THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

T.M.

APRIL 1994/$3.00

VCR problems

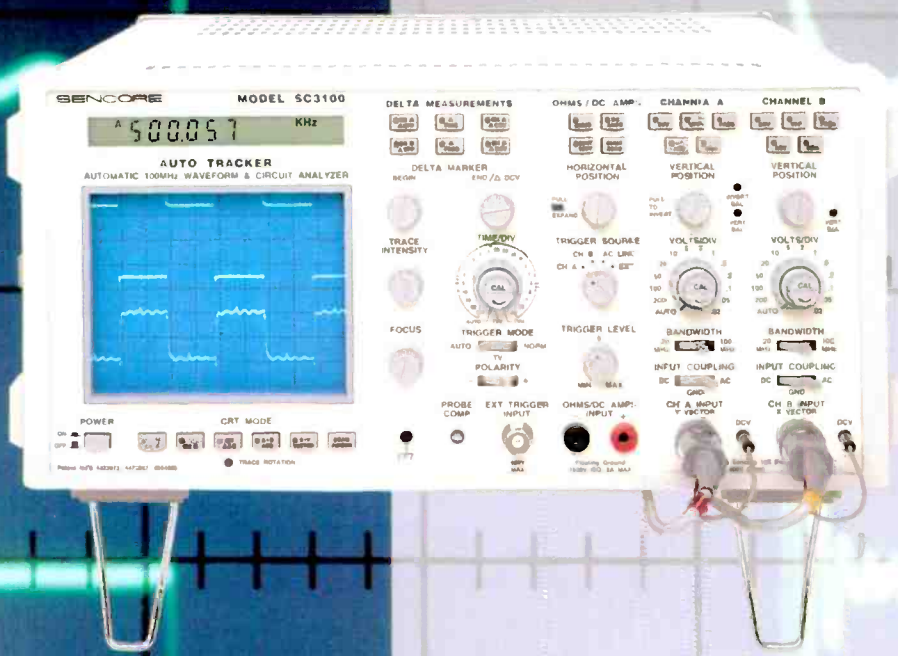
Testing microprocessors using an oscilloscope

Oscilloscope update: An oscilloscope refresher

"AUTO TRACKER"™

The Only Waveform & Circuit Analyzer

NEW!



In A Nutshell, Here's What The "AUTO TRACKER"™ Offers You!

- A complete waveform and circuit analyzing system in one instrument
- Auto-Tracking™ digital readout of voltage and frequency with one probe connection
- Integrated measurements of all circuit parameters for fast analyzing answers
- Full performance, 100 MHz dual trace oscilloscope
- Exclusive autoranged timebase and vertical attenuators eliminate wasted time
- Digital delta measurements to analyze every portion of any waveform
- All functions microprocessor integrated for ease of use

Exclusive:

- ***Autoranging timebase***
- ***Autoranging attenuators***
- ***Integrated current & ohms measurements***

SC3100 "AUTO TRACKER"™ Automatic 100 MHz Waveform & Circuit Analyzer

If you feel like something has been missing from your service bench, then maybe you're needing a waveform and circuit analyzer. Only the SC3100 "AUTO TRACKER" allows you to touch and test any circuit test point and make autoranged, error free measurements in a fraction of the time you now take.

Only the SC3100 "AUTO TRACKER"™ provides virtually hands-free digitally accurate waveform and circuit analyzing.

TECH CHOICE SYSTEM

The SC3100 is the only analyzer that guarantees an increase in technician efficiency and bottom-line profits for your business. But we'll let you prove it to yourself. Simply call Sencore and request a waveform and circuit analyzing package. The package is free and could prove to be one of the best business decisions you'll make this year.

Call 1-800-SENCORE, Today!

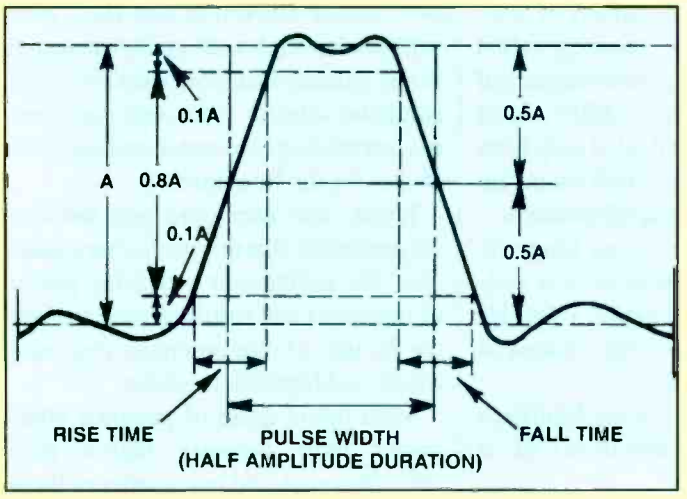
(736-2673) ext. 802

Circle (24) on Reply Card

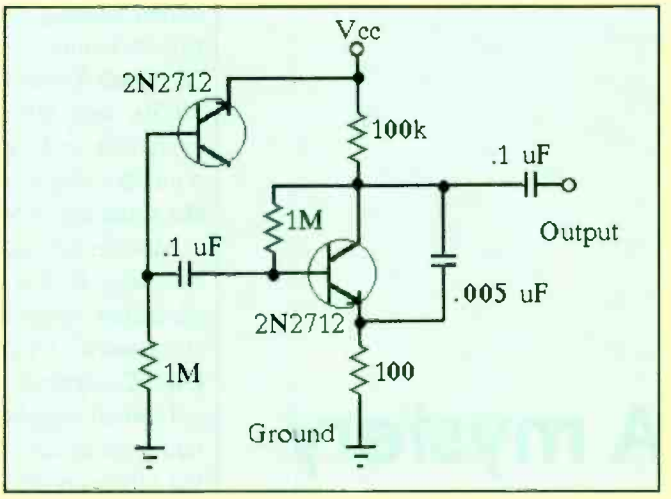
SENCORE
3200 Sencore Drive, Sioux Falls, SD 57107
Direct (605) 339-0100 Fax (605) 339-0317

Contents

Volume 14, No. 4 April 1994



page 6



page 56

FEATURES

ADVERTISING SUPPLEMENT

DEPARTMENTS

ON THE COVER

Over the years, as electronics has evolved, oscilloscopes have evolved. Today, they can examine more than one circuit point at a time. Newer features include digital readout of signal levels and frequencies and because of the constantly shrinking size of microelectronic components and ICs, oscilloscopes can be made increasingly portable. (*Photo courtesy Fluke*)

ELECTRONIC Servicing & Technology

A mystery cleared up

A number of readers have written or called looking for an address or telephone number for a company called Multitech/Dynatech, a manufacturer of VCRs and televisions. After much searching, and a great deal of help from a number of people, we have found out the situation on Multitech/Dynatech.

Multitech/Dynatech is no longer in business. It was a division of a conglomerate based in Holland. I got this information from the management at CRC Components, Inc.

Limited supplies of some Multitech components are available from CRC at the following address:

CRC Components, Inc.
186 University Parkway
Pomona, CA 91768
Order desk: 800-822-1272
Fax: 909-594-4761

CRC is a major distributor of flyback transformers, integrated circuits and transistors for consumer electronics products such as televisions and computer monitors. They also carry servicing information such as schematic diagrams for monitors. They do not however, do servicing.

For your further information, at one time CRC operated a division called Transworld Electronics that handled the Multitech parts, but that group's functions have been incorporated into CRC's Parts/Order department, and thus no longer functions as a single division.

Computers are consumer products

Over the past few years, more and more individuals have been purchasing personal computers for home use. Because of this increasing number of computers in homes, an increasing number of service centers have begun to service computers. If there was any doubt remaining that computers were becoming firmly ensconced as a consumer product, an article in the *Kansas City Star* of Tuesday January 25, 1994, based on recent consumer research should dispel it.

According to the column, estimates by Channel Marketing and IDC, both well-known high-tech market research firms, indicate that more than half of all computer sales in 1993 were for home use, surpassing corporate computer purchases for the first time.

It was clear three years ago, the article continued, that this was going to happen. The falling cost and rising power of machines and software were turning the PC into a home entertainment, education and business machine.

Most home users of personal computers have incomes higher than $50,000 a year, and one quarter of them have incomes higher than $70,000 a year. The higher the income level, in fact, the more certain it is that they have a personal computer. About one-fifth of computer households have more than one machine.

Finding computer parts

Now that personal computers have become as much a part of the consumer electronics product mix as TVs, VCRs, CD players and microwave ovens, the owners of these products will expect to be able to bring them into the local consumer electronics service center and have them serviced. That's a wonderful opportunity for those service centers who are prepared to offer that service.

It's a problem as well, though, because many personal computer and monitor manufacturers seem to be intent on keeping information and replacement components from independent servicers. Because this is a serious problem, we have provided a partial solution to it in this issue. This month's Computer Corner, titled "Sources for Monitor Schematics and Parts," provides readers with useful information on who provides service literature and parts and who does not, and offers some alternative sources of parts and information.

As computer service and replacement parts information becomes available, we'll share it with you.

Nils Conrad Person

QUALITY or Low Cost

Get Both From Leader

New DC Power Supplies

DIGITAL DISPLAY

110V 3A

75V 5A

60V 3A

35V 10A

18V 20A

18V 10A

30V 3A

18V 5A

18V 3A

Call toll-free

1 800 645-5104

In NY State

516 231-6900

LEADER

FOR PROFESSIONALS WHO KNOW THE DIFFERENCE

Leader Instruments Corporation, 380 Oser Avenue, Hauppauge, New York 11788
Regional Offices: Chicago, Dallas, Los Angeles, Atlanta. In Canada call Omnitronix Ltd., 416 828-6221

Circle (38) For Product Information Only

Circle (39) For Product Information & Demonstration

News

Video market gains eight percent in 1993

The video market gained eight percent in 1993 over 1992 on the strength of all-time records for annual sales volume of direct view color televisions, projection TVs, VCR decks, camcorders, and TV/VCR combination units, according to the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

"1993 should be viewed as a spectacular year for the consumer electronics industry," says Joseph P. Clayton, Executive Vice President, Marketing & Sales–Americas & Asia, Thomson Consumer Electronics. "As the final quarter approached, the industry shifted into high gear, racing to new records for color TV and VCR unit sales and eclipsing the three million mark for camcorders.

"A relatively new category, TV/VCR combos, was a runaway best-seller with a 74 percent unit sales increase over 1992. High end sales, the industry's profitability gauge, continued to climb with big-screen color TV unit sales leading the way.

"The successes of 1993 reflect the consumer's satisfaction with the performance of consumer products and an awareness of their value. As the home theater trend expands and digitally-driven products emerge, industry results could improve even more dramatically."

Sales of direct view color TVs rose a very strong nine percent in 1993, besting the eight percent gain recorded in 1992. Sales broke the 23 million unit mark for the first time ever, surpassing the previous all-time high of 21.7 million units set in 1989. Large screen TV sales (27 inches and over) were strongest among category performers in 1993, jumping 28 percent to sales of 4.5 million units. The market leaders in terms of sales volume, however, were 19- and 20-inch sets, which together rose four percent in 1993, with sales totaling nearly 9.6 million.

Projection television sales ended 1993 over 465,000 units strong—a 15 percent gain over 1992. This was the best annual growth for the category since the 29 percent increase of 1990. Sales of sets 49-inches and under closed out 1993 with a six percent gain, while sets 50 inches and over tripled that gain with an 18 percent increase, and sets 55 inches and over rose nearly 11 times that much.

VCR deck sales rallied in the latter part of 1993 to finish the year with a second consecutive all-time record, realizing sales of nearly 12.5 million units. Sales of stereo models surged 10 percent.

Camcorders passed the three million unit mark in 1993, and posted a 10 percent increase in sales to dealers. Full-size camcorders rose 16 percent during 1993, with sales totaling just over 780,000 units. Compact camcorders rose eight percent.

TV/VCR combination units closed out a phenomenal sales year, rising 74 percent with sales of 1.6 million units. The second half of 1993 was particularly strong for the category, as monthly growth never dropped below 52 percent, while averaging 64 percent.

EIA applauds FCC on its endorsement of the grand alliance HDTV standard proposal

The Electronics Industries Association (EIA) and its Advanced Television Committee applaud the recent unanimous actions by the Federal Communications Commission (FCC) and the FCC Advisory Committee on Advanced Television Service for its endorsement of the Grand Alliance standard proposal for digital high-definition television (HDTV) and its recommendation to construct hardware for system verification testing.

In letters to FCC Chairman Reed E. Hunt, Secretary of Commerce Ron Brown and Assistant Secretary Larry Irving (NTIA), as well as House Telecommunications and Finance Subcommittee Chairman Ed Markey, EIA stated that it "recognizes the broad benefits that the implementation of a digital HDTV system will bring to U.S. consumers, providers and electronics manufacturers.

"The implementation of the Grand Alliance HDTV system will also serve as an important element of the National Information Infrastructure (NII), particularly in relation to bringing the benefits of the NII to consumers."

The Association explained that the technical characteristics of the Grand Alliance system are responsive to the needs and concerns of consumers, broadcasters, cable operators in the computer industry, along with the telecommunications industry and manufacturers.

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*
Linda Romanello, *Assistant Editor*

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 Terzo, *Assistant Art Director*
Susan Reale, *Artist*
Edmond Pesonen, *Electronic Composition Mgr.*
Dorothy Kehrwieder, *Production Manager*
Emily Kreutz, *Adverising Production*
Pat Le Blanc, *Phototypographer*

BUSINESS
Richard A. Ross, *Publisher*
John Dorr, *General Manager*
Frank V. Fuzia, *Controller*
Catherine Ross, *Circulation Director*
Melissa Kehrwieder, *Data Processing Manager*
Carol Licata, *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

NESDA
Member, Electronic Servicing Dealers Association

Audit Bureau of Circulations Member

ETA

AFSM INTERNATIONAL
ASSOCIATION FOR SERVICES MANAGEMENT INTERNATIONAL

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. Entire contents copyright 1994 by CQ Communications, Inc. Electronic Servicing & Technology or CQ Communications, Inc. assumes no responsibility for unsolicited manuscripts. 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, Micro-Computer Journal, CQ Radio Amateur (Spanish CQ), CQ Amateur Radio Equipment Buyer's Guide, CQ Amateur Radio Beginner's Buyer's Guide. Popular Communications Communications Guide, and Electronic Servicing & Technology.

The interoperability characteristics of the Grand Alliance system also will contribute to the expansion of the NII. Finally, and of equal importance, the development of the Grand Alliance system, and the expeditious approval of an American high definition standard, will promote U.S. competitiveness and create thousands of skilled, high-paying jobs in the United States.

The letters, signed by EIA President Peter F. McCloskey and ATV Committee Chairman Sidney Topol, concluded by saying, "The FCC/ACTS endorsement of the Grand Alliance system is an essential prerequisite to the rapid development and deployment of an interoperable high-definition television system in the United States. EIA and its Advanced Television Committee encourage the FCC to complete testing and deliberations and adopt an American standard for high-definition television at the earliest possible date. EIA hopes that swift action by the FCC will allow a demonstration transmission of the 1996 Summer Olympics in high definition which will accelerate the acceptance of the exciting new entertainment, information and multi-media services that digital HDTV promises to deliver to American homes."

The Digital HDTV Grand Alliance represents the merging of technologies developed by three groups that had been vying for the digital HDTV standard in the United States: AT&T and Zenith Electronics Corporation, General Instrument Corporation and the Massachusetts Institute of Technology, and a consortium composed of Thomson Consumer Electronics, Philips Consumer Electronics and the David Sarnoff Research Center.

Industry groups create alliance to sponsor management education

The National Association of Service Dealers (NASD), a division of the National Association of Retail Dealers of America (NARDA), and the National Electronics Service Dealers Association (NESDA) have joined forces to co-sponsor the 1994 NASD/NESDA School of Service Management. This was announced jointly by the president of NASD, Roberta Chesney, Quality TV, Florida, NY and NESDA president, Robert Masa, Electra Sound, Parma, OH. The school will be held October 8–11, 1994 at Stouffer's Atlanta Concourse, Atlanta, GA.

"This is a perfect example of the value of alliances for creating new benefits," according to NASD president, Chesney. "NASD has built a reputation for excellence in management education. NESDA is known throughout the industry for its equally excellent technical training. Our staffs will be working together to create a management program that serves the needs of both memberships."

The annual School of Service Management was started in 1958 by what was then the service division of NARDA. It is an intensive four-day management program for service business owners and managers and the service managers of self-servicing retailers.

Servicers who attend can study every aspect of managing a professional service company or department. The program will include classes on finance, parts inventory and personnel management, mar

(Continued on page 64)

Oscilloscope update— An oscilloscope refresher

By The ES&T Staff

When the first oscilloscope was conceived and built, the world of electronics changed forever. It became possible to actually *see* what was going on in an electrical or electronic system, to observe the waveforms and to determine if the circuit was working as it should.

The oscilloscope helped circuit designers visualize the results that they wanted from their circuits, helped testers determine if the finished products were performing as specified, and aided servicing technicians in diagnosing problems in circuits that were not performing according to the design.

The evolution

Early oscilloscopes were crude when judged by today's standards. They provided only synchronous sweep. So, if a waveform was irregular it was difficult, if not impossible, to observe it. The bandwidth of the first scopes was narrow, so only a small range of signals could be observed. These scopes were single channel, so the waveform at only one test point could be observed at one time. It was not possible to compare waveforms.

Over the years, as electronics in general has evolved, oscilloscopes have evolved too. Today, oscilloscopes can be used to examine more than one circuit point at a time. Bandwidths well over 300MHz are possible. Oscilloscopes now have a triggered sweep function that uses a part of the observed waveform to trigger the sweep oscillator so that almost any waveform, no matter how irregular, can be displayed.

Oscilloscope trends today

Even though the oscilloscope has by now attained the status of being a venerable old instrument, constant improvements are being made to the instrument itself and to accessories associated with the oscilloscope.

For example, in the relatively recent past, oscilloscope manufacturers have added such features as digital readout of signal levels and frequencies. Digital storage oscilloscopes allow users to store a waveform for later analysis, or comparison with other waveforms. The ability to store a waveform also implies the ability to put a copy on disk and analyze it anywhere, at a later time.

Other changes in the world of oscilloscopes include such innovations as turning a personal computer into a digital storage oscilloscope, and the development of probes that can turn an oscilloscope into a spectrum analyzer or a logic scope.

An oscilloscope refresher

Because the oscilloscope is most likely the single most important, useful, piece of test equipment available to the service technician, we're presenting this special update that provides a refresher on oscilloscope operation (based on information from the Panasonic electronic measuring instrument catalog), provides specific suggestions for using an oscilloscope to diagnose and service the microprocessors that are cropping up in every type of consumer electronics product, and reports on some recent advances in oscilloscopes.

The oscilloscope display

If a varying electrical signal is repetitive, there are two ways of making the signal stand still on the CRT screen. In the synchronous sweep method, the sawtooth signal applied to the horizontal deflection plates is chosen so that the repetition rate of the signal applied to the vertical deflection plates is an integral multiple of it.

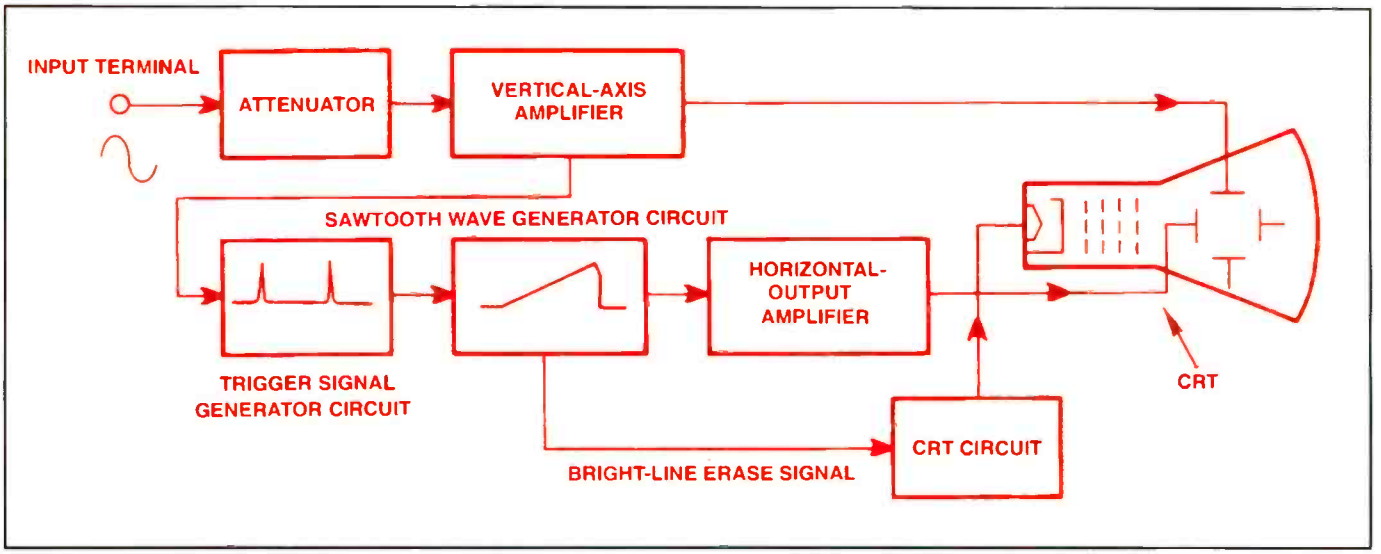


Figure 1. Most modern oscilloscopes use the trigger sweep method of developing a display.

This makes the displayed waveform stand still. Depending on the multiple chosen, one, two, or more complete cycles of the waveform may be displayed.

This method is not suitable for high frequency signals or extremely low frequency signals. Some waveforms cannot be made to stand still by this method. For these reasons, synchronous sweep is not commonly used today.

In the trigger sweep method, a pulse waveform is generated from the signal to be measured, or from a part of a signal related in time to the signal to be measured to start the sawtooth signal. This derived signal is called the "trigger." The trigger method makes it possible to observe even complicated waveforms at the same position regardless of frequency. The trigger sweep method is very effective for measuring pulse waveforms. Most modern oscilloscopes employ this method (Figure 1).

Selecting an oscilloscope based on specifications

The type of oscilloscope needed by a technician depends on what work is going to be performed using the oscilloscope, and the demands of that work. For example, the demands of a TV/video service company will be considerably less than those of a digital circuit design company. On the other hand, the demands of an oscilloscope used by a TV/video service organization will be considerably greater than one used by a company that does strictly electrical or audio work. The digital circuits of today's audio products have, however, certainly imposed greater demands on the test equipment than the strictly analog audio of a few years ago.

Frequency bandwidth

Ideally, the frequency response of an oscilloscope is designed as shown in Figure 2 so as to faithfully amplify a pulse waveform. Faithful rendition of a pulse implies that the oscilloscope amplifier would amplify all frequencies equally. In this figure, f0 is the point where the amplitude is 3dB below the reference amplitude. At this frequency, the amplitude is 0.707 of the amplitude at the reference frequency. This point is the upper limit of frequency bandwidth. If a sine wave with a frequency of 100MHz is displayed on an oscilloscope that has 100MHz bandwidth, the amplitude of the sine wave dis-

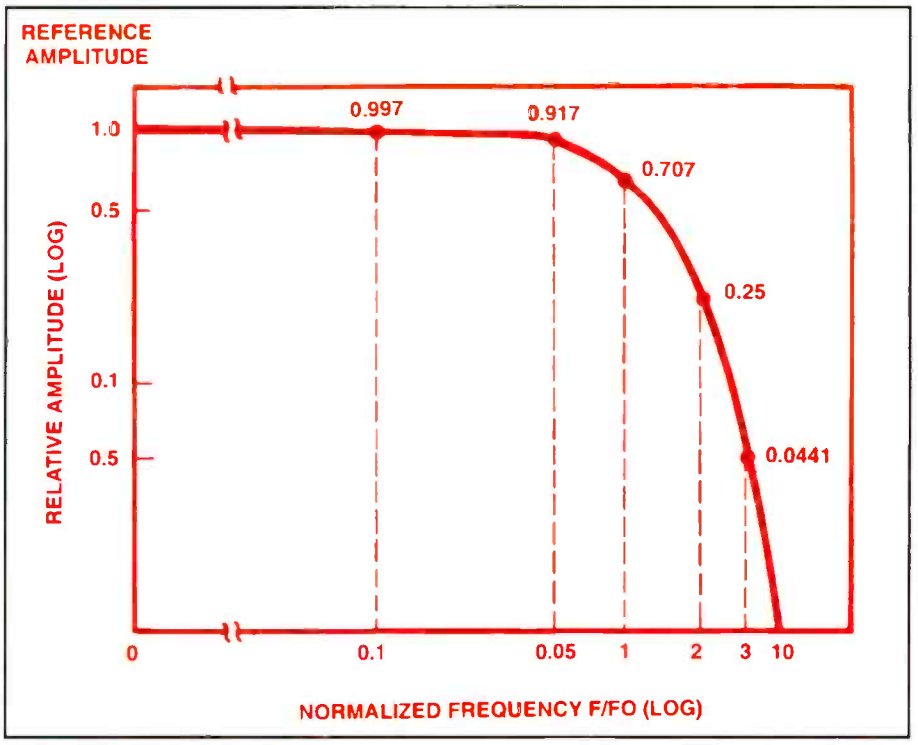


Figure 2. Ideally, the frequency response of an oscilloscope is designed so as to faithfully amplify a pulse waveform.

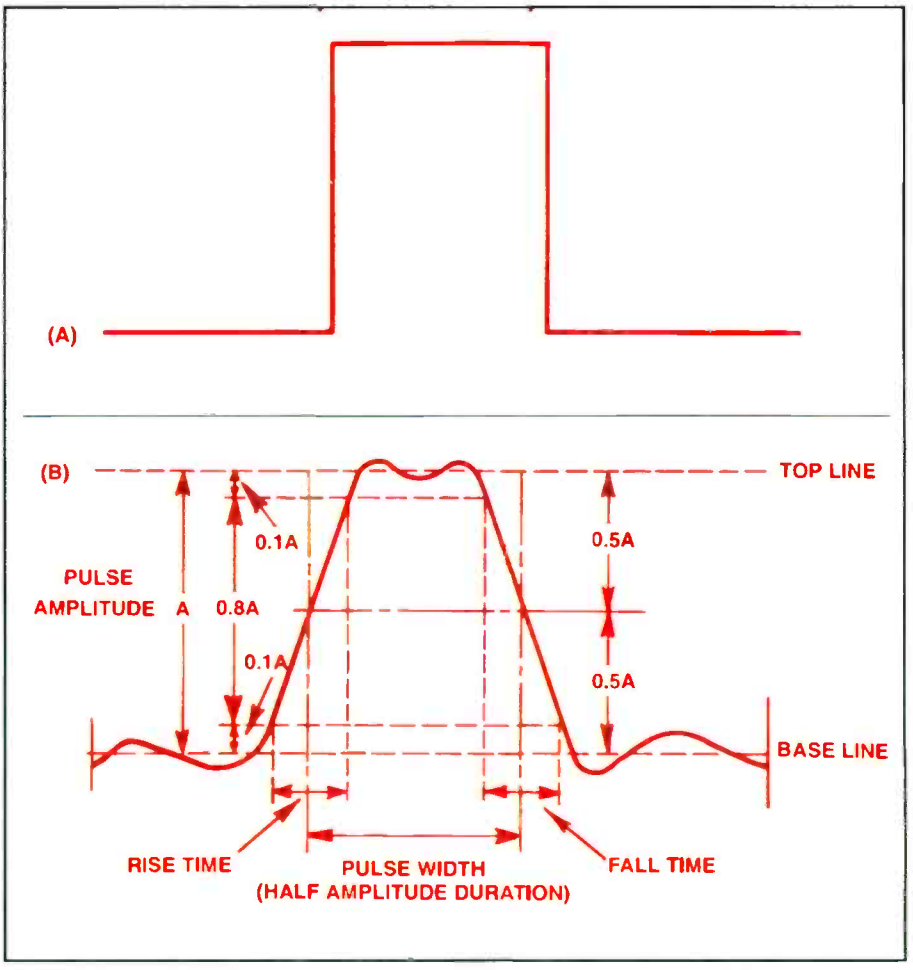


Figure 3. The oscilloscope is frequently used for measurement of pulse waveforms. An ideal pulse waveform is shown in Figure 3a. Such a pulse shape cannot actually be achieved, however. An actual pulse waveform is shown in Figure 3b.

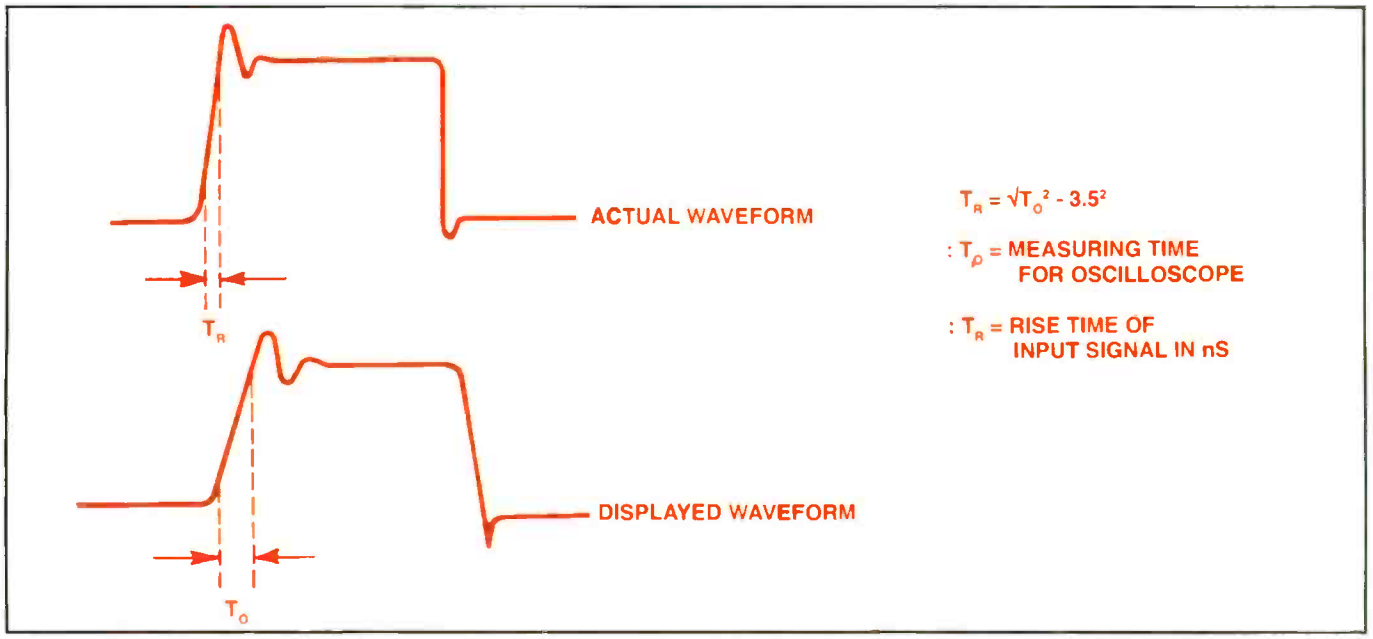


Figure 4. When you measure a pulse waveform, you have to consider the bandwidth of the oscilloscope, depending on the rise time of the pulse. The measurement error includes the rise time for the measuring oscilloscope. This figure shows the measurement on a pulse waveform using a 100MHz oscilloscope.

played will be about 30% lower than the actual amplitude.

As shown in Figure 2, the response is 8% below reference amplitude at a frequency equal to 1/2 the frequency bandwidth and 0.3% from the reference amplitude at a frequency equal to 1/10 of the frequency bandwidth.

When you're using an oscilloscope to observe sine waves, keep this amplitude reduction effect in mind, or you might get some confusing results.

Rise time

The oscilloscope is frequently used for measurement of pulse waveforms. An ideal pulse waveform is shown in Figure 3a. Such a pulse shape cannot actually be achieved, however. An actual pulse

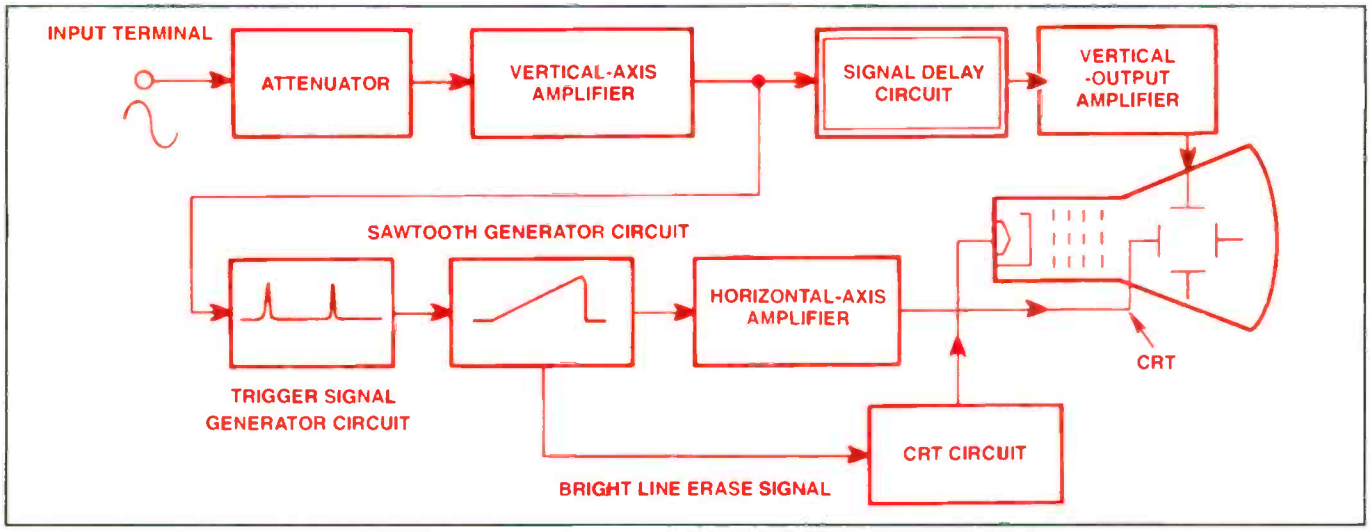


Figure 5. The sweep magnifier makes it possible to magnify the observed waveform to the left and right, with the CRT center as the center of the waveform. Here the waveform is magnified 10 times by switching the horizontal amplifier gain.

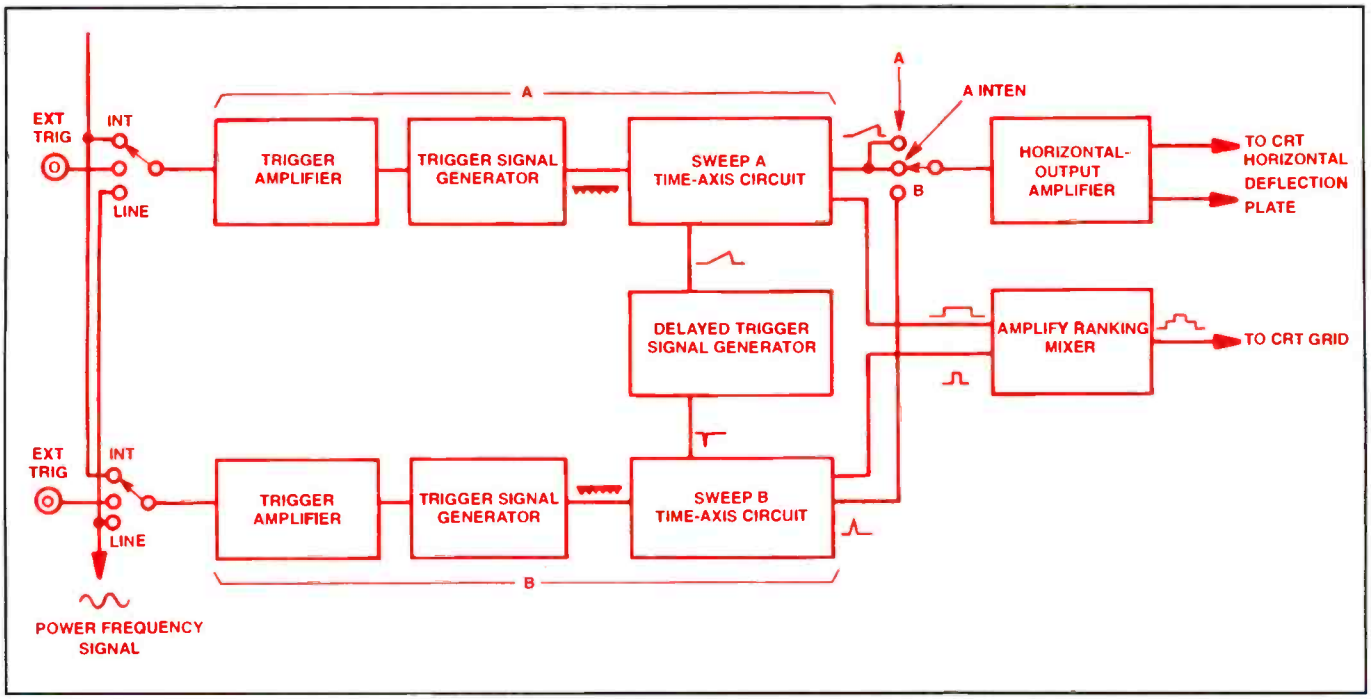
waveform is shown in Figure 3b. This figure defines each part of the waveform.

The speed at which the waveform rises is expressed by the "rise time." In Figure 3, the time during which the amplitude changes by 0.8A is called the rise time.

Rise time and bandwidth

Bandwidth is one measure of the capability of an oscilloscope. A pulse waveform can be shown to consist of an infinite number of sinewave components. Each of these components has its own amplitude and phase. If the bandwidth and risetime of the amplifier in the oscilloscope used to display these components are maintained in this relationship: Tr x B = 0.35 (where B is the 3dB bandwidth and Tr is the risetime), then it will be possible to amplify, and thus display, the waveform without any distortion.

This expression indicates the rise time that appears at the output of the amplifier system when an ideal pulse waveform with a rise time of 0 is applied to an amplifier system with bandwidth B. The relationship described by this expression



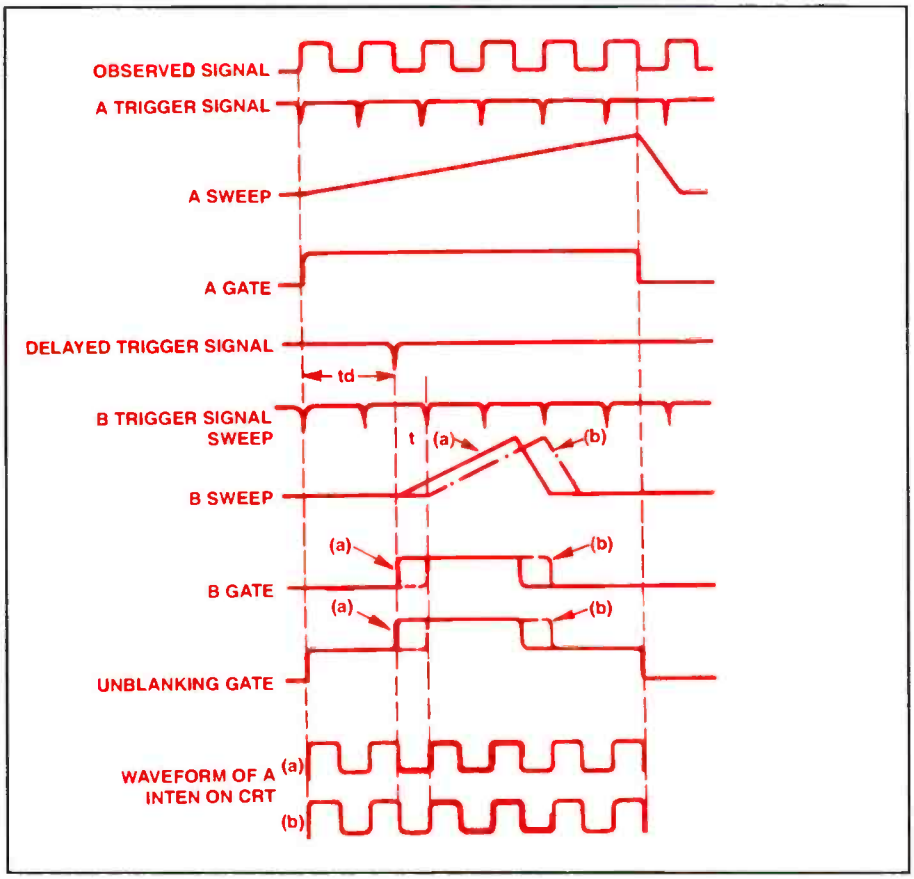


Figure 6. Delayed sweep can be operated in either of two modes. In one mode, B sweep starts immediately after delay time, td, has elapsed (waveform shown in Figure 6a. In the other mode, B sweep is started with a B trigger pulse after td has elapsed (waveform shown in Figure 6b).

makes it possible to determine the amplifier characteristic for an oscilloscope. For example, from the equation, the rise time with a 100MHz bandwidth is Tr = 0.35/B = 0.35/100 x 10^6 = 3.5ns

When you measure a pulse waveform, you have to consider the bandwidth of the oscilloscope, depending on the rise time of the pulse. The measurement error includes the rise time for the measuring oscilloscope. Figure 4 shows the measurement on a pulse waveform using a 100 MHz oscilloscope.

Input impedance

The rise time of an oscilloscope is related to the input impedance by this expression: Tr = 2.2(Re)(Cin). In this equation, Re is a value determined by Rs in the measured circuit and input resistance, Rin of the oscilloscope, and Cin is the input capacitance of the oscilloscope. The rise time can be measured as shown in the following expression by connecting the 10:1 probe to the signal source, provided that the input impedance of the oscilloscope is 10MΩ/20pF and Rs is 300Ω:

Tr = 2.2 x 300Ω x 15pF = 9.9ns

Sensitivity

The vertical-axis sensitivity of an oscilloscope is expressed as volts per division (V/div). The peak-to-peak amplitude of the waveform being observed is adjusted by the sensitivity switch to make it easy to observe. For example, a 2Vp-p signal is being observed with the oscilloscope.

If you have the oscilloscope set to 1V/division, the signal will be spread vertically over two divisions. If you set the oscilloscope to the 0.5V/division range, the signal will occupy four vertical divisions. The voltage of any input signal can be measured by multiplying the number of vertical divisions covered by the displayed signal times the V/div setting.

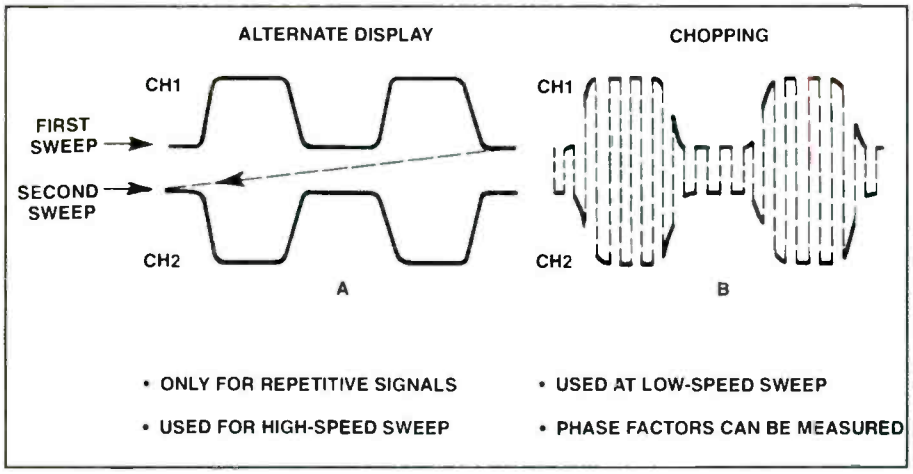


Figure 7. Dual trace realtime display of two signals can be done in one of two ways: alternate display and chopping.

Sweep rate

The horizontal sweep rate of an oscilloscope is measured in seconds/division. This magnitude is calibrated by the time per division on the CRT screen.

The amount of time required to move the spot horizontally the distance of one division is called the sweep rate. Sweep rate is expressed in seconds per division.

Signal delay time

In the trigger sweep method, the oscilloscope generates a trigger pulse to drive the sawtooth generator circuit from the signal output of the vertical-axis amplifier.

If the signal being observed has a fast rise time, the amount of time the signal takes to reach the vertical deflection plates is less than the amount of time it takes for the trigger signal to trigger a sweep on the horizontal axis. When this happens, the rising edge of the signal cannot be observed.

To correct this problem, a signal delay circuit is added to the vertical-axis amplifier circuit to delay the signal before it is applied to the vertical deflection plate.

Sweep magnifier

The sweep magnifier makes it possible to magnify the observed waveform to the left and right, with the CRT center as the center of the waveform. Figure 5 shows an example of magnifying the waveform 10 times by switching the horizontal amplifier gain.

If a waveform is magnified 10 times, the sweep time per division on the CRT screen is 1/10 the sweep time per division to display the waveform normally. If a waveform is displayed normally at a given sweep rate, when it is magnified 10 times the sweep rate becomes one tenth the normal sweep rate.

Delayed sweep

When you're observing a complicated waveform on the oscilloscope you may

Oscilloscope Update:

Turning a scope into something else and turning a computer into a scope

An oscilloscope is essentially a device for turning a signal that's applied at its inputs into a display that the user can interpret, and, on the basis of that interpretation, decide if the circuitry that's producing that signal is operating correctly.

In most cases, the signal to be viewed is a voltage that's varying in some way. And the intention is to look at the time variation of that signal.

But sometimes the oscilloscope user would really like to observe the frequency spectrum associated with the signal being observed. And sometimes the oscilloscope user would really like to observe the relationship of the logic signals at a number of points in the circuit; as on a data bus.

To observe these kinds of signals would ordinarily require a spectrum analyzer or a logic scope. Given the advanced state of electronics today, and the extremely small size of ICs and components, engineers have found ways to cram enough circuitry into a relatively small probe that will give an oscilloscope the ability to perform, to some degree, the functions of a logic scope or spectrum analyzer.

A logic probe

ITT Pomona has recently introduced a device called a Logic Scope Probe, which is connected to the input of an oscilloscope. The logic scope probe is then connected to the points of interest in the digital circuit to be observed. The probe con- verts the several inputs into an output signal to the oscilloscope which displays up to eight logic signals at the same time, in their correct time relationship.

This unit can be used in one of three different modes.

In the logic analyzer mode, the oscilloscope becomes an 8-channel logic analyzer with a memory depth of 16 words. Each channel is displayed as one horizontal line on the oscilloscope's screen in a "timing diagram" fashion.

In the trigger probe mode, the probe generates a real-time trigger signal whenever an 8-bit user-selected condition is met. You can use this mode to view analog signals (using your passive probes) while you trigger your oscilloscope externally from a digital combination.

In the MUX mode, the user can watch, in real time, 8 digital signals simultaneously on screen. The oscilloscope is triggered as in the trigger probe mode.

A spectrum analyzer probe

A spectrum analyzer provides a different way to look at a time varying signal. An oscilloscope gives a display of the signal in the "time domain." a spectrum analyzer provides a display of the signal in the "frequency domain."

As an example, as we said earlier in this article, a square wave can be considered as being composed of an infinite number of sinewaves. The oscilloscope display shows the composite of all of those sinewaves in the time domain: a squarewave.

The spectrum analyzer, in contrast, displays the frequency components of the square wave in the frequency domain. This display is made up of a number of vertical spikes rising from the horizontal signal baseline at the fundamental frequency and each harmonic. Each of these spikes shows the amplitude of the sinewave component at each harmonic.

While the oscilloscope time domain display of a signal is the most useful for a service technician, there are times when a frequency domain display would be useful. In many service centers, however, a spectrum analyzer cannot be cost justified.

An alternative to a dedicated spectrum analyzer is the spectrum analyzer probe. Of course, the amount and quality of spectrum information the probe can provide is limited, compared to the information provided by a spectrum analyzer probe. However, many times even limited information is better than no information at all.

The personal computer as an oscilloscope

While some engineers have been designing probes that extend the usefulness of the oscilloscope, still other engineers have been designing circuitry that converts the increasingly popular computer into an oscilloscope.

The oscilloscope front end for the personal computer contains the circuitry that senses the signal from the unit under test and converts the signal from analog to the digital equivalent. Also part of the package is software that formats the display screen so that it looks like an oscilloscope, and displays the signal on the screen.

Of course, because this is a computer, it is possible to do the same kinds of things with the oscilloscope data as can be done with any other computer data: store it, manipulate it, compare it with other data, put it on a floppy disk and examine it later, and more.

want to magnify a portion of it so you can look at it more closely. You can do this if your oscilloscope has the feature called delayed sweep. Ordinarily, the main sweep is called the *A* sweep and the delayed sweep is called the *B* sweep. The sweep waveform of *A* sweep is sent to the delayed trigger signal. This delayed trigger signal starts *B* sweep. Figure 6 is a block diagram of this circuit.

Delayed sweep can be operated in either of two modes. In one mode, *B* sweep starts immediately after delay time, td, has elapsed (waveform shown in Figure 6a). In the other mode, *B* sweep is started with a *B* trigger pulse after td has elapsed (waveform shown in Figure 6b).

With delayed sweep you can accurate-

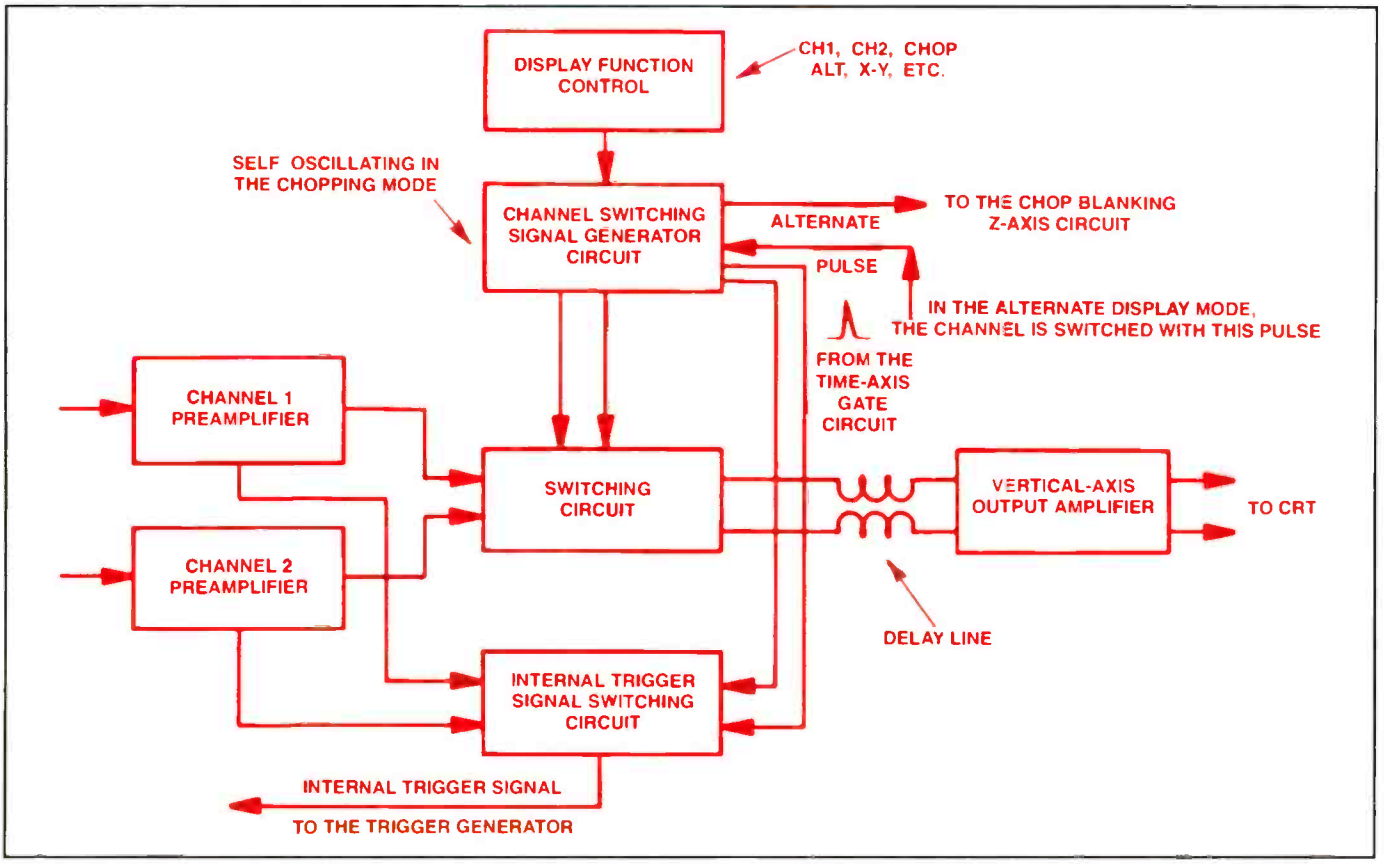


Figure 8. Two channel switching on an oscilloscope is accomplished as shown here.

ly determine the delay time by means of the turn pot. Any part of the waveform can be magnified and observed.

Dual trace and dual beam

Many times it's desirable to observe two waveforms at the same time. For example, a technician might want to look at the input signal into an amplifier, and observe the amplified signal at the output at the same time. A two channel oscilloscope allows for this. Two electron beams can be generated to display two lines on the CRT screen. Alternate display and chopping can also be employed for realtime switching of one electron beam.

Alternate display and chopping

Dual trace realtime display of two signals can be done in one of two ways: alternate display and chopping. In the alternate display mode, the first sweep displays the channel-1 signal and the second sweep displays the channel-2 signal, as shown in Figure 7. Dual trace operation is thus possible if the two signals have the same periodicity.

In the chopping mode, the channel-1 and channel-2 signals are chopped into pieces and are displayed alternately during the same sweep, as shown in Figure 7. In chop mode, either random or repetitive signals can be observed.

When the sweep rate is high, however, the chopped segments are too noticeable on the screen. Ordinarily, the alternate mode is used at high sweep rates, and the chopping mode is used for slower rates.

Two channel switching circuit

To achieve a two-channel display, the signals output from the channels 1 and 2 preamplifiers are applied to the switching circuit, which is driven by the signal from the channel switching signal generator circuit. In the alternate display mode, the gate pulse from the time-axis circuit switches the channel during the blanking period. In the chopping mode, the oscillator built into the switching signal generator circuit switches the channel in the oscillation cycle. The part of the signal which would be displayed during switching is blanked because this would make it hard to observe the waveform. This is called chop blanking. Figure 8 shows a block diagram of a two-channel switching circuit. ■

Testing microprocessors using an oscilloscope

By The ES&T Staff
Based on Sencore Tech Tip 109

Microprocessors are now being used to control every kind of consumer electronics products: TVs, VCRs, CD players, and microwave ovens. Many technicians think that these microprocessors are difficult to service. It may be that these technicians think of microprocessors as computers. Most microprocessor systems are used as controllers, however, not as computers. Knowing this, and knowing how to approach microprocessors with familiar test equipment can make servicing microprocessors a lot less fearsome.

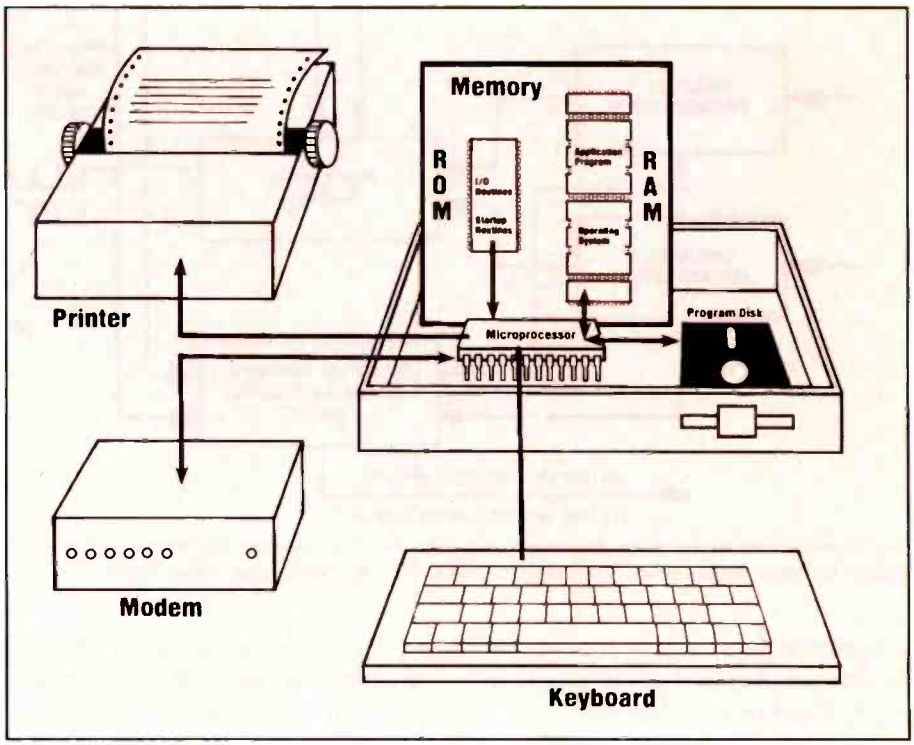


Figure 1. The main difference between a computer and a controller is that the computer may be easily reprogrammed from a disk or a tape. It also has external memory and complex inputs and outputs.

Microprocessors rarely fail

Let's start with a piece of practical advice: don't be too quick to change the microprocessor. Time and time again, technicians find that changing a microprocessor doesn't help a problem that looks like it might be caused by a bad micro. Microprocessors rarely fail. They are protected from static discharge and power line surges by filtered power supplies and by buffering transistors and ICs. The best procedure to follow when you suspect a failed microprocessor is to leave it on your list of suspects, but be sure to interrogate all the other likely culprits first.

You can quickly isolate most microprocessor-related problems using an oscilloscope and five quick tests to be described a little later. First, let's see how a microprocessor used as a controller differs from one used as a computer so that you can see why the approach to microprocessor servicing is different from the approach to computer servicing.

The computer vs the controller

The biggest difference between a microprocessor used in a computer and one used as a controller has to do with programming. A computer can be reprogrammed as needed, usually by entering information from a magnetic disc or tape. The controller, on the other hand, lives a relatively boring life, playing the same program over and over. Microcontrollers are rarely reprogrammed once the system has left the factory. This main difference leads to several other differences as well.

Computers, whether desk-top personals or large mainframes, handle large volumes of assorted data. One batch may be numbers for a payroll, and the next may be a document for a word processor. Controllers, by comparison, deal with much smaller volumes of data. The data are repetitive and predictable, often representing inputs from simple switches and sensors within the system.

The microprocessor used in a computer connects to thousands or millions of bytes of external random-access memory (RAM), each byte containing 8 memory locations. This RAM may require dozens of external memory chips. The microprocessor used as a microcontroller only needs a small amount of memory, often inside the microprocessor chip itself.

Lastly, a computer has complex inputs and outputs. Inputs come from keyboards, disk drives, or modems. Outputs feed printers, plotters, CRT displays, or other computers. The controller only has inputs from a few switches or sensors. It only feeds a few ICs, relays, and a simple digital display.

Servicing controller-type microprocessors doesn't need to be any more complicated than servicing any integrated circuit. The limited environment of the controller means that you don't have to know many things that you might think you need to know.

The simplified system

One of the biggest differences between servicing computers and controllers is that you don't have to worry about software problems in controllers. You don't need to know programming or ASCII

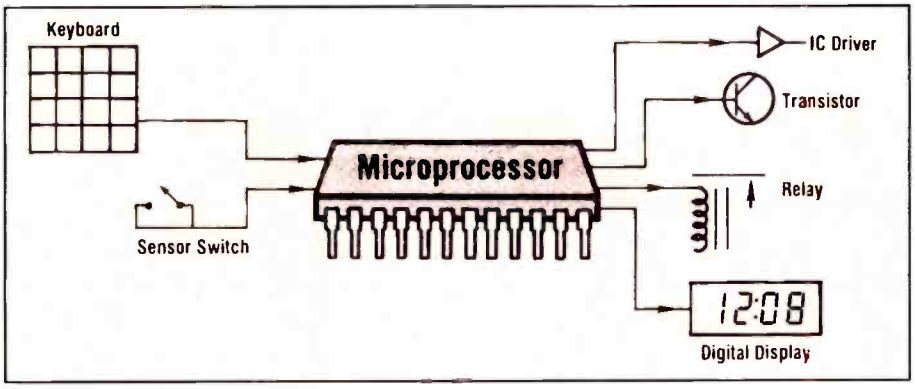


Figure 2. The microprocessor used as a controller is programmed one time at the factory. It uses simple switches and sensors for inputs, and transistors, ICs, relays and digital displays for outputs.

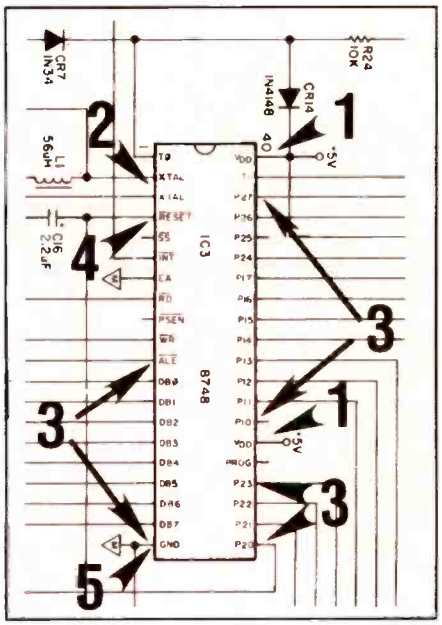


Figure 3. Most defects in a microcontroller system are caused by problems outside the microprocessor. Test the microprocessor inputs and outputs in this sequence to isolate external problems before replacing the microprocessor.

codes. If you suspect a software problem, you have only one option: change the program chip.

Second, you don't have to sort through rows and rows of memory chips. This means that you don't need a $20,000 logic analyzer or an 8-channel scope to view each byte of data separately in order to locate a defective memory location. If an internal memory location is bad, you have to change the microprocessor.

Finally, the controller has limited inputs and outputs: generally no more than eight of each. You can test each one separately to confirm whether the problem is coming from inside the microprocessor or from an external component.

Once you stop worrying about software, memory, and complicated interface systems, the microprocessor takes on a whole new look. You can find most problems with five standard tests using an oscilloscope. The tests are of:

- The power supply
- The clock
- The input and output lines
- The reset circuit
- The grounds

Test the power supply

Always test the power supply first, whether the problem is a totally dead micro or one with erratic operation. Start with the dc level. Set the oscilloscope for dc input, and set the trace at the zero level. Touch the probe to the power supply pin and observe the dc level on the scope, or check the scope's digital readout to determine the dc voltage. The voltage should ordinarily be in the range of 5 to 12 volts. The voltage you observe should be with-

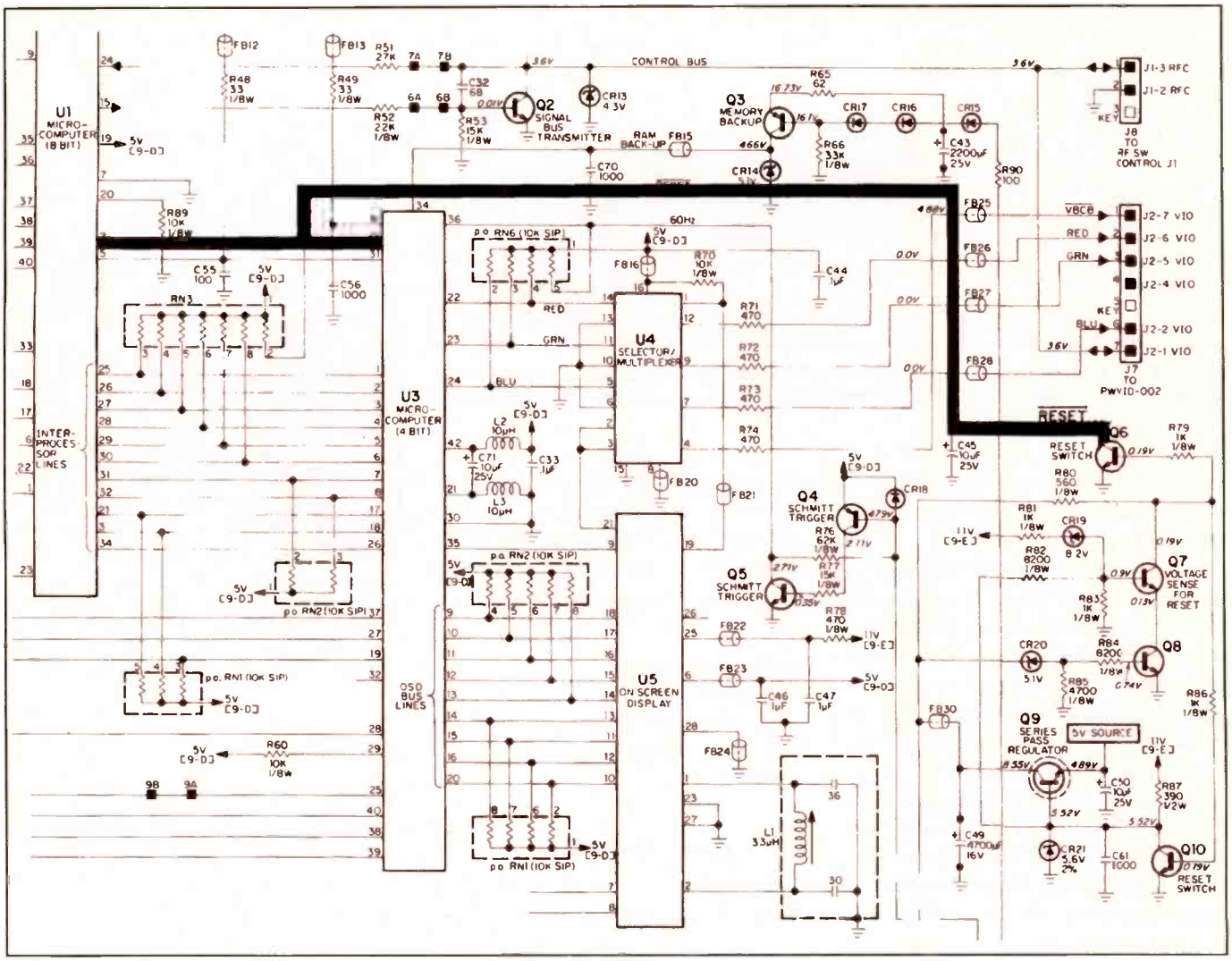


Figure 4. Watch for a reset pulse when you first apply power. Defective reset circuits make the microprocessor appear defective because it does not start at the beginning of the program.

in about 0.2V of the specified level.

But don't stop there, because noise often enters the microprocessor through the power supply, causing it to act erratically. Check the CRT to confirm that the signal is clean. If the oscilloscope has a digital readout, use the appropriate procedure to obtain a digital readout of the peak-to-peak voltage. This will give you an indication of the magnitude of the ripple.

You may see 60Hz ripple from a bad filter or regulator. Or you may see high frequency digital noise from another stage, which can cause the micro to freeze as the noise pulses intermix with normal input signals. If so, suspect a bad filter or decoupling capacitor on the power supply line, or a bad IC on the same line that is loading the supply. If the microprocessor has more than one power supply source, check the other sources in the same manner.

Test the clock

A problem in the crystal-controlled clock can cause intermittent operation. Watch for the following conditions as you probe one, then the other of the microprocessor pins, connected to the clock input pins, usually coming from a crystal.

First, adjust the scope to achieve a stable trace and note the period of the waveform. The frequency is the inverse of the period. If your oscilloscope has a digital readout, use the appropriate procedure to display the frequency. If the frequency is not in agreement with the specification, suspect that the crystal is bad.

Next note the amplitude of the crystal output to make sure that it is in accordance with the specification. Even if the crystal frequency is correct, if the amplitude is below the threshold needed by the microprocessor, the clock information might not be reaching the clock.

Finally, look carefully at the clock waveform to be certain that the clock does not include extra "glitch" signals. These extra signals might cause the microprocessor to intermittently skip a program step, or could cause the whole system to run too fast. The clock should be a clean sine or square wave.

Test the input lines

Generally, input defects affect only a few functions. Use the product's control buttons, knobs and other controls to try every function controlled by the micro and note which ones work correctly and which ones have troubles. Then, determine which input pins are associated with the bad functions. For example, one or two switches might provide an input to a single function and not be used with any other of the micro's inputs.

Connect the scope probe to the pins associated with the questionable functions and observe the trace as you cycle the input switches. Either on the trace or on the digital readout, note the dc level with the switch contact open and with it closed to be sure that the level properly changes between the one and the zero logic level. Be sure that neither level falls into the "undefined" area between the two logic levels, or the microprocessor might not be able to decide whether a high or a low condition exists.

Check contact resistance or pull-up resistors if the levels are wrong. Watch for noise or glitches which may cause the micro to interpret a single switch operation as two or more separate switch closures. Check the switch contacts, decoupling capacitors, and switch buffer circuits to isolate noise conditions.

Test the output lines

Next, test all data (output) lines to be sure that one isn't stuck at logic high or logic low. Touch the probe to each microprocessor output pin, one at a time. Don't worry that the signal shows a blur of lines—seemingly out of sync. This is simply because of the asynchronous (random) data coming from the micro.

Set the oscilloscope to dc coupling to confirm that the low points on the waveform are below the minimum level for a zero, and that the high points are above the minimum level for a one. Suspect a bad pullup resistor or an IC outside the micro if the signals are falling between logic levels.

If the signal at a pin remains cemented to ground or B+, look at the schematic to see when that pin is used. You might have to trace the pin to a relay or an IC to find out which functions it controls. Then force the microprocessor into a function that uses this pin by pressing a button or cycling a sensor.

If the signal at the pin doesn't change, isolate the pin from the external circuits by carefully removing the solder between it and the foils on the pc board. Connect the oscilloscope to the isolated pin and again check for toggling. If the pin toggles with the load removed, the problem is most likely outside the micro: an external component is holding the pin high or low. Isolate each component on that line, one at a time, until the line toggles. Then replace the defective part.

If the pin remains stuck after being isolated, it's beginning to look more like a defective microprocessor, but don't unsolder the other legs yet. There are two more checks to make.

Test the reset circuit

Microprocessors need an external reset pulse at turn-on. Without the reset pulse, the microprocessor starts in the middle of the program, resulting in totally unpredictable operation.

Take advantage of the oscilloscope's CRT to check the reset pulse. Set the Trigger Source switch to channel A, the Trigger Mode switch to "Norm" and the Trigger Level control to the zero at the center of its rotation.

Connect the device containing the microprocessor to a switched ac outlet strip, so you can turn the power off and on. Don't rely on the device's power switch, since the microprocessor often receives power independent of the power switch. In fact, many "power" switches are simply one of the microprocessor inputs and don't actually interrupt the power.

Turn off the power and connect the oscilloscope channel A probe to the reset pin. Watch the CRT as you apply power to the system. If you see the trace flash across the CRT, you know a reset pulse occurred and triggered the oscilloscope's sync circuits. If you didn't see a trace, there may be a problem in the reset circuits.

Check grounds

If all of the tests so far have not pointed to a faulty component or components in the circuitry surrounding the microprocessor, now the microprocessor is highly suspect. But don't unsolder it yet. First, check every grounded pin. Each should show zero volts dc and 0 volts ac. If any grounded pin has a signal on it, it will cause the microprocessor to act as though the micro itself is bad. The presence of a signal tells you that there is an open in the grounded path: either a broken pc foil or a bad solder connection. Repairing the bad ground will probably clear up the trouble.

If the grounds are good, replace the micro. You've already confirmed that all the inputs and outputs are normal. ■

Solving VCR system control problems

By Arthur Flavell

A cassette is placed into the VCR and nothing happens. Or perhaps the tape loads, plays for two seconds and stops. What is going on?

Chances are you are experiencing a system control or "SYSCON" problem. As the name implies, SYSCON directs every aspect of VCR operation. It is a fairly complex system and numerous signals to and from the system-control microprocessor are necessary to make everything tick. One improper or missing signal will show up as a fault in some phase of the VCR's operation.

The key to troubleshooting SYSCON problems is understanding the circuit's operation. Armed with this knowledge, a service manual and some basic test equipment, you are ready.

Flavell is owner of an independent consumer electronics service center in Alaska.

Test equipment

Most voltages on the system control microprocessor are logic signals. A logic probe is useful for initial troubleshooting. A digital VOM or high-impedance multimeter, oscilloscope and frequency counter may also be needed.

SYSCON circuits

Let's examine a typical SYSCON microprocessor, its inputs and outputs and the sources and destinations of the various signals. To simplify the explanation, only the primary control signals are shown (Figure 1).

Pins 1 and 2, labeled OSC 1 and 2, are tied to the on-board clock oscillator. A crystal is mounted externally on the circuit board. A check with the oscilloscope and frequency counter will determine whether the oscillator is operating and if it's on frequency.

Mode switch signals

Pins 4 through 7, POS A through D, are connected to the mode switch. This multi-position switch senses the position of the mechanical assembly. Depending on the mode (STOP, PLAY, Fast Forward, etc.), one or more of the switch terminals will be grounded and place a logic low on the associated microprocessor input(s) (Figure 2.)

CASS IN on pin 8 tells the micropro-

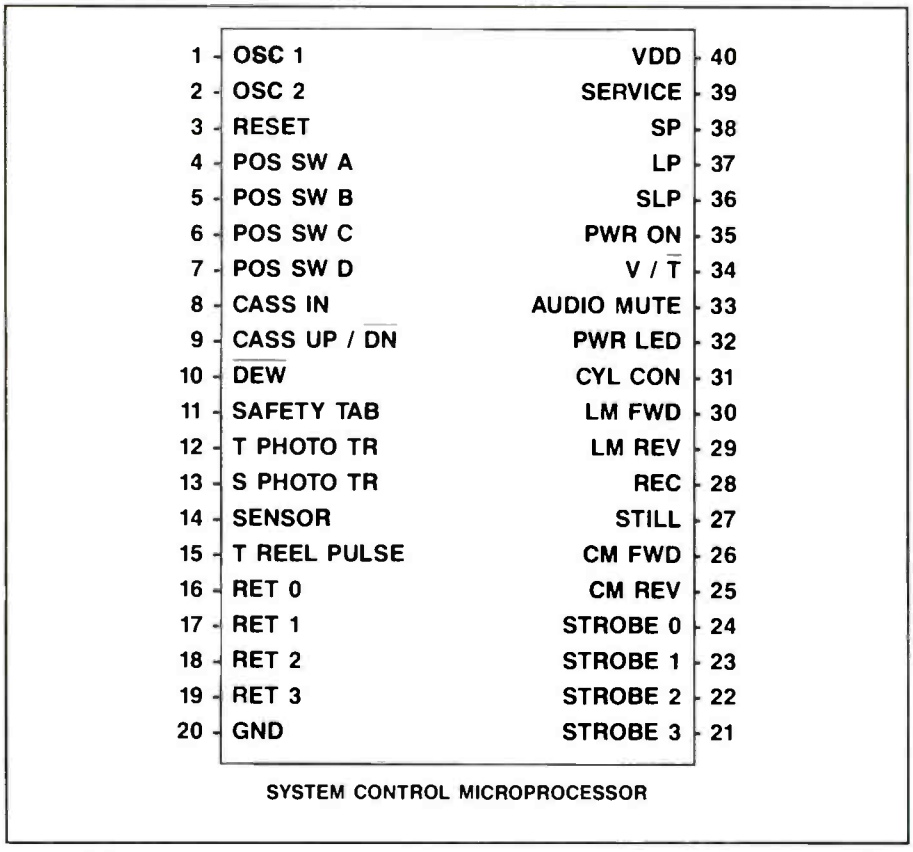
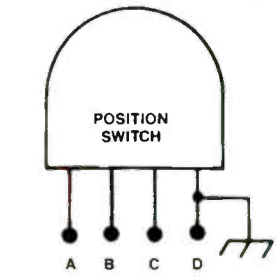


Figure 1. A typical SYSCON microprocessor, its inputs and outputs and the sources and destinations of the various signals. To simplify the explanation, only the primary control signals are shown here.



MODE SELECT

	A	B	C
STOP	L	H	H
FF/REW	H	H	L
PAUSE	L	L	H
REVIEW	H	L	H
PLAY	H	H	L

Figure 2. Pins 4 through 7, POS A through D, of the SYSCON microprocessor are connected to the mode switch. This multi-position switch senses the position of the mechanical assembly. Depending on the mode (STOP, PLAY, FF, etc.), one or more of the switch terminals will be grounded and place a logic low on the associated microprocessor input(s).

cessor that a cassette is present and initiates the loading process. The source of the CASS IN signal is usually a leaf-contact switch mounted on the top cover of the cassette compartment, or on the cassette mechanism gear train.

The signal at pin 9, CASS UP/DN, tells the microprocessor whether the cassette is in the up or down position. The solid line above the DN means that a logic low is present in that condition, and is referred to as "down not." Thus, if the cassette is in the "UP" position, a logic high is applied to pin 9, while a cassette in the "DOWN" position generates a logic low. Position detection comes from a leaf contact switch on the cassette loading mechanism gear train.

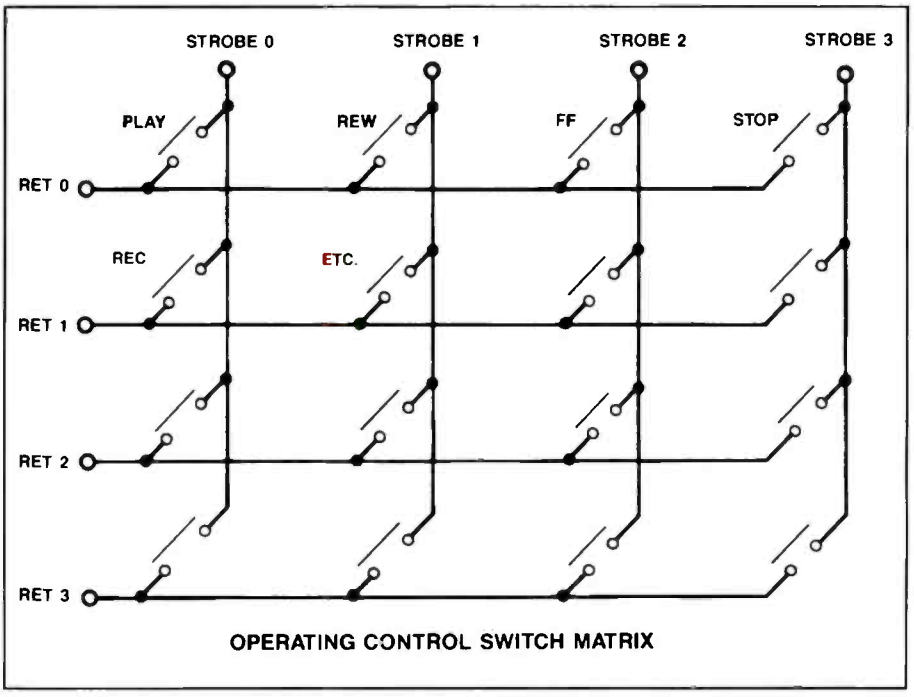


Figure 3. A four by four switching matrix on the front panel of the VCR allows control of up to sixteen operator functions. Each strobe output may be routed to any of the return line inputs. On some newer machines, operator inputs are handled by a separate microprocessor on the operation board.

SYSCON safety inputs

The DEW signal on pin 10 is one of a number of safety inputs. An accumulation of condensed moisture in the tape path can cause binding and damage to the video tape. The dew sensor changes resistance in the presence of moisture and sends a logic low which prevents tape motion. The dew sensor is located on the rear side of the lower drum assembly. Some VCR models have a dew warning light on the front panel.

The SAFETY TAB input on pin 11 prevents recording on cassettes that have been record protected. The record safety signal is provided by a switch located at the front of the cassette compartment. A spring-loaded activation lever on the switch enters the cavity left by removing the record safety tab on the cassette.

Pins 12 and 13, the takeup and supply phototransistors are both safety and operational inputs. The phototransistors detect visible light or infrared energy produced by a sensor lamp or LED.

The takeup transistor, located on the right side of the cassette compartment, detects light when the clear leader at the end of a tape passes between it and the sensor. The signal produced initiates auto-rewind.

The supply transistor, located on the left side of the cassette compartment, generates a signal when it detects light through the clear leader as the beginning of a tape passes between it and the sensor light. This signal causes the VCR to cease the rewind function.

If both transistors sense light at the same time (as when no cassette is present), tape transport motion is prohibited. *CAUTION: With the VCR cover removed, a work bench light may activate the phototransistors, even with a cassette in place, giving a false indication of trouble.*

When servicing without a cassette in place, it may be necessary to block the phototransistors with a small piece of tape. This simulates the presence of opaque videotape. *CAUTION: Do not fast forward or rewind to the end of the tape with the supply and takeup transistors covered. Tape damage may result. Don't forget to remove the tape when service is completed.*

The SENSOR input on pin 14 is another safety input which monitors current flow in the sensor light device. The sensor is located on the deck in the center of the cassette compartment. If the sensor fails, tape motion is inhibited. If it were not, tape would run to the end of the leader and reel drive action would continue. This could result in detachment of the tape end from the reel, especially during rewind and fast forward operations.

Pin 15 is the takeup reel pulse input. This signal tells the microprocessor that the reel is being driven in the play mode. It is a tape protection function that prevents video tape from being spooled out into the mechanism if the takeup drive fails.

The takeup reel pulse on newer machines comes from a sensor under the takeup reel. It may be an LED/phototransistor combination which reflects light off mirrored sections on the bottom of the reel or it may be a Hall device.

Older VCRs use a permanent magnet/pickup coil arrangement on the mechanical tape counter. On these machines, belt breakage on the tape counter will prevent operation.

Front panel signals

RET 0 through RET 3 (pins 16 through 19) and STROBE 0 through STROBE 3 (pins 21 through 24) work together to transfer operator commands from the front panel to the SYSCON microprocessor (Figure 3). Strobes 0 through 3 are four unique pulse train outputs which are routed to the switch matrix on the front panel. These outputs are present whenever the VCR is connected to a source of power. Return lines 0 through 3 are command inputs to the microprocessor. A four by four switching matrix allows control of up to sixteen operator functions (see Figure 3).

Each strobe output may be routed to any of the return line inputs. On some newer machines, operator inputs are handled by a separate microprocessor on the operation board. A serial data signal is sent from the operation microprocessor to

the SYSCON microprocessor. The overall operation is the same.

Pin 20 is the electrical ground for the microprocessor. It may be labeled VSS.

Outputs

CM REV, CM FWD and STILL, pins 25, 26 and 27 are control outputs which tell the capstan motor when and in which direction to rotate. These signals are routed to a capstan motor control circuit.

LM REV and LM FWD, pins 29 and 30, are output signals which tell the loading motor when and in which direction to move. These signals are routed to a loading motor driver circuit.

Pin 31, the CYL CON output, tells the cylinder (video head drum) when to rotate. This signal is routed to a cylinder motor driver circuit.

The PWR LED output on pin 32 transmits a drive signal to an LED driver on the front panel to illuminate the "Power On" pilot indicator.

The AUDIO MUTE output on pin 33 quiets the audio output when no signal is present on the video tape. It is generated by a CTL or control track pulse input to the SYSCON microprocessor.

The V/T output on pin 34 sends a control signal to the tuner which selects the RF output of the VCR. If the input is high (V), the VCR's tuner is activated and RF output is on channel 3 or 4. If the input is low (T NOT), the signal from the RF input jack is passed through to the RF output jack and channel selection is made on the TV set.

Pins 36, 37 and 38 are outputs which tell the capstan drive circuit the proper speed mode. In playback, CTL pulse intervals are detected by the microprocessor and the appropriate speed output pin is activated. In record mode, operator commands from the front panel determine the speed signal to be sent to the motor driver circuit. The speeds are: standard play (SP), long play (LP) and super long play (SLP). Some units may call the SLP mode "EP" or extended play.

SERVICE, on pin 39, is an input used by technicians to operate the VCR without a cassette in place. It is enabled by strapping the pin to ground.

Pin 40, VDD, is the voltage input to the microprocessor.

Troubleshooting

Troubleshooting SYSCON problems is straightforward. Begin by determining which function or functions are not operating properly. Troubleshooting flow charts are helpful in pinpointing the signals and peripheral circuits which may be causing the problem. If your manual does not have flow charts, use the SYSCON block diagram to analyze circuit function.

Here is the step-by-step troubleshooting process for the problem mentioned at the beginning of the article. A cassette is placed into the VCR and nothing happens. If you do not get the proper indication in a particular step, stop and determine the cause. Keep in mind that all of the signals must be correct for proper system operation.

1. Turn the power on and check the front panel for normal indications (Power ON pilot lit, display panel lit). If indications are abnormal, check the power supply and operation sections.

2. Check the microprocessor supply voltage at pin 40 for correct amplitude and absence of noise or ripple on the line. If the supply voltage is not correct, check the power supply and decoupling capacitors on the VDD line.

3. Check pins 1 and 2 for correct clock amplitude and frequency. If incorrect, check the crystal and external components in the oscillator circuit. If these all check out, the internal clock oscillator is defective.

4. Check the DEW input. It should be high for normal operation. If it is low, gently apply warm air to the interior of the VCR mechanism to dry it out.

5. Check the POS A through D inputs on pins 4 through 7. They should reflect the "STOP" mode. In this case, pin 4 should be low and pins 5 and 6 should be high. If the position signals are wrong, check the physical position of the mechanism and the switch. The position switch has a mechanical alignment indicator which should show proper position in the STOP mode. If the alignment is correct, remove the position switch and check continuity.

NOTE: Place a cassette in the VCR and push it gently into the loading position for the remainder of the steps.

6. Monitor pin 8, CASS IN. When the cassette is pushed in, pin 8 should go high. If it does not, check the cassette-in switch.

7. Check pin 32, LM FWD. It should go high in response to a high at CASS IN. If it does not, do not assume the microprocessor is at fault. Desolder pin 32 and recheck the output signal while it is not loaded. If the indication is now normal, check the driver circuit input for faults.

8. Check the loading motor driver circuit. Motor drive voltage should appear at the output terminals. If it does not, disconnect the motor from the driver and recheck the output voltage. If the voltage is then normal, go to the motor check.

9. Check the loading motor. Remove or unplug the power supply wires to the motor. Apply the specified operating voltage to the motor from a bench supply to see if it turns.

The rewards of servicing VCRs

The proliferation of VCRs has made servicing them bread and butter for many service centers. To keep pace, VCR repairs must be made by proficient, well-trained technicians.

VCRs are complex systems, but a firm grasp of some of the basics, along with a logical approach to troubleshooting, will lead to resolution of most problems without too much difficulty. ■

Business suggestions from the best idea contest

Results of a one-hour think tank of independent servicers

By The ES&T Staff

Every year at the National Professional Electronics Conference (NPEC), an annual convention and show held by the National Electronic Service Dealers Association (NESDA), attendees have a meeting at which they share ideas with each other for improving the operation of their service centers.

This meeting is called the "Best Idea Contest." Some of these ideas are actual servicing tips, some suggest ways to improve business operations, some suggest ways to avoid waste or improve customer relations.

Following is a listing of the best ideas generated at the 1993 NPEC, generously shared with **ES&T** readers by the people who generated them.

Best Ideas

1. Get the most out of yellow page advertising by using the yellow page coupon system and referring to them in your display ads. Gives the prospective client another reason to do business with you. Don't refuse outdated coupons, but challenge the client cheerfully to "make up" for the fact that it's outdated by referring their friends to your company.

2. Create an "*I love me*" wall in your service center. Put up all training certificates, CET Certificates, awards etc. This helps to boost the morale of employees.

3. Develop a team approach to servicing. At least three techs per team (teams of two seem to fail). Reworks can be done by any team member. This helps everyone pull together and become a more productive team.

4. To remind members of association meetings, supply each member with a calendar for the year with all meeting dates stamped on it.

5. Make cards to be put on repaired VCRs during the winter months stating "*Cold weather warning.*" This alerts owners who are picking up repaired VCRs to let their recorders reach room temperature before inserting a tape.

6. When tape damage and debris is found in VCR servicing, use a sign on the door of the VCR telling the client to replace their defective tapes. Include instructions on how to examine, store, care for and purchase videotape.

7. Have a calendar printed on the back of your business cards. Gives another reason to keep your card.

8. Create a flyer telling of the benefits of calling a service center that employs CETs. Put your service center name, address, and phone number at the bottom. This allows for a self-imposed standard and brings a servicer to another level by association involvement.

9. Charge a hazardous material disposal charge. Five percent of parts billing.

10. Request effective placements of print advertisements. Best placement is the outside half of the page. Study your media buys.

11. Try a reverse print ad to draw attention. Use a black background with bold white print.

12. Use trade listing in outlying area phone books. List your company logo in column ads.

13. Use a separate phone number to track Yellow Pages ads in outlying area phone books to track where phone calls are coming from. Ask your yellow page salesman to tell you about key call forwarding. This inexpensive method will require no added phone lines, but count the number of incoming calls generated by a specific ad.

14. Prepare a hardbound service center brochure to give to prime clients, retail dealers, bankers; whoever you wish to impress with the scope and professionalism of the company. Use color pictures—of your exterior and work areas. Neatness always counts.

15. Give dissatisfied clients, upon making amends, a ten dollar appreciation postcard coupon to be used for the next time they need service. Gives you a second chance to please them. Confirms the concept that you truly want to please them and do business with them again.

16. Use a six-inch length of folded duct tape on your test video tapes to stick out of VCRs so the test tapes don't get lost. Apply this tape to the bench area and the front office test videotapes to avoid leaving them in the repaired and tested video recorders. This works for Nintendo test cartridges and some audio applications.

17. Create an advertisement on the tape described in the item above.

18. Use yellow safety tape on the test tapes above.

19. Print hookup instructions for clients. Place on all outgoing repaired products. Be certain to put an advertisement (of what other work you do) with a coupon on this instructive flyer.

20. Whenever presenting a bill to a client, declare: "You must not have a service contract, I see there is a charge—

would you want to purchase extended service coverage?"

21. Make a deal with video rental stores to put your coupon with each tape rentals going out, to promote your service. Reciprocate with cleaning clinics at their video stores.

22. If you do a high volume of shipping, charge the client for insurance and put this money in a separate account and pay claims yourself instead of paying the package delivery company.

23. Spruce up your service center by putting up manufacturers logos, lights, flyers and banners. Many are free from the manufacturer—just ask. Some must be requested from sales departments.

24. On all VCR repairs, place a card that provides details of VCR adjustment and cleaning entails. A good beginning sample document is provided in the advertisement of test alignment equipment manufacturers.

25. Save counter space by mounting computer monitors under the counters and the keyboards on drawers. This also looks very professional.

26. Update your credit card machine. Use a new scanner that produces the invoice; some scanners even have an ATM that can put the money directly into your account. Stay in contact with your bank for new services.

27. Print business cards that have a spot for your pager number. This is now a well accepted modern day contact system. Most clients know how to use pagers.

28. Use a red ink stamp on billings that imposes a financial penalty if "not paid within thirty days." Allow a space for the cutoff date after which a $15.00 late charge would be imposed. This declares an anticipation of timely payment with a penalty if delinquent.

29. Generate a postcard that states if the serviced unit is not picked up within two weeks after notification, a dollar-a-day storage charge will be levied. Check to be sure this is allowed by local ordinances.

30. Use an "extra service performed" checklist sheet and tape it to the repaired unit. Detail cabinet cleaning/inspections, door reseating, antenna rod lubricating, etc.

31. When units are left for over a few weeks, send a letter requesting ten dollars for a disposal fee. This provokes the action of the owner to either send the money or pick up the product.

32. Put a stamp or a card on your invoices to proclaim membership in professional organizations—let clients know your company is industry alert and a participating member of an organization.

33. Conduct a free VCR cleaning clinic. If you are an independant servicer, work out an agreement to do this at a dealers store. If you are a servicing dealer, do this on your sales floor. Focus the session toward working VCRs in need of cleaning. Give preliminary estimates on any unit needing repairs. Sell new units, tapes and accessories at this session.

34. Create an employee involvement suggestion program. Offer rewards from $25 and up depending on how productive and useful the suggestion.

35. Whenever an ASR (Additional Service Required) product arrives at the front counter, have available a red tab to place prominently on top of the work order, to show the client that immediate service will be performed on their unit. This acts as a direct front counter action to confirm the expedite process to the set owner.

36. On some products you can use a tier method for estimates. If the primary estimate is turned down, give another estimate using generic parts at a lower price. This will often help save the job. Uses the same concept of generic medicines as a cost alternative in health care.

37. Have a system for preapproved estimates at the incoming counter. Only call an estimate if it exceeds that amount. Use history of product classifications and dominant symptom code as a guide.

38. Establish a "C & L" charge on invoices—a suggestion was to add $5.00. C & L stands for clean and lubricate. An alternate suggestion: use "C, L & M." This stands for cleaners, lubricants and service manual.

39. Detail all charges on your service invoice for cleaners, other chemicals, and service data—this confirms, during tax audits, that taxes have been paid on all chemical sales, and that therefore, no added vendor sales tax is due on your chemical purchases for resale.

40. Add a charge for chemical products and one for safety and leakage checks.

41. Inventory your investment in service literature and calculate dollars compared to units serviced. Include return on investment. Suggestion is to charge a $2.00 service literature charge on each invoice.

Test Your Electronics Knowledge

Resistors, circuits, thermoelectric effects & more!

By J.A. Sam Wilson, WA8RMS

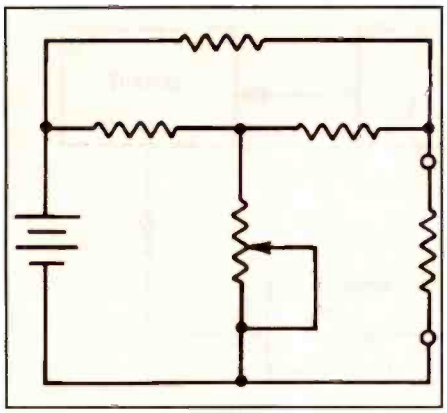


Figure A. Can you add a resistor to convert this circuit into a Wheatstone bridge?

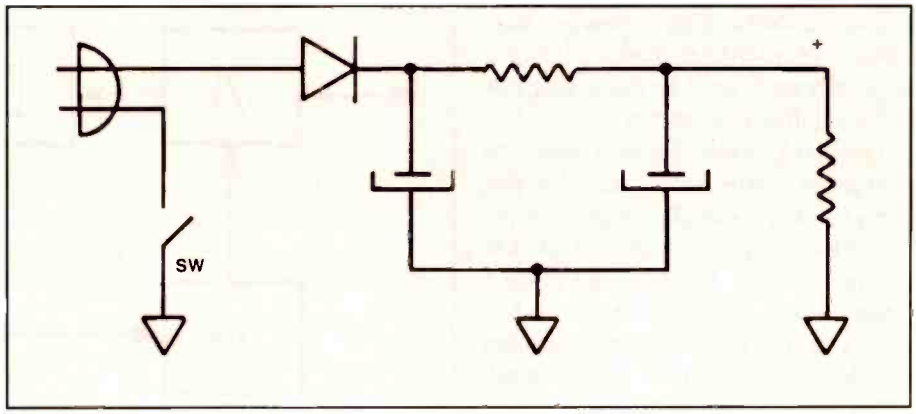


Figure B. Can you obtain a power supply with negative output voltage by reversing the diode in this circuit?

1. Can you add a resistor to convert the circuit in Figure A into a Wheatstone bridge?

2. A certain LC-tuned circuit passes a range of frequencies 15KHz wide. It has a resonant frequency of 500KHz. What is the Q of the tuned circuit?

3. How many revolutions are there in 200π radians?

4. Refer to the circuit in Figure B. Can you obtain a power supply with a negative output voltage by reversing the diode?

5. The three wheels in Figure C have rubber tires and they are pressed together. Wheel #1 is the driving wheel. Which direction will wheel #3 turn?

6. A robot that looks and acts like a human is said to be_____.

7. What is the name for a value that is being sensed by a transducer?

8. If you heat one end of a metal rod there will be a voltage across the rod. What is the name for this thermoelectric effect?

9. What type of radio has a block diagram like the one shown in Figure D?

10. Which of the following is a characteristic of all tunnel diodes?

A. very high forward current
B. tunnel diodes are no longer available
C. used only as a video detector
D. has a characteristic curve with a negative resistance region.

(Answers on page 67)

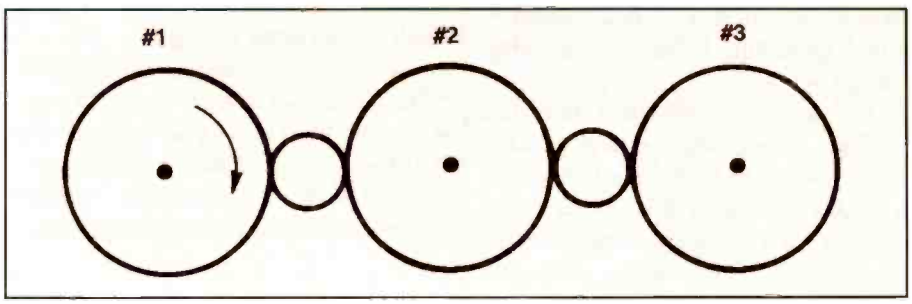


Figure C. If wheel #1 is the driving wheel in this figure, in which direction will wheel #3 turn?

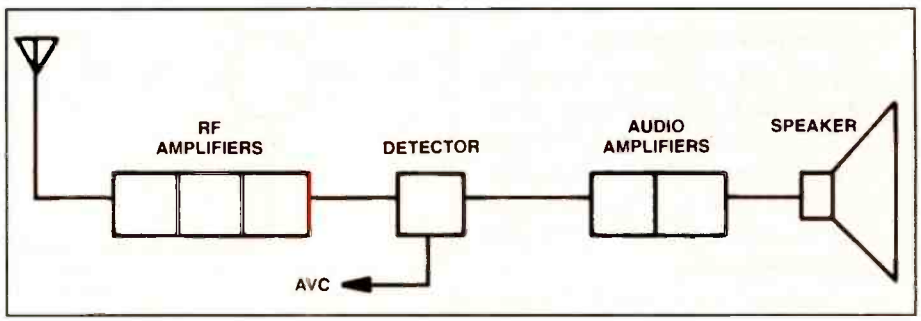


Figure D. What type of radio has a block diagram like this?

Wilson is the electronics theory consultant for ES&T.

What Do You Know About Electronics?

Servo systems

By J.A. Sam Wilson, WA8RMS

Every VCR and camcorder contains a servo system to control tape speed. A thorough understanding of these products requires a working knowledge of servos. For that reason, we'll be discussing servos in depth in this column.

By way of review, Figure 1 shows an example of a phase-locked loop. It is one form of a servo system. Remember that any closed-loop, negative-feedback system is a form of servo. The loop in Figure 1 comes close to the type of servos used in a VCR. In fact, with a little modification it could be used for motor speed control.

The system shown in Figure 2 is more like the way a servo is actually constructed. The output signal from the motor speed sensor may not require amplification. If it does, the amplifier will likely be in an integrated circuit.

There is no need for a VCO (voltage-controlled oscillator) in the motor speed control system because the output pulses from the motor speed sensor are easily matched with a reference.

The low-pass filter is not needed because the motor is not sensitive to high frequencies coming from the comparator. In fact, those high frequencies probably don't exist anyway.

After you take out all of that stuff from the phase locked loop you have a motor speed control like the ones actually used in a video cassette recorder. We are back to Figure 2. That could be a speed control for either the capstan motor or for the drum motor.

Let's look at each of the blocks and see how the signals are obtained.

The motor speed sensor

A popular way to sense the speed is to embed a magnet in the rotating part of the motor. For drum speed control, the magnet is located in the lower part of the drum, as shown in Figure 3. (This illustration was drawn over from a 1992 J.C. Penney Model 6219 manual).

The speed sensor is often a Hall device.

Wilson is the electronics theory consultant for ES&T.

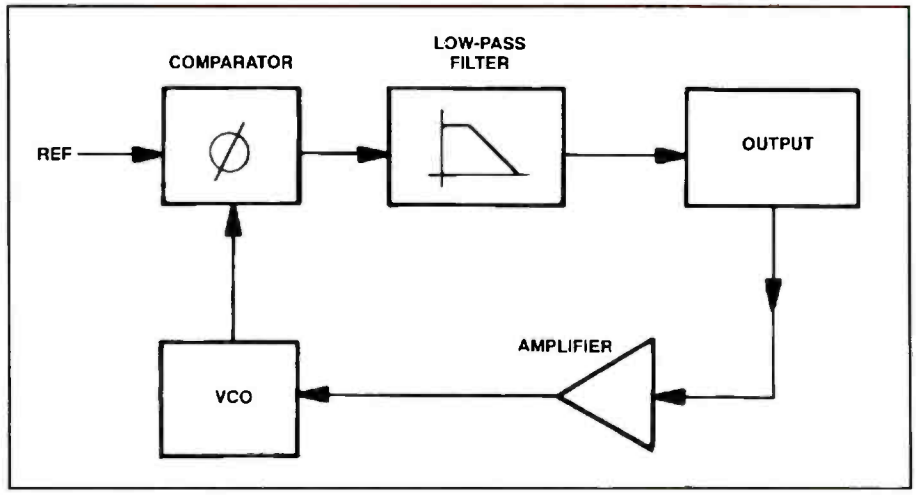


Figure 1. A phase-locked loop is one example of a servo system.

Figure 4 reviews the principle involved. With no magnetic field the electron current through the device is evenly distributed throughout the conductive element, so there is no voltage across the sides.

When there is a magnetic field through the conductive element the electron current is deflected so there are more electrons on one side of the conductor. That results in an output voltage.

Therefore, every time the magnet passes the Hall device there is an output voltage in the form of a pulse. Instead of a Hall device it is possible to sense the magnetic field with a coil. A head from an audio tape recorder would work in this application.

In the previous issue we looked at some sensors that would work very well. The bottom line is this: *There must be some method of sensing the motor speed!* The speed sensor is what I call a touch point. It is a place where you can use your scope probe to look into the closed loop to see how things are going.

I have suggested in past issues that you could disable this sensor and substitute a pulse of your own. Manufacturers usually don't mention that possibility in their troubleshooting manuals. One reason is that you have to be very careful not to exceed the amplitude of the normal sensor pulse. That pulse is often delivered to an

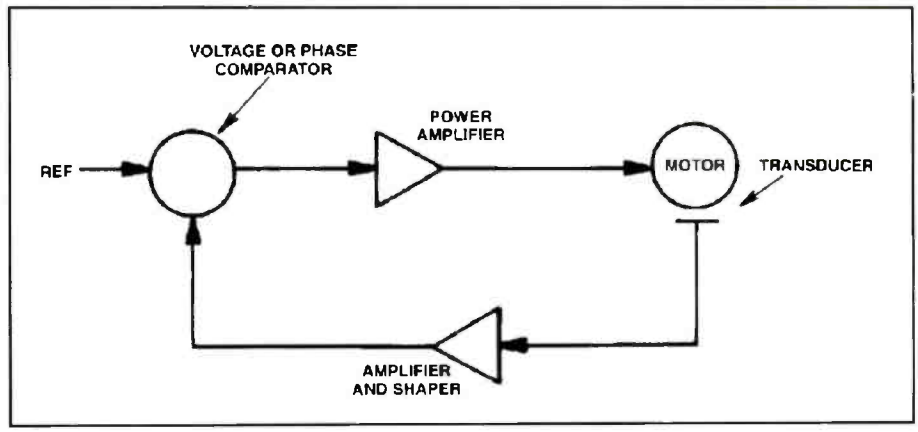


Figure 2. This system is more like the way a servo is actually constructed.

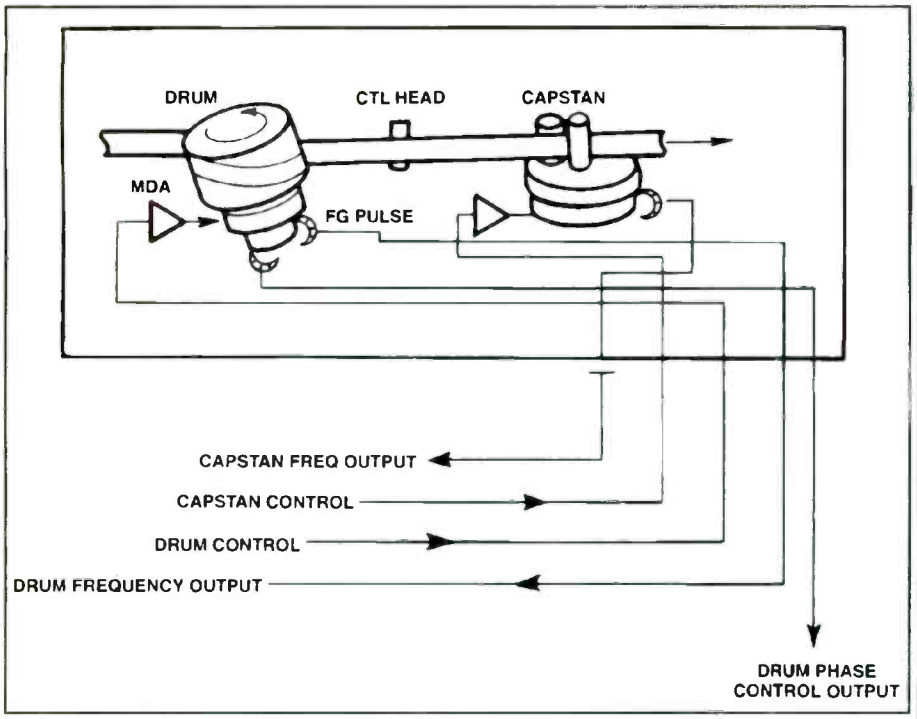


Figure 3. One way to sense motor speed is to embed a magnet in the rotating part of the motor For drum speed control, the magnet is located in the lower part of the drum.

integrated circuit and you don't want to overpower one of those guys—even if it is momentary and accidental.

There is another problem that you might run into. You may not be able to get to that sensor. You can, however, usually get to the point where the speed sensor signal goes.) I am not saying to disregard the manufacturer's suggested troubleshooting procedure, but, I know technicians with much experience and good test equipment who use their own procedure in some applications.

Comparator

There must be a place in the servo system where the speed sense signal from the motor is compared with a reference. In a previous issue I used a crystal oscillator as a reference. In VCR servo systems the

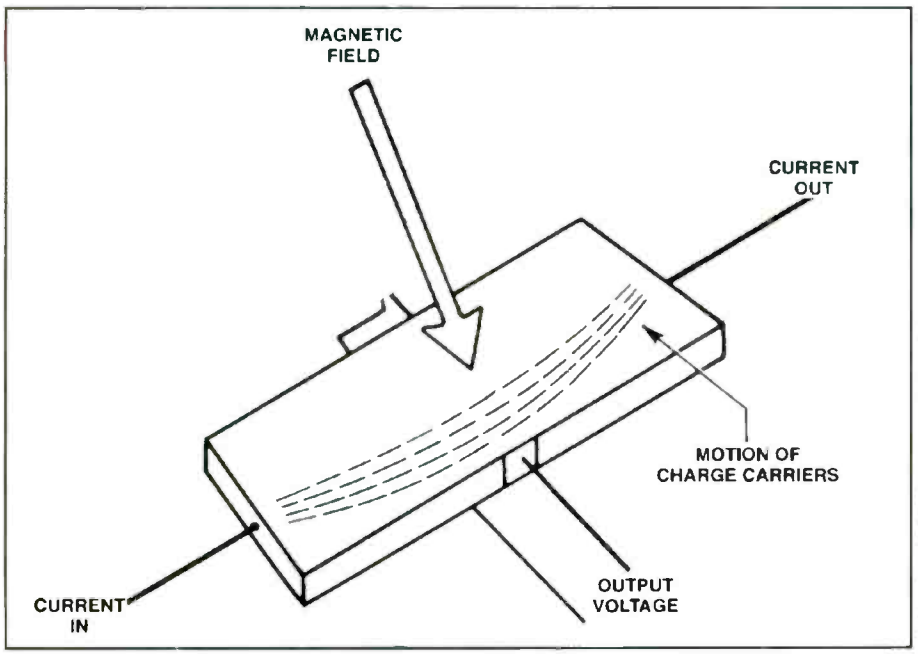
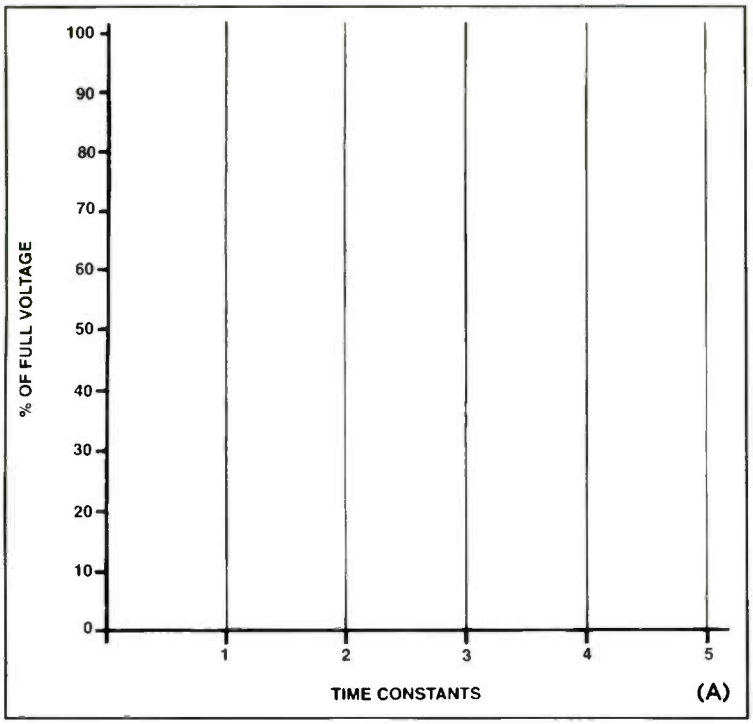


Figure 4. A Hall-effect device, whose principle is shown here, is often used as a speed sensor in VCR motor speed applications.



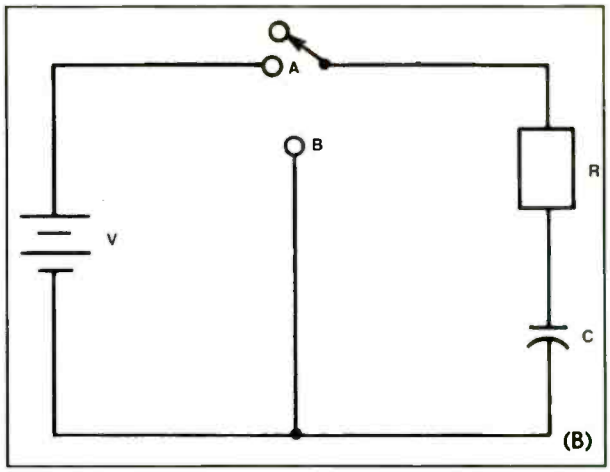


Figure 5. You can construct a capacitor charge/discharge curve of this circuit (B) using this set of coordinate axes (A) and a calculator, as described in the text.

3.58MHz frequency may be counted down and used for comparison with the motor speed pulses. Another possibility is to use a pulse in the video signal—like the vertical sync pulse.

So, you are looking for two pulses into the comparator: speed pulses and a reference signal. The location of those two signals are touchpoints.

Don't overlook the possibility that the speed pulses are rectified and the resulting dc is used for comparison. The speed pulses can also be shaped and used in another form. But, when you get done with all of the possibilities, you are still looking for two signals or voltages. If you can't find either one, you are in the vicinity of the problem.

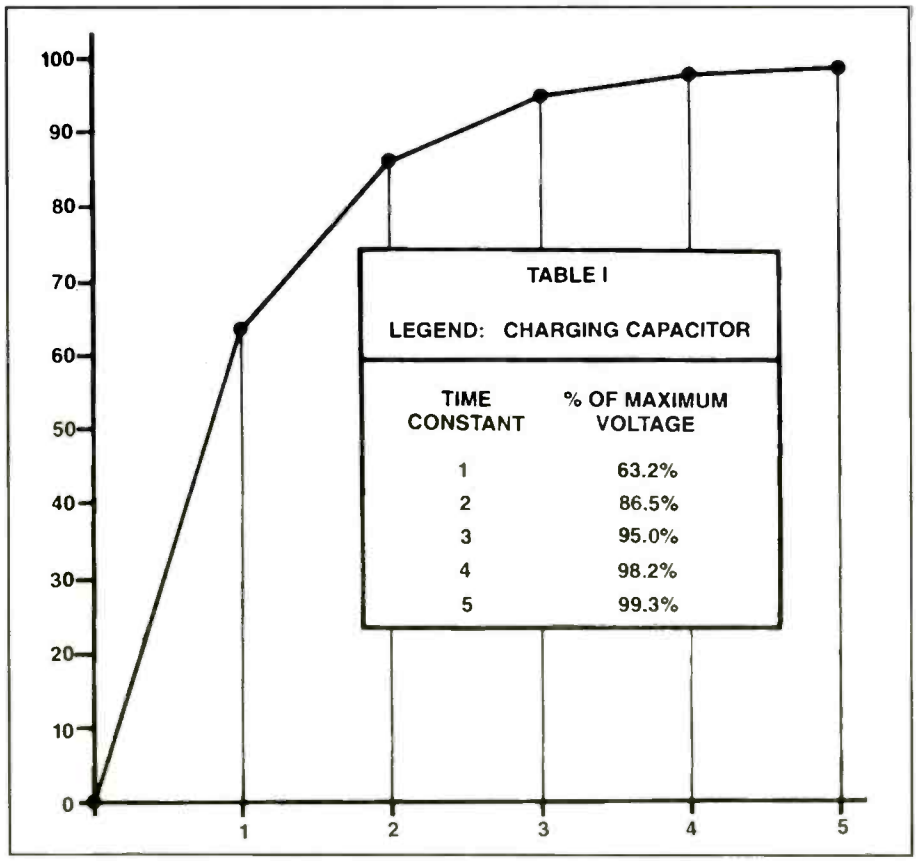


Figure 6. Using a calculator to compute the various points on the time-constant curve results in this graph.

Power amplifier

At the point where the signals are compared there must be an output control signal—one that is produced in the comparator. That signal will change when there is any variation in the motor speed. Whatever the reason for that change, the comparator has to produce an output signal that will get the motor back to the correct speed.

If you are innovative and resourceful you might slow the drum or capstan with a very light touch and watch the comparator output.

That output should change when the friction is added.

In some cases, that output signal goes to an analog amplifier that can deliver enough power to operate the motor. Power amplifiers are always to be looked at with suspicion. Even if it is located inside an integrated circuit, it has to deliver an output signal to control the motor speed.

That is another touchpoint.

To summarize, you can use the manufacturer's test procedure to locate trouble

in the servo system. There are also certain touchpoints where you can look at signals. Using those touchpoints should help in deciding the source of the problem.

There will be further discussion of servos in future installments of "What Do You Know About Electronics?"

Piecewise approach to time constant problems

So far we have looked at time constant problems using a mathematical approach and a graphical approach. In this article we will extend the graphical approach. I think you will find it interesting to see how this method makes it possible to solve all of the time constant problems in the FCC General Radio Operator License (GROL) exam.

The GROL exam is the new licensing test that takes the place of the long-standing FCC license exam.

The graphical approach to solving time constant problems was previously given in this column. It required a universal time constant curve as a starting point. That brings up the next question: what to do if you can't lay your hands on the universal time constant curve?

The answer is that you can make one by making graphical coordinates and using a simple calculator. Let's go through the procedure together. Refer to Figure 5. The horizontal axis is used for time constants and the vertical axis represents the percent value of the dc voltage. For convenience, we can say that the vertical axis is marked for 100V. However, it can also represent 100% of any voltage.

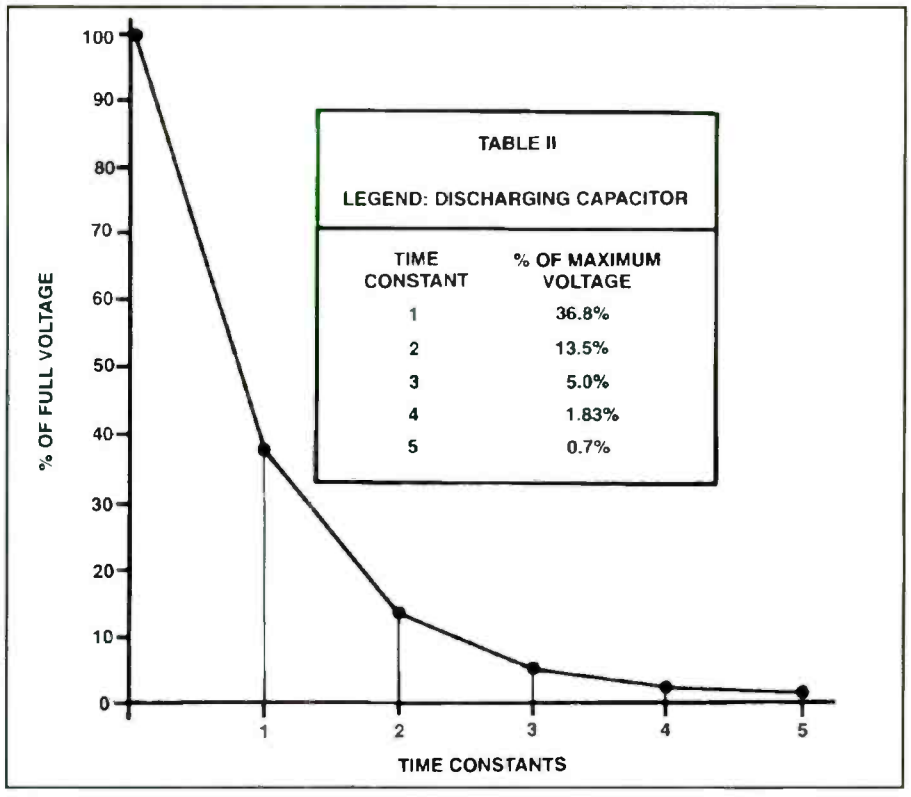


TABLE II

LEGEND: DISCHARGING CAPACITOR

TIME CONSTANT	% OF MAXIMUM VOLTAGE
1	36.8%
2	13.5%
3	5.0%
4	1.83%
5	0.7%

Figure 7. The voltage across a capacitor as it discharges varies like this.

Figure 5 also shows the circuit used to describe what is happening. When the switch is turned to position 'A,' capacitor C begins to charge through resistor 'R'. You know that at the end of one time constant the voltage across the capacitor will be 63.2V.

When the switch is in position B the charged capacitor discharges through the resistor. You know that the voltage across the capacitor will drop to 36.8% of the original full-charge voltage in one time constant.

Our discussion starts with the switch

turned to position A. From the moment the switch is turned to position A until the marking for the first time constant, the capacitor charges to 63.2% of applied voltage.

During the period betwen the first and second time constant, the voltage will increase another 63.2 percent of the remaining voltage. In other words, at the first time constant marking, the voltage will charge to 63.2V. During the next time constant period the capacitor will charge to 63.2% of the remaining voltage (that is, it charges to 63.2% of 26.8V between the first and second time constants). In fact, during each time constant period, the capacitor charges to 63.2% of the remaining voltage.

Taking that into consideration, I have made a simple step-by-step procedure for plotting the points on the time constant curve for the charging capacitor. Table I (Figure 6) shows the result of each step.

Step 1: Voltage of the previous step: _____V.

Step 2: Subtract the voltage in Step 1 from 100:_____V.

Step 3: Multiply the voltage in Step 2 by 0.632:_____V.

Step 4: Add the voltage in Step 3 to the voltage in Step 1.

The voltage in Step 4 is the voltage marked on the next time constant line.

Enter the voltage in Step 4 into the table and the graph. Here are a few examples:

At the first time constant:

Step 1: Voltage of the previous step: 0 V.

Step2: Subtract the voltage in Step 1 from 100: 100 V.

Step3: Multiply the voltage in Step 2 by 0.632: 63.2 V.

Step 4: Add the voltage in Step 3 to the voltage in Step 1 63.2 V.

The result of Step 4 is the voltage at the first time constant line.

For the voltage at the second time constant line:

Step 1: Voltage of the previous step: 63.2 V.

Step 2: Subtract the voltage in Step 1 from 100: 36.8 V.

Step3: Multiply the voltage in Step 2 by 0.632: 23.3 V.

Step 4: Add the voltage in Step 3 to the voltage in Step 1 86.5 V.

The result of Step 4 is the voltage at the second time constant line.

For the voltage at the third time constant line:

Step 1: Voltage of the previous step: 86.5 V.

Step 2: Subtract the voltage in Step 1 from 100: 13.5 V.

Step3: Multiply the voltage in Step 2 by 0.632: 8.56 V.

Step 4: Add the voltage in Step 3 to the voltage in Step 1: 95 V.

The result of Step 4 is the voltage at the third time constant line.

Continue with the fourth and fifth values. Then, connect the dots on the graph and you will have a piecewise graph of the time constant. The final result is shown in Figure 6.

To make the discharge curve you simply take 36.8% of the voltage at the previous step. See figure 7. For example, on the discharge curve the voltage at the first line is 100V.

Take 36.8% of that to get the voltage at one time constant. That gives you a voltage of 36.8V (see Figure 7, Table II). For the second point you take 36.8% of the voltage at the first step:

0.368 x 36.8V = 13.5V

For the third point you take 36.8% of the voltage at the second step:

0.368 x 13.5V = 5V

Continue to do that until you have completed Table II (Figure 7).

Readers with a flair for drawing can smooth out the lines to get a reasonably close time constant curve.

Now you can solve any time constant curve graphically. To solve problems on the FCC test, however, you do not need the time constant curve! All you really need is the table. In fact, I will go one step further. You don't even need the table if you remember how you got the values in the table!

In the next issue of **ES&T**, I will continue this discussion. ■

Literature

Environmentally-safer chemical products

CAIG introduces a new line of environmentally-safer products in its new 1994 catalog. These high-performance products can eliminate the need for repeated cleaning with ozone-depleting or hazardous cleaning and lubricating products. Many aerosols are completely safe for the environment, but recognizing that many aerosol packages have no safe alternatives, CAIG offers a complete line of these concentrated formulations using non-aerosol applicators (wipes, pens, precision needle & syringe dispensers, etc.) for the aerosol-sensitive customers. Products include; connector/contact deoxidizers, conditioners and preservatives, precision lubricants, anti-static products, solvents, pastes, cutting oils and many other industrial chemical products.

Circle (80) on Reply Card

Test equipment catalog

Print Products International just released their 84-page, 1994 discount test and measurement equipment catalog. The completely revised catalog is 30% larger than the 1993 edition and features new lines of equipment from Stanford Research Systems, N.T.E., Yokogawa, Datacom, Goldstar, Instek, Sadelco and more. Products in the 20 new pages include spectrum analyzers, signal strength meters, logic analyzers, protocol analyzers, digital and analog oscilloscopes, semiconductors, and surface mount soldering/desoldering equipment.

Circle (81) on Reply Card

Guide to selection of solders and chemicals

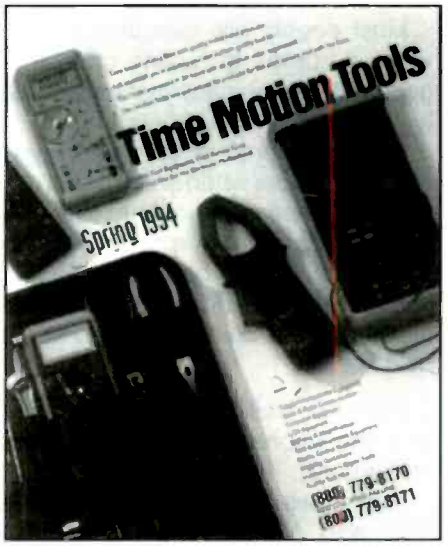
A new six-page, four-color brochure from Multicore Solders provides a quick reference guide to the company's complete product line.

Among the categories of products covered are: cored solder wires, soldering fluxes, coatings, wave and static bath solders, solder creams, SMD adhesives, cleaning liquids, specialty products, prototype production equipment and process control instruments. A variety of products within each category are described with general applications for each included.

Circle (82) on Reply Card

Catalog of new tools

A new 80-page, full-color tool catalog is now available from Time Motion Tools. It includes field service tools and tool kits for the electronic professional.



A new expanded section featuring lighting and magnification equipment has been added to this easy-to-use catalog which also features computer, telecommunications, LAN, test and measurement equipment and maintenance and repair tools.

Circle (83) on Reply Card

Literature sheet describes power supplies

Coupling the ease of keypad data entry with four-digit LCD readout accuracy are the five 300 Series of linear programmable power supplies from American Reliance Inc. The top-of-the-line LPS-305 is a triple output supply with RS-232 interface.

These user-friendly single and triple output supplies, with output power ranging from 30W to 165W are described in a two-page literature sheet.

The units feature microprocessor control; digital programming and readback; keypad data entry; power-off memory; voltage and current slew function; low PARD/noise and ripple; superior line and load regulation; output enable/disable; and two year warranty. Current accuracy on all units is ±0.5% of reading + five digits. Voltage accuracy is ±0.2% of reading + two digits. Setting resolution is 1mA; line regulation, 15mA; and load regulation 5mA.

Power-off memory of all units retains both voltage and current settings. An output enable/disable function allows the user to safely disable the output without changing the voltage or current settings. Status annunciators on the LCD panel are updated continuously to inform the user of the power supply's status at all times.

Circle (84) on Reply Card

Application/selection guides for benchtop cleaners

A series of application and selection guides outlining the benefits of the latest alternative benchtop cleaners for electronic circuitry is now available from Micro Care Corp.

The new literature provides inputs on major brand chemicals and consists of a three-fold pamphlet entitled "Straight Talk About Alternative Cleaners" as well as two single-sheet handouts featuring easy-to-read charts.

The "Straight Talk" pamphlet discusses the whys and wherefores of non-CFC cleaners at the workbench and specifically details the application and effect of the new HCFC cleaners, PFC cleaners, alcohol and deionized water, plus several new chemistries formulated to meet the latest environmental regulations.

The single page "Product Selection" guide discusses the use and effect of mild, moderately strong and highly active cleaners along with their abilities to substitute for old-style solvents.

The companion "Technical Applications" bulletin outlines critical handling characteristics of "planet-safe" chemicals and charts product characteristics such as strength, health, safety, and environment effects and brief comparative summaries.

Circle (85) on Reply Card

Product catalog

Galco Industrial Electronics has released an updated, easy-to-use, product catalog which contains over 260,000 items. These items are easily located through the use of either the product index or the manufacturer index. In addition, each section has an individual index for quick referencing.

The catalog contains technical specifications and application information. In addition to what is available in the catalog, the company's sales staff can assist the customer in identifying and locating the hard-to-find parts.

Circle (86) on Reply Card

When a service technician sits down to perform a diagnosis on a set that has malfunctioned, in many instances it becomes a major effort to locate service information. When a technician completes a diagnosis and determines the cause of a problem in a TV, VCR or other consumer electronics product, often that's merely the prelude to the serious problem of locating a replacement part that will restore the product to proper operation.

In years past, finding service information and replacement parts was not as much of a problem as it is today. There was only a relative handful of products and manufacturers, and most service information and replacement components were readily identifiable and obtainable. Nowadays, obscure products from hard to find manufacturers are increasingly likely to be brought in for service, and locating service information and parts may require detective ability and tenacity.

Fortunately, there are a number of organizations that can assist a technician in the search. A well-organized, well-stocked distributor is one agency that can provide a great deal of assistance in finding the necessary information and products. Because a good distributor can provide important help, whether you do almost all of your business with a local distributor or a mail order firm, or some combination of the two, it is prudent to choose carefully the distributor(s) with whom you do business.

Similar but different

Just as with any other kind of selling organization, you'll find many similarities and many differences among distributors. Most distributors are well organized and well stocked, can help you with special requirements, and have a research department to help you find the part you need; some are not. Some mail-order distributors can accept your orders in a variety of ways including mail, telephone (some with 800 numbers), fax, etc.; some cannot. Some distributors charge a reasonable fee for shipping and handling; some will charge you what you will conclude is an exorbitant amount. Some distributors will send your order right away even before your check clears, some will wait until your check clears, and some will keep your money well beyond the point when they should have shipped your order.

Some variables to consider

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

Here are some of the factors you should consider when settling on a distributor. Some apply only to the local distributor, and some apply only to mail order, but it would be a good idea to keep them in mind any time you're thinking about doing business with a new firm.

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

These questions can be important

Some of these questions may not seem important, but from what we have learned from some of our readers, they may be very important. For example, we learned from one of our readers that one mail order company made a regular practice of charging unnecessarily high shipping charges.

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

Don't forget to ask about restocking fees. Some distributors charge a restocking fee even when they were responsible for shipping the incorrect product in the first place

Let the buyer beware

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

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

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

Philips Technical Training

401 East Old Andrew Johnson Highway
Jefferson City, TN 37760
Phone: 615-475-0044
FAX: 615-475-0221

Philips Technical Training is one of the many departments that make up Philips Service Company. Our primary responsibility is to provide for the training needs of all servicers, including Philips Authorized Servicers. We produce various forms of training materials, such as hands-on technical training books, and conduct training classes all over the country. The locations of these classes are specifically chosen for easy access of service companies.

Hands-on training

Our hands-on training is the most comprehensive service training available today, teaching both circuit operation and troubleshooting! Philips Technical Training has been voted "Number One in Technical Training" for eight years running by servicers attending these classes!

Communication with servicers is the key to our success. Servicers attending our classes keep us informed of problems being faced on a daily basis, as well as subject material that is of interest to them. We take this information and structure our training materials to better fit their needs. If there is a product servicers would like made available to them, to help them in their profitability and efficiency, we do our best to make it available.

Light boxes

We learned from these training meetings that there was a need for an inexpensive light box with charts. So we built our own, and are currently selling it at a price that makes camera repair more profitable. It is now much more cost-effective for servicers to make the transition from VCR to camera repair.

Computer software

Servicers informed us of a need for a computer program that would give instant access to part numbers, substitute numbers, dealer cost, dud prices, descriptions, and availability. We immediately began working to develop a program. Today, it is available, and includes over 260,000 part numbers. It includes generic and Philips part numbers, as well as all other requested information.

Video tape

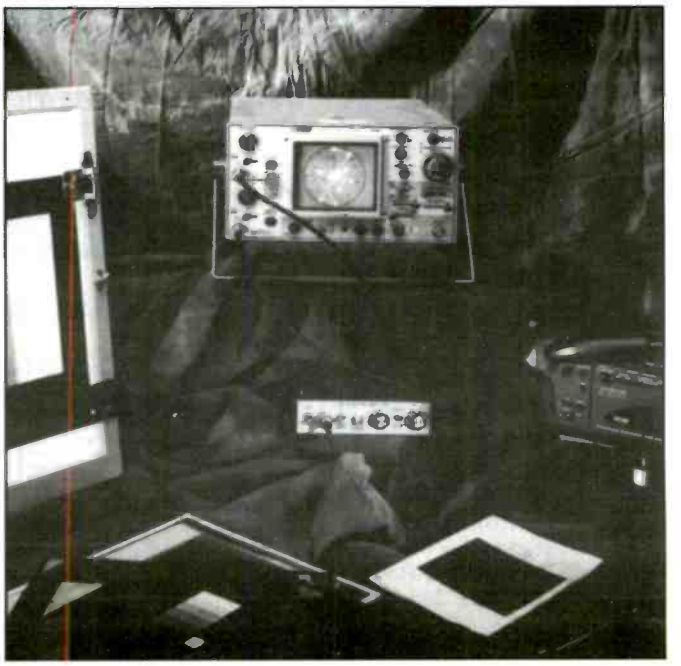
As a result of requests for more videotapes covering electronics repair, we are offering videos covering VCR mechanics, CD repair, switching mode power supply service, service tips review, and cameras. In fact, the demand was so high we decided to expand our video production facilities to triple our output of videos by the end of 1993!

Highest quality

Philips Technical Training is committed to providing total customer satisfaction. We are also committed to producing the highest quality of training in the industry. Our hands-on classes, training books, tapes, and software are all accompanied by a quality survey card. This survey is used to constantly check the quality of our products as seen by the technician. Quality and effective training are of the highest importance to us!

Order your catalog

A free catalog, containing descriptions of all products and training materials offered, is published annually by Philips. You can get your catalog by calling the Technical Training department at 615-475-0044.



PTS Corporation

5233 Highway 37 South • PO Box 272
Bloomington, IN 47402-0272
Phone: 800-844-7871
FAX: 800-844-3291

PTS Electronics has been the electronics service dealers best friend by providing fast dependable service to thousands of service dealers for more than 25 years.

PTS is the nation's largest single source for all major brands of television tuners and TV main boards. Brands such as RCA, Zenith, GE, and NAP are available at substantial savings of up to 60% when compared to OEM direct replacements.

Recently, PTS has updated and expanded our offering of PC boards for Sharp Microwave ovens. Since 1979 PTS has been involved in the repair of Microwave PC boards. In the coming months, we will be adding other manufacturers to our line of Microwave PC boards.

Rebuilding is what we do best

PTS began in 1967 remanufacturing television tuners, and now remanufactures television main boards, satellite receivers, complete chassis, projection set boards, computer monitors and microwave oven panels.

Specialization has made PTS the largest and most efficient independent electronics rebuilder in the world. Maximum use of available resources and skill has made PTS the leader in electronics rebuilding, with the ability to adapt to new technologies and advance into new markets according to customer needs.

PTS specializes in rebuilding/remanufacturing electronic timing devices, modular circuits, and electronic tuners and main boards. PTS currently maintains contracts with major manufacturers in a variety of industries including white goods, television, computer, automotive, medical and various government agencies.

Currently, PTS rebuilds over a million analog and digital products, components and subassemblies each year.

Dedicated to customer satisfaction

At PTS, just providing our customers with high quality products and services is not enough. Our goal is total, unconditional customer satisfaction. Since 1967, PTS has been the world's leading independent electronics rebuilder and parts supplier. We provide the electronics industry with quality repair services and parts. We have worked with leading manufacturers to develop service programs for emerging technologies. We've seen a lot of changes over the years, but there's one thing that hasn't changed. That's the value and quality of our products and service programs.

You don't just become an industry leader overnight. It takes several years of experience and dedication to achieve excellence. It also takes a real commitment to training as well as state-of-the-art diagnostic and service equipment. PTS has the commitment.

Our staff are seasoned veterans who put themselves in the customer's shoes. They know how to listen and respond to a customer's needs. Each call is evaluated very carefully, and the response is always supportive and helpful. When you use PTS products and services, you become a part of our family. We'll go that extra mile to make sure you're happy and satisfied. When you call PTS, we really mean it when we say "PTS Electronics, how may we help you?"

PTS maintains a state-of-the-art computer system that allows instant response to your order inquiries. Our staff of customer service representatives are very knowledgeable of our products and services, and can help ensure that you get the part you really need.

PTS carries thousands of different parts for virtually every major manufacturer, and has more than 3 million parts in stock.

With a 40,000 square foot corporate facility, PTS employs more than 175 technical personnel and support staff. Branch operations are located in Longview, TX and Arvada, CO. There are over 300 individual test positions for live testing of television tuners and mainboards. PTS keeps thousands of tuners and mainboards in stock for immediate shipment and also services all major brands.

So, call today to place your order and ask for our free price guide or for more information.

Herman Electronics

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

Herman Electronics is a diverse, full-line distributor of everything in electronics. The company, now over 40 years old, has clearly established itself as one of the best in the industry by providing quality products to all phases of the electronics industry.

Herman Electronics' supplies full "in-stock" deliveries from their vast assortment of semiconductors, batteries, connectors, wire and cable. They also specialize in test equipment and tools from such quality companies as B&K, Wavetek/Beckman, Fluke, Goldstar, and Hitachi. Herman offers a huge selection of soldering and desoldering equipment from Hakko and Weller. Essentially, they are a "one-stop" supplier for servicing personnel.

The heartbeat of the business lies in the OEM parts department. While servicing the industry for over three decades, Herman Electronics has acquired many of the major OEM parts lines in order to provide more efficient and cost effective service to you. Herman Electronics is a factory authorized original replacement parts and accessory distributor for Sony, GE, Samsung, Panasonic, RCA, Quasar, Casio, Technics, and Toshiba. Stocking one of the largest and most comprehensive inventories, we fill over 80% of our orders from our 25,000 stocking items and guarantee two-day service to your door on all in-stock orders placed before 2:00 p.m. (EST).

Herman Electronics is able to provide a variety of customer support services as a result of the company's commitment to maintaining a standard of excellence in serving customers. We have several service representatives to serve your needs from 8:30 a.m. to 5:30 p.m. (EST) Monday through Friday and from 8:30 to 12:30 on Saturday. Whether your request is for pricing, stock availability, or research, the company's toll-free lines and 24-hour fax lines are readily available to fulfill all of your requests. Furthermore, the company guarantees to fill your research requests within three hours and generates computerized backorder reports with ETAs to keep you abreast of your backordered items.

The company prides itself on being flexible and accommodating to its customers' requests. "We realize there are many good distributors throughout the country" says Jeffrey A. Wolf, Vice-President and son of one of the company's founders. "It is our job to be better by taking that extra step in giving our customers professional personalized service. Our industry has clearly become service oriented. Therefore, we are dedicated to maintaining a standard of excellence in serving our clientele."

The fringe benefits provided by Herman are several resulting in service and customer satisfaction second to none. All out-of-state orders are shipped UPS 2nd day air at no extra charge. Several methods of payment are available including a net 30 day open account, COD, and Visa, MasterCard, and American Express. To accommodate the west coast, and after-hours orders and requests, Herman Electronics' has a sophisticated electronic phone ordering system to accommodate you 24 hours a day, seven days a week.

If you have not given Herman Electronics a try, please do so, you will be glad you did. Call now! Herman Electronics—our parts are factory original and our service is state-of-the-art.

Projector-Recorder Belt Corp.

PO Box 176
Whitewater, WI 53190-0176
Phone: 1-414-473-2151
FAX: 1-414-473-4727

Projector-Recorder Belt Corp. (PRB) has been the nation's leading wholesale supplier of replacement belts and parts for the electronic industry for over 36 years. To support and enhance the sale of electronic replacement belts and parts, PRB began publishing our own CROSS REFERENCE BELT GUIDE in 1970. We feel our customers deserve the time, energy, and money we have invested every year since to improve this excellent resource. This year the new PC CROSS GUIDE allows the user to merely enter the specifications of their original belt and **instantly** obtain all the suggested PRB replacement belts. With easy-to-follow, menus, finding your replacement belt or part has never been easier or faster. In addition, we've added new listings of many R.F. Modulators and Sensing Lamps. The PRB PC CROSS GUIDE will save you time and disk space.

Both the PC and Book Format version of the *'94 PRB COMPREHENSIVE BELT & VCR PARTS CROSS REFERENCE GUIDE* feature detailed information on replacement parts for VCRs, Camcorders, Cassettes, Compact Discs, Answering Machines, Car Stereos . . . and Replacement Belts for Tape Recorders, Turntables, Audio/Visual Equipment and Office Machines. The Cross Guide lists a majority of the mechanical parts BY MANUFACTURER MAKE AND MODEL . . . and is crossed to the recommended PRB Line Replacement Part.

PRB is also pleased to offer "InnerWorks. . .VCR Mechanical Replacement Booklets." The InnerWorks Series covers a wide variety of VCR makes and models. The booklets include easy-to-follow mechanical drawings, as well as a complete listing of all mechanical parts and assemblies.

InnerWorks Booklets are arranged and grouped in families so YOU can:

- Economically obtain the information you need . . . each booklet provides detailed data for approximately 15–20 VCR models of a particular manufacturer.
- Easily solve VCR failures . . . since 80% of them are due to mechanical parts malfunction.
- Learn how many different models and manufacturers use the same parts.

Throughout our many years of serving the electronic industry PRB has always put our customers first. Satisfying them is our goal. Our in-house staff of professionals all work hard to provide the best possible products and superior service. The PRB LINE offers . . . the products . . . the quality . . . the service . . . the prices . . . you can depend on. For complete details just call 1-414-473-2151.

Print Products International

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

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

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

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

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

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

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

PRINT™ Products International

★ ★ ★ DISTRIBUTORS' SHOWCASE ★ ★ ★

Tritronics, Inc.

1306 Continental Drive
Abingdon, MD 21009-2334
Phone: 410-679-6688
FAX: 1-410-676-7658
1-800-888-FAXD

Tritronics, Inc. is a family owned and operated parts distributor, which has been in business since 1975. Our specialty has been supplying exact replacement parts to the electronic service industry. In the past year, we have branched out, and now offer several quality lines of general replacement parts through a catalog and monthly special fliers.

Tritronics' goal is to provide timely and efficient service for their customers. To achieve this, they provide the following services:

1. Orders received by 3:00 p.m. E.S.T. are shipped that day.
2. Stock over 45,000 line items, over 3,000,000 parts.
3. Initial shipments are 85% filled.
4. Price and availability is provided on toll-free numbers for common parts by description and by part number. In Maryland call 1-800-638-3328 or FAX 1-800-888-3293 and in Florida call 1-800-365-8030 or FAX 1-800-999-3293.
5. As of April 1, 1993, Tritronics, Inc. is a Premier distributor for RCA, GE, and Proscan, offering prompt shipments and "DDS" to help improve your "QOS!"
6. Dragnet, an on-line ordering system, allows easy access to information on over 1.5 million parts, prices, inventory, substitutions and common parts by mocel and description.

Tritronics is committed to supporting the *independent* electronic service industry. Our support has included being a founding member of NESDA affiliate Chesapeake Electronics Association; cosponsoring a membership drive with NESDA; and supporting various local organizations by advertising in trade journals, sponsoring and participating in special events.

Setting our goals high has paid off for Tritronics' customers as well: two of the three Sharp Servicers who won vans in 1992 and two of three Sharp Servicers who won trips to Japan in 1993, purchased their parts from Tritronics. The CEO, Roger Williams, won NESDA's regional Friend of Service Award in 1991, and the company also garnered several performance awards from Matsushita Service Company and Sharp Electronics Corp.

Tritronics has a full staff in both our parts research and sales departments that are knowledgeable, efficient and have been with the company for several years. The use of advanced telephone and computer equipment insures the quick handling of your order with personal service.

In our travels to the various industry meetings, Tritronics' officers often have the pleasure of meeting other people who work their business with family members. The Tritronics family looks forward to serving your business now and in the future. Our customers say that we are: LARGE ENOUGH TO SERVE YOU, SMALL ENOUGH TO KNOW YOU!

Circle (56) on Reply Card

East Coast Transistor Parts, Inc.

2 Marlborough Road
West Hempstead, NY 11552
Phone: 800-645-3516 Nationwide/Canada
Phone: 800-632-3323 New York
FAX: 800-733-5904

East Coast Tansistor Parts, Inc. continues as the preeminent electronics industry leader with the addition of Casio, Panasonic Batteries and Zenith. We have built upon a reputation for speed, superior technical support and an unsurpassed stocking ability. With over 65 national parts distributorships, and over 200,000 parts under one roof, we are poised to supply virtually any electronic component, no matter what the application.

We are a national parts distributor for Audio Technica, B&K Test Equipment, Beckman, Bussmann, Casio, Chemtronics, Dantona, Duracell, ECG, Eveready, Gemini, Hakko, Jabro, Kenwood, Mabuchi, Maxell, Nisshoku, Panasonic Batteries, Pickering, Pyle, Russell, Speco, Stanley, Tech Spray, Weller, Xcelite, Ungar, Vaco and Zenith.

East Coast is a full stocking distributor for Zenith, Casio and Kenwood. We are Kenwood's national authorized parts distributor for Consumer Audio, Amateur Radio and Warranty Stations.

East Coast is a direct importer of Japanese semiconductors. In fact, we're one of the nation's largest sources of semi's, with prices that can't be beat. We offer large volume discounts and OEM quantities are also available.

Our sales/customer service staff are on hand to answer any questions you may have concerning pricing or parts availability. Our highly trained technician's reputation for providing technical assistance and answers to our customers product questions is unmatched in the industry. Our staff is available Monday thru Friday 9 – 6 EST. For your convenience, our new state-of-the-art phone system allows you to place your order after our regular business hours. Our toll-free fax lines (800) 733-5904 are also available to place your orders. The East Coast order lines are open 24 hours a day, 7 days a week. Customers receive additional discounts when they place their orders via the fax lines or through our new automated voice mail system.

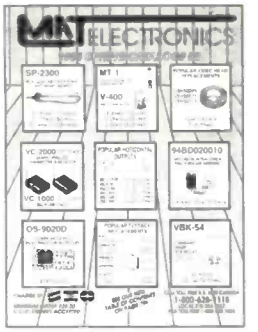
Every order is given top priority at East Coast. We deliver your purchase quickly and with precision. Our quality control officials oversee the warehouse/shipping departments to ensure you get what you pay for, the first time and every time you order from East Coast. Overnight and second day deliveries are available for all orders placed by 3PM EST. While the majority of orders are shipped the same day, you can be assured that all orders are ready to ship within 24 hours from the time they are placed. Customers may establish a Net 30 account or purchase by credit card or COD.

While East Coast has grown over the years, we have strived to maintain the personality of the small company we once were. Your business is important to us, and at East Coast we'll go the extra mile to prove it. Give us a try, you won't be disappointed.

For more information or for a free copy of our newest sales catalog featuring new price reductions and incentives plus the very latest products, call our toll free hotlines—Nationwide/Canada: 800-645-3516, New York: 800-632-3323.

MAT Electronics

975 Jaymor Road
Southampton, PA 18966
Phone: 800-628-1118
FAX: 800-628-1005



MAT Electronics has expanded into a full-line parts distribution center, gearing its inventory to the TV, VCR, computer monitor, and stereo repair industries. The growth of MAT Electronics has been due to the following: quality products, competitive prices and fast reliable shipping. The company's products are used by manufacturers, engineers, technicians, trade schools and hobbyists.

MAT Electronics stocks an extensive line of flybacks (TV and monitor), Japa-nese semiconductors, capacitors and MATV accessories. In the past year, MAT Electronics has started to distribute original parts from Hitachi, NEC, Panasonic and Sony at competitive pricing.

The company publishes an easy-to-read 80-page catalog filled with thousands of inventoried items, which can be accessed immediately on their state-of-the-art computer system.

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

MAT Electronics takes great pride in its ability to accommodate the various needs of all its valued customers. The company normally ships orders within 24-hours of receipt of your order, but UPS red and blue label service is also available to ensure even faster delivery service if necessary.

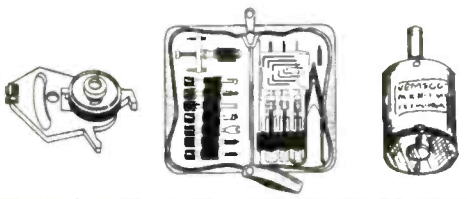
The company takes pride that it has friendly and knowledgeable telephone operators waiting to take your phone call, and deal courteously with any questions you may have about any electronic part. And, if you don't see it in the catalog, just ask for it.

MAT Electronics takes the risk out of ordering from a catalog, offering a 90-day, 100% guarantee on all purchases.

Large volume discounts are available. Orders from foreign countries are no problem. The company's toll-free lines are open weekdays 8:30 a.m. to 7 p.m., and Saturdays from 8:30 to 2:00 p.m., and a toll-free FAX number is available 24 hours a day.

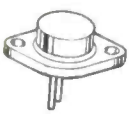
VCR REPLACEMENT PARTS

VXP0521 Panasonic Idler	$2.99ea (10 min)
164113 RCA Idler Original	$2.99ea (10 min)
NPLV0111GEZZ Idler Original	$7.95ea (10 min)
613-022-2534 Sanyo/Fisher Gear	$.69ea (10 min)
199347 RCA Belt Kit	$1.99ea
VTK-1 Video Tool Kit	$39.95ea
198522 Audio Bias Oscillator	$2.25ea
VSJS0018 Orig. Panasonic Solenoid	$5.95ea
VEMS0099 Panasonic Motor	$8.95ea
143-0-7504-01000 Fisher Belt	$.85ea (10 min)
157061 RCA Belt	$.85ea (10 min)
157062 RCA Belt	$.85ea (10 min)
MSU911 Toshiba RF Mod	$14.95ea
MSU951 Toshiba RF Mod	$14.95ea
VA3409 Emerson RF Mod	$14.95ea
VA3422 Emerson RF Mod	$14.95ea
RTU006GEZZ Sharp RF Mod	$14.95ea
RTU0035GEZZ Sharp RF Mod	$14.95ea



POPULAR SEMICONDUCTORS

8U208R	$1.99ea (10 min)
2SD869	$1.99ea (10 min)
2SD1397	$1.99ea (10 min)
2SD1398	$1.99ea (10 min)
2SD1426	$1.99ea (10 min)
2SD1427	$2.50ea (10 min)
2SD1650	$1.99ea (10 min)
2SD1651	$2.50ea (10 min)
2SD1879	$2.50ea (10 min)
JU0017	$11.95ea
JU0069	$11.95ea
SDA-3202-3	$6.50ea (10 min)
STK4273	$8.95ea (10 min)
STK0080	$13.00ea (10 min)
STK5481	$12.25ea (10 min)
TA7777	$9.50ea (10 min)
TDA4505A	$8.95ea
TDA8305	$9.50ea (10 min)
UPD1705-C12	$9.95ea

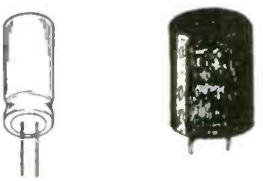


POPULAR FLYBACK REPLACEMENTS

154-040A	$19.95ea
154-074E	$19.95ea
2434391	$24.95ea
2434651	$24.95ea
3214003	$24.50ea
043220011	$27.95ea
79A307-1	$24.95ea
1-439-357-11	$26.95ea
F0014	$19.95ea
F0015	$19.95ea
F0016	$19.95ea
F1588	$27.95ea
TLF14401F	$29.95ea
TLF14423F	$29.95ea
TLF14530	$26.95ea
TLF14515F	$26.95ea
TLF14561F	$26.95ea
TLF14801F	$24.50ea
FCC1415AL	$19.95ea
FCM2015AL	$19.95ea

CAPACITORS

4.7M/160V	Radial	$.45ea (10 min)
4.7M/250V	Radial	$.55ea (10 min)
4.7M/350V	Radial	$.65ea (10 min)
10M/160V	Radial	$.55ea (10 min)
10M/250V	Radial	$.65ea (10 min)
10M/350V	Radial	$.75ea (10 min)
100M/50V	Radial	$.50ea (10 min)
100M/63V	Radial	$.50ea (10 min)
100M/100V	Radial	$1.00ea (10 min)
100M/160V	Radial	$1.00ea (10 min)
100M/200V	Snap-in	$1.00ea (10 min)
100M/250V	Radial	$1.25ea (10 min)
330M/200V	Snap-in	10/for $19.90
470M/200V	Snap-in	$1.99ea (5 min)
680M/200V	Snap-in	$2.99ea (5 min)
800M/200V	Snap-in	$2.50ea (5 min)
153671	RCA Replacement	$5.95ea
270172-1	NAP Replacement	$5.95ea



FREE 80 PAGE CATALOG!

DISCOVER VISA MasterCard

C.O.D. Orders Accepted
We Ship Throughout U.S. & Canada

MAT ELECTRONICS®
975 JAYMOR ROAD SOUTHAMPTON, PA 18966

THE ON TIME ELECTRONIC DISTRIBUTOR

CALL OUR TOLL-FREE ORDERLINE

1-800-628-1118

FAX# 215-364-8554

Circle (42) on Reply Card

Diversified Parts

20th Anniversary

2114 S.E. 9th Ave.
Portland, OR 97214
Phone: 800-338-6342 • FAX: 800-962-0602

1994 is the year of Diversified Parts' 20th Anniversary as a distributor of OEM and General Replacement Parts. The company specializes in the sale of consumer electronic parts, accessories, chemicals and service literature.

As we look back over twenty years of tremendous growth we are especially grateful to our customers whose loyalty we treasure, and who have made us one of the 'key players' in our industry.

But no celebration would be complete without saying 'Thank You' also to the many fine manufacturers and vendors Diversified Parts represents; for it is they, who had the faith in our company to get the job done for them.

So, after twenty years of continuous growth and service, we are where we are today, and who we are today, because we had learned to listen to what both our customers and manufacturers expected from a successful distributor; and that is to provide the very best 'Service, Service and again Service.'

Yes, we are certain that it is indeed the level of service we provide to both our customers and manufacturers that sets Diversified Parts apart from many others in our industry. For we could have the greatest inventory and the highest percentage fill-rate, but without the best possible level of service we would be nowhere near the market penetration and customer satisfaction we currently enjoy.

So, on the eve of our 20th Anniversary, Diversi-fied Parts invites all potential new customers to take advantage of the levels of service we provide. It might just be the best choice and decision you've made in a very long time.

Diversified's Hours of Operation are Monday through Friday from 8:00 AM to 4:30 PM West Coast Time. You can call us on our toll-free 800-Numbers for parts orders, research and accounting. Yes, we are glad to even pay for your call when it is not an order, because your problems, inquiries and concerns become also our problems, inquiries and concerns. Or if you prefer you can reach us 24 hours a day, 365 days a year on our toll-free Fax Lines.

We extend to our customers the choice of an open account, COD, or payment by VISA or MASTER CARD. And when you call us you have direct access to our courteous and professional staff. At Diversified Parts you can still conduct business without the use of automated telephone answering systems or electronic voice mail. We are there for our customers in person, whenever you call.

We ship by UPS and AIRBORNE EXPRESS for a very low flat fee regardless of weight, zone, number of line items or different brands shipped. There is no shipping and handling fee for any backorders generated off new orders. Your orders arrive Red Label or the Next Day to 90% of all Zip code destinations, Blue Label or the Second Day to the remaining 10% of locations. All orders are delivered nationwide in one to two days! We call this level of service our DP TURN-AROUND EXPRESS. Our warehouse staff works every evening until 8:00 PM. Our last scheduled parts pick-up of the day is at 7:00 PM West Coast Time, that is 10:00 PM East Coast Time.

Diversified Parts warranties all parts we sell, we do not have minimum orders, and we have in place perhaps the most liberal return policy of any distributor in the country. To all of these levels of service add quantity discounts and continuous sales and promotions, and you might just have found in Diversified the kind of distributor that 'talks your language.' We'd love to hear from you! Start to rely on Diversified Parts for your best choice and diversity in parts, accessories and chemicals; but above all, rely on us to provide for you the level of service you should expect from a distributor where you spend your money.

As we look to the future for Diversified Parts over the next twenty years to be part of our growing electronics industry, nothing would make us happier but to count you among our many fine and prosperous customers from Coast to Coast.

Andrews Electronics

PO Box 914
Santa Clarita, CA 91380
Phone: 800-289-0300 • 805-257-7700 • FAX: 800-289-0301

What is the most important quality that you as a servicer look for in a distributor? Is it an extraordinary supply of parts on hand or superior service? By itself, either would be practically useless. Welcome to Andrews Electronics, the best of both worlds!

We are the most well-stocked wholesale distributor of our kind, with over 250,000 line items in our warehouse an average fill-rate of over 90%, and over an acre of floor space filled with parts, all in one location. We are the largest supplier in America for the majority of the manufacturers that we represent.

Just how dedicated is Andrews Electronics to service? We were the first distributor to supply RCA/GE and Zenith parts to the service industry. Andrews was the first to pioneer a computerized system for inventory control/updating and order processing, even before most of the manufacturers! Also, we were the first to offer an 800 line for ordering parts. Is it starting to sound like we wrote the book on OEM Parts Distribution?

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

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

And we don't just talk about better service and part availability . . . we formulated it, believe in it, and stand behind it! Well into our fifth decade of serving the industry's OEM needs, Andrews is the old-timer in a relatively young field. Our seasoned staff has combined old-fashioned principles with innovative and fresh ideas utilizing the latest state-of-the-art technology.

Wouldn't getting those extra units repaired a week or two sooner be good for your reputation? Sure, it would. And, we can help. After all is said and done, it is performance that counts. We know that your ability to perform your job depends on how well we perform ours.

Our regular office hours are from 8:15 to 4:45 PST and we're closed for lunch between 12:00 and 12:30.

When you think of electronic parts . . . think of Andrews.

★ ★ ★ DISTRIBUTORS' SHOWCASE ★ ★ ★

MCM Electronics

650 Congress Park Dr.
Centerville, OH 45459-4072
Phone: 513-434-0031
FAX: 513-433-3272

Best brands in the business

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

A new name emerges

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

Discover for yourself

MCM publishes two full-sized catalogs each year. Every issue introduces hundreds of new products with at least 30 pages devoted to test equipment. Not only do we have an extensive line of test equipment, but we also stock over 20,000 of the most commonly used replacement parts and components in the electronics industry. Sales f'yers are also mailed regularly which feature specially priced products. These flyers keep our customers constantly informed of new items that are being added.

Superior customer service

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

Top notch distribution facilities

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

Will Total Quality Management work for you?—Part seven

By John A. Ross

This is the seventh part in the Business Corner series on W. Edwards Deming's Total Quality Management.

TQM Point 7

Institute leadership. The aim of leadership should be to help people, machines, and gadgets do a better job. Supervision of management is in need of an overhaul, as well as supervision of production workers.

The responsibility for leadership

Everyone will readily agree that management has the responsibility for leadership. To achieve and maintain their leadership, managers should work to find what factors keep employees from doing a better job. In some cases, deadline pressures, attempts to please certain customers, and internal competition make quality more difficult to achieve. Much of this exists because owners, top-level managers, or supervisors have become separated from day-to-day employee activities.

Since a management position may require different skills than a purely technical position, managers may lose contact with the technical side of the organization. Moreover, some managers may not have any need or willingness to constantly upgrade their technical skills.

For example, a friend of mine, "Gene," recently moved into a management position with a well-known computer network service company. As Gene's priorities shifted from troubleshooting to employee relations and other managerial duties, he became less aware of the challenges faced by the technicians under his supervision. In addition, he became more concerned about pleasing his superior.

After a period of time, Gene found himself placing the same demands on his employees that had nearly driven him away from the company. A short case history illustrates how problems can occur.

Dealing with problems

With the introduction of a new version of a network operating system to a customer site, Gene's employees had difficulties with various software applications, compatibility, and system memory allocations. Because the technicians had no prior experience with the new system, they were learning about the software while working at the customer site.

In one instance, the entire system "locked up" while the customer's administrative assistants were working with a large spreadsheet calculation. When the customer complaints arrived at Gene's desk, he realized that he had not provided his employees with the new version of the software or any formal training concerning the local-area network.

Blaming his employees for the system

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

problems would have been the easy way out of the predicament for Gene. Given his position, the customer would have accepted that kind of explanation. However, he answered the customer complaints by personally visiting the customer site and taking responsibility for the problems.

In addition, Gene scheduled an office meeting with his employees, listened to their complaints, and again accepted responsibility for the problems. After those meetings, he drafted a company policy that covered the needs for formal training and resource development.

Taking responsibility and corrective action

The situation that Gene encountered reveals several positive results of his management style. Since he assumed responsibility for the system problems, he actually gained credibility. Both his customers and his employees respected his honesty and leadership. Although the customer had complained about the difficulties, Gene's on-site appearance led to an even larger network system installation.

While his employees respected both his taking responsibility and his incisive action, they also respected Gene's priorities. By attempting to eliminate the barriers that prevented them from performing well, Gene demonstrated that the quality of their work—rather than the quantity of their work—stands as his first priority.

Management/employee balance

The situation encountered by Gene and his solution for the problem also illustrates the balance that must exist between management and employees. While TQM originator W. Edwards Deming calls for an overhaul of the supervision of both entities, real life may show that a balance between the two forces may implicitly provide both the changed supervision and enhanced performance.

The lack of adequate performance by the employees caused management to reevaluate its priorities. In effect, the employees instituted an overhaul of managerial supervision by showing why they could not accomplish management's goals. Rather than become preoccupied with pleasing superiors, both the management and the employees again looked at the overall organizational goals. ■

Audio and commercial sound servicing

Ron C. Johnson

This month let's talk about some handy gadgets that can help in servicing audio and commercial sound equipment. Some of them are for bench service but some can also be used when you're field testing equipment at the customer's location. There are all kinds of useful (and expensive) pieces of test equipment available that you may already have on your bench: a multimeter, an oscilloscope, and usually an audio or function generator. But there are a few more handy and less expensive gadgets that you can build yourself.

A portable signal source

For troubleshooting audio equipment, as with any other electronic equipment, you have to narrow the problem down to a specific area before you can look for faulty components or connections. To do that it helps to be able to inject a signal and then check its progress through the equipment.

For this you need a signal source. You may have a function generator on the bench, but you may not want to carry it along out in the field. Of course there are portable signal sources available that you can buy, but it really isn't that difficult to put together a little battery-powered oscillator that you can keep in your tool box.

Figure 1 shows the schematic of a simple phase shift oscillator that will do the job for you. This circuit is cheap (and dirty, to be sure), but it will give you an audio signal at about 800Hz. Actually phase shift oscillators are notorious for their temperature sensitivity so the frequency will change if you're working in a cool area. The potentiometer allows adjustment of the output amplitude and the circuit is powered from a 9V battery. You can build it into a small box and keep it in your tool box.

An alternate to this idea would be a 555 timer circuit like the one shown in Figure 2. The 555 is operating as an astable multivibrator (a pretty familiar circuit, to say the least). Of course this circuit provides a square wave, the advantage of which is that you can get a better idea of any frequency response problems. It's relatively easy to see if the output waveform is distorted or high frequencies rolled off (if the corners are rounded).

Another possibility would be the circuit shown in Figure 3, a pink noise

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

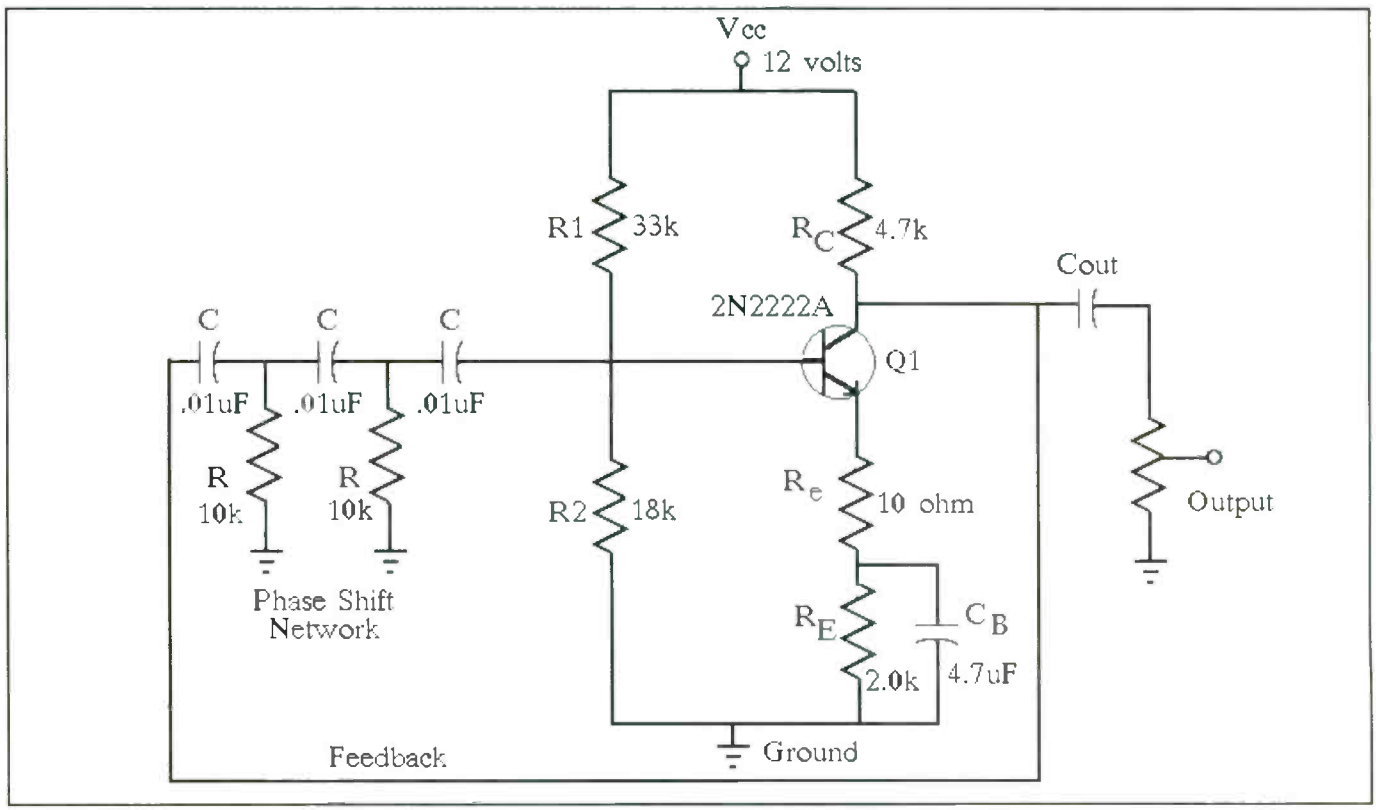


Figure 1. A Phase Shift oscillator.

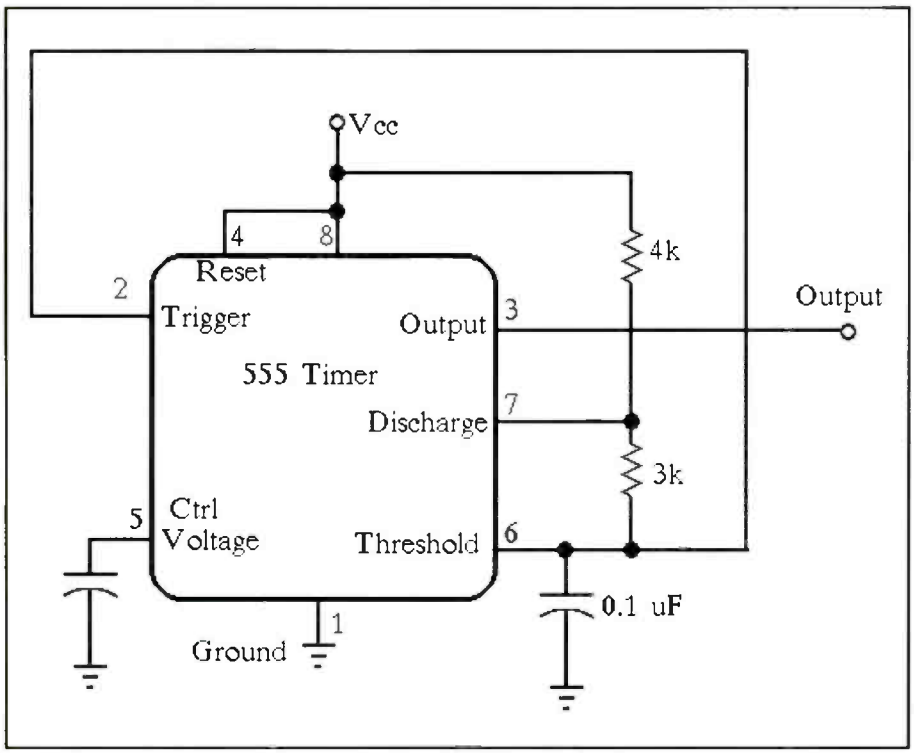


Figure 2. A 555 timer astable.

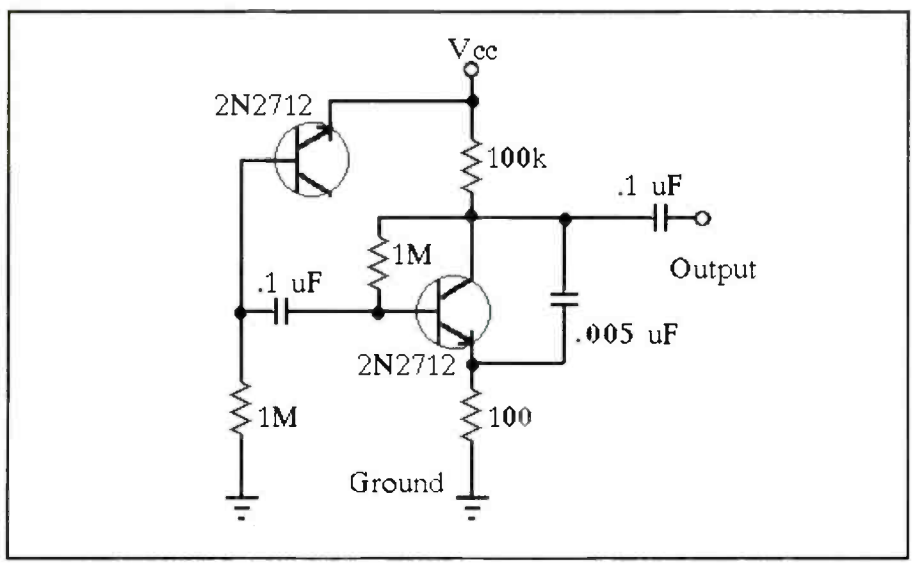


Figure 3. A Pink Noise generator.

source. Pink noise consists of frequencies shaped to give equal energy per octave throughout the audio frequency range. Pink noise is handy for checking the frequency response and sound pressure levels of a sound system. Ideally, you would also have a real time analyzer (frequency response display) or at least an SPL meter to check the sound pressure levels at various spots in the room.

Microphones and speakers

It's also handy to have a couple of microphones for checking sound systems, both high and low impedance. If you have a real time analyzer you'll need a good quality low-impedance microphone as an input. Actually, to do the job right, it should be a special calibrated microphone with a very flat response (these are pretty expensive, but so is a real time analyzer).

As previously mentioned, an oscilloscope is great to have on the bench, but most of them are a bit bulky to carry around on service calls and installations. You can use your meter to get a crude indication of signals at various points in a system, but it doesn't tell you much. One possible solution would be a portable oscilloscope. These are now available from several manufacturers.

At the output end of audio equipment you need some kind of a speaker load. On your bench you can keep a small bookshelf speaker, and you could carry one with you as well but they are bulky and easy to damage. The other problem is that you need to be able to crank up the signal and really drive the load to check for distortion, equal clipping, limiting (on some amps) and thermal problems.

For this you need a dummy load (two, actually, for stereo amps). You can buy these, too, but they're inexpensive and easy to make using some high power resistors. For a few dollars you can get a couple of 200W, 8Ω resistors and mount them on a board or in a ventilated box. A muffin fan could be useful here to keep them cool.

Special cables are useful for servicing

The simplest gadgets that can be useful on the bench or in the field are a variety of special cables. Usually, it isn't the lack of anything else that slows you down, it's the fact that you don't have the right cable to connect a couple of pieces of equipment. So, it's a good idea to make yourself up a bunch of cables and adaptors and keep them in their own kit.

Here's a list of some of those cables, connectors and adaptors:

- low impedance microphone cable (XLR connectors),
- high impedance microphone cable (some of the older mics have special connectors at the microphone),
- a couple of heavy speaker cables (16 gauge or heavier),
- RCA to RCA cables (double cables like those with a tape deck),

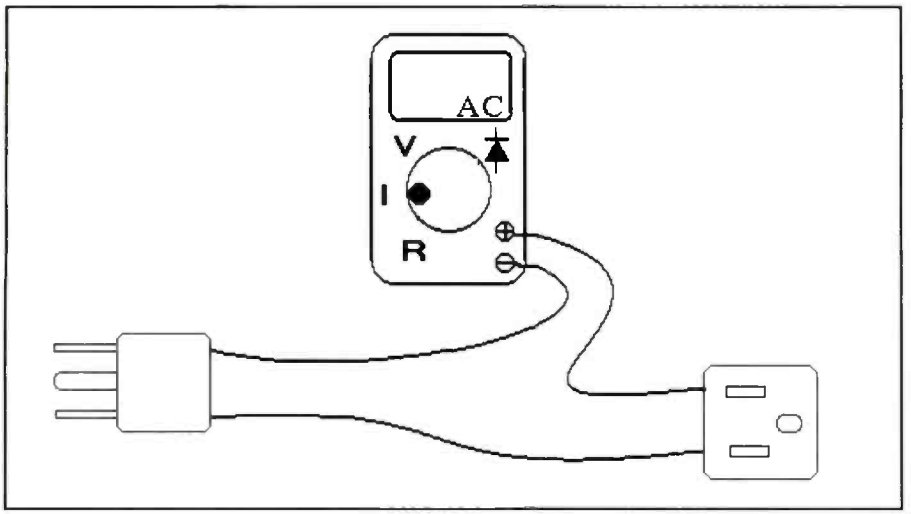


Figure 4. Cable for checking current.

Figure 5. This portable audio test unit includes a public address amplifier, connectors, adapters, speakers, and other audio test equipment.

- 1/4 inch phone plug cable,
- 1/4 inch to RCA plug adaptor,
- 1/4 inch, RCA and XLR to alligator clip adaptors.
- XLR male to male and female to female adaptors,
- AC power cord with alligator clips (be careful with this one),
- an assortment of XLR, 1/4-inch, RCA plugs and jacks, plus some lengths of various kinds of audio cable.

One special ac power cable that is especially useful in the shop for troubleshooting power amps is shown in Figure 4. Note that one side of the power is interrupted and can be connected through an ac ammeter. When troubleshooting power amps that have blown output transistors you can replace the parts you know are faulty and then bring up the power slowly using a variable transformer. The ammeter will allow you to see the current start to increase and you can shut the amp down again before any damage is done.

A portable audio test unit

One obvious problem with this collection of cables, connectors and adaptors is keeping it all together and in good shape (not to mention hauling it all over town). One partial solution I found was to build a portable audio test unit (Figure 5). Starting with an inexpensive, low power public address amplifier, I built a portable box and mounted all the connectors, adaptors, speakers, dummy loads, high-to-low-impedance transformers, 70V line transformers, and other paraphernalia. A removable cover on the front protected all the connectors and amplifier controls and a hinged door in the back allowed storage of cables.

I also brought all the connector wiring out to a long terminal strip on the front panel just in case I needed to connect wires directly to the unit. The box was pretty crude (made out of thin plywood on a frame of one by twos) but overall the unit was quite useful (albeit a bit heavy).

I could plug in any kind of microphone, auxiliary (tape deck, etc.), or line input. (I even had a phono preamp with equalization for magnetic cartridges). A microphone impedance transformer (high side connected to a 1/4-inch jack and low side to an XLR connector) allowed microphone impedance conversion. An internal 70V speaker transformer allowed an external amp to drive a speaker load or the internal dummy load.

The internal amplifier also had its 4Ω and 8Ω and 70V outputs brought out to 1/4-inch connectors so an external speaker could be driven. In the top of the box I mounted two 4-inch ceiling speakers, one connected directly to a 1/4-inch jack, the other with its own 70V transformer, also connected to a jack.

When it was done I could drag it along anywhere I went and check pretty well any kind of audio equipment. The amplifier didn't have a great frequency response or distortion figure (commercial sound amps generally don't) but, for a quick check it served its purpose. Later on I acquired an SPL meter and a real time analyzer with built in pink noise generator. Although it was a lot to carry, this collection worked out well for testing.

There was nothing high tech about this unit but it did serve the purpose, saved me some time in field and it also gave my employee some exercise carrying it in and out of the job site. ■

Sources for monitor schematics and parts

By John Bachman

Two problems in servicing computer monitors are where to get schematics, and where to get parts. Schematics and other technical data are nearly impossible to acquire for many monitors. Some manufacturers are willing to sell their schematics and technical manuals; many will not. Some manufacturers cannot be found. This article will help with the schematic problem, but there *are* monitors for which no data is available.

Finding parts is not as difficult as finding schematics, but it still can be a problem. Some manufacturers try to control parts availability but a third party monitor parts industry fills much of the gap. Most parts can be found if you know where to look. But, once again, there are some parts that are simply not available. This article will provide a list of parts sources that should solve this problem.

Technical manuals and schematics

There are two sources for schematics: manufacturers and reverse engineering companies. Some manufacturers will sell a copy of their technical manuals and/or schematics which are generally very accurate, giving you all of the details, optional circuitry and design changes. Some manufacturers restrict the information to their authorized dealers and repair centers but *will* supply parts.

Bachman is President of AnaTek Corporation

The requirements for becoming authorized vary from just asking (Tatung) to being required to attend lengthy training sessions overseas (KFC), and everything in between. If you want to become an authorized service center call the manufacturer and ask about their requirements. Table 1 lists the manufacturers and their policies on schematics, technical manuals and parts.

Reverse engineering provides some schematics

Reverse engineering companies purchase a monitor, disassemble it and trace the circuits to create a schematic. The result is usually representative of the unit that was disassembled, but cannot reflect any design changes, updates or optional circuitry. Management Information Technology (513-339-8095) has an extensive list of reverse engineered schematics and is especially strong in the Packard Bell product line.

Parts

Parts availability is a happier story than technical documentation due to an active third party parts industry. While some manufacturers will sell replacement parts (see Table 1) they are usually the most expensive source. If you can find an independent source for the part you need, and you usually can, it is likely to be less expensive than the manufacturer's part. Table 2 lists distributors who specialize in unique monitor parts.

Other sources

Because computer monitor servicing information and replacement parts have been so hard to obtain, companies have been formed that provide servicing tips, as well as information on finding schematics and replacement parts.

Manufacturer operated bulletin board systems are another source of technical data. To access a bulletin board, you need a computer equipped with a modem. Acer's bulletin board, 408-428-0140, includes information on common failures and engineering design changes. Packard Bell's bulletin board, 818-773-7307, provides basic technical data on all their monitors, but not much troubleshooting help. Other manufacturers restrict access to their bulletin boards to authorized service centers.

Table 1—Manufacturers Manuals and Parts Policies

Manufacturer	Manual Available	Parts Available	Telephone	Comments
Aamazing	No	Yes	714-255-1688	
Acer	Yes	Yes	800-733-2237 800-652-6672	*Acer's bulletin board, 408-428-0140
Compaq	No	No	800-345-1518 800-652-6672	Compaq suggests that you contact the nearest Compaq authorized distributor for parts. Call Compaq to identify a distributor near you.
CTX	Yes	Yes	800-342-5289	

Manufacturer	Manual Available	Parts Available	Telephone	Comments
Dell	Some	Some	800-624-9896	Dell does not support their monitors directly, but will refer inquiries to the monitor manufacturer.
Epson	No	No	800-922-8911	Epson monitors are difficult to support because of unavailabilityof technical data and parts.
Goldstar	Yes	Yes	800-922-8911	
Hitachi	Yes	Yes	800-225-1370 X319	
IBM	No	Yes	800-426-7282	IBM supplies only subassemblies, no component parts.
KFC (Kuo Fong Corp.)	No	Yes	800-253-2872	KFC supplies service manuals only to authorized dealers.
Matsushita	Yes	Yes	800-447-4700 201-348-9090	
Nanao	Some	Yes	800-800-5202	Service manuals are available only for older models of Nanao products.
NEC	Yes	Yes	800-388-8888	NEC makes manualsand parts available for older models only,(up through "D" models are currently available).
Packard Bell	No	Yes	800-398-3003	Packard Bell service manuals are available only to authorized service centers. Packard Bell's bulletin board, 818-773-7307.
Relisys	Yes	Yes	408-456-6900	Relisys schematics and Q-Squared parts are available through Q-Squared, 2035 O'Toole Avenue, San Jose, CA 95131.
Sampo	Yes	Yes	404-449-6220	
Samsung	Yes	Yes	800-446-0262 800-627-4368	Service manuals are also available through distributors such as J&J International and Arocom(See "Parts"section of this article).
Sony	Yes	Yes	800-352-7669 800-488-7669	Sony will refer you to a distributor who can supply you with what you need.
Tatung	Yes	Yes	800-827-2850	
Xtron	Some	Yes	201-798-5000	Xtron has been out of the monitor business for several years, but they still supply some technical manuals and parts.
Zenith	No	No	800-553-0331	Zenith treats monitors as non-repairable. Therefore, the only parts they offer are complete monitors. There are over 700 authorized service centers.

Table 2—Monitor Parts Distributors

Distributor	Flyback Transformer	Monitor IC's	Monitor Semicond	Schematics
AmcoTron 14821 Spring Avenue Santa Fe Springs, CA 90670 800-344-3882 Fax: 310-802-0061	Yes	Yes	Yes	Samsung & Samtron
B & D Enterprises 452 Hamburg Turnpike Wayne, NJ 07470 800-458-6053 or 201-628-7373 Fax: 201-696-5623	No	Yes	Yes	No
Consolidated Electronics 705 Watervliet Avenue Dayton, OH 45420-2599 800-543-3568 or 513-252-5662 Fax: 513-252-4066 BBS: 513-252-9992	Yes	Yes	Yes	Yes* Howard W. Sams & Co.
Computer Component Source 135 Eileen Way PO Box 9022 Syosset, NY 11791-9022 800-356-1227 or 516-496-8727 Fax: 800-926-2062	Yes	Yes	Yes	No
CRC Components, Inc. 186 University Parkway Pomona, CA 91768 800-822-1272 or 714-468-9711 Fax: 714-468-9667	Yes	Yes	Yes	Yes
Dalbani Corporation 4225 N. W. 72nd Avenue Miami, FL 33166 800-325-2264 Fax: 305-594-6588	Yes	Yes	Yes	No
Digi-Key Corporation 701 Brooks Avenue South PO Box 677 Thief River Falls, MN 56701-0677 800-344-4539 Fax: 218-681-3380	No	Yes	Yes	No
FOX International Limited 23600 Aurora Road Bedford Heights, OH 44146 800-321-6993 Fax: 800-445-7991	Yes	Yes	Yes	No
J & J International PO Box 5778 Parsippany, NJ 07054 800-627-4368 Fax: 201-884-4378	Yes	Yes	Yes	Yes Samsung & Samtron
LEAD Electronics, Inc. 8370 Thompson Road Cicero, NY 13039 315-699-6099 Fax: 315-699-6280	Yes	Yes	Yes	No

Distributor	Flyback Transformer	Monitor IC's	Monitor Semicond	Schematics
MAT Electronics 975 Jaymor Road Southampton, PA 18966 800-628-1118 Fax: 215-364-8554	Yes	Yes	Yes	No
MCM Electronics 650 Congress Park Drive Centerville, OH 45459-4072 800-543-4330 Fax: 513-434-6959	Yes	Yes	Yes	No
Mouser Electronics 2401 Highway 287 North Mansfield, TX 76063-4827 800-346-6873 Fax: Various	No	Yes	Yes	No
Prelco Electronics Distributors 605 Chestnut Street Union, NJ 07083-9318 908-851-8600 Fax: 908-686-4656	No	Yes	Yes	No
Russell Industries, Inc. 3000 Lawson Boulevard Oceanside, NY 11572 800-645-2202 or 516-536-5000 Fax: 800-645-2200 or 516-764-5747	Yes	No	No	No

Products

Portable ionizer

The Portable Ionizer from *Richmond Static Control Services* has a fan size of just three inches to provide a constant flow of positive and negative air neutralizing ions for the elimination of static in the work area.

Other features of this ionizer include a grounded case, eliminating any concern of static being generated on the case. The field replaceable electrodes are internally mounted, guaranteeing virtually zero space charge even at one inch in front of the unit. A mounting bracket is included for the lightweight unit, which allows mounting to the side, back or underside of the workbench.

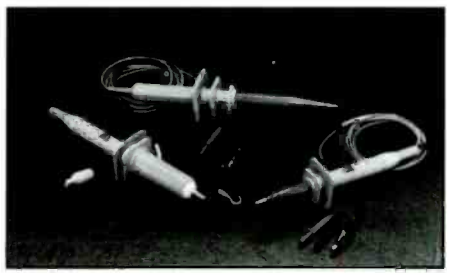
Circle (90) on Reply Card

Splitter for monitor burn-in

Network Technologies Inc., introduces the VOPEX-8M video splitter which allows one MacIntosh to drive eight monitors, all displaying the same image simultaneously. With 10MHz bandwidth, this device displays images as crisp as the original. All of the monitors connected to the unit must be the same type and can be plugged directly into any of the eight output ports. The splitter can be used by depot repair centers, as well as monitor manufacturers by allowing eight monitors to be burned-in from one Mac computer.

The unit is compatible with all Mac's that have external monitors. It connects directly to the video output port via a three-foot supplied interface cable.

Circle (91) on Reply Card



High-voltage probes

ITT Pomona has introduced three new high-voltage probes to provide improved measurement versatility when used with DMMs and oscilloscopes.

Offering a dc to 300Hz bandwidth, Model HV40B is designed for low frequencies when used with any instrument with a 10MΩ input resistance. The unit is rated at 40KV dc plus peak ac to 300Hz, with a 1000:1 voltage division ratio. Used with handheld and bench DMM's, the probe provides accurate step down voltage readings.

The Model HV15HF is a higher frequency probe, suitable for use with oscilloscopes or DMMs, featuring a 5MHz bandwidth, 15KV maximum input voltage rating (dc plus peak to peak ac), 3pF input capacitance, 500MΩ input resistance and a compensation range of 15 to 50pF. It can be used with instruments having 1MΩ and 10MΩ input resistance. A thumb-slide switch on the handle allows easy input selection.

The Model HV6 introduces 6KV rated performance (dc or peak ac) and a 10KHz bandwidth, offering users of newer ranging multimeters a quality high voltage probe equipped with a selectable slide-switch for use with a wide variety of 1MΩ and 10MΩ instruments.

Circle (92) on Reply Card

Invoicing program

After five years of research and nearly a full year of development, *DataBasic* has released a computerized invoicing program called RepairMan that is designed to run on any IBM compatible computer.

What RepairMan does is automates invoices and keeps records for repair businesses. It records the exact date and time of steps in the repair process with two key-strokes. The computer automatically determines the status of the repair for easy retrieval by category. A list of all units that are waiting on parts is kept, as well as those units waiting for estimates, or to be picked up. It also prints invoices, claim tickets, and unit tags on plain paper.

For the months of April and May, the company is offering the program at a special introductory price. In addition, a technical support line will be provided. A manual is included for reference.

Circle (93) on Reply Card

Software tools

CyberMedia Inc. announces three software tools for MS/PC-DOS, Windows and NetWare users, network administrators, technical-support engineers and software developers.

PC911, which compiles system-level information about the configuration of a personal computer, checks this information each time the system is booted up for

Products

hardware and software conflicts and other problems, then guides the user or technical-support engineer in how to fix the system when a problem is encountered.

WIN WIN "unsticks" Windows by checking the integrity of and tuning the Windows environment and leading Windows applications. When a user encounters a Windows error message, Win Win pops up to detail how to fix the problem—with network administrators able to fix the problem remotely.

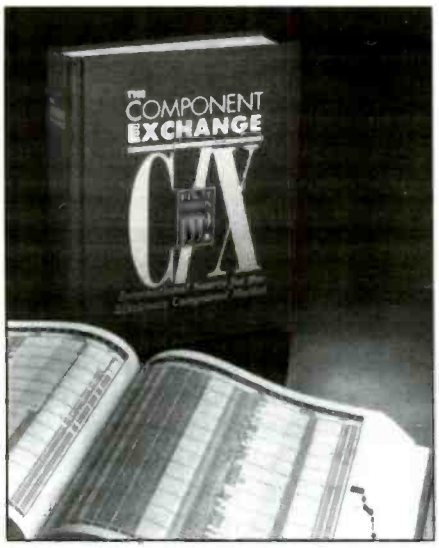
MultiTalk for Windows automatically translates the menus, dialog boxes and message boxes of any Windows program into any one of 15 languages, in seconds.

Circle (94) on Reply Card

Directory of electronic components

The Component Exchange, a directory with listings of over 150,000 active and passive line items offered from inventory by electronic component distributors, is now available.

In past years this directory was used exclusively by electronic distributors as a medium within the trade for buying and



selling inventories. The 1994 issue has been broadened to meet the needs of the entire industry. Sources for hard-to-find components and inventory used for small production runs are listed by manufacturer, part number and source. Once a part number is located, a code number leads the user to the distributor with inventory. Included is a contact phone number.

Circle (95) on Reply Card

News *(from page 5)*

keting and advertising, strategic planning, family business and legal issues, and other subjects.

Tuition scholarships will be part of the expanded value of the new School of Service Management. The registration cost is expected to be $299.00 and the service divisions of a number of manufacturers will be offering scholarships to their authorized service agencies and self-servicing retail dealers.

"We recognize that success in the 90s will depend on creating alliances with organizations that have similar missions," according to NARDA president, Con Maloney, Cowboy Maloney's, Jackson, MS. "The increasingly complex demands of doing business as we enter another century require us to leverage each other's strengths with these alliances."

NARDA formed such an alliance with the Association of Home Appliance Manufacturers (AHAM) last year to create the EPA approved Technician Certification Test for CFC Recovery. This alliance between NASD and NESDA is another step in that process. ■

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 Linda Romanello 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 North Broadway, Hicksville, New York 11801
Attn: Linda Romanello
Phone: 516-681-2922 FAX: 516-681-2926

FOR SALE

HELLO! Doctors Do It! Airlines Do It! Lawyers Do It! TV/VCR TECHNICIANS SHOULD DO IT! In any profession, knowledge coupled with the ability to quickly access case or service history PAYS BIG!! A doctor's ability to diagnose quickly and confidently is largely attributed to use of and access to data and information of previously diagnosed symptoms. Lawyers can predict the outcome of their present case by using prior case histories exhibiting similar symptoms. A productive TV/VCR technician will not rely on memory alone to diagnose symptoms and part numbers. Instead they will call upon past case histories, which will enable the smart servicer to avoid the costly mistakes of mis-diagnosed part orders and loss of extremely valuable time . . . From the original World Wide TECH-TIP Program comes 2.5 Million Dollars worth of actual solid repairs. 1987 through August 1993. Whether you are computerized or not, our Tech-Tip program provides the most current comprehensive published paper format that there is today. You may also wish to choose our Tech-Tip computer program, licensed World Wide under (PARADOX) by The Boreland International Co. We're not fooling around and you shouldn't either. Remember it's not the quantity of tips but the constant update quality of part numbers and solutions that makes the difference. Our initial 10,000 TECH-TIPS cover VCR-VCP-TV/ VCR combo CD LD-FAX-Camcorder-VHS/ SVH/ C/8MM-Stereo-Monitors-Amps Projection Front and Rear-Micro wave-Satellite. Category is easily cross-referenced first by Model, Chassis or FCC ID Number and printed out or simply scanned by Make and Category. Unlike other programs, we provide OEM Part numbers and substitutes. Our on-going program is actual day-to-day repairs written on the Bench by technicians for technicians. No need for you to spend time updating your data base or paper binders. We send you a complete revised program at each update of your choice (Computer or Paper Format). Outside technicians and students love the portability and say it is a must in the field where time is very critical. As an added Extra, we provide an FCC ID Cross-Reference list which saves the expense of purchasing Service Manuals you may already have and just don't know it. This program was produced by Ed Erickson technician and owner of TV-Man Sales & Service, Inc., and President of The Professional Electronics Association of South Florida. The PHONE CALL is "FREE" and so is the Disk or Paper Sample Demonstration. **CALL (800) 474-3588 or Write TV-Man (TECH-TIPS), 7040 W. PALMETTO PK. RD. #2-112, Boca Raton, FL. 33433.**

EXTENSIVE DATABASE, Electronic Part Distributors, Listed by Manufacturer. IBM/Compatible—$34.95 plus 4.50 S&H, Mastercard/ Visa 1-800-580-4562. Ext 80. TECH RESOURCE, P.O. Box 1414, Noblesville, IN 46060. Brochure available.

FOR SALE

>> • • • TIPS SUPER SALE • • • << THE TIP COMPUTER PROGRAM is now on sale for a special price. Over 13,000 TIPS & growing !!! One of the **LARGEST** tip databases in the WORLD - TV's, **VCR's, CAMCORDER's** plus other electronic equipment. **HIGH QUALITY PROFESSIONAL SOLUTIONS** with up to **8 LINES of problem solving information. ADD** your own tips to the program and find them **FAST !!!** Stop writing YOUR valuable repair tips on schematics. **PRINT** any tip. Special **DATA EXCHANGE & UPDATE** feature **INCLUDED** with every program. Our customers say this is the *** BEST *** technical tip database program on the market today. **Pays for itself with 1 or 2 repairs.** Works on **ANY** IBM compatible computer with a hard drive **INCLUDING** 486, 386, AND older 286 & XT models. **Updates & Network** versions available. Used by National, State & Local Electronic Association Members & Officers. **Only $175.00 !!!** (High density disks - specify size). Prepaid orders (check/money order) within the U.S.A. are shipped **FREE.** Call for: C.O.D., Double density disks, and shipping outside U.S.A. Have your own tips? Ask about our **TIP EXCHANGE policy with FREE Updates.** Already have a tip program? Ask about our **competitive upgrade Discount.** P.S.—can't find the right software for your business or other interests? We write **CUSTOM SOFTWARE** to fit your needs. **CALL NOW !!! (516) 643-7740 HIGHER INTELLIGENCE SOFTWARE, 60 Farmington Lane, Melville, NY 11747**

*** * * DON'T BE MISLED BY OTHER TECHNICAL TIP PROGRAMS - SERVICE TIPS IS DIFFERENT FROM ALL OTHERS * * * IT ORGANIZES 15,700 CURRENT SERVICE TIPS IN ALPHABETICAL ORDER BY Model/Brand & Symptom with Concise Solutions, Part Numbers, Values & Locations** on ALL CONSUMER ELECTRONIC EQUIPMENT. Created by 2 CET'S with over 20 YEARS experience and a computer programmer, **IT'S AN INDISPENSABLE TOOL FOR ANY SERVICE CENTER.** Members of electronics associations such as **NESDA-NYS, NESDA, METSDA, TESA-LI** use this program and confirm there is no better program available today. **DUE TO THE OVERWHELMING RESPONSE TO OUR PREVIOUS ADS, * * * NOW for a LIMITED TIME ONLY SERVICE TIPS is available for the low price of $129.95 * * *** Demo Disk & Quarterly Updates are also Available - Call or Write **Electronic Software Developers, Inc. 826 So. Main Street, South Farmingdale NY 11735 Phone (516) 221-6403.**

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

FOR SALE

Tek 465B 100MHz scope $575, Tek 2215 60MHz scope w/TV Trigger $489, Many other scopes available. All in Excellent Condition. Call for listing of our used equipment. We buy surplus equipment. **Test Equipment Sales** (603) 434-2544.

VHS-VCR Repair Solution Sets I - IX. Each contains 150 symptoms and cures, cross reference chart, free assistance, $19.95 each, all nine $49.95. Visa/MC. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530.

Earn $$$ Repairing Zenith TV's to component level—now over 1000 models 1983-1993. Guaranteed effective and reliable cost cutting symptom/cure format. Buy manual and receive **FREE** report, "Repair Shorted CRT's Fast" (raster one color) $89.95. Demo Sampler $19.95. **ZMEX**, 807 Queen Palm Lane, Sarasota, FL 34243.

MAKE MORE MONEY! In Your Electronic Repair Business! New Report **"COD Repairs—TV Servicers CA$H Crank!"** Reveals How! Send $39.00 + $2.00 S&H Check or M.O., of S.A.S.E. For More Info to: Electronic Services, P.O. Box 461, Belleville, MI 48111. Guaranteed! Since 1951.

TECHNICIANS, FINALLY A BREAKTHROUGH IN *SMD* REMOVAL! CHIP QUIK™ SMD REMOVAL KIT. •NO DAMAGE TO CHIP OR BOARD •LOW OPERATING TEMPERATURE •EASY TO USE •INEXPENSIVE. $12.00 per kit + $2.00 S&H. 24 hr. Fax for credit card orders (508) 879-7727. Info available, call **MTS ELECTRONICS (508) 879-3131.**

REDUCED 85%. Diehl Mark III $69, Diehl Mark V Horizontal circuit tester $179. New. Conductive coating for remote control keypads $9.99 ppd. WEEC, 2411 Nob Hill Road, Madison, WI 53713. 608-238-4629, 608-233-9741.

*** * * * * * ZENITH MODULE REPAIRS * * * * * *** Save Money Repair Your Own ZENITH Modules 248 CURES 9-124 THRU A-9740 LASER PRINTOUT $29.95 INCLUDES S/H MAIL CHECK TO: **Electronic Software Developers Inc.** 826 S. Main Street, South Farmingdale, NY 11735

TV CASE HISTORIES: Booklet with 1,750+ histories. Satisfaction assured. Only $35 (two-day priority shipping, add $1.90). Mike's Repair Service, P.O. Box 217, Aberdeen Proving Ground, MD 21005. Same mailing address 30 years. Send SASE for samples. 410-272-4984, 11am-9pm.

Readers' Exchange

Readers' Exchange has been reinstated as 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

WANTED

One AD737 rms-to-dc converter; one Op-177GP Precision Operational Amplifier. *(908) 888-0608.*

FME reel-to-reel tape recorder (manufactured by Federal Manufacturing & Engineering Corp., Model 47-A or other); working or not, as whole unit, parts source, or parts. Also seeking literature on product. *Contact Kevin Wheeler, 3907 Sunbeam Ave., Chattanooga, TN 37411, (615) 698-3643.*

Good used yoke for Hitachi TV Models CT19Z3, CT1933 part number 2441558. *Send price to Don Ande, 1666 S. Fares Ave., Evansville, IN 47714.*

Published inmate author/inventor seeks collaborator for ground-breaking invention. Experience with micro-electronics a MUST! References available; send qualifications/phone. *Contact Dale C. Shackelford, FCC ID#153259, 1012 W. Columbia, Farmington, MO 63640-2902.*

Service Manual for Magnavox, Model T815-02AA. Need schematic that shows where diode D1 on CRT board #703917-3 is connected. (Photo of this on page 42, Fig. 5 of June 1993 ES&T). *Charles Hess, 201 S. Oak St., Buchanan, MI 49107.*

New or good used IC1410, synthesizer IC part #15-3015689-1 for Sylvania Model CX0178WR, Chassis E53-02. *Price TV, P.O. Box 291, Parker City, IN 47368, (317) 468-6858.*

High-voltage focus block for #CT5061 Hitachi big screen TV, Part #161366; also need big screen module, Part #DUNTK 4039DE00, power supply for Sharp PWB-C; new or working used parts. *Contact Andrew or Shaun Scarborough, (912) 272-6561 collect, day or night, or send post card to Scarborough TV, 1418 Highway 199 South, Old River Road, East Dublin, Georgia 31021.*

Motor Capstan #150538 for RCA VGP170 VCR, Audio Video PCB 4-2284-041000 for Fisher FVH922 VCR. *L. McHenry, 6225 N. 20th Lane, Phoenix, AZ 85015. (602) 249-2325.*

Tips and heaters for Permax line of soldering irons (25w and 30w) or a source of supply for same; also Manual set for Tandy Model 16B Xenix 15mb HD system; also Telephone line simulator, Teletone TLS-3 or 4, B&K Elec. Design Teletester II or III. Please quote condition, availability and price. *LMS Electronics, 11241 Northwest Seventh Street, Coral Springs, FL 33071.*

Schematics for Coronado radio, Model #740 (BRC-740). *Ed, (206) 631-9235.*

B&K sockets for Model 470; B&K picture tube tester, numbers 27 and up. *Chuck McDonald, 595 Huntmere Drive, Bay Village, OH 44140, (216) 871-6523.*

New or used red CRT/Lens assembly, Part #705187-002 for Magnavox rear projection TV, Model #RF8505AK05. *Kevin, (716) 265-4113.*

Manual/schematic for Stoddart NM20B F/S meter, a.k.a. AN/PRM-1. Buy or copy & return. *D.J. Robinson, 1277 Gatewood Dr. NE, Lawrenceville, GA 30243. (404) 962-3949.*

New or good used 4ADC4 CRT, Sylvania IC, 15-3017815-1 or ECG 865, interface IC in tuner of E51-44. *Contact A-OK TV, 42 Creeping Hemlock Dr., Norwalk, CT 06851, (203) 847-9254.*

FOR SALE

Sams Photofacts, 3 through 960. Some missing total 395. $1.00 each plus shipping or make offer for all. *Call Sigmund 717-264-3846.*

About 40 to 50 year old parts, etc. Military surplus transformers, chokes, swinging chokes, and radio power transformers and 6V and 12V vibrators—$2.00 to $3.00 each plus shipping. Send SASE for your needs or more details. *S. O. Sellers, 7308 Franklin Dr., Bessemer, AL 35023-5557.*

We have for sale a Tektronix Spectrum Analyzer, model 492, serial BO54732, in excellent condition for $9,000.00. *Sherry Burks, Able Video Electronics, 615-256-2852.*

Sencore SC3080, VC93, PR57, and all 4 Tentel VCR mechanical gauges. All with light use. *Call Rick, 315-699-3935.*

Sencore LC75 Z meter and SCR250 accessory, $500.00. Sencore VA62, used less than 100hrs., $1500.00, B&K 3010 function generator, $95.00, B&K TR110 isolation transformer, 4 outlets, 2 direct, 2 isolated, $95.00., Leader LD21 dummy load, $50.00, Fluke 77 DMM and 80KΩ high voltage probe, $95.00. *Orland Lynd, ORCO Electronics, 2300 Harvard Way, #124F, Reno, NV 89502-4044.*

2 Bell & Howell Microfiche viewers, $75.00 w/o printer $175 w/printer. Excellent condition. *Dave 817-465-0257.*

Sencore SC3080 80MHz waveform analyzer, $2,300.00/VC93 all format VCR analyzer, $2,000.00, Sencore PR57 variable isolation transformer, $350.00. All new 12/92, lightly used thru 6/93. All excellent cond., w/original boxes, manuals, leads, etc. Will sell all for $4,000.00; will consider best offer. Must sell. *Call Don at 1-313-498-3922. Leave message if no answer.*

Brand new Sencore VC-93 VCR Analyzer. *Contact 1 (216) 898-3339.*

Sams Photofacts 1000–2336 for $1200.00; Audio manufacturer's service data, 1960–1980, for Pioneer, Sansui, Kenwood, Onkyo, Fisher, Scott, etc. Send large SASE for a list. *Contact A-OK TV, 42 Creeping Hemlock Dr., Norwalk, CT 06851, (203) 847-9254.*

Amtek AC surge and filter suppresser #MP208ERF.120/208 wye operating voltage, $3500.00; Metcal soldering iron power supply, $100.00; Signal Corp. Frequency Meter #BC-221-AH, 25 Hz–20 MHz, $75.00; Kar Kar #KPN5725, 8–16 MHz band suppression filter, 75/75 Ω unbal., $50.00; 10–9" Ball Electronics monochrome monitors $20.00 each. *Contact (214) 524-0104.*

RCA Service Data Consumer Electronics Products, 1967–1978, and Sams Photo Facts. *Contact Ann Bichanich, 15 1/2 W. Lake St., Chisholm, MN 55719, 1 (218) 254-4421.*

LBO-52A Leader 35 MHz dual-trace scope; NLS MS-230 30 MHz dual-trace scope; Sencore SM152 marker/sweep generator; Tektronix Model 211 portable scope. For sale or trade for Sencore VA62-62A. *Contact 1 (914) 679-6629 after 6 pm.*

Tektronix 2244A 4-Ch. oscilloscope, 100 MHz digital readout w/pouch & cover, tilt swivel base, 4 probes, including high voltage & service manual; like new, recent factory calibration, $2000.00 or best offer. Also, Tektronix CMC250 2-Ch., 8-digit 1.3 GHz multifunction frequency counter. New condition, in original box w/manual, $400.00 or best offer. *Contact Bruce (516) 437-2277.*

Fluke 8024B handheld digital meter, $125.00; Amprobe RS-1 current clamp, $25.00; both items in like-new condition. *Contact Ted, 15669 Couzens, Eastpointe, MI 48021, (810) 777-5661.*

Forty to 50 year old radios and intercoms (8 stations/masters, etc.) and radio chassis complete with tubes (except speakers) and 1 or 2 electromagnetic speakers. $3.00 to $5.00 each plus shipping. Send SASE for your needs or more details. *Contact S. O. Sellers, 7308 Franklin Dr., Bessemer, AL 35023-5557.*

Sencore CM2000 computer monitor analyzer with adapters, cables, and manuals in original box. Cost $3295.00, will sell for $3000.00. *Contact Warren, (701) 845-3484, 9–5.30 CST.*

Sencore ST66 stereo TV gen. $300.00; Fluke 37, $125.00; Tektronix 2213, 60 MHz scope, $600.00. *Contact Bud, (413) 533-7566 after 5 pm EST.*

Test Your Electronics Knowledge

Answers to the quiz

(*Continued from page 23*)

1. No. It is already a Wheatstone bridge.

2. The Q of a tuned circuit is calculated by the equation:

Q = resonant frequency/bandwidth
So, Q = 500/15 = 33.3 (no units)

3. There are 2π radians in one revolution. So, if

2π radians = 1 revolution
200π radians = 100 revolutions

You may have learned to solve problems like this by making a ratio—

2π: 1 rev. = 200π: x rev. (therefore x = 100 rev.)

4. No. If you try it you will destroy both electrolytic capacitors!

5. Clockwise. The small wheels are called *idlers*. They do not reverse the direction of the large wheels.

6. Anthropomorphous or Anthropomorphic. (*not* cyborg!)

Both answers are correct. If your answer was correct give yourself two extra bonus points for knowing the word and another two points if you spelled your answer correctly.

7. It is called the *measurand*. Take off four bonus points if you called it "the thing being measured."

8. The Thompson Effect. It is one of several important thermoelectric effects.

9. It is called a TRF (tuned radio frequency) receiver. In the early days of radio—before Major Armstrong's superheterodyne receiver—it was the favored receiver. More recently it was used in some garage door opener systems, and, in some high-fidelity systems. It has better fidelity but is not as sensitive as the superhet.

10. D. As you know from reading WDYKAE?, tunnel diodes *are* still available. I ran a series of discussions on tunnel diodes in recent WDYKAE? articles. ■

Advertiser's Index

We'd like to see your company listed here too. Call Diane Klusner at 516/681-2922 to work out an advertising program tailored to suit your needs.

DON'T READ THIS UNLESS...

PHILIPS TECHNICAL TRAINING

Leading Supplier of Hi-Tech Training

YOU WANT TO SERVICE MORE PRODUCTS...

Voted number one in the technical training industry for nine years running, Philips will teach you the "ins and outs" of service.

From diagnosing the problem to fixing the most complex electrical systems, our training programs will give you the fundamental information needed to service a wide variety of consumer electronics products.

Receive hands-on training, using the latest in testing equipment and learn valuable tips and techniques from our technical experts.

Your satisfaction is guaranteed!

IMPROVE SERVICE PRODUCTIVITY...

Finding the problem is one of the most time-consuming responsibilities of a servicer. With troubleshooting tips in every course, our training programs are designed to substantially decrease time spent on the front end and increase productivity.

After diagnosing the problem, you will receive hands-on experience repairing this and a variety of problems for a variety of products, such as VCRs, computers, monitors, power supply, and more!

Our experts will show you how to find the problem and fix it in record-breaking time, the first time.

AND INCREASE PROFITS!

By increasing the variety of products serviced, you increase your potential customer base. By improving service productivity and efficiency, you improve customer satisfaction. All this comes down to the bottom line—increased profits!

Philips Technical Training courses are designed with the servicer in mind. Using the knowledge our service experts have gained, we will help your business and your profit margin grow.

YOUR SATISFACTION IS ALWAYS GUARANTEED!

JUST A FEW OF THE COURSES COMING YOUR WAY!

VCR Repair:
VHS Operating Systems
High-Speed VHS VCR Troubleshooting

Camcorder Repair:
Fundamentals of Color Camcorder

Compact Disc Repair:
Compact Disc Digital Audio
Compact Disc Interactive (CD-i)

Power Supply Repair:
Switching Mode Power Supply V

Mechanical Maintenance:
VCR Mechanical Maintenance
Camcorder Mechanical Maintenance

Computer Monitor Repair:
Hi-Res Computer Monitor Repair

Now using SENCORE test equipment.

To order your catalog or receive the latest training flyer...

Call, Fax, or Write:
615-475-0044
FAX 615-475-0221

Philips Technical Training
401 East Old Andrew Johnson Hwy., Box 555,
Jefferson City, TN 37760

PHILIPS

Circle (60) on Reply Card

Multi-Choice.

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

Fluke 77
The classic
Multimeter
$169.00

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

Fluke 83
Full-featured
Multimeter
$255.00

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

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

Fluke 12
Auto-function
Multimeter
$95.00

FLUKE 12	FLUKE 77	FLUKE 83
The Fluke meters listed above feature DC/AC voltage, resistance, audible continuity and diode test.		
Capacitance measurements	Auto Touch Hold®	Auto Touch Hold® and Relative modes
V Chek™ (auto function)	Current measurements	Current measurements
Min/Max Record with Relative Time Stamp	Analog/Digital display	Analog/Digital display
Two-year warranty	Three-year warranty	Three-year warranty
Continuity Capture™	Yellow holster with Flex Stand™	Yellow holster with Flex Stand™
Basic accuracy 0.9%	Basic accuracy 0.3%	Input Alert™
	For measurements to 4800 V-A	Capacitance measurements
		Frequency and Duty Cycle
		Min/Max/Avg. Recording
		Basic Accuracy 0.3%

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

FLUKE®

Circle (1) on Reply Card