNNNN0LHHHHHLNN
*V16 C0111NNNNN0HLLHHHHNN
*V17 C1111NNNNN0HLLLHHHNN
*AB66
```

File 3. This is the HEX.JED created by the proLogic compiler from the HEX.PLD file.

ner: DATA D = pin5, DATA C = pin4, DATA B = pin3, and DATA A = pin2. The segment lines have been used in this way: SEGMENT a = pin12, SEGMENT b = pin13, SEGMENT c = pin14, SEGMENT d = pin15, SEGMENT e = pin16, SEGMENT f = pin18, and SEGMENT g = pin17. The reason that pins 17 and 18 are reversed has to do with how they will be put on the PC board.

The next step is to create a file named HEX.PLD (File 1). The first line of this file is the title(). The title of the file is between the parentheses. The next line is the include statement to tell the compiler what model to use. Notice that the rest of the lines end with a semicolon (;). The next several lines are the equations that we took from the truth table, each equation ending in a semicolon.

The test vectors

The last section is the test_vectors(). Pin one of the PAL is used as the clock to latch the data into the register. The signal that is used as input to pin 1 of the PAL, the PAL's clock input, is not the clock signal from the computer; it is the !I/OW (input/output write active low) line. Pin one is positive edge triggered. When the signal from the !I/OW starts going high the data is latched from the data bus. The data stays current until the next !I/OW line goes active again.

Pin 11 is used to enable the chip. When this pin is high, the PAL is disabled. When the pin is low, the PAL is enabled. In this case it is tied to ground so that the chip is always enabled. The Xs can be either a one or a zero. The outputs are Zs, indicating an open circuit or high impedance state. This is known as the "tristated" condition. The rest of the lines are taken from the truth table.

The compiler

The compiler that I used is proLogic from Texas Instruments. It displays error messages if it encounters a mistake. The text file should have the extension PLD (Programmable Logic Device). I created the file HEX.PLD (File 1) using a text editor. After that I used the proLogic compiler to create the file HEX.LST (File 2) and the file HEX.JED (File 3). This will work smoothly providing that there are no errors in the HEX.PLD file.

Finally, after that is completed I used the proLogic Simulator which creates a file HEX.TST (File 4). Now there are four files HEX.PLD, HEX.LST, HEX.JED, and HEX.TST.

The files

The HEX.PLD (File 1) file is the ASCII text file, which we created. It has a title, include statement, the output statements or Boolean equations for the pins, and the test vectors or the truth table.

The HEX.LST (File 2) file was created by the compiler from the HEX.PLD file. It lists the equations from the PLD file and the fuse plot. This file shows you what fuses have been blown and which fuses are intact. An a indicates a blown fuse and an X indicates that the fuse is intact. The fuse plot should be compared to Figure 5 (Part 2). They must both be the same. If they are not the same, one or both have errors and must be corrected.

The HEX.JED (File 3) file was created

```
File 4 HEX.TST
proLogic Simulator
Texas Instruments V2.0
Copyright (C) 1991 Prologic Systems

Architecture Description: p16r8.lxa
JEDEC Fuse Information:   HEX.jed
JEDEC Test Vectors:       HEX.jed


V01     CXXX      XNNN      NN1Z      ZZZZ      ZZNN
V02     C000      0NNN      NN0H      HHHH      LHNN
V03     C100      0NNN      NN0L      HHLL      LLNN
V04     C010      0NNN      NN0H      HLHH      HLNN
V05     C110      0NNN      NN0H      HHHL      HLNN
V06     C001      0NNN      NN0L      HHLL      HHNN
V07     C101      0NNN      NN0H      LHHL      HHNN
V08     C011      0NNN      NN0H      LHHH      HHNN
V09     C111      0NNN      NN0H      HHLL      LLNN
V10     C000      1NNN      NN0H      HHHH      HHNN
V11     C100      1NNN      NN0H      HHLL      HHNN
V12     C010      1NNN      NN0H      HHLH      HHNN
V13     C110      1NNN      NN0L      LHHH      HHNN
V14     C001      1NNN      NN0H      LLHH      LHNN
V15     C101      1NNN      NN0L      HHHH      HLNN
V16     C011      1NNN      NN0H      LLHH      HHNN
V17     C111      1NNN      NN0H      LLLH      HHNN


No errors detected with 17 Test Vectors.
```

File 4. The proLogic Simulator which created this file, HEX.TST.

Table 1. Parts list.

Part #	Product #	Description	Quan.
21531	JE417	PC\XT 8BIT	1
28020	PAL16L8	PORTIOAD	1
28038	PAL16R8	HEX DECODER	2
108572	DIP RES	330 OHMS (8)	3
108599	DIP RES	1K OHMS (8)	1
24782	MAN74	SEVEN SEG. (CC)	2
34622	XC209R	RED LED	5
37161	14LP	14 PIN SOCKET	2
38607	20LP	20 PIN SOCKET	3

This is the parts list. I purchased mine from Jameco, but most or all of these components can be purchased from any full-line distributor.

Plus you need the standard handtools and wire, solder, and etc.

You can program the PALs yourself, or enlist the services of a local company to program the, or programmed PALs can be purchased from the author

Harvey K Schwertly
3226 Harris St.
Lemon Grove, CA 91945-2221

by the compiler. This file is used by the device programmer to program the chip. It lists the lines to be programmed and ones and zeros. Ones are the fuses that are blown and the zeros are the intact fuses. This file can be compared to both the JED file and Figure 4. They must all be the same. The line numbers start at 0000 and each line goes up by 32. The last line of the file is numbered 2016. The line numbers on the HEX.JED file and the line numbers on Figure 5 (Part 2), the logic diagram, are the same.

After that the next thing are the test vectors. They come from the HEX.PLD file. The first line of the test vectors starting with C is pin 1, the clock. The XXXX is pins 2 to 5, this is the inputs from the data

```
159F:0100 B000            MOV AL,00
159F:0102 BA8000          MOV DX,0080
159F:0105 EE              OUT
159F:0106 FEC0            INC AL
159F:0108 B284            MOV DL,84
159F:010A EE              OUT DX,AL
159F:010B FEC0            INC AL
159F:010D B290            MOV DL,90
159F:010F EE              OUT DX,AL
159F:0110 FEC0            INC AL
159F:0112 BA8002          MOV DX,0280
159F:0115 EE              OUT DX,AL
159F:0116 FEC0            INC AL
159F:0118 BA0003          MOV DX,0300
159F:011B EE              OUT DX,AL
159F:011C FEC0            INC AL
159F:011E BABC03          MOV DX,03BC
159F:0121 EE              OUT DX,AL
159F:0122 FEC0            INC AL
159F:0124 3CC0            CMP AL,C0
159F:0126 75DA            JNZ 0102
159F:0128 B44C            MOV AH,4C
159F:012A CD21            INT 21
```

Table 2. Debug program.

bus. The N indicates that these pins are not programmed. The 1 is pin 11, this pin is the output enable pin. If the data at this pin is a logic high the chip's output is disabled. The Zs are the open circuit or HI Z (impedance) state or tristated condition for pin 12 to 18 output to the seven segment display (CXXXXNNNNNN1ZZZZZZZNN).

In the second line the 4 zeros are the input from the data bus, the zero on pin 11 is an active low to enable the output to the seven segment display. The L stands for a low output, the H stands for a high output (C0000NNNNN0HHHHHLHNN). These test vectors should match the test vectors in the HEX.PLD file.

The HEX.TST (File 4) file was created by the simulator. This file has the same test vectors as the JED file unless it finds errors. If there are errors, this file will let you know what is wrong.

Figure 5 (Part 2) is the schematic of the POST Code Diagnostic Display. See the parts list, Table 1, for the bill of materials. The board was the most expensive part of this project. I used point to point wiring for the board, but it could also be fabricated using a copper-clad board.

Operation of this POST reader board

The PC XT features the microprocessor (8088), the bus controller (8288), and the DMA (Direct Memory Access or 8237) as the core chips. When the DMA

```
386SX POST CODE ADDRESSES, NUMBERS, AND MEANING
FFFF:0000       JMP F000:E05B
F000:E05B       JMP 80B9
F000:80B9
F000:81B0       01 NMI DISABLED AND ABOUT TO START
                REGISTER TEST
F000:81E4       02 REGISTER TEST OVER
F000:81FE       03 ROM CHECKSUM OK
F000:8342       14 8042 KEYBOARD CONTROLLER
F000:8383       JMP F1D4
F000:F1D4
F000:F1DC       JMP 8386
F000:8386
F000:83A4       04 8259 INITIALIZATION OK
F000:83CA       05 CMOS INTERRUPT DISABLED
F000:83F3       06 SYSTEM TIMER COUNTING OK
F000:843A       07 CH-0 OF 8254 TEST OK
F000:844F       08 CH-2 DELTA COUNT TEST OK
F000:845E       09 CH-1 DELTA COUNT TEST OK
F000:84C8       0A CH-0 DELTA COUNT TEST OK
F000:84EC       0B PARITY STATUS CLEARED
F000:850A       0C REFRESH & SYSTEM TIME OK
F000:8521       0D REFRESH LINK TOGGLING OK
F000:9060       10 ABOUT TO START 64K MEMORY TEST
F000:909C       11 ADDRESS LINE TEST OK
F000:90D4       12 64K BASE MEMORY TEST OK
F000:913D       15 CMOS READ/WRITE TEST OK
F000:91B8       16 CMOS CHECKSUM/BATTERY CHECK
F000:91E2       17 MONOCHROME MODE SET OK
F000:91F0       18 COLOR MODE SET OK
F000:91F7       19 VIDEO ROM SEARCH
F000:9213       1A OPTIONAL VIDEO ROM CONTROL OK
F000:925F       1B DISPLAY MEMORY R/W TEST OK
F000:928B       1C ALT. DISPLAY OK
F000:92C4       1D VIDEO RETRACE CHECK OK
F000:9311       1E GLOBAL BYTE SET FOR VIDEO OK
F000:9347       1F MODE SET FOR MONO/COLOR OK
F000:934D       20 VIDEO TEST OK
F000:9364       21 VIDEO DISPLAY OK
F000:9371       22 POWER ON MESSAGE DISPLAY OK
F000:9378       23 *
F000:9381       24 *
F000:9391       25 *
F000:9395       JMP AAE4
F000:AAE4
F000:AAEA       30 VIRTUAL MODE MEMORY TEST
F000:AB1C       31 VIRTUAL MODE MEMORY TEST STARTED
F000:AB32       32 PROCESS IN VIRTUAL MODE
F000:AB36       JMP AB57
F000:AB57
F000:AB73       33 MEMORY ADDRESS LINE TEST
F000:AB82       34 MEMORY ADDRESS LINE TEST
F000:AB92       35 MEMORY BELOW 1MB CALCULATED
F000:ABA0       36 MEMORY SIZE COMPUTATION OK
F000:ABAB       37 MEMORY TEST IN PROGRESS
F000:ABC5       38 MEMORY INIT. OVER BELOW 1MB
F000:ABDA       39 MEMORY INIT. OVER ABOVE 1MB
F000:ABE9       3A DISPLAY MEMORY SIZE
F000:ABF4       3B ABOUT TO START BELOW 1MB
F000:AC0A       3C MEMORY TEST BELOW 1MB OK
F000:AC14       3D MEMORY TEST ABOVE 1MB OK
F000:AC2B       3E ABOUT TO GO TO REAL MODE
F000:AC32       3F SHUTDOWN SUCCESSFUL
F000:AC3F       40 ABOUT TO DISABLE GATE A-20
F000:AC4A       41 GATE A-20 LINE DISABLED
F000:AC4F       42 ABOUT TO TEST DMA CONTROLLER
F000:AC56       43 *
F000:AB41       4E * ADDRESS LINE TEST OK
F000:AB48       4F * PROCESSOR IN REAL MODE
F000:AC69       JMP
F000:CEA4
F000:CECA       50 DMA PAGE RESISTER TEST OK
F000:CED1       51 DMA UNIT-1 BASE REGISTER TEST
F000:CEF1       52 DMA UNIT-1 CHANNEL OK, BEGIN CH-2
F000:CF02       53 DMA CH-2 BASE REGISTER TEST OK
F000:CF05       54 ABOUT TO TEST LATCH FOR UNIT-1
F000:CF14       55 F/F LATCH TEST BOTH UNITS OK
F000:CF35       56 DMA UNITS 1 & 2 PROGRAMMED OK
F000:CF5E       57 8259 INIT OVER
F000:CF6F       JMP
F000:93FE
F000:9429       71 KEYBOARD BATTERY TEST OK
F000:9464       72 KEYBOARD TEST OK
F000:948A       73 KEYBOARD GLOBAL DATA INIT.
F000:94AA       74 FLOPPY SETUP ABOUT TO START
F000:94D2       75 FLOPPY SETUP OK
F000:94E8       76 HARD DISK SETUP ABOUT TO START
F000:94F0       77 HARD DISK SETUP OK
F000:94F8       78 *
F000:94FF       79 ABOUT TO INIT. TIMER DATA
F000:9515       7A VERIFY CMOS BATTERY POWER
F000:9541       7B CMOS BATTERY VERIFICATION DONE
F000:954C       7C *
F000:9554       7D ANALYZE TEST RESULTS FOR MEMORY
F000:95C6       7E CMOS MEMORY SIZE UPDATE OK
F000:95E9       7F CHECKED OPTIONAL ROM C000:0
F000:9613       80 KEYBOARD SENSED TO ENABLE SETUP
F000:962A       81 OPTIONAL ROM CONTROL OK
F000:96B5       82 PRINTER GLOBAL DATA INIT. OK
F000:96DD       83 RS-232 GLOBAL DATA INIT. OK
F000:9777       84 80387 CHECK/TEST OK
F000:97B4       85 ABOUT TO DISPLAY SOFT ERROR
F000:98B6       86 GIVE CONTROL TO SYSTEM ROM E000:0
F000:98CC       00 CONTROL TO INT 19
F000:98DD       JMP 8FA4
F000:8FA4
F000:8FAB       INT 19
F000:8FC5
F000:9036       JMP 0000:7C00
F000:8FAD       AA *
Note: * DO NOT KNOW
```

Table 3. POST codes for the 386SX.

486 AMI BIOS, am not sure of their meaning at this time.		F000:50E1	2D	F000:E2C6	
FFFF:0000	JMP F000:E05B	F000:50E8	2E	F000:E2F7	60
F000:E05B	JMP F000:CFE0	F000:511D	30	F000:E2FE	61
F000:CFE0	JMP F000:CAFE	F000:5144	31	F000:E326	62
F000:CAFE		F000:514E	32	F000:E33F	63
F000:CBD8	01	F000:517B	CALL F000:7090	F000:E343	64
F000:CC0C	02	F000:7090	33	F000:E351	65
F000:CC35	03	F000:70B6	RET	F000:E372	66
F000:CC46	04	F000:517E		F000:E39B	67
F000:CC65	05	F000:5195	34	F000:E3AC	JMP 10E0
F000:CC6C	06	F000:51D7	35	F000:10E0	F4
F000:CCA0	07	F000:51DE	36	F000:10E7	80
F000:CCC4	08	F000:51F0	37	F000:1135	81
F000:CD02	00 JMP F000:CAFE	F000:51FA	38	F000:114B	82
F000:CD16	09	F000:5202	F3	F000:117A	83
F000:CD2A	0A	F000:5219	3A	F000:1194	84
F000:CD44	0B	F000:5223	3B	F000:1209	85
F000:CD5E	0C	F000:522A	JMP 43F4	F000:1241	86
F000:CD72	0D	F000:43F4		F000:124A	87
F000:CDAC	0E	F000:43FA	40	F000:12AA	88
F000:CDF4	0F	F000:4401	41	F000:12B6	89
F000:CDFB	10	F000:4425	42	F000:12CF	8A
F000:CE76	11	F000:4429	43	F000:12DE	8B
F000:CE90	12	F000:443F	44	F000:12EA	8C
F000:CEC3	13	F000:4470	CALL F000:70C0	F000:12F3	8D
F000:CECA	14	F000:70C0		F000:131F	8E
F000:CF1A	JMP 71B0	F000:7279	45	F000:1332	8F
F000:71B0		F000:732A	RET	F000:133A	90
F000:71B9	15	F000:4473		F000:1350	91
F000:71C0	JMP CF1E	F000:447D	46	F000:1358	92
F000:CFIE		F000:449E	47	F000:135F	93
F000:CF56	1A	F000:44AC	48	F000:136A	94
F000:CF89	1B	F000:44C0	49	F000:13B3	95
F000:CF8D	JMP F000:4FAC	F000:44DB	4A	F000:13BA	96
F000:4F4C	20	F000:44E6	4B	F000:13EC	97
F000:4F9F	21	F000:4522	4C	F000:1403	98
F000:4FB0	22	F000:453D	4D	F000:1410	99
F000:4FBE	23	F000:4550	4E	F000:1489	9A
F000:4FD4	24	F000:455E	4F	F000:1548	A0
F000:5013	25	F000:4568	50	F000:156B	A1
F000:5061	26	F000:4587	51	F000:1574	A2
F000:507C	27	F000:4590	52	F000:15DB	A3
F000:5089	F0	F000:45C4	53	F000:1608	A4
F000:5090	F1	F000:45DB	54	F000:1611	A5
F000:5097	F2	F000:45E0	55	F000:161C	A6
F000:509E	28	F000:45EC	56	F000:1624	A7
F000:50A7	29	F000:45F3	57	F000:1637	A8
F000:50B5	2A	F000:45FA	58	F000:1640	A9
F000:50C6	2B	F000:4607	59	F000:164D	AA
F000:50CF	2C	F000:461A	JMP F000:E2C6	F000:1654	00
				F000:1705	FF

Table 4. POST codes for the 486.

is in control of the busses, the microprocessor is in a no operation state and the bus controller is disabled. After the DMA completes its task it returns control back to the microprocessor and enables the bus controller. It does this by controlling AEN (Address ENable) and CEN (Command ENable) pins. There are other pins that control the latches, buffers, and transceivers. The pin we are concerned about is the AEN. When these pins are active the bus controller is enabled.

The microprocessor sends out signals on S0, S1, and S2 (on the other Microprocessors the lines are S0, S1, and M/!IO), the signal is 0, 1, and 0 respectively to the bus controller, this tells the bus controller to transmit data to the I/O (input/output) port, that is addressed by the latches . The bus controller sends out a signal to the address latches to latch that address into them. The ALE (Address Latch Enable) is the name of the pin. After the address has been latched into the chips.

The bus controller sends out the !IOW signal, then the bus controller sends out two signals to enable the transceiver and to transmit data from the microprocessor on its data bus to the expansion slot. When the correct address lines, the !AEN and the !IOW lines go active. This will send a pulse to the PAL address decoder on the board, then pin 12 will go low and that will latch the data from the data into PAL chips so that the POST code will be displayed on the seven-segment display.

Outside of the microprocessor, the system does memory or port read or write operations only, everything else is done in the microprocessor.

Construction

To build the board, purchase the parts first or use sockets for the programmed chips (PALs). The programmed PALs can be purchased from me. See the parts table. Just position the parts for your convenience, their position is not critical. Follow the schematic as you would in any other electronic device.

Attention to detail!

After assembling, make sure that the power pins are not connected together. If they are connected together, it is important to correct this situation.

Check all connections carefully. If

ES&T Calendar

ServiceTech '96: Fourth Annual Conference of Innovation in Services Technology
September 9-12, 1996
Boston, MA
800-333-9786 or 941-275-7887

1996 Technical Workshop
Video Laser Disk Technology & Servicing
September 11-13, 1996
Arlington, VA
703-907-7656

Eighth Annual Digital Audio & Video Workshop
October 1-4, 1996
Philadelphia, PA
703-907-7674

EIA/CEMA
1996 Technical Workshop
Color TV Technology & Servicing
October 2-4, 1996
Tampa, FL
703-907-7656

EIA/CEMA
1996 Technical Workshop
Color TV TEchnology & Servicing
October 8-10, 1996
Arlington, VA
703-907-7656

Business to Business Expo
VFW Hall, Memorial Building
October 9, 1996
Franklin Square, NY
516-221-6043

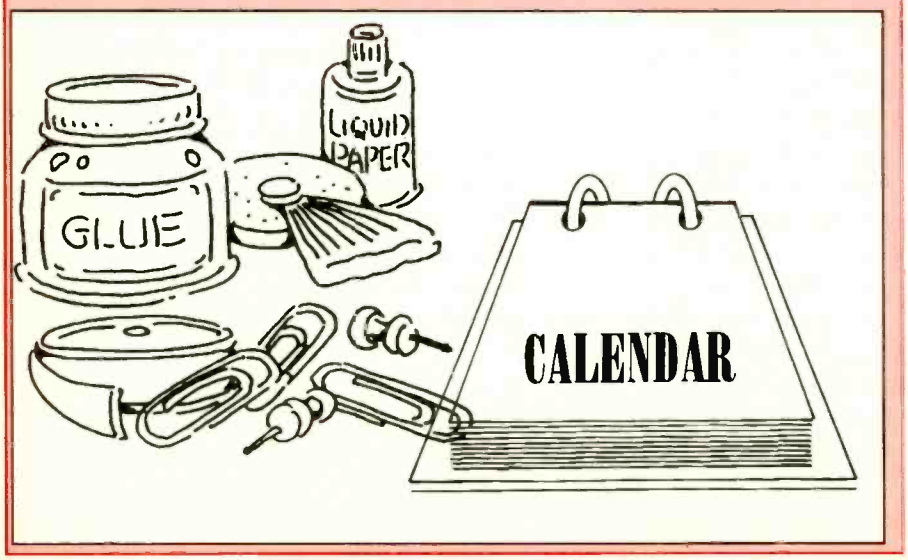
EIA/CEMA
1996 Technical Workshop
Color TV Technology & Servicing
October 14-16, 1996
River Grove, IL
703-907-7656

EIA/CEMA
1996 Technical Workshop
Computer Monitor Servicing
November 6-8, 1996
Arlington, VA
703-907-7656

EIA/CEMA
1996 Technical Workshop
Color TV Technology & Servicing
November 12-14, 1996
Walnut, CA
703-907-7656

International Winter Consumer Electronics Show
January 9-12, 1997
Las Vegas, NV
703-907-7674

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



everything looks okay, plug the board into any slot with the power off. Switch the power on and observe the POST code diagnostic display. The next section has a program that you can use to make sure the board works properly.

Program for checking board operation

Table 2 has the listing of the entire program that you can type in using DOS's DEBUG program.

POST code list

Using SOURCER and going through the unassembled BIOS step by step on a couple of computers, I have derived a listing of the POST codes for these computers. I confirmed these codes by using the POST code reader card. The assembly language text file is 846,252 bytes or 339 pages. I will only show two different AMI BIOSes. The first is from my 386SX laptop, the second is from a 486DX. I listed the addresses by segment: offset next to that a jump instruction or the POST code and the meaning. See Tables 3 and 4.

Conclusion

One way to gain useful information for use in troubleshooting a hard down computer is to use this POST code reader card, or one that you buy, and record the hexadecimal numbers representing each of the POST steps, and the order in which the BIOS emits them. This will help to familiarize yourself with the bootup process. If you are using a commercially manufactured board, you will most likely have a list of the POST codes that were provided with the POST card. If you're using a POST card that you made, you can then write to the BIOS manufacturer for the meaning of the POST codes that you listed.

Editor's note: Another source of BIOS code information for the AMI (American Megatrends, Inc.) BIOS is the book "Programmer's Guide to the AMIBIOS," Published by:

Windcrest/McGraw-Hill
Blue Ridge Summit, PA 17294-0850,
or you might try contacting:
American Megatrends, Inc.
6145F Northbelt Parkway
Norcross, GA 30071. ■

Test Your Electronics Knowledge

By Sam Wilson

Sam Wilson is currently busy with other urgent projects, and was therefore unable to prepare What Do You Know About Electronics/Test Your Electronics Knowledge for this issue. This is a reprise of a What Do You Know About Electronics/Test Your Electronics Knowledge that appeared in a previous issue.

1. A certain transducer has a specific dc output voltage that corresponds to a given temperature input. To use this transducer for a computer input you need.
   A. An A/D converter
   B. A D/A converter

2. Which of the following transducers produces a dc output voltage related to a given temperature input?
   A. Thermistor
   B. Hall Device
   C. Thermocouple
   D. (None of these choices is correct.)

3. Hexadecimal MNEMONICS can be converted into machine language in
   A. A PIO.
   B. An assembler.
   C. A PIA.
   D. An ACIA.

4. Which of the following can be missing in a phase-locked loop?
   A. An amplifier
   B. A high-pass filter
   C. Both choices are correct
   D. Neither choice is correct

5. Which of the following can be the output of a passive transducer?
   A. Inductance
   B. Capacitance
   C. Resistance
   D. All of the choices are correct.

6. A loudspeaker
   A. is an example of a transducer
   B. is not an example of a transducer

7. Which of the following is a type of motor used in clocks operated from the ac power line?
   A. Synchronous
   B. Brushless dc motor
   C. Induction motor
   D. All of these choices are correct.

8. In a superheterodyne radio receiver, heterodyning takes place in the mixer (or converter) stage. Name another section of a radio receiver where heterodyning takes place. _____

9. Refer to Figure 1. Which of the phasors is in the correct position to represent a series RC circuit?
   A. The one marked (a).
   B. The one marked (b).
   C. Both choices are correct.
   D. Neither choice is correct.

10. To save money, you and a friend divide a pie equally. You only eat one-fourth of your part, but you generously give your friend a fourth of your total share. Therefore, your friend got _____ of the original pie.

(Answers on page53)

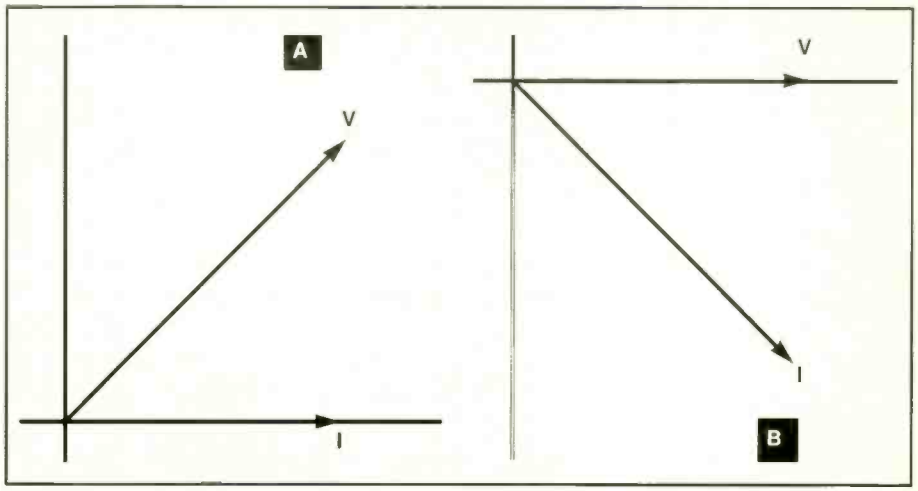


Figure 1. Which of these phasors is in the correct position to represent a series RC circuit?.

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

Try value pricing to increase your profit

By Charles Varble, Jr.

Value pricing is a concept about which we are starting to hear a lot more lately. Many business people are asking questions such as:

- What exactly is value pricing?
- What types of business are currently using value pricing?
- Why do they use value pricing?
- Could value pricing be used in my consumer electronics servicing business?
- How would you determine the pricing for value pricing?
- How would I implement value pricing for my business?
- What are the disadvantages of value pricing, if any?

This article will examine what value pricing is and scrutinize the many aspects of this pricing scheme.

What is value pricing?

Value pricing is the term used for the adjustment of the prices for merchandise or service based on the volume of business being done in any given time period. When business is brisk, the company charges their stated rates. When business slows down, the company offers reduced prices in order to attract more business.

For some businesses the period for which value pricing makes sense is for a short span of time in the afternoon, or evening, when business is slow. To attract more business during those hours, a company might offer the best pricing at the time that they would not normally be busy, or do not operate to full capacity. They sell their service at the regular price during the busy times. Value pricing helps to equalize the business cycle.

Value pricing is not new

Value pricing is certainly not a new concept. Many businesses use value pricing and have been using it for many years. Value pricing makes sense for a sales or service company to try in order to optimize the use of available resources.

A company is most profitable when it stays busy all of the time. Fixed expenses are the same whether a company is making sales or just waiting for business. Reducing prices during the slow times may allow a company to increase business during those times, resulting in an increase in income.

The telephone company uses value pricing in the evening and on Saturday and Sunday when their equipment is not being used to its potential. If you examine the rates you will find that they vary by a factor of about three from the highest rate to the lowest rate. This means that the lowest rate is about one third of the highest daytime rate. Customers do not question the fact that the long distance rate is higher in the daytime when businesses are using the telephone system heavily; they are happy to wait until evening to get a better rate.

Ice cream shops frequently have lower prices and "specials" in the winter time when business is traditionally slow. They also promote special pricing at the start of the warm season to get people used to coming back and purchasing from them.

"Early bird" specials in restaurants, seatings that usually occur between 4:30 and 6:00 PM, encourage people to come in then and save several dollars on a meal. Restaurants choose this time frame to attract two sets of people; those who ordinarily might not be planning to go to the restaurant at all, and some of those who might ordinarily be going to that restaurant later in the evening. Thus value pricing may both increase the total amount of business, and help to equalize the amount of business throughout the time when the establishment is open.

Another example of value pricing in the restaurant business is "twofers;" purchase one entree at regular price and receive the second one at an equal or lower price free. These special prices may only be available with a coupon, and may only apply some days, typically the slow days, and usually the drinks, appetizers and desserts are extra.

Filling stations have used value pricing for many years. When business is slow and gas supplies are plentiful they lower the price of gasoline and sell more of it. During the busy season, usually summer, the prices rise because customers use a lot more gas and are willing to pay the higher price.

Companies choose value pricing because it benefits their business. Frequently they start on a trial basis and reduce some prices and offer specials during the slow times and find that it does increase their profits. New customers come to them for the special prices and then decide to become regular customers.

Could I apply value pricing to my service business?

There are a lot of consumer electronic service centers, but I do not know a single one of them that uses the value pricing concept. Value pricing works for all of the other firms that use it and the trend is greater use of value pricing. It's something that consumer electronics service centers should at least look into, and perhaps experiment with.

Implementation of value pricing is fairly easy. You have to determine the times when you do not fully use your technicians and come up with a plan that will increase business during that time. You might find that summer is typically a slow time for you and you can come up with some promotions.

Offer a tune-up

You might offer a "VCR tune-up" that includes cleaning the video and audio heads, checking the tape tension, record

Varble is a retired consumer electronics service business owner.

and playback on all available speeds, and checking fast forward and rewind. You could also check the timer record and be sure to thoroughly clean the cabinet before you return the product to your customer. If you offer this service for a reduced price you will attract customers who will want to take advantage of it.

Some of the products that your customers bring in for the special service will need more major repair, further increasing your business. If you find that that's the case, you can give the customer an estimate on the complete repair.

Value pricing outside calls

If you provide outside service you might offer an in-home "TV tune-up" that includes degaussing of the set (very important) cleaning noisy controls and adjusting the color temperature, color and tint controls and focus and cleaning the screen. If you offer this at a fixed price that is slightly lower then your normal service call, it might produce some additional business.

Promote your specials

If you do not advertise regularly, you might put a small ad in the local paper and include a coupon that describes everything that you will do for the reduced fee. You might have someone in the office call your existing customers and tell them about this exciting offer.

You might include a special on cleaning projection TV sets. The picture produced by projection sets can be improved considerably by cleaning the picture tubes, lenses and screen, something the customer will really appreciate.

Increase prices when you're busy

Changing prices would also allow you to charge more during the very busy season when you cannot provide service as fast as your customers would like it. Your customers see the price of a service call and an estimate but they do not know what you charge for the many other item repairs. You can change these charges several times during your business cycle which will help you to make a profit.

Service charges should be reviewed at least annually and changes made as needed. In some cases you will have to decrease some of the rates, not because they are not justified, but because you are losing business because your customers are replacing the products instead of having them repaired.

If you provide warranty service it is important that you change your rates as often as your cost of providing service increases. You normally have to purchase and pay for the parts, and sometimes shipping, and you only recover the net cost of the parts at a later date when you are paid for the service.

Make sure you charge for everything

While value pricing may bring in addi-

tional income during periods when business is slow, it's also important that you charge for all materials and services that you provide the customer. For example, most invoices should include charges for "chemserv", chemicals and service data. A few years ago most companies just absorbed these costs but today you must collect for these items that cost you a lot in your business.

Chemicals and lubricants are very expensive and if you do not charge each customer something you are cheating your company. The costs of technical data and service manuals have also greatly increased in the past few years. Many manufacturers that supplied them at no charge now charge an annual fee which increases your cost of providing service.

Charge to deliver a repaired set to the owner. Some companies do not charge a delivery charge when a unit is delivered back, but delivery takes time and can not be absorbed with the service call charge only. Does your outside technician run a full schedule of calls and then take the deliveries also?

Price sheets

Printed price sheets are essential; every service center should use them. When you have an additional charge to install a module it should be on your printed price list.

When your technician solders in parts in the home the charge should be on his list and he should allow the customer to see it as he writes up the invoice. A customer will rarely question a printed price but he will complain if he thinks that your technician is pulling the price out of the air. If you do not use a computer to generate your price sheets you should have someone type up the price sheets and make a copy for each technician to carry.

Service prices should be on printed price sheets, and the sheets should be rigidly used. Your technician should use his printed price sheet even though he knows all of the prices from memory.

If you have a designated charge for installing a module or soldering in a part you should have the word "minimum" behind it. The advantage of this is that the technician can show the customer that he is charging them the minimum charge for the service rendered. Of course he can and should also charge more if the operation on a particular set is more difficult or time consuming then normal.

Provide detailed information

You should have detailed prices for cleaning and lubricating the tuner, repairing push button switches, convergence adjustments and color temperature adjustments and other routine services.

Detailing charges will produce more income for you and will make the customer feel more comfortable because each itemized charge is not very much even though the total service bill may be quite expensive. Make sure that parts

charges are listed separately and that each item of service is detailed. Make sure the service call, and delivery if applicable, are listed separately.

If a customer questions the high cost of a repair ask him what part of the bill appears high to him. You might explain that the bill could be less if you did not put in all of the replacement parts but then he would have an incomplete repair and would experience problems in the future.

Evaluate before you come to a conclusion

Take time to check the unit thoroughly even though it is obvious to you what the problem is when you take your first look at the set. One of our customers called with a complaint about her TV set. John, the technician who went on the call, almost told her before he took the back off of the set that it looked like a bad picture tube, but he checked the high voltage and screen supply voltages anyway. He then told the customer that the picture tube was bad.

The customer authorized him to replace the picture tube and do the necessary work. She commented that she had called someone else and "as soon as he walked in the door he said 'lady your picture tube is bad,' so I did not even let him check my set. I could see that your technician thoroughly checked my set and made sure that the picture tube was really the part that was bad."

Be honest

Honesty is still the very best policy. Never allow your technicians to charge for a service that was not provided. Never put in parts that are not needed and of course never charge for parts that you do not install. Never bill a manufacturer or a dealer for a service that you did not perform. Your integrity should be beyond question. If you are dishonest, or do not stick to your word, your associates and employees will find out and it will be difficult to keep their trust.

Sell the value of the service

Consumers resent paying for service because you have just restored their product to the condition that it was in shortly before the unit failed. Frequently they do not really feel that they have received value for the money spent.

You probably feel the same way when your car stops running and you have to pay for service. If you install an outdoor antenna, or perhaps extra speakers, the customer can see the value in the money spent but, they do not perceive the same value for service rendered even though it may have been much more difficult then installing something new. Tell you customers truthfully that they have a good product and the service you provided is guaranteed and will give them good service. It is very important that you sell the service to the customer.

Disadvantages of value pricing

What are the disadvantages of value pricing? You may have customers who would compare the charges for a specific job and found that the charges were different. When they question you about the differences you should say that the lower price was charged because of a special price that was applicable only during the time frame when the service was rendered. You also have to spend some time to analyze your business and see when and how you would apply value pricing. You might need to make an additional price list to use.

Another problem could be that you get more business then you can handle, but that is a "problem" that most people in business would welcome. In a case like this, you can usually increase the hours worked, or hire additional personnel if necessary. A problem many restaurants encounter is that a customer requests the "early bird special" even though it is past the time for the special. In many cases the customer stays and dines at whatever prices prevail at the time.

Experiment with value pricing for your service business. You may find that it can restore needed profits, keep your personnel busy during the traditionally slow times, and give customers added incentives to do business with you. ■

Test Your Electronics Knowledge

Answers to the quiz

(from page 49)

1. None of these choices is correct. The diode is used primarily in high-voltage circuits, and is there to protect the regulator in case of loss of input voltage.

2. C - A thermistor is a passive transducer. It does not produce an output voltage. A hall device senses a magnetic field. The thermocouple is an active transducer. For a given temperature its output is a dc voltage.

3. B - This is what an assembler does.

4. C - A phase locked loop may not have an amplifier. It has a low-pass filter but not a high-pass filter.

5. D - Passive transducers are made for each of the outputs listed.

6. A - The loudspeaker input is electrical energy and the output is sound energy.

7. A - The speed of a synchronous motor depends upon the frequency of the input power.

8. There are two possible answers: The BFO (beat-frequency oscillator), and the diode detector.

9. D - Both show the voltage leading the current. The current leads the voltage in an RC series circuit.

10. 5/8 of the original pie.

Bar code guide book

The Bar Code Products division of Numeridex, Inc., announces the publication of a new 20-page "Professional's Guide to Bar Coding".

This guide is a desktop reference for new or advanced bar code users. The guide covers the basic decisions you will face in assessing your bar coding needs and implementing a system to meet them, and can also function as a reference source on the key aspects of bar coding. The guidebook provides descriptions of the different symbologies and includes an extensive glossary of bar code terms.

Circle (20) on Reply Card

Soldering and desoldering systems catalog

A new 32-page catalog featuring soldering stations and irons with sensor tips that assure stable tip temperatures, fume absorbers, flux dispensing and rework tools, and related products is being offered by Bonkote America, Inc.

The catalog features a broad range of soldering stations, variable temperature control soldering irons, pencil-type and standard size irons with built-in sensor tips to assure stable tip temperatures, flux dispensing tools, dual station fume absorbers, digital iron testers, digital thermometers, iron stands, hot tweezers, and desoldering and rework systems, tools, and tips.

Circle (21) on Reply Card

Electronics catalog

MCM Electronics announces their newest catalog - number 37. This catalog includes over 3,800 new items, including project accessories, semiconductors, connectors, test equipment, computer products, audio, and hundreds of original OEM and generic TV/VCR repair parts. The catalog also announces permanent price reductions on semiconductors, video heads, flybacks, and many other items used in consumer electronics service.

Circle (22) on Reply Card

CFC-free chemicals catalog

Rite-Off, Inc. offers their Generation 2000 Electronic products catalog. This catalog provides detailed information on the company's products that are formulated without chlorinated fluorocarbons (CFCs) so that they comply with environmental regulations and do not cause depletion of the ozone layer in the atmosphere. Included are detailed descriptions of the company's products such as isopropyl alcohol, 1,1,1-trichloroethane, electronic washer/degreaser, label and adhesive remover, contact cleaners, defluxers and more. Other products detailed in this brochure are the company's line of non-CFC dusters and component coolant spray, anti-static chemicals, swabs, wipes and desoldering braids.

The back page of the brochure contains a thumbnail history of the company, and a comparison chart of the chemicals in the brochure. The chart allows the purchaser to compare the company's solvents for such characteristics as compatibility with plastics, evaporation rate, residues after drying and flammability.

Circle (23) on Reply Card

Catalog of ISO 9001 compliant chemicals

M.G. Chemicals offers their catalog of chemicals that comply with the ISO 9001 quality standards set by the International Standards Organization. The catalog provides detailed descriptions of the application of the chemicals manufactured by the company that are intended for use in electronics, such as control cleaner, contact cleaner, rubber rejuvenator, dusters, head/disc cleaner, coolant spray, isopropanol, and more. Also described in the brochure are brushes, swabs, desoldering braid, and a photofabrication kit for producing PC boards.

Circle (24) on Reply Card

Brochure of pick-and-place tools

Virtual Industries offers a brochure detailing their line of ESD-safe vacuum handling tools. These are vacuum-operated tools that allow the service technician to easily pick up tiny electronics components, such as surface-mounted resistors, transistors and ICs and place them in the precise location on the printed circuit board for soldering. Products in the brochure range from simple finger-operated tools that require no outside source of vacuum to high performance continuous vacuum handling systems.

Circle (25) on Reply Card

BOOKS

VCR Cross-Reference and Parts Cross Reference, ISCET, $29.95 (book), $69.95 (disk)

Version Seven of the VCR Cross-Reference and Parts Cross Reference is now available in both paper and software editions from the International Society of Certified Electronics Technicians (ISCET).

The software allows the user to search by manufacturer for model numbers and description for part numbers, and a subsearch by manufacturer and part description is also a feature of the program. The editing sequence for parts shows on screen all the available substitutes for the part entered.

There are 1,746 models and over 6,000 parts with all updated prices in the 144-page laser-printed book. The book is three-hole punched and shrink-wrapped for ease of filing. Even though the model and part numbers have been increased by hundreds, the price for the new edition will remain the same. The book sells for $29.95 plus $3.00 shipping.

First time purchasers of the software can buy the program and data disks (one 3-1/2 or two 5-1/4 disks) for $69.95 plus $2.00 shipping. Registered previous purchasers of the original program can purchase the upgrade for $29.95 plus shipping.

ISCET, 2708 West Berry, Fort Worth, TX 76109

Vehicle Security Systems, Build Your Own Alarm and Protection Systems, By A.L. Brown, Butterworth-Heinemann, 160 pages, $28.95 paperback

Butterworth-Heinemann is pleased to announce the publication of Vehicle Security Systems, Build Your Own Alarm an Protection Systems by A.L. Brown. The menace of car theft has afflicted us all. If not directly, then through spiraling insurance premiums, we are all paying the price of the crime wave on our streets and dashboards. This book provides the enterprising electronics enthusiast with all information and designs they need to take a step towards a more secure life, by comprehensively protecting their car.

Every circuit in this book is clearly described and illustrated, and contains components that are easy to source. Advice and guidance are based on real experience, and the designs themselves have been rigorously put to use on some of the most car-crime-ridden streets in the world. The designs in this book include systems as simple as a warning beacon, a range of immobilizers, and a basic alarm system; and more advanced systems that include add-on features such as a personal attack button and a courtesy light delay. Intruder detectors are described, and full constructional details are given including a guide to fault diagnosis and step-by-step installation instructions.

Butterworth-Heinemann, 313 Washington Street, Newton, MA 02158-1626

Power Supply Projects: A collection of innovative and practical design projects, Butterworth-Heinemann, 177 pages, $19.95 paperback

Using circuit diagrams, PCB layouts, parts lists and clear construction and installation details, this latest book in the Maplin series provides everything someone with a basic knowledge of electronics needs to know to put that knowledge into practice, according to the publisher.

This collection is a variety of power supply projects, including laboratory power supply projects for which there are a wide range of applications for the hobbyist, from servicing portable audio and video equipment to charging batteries; and miscellaneous projects such as a split charge unit for use in cars or similar vehicles when an auxiliary battery is needed to power 12V accessories in a trailer.

While all circuits given with integrated circuits in the book are intended for experimental use only, they are not full projects by any means, a printed circuit board track and layout are detailed.

Butterworth-Heinemann, 313 Washington St. Newton MA 02158-1626

McGraw-Hill Circuit Encyclopedia Volume 3, By John D. Lenk, McGraw-Hill Professional Book Group, 706 Pages, hardcover

Hundreds of pre-designed circuits organized by function along with specific testing strategies and troubleshooting approaches for locating problems during circuit failure make this newest guide in the Circuit Encyclopedia series useful to engineers, technicians and hobbyists. According to the publisher, Volume 3:

- familiarizes the reader with more than 700 circuits commonly used in all phases of electronics,
- allows easy integration of circuits into user systems,
- presents actual circuits with proven component values in full detail so that the circuits can be used without alteration
- shows how circuit values can be selected to meet goals on frequency range, power output, bandwidth and other important parameters.

Also included is information covering amplifiers, power supplies, special analog circuits, micropower circuits, digital systems support, converters, switching regulators, interface circuits, signal conditioning, timers, oscillators and generators, Norton amplifiers and more.

This guide also features substitution and cross-reference tables to help locate substitute ICs, circuit sources with full mailing addresses, and more than 750 detailed illustrations and drawings.

McGraw-Hill Professional Book Group, 13311 Monterey Ave, Blue Ridge Summit PA 17294-0850

Newnes Computer Engineers Pocketbook, Fourth Edition, By Mike Tooley Newnes, Butterworth-Heinemann, 272 pages, $24.95 hardcover

This edition of the Newnes Computer Engineers Pocketbook, Fourth Edition, by Mike Tooley has been completely restructured and rewritten to bring its coverage up to date.

Now established as a valuable compendium of facts, figures, circuits and data, this pocket book is useful to the designer, student, service engineer and all those interested in computer and PC systems. It covers a vast range of subjects at a practical level, with just the necessary explanatory text. The data is presented in a succinct and rapidly accessible form so that the book becomes part of an engineer's or technician's every day tool kit, according to the publisher.

Butterworth-Heinemann, 313 Washington St. Newton MA 02158-1626

What Do You Know About Electronics?

Visual modulation

By Sam Wilson

Sam Wilson is currently busy with other urgent projects, and was therefore unable to prepare What Do You Know About Electronics/Test Your Electronics Knowledge for this issue. This is a reprise of a What Do You Know About Electronics/ Test Your Electronics Knowledge that appeared in a previous issue.

Unless you are a specialist in communications, you may not have spent much time trying to visualize the various types of modulated signals. However, this is an important part of understanding modulation and other complex waveforms. It is especially important today when these complex waveforms are being converted into digital equivalents for the new all-digital audio and TV systems.

In this article I want to lay some of the groundwork that will give a better understanding of some modulated waveforms.

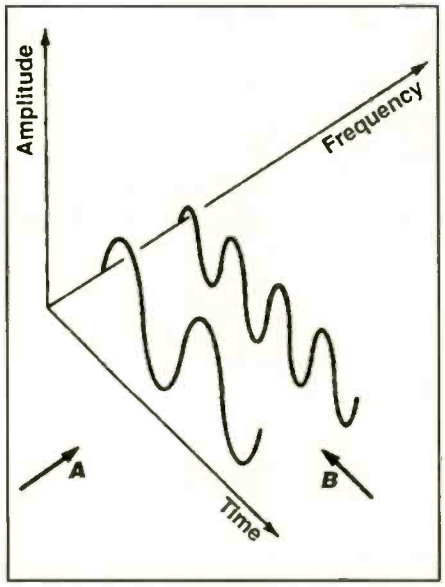


Figure 1. This representation gives a picture of how the amplitude, time and frequency are related in a waveform.

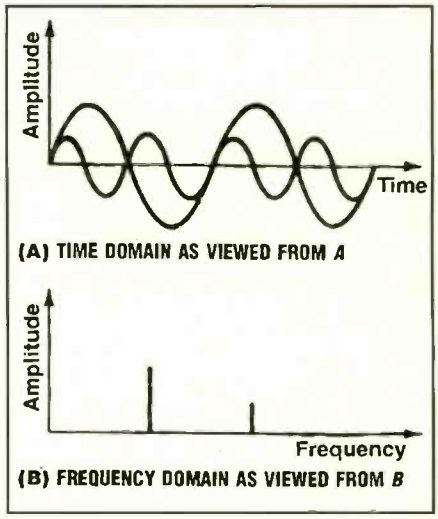


Figure 2. Looked at in the direction of arrow A in Figure 1 (the time domain), the amplitude-time-frequency plot would look like the one shown in A. Looked at in the direction of arrow B in Figure 1 (the frequency domain), the amplitude-time-frequency plot would like the one in B.

Oscilloscope displays

The oscilloscope is the best instrument to use for visualizing waveforms. Unfortunately, it only provides a 2-dimensional display of a 3-dimensional waveform, so, we have to imagine our position for the third dimension.

There are three facets of a waveform: *amplitude*, *frequency* and *time*.

Figure 1 is a 3-dimensional drawing that shows how the three facets are related. Figure 2 shows how the waves look on a time domain display (viewed from A of Figure 1) and a frequency domain display (viewed from B of Figure 1).

Time domain displays are used when it is necessary to view the shape of a waveform. That is the usual oscilloscope display and it will not be discussed further in this article.

The *frequency domain display* is useful for showing the relationships between frequencies.

Another type called the *logic domain* displays the zeros and ones for various points in a logic circuit. It will not be discussed here.

There hasn't been much success with 3-dimensional displays, but I remember one very clever version. It was used to track the path of missiles that were fired down the Atlantic range.

The scope was made in an aquarium filled with a plain gelatin. The bottom of the aquarium was a relief map of the eastern seacoast of North and South America.

When the missile fired, its route was

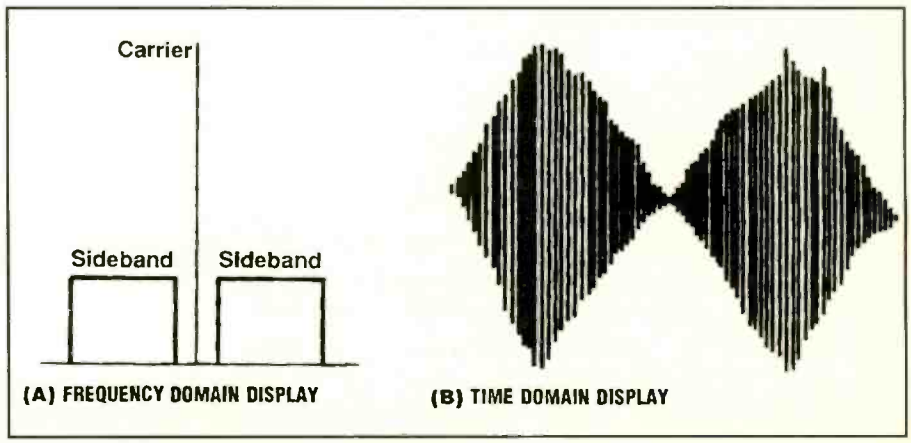


Figure 3. An amplitude-modulated signal would appear as the drawing of A in the frequency domain and as the drawing B in the time domain.

Wilson is the electronics theory consultant for ES&T.

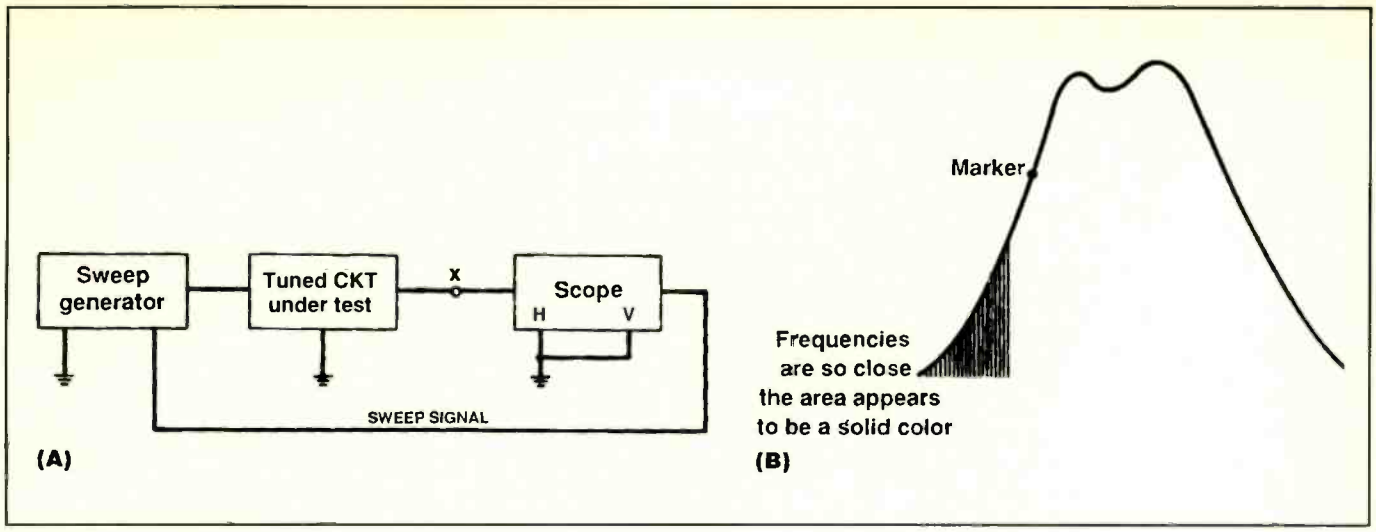


Figure 4. Sweep alignment is carried out using a setup such as this.

traced with the end of a fine(long) hollow needle. India ink was emitted from the end of the needle, and the ink was trapped by the gelatin.

As the missile moved, the ink from the pen left a permanent path that showed the down-range trajectory.

You can accomplish the same thing today with a personal computer graphic display. We have come a long way in the 30-plus years since the gel scope.

Figure 3 shows the frequency domain display of a signal that is amplitude modulated. A time domain display of the AM signal also is shown in this illustration.

In the frequency domain display, the carrier is a single frequency seen from the end view. There is an infinite number of frequencies set edge to edge in each sideband display. This display shows that over a period of time all of the audio modulating frequencies would eventually be present.

The two displays of Figure 3 demonstrate the problem of oscilloscope 2-dimensional displays. You can't see the sidebands in the time domain display, you can't see the waveshape in the frequency domain display. In other words, it takes two displays to show the signal accurately.

In order to perform a sweep alignment, it is necessary to use the oscilloscope in the frequency domain display. Figure 4 illustrates this concept.

The familiar test setup is shown in Figure 4(a). The sweep generator moves the scope trace horizontally along the line that is marked "frequency" in Figure 1. The amplitude at every point is based on

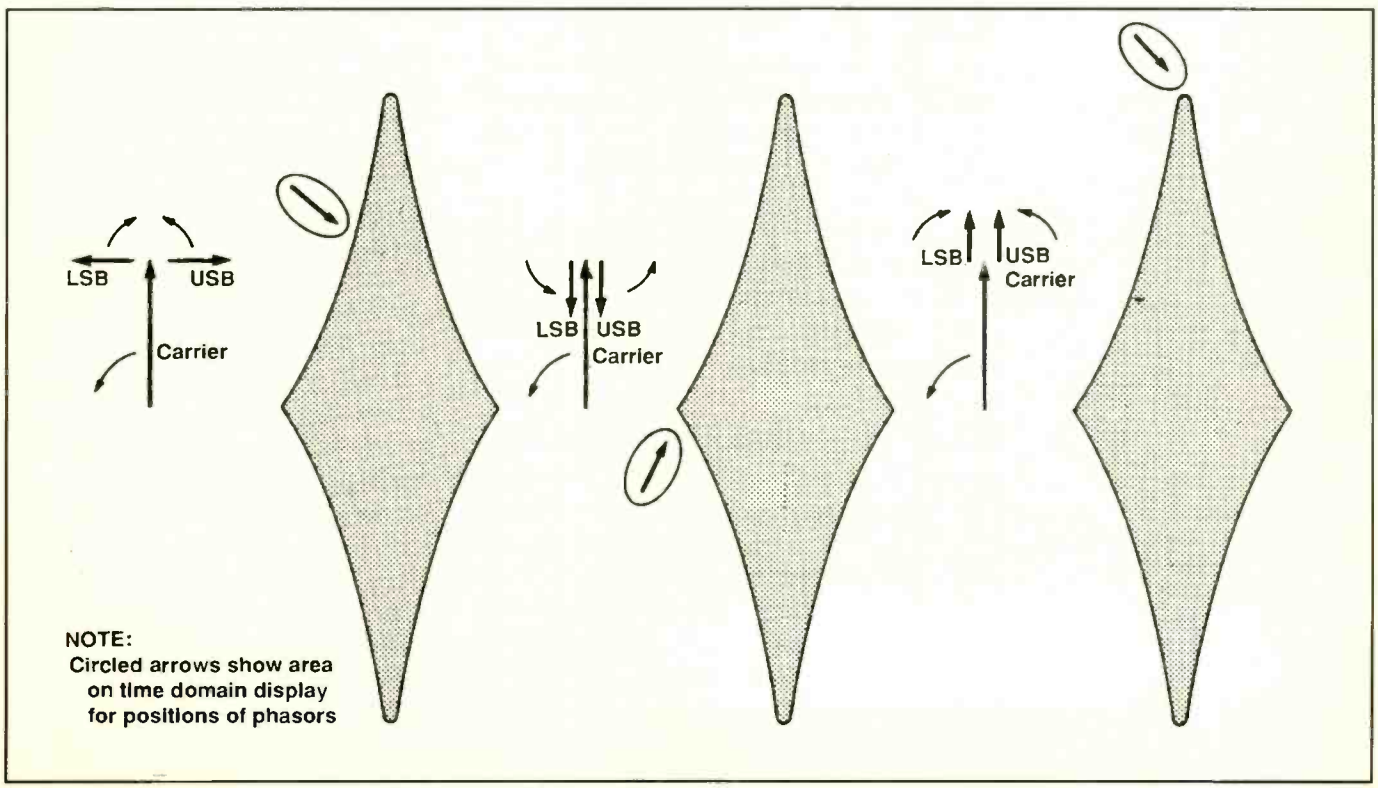


Figure 5. Another way to visualize waveforms is to use rotating phasors.

PHOTOFACTS

GE
CTC175L2 3702
CTC187CL 3695
19GT352TX2 3702
19GT354TX2 3702
31GT670FM1 3695

HITACHI
M3LXU 3697
27CX5B 3697
27CX6B 3697

MAGNAVOX
AV1977A201 3703
PR1915C221 3703
PR1916C221 3703
TP2526C103 3698
TS2542C101 3700
TS2542C102 3700
TS2542C123 3700
19PR14C221 3703
19X603 3703
25P512 3700
25P615-00AA 3700
25P625 3700
25R502-00BB 3698

QUASAR
ALEDC246 3693
ANEDC233 3692
SP2017T 3692
SP2017T-1 3692
SP2727T 3693
SP2727UT 3693

SAMSUNG
TXC2726 3705

SHARP
VC-A343U VCR-279
VC-A542U VCR-279
27G-S200 3699
35H-X1000 3696

SONY
KV-9PT50 3704
SCC-J58A-A 3704
SCC-J59A-A 3704

ZENITH
SR0953X 3694
SR2722MK 3701
SR2722RK 3701
SR2723BW 3701
SR2725N 3701
SR2728RK 3701
SR2728RKM 3701

the frequency response of the turned circuit under test.

The overall result, shown in Figure 4(b), is an infinite number of frequencies seen on edge. A marker on the response curve is used to indicate some particular frequency on the response curve.

I have never been able to understand the reluctance of technicians to use the Z-axis of an oscilloscope for adding the markers to the display. The Z-axis controls the display brightness.

When the marker signal, which is a fixed frequency, is delivered to the Z-axis, there is a bright spot on the display that represents the marked point.

The advantage of using this method for marking is that there is little likelihood of it interfering with the sweep display.

The marker also can be added between the turned circuit and scope. This point is marked with an "x" in Figure 4(a). That is sometimes called the *post marker* method.

Markers should *never* be inserted at the point marked "y" because that is almost sure to produce distortion of the display. This is true although the amplitude of the marker is set per manufacturer's recommendations.

Before there was sweeping there was wobbulating

When someone finally gets around to making a trivia game for technicians, the term wobbulator is sure to be included. That is the name of early (1930s and 1940s) sweep generators used for aligning the IF stage of superheterodyne radios. It was a signal generator with an L-C tuned circuit. One plate of the capacitor was mechanically jiggled to cause the frequency to sweep.

Phasor representation

Another way to visualize waveforms is to use rotating phasors. As with the oscilloscope displays, all waveforms can be represented this way. However, it does require a considerable amount of imagination. Take the case of a rotating phasor used to produce a 100% modulated AM signal. (This type of waveform is shown in Figure 3.)

Figure 5 shows how the rotating phasors produce the AM signal.

The AM signal is produced by three individually rotating phasors. The long one represents the carrier. The audio modulating signal produces sidebands that are represented by smaller phasors rotating in opposite directions.

To get any point on the amplitude-modulated signal you simply take the resultant of the three phasors. If you are trying to visualize the rotating phasors, you must make the carrier phasor rotate at the AM frequency - say 1 MHz. The sideband carriers rotating in opposite directions must turn at a rate that is one-thousandth the speed of the carrier phasor.

In other words, for a 1,000Hz modulating signal on a 1MHz carrier, the carrier phasor rotates a thousand times each time the sideband phasors rotate in one complete circle.

You can see from this visualization that the illustration in Figure 3 is not entirel accurate. To make it accurate, you would have to draw 1,000 carrier waveforms in the space of one audio cycle on the signal envelope.

When you are visualizing the rotating phasors, it is convenient to start by packing the place where the modulated signal has zero amplitude and also where the modulated signal is twice the average amplitude. When the sideband phasors are pointing against the carrier phasor, they add together to equal the carrier and the amplitude is zero. This is shown in Figure 5.

When the sideband carriers are both pointing in the same direction as the carrier, they add together to produce a resultant that is twice the carrier length.

At all other points, the sideband phasors combine to produce the resultant waveshape.

It takes a very healthy mind to be able to visualize a simple amplitude-modulated wave in this manner. In a single sideband signal, you eliminate the carrier phasor and one sideband phasor and then visualize the remaining phasor as it moves around in its orbit. The projection of that phasor on a time axis represents a single sideband signal. That takes an even healthier mind.

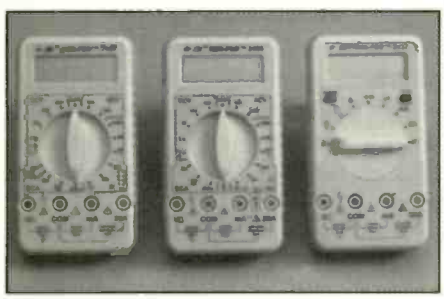
Nevertheless, many technicians visualize complex modulated waveforms in this manner. If you aren't already doing so, you should at least give it a try. ■

Multitester

HC Protek introduces new 20KΩ/V VOM analog meter, the model A-421.

This meter measures dc and acV; A; resistance; decibels; as well as transistors and continuity. Handheld for field or bench operation, it features a high impact, plastic housing, a 3-1/2" mirrored scale with bold numerals, and provides diode and fuse overload protection. All probes and input jacks are designed to meet UL 1244 and VDE0411 safety requirements.

Circle (28) on Reply Card



DMMs

B&K Precision has expanded their lineup of digital multimeters to include three new models, the Mini-Pro series.

Model 2405 measures dc (0.5% accuracy), acV to 600V, acA to 20A, and resistance to 20MΩ and also features diode and transistor tests.

Model 2406 is similar to the base model 2405, except that it can measure temperature. A type K thermocouple input is provided, calibrated in Fahrenheit degrees, making it useful for HVAC and appliance servicing.

Model 2407 has a bargraph, 3200 count display, acV and dcV and current measurement capability, plus diode and continuity tests. A range hold button is provided to lock onto the desired measurement range and defeat auto ranging.

Circle (29) on Reply Card

Fiber optic test tools

The Fluke Corporation has introduced a new fiber optic test accessory that can be plugged directly into a digital multimeter (DMM) for troubleshooting of fiber optic cable systems.

The new Fiber Optic Meter accessory addresses the growing use of fiber optic cable across a broad band of high-speed voice and data transmission applications and markets, from industrial electrical to telecommunications, data communications (LAN) networks and cable television.

The fiber optic accessory is compatible with all of the company's DMMs or other models that have an mV dc function and 10 MΩ input impedance. Used in conjunction with the company's fiber optic source (FOS) light sources, the Fluke FOM measures most fiber optic testing needs, from design and installation, to field service and quality control.

Circle (30) on Reply Card

Programmable dc power supply with true IRMS readback

American Reliance introduces a new generation of dc programmable power supplies capable of true IRMS reading. This power supply features a true rms output current meter.

The power supply is equipped with an 8MHz true dc+ac rms converter that can accurately measure true rms value of different current waveforms up to 8MHz in bandwidth. Since the true rms current value is the dc equivalent of the original current waveform, this parameter provides a reliable basis for comparing dissimilar current waveforms.

Circle (31) on Reply Card

Pentium board test instrument

International Test Technologies announces the MT2100 test device. It connects to the Pentium Processor board via its debug port, enabling one hardware configuration to support the complete range of Pentium processors. It provides effective modes for troubleshooting completely "dead" boards. Windows software driven, the tester comes with pre-programmed PC Test diagnostics, a defect analyzer linked to functional tests for more accurate fault statistics, and integral 100MHz signal capture probe, and capture signals displayed as waveforms or data.

With minimal set-up thanks to its Microsoft Windows interface, pre-programmed tests, and optional turn-key test routines, the unit allows the technician/engineer to become proficient in Pentium test and repair quickly, according to the manufacturer. The product is compatible with the company's existing test system and supports the entire range of INTEL x86 microprocessors and the INTEL i960 range of microprocessors.

Circle (32) on Reply Card

Test accessory kit

The new Test Companion Model 6120 accessory kit from *ITT Pomona Electronics* is designed specifically for users of the Fluke Series I and II ScopeMeter.

A full line of accessories including: DMM test lead set and probes, fully insulated oscilloscope probes (X1/X10 switchable), flexible Grabber test clips, a set of large safety alligator clips, and a set

of medium alligator clips, is contained in a large, briefcase-style Cordura carrying case with shoulder strap. The case is designed with extra padding to protect the instrument as well as various zipper- and Velcro-sealed pockets which are ideal for service manuals, other tools, batteries and anything else needed for testing at the plant or in the field. These accessories are designed to meet IEC1010.

Circle (33) on Reply Card

Circuit repair kits

Pace introduces four new ThermoBond Cir-Kits for the fast repair and modification of SMT lands and thru-hole pads, edge connector fingers, and other circuitry, to meet original board manufacture specifications.

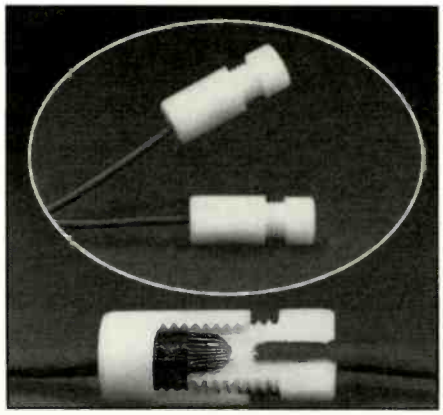
The ThermoBond Cir-Kit frame incorporates an advanced "dry-film adhesive backing" that is hot-bonded in 15 seconds at safe, low temperatures. This repeatable process saves repair time, requires no messy mixing and application of liquid epoxy and restores the circuit board to original product reliability.

Twelve different Selector frames are now available, providing a wide and unique variety of pattern sizes and shapes to meet all your specific requirements.

Circle (34) on Reply Card

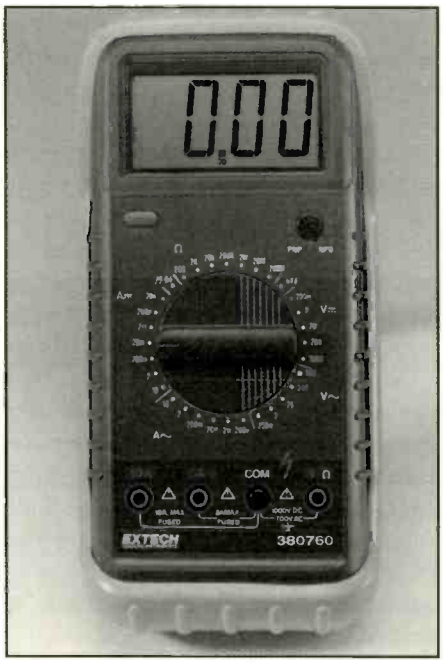
Cable connector

Swenco Products, Inc. announces the Posi-Lock connector for single and multicable connections. It provides a quick and positive electrical connection which is low in cost and easily performed in close quarters. Patented design features a positive connection that will not pull apart. Easy to connect and disconnect, the connector consists of molded nylon, male and



female couplings with threaded walls that simply screw together and clamp the wire ends. The connector is good for permanent or temporary connections. The device is lightweight, chemical resistant and has a wide temperature range.

Circle (35) on Reply Card



Digital multimeter

Extech's new digital multimeter provides 30 ranges and 8 multimeter functions including dc/ac voltage, dc/ac current, resistance, diode test, transistor test, and audible continuity test. Designed to meet IEC-1010 standards, this DMM provides ±0.5% basic dc voltage accuracy. An oversized 1 inch LCD display provides 1,999 counts with two to three updates per second. Overrange, polarity, and low battery indications are featured along with auto power off and data hold. Four input jacks are provided with overload protection. Complete with test leads, 9V battery, and protective holster with dual position tilt stand.

Circle (36) on Reply Card

Connector spray

Caig Laboratories announces that DeoxIT is now available in a pocket size mini-spray. The product cleans, preserves, lubricates and improves conductivity on metal connector and contact surfaces. The spray contains improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing and RFI inhibitors and provides extended temperature range (–34°C to 200°C). The chemical also prevents dissolved oxides and contaminants from reattaching to metal surfaces, providing longer lasting protection. Use on switches, poteniometers, relays, PCB edge connectors, batteries, faders, interconnecting cables, plugs, jacks, etc.

Circle (37) on Reply Card

Adaptor kits for projection and giant TV receivers

Telematic announces adaptor kits for large projection or direct view TV sets.

Using the adaptor kit, one man can pull the chassis from the heavy and bulky cabinet, hook it up to his test jig and transport it back to the service center in a car. Because of the reduced size of the equipment being transported, several units can be taken back to the service center saving trips back and forth.

The projection TV adaptor kit consists of a matrix CRT cable, a yoke adaptor, and a high voltage extension.

Circle (38) on Reply Card

ES&T Book Shop

Industrial Electronics for Technicians

By J.A. Sam Wilson and Joseph Risse

Industrial Electronics for Technicians provides an overview of the topics covered in the Industrial Electronics for Technicians CET test, and is also a valuable reference on industrial electronics in general.

Order# 61058 • • • • • $16.95.

Introduction to Microprocessor Theory and Operation

A Self-Study Guide with Experiments

By J.A. Sam Wilson and Joseph Risse

Introduction to Microprocessor Theory and Operation takes you into the heart of computerized equipment and reveals how microprocessors work. **Order# 61064 • • • $16.95.**

Semiconductor Essentials

By Stephen Kamichik

This book is first course in electronics at the technician and engineering levels. Each chapter is a lesson in electronics, with problems presented at the end of the chapter to test your understanding of the materials presented.

Order #61071 • • • • • *$16.95.*

Real-World Interfacing With Your PC

By James "JJ" Barbarello

Real-World Interfacing With Your PC provides you with all the information you need to use your PC's parallel port as a gateway to real word electronic interfacing. Now you can write software to control that hardware.

Order# 61078 • • • • • $16.95.

Tube Substitution Guide

Complete Guide to Replacements for Vacuum Tubes and Picture Tubes

By William Smith and Barry Buchanan

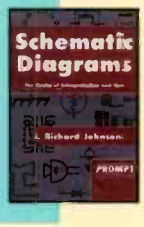
The Tube Substitution Handbook will help antique radio buffs, consumer electronics technicians and other interested individuals find the right replacement tube when servicing older electronics products.

Order# 61036 • • • • • $16.95.

Schematic Diagrams

The Basics of Interpretation and Use

By J. Richard Johnson



Step-by-step, Schematic Diagrams shows you how to recognize schematic symbols and their uses and functions in diagrams, and to interpret diagrams so you can design, maintain and repair electronic equipment.

Order# 61059 • • • • • $16.95.

Surface-Mount Technology for PC Boards

By James K. Holloman, Jr.

Surface-Mount Technology for PC Boards describes the benefits and limitations of SMT, and provides details on the nature of surface-mount components and SMT manufacturing methods. Additionally, this book covers practical applications, standards, and reliability and quality assurance considerations relating to SMT. A glossary of SMT terms is included.

Order# 61060 • • • • • $26.95.

Digital Electronics

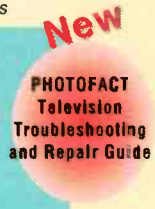
By Stephen Kamichik

Digital Electronics is designed to supplement an introductory course, teach the electronics hobbyist about digital electronics and serve as a review for practicing technicians and engineers. With the proper equipment, you can also build the circuits described. Building and testing a circuit is the best way to fully understand its operation.

Order #61075 • • • *$16.95.*

PHOTOFACT Television Troubleshooting and Repair Guide

By the Engineers and Technicians of Howard W. Sams & Company



The most complete and up-to-date television repair book available. 384 pages of complete repair information, illustrated with useful photos, schematics, graphs and flow charts.

Order# *61077* • • • • • *$29.95.*

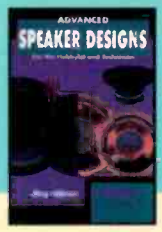
IC Cross Reference Book

By Howard W. Sams & Company

The IC Cross Reference Book, compiled from manufacturers data and from the analysis of consumer electronics devices for Photofact service data, will help you find replacements or substitutions for more than 35,000 ICs or modules. **Order# 61049 • • • • • $19.95.**

Advanced speaker Designs

By Ray Alden



This book shows the electronics hobbyist and the experienced technician how to create high-quality speaker systems for the home, office or auditorium.

You can build speaker systems from the parts lists and instructions provided or you can actually learn to calculate design parameters, system responses and component values with scientific calculators or PC software. **Order# 61070 • • • • • $16.95.**

Semiconductor Cross Reference Book

By Howard W. Sams & Company

From the makers of Photofact service documentation, the Semiconductor Cross Reference Book is the most comprehensive guide to replacement data for all major types of semiconductors. This volume contains over 475,000 part numbers and other identifying numbers.

Order# 61050 • • • • • $24.95.

YES! I want to learn from the experts. Rush me my book(s)right away!

Please add $4 shipping & handling. **FREE shipping & handling for orders $50 and over.**

Please make your check or money order payable to: Electronic Servicing & Technology

To Order Call 516-681-2922

Qty	Order#	Description	Price	Total Price
			Shipping/Handling	
		New York Residents add applicable sales tax	Total	

Name _____

Address _____

City _____ State _____ Zip _____

MC/VISA/AMEX/Discover # _____ Expires _____

Form of payment: ☐ MC ☐ VISA ☐ AMEX ☐ Discover ☐ Check ☐ Money Order

Please mail your orders to: Electronic Servicing & Technology , 76 North Broadway, Hicksville, New York 11801-9962 FAX 516-681-2926

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 additional. No agency discounts are allowed for classified advertising by the word. Contact Kirstie Wickham at 516-681-2922 to place your classified ad (by-the-word). Mastercard, VISA, American Express and Discover are accepted for FAX or mail orders.
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 call 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

Send your order, materials and payments to:
Electronic Servicing & Technology, 76 N. Broadway, Hicksville, N.Y. 11801 Attn: Classified Department Ph: 516-681-2922 FAX: 516-681-2926

FOR SALE

***************************FREE ZENITH CURES****************************
Earn $$$ Repair Zenith TV modules found in over 1,000 models, 1983-1993. Symcure manual shows you how. $89.95 or send SASE for **FREE** samples. **ZMEX,** 807 Queen Palm Lane, Sarasota, FL 34243

********TECHNICAL TIPS****** THOUSANDS & THOUSANDS of VALUABLE** REPAIRS for TV's, VCR's, Projection TV's, Camcorder's, CD Players, Audio & other electronics organized in an **EASY** to use Computer Program - **The TECHNICAL TIP REPAIR Program. PROFESSIONAL BOARD LEVEL & COMPONENT LEVEL REPAIRS. ADD** your own tips. **PRINT** tips. **BACKUP** & save your o wn tips. Have your own tips? Ask about our **TIP EXCHANGE** policy with ****FREE Updates**.** Works on IBM compatible computers with a hard drive (Also works on some Apple Macintosh computers). **ONLY $150.00 **FREE SHIPPING**. NEW VERSION works in DOS, WINDOWS 3.1 & WINDOWS 95. Try the DEMO. Send $10.00 to HIGHER INTELLIGENCE SOFTWARE, 60 FARMINGTON LANE, MELVILLE, NY 11747. AND, when you buy the Regular version of the TIP PROGRAM, we give you back your $10.00 by taking $10.00 off the purchase price of the TIP Program ************* CALL 1-800-215-5081/1-516-6 4 3 - 7 7 4 0 ***************

TEST EQUIPMENT BOUGHT & SOLD: OSCILLOSCOPES, ETC. 1-408-738-4206. FAX 1-408-736-6946.

SERVICE DATA & HARD TO FIND PARTS previously-owned SAMs, manufacturers data, books, FREE catalog. **AG Tannenbaum**, Box 386, Ambler, PA 19002, 215- 540-8055, fax 215- 540-8327.

FURTHER PRICE REDUCTION. Diehl Mark III $49, Diehl Mark V Horizontal circuit tester $169. New. Conductive coating for remote control keypads $9.99 ppd. **WEEC**, 2411 Nob Hill Road, Madison, WI 53713. 608-238-4629, 608-273-8585.

Monitor Service Information. Techtips Repair Program on Disk, FCC ID Cross Program on Disk, and **Monitor Schematics.** From $39.95. Visa/MC **MI Technologies** 513-335-4560.

CRT ADAPTER KIT - Hooks your CRT tester to ALL picture tubes. Win the "socket war". Obsolete proof! $59.00 **DANDY,** 2323 Gibson, Muskogee, OK 74403. 918-682-4286.

Electronic Service Tips. Over 3500 Real world tips and case histories from our Service dept & others. TV, VCR, AUDIO,CAMCORDER, COMPUTER MONITOR, MICROWAVE OVEN, & MISC. Sorted alphabetically by model or chassis, and alphabetically by symptom within a given model. Paper version 6.0 $39.95 + shipping in USA. **KDTV** 812-926-4321. 514 Third Street, Aurora IN 47001. Fax 812-926-1014.

Sencore VC93 all format VCR analyzer. Great for VCR repair. Excellent condition. $1800.00 or best offer. Contact Eugene at 410-730-1460.

********SERVICE TIPS VERSION 4.0 IS HERE****** 21,034 TECHNICAL TIPS REPRESENTING OVER 117 MANUFACTURERS' CONSUMER ELECTRONIC PRODUCTS.** ***NO OTHER technical tips program available today*** is used, supported, and endorsed by members of the Electronic Associations and technicians worldwide since 1989. ***SERVICE TIPS is available for ONLY $169.95 plus s&h and*** *is DOS or Windows Compatible. For more information or to order* ***CALL us at 1-800-621-8477,*** *ELECTRONIC SOFTWARE DEVELOPERS INC., 826 SO MAIN STREET, SOUTH FARMINGDALE, NY 11735.*

FOR SALE

((30,000)) CURRENT TECH-TIPS - LIGHTNING FAST REPAIRS AT FINGER TIPS and Growing faster than ever. The staff of TV-Man Tech-Tips had a wonderful time as participants at the NPSC '96 convention in St. Louis. We enjoyed meeting our members first hand, and look forward to the next convention. **Since APRIL 1992 TV-MAN TECH-TIPS has, without waver, CONSTANTLY PROVIDED to our members the only ON-GOING HISTORICAL SUPPORT PROGRAM which adds a MINIMUM OF 2,000 NEW REPAIRS** at each semi-annual update. **DON'T LET WHAT YOU CANNOT DO INTERFERE WITH WHAT YOU CAN DO! START WITH THE BEST!!** Our quality, and constant improvements have always increased for each member's benefit. The proof is in our product - **HANDS DOWN** - We are **THE FIRST AND ONLY COMPANY** in the USA to offer our type of program in **CD and 3.5HD FORMAT** for **DOS** and a full blown **TRUE WINDOWS** program for **Windows 3.1, 3.11 & WIN 95,** in which you may Enter, Edit or TAG any repair or Press one key to printout all the repairs on a particular Model or Chassis. For the majority of our industry not computerized, we continue to provide the **ONLY** published **PAPER MANUAL** format of Tech-Tips. *************(Proven to pay for itself within a few repairs)********** **FEATURES INCLUDE: "FREE" FCC-ID MANUAL with 13,656 VCR and 685 Microwave** cross references. **"FREE"** Product Processing Forms. **Our One-Time Membership Fee** of **$350.00** Provides you **30,000 Repairs, 1977 thru July 1996,** TV, VCR, CD, LD, Projection, Monitor, Stereo, Camcorder, Amplifier, Combo Units, Fax Machine, Satellite, etc., **"FREE" 48 page SEMI-ANNUAL NEWSLETTER magazine** with **Step-By-Step Repairs WRITTEN BY OUR TECHNICIANS,** using today's techniques and technology. **NEW** Product Information, **Industry News and Service Center Assistance. Membership "PAYS" Our members received 10,000 NEW TECH-TIPS "FREE" in 1995 and now 4,000** in addition to the standard **2,000** in **1996.** Our program covers complex repairs & part number information for **193 BRANDS, ALL IN ONE CONVENIENT PROGRAM.** Repairs are collected daily at four major service centers and sent weekly to our Data Center where each Tech-Tip is gone over completely, additional Lookup and Cross Reference Information is added. This process is how we constantly **IMPROVE** and **INCREASE** the program **FOR YOUR BENEFIT** at each update. **SAVE TIME** diagnosing, **ORDERING** service manuals and **RESEARCHING** part numbers you may not need! Phone for a **"FREE"** demonstration or **simply order. GET TO THE BOTTOM LINE "PROFITABLY".** Call and speak to a **Service Center Owner** and **Technician** Ed Erickson, **NESDA** Member and Past **President** of **(THE PROFESSIONAL ELECTRONICS ASSOCIATION OF SOUTH FLORIDA) YOU'LL BE GLAD YOU DID! (800) 474-3588 (954) 349-2455 .**

INCREASE YOUR KNOWLEDGE, BOOST YOUR PROFITS. Add COMMERCIAL and RESIDENTIAL **MICROWAVE OVEN REPAIR** to your services. Plus, bonus: **VCR Know-How!** Powerful new video and textbook package. Satisfaction guaranteed. See it: **http://www.yup.com/microtech** Call **800-700-UFIX (8349)**

SENCORE, TEKTRONICS, HEWLETT PACKARD (all models). We **BUY, SELL, & TRADE** . Please call **"CHOICE ELECTRONICS"** for all of your test equipment needs. Complete financing options available. Call 1-800-609-0677, ask for Lance Tople.

NAP tuner 340309 1001/.2/.3. Have a problem with a snowy picture? Will repair for $25.00. **Tip Top TV & VCR**, 18441 Sherman Way, Reseda, CA 91335, 818-345-1974.

For sale - Approximately 1,500 scrap VCRs to be used for parts. Many different makes and models. Best offer, call Donny, 718-531-8143.

FOR SALE

IN-CIRCUIT CAPACITOR ESR CHECKER - Find bad caps FAST and RELIABLY with the new Capacitor Wizard in-circuit ESR Tester! Great for monitors, switching power supplies, TVs, etc. Only $179.95. MC/VISA **Independence Electronics Inc., 800-833-1094**.

Sencore CVA94, VR940, VC93, SC3100. Cables, manuals, test tape, training tapes, original boxes included. Purchased 1994. Never used. $6500.00. 919-636-5124.

TV CASE HISTORIES: Booklet with 2,440+ histories. Satisfaction assured. Only $49 (plus $3.00 for priority mail). **Mike's Repair Service,** P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 32 years. Send SASE for samples. 410-272-4984,1-800-2-FIX TVS 11am-9pm.

BUSINESS OPPORTUNITIES

CE Software Company seeks independent manufacturer and distributor representatives with close contacts to servicers and retailers. **Call 561-394-8771.**

For Sale in beautiful Montana: Successful, fully equipped, well established (48 years), consumer electronics service and sales business in the small but thriving town of Livingston where they filmed "A River Runs Through It." $55,000.00, 406-222-0830.

READER' EXCHANGE

Readers' Exchange is a free service.
The following restrictions apply to Readers' Exchange:
• Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.
• Readers' Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).
• All submissions must be typed or printed clearly!
Send your Readers' Exchange submissions to:
Readers' Exchange, Electronic Servicing & Technology
76 N. Broadway, Hicksville, NY 11801 Ph: 516-681-2922 FAX 516-681-2926

FOR SALE

Sencore VG91, TVA92. SC3100, CR70, HP200, asking $6000.00 or best offer. *Contact: 810-785-5084, please leave message.*

Sencore VG91 and TVA92, new condition $3500.00. Sams Photofact 543 through 1759, best offer. *Contact: 803-385-6467 (evenings).*

Sams folders or sets misc. 1 - 2,000. 25 cents each and up plus postage, minimum $10.00. *Contact: McCombs Electronics, 703 Old Cedar Rock Road, Easley, SC 29640, 864-859-6032.*

Phillips TV and VCR service literature 1991-1995. Offer or trade. *Contact: Dave Burruss, 1540 Shady Lane, Keizer, OR 97303, 503-463-4425.*

Seeburg - stereo speaker 17"Lx12W. Wireless phono-portable model 6J. *Contact: Ann Bichanich, 151/2 W. Lake Street, Chisholm, MN 55719, 218-254-4421.*

Sencore VA62 includes VC63, NT64, EX231, and protective cover. $1500.00. Sencore SG165 AM-FM stereo analyzer, $500.00. Sencore SC-61 scope $1500.00. All equipment in excellent condition with original boxes, cables, and manuals. *Contact: Ron Walker, 1175 Waldo Way, Twinsburg, OH 44087, 216-425-9038.*

Sencore VA62, $1500.00, Simpson 380 microwave leakage tester, $225.00, B&K 820 capacitance meter, $125.00. All accessories included. *Contact: Ray, 706-863-2480.*

Must sell. Sencore CVA94 camera video analyzer with VR940 light box, VC93 VCR analyzer, SC61 dual trace scope. *Contact: Jim, 915-235-3520, 915-236-6209 PM.*

Sencore VC93 all format VCR analyzer. Original box, manuals, cables. Like new. $1300.00 Firm. *Contact: Mike, 541-839-6609(day), 541-825-3268 (eve).*

Flyback transformers, mostly monitor types, over $1200.00 worth, selling for $500.00. Also old test equipment for sale (H-P, military, etc.). make offer. Send SASE for lists. *Contact: Marc Loring, 1924 Mark Street, NE, Olympia, WA 98516, 360-491-2802.*

Sencore waveform analyzer (SC61) like new, used very little, in original box with probes and manual, $1400.00. *Contact: Gerald, 919-745-4493 or 919-745-5707.*

Sams Photofact TV and radio service manuals $7.00 each postpaid. Good originals from collection covering Sams #25 to #3071. *Contact: William Miller, 2691 Fox Hill Drive, Camby, IN 46113, phone: 317-831-0896, E-mail eagle@trader.com.*

Sencore MU150 tube tester, TC162 tube tester and much more. Best offer. SASE (legal size). *Contact: Fred Ingersoll, GI Electronic, 6845 Lathers, Garden City, MI 48135.*

HP scope model 1715A. *Contact: Jack Schultz, 912-352-0585 or 800-866-8938, pager, 912-239-4377.*

WANTED

Need computer interface card for "The Complete Page Scannex" model no. 00-2002-01. *Contact: Leslie Robensin, 4662 Esther Street, San Diego, CA 92115-3834, 619-582-5153.*

New or good used scope DVM-636 40 pin IC model TSC7106 CPL/8707BJ; Sylvania VC4526 portable VCR service manual; Microprocessor, 42 pin IC5001 model UPD1511C-081 for a candle JCTV 3150 chassis no. 20404. *Contact: Fred's Electronics, Box 463, Elkhorn, MB Canada Fax/Phone 204-845-2359.*

Service manual wanted for Sony projector model FP60. *Contact: Tom, T&D Electronics 410-398-0471.*

Motorola 12V equlalizer amplifier for car stereo system. Also any other Motorola aftermarket stereo items you might have for cars. AM/FM cassette players, speakers, etc. *Contact: William K. West, 330-966-1335, 340 Hillcrest Apt. 8, N. Canton, OH 44720.*

Heathkit 6809 conversion for the ET-3400A µP trainer and documentation. Pioneer SM-B200A tube receiver schematic. *Contact: Edward Bolt, PO Box 1807, Laramie, WY 82070, 307-742-6580.*

Mitsubishi horizontal Oscillator coil part no. 332P00501 from Mitsibishi CS2594 TV. (NLA). Also Mitsubishi tuner part no. 295P20701 from Mitsubishi projection TV model VS-510U. *Contact: Anchor VCR & TV Rpeair, Klamath Falls, OR, 541-884-5985.*

ADVERTISERS' INDEX

Company	Page Number	Reader Service Number	Advertiser Hotline
Andrews Electronics	45	51	800/289-0300
B & K Precision	20	116	800/462-9832
Computer & Monitor Maintenance	22		800/466-4411
Contact East	16	52	800/225-5334
Dalbani Corporation	26	69	800/325-2264
ES&T Bookshop	63		516/681-2922
Electronix Corporation	66	53	513/878-1828
Electronics Technicians Association	14	54	317/653-4301
EXTECH INSTRUMENTS	22	55	617/890-7440
Fluke Corporation	BC	111	800/59-FLUKE
GEnie Radio & Elec. RoundTable	66	73	800/638-8369
Global Specialties	27	56	800/572-1028
HC Protek	13	64	201/767-7242
Herman Electronics	49	57	800/938-4376
Hitachi Denshi	17	120	310/328-6116
ISCET	26		817/921-9101
ITT Pomona	19	59	800/241-2060
International Components Corp.	66	58	800/645-9154
Jesse Jones Industries	52		800/825-6690
LG Precision	15	60	310/404-0101
Leader Instruments	3	84,85	800/645-5104
MCM Electronics	25	61	800/543-4330
Parts Express	14	62	800/338-0531
Philips Technical Training	IFC	113	423/475-0044
Sams & Company, Howard	51	70	800/428-7267
Sencore	IBC	1	800/SENCORE
Sperry Tech	66	65	800/228-4338
Tentel	11	66	800/538-6894
T.E.S.A	16	6	516/221-6403
Thomson Consumer Electronics	9	107	800/336-1900
Wavetek	5	67	800/854-2708

We'd like to see your company listed here too. Call Diane Klusner at 516/681-2922 or E-Mail her at dianekest@aol.com to work out an advertising program tailored to suit your needs.

A Split Second Is All It Takes...

You're troubleshooting a high powered circuit – say a TV horizontal output circuit. You're carefully holding the scope probe on a test point in a hard-to-reach area. You anxiously look up and see a rolling, fuzzy line on your scope's display. Do you take the probe off and readjust the scope? Or do you reach over and adjust the scope taking the chance of slipping off the test point for a split second shorting out an expensive component and damaging circuits?

You can save a lot of time in a split second.

A split second is all it takes for the SC3100 "AUTO TRACKER" to display a locked-in waveform. In fact, the signal will be on the screen before you look up from the circuit. The autoranging display adjusts as the signals change – it's that simple. Now you can spend your time solving problems, not adjusting your scope controls and reattaching probes. This powerful troubleshooting tool saves time and gives you added confidence every time you pick up the probe.

Call Us For A No-Obligation Trial Today At 1-800-SENCORE (736-2673)

SENCORE
3200 Sencore Drive, Sioux Falls, SD 57107
Direct: (605)339-0100 Fax: (605)339-0317

Circle (1) on Reply Card

FLUKE®

Before you get turned on by the front of a meter, make sure there's something behind it.

There is a whole family of Fluke DMMs and one that meets your needs.

Fluke meters are designed for professionals who demand the best.

There's nothing thin about the promises Fluke gives you. **Safety.** Rated IEC 1010-1 up to CAT III, 1000V, the highest available safety standard for handheld multimeters. And while other meters are merely "designed to meet certain guidelines," Fluke designs and builds a full line of meters that actually achieve UL, VDE and TÜV safety certification. **Rugged.** Pick up a Fluke meter and you can feel that it's a substantial tool. Designed to fit the application and the way you work. **Reliable.** Every Fluke multimeter is built in an ISO 9001 certified factory in the United States, where it's calibrated and tested. No exceptions. **Accurate.** Fluke meters attain stable, accurate readings in half the time of most imitations, making you more productive on the job. **Warranty.** A full three years. **Trustworthy.** Proven in the field for years, Fluke is the name millions of professionals trust with their reputation and their safety.

Contact your local distributor at **1-800-59-FLUKE.** Fluke—keeping your world up and running.

SUPPLIER TO THE OLYMPIC GAMES

Circle (111) on Reply Card