

ELECTRONICTM

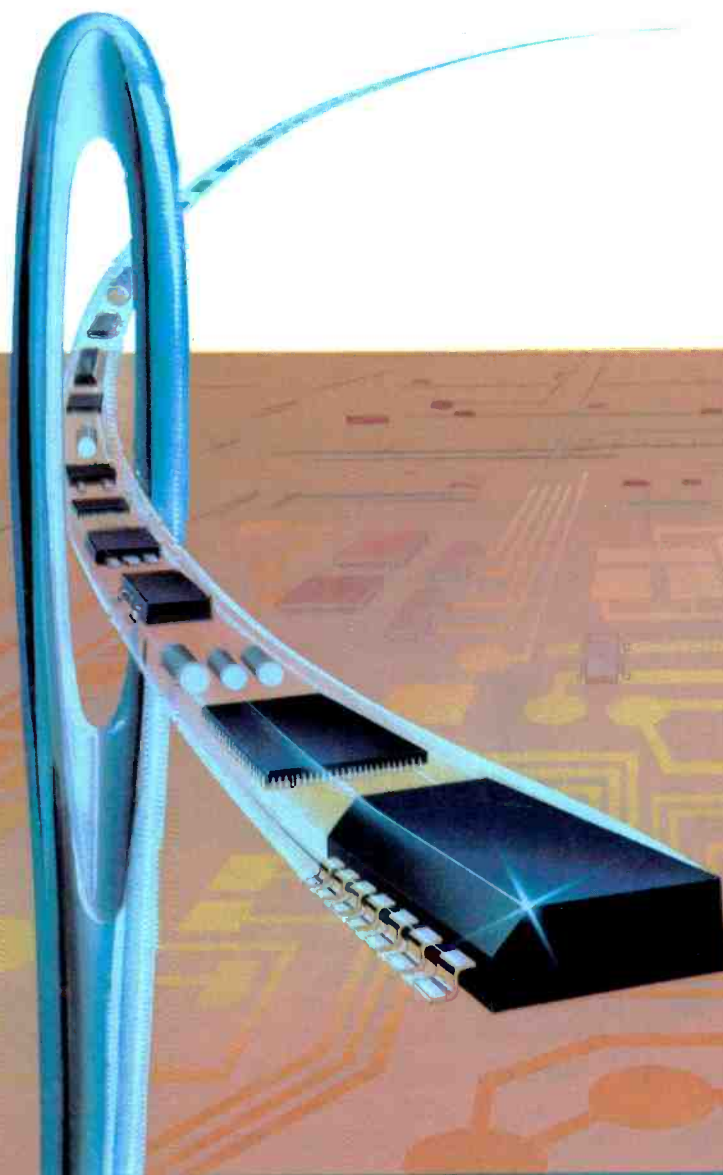
Servicing & Technology

FEBRUARY 1985/\$2.25

Audio compact-disc players • Power line disturbances

Resistors and diodes • Analysis of Sylvania Superset-Two

Surface-mount components





New protection – especially in stormy weather – for the electronics you use, sell or service!

A brief, high voltage surge – or spike – can occur in any AC line system and, at amplitudes lower than 600V, cause little or no damage.

But at greater amplitudes, a spike can do real damage. And the greater the high voltage surge – resulting from nearby lightning, for example – the greater the risk of harm, especially to solid-state devices.

That's why Zenith now announces the availability of two Spike Suppressors – one with a grounding plug and the other without.

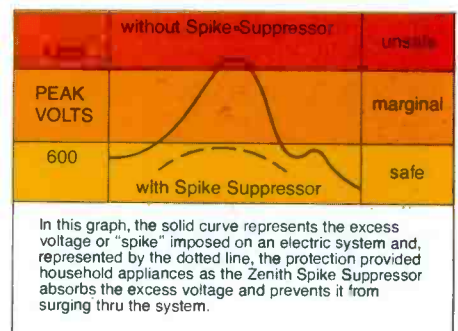
Both are designed to provide susceptible TV receivers, household appliances and other electronics with two-way protection from high-voltage surges.

First, a Zenith Spike Suppressor absorbs a wide range of voltage spikes so only a safe voltage level reaches the protected equipment.

Second, heavy or prolonged voltage surges cause a Zenith Spike Suppressor to cut off power completely to protected equipment thereby signaling the need for a replacement Spike Suppressor.

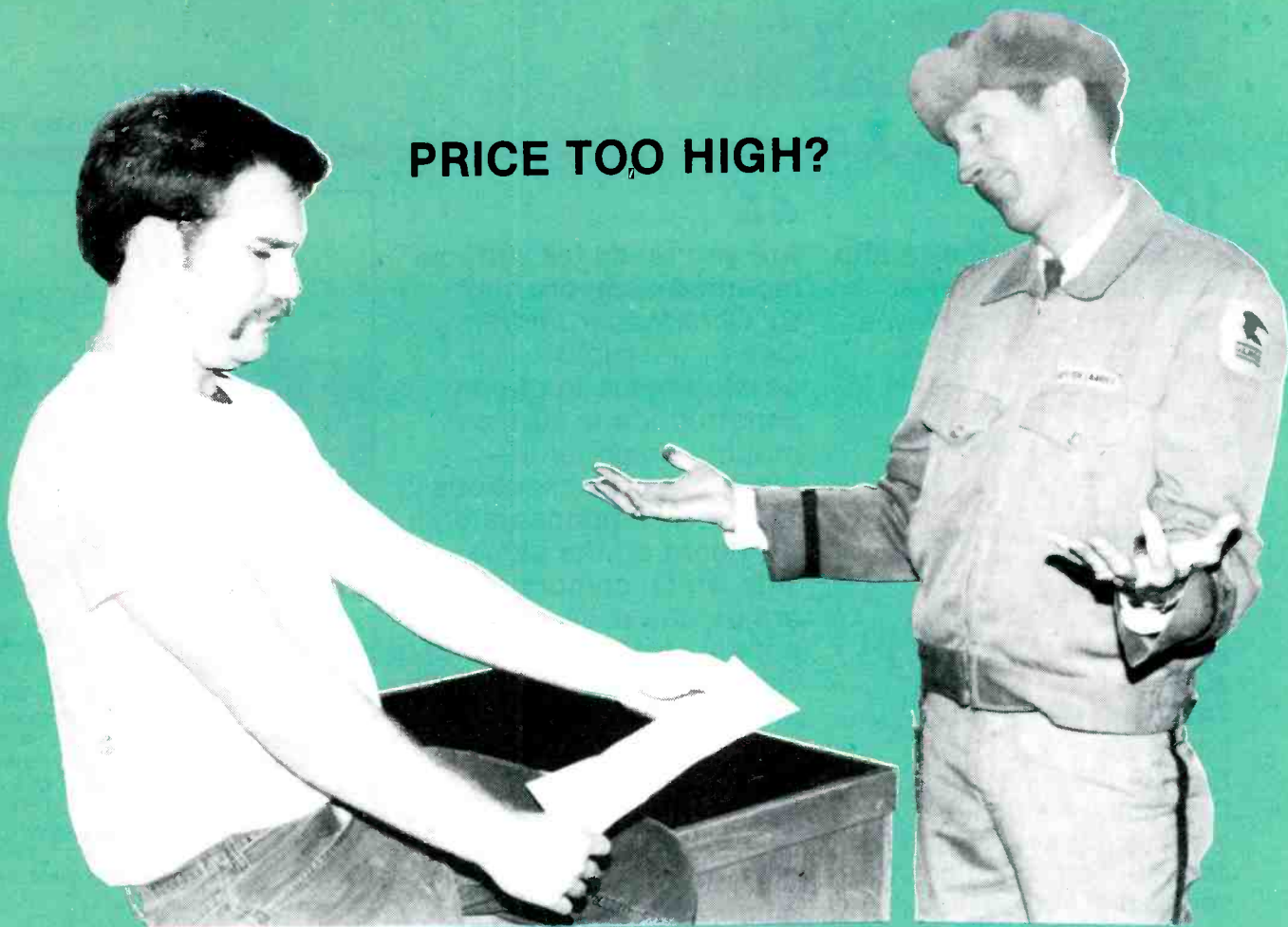
That's double-duty protection against spikes for the electronics you use, sell or service. And ample reason for you to lay in a supply of Zenith Spike Suppressors soon.

Both should be available at your Zenith distributor's now. Call and pick up several before the next storm hits!



ZENITH
The quality goes in before the name goes on®

PRICE TOO HIGH?



In the rapidly changing field of electronics, it isn't surprising to be able to telephone a company many miles away, place an order (the computer tells you if it is in stock) and have it delivered within a matter of hours. The surprise comes when you receive the bill.

At CEI, our surprise is that when you call, you will know the full price of your order and the method and cost of delivery. You see, we give you a choice of overnight delivery of a less costly transportation depending on your needs.

Just like our competitors, we can ship your needed part immediately but if you are supplementing your store stock with specials from the CEI catalog why not let us save you the extra cost of immediate delivery.

That's extra savings to you making our already value priced catalog items even a better deal. Give us a call to find out just how much you can save on our complete selection of electronic parts. But don't tell your competitors. Leave the surprise for them.

It's no surprise, CEI saves you money.

1-800-543-3568

NATIONAL WATS

TELEX NO.288-229

1-800-762-3412

OHIO WATS

IN DAYTON:(513) 252-5662

CALL TOLL FREE!

CEI Consolidated Electronics, Incorporated

Circle (4) on Reply Card

705 WATERVLIIET AVE,
DAYTON OH. 45420-2599

February 1985 *Electronic Servicing & Technology* 1

ELECTRONIC

Servicing & Technology

Volume 5, No. 2 February 1985

10

Understanding the audio compact disc player

Audio compact disc players are rapidly becoming the preferred audio instrument among consumers; but servicers of these devices find they involve some rather complicated circuitry. Here's an in-depth look at these sophisticated digital instruments.

28

Test your electronic knowledge

By Sam Wilson

Continuing his popular monthly quizzes, Wilson asks 10 more questions for you to test your skill.

38

Don't let power line disturbances damage your electronic equipment – Part one

By Jerry Whitaker

Power sags, surges and transients all can cause a great amount of damage to electronic equipment unless you protect your equipment. This first installment to a 2-part series examines the different types of power disturbances.

Departments:

- 4 Editorial
- 6 Technology
- 61 New Products
- 62 Readers' Exchange
- 62 Photofact

44

Are you ready for surface-mounted components?

By Christopher Fenton

One of the rapid developments in circuit construction is surface-mount components – placing interconnections between components on a PC board on the same side which components are mounted. Written from a manufacturer's point of view, Fenton explains how and why it is being done.

50

An analysis of the Sylvania Superset Two, model RXS198WA

By Carl Babcoke, CET

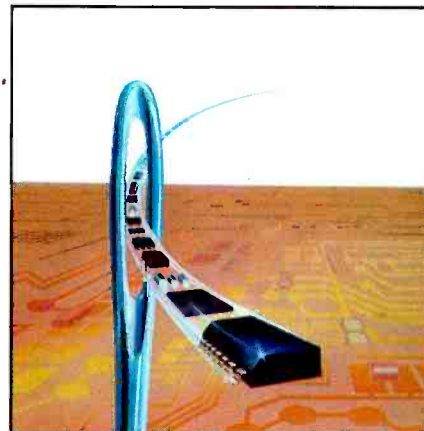
Sylvania's Superset Two is one of many recently developed TV receivers which incorporates stereo broadcast capabilities, cable and VCR hookups and many other unique features.

58

What do you know about components? More about resistors and diodes

By Sam Wilson

Returning to the subjects of resistors and diodes, Wilson looks at carbon film resistors, details the construction of point contact diodes and also talks about plotting load lines to graphically find the current in diodes.



The current crop of tiny lightweight consumer electronic products: Walkman cassettes, Watchman televisions, handheld TV cameras, pocket-sized color televisions, all owe their existence to manufacturing technology that crams huge numbers of circuit functions into almost no space at all. Key to this extreme miniaturization are surface-mount components and ICs, such as those depicted on the cover. (Photo courtesy of Motorola Semiconductor Products.)



Page 8

We advanced the technology to make the soldering simple.

By changing the grounded heat sensing tips, the Weller WTCPZ automatically controls output and temperature in three stages (600°F, 700°F and 800°F). Once selected, you can be assured of constant, accurate temperature control without dials to turn or settings to watch. To make working with sensitive components that safe and simple, Weller has incorporated state-of-the-art technology into an attractive impact resistant case, that's ideally suited to assembly work. Check with your Electronics Distributor.



More Weller advances

If voltage transients are your problem, the WTCPZ has a special zero-voltage electronic switching circuit to prevent possible damage to sensitive components.

WTCPZ Soldering Station features the WEC24 iron which has adjustable control circuitry completely contained in the handle.

The Weller® WTCP series

CooperTools

The difference between work and workmanship.

BOKER® CRESCENT® LU-KIN® NICHOLSON® PLUMB® WELLER® WISS® XCELITE®
The Cooper Group PO Box 728 Apex NC, 27502 USA Tel (919) 362-7510 Telex 579497

Circle (5) on Reply Card



Dealing with surface-mount technology

Back in the early days of electronics, it was possible to perform a lot of service on radios and televisions without even knowing what a soldering iron looked like. If a diode or an active device (vacuum tubes) was the cause of the problem, which was most often the case, it was a simple matter of pulling the old tube out of the socket and plugging in a new tube.

Then came transistors, and although some transistors were socketed, many more were soldered directly into the circuit. The arts of soldering and desoldering flowered.

Not too many years ago, integrated circuits were introduced, and soon servicers were scratching their heads and trying to figure out ways to unsolder a 16-pin DIP. New soldering/desoldering equipment and aids hit the market: soldering iron heads capable of heating all IC pins at once, spring-loaded IC extractors, vacuum desoldering tools, desoldering braid. In fact, thanks to the advent of ICs, soldering and desoldering have been elevated to the status of a fine art.

It seems though, that manufacturers are determined to stay several steps ahead of people who are trying to desolder and resolder their circuits. Now that people are beginning to become adept at dealing with dual-in-line packaged (DIP) ICs, the manufacturers are beginning to introduce surface-mount components.

Actually, there are a number of advantages to surface mounting of components: tighter packaging and lower production costs, to name two. But that doesn't alter the fact that it presents yet another learning process for someone who wants to service these products. But then, like it or not, innovation, with its attendant changes in methods and procedures, is the lot of anyone involved in a business as dynamic as electronics.

Make no mistake about it, surface-mounted components and ICs are already here in such small products as video cameras and watchman-type televisions. In the future, a veritable flood of these devices will be introduced into consumer products. Anyone who wants to service the next generation of consumer electronic products will have to know how to handle them.

In this issue, "Are you ready for surface-mount components?" describes in some detail why manufacturers are introducing surface-mount components and how they're connected to printed circuit boards. The information it contains might help you prepare for this new technology.

We'll bring you further information on surface-mount as we learn about it.

Nils Conrad Persson

ELECTRONIC Servicing & Technology

Editorial, advertising and circulation correspondence should be addressed to: P.O. Box 12901, Overland Park, KS 66212-9981 (a suburb of Kansas City, MO); (913) 888-4664.

EDITORIAL

Nils Conrad Persson, *Editor*
Carl Babcoke, *Consumer Servicing Consultant*
Rhonda Wickham, *Managing Editor*
Joy Culver, *Associate Editor*

ART

Kevin Callahan, *Art Director*
Joni Harding, *Graphic Designer*

CIRCULATION

John C. Arnst, *Director*
Evelyn Rogers, *Manager*
Dee Manies, *Reader Correspondent*

ADMINISTRATION

R. J. Hancock, *President*
Cameron Bishop, *Publisher*
Eric Jacobson, *Associate Publisher*

ADVERTISING

Greg Garrison, *National Sales Manager*
Julie Roberts, *Production Manager*
Stephanie Fagan, *Marketing Coordinator*



Member, Audit Bureau
of Circulation



Member, American
Business Press

ELECTRONIC SERVICING & TECHNOLOGY (USPS 462-050) (with which is combined Electronic Technician/Dealer) is published monthly by Intertec Publishing Corp., 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212-9981. Second Class Postage paid at Shawnee Mission, KS 66201. Send Form 3579 to P.O. Box 12952, Overland Park, KS 66212-9981.

ELECTRONIC SERVICING & TECHNOLOGY is the "how-to" magazine of electronics. It is edited for electronic professionals and enthusiasts who are interested in buying, building, installing and repairing home-entertainment electronic equipment (audio, video, microcomputers, electronic games, etc.).

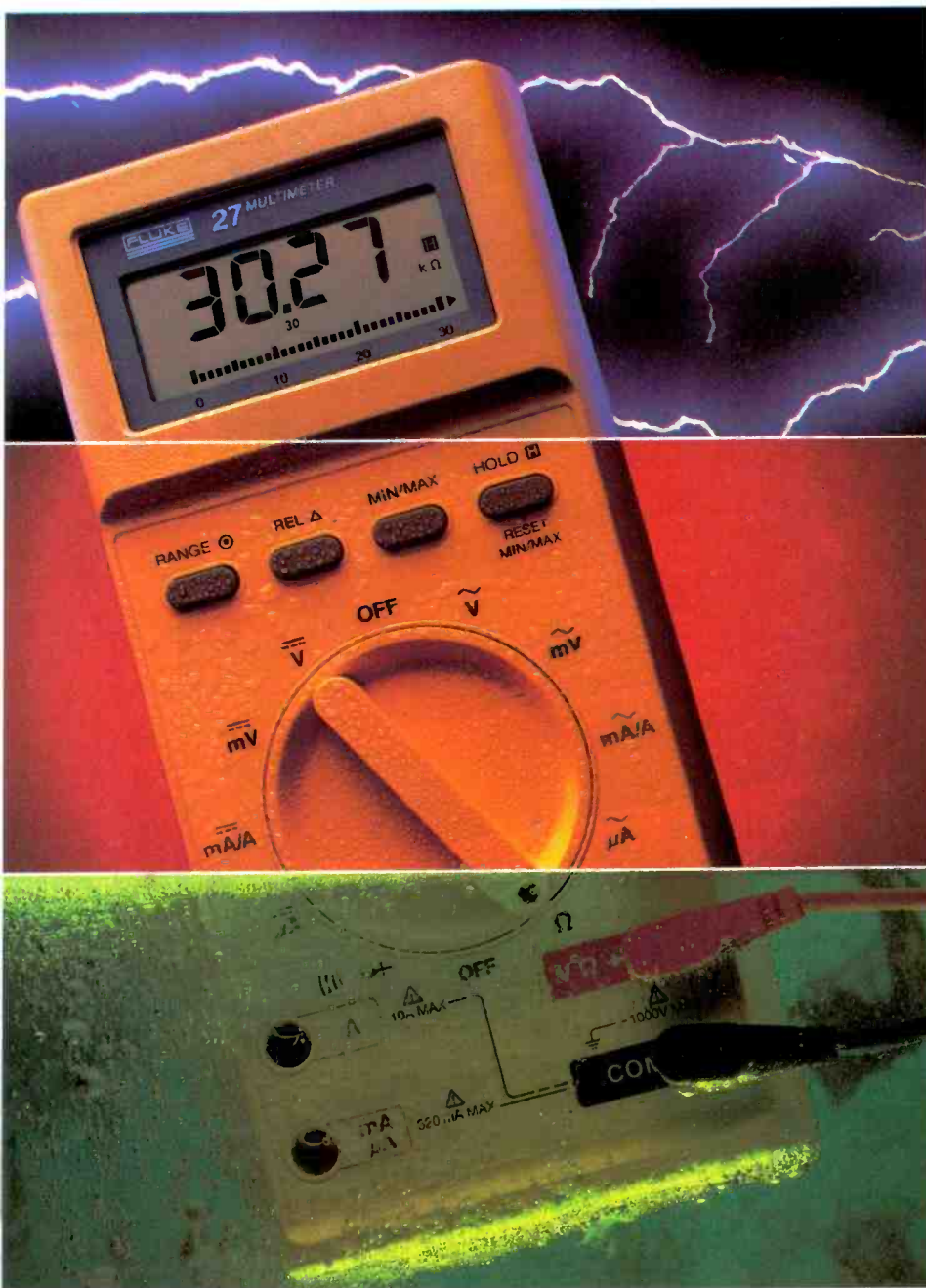
SUBSCRIPTION PRICES: one year \$18, two years \$30, three years \$38 in the USA and its possessions. Foreign countries: one year \$22, two years \$34, three years \$44. Single copy price \$2.25; back copies \$3.00. Adjustment necessitated by subscription termination to single copy rate. Allow 6 to 8 weeks delivery for change of address. Allow 6 to 8 weeks for new subscriptions.

PHOTOCOPY RIGHTS: Permission to photocopy for internal or personal use is granted by Intertec Publishing Corp. for libraries and others registered with Copyright Clearance Center (CCC), provided the base fee of \$2 per copy of article is paid directly to CCC, 21 Congress St., Salem, MA 01970. Special requests should be addressed to Cameron Bishop, publisher.
ISSN 0278-9922 \$2.00 + 0.00

INTERTEC
PUBLISHING CORPORATION

©1985 All rights reserved

Tough enough to work anywhere you work.



The Fluke 20 Series. A tough new breed of Analog/Digital Multimeters.

Put them to the test.

The new Fluke 20 Series are the first lab-accurate analog/digital handhelds tough enough to withstand water, contaminants, chemicals, accidental drops, extreme temperatures, and severe electrical overloads.

They're also the first sealed meters to offer fast autoranging, an analog bar graph, a continuity/diode test beeper, and Fluke's unique "Touch Hold"* display.

All in your choice of two models, the Fluke 25, and the Fluke 27, which adds "Relative" (difference) and "Min/Max" recording modes.

Each features 0.1% basic dc accuracy, and a unique combined analog *and* digital display for quick measurement of changing or stable signals.

So now you can get high performance under the harshest of working conditions.

With another first that's tough to beat. They're made by Fluke, first choice of professionals worldwide.

For the name of your nearest distributor, call toll-free anytime **1-800-227-3800, Ext. 229**. Outside the U.S., call 1-402-496-1350, Ext. 229.

**FROM THE WORLD LEADER
IN DIGITAL MULTIMETERS.**



FLUKE 25

\$229†
Charcoal or yellow case
Analog/digital display
0.1% basic dc accuracy
100 μ V to 1000V ac and dc
0.1 μ A to 10A, all fused
-15°C to 55°C operation
Two year warranty

FLUKE 27

\$259†
Charcoal or yellow case
Analog/digital display
0.1% basic dc accuracy
100 μ V to 1000V ac and dc
0.1 μ A to 10A, all fused
-15°C to 55°C operation
Two year warranty
Relative (difference) mode
MIN/MAX recording mode

*Patent pending.
†Suggested U.S. list price, effective November 1, 1984.



Copyright © 1984, John Fluke Mfg. Co., Inc. All rights reserved. Ad No. 4705-20
For technical data circle number (6).

Restoring versatility to your cable-connected VCR



Thousands of new cable subscribers, who also own VCRs, have discovered that their VCRs programmability has suddenly been limited to single-channel recording, and that their cable converter must now be left on for extended periods of time in order to do time-shift program recording. The problem with VCRs is their incompatibility with the converter/descrambler, which prevents the VCR recorder from changing channels. A consumer who has bought a VCR with a 14-day, 8-event, automatic time feature has wasted the investment, because the only channel that can be taped is the one to which the converter/descrambler is tuned. The VCR, of course, must always be set to channel 2 or 3 to match the converter. The problem becomes clear—it's the converter/descrambler tuner which must be given programmability.

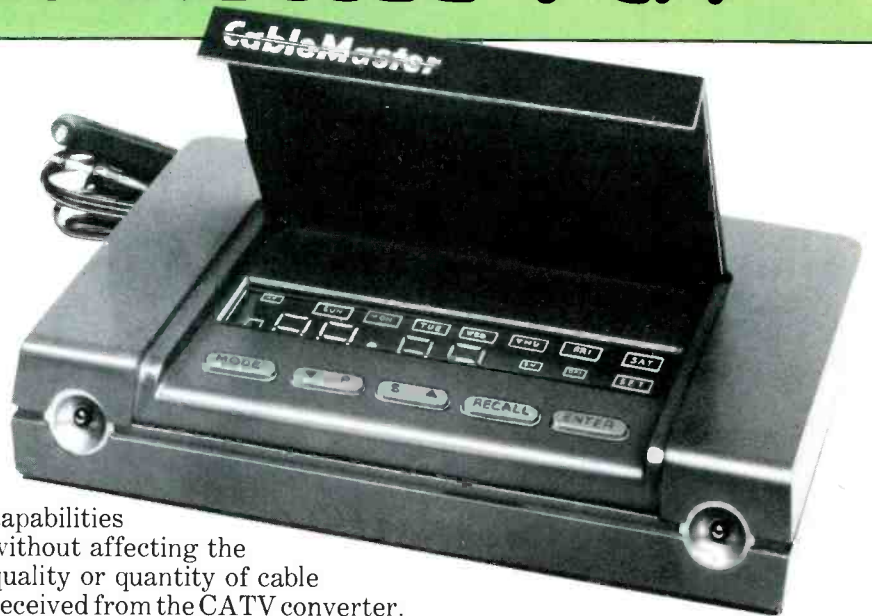
The CableMaster from JNEL Corporation, Mansfield, MA, solves this problem. It enables cable subscribers to use their VCRs full programming

capabilities without affecting the quality or quantity of cable received from the CATV converter.

The infrared CableMaster cable/VCR programmer system turns the CATV converter on and off to the chosen channels at preselected times that have also been programmed into the VCR. By controlling the cable TV converter, it enables the VCR to record unattended up to eight separate programs on eight different channels, including pay channels over a 2-week period.

Also, the unit's infrared circuitry and personality plug-in modules are designed for compatibility with every make and model of infrared cable TV converter. Should the cable converter model be changed for any reason, the device will require only a different personality module. Personality modules will also be available to control satellite receivers with infrared remote features.

The programmer will control and enhance older VCRs with little

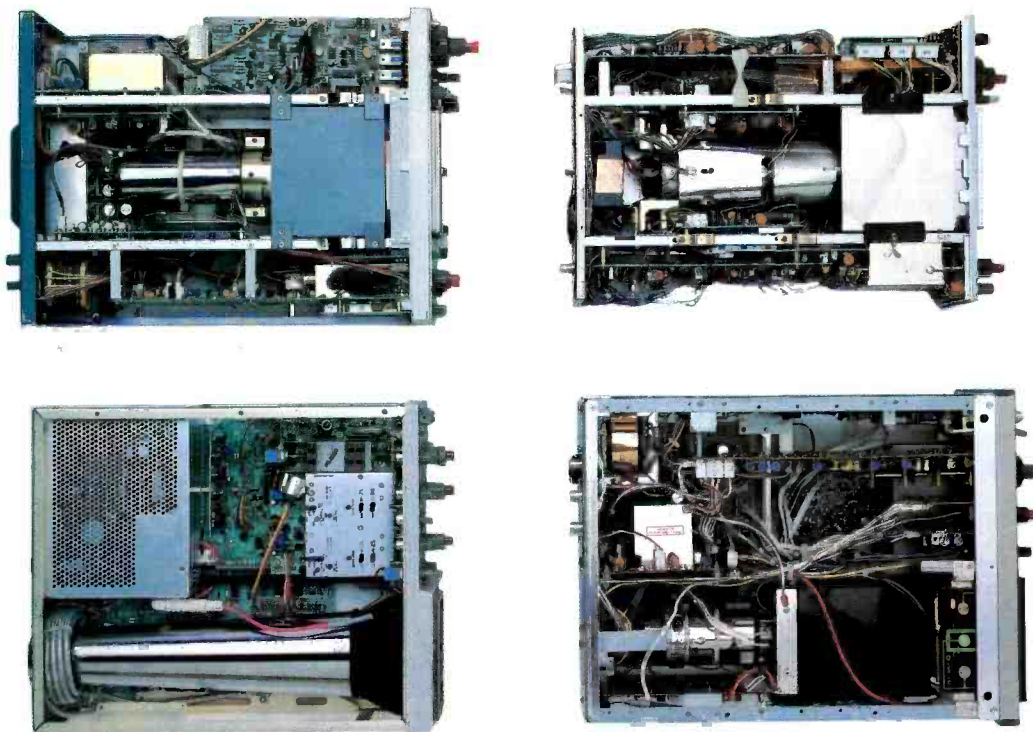


The Cablemaster cable/VCR programmer bridges the gap between cable TV and VCR programming. The system uses the VCR's full programming capabilities without affecting the quality or quantity of cable received from the CATV converter by turning the CATV converter on/off to the chosen channels at preselected times.

or no timing ability. Other features include automatic sequencing of programmed events; no cables or other connections to the VCR or cable TV converter; elimination of the need for cable ready VCRs; an ac power adapter—either 120V, 60Hz or 50Hz. Installation of the unit requires little more than setting the unit on top of your VCR or cable converter and making program selections. Once programmed, it works automatically.

The unit is expected to be available in this month, and it will be provided with one personality module. Replacement personality modules will be available.

You can't judge a scope by its cover.



When you look at our simplified, practical internal design, you see why the Tek 2200 Series delivers unparalleled high performance and reliability in the field. You get quality that's unmistakably Tektronix in scopes so advanced, they cost you less to buy and own.

Through an innovative new concept in scope design we reduced the number of mechanical parts by 65%. Reduced cabling by 90%. Virtually eliminated board electrical connectors. And eliminated the need for a cooling fan.

The result: a scope with designed-in simplicity that increases reliability as it cuts downtime and repair costs. All of which means outstanding value in

a compact, lightweight package that your service technicians will appreciate.

Plus, you get a selection of performance to precisely match your needs. There are the 60 MHz single time base delay 2213A at \$1200* and the 60 MHz dual time base 2215A at \$1450*. And at 100 MHz, the dual time base 2235 at \$1650* and the 2236 with an integrated counter/timer/multimeter at \$2650*.

The industry's first three-year warranty† is testimony to 2200 Series dependability. Adding value to value are a variety of optional service plans that can economically extend this coverage to five years.

Consider what you're paying

now in downtime, in service, in back-up scopes. On the bottom line, a Tek 2200 Series scope will save you money, time and trouble now and in the years to come.

Contact your Tek Sales Engineer for a demo today. Or call 1-800-426-2200, Ext. 201.

In Oregon, call collect: (503) 627-9000, Ext. 201.



Tektronix
COMMITTED TO EXCELLENCE

Circle (7) on Reply Card

see what he's saying —

Phone system offers video and audio communications

The first compact color video phone system, considered by many to be the key to widespread use of videoconferencing in business, government and eventually home applications, has been introduced. At \$20,000 for a terminal, it's a little steep for home use just yet, but electronic products, from computers to VCRs, have a history of coming down in cost to where they are affordable.

The new motion color system, called the PVS (Personal Videoconferencing Station), by Widcom, Campbell, CA, consists of four components: a desktop console with speaker, color camera and two color monitors, a copy stand for color graphics and a versatile keyboard/drawing pad that controls the system.

According to Robert D. Widergren, president of Widcom, "The system will permit videoconferencing to originate from individual offices for the first time, placing the technology where it belongs. During the next few years, we intend to make video telephoning as routine as the traditional voice phone call."

The PVS is engineered to work in a local area network with each PVS in a building connected by coaxial cable. It can co-reside on broadband cable with various data networks.

When used with Widcom's VTC-56 coder/decoder, users may telephone across the country or around the world using one of several common carriers with video transmitted and received at 56 kilobits over digital phone lines or satellite links.

"In addition to its unusually low operating costs, 56 kilobit service



The newly introduced Personal Videoconferencing Station (PVS) designed for business and government applications offers the following features: dual memory still-store system; 6-color electronics blackboard; alphanumeric character generator; copy stand and variable audio system.

does not lock the user into singular point-to-point communication. It's the only service that's as easy to use as regular telephone service and which permits the user to call a variety of sources," Widergren said.

The combination of the compact office phone and the Widcom VTC-56 codec, with its dramatically reduced transmission costs, will open major new opportunities in the field of telecommunications. **ES&T**

Electricity and water don't mix. At least not in our Heavy Duty Digital Multimeters. Because these Oops Proof™ instruments are protected by a system of seals to ensure contamination-free dependability in even the cruddiest conditions.

Other abuse-proof features include the best mechanical protection ever built into a precision Digital Multimeter. In fact, every one of our Oops Proof multimeters will survive a drop from ten feet onto a concrete surface!

All the Heavy Duty series meters measure up to 1000 volts AC and 1500 volts DC, with full overload protection to those maximum voltages even on the lowest range settings. Overload circuitry also provides transient protection to 6KV on all voltage ranges and up to 600 volts on all resistance ranges.

We also invented a unique, long-life rotary switch for our Digital Multimeters. You can actually feel the difference just by

rotating the function selector knob.

You'll find these features in a full line of Heavy Duty DMMs that offer a 4½ digit readout, 0.05% VDC accuracy, a 10-amp current range, a 2000-hour battery life, diode test, true RMS and temperature measurement. All this and a no-questions, one-year warranty.

You'll want to try one out, of course, so drop into your nearest electronics distributor and drop one.

Our lips are sealed.



© 1981 Beckman Industrial Corporation, A Subsidiary of Emerson Electric Company,
630 Puente Street, Brea, CA 92621 (714) 773-8111

Beckman Industrial!™

Circle (8) on Reply Card

www.americanradiohistory.com

Understanding the audio compact-disc player



The compact digital audio disc player is designed to convert information permanently recorded on a 4¼-inch disc into an analog signal that can be amplified by an audio amplifier and played through speakers to reproduce sounds; ordinarily music. While this disc is being played, it is turned in a circular motion by a motor, while a pickup senses the information recorded on it. In these characteristics, the CD (compact disc) player, resembles a standard turntable.

That is where the similarity ends.

The CD player is an incredibly complex, sophisticated digital in-

strument. A glance at Figure 1, the block diagram, gives some idea of the circuitry that comes packed into one of these units. For starters, at the very heart of the CD player are two microprocessors: one for controlling the sensors, the other for decoding control. This complexity is a little frightening at first, but familiarization with the circuitry helps clear up what's going on.

The turntable/pickup system

As with a standard turntable, one of the key components in a CD player is the motor that turns the disc. On a standard turntable, the disc turns at a steady 33½ rpm (or

perhaps 45 or 78 rpm) and the stylus rides the groove from the outside to the center. The variation in tangential velocity, resulting from the decreasing radius between the spindle in the center and the stylus, is compensated for by varying the modulation rate of the audio signal recorded on the disc in the opposite direction. Take a look at the difference in the appearance between the inner and outer grooves of a typical recording.

In the CD player, because the music signal is digitally encoded in pits and flats, as described in the related article, the rate at which the data stream is sensed by the

pickup must remain as close to constant as possible. This means the speed of rotation of the disc must be varied throughout the playing of the record in order to keep the data rate constant.

Another complicating factor in the CD is the pickup system. There is no groove to lead the stylus. There is no stylus as such. The pickup is, instead, a laser/photodiode arrangement. In order to move the laser *stylus* across the disc as it turns, a complete stylus position sensing/drive system must be introduced.

This article, based on the NAP Consumer Electronics Corporation's *Technical Training Manual for the Compact Audio Disc Player*, will give a description of this turntable pickup system. Future articles will cover other portions of the CD design and operation.

Turntable motor amp

Figure 2 shows the turntable motor amp circuitry. The rate the data streams from the disc enters the Error Correction IC is totally independent on the rotational speed of the turntable and the location of the pickup unit. The speed the track is moving with respect to the pickup unit must be kept as

constant as possible. If the disc were rotated at constant speed, the data rate near the center of the disc would be lower than that of a track near the outside edge of the disc because the diameter of the outer tracks is much larger, and so the outer tracks can contain much more information in one revolution of the disc.

In the error correction (ERCO) IC, the rate information enters is compared to the output of a voltage controlled oscillator (VCO). If the rate of data coming into the comparator is too high or too low, an error signal is created and applied to the turntable amplifier. This error signal is called *MCES* for motor control error signal and is applied to connector 325 on the servo PC board shown in Figure 2.

The *MCES* has a 50 percent duty cycle that *jitters*. The rate of jitter determines the amount of drive current supplied to the turntable motor. At initial start-up of the motor, the focus control *O* line is switched *off* (low) by the servo microprocessor and is applied to pin 3 of IC6209; this allows the turntable motor to run, starting the rate the data stream is received by the ERCO IC. *FCO* is also applied to pin 6 of IC6205, insuring the *MCES* signal does not

prematurely start the turntable motor by keeping the *MCES* signal line turned *off* with the output of IC6205 pin 1.

Radial servo

Information about the position of the radial tracking arm is obtained from the amount of light falling on the photodiodes, which converts the light deviations to electrical deviations. The photodiodes are arranged in pairs and the outputs are summed to create two error signals. Radial Error 1 is the sum of the currents of diodes 3 and 4 ($i_3 + i_4$) with Radial Error 2 being the sum of diodes 1 and 2 ($i_1 + i_2$). The radial error signal is derived by subtracting the sum of one pair from the other pair $RE \times (i_3 + i_4) - (i_1 + i_2)$.

The error sum signals are applied to the radial error amp, Figure 3, at connectors 273 and 274 and are amplified by IC6214A and B. The amplified error signals are applied to pin 1 and 7 of the multiplexer IC6216, which is used to combine additional factors to the system and maintain stability over the radial tracking servo loop. The outputs from IC6216 are applied from pins 12 and 13 to IC6214C pins 9 and 10. The radial error signal on pin 8 of IC6214C

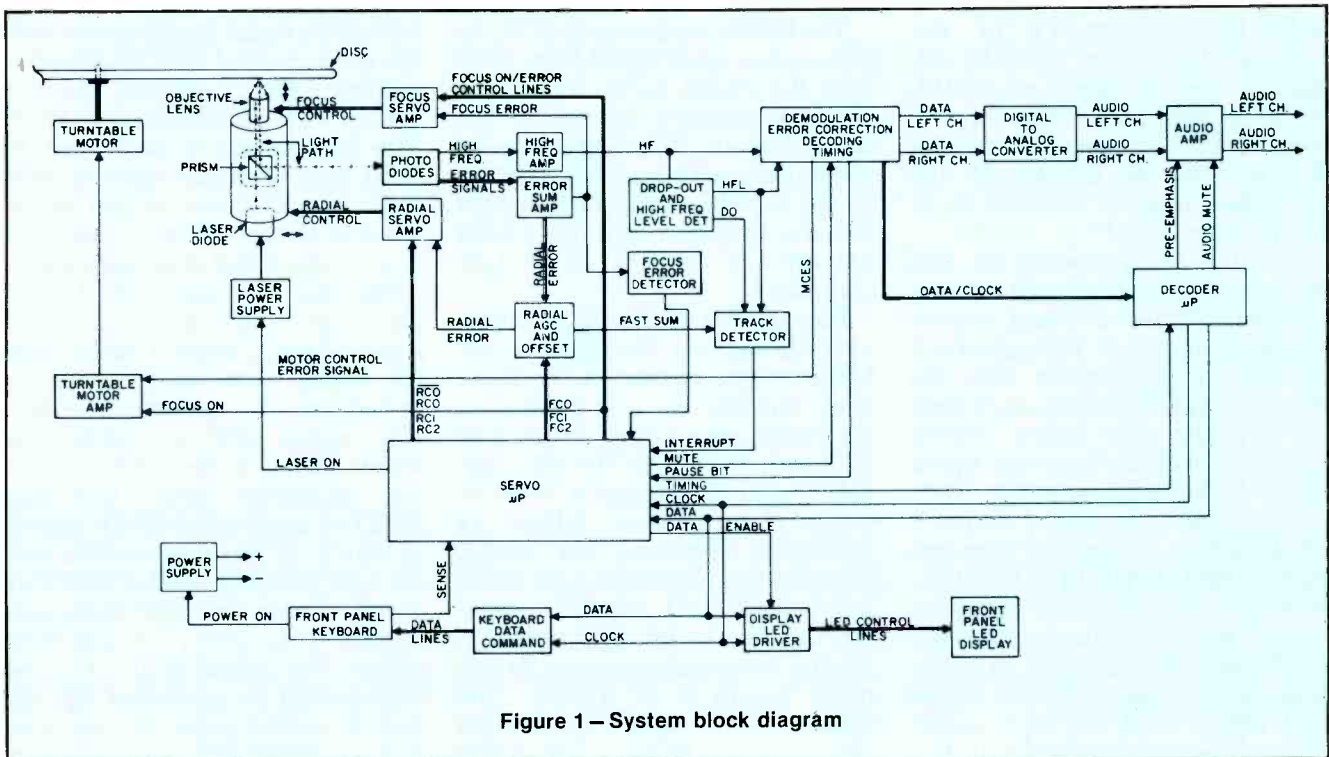


Figure 1 - System block diagram

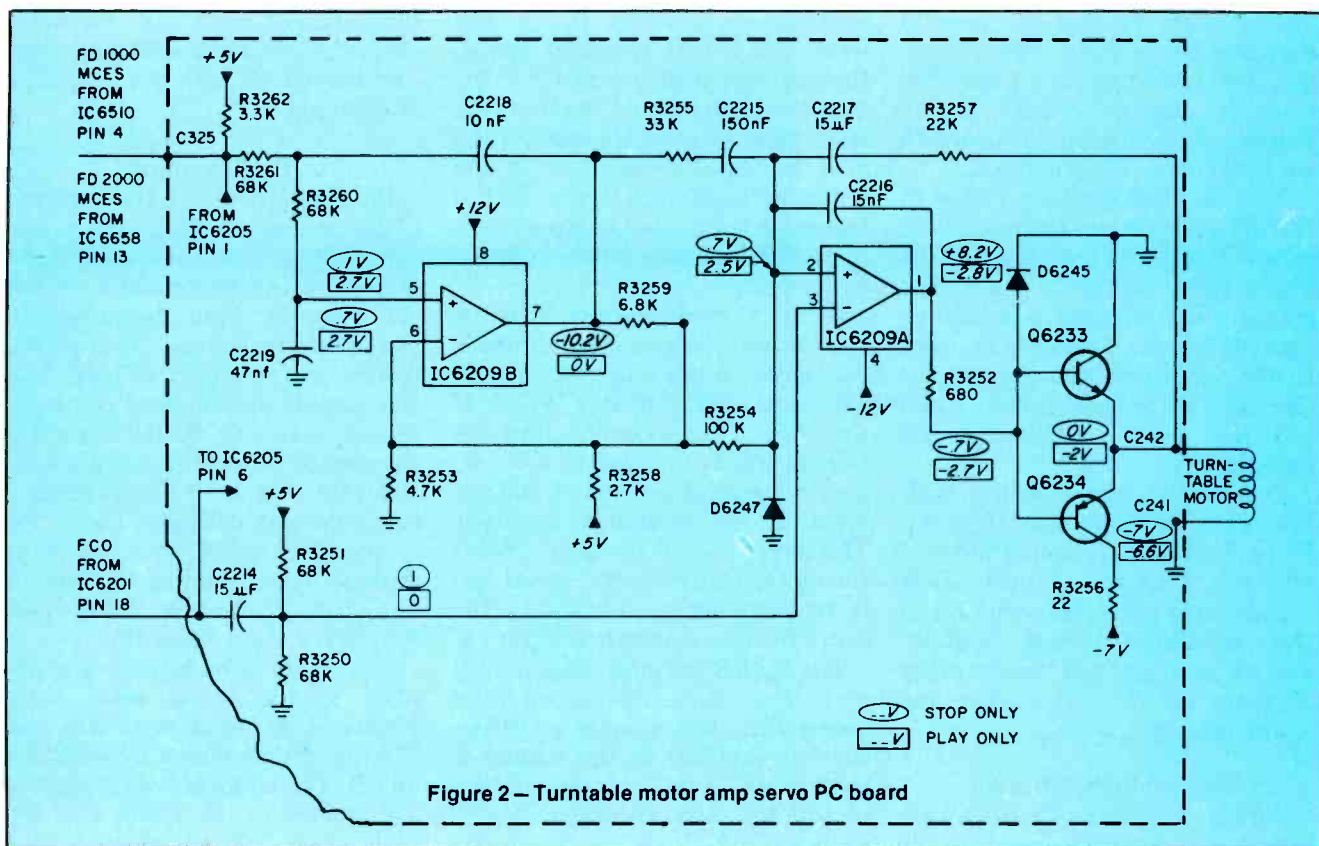


Figure 2—Turntable motor amp servo PC board

splits into four different paths (RE, RE1, RE2 and IC6212A pin 13) but it is still the radial error signal (RE). The different paths are marked for ease of following through the system.

The offset control, R3315, offsets the asymmetry of the reflected light beam (spot) by offsetting the dc gain of IC216. IC215 is used as a switch to provide dc control over the gain of IC216. This dc control of the multiplier stage is referred to as the *d* factor.

IC6217A pin 3 receives the sum of the radial error signals on connectors 273 and 274 and creates the fast sum signal. This signal will be used in conjunction with the drop-out and high frequency level to provide the servo microprocessor with an interrupt signal (INT) during track jumping.

The radial error signal on pin 8 of IC6214C is applied through R3351 (RE1) to pin 13 of IC6214C, Figure 4. The amplified signal on output pin 14 is coupled through C2259 and R3376 to pin 15 of the loop switch IC6211. Diodes D6256 and D6257 limit the high excursions of the radial error signal. The

output of the loop switch is applied to the radial drive IC6218, which provides the drive current to the radial tracking coil. Transistors Q6240 and Q6241 provides stability and increase the dynamic range of the Drive IC.

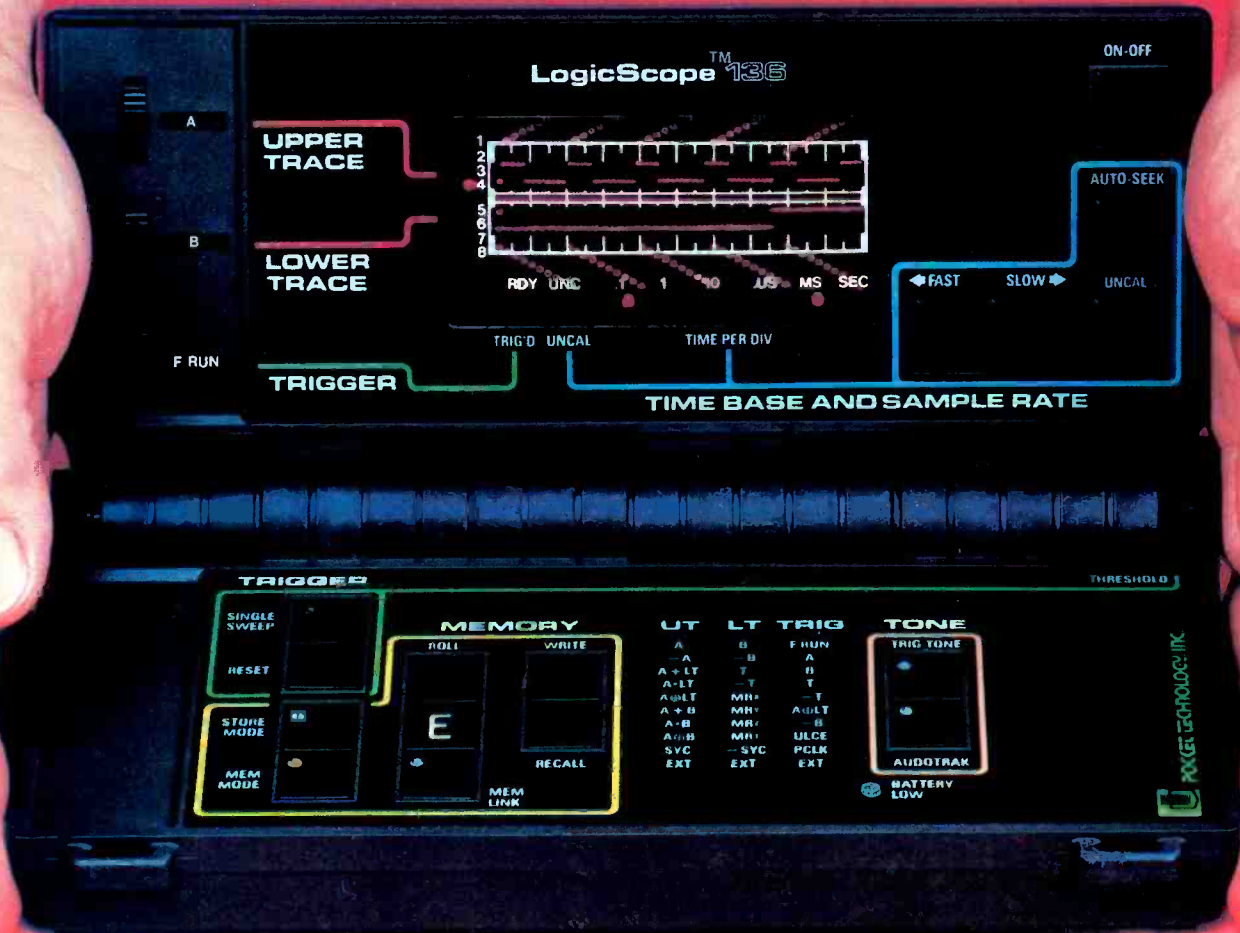
The 650Hz oscillator, IC6212, injects a sine wave signal from pin 8 into the radial servo loop. This signal is present throughout the servo system. This signal causes the radial tracking arm to oscillate at the 650Hz rate, which swings the arm back and forth for a total amount of travel of $0.1\mu\text{m}$ (± 0.05).

Because the 650Hz signal is present throughout the system and because the system is a closed loop, the sine wave is present in the radial error signal on pin 8 of IC6214C, Figure 3. The RE2 signal is applied through a low frequency bandpass filter to IC6215D; therefore, the 650Hz signal is only allowed to pass to the input of IC6215D. IC6215D in conjunction with D6252 creates a square wave signal, which is applied to pin 9 of IC6211. The square wave signal opens and closes the loop switch at the 650Hz

rate. The input to pin 10 of the loop switch is developed by the servo microprocessor to open the loop switch when radial tracking is lost or track jumping is required by the system. This allows the servo microprocessor to take over control of the radial tracking arm with the radial control 1 (RC1) and radial control 2 (RC2) opening the loop switch with radial control 0 (RC0). The loop switch is held open by RC0 during initial start-up with RC1 and RC2 controlling movement of the arm from its rest position to the initial start position.

The fast sum signal (FS) from pin 1 of IC6217A contains the sums of radial error 1 and 2 plus the 650Hz sine wave signal injected into the system. The fast sum signal (FS) is applied to R3391, which is the input to an active bandpass filter network. IC6215A applies the 650Hz signal to pin 3 of the loop switch and through R3393 to pin 9 of IC6215B which inverts the sine wave and applies it to pin 5 of the loop switch. The output on pin 4 of the loop switch is controlled by the switch control pulse on pin 9 of IC6211, which switches the output

Here's The Savvy-est True Dual Trace 10 MHz Digital Storage Scope You Ever Saw ... At The Saving-est Price. Only \$595.



The Handy New LogicScope™ 136

True Dual Trace • 10 MHz Real Time Bandwidth • 3 Input Channels • I/O Port
Digital Waveform Storage • Boolean Waveform Operations • Audio Functions
8.0 (L) x 4.5 (D) x 1.75 (H) Inches • 1.25 Pounds • 9 Volt Battery/AC Operation

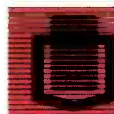
Consider the LogicScope 136

- The LogicScope 136 is the next logical step in test instrumentation for you. It combines many of the features and capabilities of sophisticated logic analyzers and oscilloscopes . . . and it fits in your hand. Never before has so much technology been available in so small an instrument, at such a low price.
- The pocket-sized LogicScope 136 is made possible by a patented breakthrough in display technology. The conventional CRT has been replaced by a unique array of 400 LED's that permits simultaneous display of two digital waveforms.
- The 136 can be used for viewing single shot events, or repetitive waveforms. It can be operated in real time mode, or in memory mode which permits acquisition and storage of up to 50-100 bit waveforms. These can be recalled, logically compared (AND, OR, EXCLUSIVE OR) to other input waveforms, or output to an external device via an I/O port. This I/O port will also accept future add-on 136 Modules.
- Its very low cost, convenience and ease-of-use make the LogicScope the ideal instrument, for designing, troubleshooting or repairing digital systems. Made in U.S.A.

Consider its Engineering & Field Service Applications:

- On microprocessor-based systems, check the timing relationship of various parameters relative to the system clock and other key events. Its storage capability allows visual and logical comparison of non-repetitive waveforms to known reference signals. Output in the start-up of the digital device can be compared to reference signals to determine the operating state of the device. Questionable waveforms can be stored for analysis.
- Its light weight and small size make the LogicScope convenient to take on every service call. The 136 provides much more information for trouble shooting a digital system or peripheral than a logic probe or digital counter without having to lug an oscilloscope or logic analyzer along.

Contact us for the name of your local distributor



POCKET TECHNOLOGY, INC.

7320 Parkway Drive, Hanover, MD 21076 U.S.A.
301-796-3300 TELEX 908207
Division of Renaissance Technology Corp.

Circle (9) on Reply Card

February 1985 *Electronic Servicing & Technology* 13

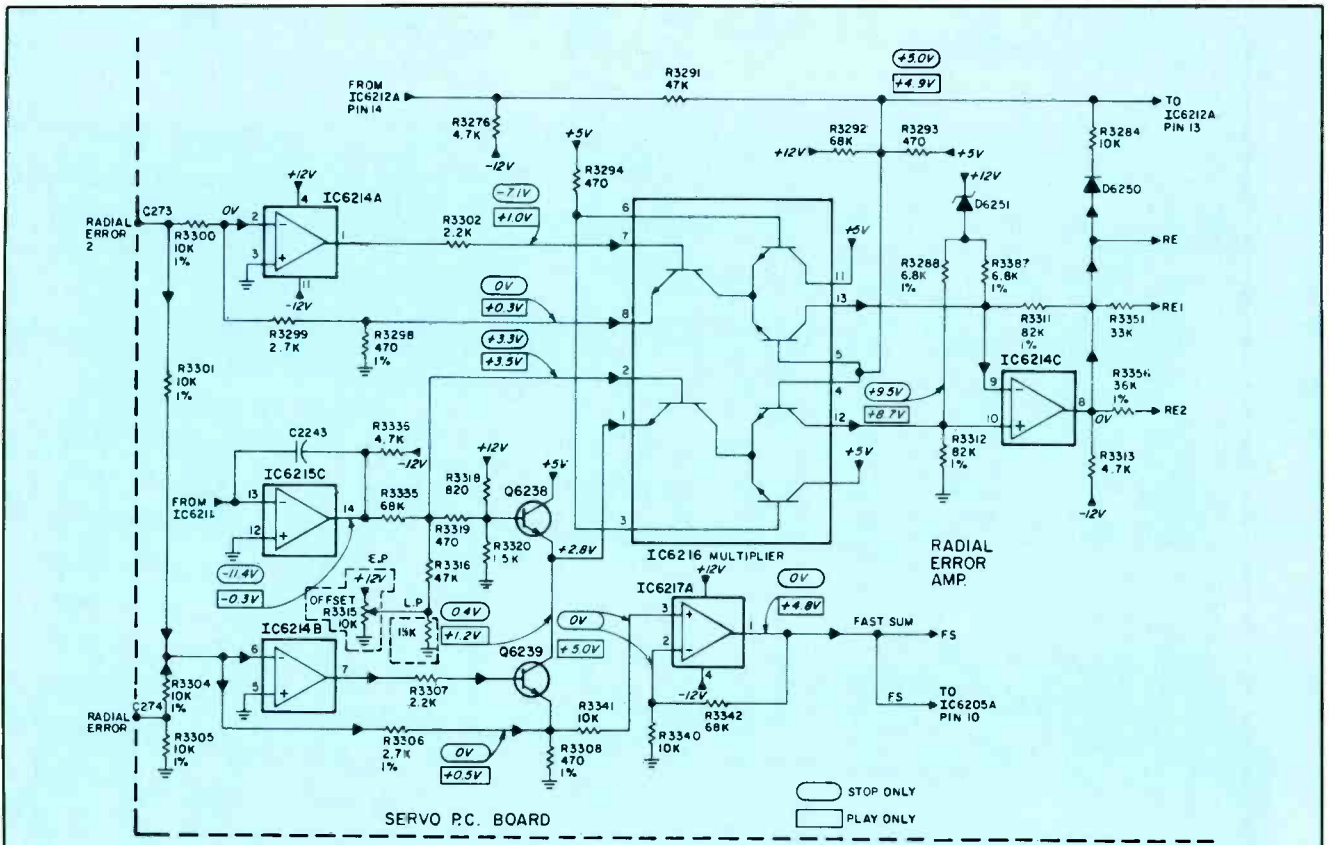


Figure 3 – Radial error amp servo PC board

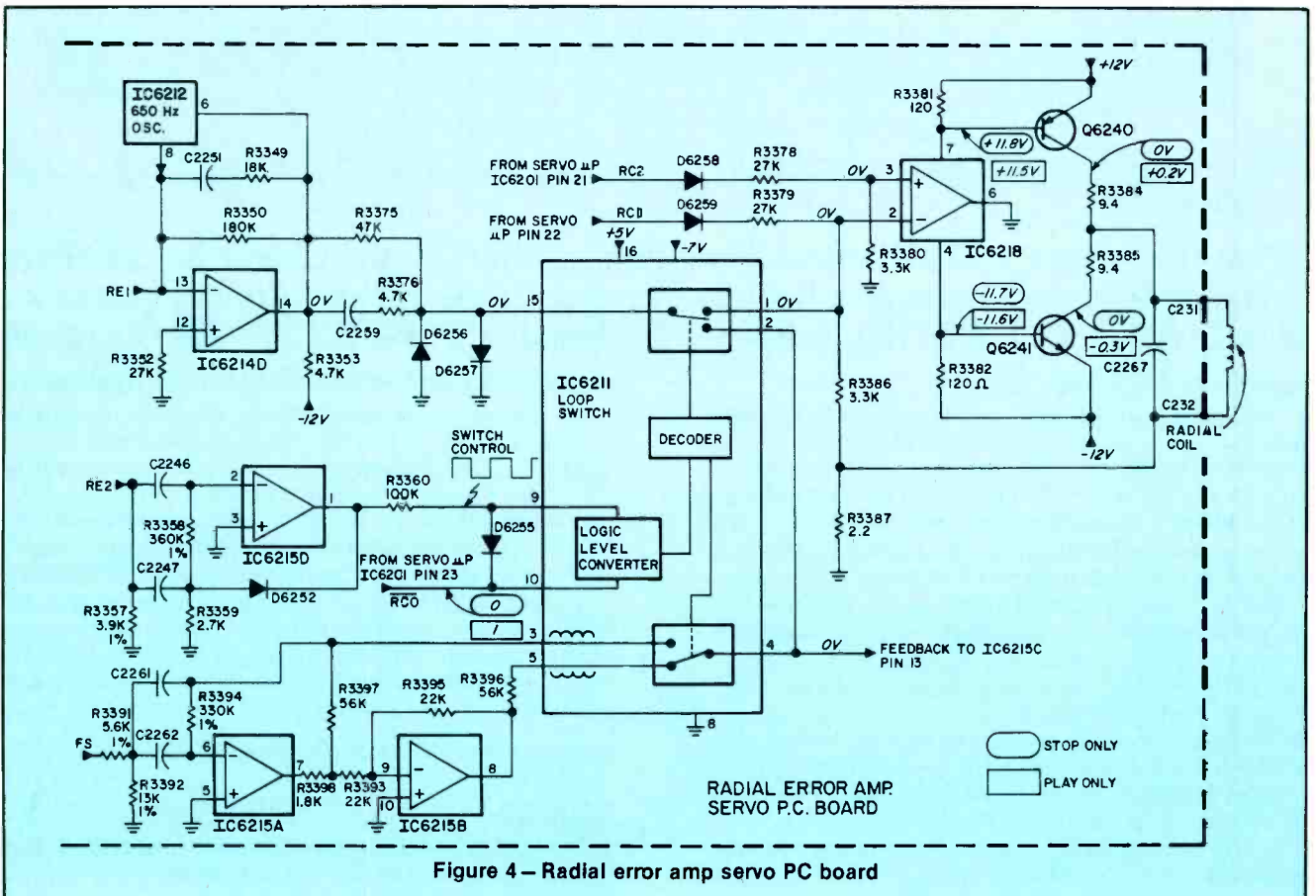
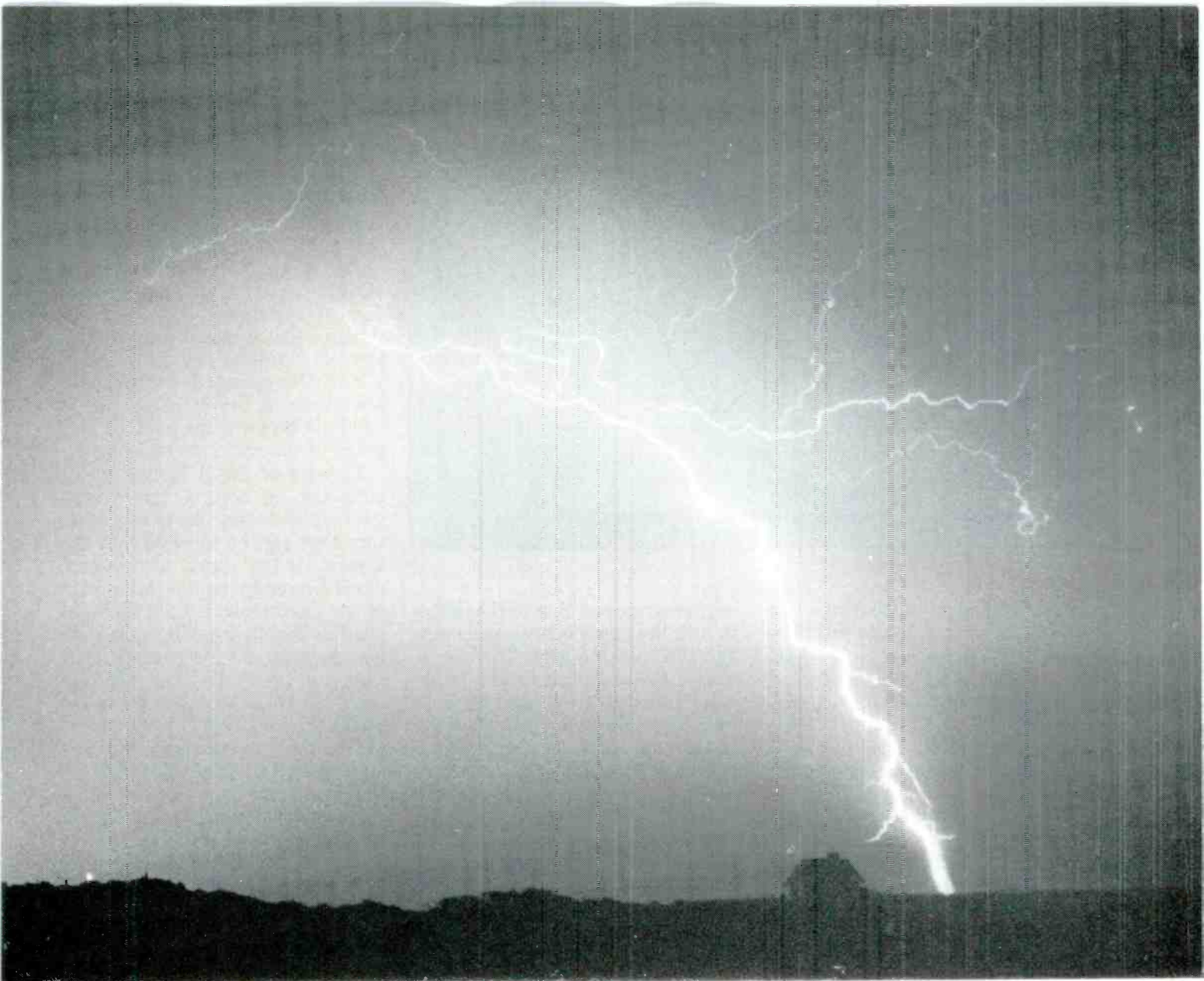


Figure 4 – Radial error amp servo PC board



People don't know the importance of 40% more surge protection until lightning strikes.

Compared to most other surge suppressors, Philips ECG Surge Suppressors handle 40% greater surge current. They tame 53% more surge energy. Each has a positive overload protector that automatically shuts off equipment in the rare event of a massive overload surge. And each clamps spikes to 24% lower voltage. Philips ECG delivers almost twice the protection at a competitive price.

A good thing to have when lightning strikes.

Sell maximum protection. Call Philips ECG today for the name of your nearest distributor: 1-800-225-8326 (in Massachusetts, 617-890-6107).

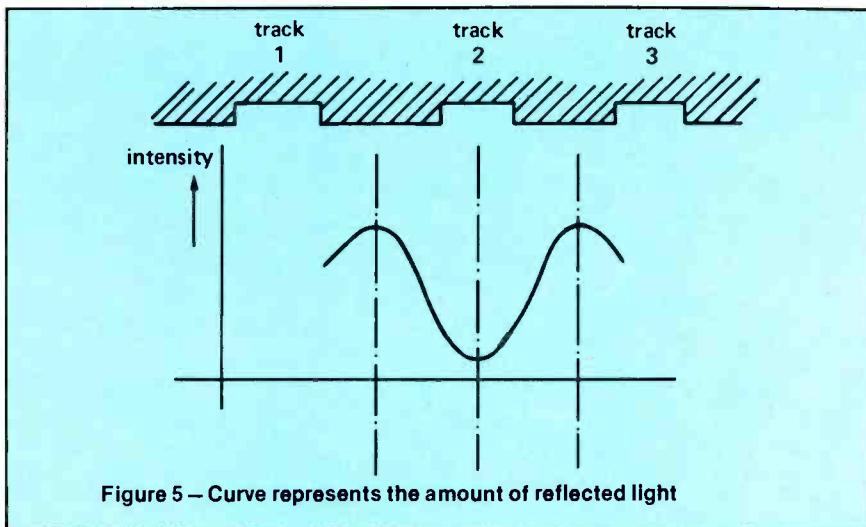
**If it's ECG[®], it fits.
And it works.**

*Philips ECG Surge Suppressors
are available in 2- and 3-prong units.*



Philips ECG

A North American Philips Company



on pin 4 between the two inputs on pins 3 and 5 at a 650Hz rate. The signal developed on pin 4 of the loop switch is the feedback to pin 13 of IC6215C, Figure 3. The output on pin 14 of the IC is the average dc voltage level to control the gain of the stage connected on pin 2 of the multiplier IC6216.

Figure 5 illustrates the curve that represents the amount of reflected light from the disc. The curve shows that maximum light is reflected when the beam is directly between the tracks, and minimum light is reflected when the beam is directly on the center of the track. Then by injecting a 650Hz signal into the radial servo loop, the tracking arm starts to oscillate at that rate.

Figure 6 shows the effects of the oscillation on the reflected light beam. When the light beam hits the center of the track, it results in a positive signal as a result of the injected 650Hz signal. If a shift occurs in the beam to the right of the track, the resulting reflected beam will be in phase with the injected signal, and during a shift to the left of the track, it will result in a reflected beam that is in phase opposition (out of phase) with the injected signal. Then by detecting the reflected signal synchronously, a dc control signal is developed and is referred to as the *d Factor*. The *d Factor*, in conjunction with the radial error signal, controls the gain of one section of the radial servo loop.

The *d Factor* corrects for an

asymmetric spot, due to the deviation in the angle between the disc and the tracking arm. This deviation in the angle causes the radial error signals ($i1 + i2$) and ($i3 + i4$) to become unequal, even when the beam is on center of the track.

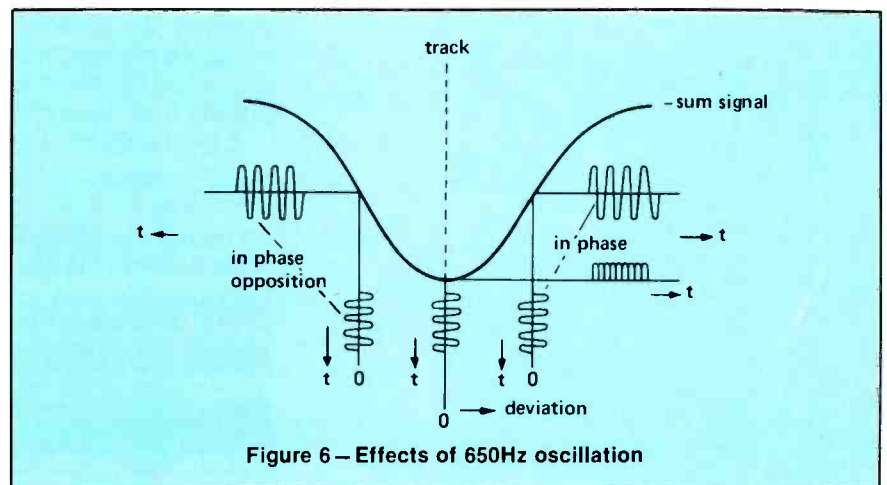
Figure 7A shows the resulting waveforms and dc level created from the 650Hz signal when the light beam is directly on the center of the track. The switch-controlled square wave signal applied to pin 9 of IC6211 switches the input signals on pins 3 and 5 of IC6211 at a 650Hz rate. The input on pin 3 is the opposite of the input on pin 5. The output on pin 4 of IC6211 is a sine wave swinging above and below the zero reference. This signal is applied to pin 13 of IC6215C, which results in an average dc level of zero on the output of IC6215C pin 14.

Figure 7B shows the results of the signal when the light beam is to the left of the center of the track. The input signals on pins 3 and 5 are out of phase and appear on pin 4 resulting in the output of IC6215C pin 14 to go negative. Figure 7C shows that only the positive half cycles are applied to pin 4 resulting in pin 14 of IC6215C to go positive. Therefore, the phase of the 650Hz signal is used to control the gain of this stage of the radial servo loop.

The use of the *d Factor* is not sufficient to control the overall gain of the system due to other factors that can be induced into the system. If the output of the laser diode decreases or the reflectivity of the disc is low, it then becomes possible for the tracking system to become unstable; to prevent this, the gain must be controlled to react to this deviation from the nominal level. This is provided by the *k Factor* to adjust the systems gain when the signals deviate from the normal levels.

The 650Hz signal is once again used by the radial tracking system. The phase of the 650Hz signal is strongly influenced by the gain of the system. If the gain increases or decreases, then the phase shift between the original and the returning signal will also increase or decrease. Then both signals can be compared and the resulting signal can be used to control the gain of the second stage of multiplier IC.

Figure 8 shows the 650Hz oscillator and the dc control generator for the *k Factor*. The



TAKE HOLD OF THE FUTURE



Leave it to A.W. Sperry Instruments Inc. to transport electrical testing equipment into a new era of engineering!

Introducing two new additions to the innovative AWS Digisnap™ Series. The DSA-7600 Digital Snap-Around Ammeter and DSA-7610 Digital Snap-Around Volt-Ammeter with audible continuity buzzer. Incredibly low priced. Sleak, spaceline design. Compact and lightweight. The DSA-7600 and 7610 are the smallest and lightest digital snap-arounds on the market today.

And though each are only 7" X 1 3/4" X 1 1/4", weigh only 8 ounces and carry a price tag starting at \$79.95, you'll find features many larger, more expensive units would envy. Autoranging and an instantaneous continuity buzzer are finely engineered into the DSA-7610 while both models feature an easy-to-read 3 1/2 digit LCD, electronic data-hold, low battery indicator, electronic circuit protection and positive action On/Off switch. Either way, you can count on reliable, accurate readings time after time because

Circle (12) on Reply Card

both are designed to industry respected AWS standards. So move-up to the future today with the new AWS Digisnap DSA-7600 or DSA-7610.

Precise electrical testing for the eighties, and beyond.

Ranges

DSA-7600: 0-200 Amps AC (1 range)
\$79.95

DSA-7610: 0-200/300 Amps AC (2 ranges, autoranging)
\$89.95 0-200/500 Volts AC (2 ranges, autoranging)
Continuity Buzzer

For more information, see your local distributor today or contact A.W. Sperry Instruments, Inc., 245 Marcus Boulevard, Hauppauge, NY 11788 or call Toll Free 800-645-5398 (New York, Hawaii, Alaska call collect 516-231-7050).

A.W. SPERRY INSTRUMENTS INC.
The Measurable Advantage.

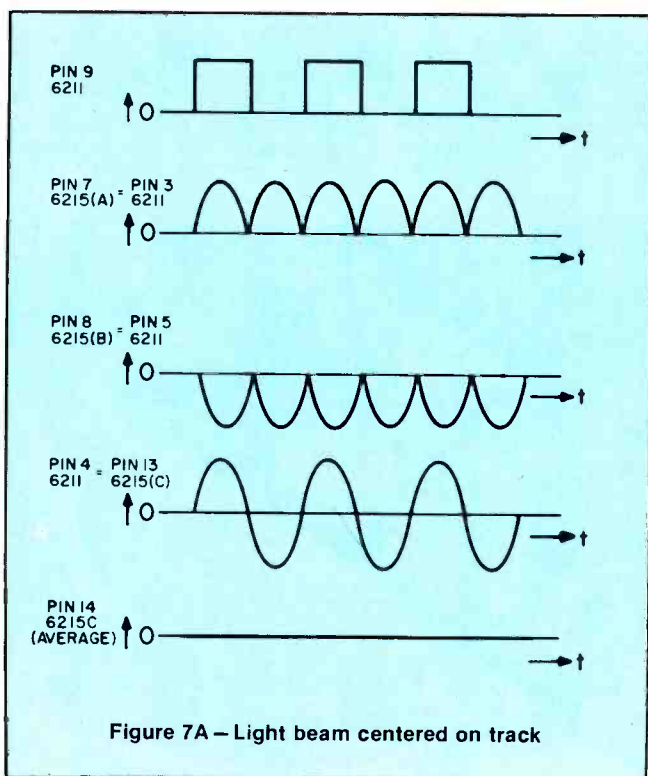


Figure 7A – Light beam centered on track

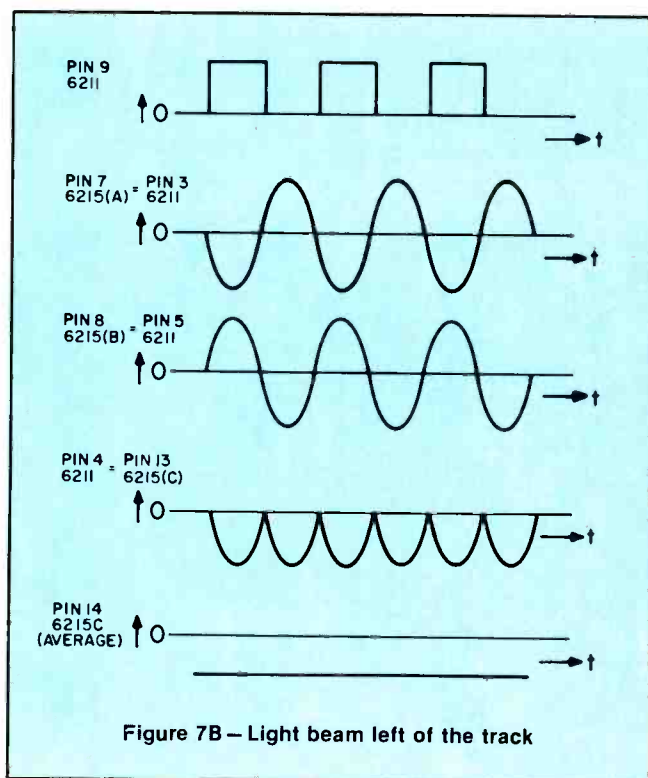


Figure 7B – Light beam left of the track

oscillator, IC6212B, injects the signal into the radial servo loop through R3328 and C2244, a 45-degree phase shifter, to pin 13 of IC6214D, Figure 4. The signal is also extracted from the loop at pin 14 of IC6214 and applied to R3370, Figure 8, which is the input to the bandpass filter of IC6212D and associated circuitry. The 650Hz signal is extracted from the system and applied to pin 6 of the square wave converter IC6213B. The output on pin 4 is applied to a phase detector, IC6213C. The oscillator output on pin 8 of IC6212B is applied to a reference IC, IC6213D pin 8 which converts the oscillator output to a square wave that is in phase with the generated 650Hz sine wave. The output of the reference IC, pin 10, is applied to the phase detector IC pin 1, where the phase of the generated signal is compared to the phase of the extracted 650Hz signal. If the gain increases or decreases, the phase of the returning signal increases or decreases. The two signals, compared by the phase detector, develop a difference signal on the output pin 3, which is applied to pin 12 of the switch IC6213A.

The Radial Control O (RCO) is applied to pin 13 of IC6213A and is

used to control the output of IC6213A. If the player is correctly tracking, then RCO is positive and RCO is zero, thus allowing the difference signal to appear on pin 13 of IC6212A. If the reflected light is less than nominal, then the phase shift of the 650Hz signal from the servo loop decreases relative to the oscillator signal.

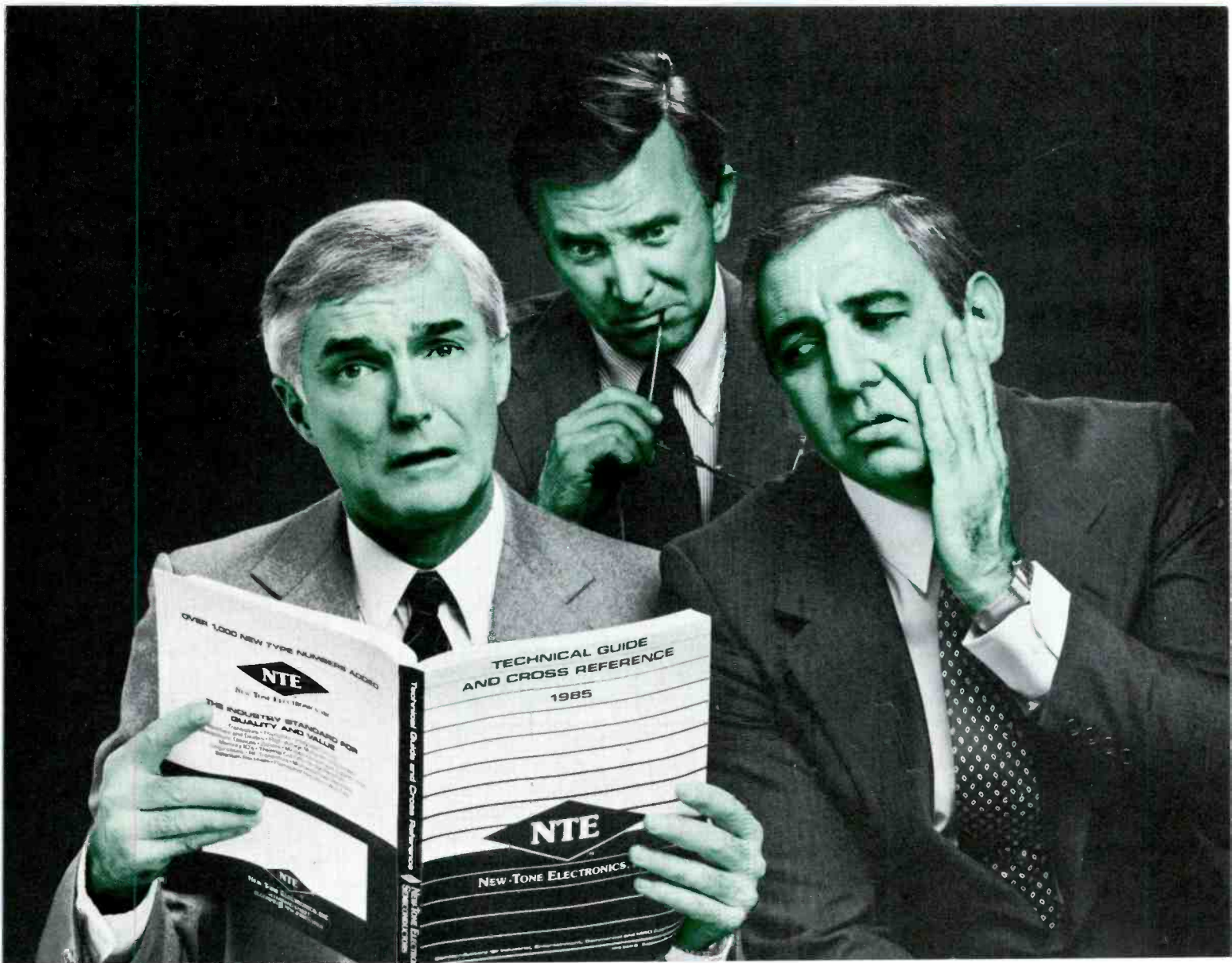
As a result, the duty cycle of the phase detector decreases. The input on pin 13 of IC6212A, an integrator, becomes less positive causing the output voltage on pin 14 to go more positive. The output on pin 14 of IC6212A is feedback to pins 4 and 5 of the multiplier IC6212, which results in transistors connected to the two pins to conduct harder and the amplification factor returns to its nominal level.

When the radial tracking has been switched off by the servo microprocessor, the incoming information from the phase detector is also switched off. Diode 6250 and R3284 pass the radial error (RE) signal from pin 8 of IC6214C to the integrator IC6212A. If the radial error signal becomes greater than nominal, then the input on pin 13 of the integrator becomes more positive, therefore decreasing the output level on pin 14 and IC6216

will conduct less. Consequently, the radial error signal decreases to its nominal value. This creates the conditions necessary for AGC, which keeps the gain and system bandwidth constant by the use of the 650Hz signal.

Figure 9 shows the left and right motion detector circuit. The radial error (RE) signal from IC6214C pin 8, Figure 3, is applied to pin 13 of the servo microprocessor. The microprocessor measures the time between two consecutive positive going signals, which is approximately 0.5ms. If the speed of the arm's motion across the tracks is constant, the time between the two consecutive pulses will also be constant. If the speed is too slow, the time between the positive going edges of the square wave will be longer than nominal. If the speed is too high, the time will then be shorter than nominal.

When track jumping is being performed, the servo microprocessor takes over the control of the radial tracking arm. The microprocessor monitors the input on pin 13 to determine the rate of the track jumping. If it is too fast or too slow, the microprocessor applies a positive voltage to either RC1 or RC2 until the width of the input signal on pin 13 returns to



WE'RE TURNING THE COMPETITION GREEN WITH ENVY.

NTE is the red hot success story of the electronics industry and the big boys are green with envy. They don't like the fact that we've built our reputation on giving you more of what you're looking for in a replacement part. More quality. More reliability. And, more parts to choose from. That's why more and more technicians across the country are picking the package with the green NTE diamond on the front.

NTE parts are extensively tested on state-of-the-art equipment during every phase of production to ensure top performance — performance that's backed by the industry's only two year warranty.

What's more, NTE uses a special computer controlled inventory system, so when you replace or design with NTE, you can be sure that the part you need is on your distributor's shelf. Our new 1985 Technical Guide and Cross Reference manual, which has over 3,100 NTE types cross-referenced to over 220,000 industry part numbers, is now available.

Why settle for our competitor's parts when you get more quality and service with NTE? Look for NTE's replacement parts in the bright green polybags and cartons at your distributor today.

Don't forget to ask about our new Flameproof Resistors and Wire Ties, too!

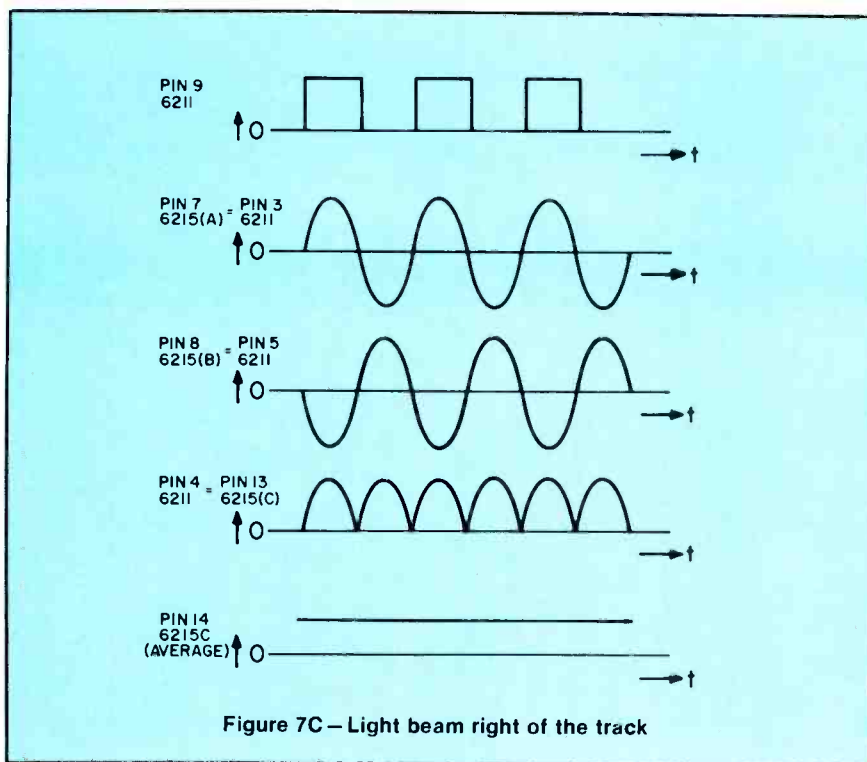


NEW-TONE ELECTRONICS, INC.

44 FARRAND STREET, BLOOMFIELD, NEW JERSEY 07003

Circle (13) on Reply Card

February 1985 *Electronic Servicing & Technology* 19

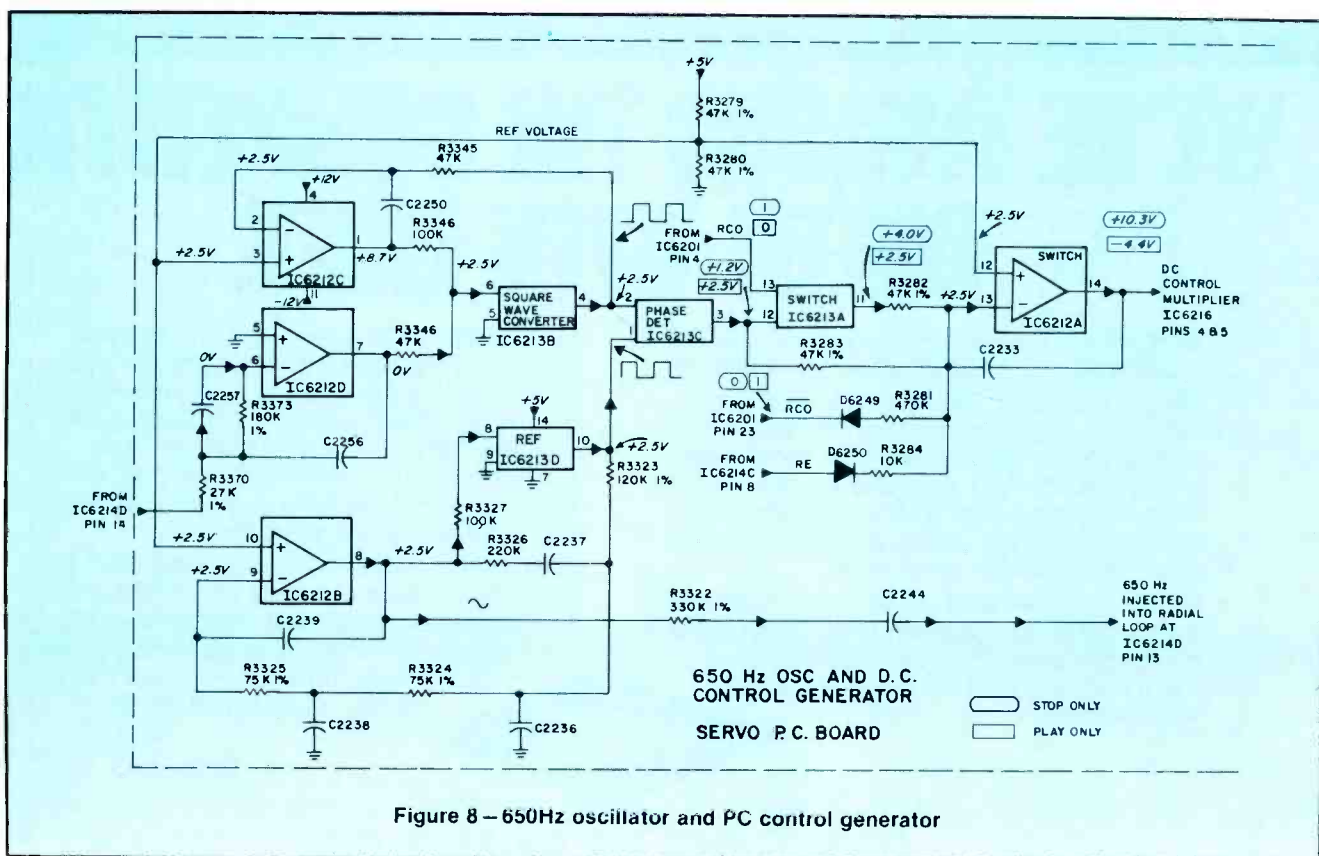


or RC1 on to correctly brake the movement of the tracking arm. If the shock comes from the top and side at the same time, then loss of focus and radial error is possible if the shock is too drastic. The loss of these two signals will cause the servo microprocessor to shut the system down and return to the normal start position.

The focus control O (FCO) output on pin 18 of the servo microprocessor is used to hold the motor control error signal (MCES) line at 0V before start-up, thus preventing the turntable motor from rotating until the servo microprocessor receives the *play* command from the front panel. The high frequency (HF) signal from the HF amplifier is applied to connector 531 on the decoder PC board, Figure 10. The HF signal is coupled through C2516 to the differential amplifier, consisting of Q6530, Q6531 and their associated circuitry. The two outputs are coupled through C2520 and C2521, inverted relative to each other, and applied to two fullwave rectifiers consisting of diodes D6550, D6551, D6548 and D6549. Diodes D6544, D6545 and D6546 along

nominal. If the speed is too slow, RC2 will be made positive by the microprocessor, and if the speed is too high, then RC1 is made positive, thus holding the track jumping at a constant rate of speed.

If a shock occurs to either the left or right side of the player, this will also cause the width of the signal on pin 13 to increase or decrease. The microprocessor acts accordingly, either switching RC2



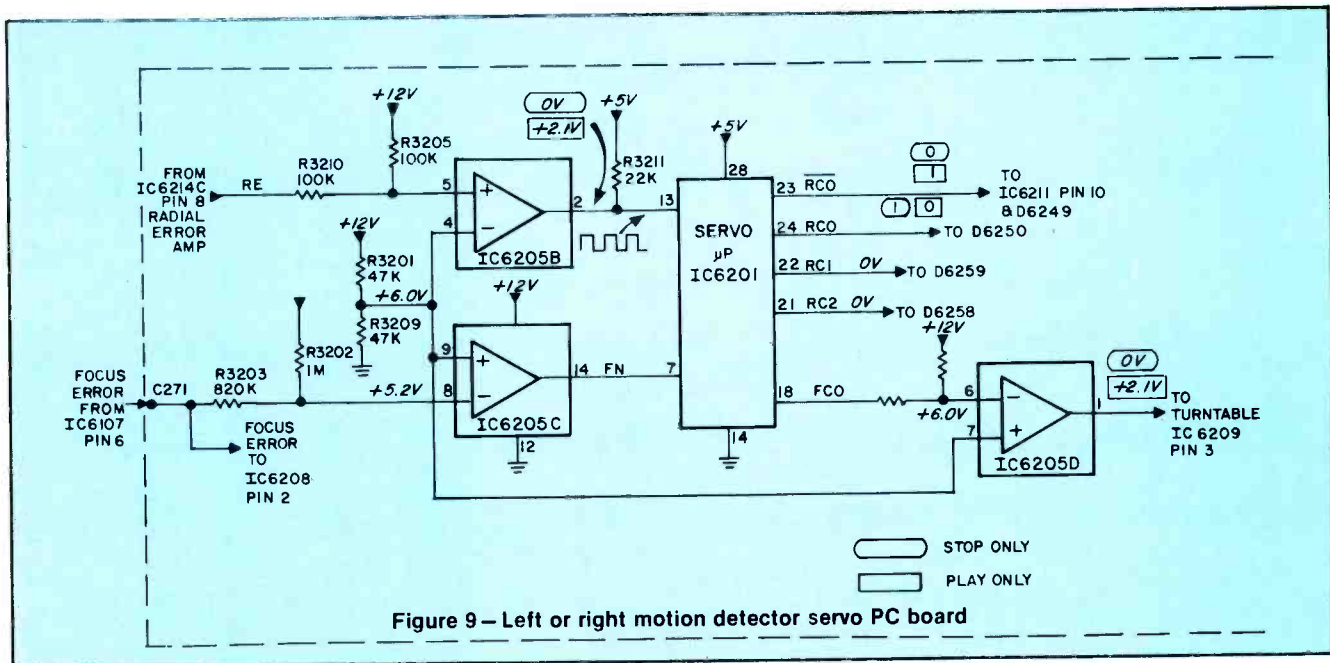


Figure 9 – Left or right motion detector servo PC board

with R3552 form a clamping circuit to clamp the output level of the differential amplifiers.

The output from the fullwave rectifier D6550 and D6551 is applied through R3536 to pin 2 of IC6508A, the HF Level Detector, and through R3537 to pin 6 of IC6508B, the drop-out detector. The output of the second, fullwave rectifier diodes D6548 and D6549 is applied to pins 3 and 5. The input on pins 3 and 5 will not vary as much as the input on pins 2 and 6, due to the smoothing capacitors C2525 and C2527. These two capacitors have different values and are discharged through different resistor values.

If the level of the HF signal is nominal (1 Vp-p) and no drop-outs are in the signal, then pin 3 will be positive relative to pin 2, and the output on pin 1 will be positive. The voltage on pin 3 is also applied to pin 5 and is more positive than the voltage on pin 6, therefore causing pin 7 of the output to become positive also.

If the signal level drops to approximately 65 percent of its nominal value, then pin 3 will go negative, causing the output on pin 1 to go to 0V, therefore indicating a loss of HF signal. The voltage now on pin 5 goes negative, but the voltage on pin 6 is more negative than the voltage on pin 5, which causes no change in the output on pin 7.

When a drop-out (DO) in the HF signal occurs, the level will drop to 10 percent of its nominal value. Then, the voltage on pin 5 will become more negative than the voltage on pin 6 and the output on pin 7 will become 0V, indicating a drop-out has occurred in the HF signal. The output voltages on pins 1 and 7 of IC6508 are prevented from changing very quickly by Q6533. The high frequency level HFL and DO levels can change very rapidly when the light beam encounters fingerprints on the disc, which causes the levels to switch back and forth very quickly. This can cause the system to become unstable due to fast variations in the two levels.

The drop-out and high frequency level is applied to connectors 321 and 322 of the track detector on the servo PC board, Figure 11. When the radial tracking arm moves quickly across the disc, the radial error (RE) which controls the arm, must be switched *off* by the servo microprocessor. Control of the radial servo system is obtained by using the DO and HFL signals in conjunction with the fast sum (FS) signal from the radial servo system.

When there is no DO in the HF signal, then DO equals zero and goes positive and the HFL is positive when the HF signal is nominal (1Vp-p). The two levels are the reverse of each other when

DO and HFL does occur. The FS signal from the radial servo system appears on the collector of Q6242, which acts as a switch and is operated by the HFL applied to IC6217B. Q6242 conducts when the level of HFL is correct. When the transistor conducts, the FS signal appears on pin 11 of IC6205A.

The output signal on pin 13 will become positive if the slow sum (SS) on pin 11 is more positive than the signal on pin 10, and pin 13 will be 0V if pin 11 is more negative than pin 10. When a loss of HF signal occurs, pins 3 and 5 of IC6207B will then become zero and pin 4 the drop-out input stays at zero. Then pin 6, which is tied to pins 1, 2 and 8 of IC6207A, will go to zero causing the output on pin 9 to go to zero.

The interrupt (INT) signal to the servo microprocessor pin 12 is active when its level is zero. When pin 12 of the servo microprocessor is low, it takes over the control of the radial tracking arm by activating the four outputs to the radio servo system. These outputs are used to move the arm from inside to outside and back to the inside during track jumping and to hold the arm in its last known position due to a large loss of information. This can be caused by dirt, fingerprints, and scratches blocking the passage of the light beam to a portion of the track of pits on

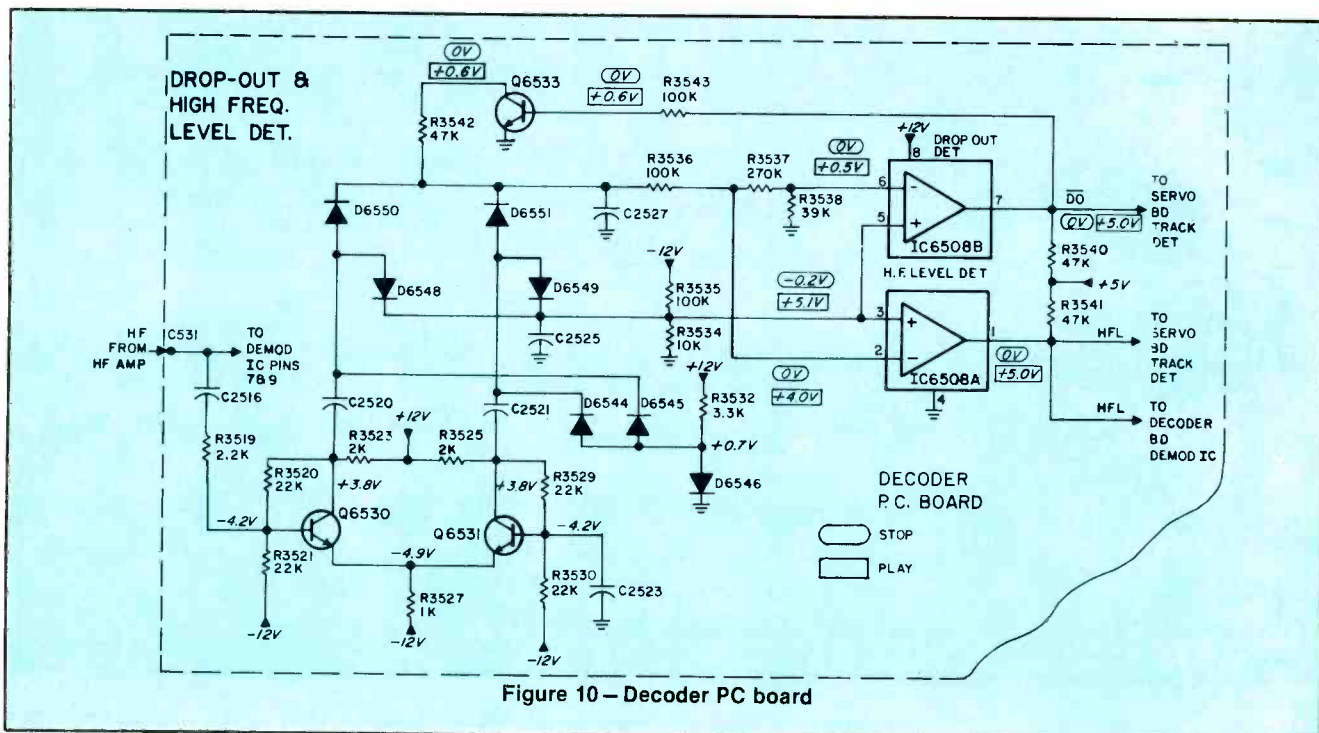


Figure 10 – Decoder PC board

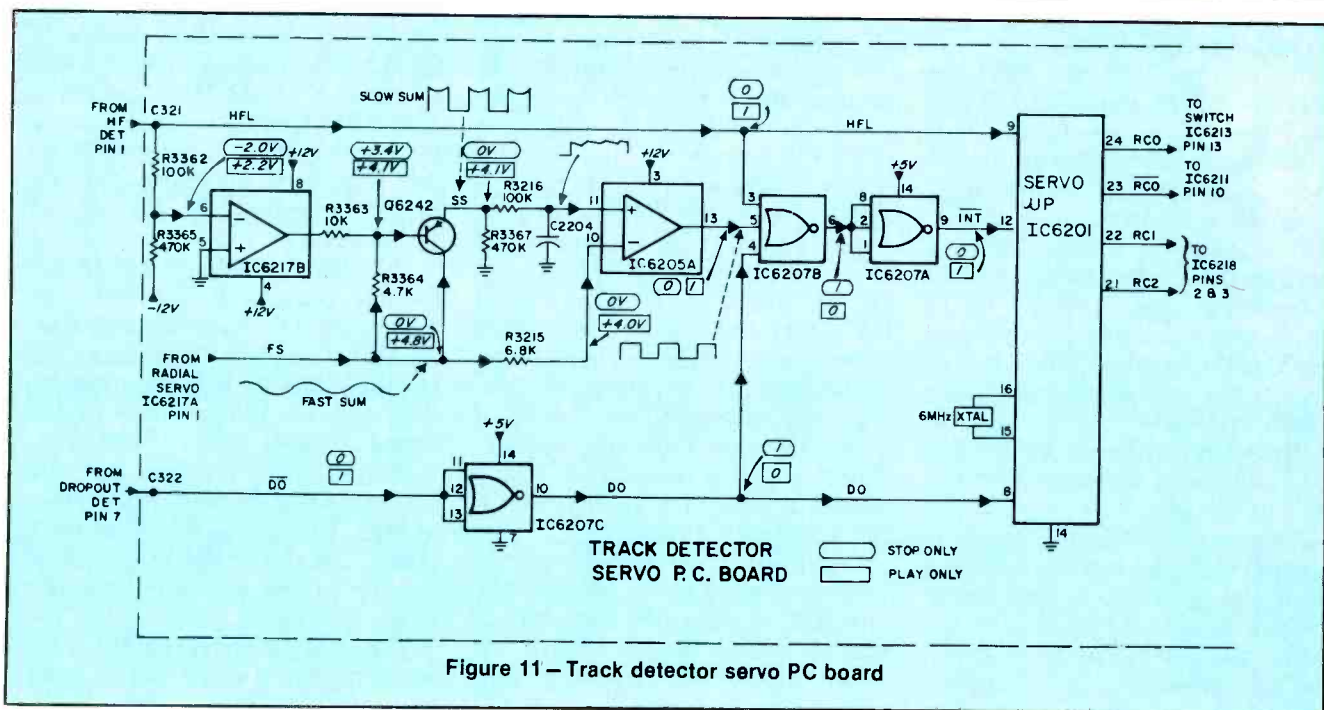


Figure 11 – Track detector servo PC board

the disc. This prevents the system from becoming unstable and start to skip or jump tracks each time the loss occurs.

The age of digital control is here

This discussion should make clear that the application of digital technology to music playback has made what was once relatively straightforward and simple to comprehend, extremely complex.

That's what happens every time digital technology is applied to anything.

But digital technology is applied to systems in spite of the massive increase in complexity because the benefits of digital technology are great. Table 1 compares the performance of a standard disc player with that of a compact disc. In every way, the digital system beats the analog system. Also, the

introduction of microcomputer control makes it possible to program the player to play the disc as chosen by the operator. It's possible to skip sections or to repeat selections or to perform other operations not available on standard analog turntables.

This article is a first step by **ES&T** to describe the technology of digital disc players. Other articles will follow.

ELECTRONICS Book Club

The Best Source for Hobbyists and Professionals
for Over 19 Years!

Time- and Money-Saving Advice . . .
Practical Troubleshooting & Repair Tips . . .
State-of-the-art Technology . . . Hundreds
of Projects . . . Plus, Exceptional Savings

Take Any 4 Books for Only \$2⁹⁵



Join Now, Get a Utility Apron FREE!



1492
List \$14.95



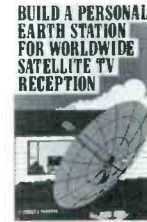
1553
List \$15.95



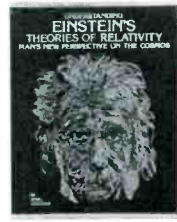
1277
List \$21.95



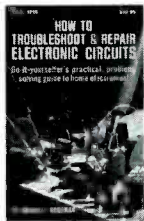
1673
List \$13.95



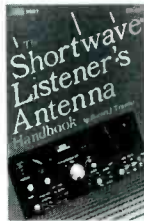
1409
List \$15.95



1505
List \$11.50 (paper)



1218
List \$18.95



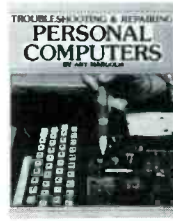
1487
List \$15.95



1211
List \$9.95 (paper)



1199
List \$19.95



1539
List \$21.95



1498
List \$10.25 (paper)



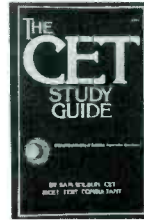
1108
List \$16.95



1465
List \$16.95



1537
List \$16.95



1791
List \$16.95



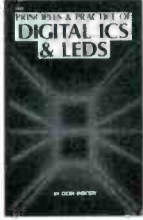
1543
List \$19.95



1529
List \$14.50 (paper)



1820
List \$16.95



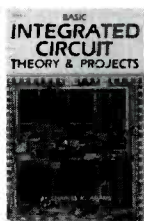
1577
List \$19.95



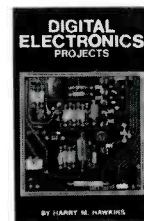
1183
List \$16.95



1542
List \$21.95



1699
List \$19.95



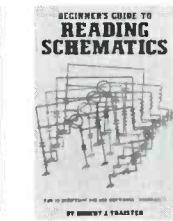
1431
List \$17.95



1474
List \$16.95



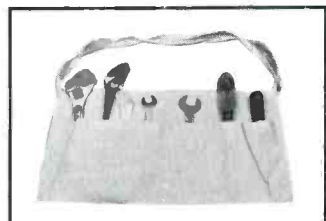
800
List \$19.50 (paper)



1536
List \$14.95



1719
List \$18.95



FREE Utility Apron

7 very good reasons to join the Electronics Book Club

- **Big Savings.** Save 20% to 75% on books sure to increase your electronics know-how
- **No-Risk Guarantee.** All books returnable within 10 days without obligation
- **Club News Bulletins.** All about current selections—mains, alternates, extras—plus bonus offers. Comes 13 times a year with hundreds of up-to-the-minute titles to pick from
- **Automatic Order.** Do nothing and the Main selection will be shipped automatically! But . . . if you want an Alternate selection—or no books at all—we'll follow the instructions you give on the reply form provided with every News Bulletin
- **Bonus Books.** Immediately get a Dividend Certificate with every book purchased and qualify for big discounts of 60% to 80%
- **Extra Bonuses.** Take advantage of added-value promotions, plus special discounts
- **Exceptional Quality.** All books are first-rate publisher's editions selected by our Editorial Board and filled with useful up-to-the-minute information

ELECTRONICS Book Club

P.O. Box 10
Blue Ridge Summit, PA 17214

Please accept my membership in the Electronics Book Club and send the 4 volumes circled below, plus my FREE utility apron billing me \$2.95 plus shipping and handling charges. If not satisfied, I may return the books within ten days without obligation and have my membership canceled. I agree to purchase 4 or more books at reduced Club prices (plus shipping/handling) during the next 12 months, and may resign any time thereafter.

800 1108 1183 1199 1211 1218 1277 1409 1431
1465 1474 1487 1492 1498 1505 1529 1536 1537 1539
1542 1543 1553 1577 1673 1699 1719 1791 1820

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

Valid for new members only. Foreign applicants will receive special ordering instructions. Canada must remit in U.S. currency. This order subject to acceptance by the Electronics Book Club.

EST-285

Circle (14) on Reply Card

Here's how music is encoded on a compact digital audio disc

The digital information contained on the compact audio disc record is retrieved from the record by the means of a laser beam, which generates an infrared light beam that detects the track of pits and flats on the disc. The beam is generated by a semiconductor diode mounted in a light pen assembly shown in Figure S1. Figure S2 shows the laser unit separated from the upper section. The upper section contains the photodiodes and collimator lens. The laser unit contains the laser diode and a single photodiode and the prism.

The laser generates two light beams as shown in Figure S2. The main beam emerges from one end of the laser diode and is used to retrieve the information on the disc. The secondary beam emerges from the other end and is used to control the intensity of the light beam being emitted by the laser.

An important factor for good operation of the player is that the amount of light landing on the disc is held constant as possible. The intensity is, however, dependent on the current fed through the laser and on the temperature of the diode. Therefore, the intensity of the light beam can be kept constant by controlling the current supplied to the laser diode. There is a fixed relationship between the intensity of the

main beam and the secondary beam. The light of the secondary beam is used as a measurement of the main beam, and is accomplished by installing a photodiode directly below the laser diode as shown in Figure S3.

This photodiode is called the monitor diode and the signal from this diode is applied to the laser power supply and controls the amount of current supplied to the laser diode. If the intensity of the light beam is too low, the signal from the monitor diode is too small and the current is increased, and conversely if the signal is too high.

The light leaving the laser diode passes through a semi-reflective prism, which allows the light coming from the laser to pass through. The reflected light returned from the disc is deflected onto the photodiodes. The prism is a wedge shaped optical glass that splits the return beam into two beams as shown in Figure S4. The photodiodes convert the reflected light into electrical signal. A total of four diodes have been mounted slightly apart in groups of two. The prism splits the beam and one-half lands on one pair of diodes and the other half on the second pair.

The purpose of the collimator lens is to converge the light beam into a parallel beam; that is, light

tends to spread out in all directions as the distance from the source increases. The lens converges the light beam into a parallel path to fill the aperture of the objective lens.

The objective lens is mounted on the radial tracking arm. Figure S5 shows a cut-away drawing of the optical device used to track the up and down movement of the disc. The objective lens is mounted on a ring of magnetic material and connected to the housing by two leaf springs, which are used to provide tension and keep the barrel of the objective lens straight in its cylinder throughout its range of travel. The housing contains a coil which produces a magnetic field when an electrical current is applied, and exerts a magnetic force on the magnetic material that the objective lens is mounted on. This force moves the lens up or down, depending on the polarity and magnitude of the coil current.

Figure S6 shows a drawing of the optical pick up unit and the location of each of the optical devices and the path of the light beam from the laser to the disc and return to the photodiodes. The objective lens focuses the light beam onto the disc and the reflected beam is returned to the semi-reflective prism, where the beam is split. The two beams from the prism fall on the two pairs

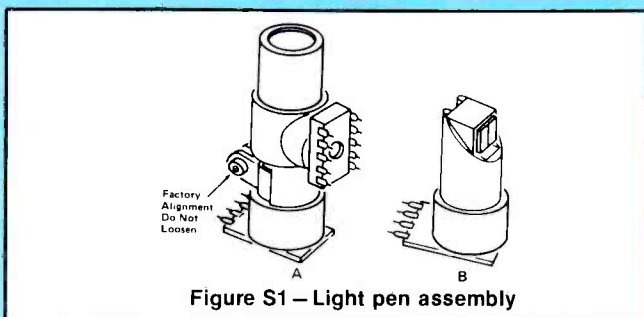


Figure S1 - Light pen assembly

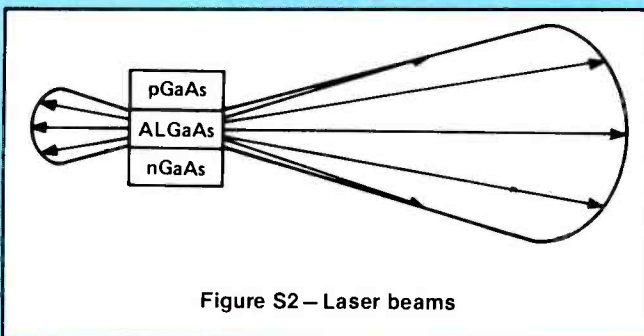


Figure S2 - Laser beams

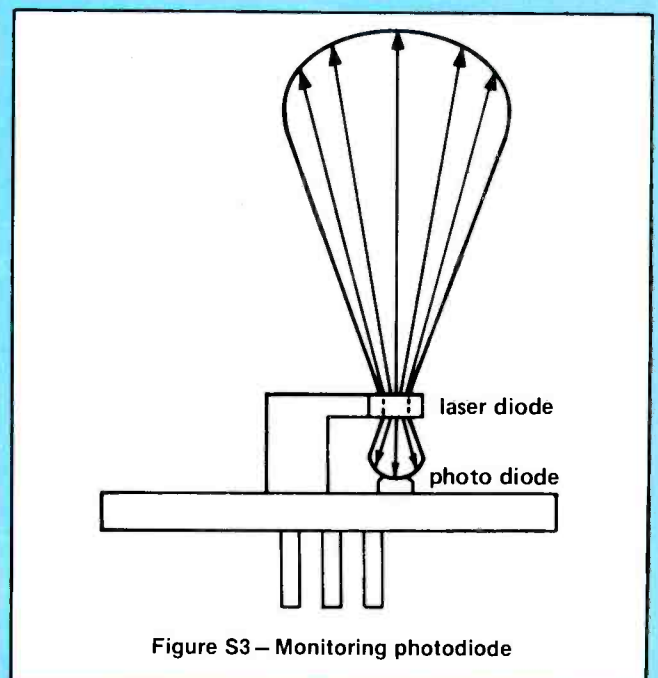


Figure S3 - Monitoring photodiode

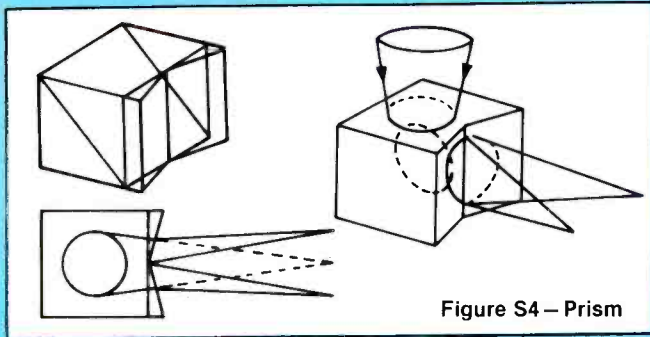


Figure S4 - Prism

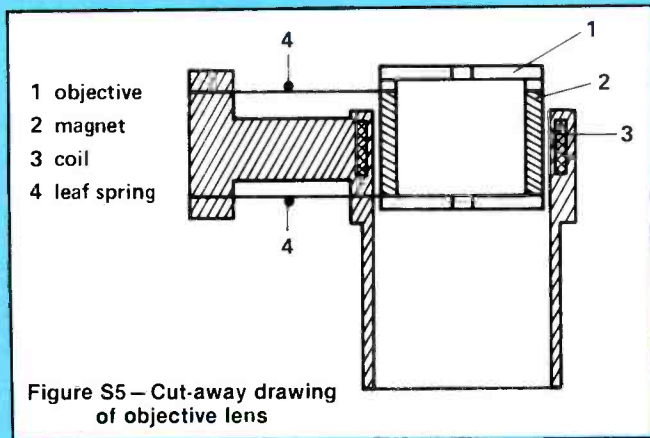


Figure S5 - Cut-away drawing of objective lens

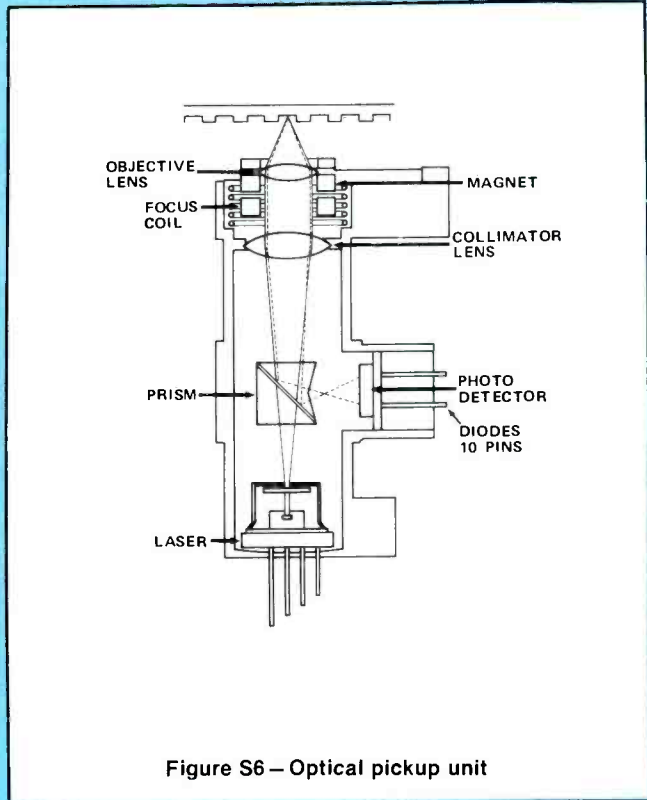


Figure S6 - Optical pickup unit

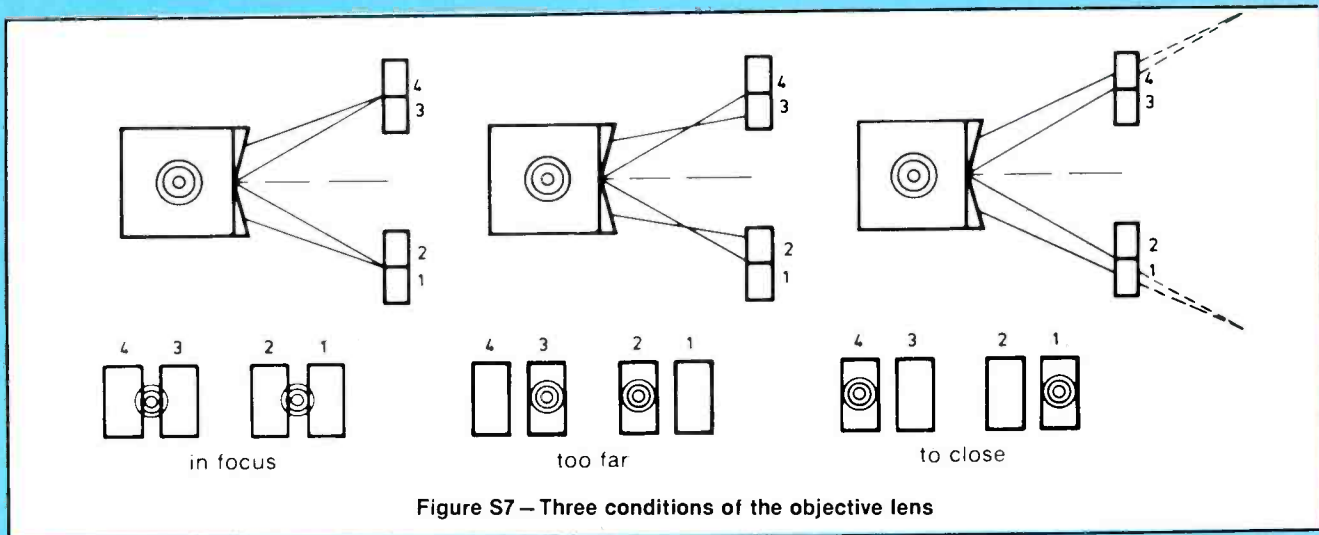


Figure S7 - Three conditions of the objective lens

of diodes, which are used to create error signals to control the movement of the objective lens and maintain correct focus.

Figure S7 shows the light beam deflected by the prism in three conditions. The first condition is when the objective lens is focused perfectly on the disc. Both beams are landing directly on the center of the two pairs of diodes. The second condition is when the objective lens is too far from the disc and the two beams are landing on the inside diode of each pair. The third condition is when the objective lens is too close to the disc and the two beams are

landing on the outside diode of each pair. In the focused condition, a zero error exists from the photodiodes and the objective lens remains at its nominal position.

In the too far condition, an error signal is created to return the objective lens to its nominal position by applying the error signal to the focus servo control circuitry. In the too close condition, the opposite error signal is created and applied to the focus servo control circuitry to move the objective back to its nominal position and zero error is once again obtained.

Figure S7A shows an illustration

of the physical layout and dimensions of the photodiodes. The four photodiodes are located on a single chip and the large area around the four photodiodes is used as a guard diode. The function of the fifth diode (guard diode) is to conduct any current created by stray light landing on the diode to ground. The stray light landing on the fifth diode causes electron-hole pairs in the silicon chip which would be recombined before they reached the four photodiodes. To avoid interference or damage to the photodiodes the electron-hole pairs are discharged to ground by the guard diode. □

The music on a CD is read out using a laser beam

This is how it's done...

Compact disc record

Figure D1 shows a magnified view of a disc, composed of thousands of circular tracks made in a continuous spiral from the inside to the outside of the disc. These tracks are analogous to grooves in an ordinary audio record. However, the tracks of a compact disc are not grooves. The tracks consist of microscopic pits: minute indentations in the disc material. The width of the pits is only $0.4\mu\text{m}$, with a depth of $0.1\mu\text{m}$. The distance between the spiral tracks is held constant at $1.6\mu\text{m}$ and is called the track pitch. The combination of the pits and flats (area between the pits) is used to reproduce the digital recorded information.

The pits and flats that represent the digital information are actually 1.1mm below the transparent surface of the disc (see Figure D3). The light beam passes through the transparent base material to retrieve the information. The light reflected by the pits is not as bright as the light reflected by the flat area. The rotation of the disc combined with the pits and flats passing over the light beam create a series of on and off flashes of light being reflected back into the system, thus modulating the light beam.

The length of the pits and flats determines the information contained on the track. Figure D3 shows a track of pits and flats. The pits and flats can vary in length from 1 to $3\mu\text{m}$. The analog waveform below the pits and flats represents the decoded signal after digital to analog conversion. The pits reflect less light than the flat area, and the length of the two vary to recreate the original analog signal.

Digital sound reproduction

Figure D4 shows the conversion from analog-to-digital and from digital-to-analog. The analog waveform in Figure D4A is sampled and measured at short intervals as shown in Figure D4B. In the analog-to-digital converter, the measured values are converted into binary numbers and encoded into a pulse train as shown in Figure D4C. The pulse train is then placed on a

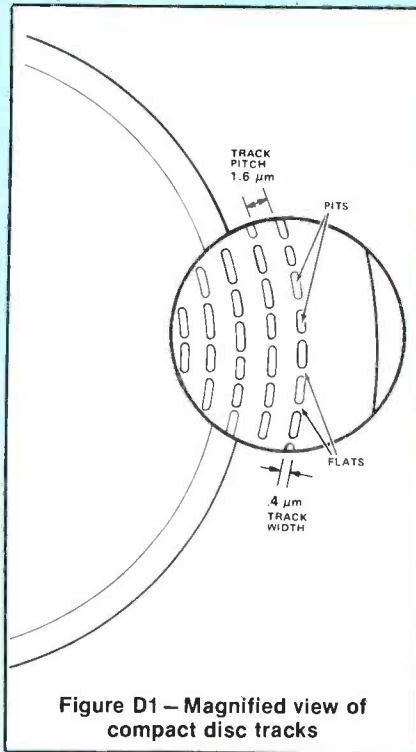


Figure D1 – Magnified view of compact disc tracks

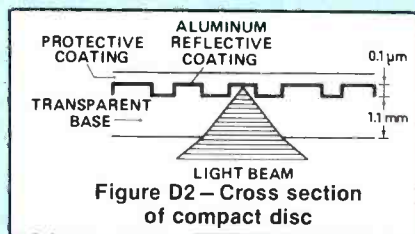


Figure D2 – Cross section of compact disc

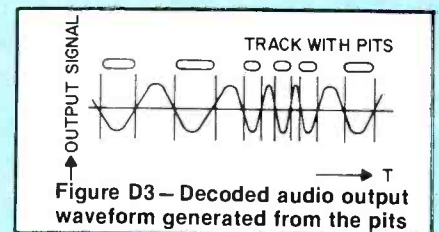


Figure D3 – Decoded audio output waveform generated from the pits

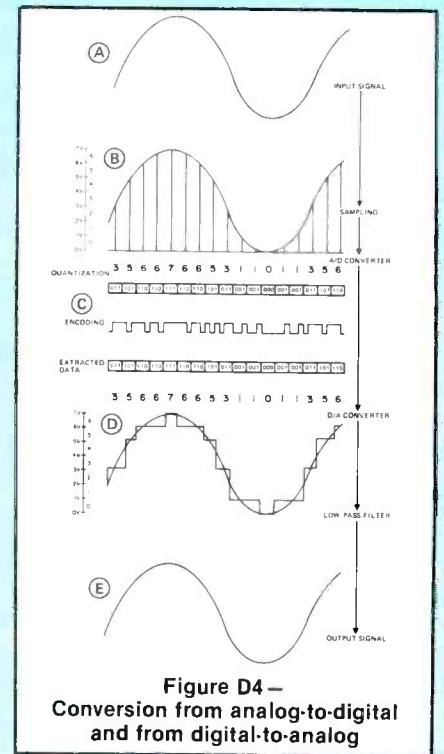


Figure D4 – Conversion from analog-to-digital and from digital-to-analog

transmission system, detected, and converted into its original form by reverse process.

The transmission system, in this case, is the compact disc. The encoded information is contained in the pits and flats of the disc. The infrared beam is modulated by the pits and flats to create the pulse train of digital information. The detected pulse train is applied to the digital-to-analog converter as shown in Figure D4. The detected information is converted back to its original waveform by the digital-to-analog converter as shown in Figure D5. The audio waveform is sampled at a high rate of speed, and the value

of each sample is measured and converted to a binary number. The string of successive binary numbers is the digital equivalent of the audio waveform and as long as the binary numbers maintain their true values, the waveform is expressed with an accuracy that depends only on the sampling speed of the binary number. The advantage of the binary code in this respect is that it has two conditions, 0 and 1, which can be easily represented by electrical circuits being switched on and off. As long as the digital circuits can detect the difference between these two conditions, the string of numbers will be perfectly preserved.

ES&T

When accuracy and portability are a must...



... you need Global Specialties' Model 3000 capacitance meter.

Versatile, easy-to-use, and only \$139.95, this precision test instrument is designed specifically for hand-held battery operation. Its accuracy, combined with uncomplicated control settings, means fast and precise capacitance measurements. In addition to 1 pF resolution, accuracy to 0.2 percent of reading, capacitance measurements from 1 pF to 2000 μ F, and switch selection of capacitance range, the meter's 0.5 inch high, numeric, 3½ digit LCD display has annunciators to indicate low battery and excessive compensation of stray capacitance (- indication).

Applications for the 3000 include sorting capacitors by value, selection of precision values, checking capacitor tolerances, matching sets of capacitors, measuring unmarked capacitors.

If you would like literature and information on where to purchase our Model 3000 capacitance meter call our ...

**Product Availability Line:
1-800-243-6077.**



GLOBAL SPECIALTIES

An Interplex Electronics Company

70 Fulton Terrace

New Haven, CT 06512-1819

(203) 624-3103 TWX: 710-465-1227

Other Offices: San Francisco (415) 648-0611, TWX: 910-372-7992
Europe: Phone Safron-Walden, England 0799-21682, TLX: 817477

Suggested U.S. resale. Prices, specifications subject to change without notice

Circle (15) on Reply Card

www.americanradiohistory.com

Test your electronic knowledge

By Sam Wilson

1. A SAW filter gets its name from:

- A.) the fact that its response curve looks like teeth on a wood saw.
- B.) the first letters of Surface Acoustic Wave.
- C.) The first letters of Severly Attenuated Width.
- D.) the fact that its cutoff is so sharp that it looks like it was sawed off.

2. Capacitor C_1 in Figure 1 is used for tuning an oscillator. Capacitor C_2 is used for making small changes in the range of frequencies set by C_1 . Capacitor C_2 is called a _____.

3. Capacitor C_2 will have the greatest effect on oscillator frequency at the:

- A.) highest frequency.
- B.) lowest frequency.

4. Rodney Lanyard decided to switch from the original manufacturer's circuit to the one he designed. (His version is shown in Figure 2.) However, he can't calculate the size of the fuse that should be used. Assuming the *rating* of the fuse is twice the actual current, what advice would you give to Rodney?

5. The voltage induced in a coil is given by the equation:

$$v = -L di/dt$$

where:

v is the self-induced voltage

L is the coil inductance

di/dt is the rate of change of current through the coil

Maximum induced voltage occurs when the sine wave current in the coil is:

- A.) maximum.
- B.) minimum.

6. It is useful to review the history of electronics to help us get into lockstep with the new technology. The first electronic TV device was developed in:

- A.) Mexico.
- B.) The United States.
- C.) England.
- D.) Russia.

7. The best way to be sure you can read the color code for all different types of capacitors is to have a good wall chart. Which of the following is *not* given in the color code of the disc ceramic capacitor shown in Figure 3?

- A.) capacity
- B.) tolerance
- C.) voltage rating
- D.) temperature coefficient

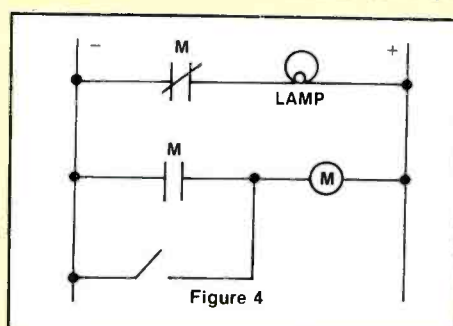
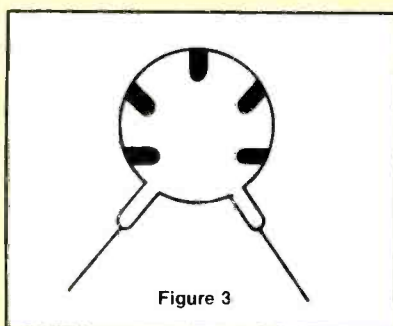
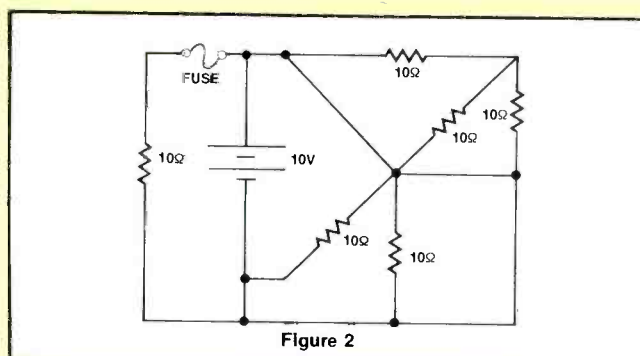
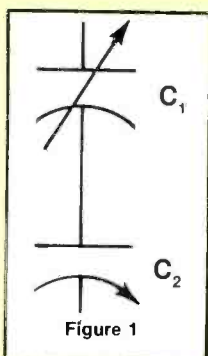
8. Some color TV receivers can be adjusted by a signal from the transmitter called:

- A.) VITS
- B.) VIRS
- C.) SCA

9. Can you read relay ladder diagrams? For the one in Figure 4:

- A.) the lamp will turn *on* when SW is closed, and, it will go *off* when SW is opened.
- B.) the lamp will turn *off* when SW closed, and, it will turn *on* when SW is opened again.
- C.) the lamp will turn *off* when SW is closed, and, it will stay *off* when SW is opened again.
- D.) none of these choices is correct.

10. You have a typical full-wave rectifier circuit that has an output voltage of +15V. Can you change that to a power supply with an output of -15V by simply reversing the diodes?



Answers on page 37

Continued from page 28

Answers to quiz

1. B. The name comes from the fact that waves travel through the filter on the surface of a piezoelectric material. Those waves are similar to the waves on the surface of a pond after you throw a stone in the water.

2. padder (not trimmer)

3. A. The tuning capacitor will have its minimum capacity at the high end of the oscillator frequency range. So, the padder will make up a greater part of the total capacity when the oscillator is at its highest frequency.

4. Advise Rodney to go back to the manufacturer's original circuit. He has designed a short circuit across the battery.

5. B. Actually, the maximum rate of change of current occurs when the current is zero.

6. D. The inventor had the unlikely name of Boris Lvovich.

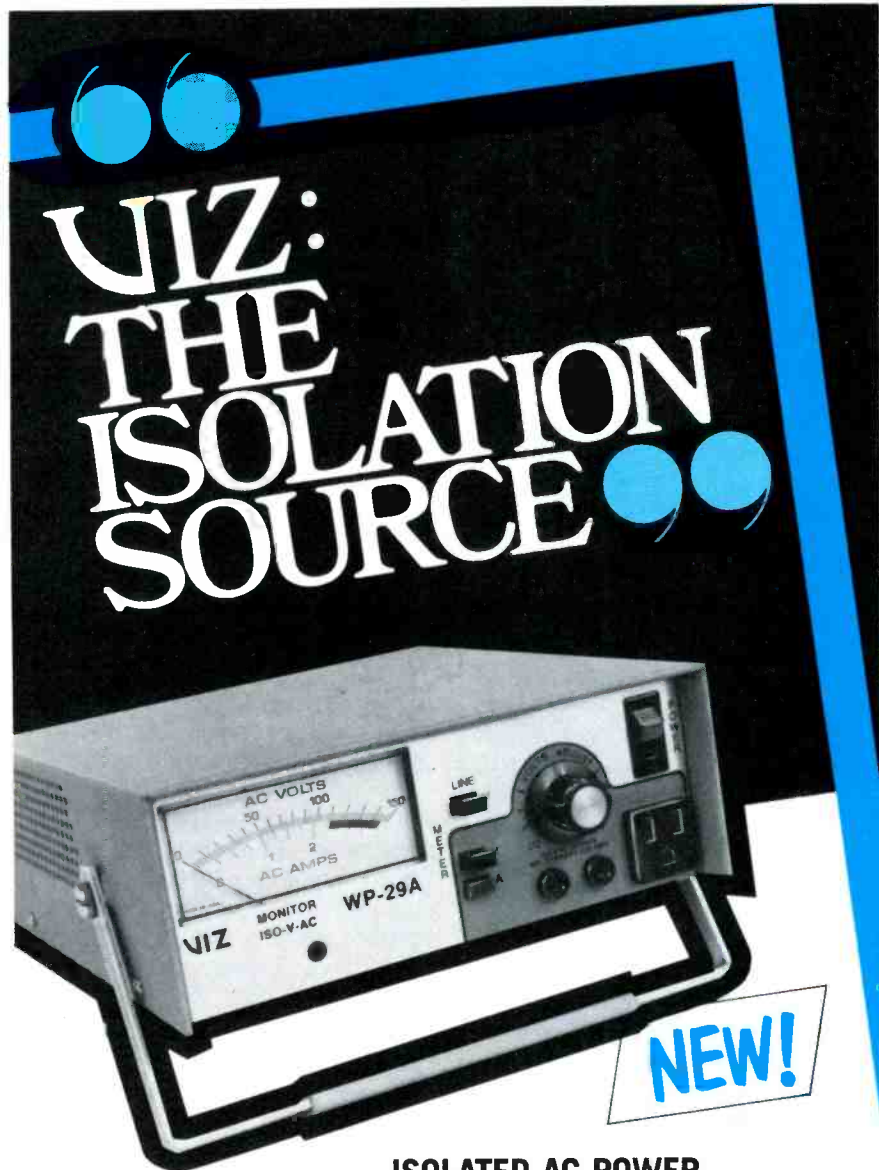
7. C

8. B

9. C. After the switch is closed, the normally-open contact closes and stays closed after the switch is opened. This is a latching circuit.

10. No! The electrolytic capacitors must also be reversed.

VIZ: THE ISOLATION SOURCE



VIZ WP-30 Isolated Power Source/
Monitor ISO-V-AC II

- *5A max current;
650 VA max power
- *Two large, color coded
taut band meters
- *Leakage tester with alarm
- *Output relay protected
with manual reset
- *Overload LED indicator
- *Two grounded AC outlets

ISOLATED AC POWER SOURCES

The new VIZ WP-29A Monitor ISO-V-AC and the WP-30 ISO-V-AC II give you more power and more accurate line monitoring for your service, quality control or educational applications.

Voltage in the WP-29A is continuously variable from 0 to 150 V, with current ranging from 0 to 2.25A maximum. (0 to 150V, 5A maximum in the WP-30). Plus large 3½" taut band meters monitor AC line voltage, load voltage and load current with an accuracy of $\pm 2\%$. Leakage is less than 0.1mA (lower than established ANSI limits!)

For your safety, our isolated power sources are protected with thermal overload devices and grounded metal cases.

VIZ has 9 Isolated AC Power Sources in all; no one else offers you more! Simply put, VIZ is the Isolation Source!

SOUTHCON BOOTH #85-1409



The New Power in Test Equipment

VIZ TEST EQUIPMENT division of VIZ Manufacturing Co.,
335 E. PRICE STREET, PHILADELPHIA, PA 19144
215/844-2626 TLX: 710-670-2626 800/523-3696

Circle (30) on Reply Card

Don't let power line disturbances damage your electronic equipment

By Jerry Whitaker, Editor, *Broadcast Engineering*

The ac power coming into a home is a potential source of electronic equipment malfunctions and component failures; it carries not only the 60Hz power needed to run the facility, but also a variety of voltage *sags*, *surges* and *transients*. These abnormalities cause different problems for different types of equipment.

An ac voltage sag is generally defined as a decrease of 10-35 percent below the normal line voltage for a period of 16ms to 30 seconds. A surge, on the other hand, is a voltage increase of 10 to 35 percent above normal, lasting 16ms to 30 seconds. (See Figure 1.) Sags and surges rarely cause problems for home electronic equipment. Transients, however, are another story.

The scope of the problem

Sensitive, solid-state equipment used today can be disrupted, or even destroyed by random short-duration spikes riding on the ac waveform. If not attenuated, these brief pulses (sometimes lasting only a few microseconds) can destroy semiconductors, disturb logic operations or latch-up microcomputer routines.

Experience in the computer industry has shown most unexplained problems resulting in disallowed states of operation are actually caused by transient overvoltages on the utility feed. With the increased use of microcomputers in home electronic products, (VCRs, compact digital audio disc players, personal computers, etc.) some form of transient protection for these devices is frequently advisable.

The subject of transient overvoltages has been extensively studied in the computer industry.

A pioneering effort by the IBM Systems Development division in 1974 (conducted by George Allen and Donald Segall), showed voltage spikes lasting between 10 and 100 μ s in a frequency range of 10-100kHz occur on an average of more than 50 times per month in a typical *commercial* environment.

Other more recent studies have shown power line transients caused by utility company switching, distribution system faults, large loads going on- and off-line and lightning, can occur as often as 900 times per month. These spikes can reach 2kV (or more) and last up to 30ms.

Transient overvoltages come in a wide variety of forms, from a wide variety of sources. They can, however, be broken down into two basic categories: those generated through natural occurrences and those generated through the use of equipment, either in the home or elsewhere.

Natural occurrences

Natural phenomena causing power line transients consist mainly of lightning and wind storms, including tornados. The *lightning effect* can be compared to that of a capacitor. (See Figure 2.) A charged cloud above the Earth will create an oppositely charged area below it of about the same size and shape. When the voltage difference is sufficient to break down the dielectric (air), the two *plates* of the *capacitor* will arc over and neutralize their respective charges. If the dielectric spacing is reduced, as in the case of a conductive steel structure (such as an antenna), the arc-over will occur at a lower than normal potential and travel through the conductive structure.

A typical lightning strike consists of a stepped *leader* progressing toward the ground at a velocity that may exceed 50m/μs. When sufficient potential difference between the cloud and the ground exists, arcs move from the ground to the leader column, completing the ionized column from cloud to ground. A fast and bright return stroke then moves upward along the leader column at about one-third the speed of light. Peak currents from such a lightning strike can exceed 100,000A with a total charge as high as 100 coulombs.* The radiated field frequency ranges from 10Hz to 40kHz. Higher frequency components are also present, but of much less intensity.

The lightning effect can also occur between charged clouds, with current movement between clouds creating a corresponding *earth current*. This earth current may induce significant voltages in conductors buried in line with the charge movement. The *wind storm effect* can induce voltages in conductors either above or below ground due to the rapid changes in the electrical potential of the atmosphere present during such occurrences. In other words, atmospheric charge energy doesn't have to actually strike a conductor, such as an antenna or utility company pole. In many cases, significant voltage transients can be generated solely by induction.

Cloud-to-cloud charge movements will generate horizontally polarized radiation, and cloud-to-ground discharges will generate vertically polarized radiation. Field strengths exceeding 70V/m can be induced in conductors a mile or so from a large strike.

Lightning and other natural occurrences don't have to strike your home, or even nearby, to be a problem. They can strike part of the utility company system and be brought into the home via the power lines.

The utility power distribution system can couple transient over-voltages into a customer's load through induction or direct charge injection. As stated earlier, a lightning strike a mile away from a

12kV line can create an electromagnetic field with a strength of as much as 70V/m. Given a sufficiently long line, substantial voltages can be coupled to the primary power system without a direct hit.

Given the layout of many parts of the utility company power system—long exposed lines over mountain tops and the like—a direct lightning strike to one or more legs of the system is a distinct possibility. Lightning is a point charge-injection process,

with pulses moving away from the point of injection. The amount of total energy (voltage and current) and the rise and decay times of that energy seen at the load as a result of a lightning strike is a function of the distance between the strike and the load, and the physical characteristics of the power distribution system (wire size, number and sharpness of bends, types of transformers, types of insulators, lightning suppressors, etc). Suffice to say any direct hit on a 12kV feeder line will

For Quality, Value and SAFETY. . .

Insist on
Simpson[®]



Recognized Test Leads, Probes, Accessories

to Assure the Integrity of Your Simpson
(and other) UL Listed DMMs, VOMs
and Clamp Ammeters

- Every one of these is tested and recognized by Underwriters Laboratories under the UL-1244 Standard for Safety — Electrical and Electronic Measuring and Testing Equipment
- Available from leading electronics and electrical distributors



SIMPSON ELECTRIC COMPANY

A Katy Industries, Inc. Subsidiary
853 Dundee Avenue, Elgin, Illinois 60120-3090
(312) 697-2260 • Telex 72-2416 • Cable SIMELCO

Circle (16) on Reply Card

Editor's note:

*A coulomb is the unit of electric charge that is transferred each second by an electric current of 1A. It is approximately equal to 6.24 X 10¹⁸ electrons.

generate a very damaging spike to any unprotected load.

Equipment-caused occurrences

Transients in the utility power system are the result of the basic nature of alternating current. A sudden change in an electrical circuit will cause a transient voltage to be generated due to the stored energy contained in the circuit inductances (L) and capacitances (C). The size and duration of the transient depends on the values of L and C and the waveform applied.

A large step-down transformer, the building block of a power system, makes an effective transient waveform generator when energized, or de-energized. Figure 3 illustrates the stray capacitances and inductances of the secondary which can generate a brief oscillating transient of up to twice the peak secondary voltage when the transformer is energized. The length of this oscillation is determined by the values of L and C in the circuit.

The second problem encountered when energizing a step-down transformer is the load is looking into a capacitive divider into the primary. If the interwinding capacitance is high and the load capacitance is low, a spike of as much as the full primary voltage can be induced onto the secondary, and thus the load. This spike does not carry much energy, because of its short duration, but sensitive equipment on the load side could be damaged upon reapplication of power to a utility company pole transformer, for example, as would occur after a power outage.

De-energizing a large power transformer can also cause high-voltage spikes to be generated. Unless switched off at or near the zero crossing, interrupting the current to the primary windings of a transformer will cause the collapsing magnetic lines of flux in the core to couple a high voltage transient into the secondary circuit. If a low impedance discharge path is not present, this spike will be impressed upon the load.

Transients exceeding 10 times the normal secondary voltage have been observed when this type of switching occurs. Such spikes can have damaging results to equip-

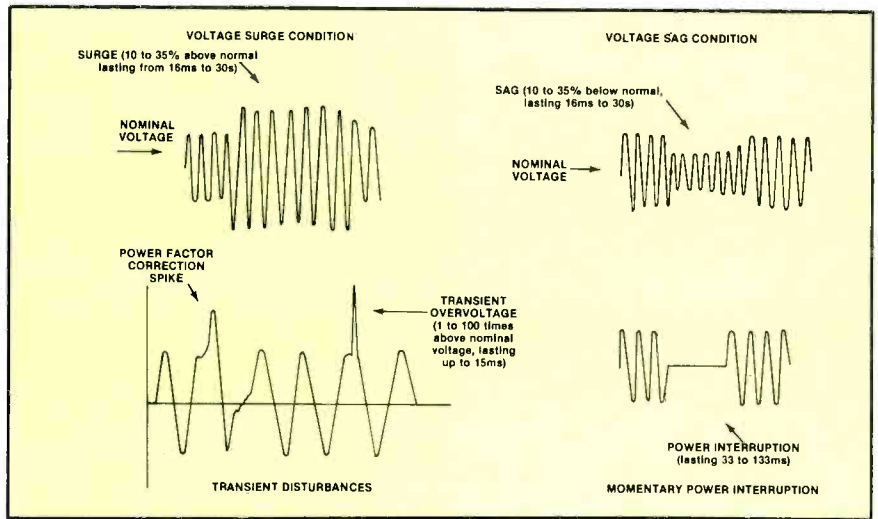


Figure 1. Voltage sags and surges can garble data and stress hardware components. Momentary power interruptions can cause a complete loss of volatile memory and severely stress hardware components. Transient disturbances can cause a wide variety of operational problems, from logic errors to complete system failure.

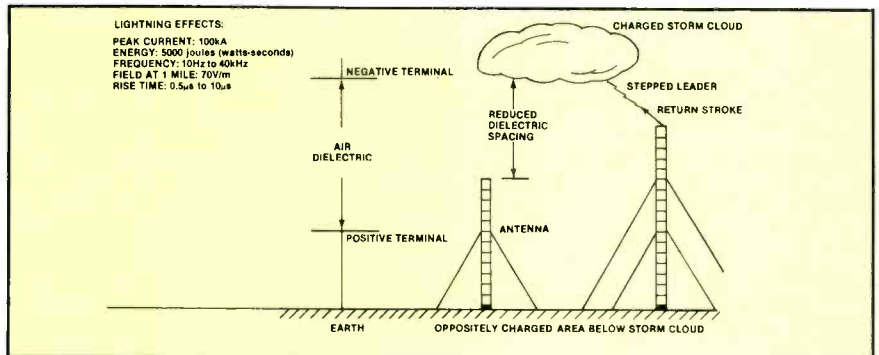


Figure 2. The lightning effect can be compared to the capacitor principle. Shown also are the parameters of a typical lightning strike.

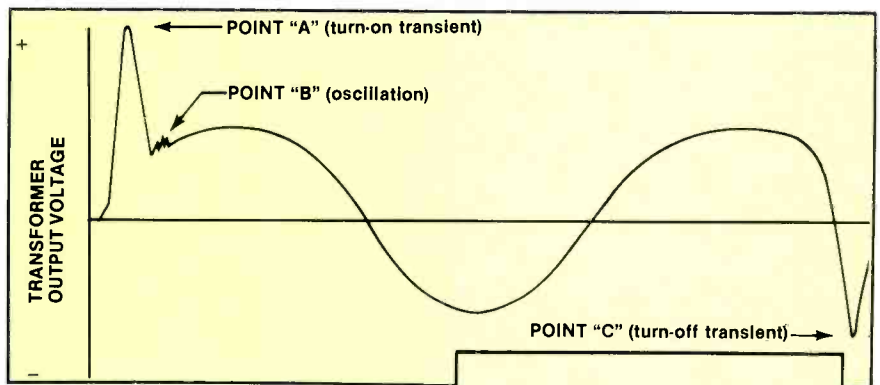
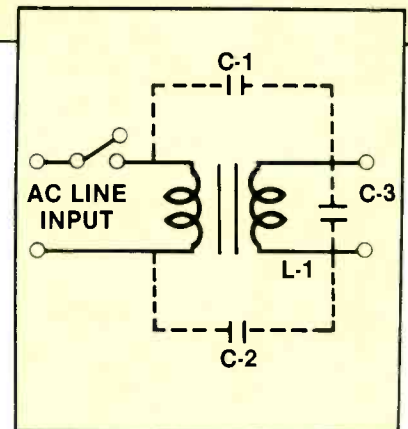


Figure 3. Inductor turn-on and turn-off spikes. C-1, C-2 and C-3 are stray capacitances which form a divider network between the primary and the secondary, causing the turn-on spike shown at point "A." The oscillation shown at point "B" is caused by the interaction of the inductance of the secondary (L-1) and C-3. The spike shown at point "C" is the result of power interruption to the transformer primary, which causes the collapsing lines of flux to couple high voltage transient into the secondary circuit. (Waveforms are exaggerated to emphasize the transient effects.)



ment. For example, the transient produced by interrupting the magnetizing current to a 150kVA transformer can measure 9 joules (watt-seconds). Whether or not these turn-on, turn-off transients would cause any damage depends on the size of the transformer involved and the sensitivity of the equipment connected to the transformer output.

Various utility fault conditions can also result in the generation of potentially damaging overvoltage transients. For example, a fault occurring somewhere in the utility company 12kV distribution system will cause a substantial increase in current in the 60-to-12kV step-down transformer at the local area distribution substation. When a fuse located near the fault opens the circuit, the excess stored energy in the magnetic lines of flux of the transformer will inject a large oscillating spike into the system. Routine load switching by the utility will have a similar effect. These transient voltages can be quite frequent, and in some instances very damaging to equipment rectifiers, capacitors and transformers.

Several other commonly experienced disturbances, such as switch arcing and relay transients, are based on these principles.

Spikes generated by contact bounce occur not only because of physical bouncing upon closing or opening, but also because of arcing between contacts resulting from transients generated by de-energizing an inductive load (see Figure 4). When current is interrupted to an inductor, the magnetic lines of flux will try to maintain themselves by charging stray capacitances. The current will oscillate in the inductance and capacitance at a high frequency; and if sufficiently high voltages are generated, an arc will jump the contacts after they have opened, clearing the oscillating current.

As the contacts separate further, the process is repeated until the voltage generated by the collapsing lines of flux is no longer sufficient to jump the widening gap of the contacts. This voltage may then look for another discharge path, such as interwinding arcing (unlikely) or other components in parallel with the inductor.

Contact arcing can also occur when an inductor is switched on, if the contacts bounce open after first closing.

Damage caused by transients

Transient protection for home electronic equipment may be necessary because many modern products contain logic systems, sensitive analog integrated circuits and low voltage discrete semiconductors. These devices require a clean supply of power to

perform correctly. The first line of defense in the protection of equipment from damaging transient overvoltages is the ac-to-dc power supply.

The power supply components most vulnerable to damage from an ac line spike are generally the rectifier diodes and filter capacitors. Diodes will occasionally fail from one large transient, but many more fail because of smaller, more frequent spikes that bit-by-bit punch through the device's

The Professionals' Choice

PTS

*Coast to coast
more professionals
choose PTS.*



Professional service dealers have made PTS the world's largest independent electronics rebuilder.

Servicemen depend on more PTS rebuilt tuners, modules, remotes, converters, and line amps than all other rebuilt brands combined.



PTS CORPORATION
P.O. Box 272
Bloomington, IN 47402
(812) 824-9331

Send for your free PTS Products Guide today!

With 15 PTS Servicenters, over 1,500 distributors, and 50,000 satisfied service dealers and technicians nationwide it's no wonder PTS is #1.

Choose PTS for service, quality and availability. PTS is The Professionals' Choice.



Circle (17) on Reply Card

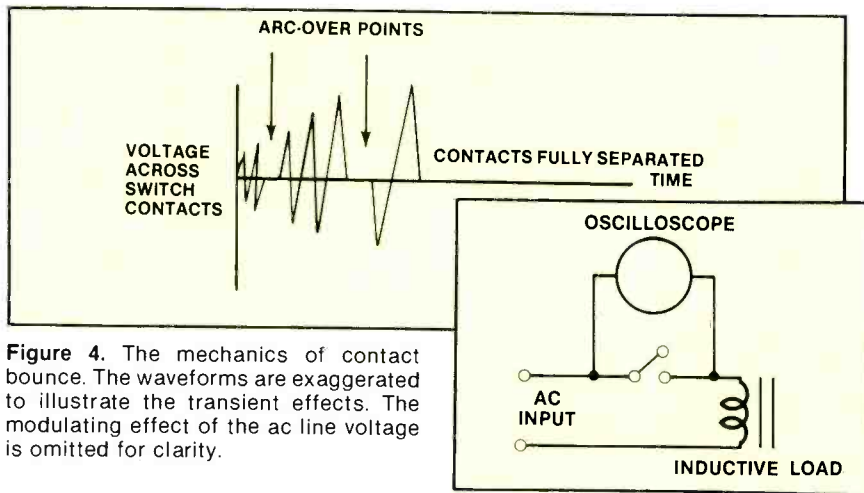


Figure 4. The mechanics of contact bounce. The waveforms are exaggerated to illustrate the transient effects. The modulating effect of the ac line voltage is omitted for clarity.

junction. Such occurrences explain why otherwise reliable systems fail "without apparent reason."

Capacitors are vulnerable to damage due to transients because the device's working voltage may be exceeded during the occurrence, punching a hole in the dielectric and leaving the capacitor useless at its normal operating value. The most damaging conditions result from the *right* timing of an operational change with the *right* amount of residual magnetism in the power supply transformer or dc reactor, or energy in the filter capacitor(s). These situations may well be rare in normal operation, however, the possibility of such *worst case* conditions cannot be disregarded.

Semiconductor failure

Transistors and other semiconductor devices can be destroyed or damaged by transient disturbances in one of several ways. A high reverse voltage applied to a non-conducting PN junction can cause avalanche currents to flow, heating the junction irregularly and consequently releasing more carriers, which conduct added current in the heated junction area. If enough heat is generated in this process, the junction can be damaged or destroyed. A damaged junction will result in higher than normal leakage currents, increasing the steady-state heat generation of the device, which may ultimately destroy the semiconductor junction.

If such a process occurs between the base and emitter junctions of a transistor, the effect may be either minor or catastrophic. In the minor failure mode, the

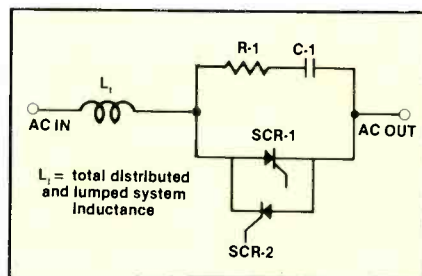


Figure 5. The basic R-C snubber network commonly used to protect thyristors from fast rise-time transients.

transistor's gain can be reduced due to the creation of *trapping centers* which restrict the free flow of carriers. These *trapping centers* are created by avalanche-damaged emitter-base junctions. In the catastrophic failure mode, the transistor ceases to function altogether.

Another transient-caused failure mode possible in a semiconductor device is thermal runaway. It is triggered by a sudden increase in gain, resulting from the heating effect of a transient on a transistor. This increased gain caused by the transient disturbance can bring a transistor (operating in the active region) out of its Safe Operating Area (SOA).

The oscillating and decaying tail of many transient disturbances can also subject semiconductor devices to severe voltage polarity reversals, forcing the components into or out of a conducting state. This action can damage the semiconductor junction or result in catastrophic failure of the component. The position of the transient on the ac wave can have a significant effect on the damaging potential of a disturbance. This explains, in part, why identical spikes do not

always cause identical component damage.

Thyristors (SCRs), like diodes, are subject to damage from transient overvoltages because of the possibility that the device's peak inverse voltage or instantaneous forward voltage (or current) ratings may be exceeded. Thyristors face an added problem because of transient occurrences due to the possibility of device misfiring.

A thyristor can break over into a conduction state regardless of gate drive if either (1) too-high a positive voltage is applied between the anode and cathode, or (2) a positive anode-to-cathode voltage is applied too quickly (dv/dt rating). If the leading edge is sufficiently steep, even a small voltage pulse can turn a thyristor on. This represents a threat to the device and to the load it controls.

Any application of a thyristor must take into account the device's dv/dt rating and the electrical environment where the unit will operate. A thyristor controlling an appreciable amount of energy should have protection against fast rise-time transients that may cause the device to break-over into a conduction state. The most basic method of softening the applied anode-to-cathode waveform is the resistor-capacitor snubber network shown in Figure 5. This standard technique of limiting the applied dv/dt relies on the integrating ability of the capacitor. In Figure 5, $C-1$ absorbs the excess transient energy, while $R-1$ defines the applied dv/dt in conjunction with the external system inductance, L_1 .

An applied transient waveform (assuming an infinitely sharp transient wavefront) will be impressed across the entire protection network of $C-1$, $R-1$ and L_1 . The total distributed and lumped system inductance, L_1 , plays a significant role in determining the ability to $C-1$ and $R-1$ to effectively snub a transient waveform. *Stiff* power sources (having little series inductance or resistance) will present special problems to design engineers seeking to protect thyristors from steep transient waveforms.

Problems can be caused by transient overvoltages, not only

Continued on page 63

Others say, "Buy this or that and it will double your production or, your money back in thirty days". But the fact is, when it comes to troubleshooting start up, shut down, hi-voltage, or any type of flyback related problem - - - including open or shorted B+ paths for video, vertical, audio, chroma, matrix, tuner circuits, etc., any circuit that relies on flyback generated B+ voltage or, any type of a dynamic short in a CRT - -in any set that uses a horiz output transistor (any brand, any age, any chassis that you can come up with);

JUST ONE

SUPER TECH

WILL OUT PERFORM ANY AMOUNT OF OTHER EQUIPMENT
BY SEVEN TO ONE

\$10,000 CHALLENGE

Let a third party choose 24 various brand TV sets that have bonifide major problems in any of the above circuits. Let our competitor bring **all** of the test equipment that he has ever sold, as well as his **entire** engineering staff. If one man with a **Super Tech** can't troubleshoot **21** of these sets down to circuit level faster than their **entire team** can do likewise to just **three** sets, we will hand them \$10,000 in cash. If they get beat, they give us permission to publicize the results! This offer is not limited to our competitors. Factory engineering teams or anyone else for that matter is welcome to try. The one using the **Super Tech** won't even need a schematic!! Are we serious about this challenge? - - - You bet we are !!

THE ABOVE FIGURES ARE CONSERVATIVE!

In about 15 seconds, you can hook up a **Super Tech** to almost any TV set. All you do is pull the horiz output transistor, plug **Super Tech** into the empty socket, then make one ground connection. In the time it takes to push four buttons, you know exactly which circuit has failed with 100% accuracy! (That's 9 points of the game when you're working on late model sets.)

THE ENTIRE TEST - - - INCLUDING HOOK-UP
TAKES ABOUT 30 SECONDS!!

SHOULDN'T YOU BE USING A SUPER TECH
AT ONLY \$995°° - - - CAN YOU AFFORD NOT TO?

Call and give us your Visa or Master Charge card number. We'll send your Super Tech prepaid. Use it for thirty days. If Super Tech doesn't do everything we say it will, send yours back and call your bank to cancel the sale. You have nothing to lose! The thing is, if we can only get a **Super Tech** in your hands, it will make your job so much easier, you won't even consider being without it. The manual that comes with your Super Tech even explains how the circuit that you are working on operates. C.O.D. orders welcome, prepaid orders deduct 5%.

DIEHL ENGINEERING • Ph. (806) 359-1824

6004 Estacado Lane • Amarillo, TX 79109

Circle (18) on Reply Card

Are you ready for surface mounted components?

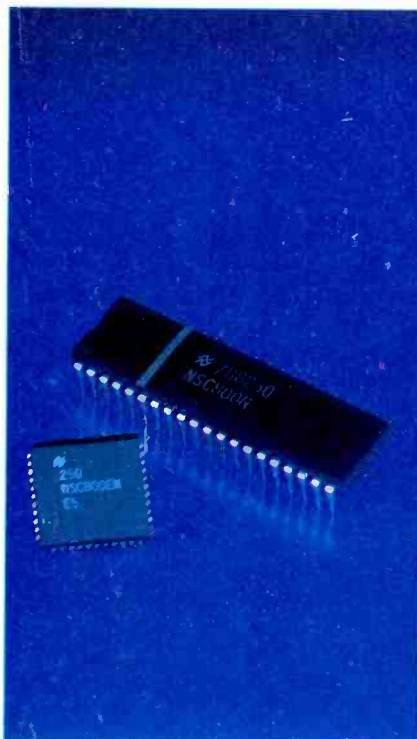
By Christopher H. Fenton, Consultant: Western Reserve Tool and Machine Company

Increasing circuit complexity, which drives a need to pack circuit components ever more densely, coupled with the eternal quest of manufacturers to reduce fabrication costs, is fueling development of a new method of circuit construction. In this system, called *surface mounting*, the interconnection between components on a printed circuit board are made on the same side that the components are mounted. There are no holes for leads to protrude, eliminating the idea of component-side/foil-side.

It probably won't be long before consumer electronics products manufacturers will be adopting this technology on a large scale. Not long after that, servicers will be facing the problem of learning how to most effectively remove and replace surface-mounted components when they fail.

This article describes surface-mount technology from the manufacturing point of view: why and how it's being done. **ES&T** will continue to keep in touch with what is going on in the area of surface mount, and plans for the future include publishing information on how to deal with surface-mounted components during servicing, as soon as we are able to obtain or develop such articles. — Editor

A radically new method of mounting electronic components to printed circuit boards has the potential of having long lasting effects on product design, manufacturing and servicing. The surface mounting could render most standard leaded components obsolete within the next several



years. Surface-mount component packages have either short *winged* leads or no through-hole leads at all. A typical resistor, capacitor or IC component package contains wire leads that are pushed through plated holes in a circuit board assembly and then soldered to copper foils on the opposite side. These types of devices are predicted to go the way of the vacuum tube with the current rise of surface-mount technology.

Surface-mount packages can house the same chips or components as do the leaded packages, but in much smaller spaces. Surface-mount devices are soldered to foils on printed circuit boards in a way much different

from the standard construction techniques used in conventional board assemblies. The circuit boards do not need to have holes drilled in them for a component's leads. As a direct result, surface-mount packages can be spaced much more closely together and the circuit board need not go through a hole drilling operation.

In some of the early applications of surface-mount techniques, they were used in areas where cost considerations were secondary to reliability and size considerations. Discrete surface-mount components were initially attached to ceramic substrates as part of mixed-composition devices. This same concept was later used on less expensive board materials, such as glass/epoxy. As size reduction became more of a factor in many non-military applications, such as computers, automobile electronics and consumer electronics, the demand for surface-mounted parts has risen considerably. As a result, surface-mount parts for these industries are being produced in larger quantities, making them more cost competitive with standard leaded components.

Initially developed during the late 1960s, the surface-mount concept remained in the background as conventional circuit board construction methods were considered adequate through the 1970s. Also, the concept was not considered cost-effective enough to be put into widespread use. With the rise of the microchip, however, size became a more important factor. A size reduction of $\frac{1}{2}$ to $\frac{2}{3}$ of conventional used

board space is possible with surface-mount devices.

The United States and Japan currently are leaders in surface-mount technology. Japan uses the greatest number of surface-mount devices, primarily in the field of consumer electronics. The U.S. manufacturers are second in number of devices used, but they have been the driving force behind the development of new surface-mount packages, primarily those with higher pin counts. Increased needs within the computer and automobile industries, where the United States is considered the front-runner, is the reason for this. Japanese companies have also developed surface-mount devices, in the form of a 4-sided flatpack. These are not widely applied in the United States, however.

Surface mounting could render most standard leaded components obsolete within the next several years.

Benefits of surface mount

Several major reasons are given for employing surface-mount components in designs using existing technology. Most importantly, with the reductions in circuit size that this process allows, several functions may be combined into single-chip packages. The overall board size may remain the same, but the board will contain more features. Another factor is that designs using surface-mount components are physically smaller than those of an equivalent circuit board built with conventional methods. Finally, surface mounting the components reduces parasitic capacitance and lead resistance. High speed digital and communications equipment are two areas where surface-mount components and construction techniques will improve electrical characteristics.

Surface-mount components are currently available in many different styles of packages. At present, the most common are the chip configurations for passive

devices, small-outline packages for semiconductors and ICs, and plastic chip carriers for ICs with high pin counts.

Most discrete components are available in surface-mount packages. The chip packages, for the most part, house resistors, capacitors and inductors. Small-outline (SO) packages generally house transistors and other discrete semiconductors. The SO packages have electrically conductive, tinned surfaces at either end of the component for solder attachment.

Analog circuits and logic families such as TTL and CMOS are produced in small-outline integrated circuit packages (SOIC). The SOIC packages are generally available with eight to 24 pins. Computer memories, microprocessors and other devices with 40 to 68 pins are provided in plastic chip carriers (PCCs). A PCC, also known as *quad-pack*, is square and contains leads on all four sides. The pins of the quad-pack are j-shaped and curl under the package.

Surface-mount component leads are spaced much closer than those of conventional components. As a result, board layout is more critical. Typical insertion-mount boards have 10-mil foils widths and spacing, with component leads and annular connectors spaced at 100-mil intervals. The majority of surface-mount devices have 50-mil lead spacing and some require 25 mils or less. Foils spacing requires six to 10 mils. As density requirement increases, foils width and spacing will decrease to about three to five mils. This change is expected to occur by the end of the decade.

Settling on a standard

Currently, some speculation exists about which package will become the industry standard for applications using 20 to 40 pins. SOIC packages are significantly more difficult to handle, because their leads protrude away from the package body. On the other hand, this makes for easy automatic testing. The PCC package resists damage during production because the leads do not protrude from the package body. Unfortunately,

automatic testing is impossible on PCC packages because the automatic tester cannot reach points where the leads are attached. Traces cannot be placed beneath the PCC because it contains closely spaced leads on all four sides. Foil layout is therefore more critical, because board space is boxed in.

Observers forecast that the adoption of SOIC packages as a standard for devices containing up to 40 pins will occur by the end of the decade. However, widespread use of SOICs by the Japanese has reduced cost and increased availability of these devices in packages with lower pin counts.

PCCs will also continue to be used appreciably and will still control a large proportion of the market, especially devices with high pin-counts and specialty devices.

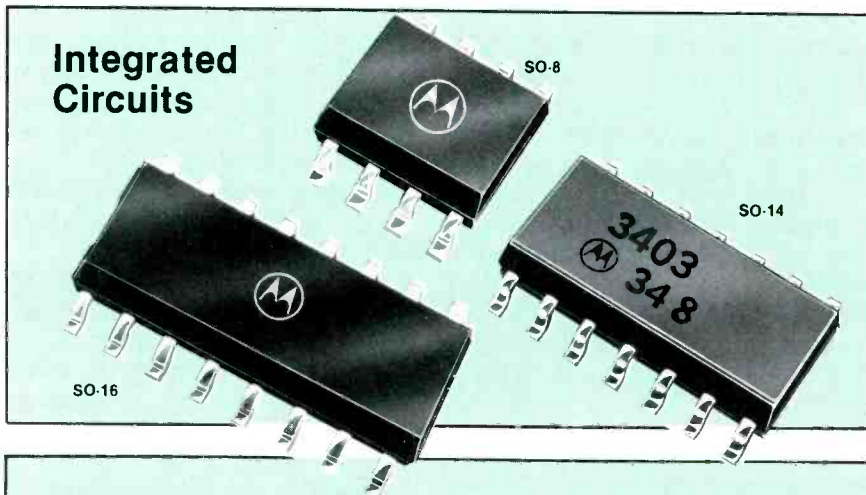
High-pin-count devices also come in other types of packages, such as pin grid arrays (PGAs), leadless ceramic chip carriers (LCCCs) and tape automated bonding (TAB) configurations. The LCCC configurations are used primarily in high reliability applications. The PGA and TAB configurations are intended for use in devices having 84 pins or more. The LCCC, PGA and TAB packages require special handling or the use of special materials to realize their full cost-effective potential.

Several functions may be combined into single-chip packages.

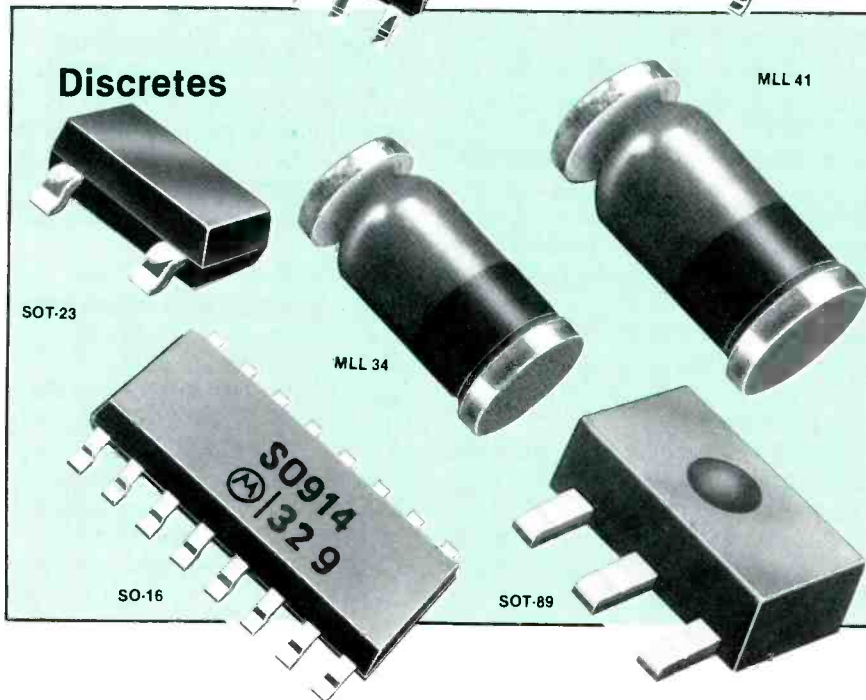
The surface-mount manufacturing process

Most manufacturing techniques for building circuit boards with surface-mount components have evolved from standard insertion mount methods. A fundamental difference exists between the two processes, however. The lead-forming stage is not present in the surface-mount process. Pick-up and place machines replace the automatic-insertion equipment in the surface-mount process. A

Integrated Circuits



Discretes



typical pick-up and place machine is computer controlled and positions parts with servo-driven heads. Parts are dispensed from 8mm tape, magazines or from bins.

Surface-mount component leads are spaced much closer than those of conventional components.

Although surface-mount components are soldered to printed circuit board, the attachment and soldering procedures differ from those used in conventional through-hole construction of circuit boards. Conventional boards are automatically *stuffed* with components on one side of the board.

These electronic device packages are representative of the appearance of surface-mount packages. SO indicates small outline, and MLL stands for Motorola leadless. The largest of these packages, the SO-16, is approximately 1/2-inch long by 1/4-inch wide (including leads). (Courtesy Motorola).

Excess wire lengths are trimmed and then the boards are wave soldered.

Surface-mount boards, on the other hand, are first screened with solder paste at all component soldering points. Placement machines then position the surface-mount devices in the solder paste. Manual placement is impractical because of the small size of the parts and their tight placement together in relation to the other components on the board. The cured solder paste

holds the components in place until soldering can take place. Larger surface-mount devices may also require adhesive mounting.

Wave soldering can be used with surface-mount devices. Wave soldering equipment may require some modification, however, if previously used with leaded parts. Solder temperature, wave size, number of waves, and the feed/speed parameters may also need to be adjusted. Wave soldering is difficult to control because it causes solder bridging on devices with high pin counts. The plastic chip carriers are particularly difficult to wave solder because they have closely spaced leads on all four sides.

Other solutions to this problem use alternative solder techniques to avoid the solder bridges. One solution called *solder reflow* seems to have the greatest potential for resolving the problem of solder bridging. With solder reflow, a solder paste is screened onto the circuit board before component placement. The paste holds the parts to the board and the assembly is then heated to 210° C. The solder paste melts or reflows, to form solder joints. Surface tension of the solder holds the components in place.

Reflow soldering is done by infrared heating or by a technique called *vapor phase reflow*. Vapor phase reflow heats the solder paste using an inert vapor that boils at 210° C. Surface-mount boards are fed through the vapor phase equipment as in wave soldering. Instead of passing over a wave of solder, the boards pass through the boiling inert vapor. Unlike wave soldering, the vapor phase reflow process is not easily viewed because the process is well controlled to minimize the loss of expensive inert material. The boiling inert fluid is at a constant temperature and conductive heating of all solder joints occurs at the same time.

The heat absorption characteristics are another consideration when infrared light is used instead of the inert vapor to reflow solder. A typical surface-mounted transistor is in a dark package while solder joints are silver colored.

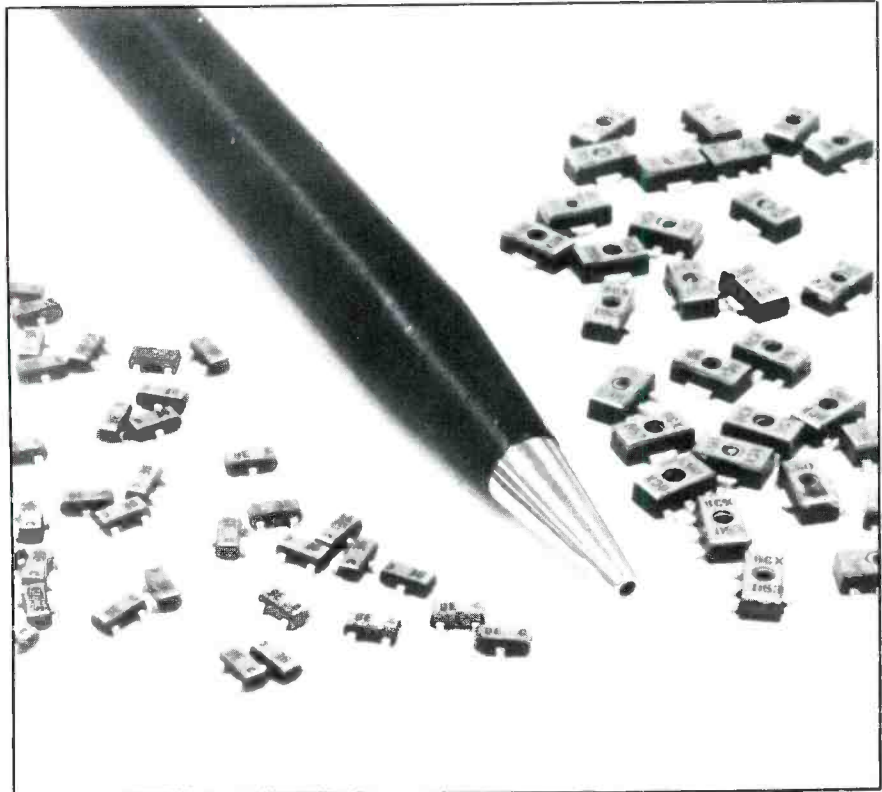
Consequently, the infrared process is not well controlled, and the point is moot on the vapor phase reflow process. The infrared technique is used in less demanding applications, such as those using only passive chip devices.

Some surface-mount attachment techniques use electrically conductive epoxy instead of solder.






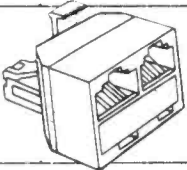
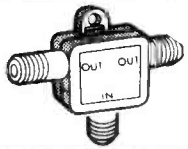
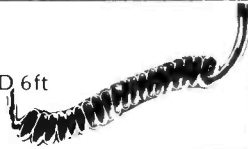


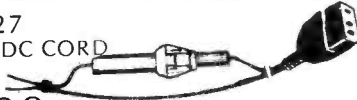




Epoxy instead of solder

Some surface-mount attachment techniques use electrically conductive epoxy instead of solder. This method has been used for years to produce hybrid circuits on ceramic substrates. Proposed surface-mount applications will use standard glass/epoxy boards. Epoxy attachment may cost less than soldering in some surface mount applications.

The process begins with the



SOT-23 and SOT-89 packages are shown here with a mechanical pencil to give an impression of size. (Courtesy Motorola).

<p>20-410 F59U 100 for \$10.00</p> 	<p>20-005 GOLD "F to F" 3ft 10 for \$10.00</p> 	<p>21-919 N-CONNECTOR DOUBLE FEMALE 10 for \$20.00</p> 
<p>20-415 DOUBLE FEMALE 10 for \$2.00</p> 	<p>12-373 SPST SWITCH 10 for \$6.00</p> 	<p>60-182 DUAL ADAPTOR 10 for \$9.00</p> 
<p>20-554 2 WAY SPLITTER 10 for \$6.00</p> 	<p>19-817 MIC CABLE 5 WIRES 1 SHIELD 6ft 10 for \$8.00</p> 	<p>50-410 4 for \$10.00</p> 
<p>20-512 COAXIAL SWITCH 2 for \$5.00</p> 	<p>19-827 3 PIN DC CORD 10 for \$5.00</p> 	<p>06-251 1KV 2.5A DIODE 200 for \$15.00</p> <p>Equivalent to 1R-250, Mallory M2.5, HEP 170, 1N1565A, 1N1568A, 1N490 series.</p> 
<p>20-067 NICKEL "F to F" 3ft 10 for \$5.00</p> 	<p>19-845 CB MIC 5 for \$15.00</p> 	<p>3AG FUSE ASST 100 ea, 2A, 3A, 5A 300 for \$9.00</p> 

MINIMUM ORDER \$10.00
800-421-2841
213-538-8335

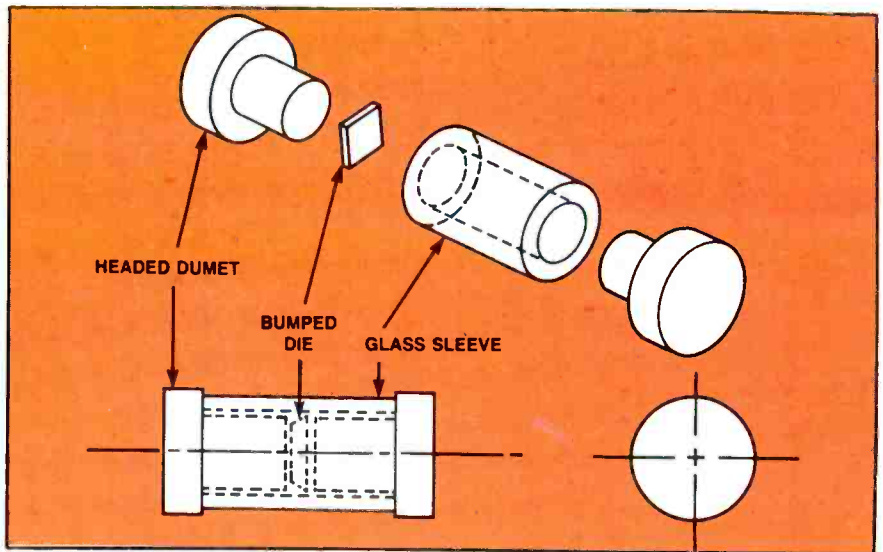
BUY ACCSYS DIRECT
SPECIAL GOOD TILL
END OF MAR. 1985

FUJI-SVEA
P.O. BOX 3375
TORRANCE, CA 90510

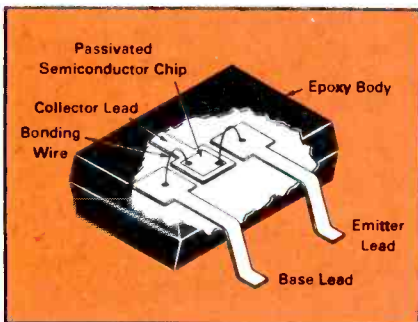
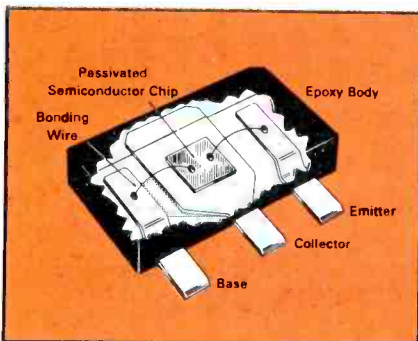
Circle (19) on Reply Card

screening of electrically conductive epoxy at all component placement points. Drops of non-conductive epoxy hold larger components in place until they can be cured. Placement machines then position the components on the board. Convection, infrared or vapor-phase heating can then be used to cure the epoxy. Epoxy curing time can occur in minutes and is temperature dependent.

The epoxy process has two key advantages. First, fewer manufacturing steps are involved than in



Leadless diode construction. (Courtesy Motorola)



These cutaway drawings show internal construction of two of these devices. (Courtesy Motorola).

clear themselves when heated. Mixed assemblies are not practical because epoxy must be applied manually to all through-hole connections.

In some cases, conductive epoxies may replace copper circuit board foils. Epoxy foils are simply screened onto the copperless board, eliminating the plating and etching step. Though the process reduces manufacturing costs, the long term reliability of epoxy foils has yet to be determined.

The cost considerations

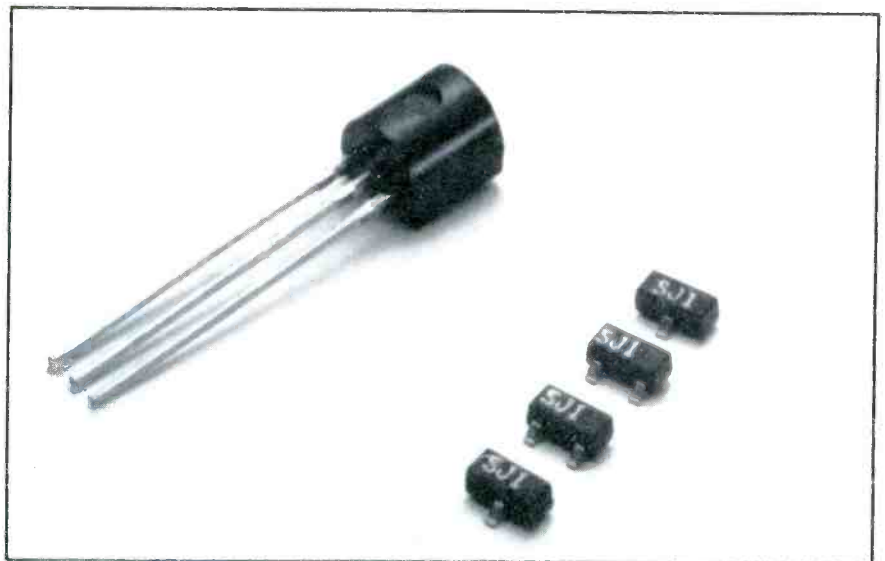
Currently, tooling costs are two

to five times higher for surface-mount boards than for conventional packages. Price parity has already occurred with some discrete components.

Even with the current cost penalties, the use of surface-mount technology can reduce overall costs. Reduction in board size as a result of using surface-mount devices can lead to lower material costs, and smaller assemblies mean less packaging and shipping costs. Surface-mount manufacturing areas require less plant space and manpower than do insertion-mount facilities of equal capacity.

the soldering process. Circuit board annular connectors need not be pre-tinned and there is no need for the soldering flux removal/cleaning operation. Second, conductive epoxies can be formulated to minimize the effects of thermal expansion coefficient mismatch between the component and board materials.

Use of conductive epoxy has some drawbacks. The material costs three times more than solder, and epoxy bridges, unlike their solder counterparts, do not



Field-effect transistors in SOT-23 packages make a standard TO-92 package look huge. (Courtesy Siliconix).

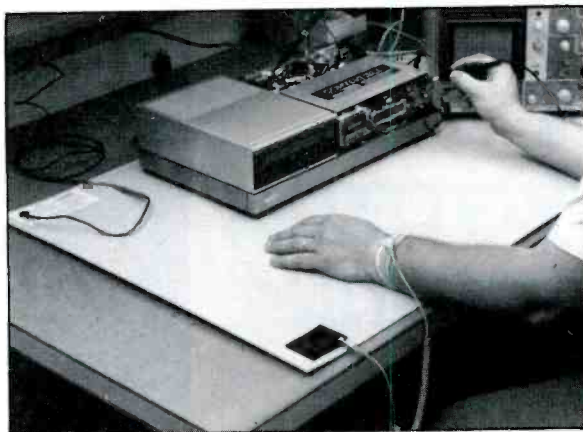
Be Sure... with RCA's Antistatic Kit.

Protect static sensitive devices from costly damage.

Electrostatic charges build up all around the work environment, posing a constant threat to static sensitive devices.

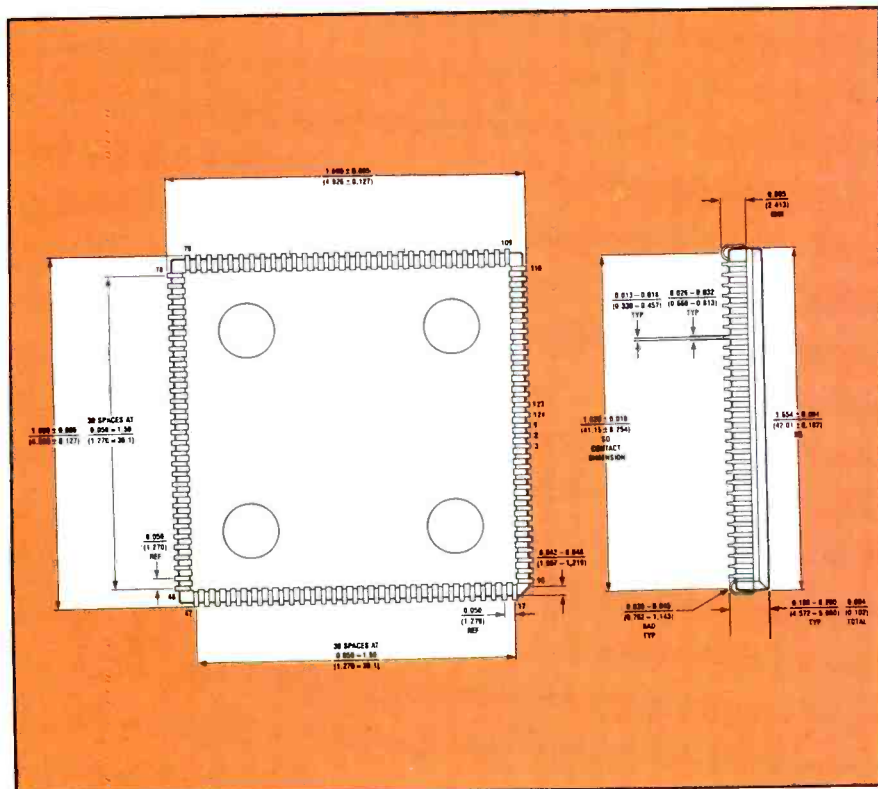
RCA's Antistatic Kit (Stock No. 162351) protects these devices from the damaging effects of static buildup. The kit consists of a static dissipative mat, a lightweight wrist strap and coil cord, and a six-foot grounding cable that safely drains electrostatic charges to ground.

No matter what kind of static sensitive



devices you test, repair, or work with, you need RCA's Antistatic Kit working for you. See your RCA Parts Distributor; or for more information write RCA Distributor and Special Products Division, 2000 Clements Bridge Road, Deptford, NJ 08096-2088. Attention: Sales Promotion Services.

RCA Distributor and
Special Products Division



Outline drawings give an idea of the appearance and complexity of a 124-pin plastic chip carrier. (Courtesy National Semiconductor).

The production equipment is physically smaller and there is no need for a machine that forms and trims compact leads. Decreased packaging, manpower and capital equipment costs may offset increased tooling and component costs.

Even with the current cost penalties, the use of surface-mount technology can reduce overall costs.

Some observers feel that surface-mounting will be the dominant force in board assembly methods by the end of the decade. Faster and more flexible pick-up and place machines are needed for placing components on circuit boards. The key reason tooling costs are so high is in part because of the lack of a standard component package, primarily in the 20 to 40 pin range. Surface-mount component prices are expected to drop to conventional parts price levels during 1986.

ES&T

Analysis of Sylvania Superset Two

Model RXS198WA

By Carl Babcoke, CET

With stereo broadcast capabilities available today, along with cable, VCR and video game hook-ups, many televisions are being built with a stereo receiver, speakers and accessory modifications included. Recently, NAP Consumer Electronics Corporation loaned to **Electronic Servicing and Technology**, a Sylvania Superset Two, model RXS198WA for our review. This first article, which gives you an overview of its features, will kick off our series concerning the Sylvania Superset Two. Later articles will analyze the circuitry involved in this particular model.

Two features found in many new color TV receivers are stereo TV sound and video/audio direct connections for VCRs and video games. Model RXS198WA (Figure 1) with its E-5000 top-of-the-line chassis has these and many more features such as: 125-channel random-access digital tuning with up-down scanning and on-screen display plus a full-featured remote control; scan-velocity modulation (SVM) for increased picture sharpness; a comb filter for better separation of luminance and chrominance signals; a Dark-Lite picture tube with conical-field focusing, and a 7W-per-channel stereo amplifier with balance and tone controls.

In **ES&T**, the emphasis always is on the circuitry, how it operates and how it can be repaired when

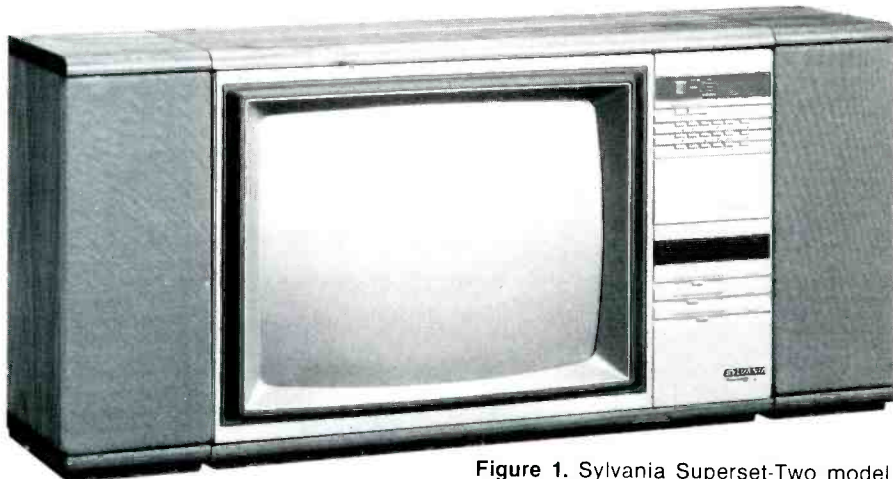


Figure 1. Sylvania Superset-Two model RXS198WA with 19C4-03AA chassis is the top of the 19-inch color-TV receiver line. The two speakers are not attached to the cabinet, and can be placed wherever the customer desires. An internal decoder board produces stereo TV sound, when the program is broadcast in stereo. VCRs and other video/audio devices can be connected to three RF inputs or to the receiver's video and audio circuits directly via a jack panel on the rear.

necessary. This series of articles will cover all those subjects in detail, but the first part will familiarize you with the customer controls, the general layout of various boards and many of the unusual functions.

Some of this information does not come automatically, even to

experienced technicians. For example, my servicing experiences included the first black-and-white TV receivers, the first color receivers, the first transistor radios, and all developments since then. But I made several mistakes by trying to set the on-screen time readout and tune in the TV channels before reading the customer-instruction booklet! Therefore, I would advise you to read the instruction manual before trying to adjust and operate a complicated receiver like this one.



Figure 2. Push-buttons and other controls are arranged in four areas of the Sylvania front panel: the remote sensor and indicator lights at the top; push-buttons for many functions are below; TV controls and other switches are under a hinged door near the center; and balance, bass and treble controls are near the bottom.

Front-panel controls

The customer-operated controls of the Sylvania Superset Two are grouped into four general areas on the front panel (Figure 2). At the extreme top are six indicator lights and the remote-control sensor. Below them are 20 push-buttons for channel selection and other functions. Below the buttons, and hidden behind a hinged door, are the seldom-used picture controls and audio/video switches. Finally, balance, bass and treble audio controls are located about 5 inches from the panel's bottom.

Figure 3 pictures the first two groups. Behind a grill in the black trim at the top is the infrared sensor for the remote control. At the right are six indicator lights that show which of the three accessory

RF inputs and which of three audio/video conditions have been selected, or now are in use.

Push-button functions—Below those are 20 push-buttons for many functions. One button is labeled *power*. It is firmly pushed to turn on the ac power, or later pressed again firmly to turn off the power. None of the 20 buttons latches mechanically at the inward position; thus they cannot indicate the condition by the position.

Next is a wide button labeled *ACC* for accessories. Any of the three RF inputs mentioned and its corresponding indicator light (mentioned before) can be selected by pressing the *ACC* button firmly for about a half second to advance the indicator light (and RF input on the receiver's rear panel) as desired. Each button push advances one step of the ACC-1, ACC-2, ACC-3, ACC-1, ACC-2, sequence. Stop when the desired accessory RF is obtained.

Digits from zero to nine are for random-access selection of TV channels, or for setting the on-screen digital time. Two valid digits must be entered for each channel before the system will change to the new channel. Channels 2 through 9 must have a zero entered before the channel number, or the tuning will not exchange (the selection was not valid).

If an invalid channel number (such as 5, 01, 99 or 85) is entered, the number will appear in the lower-right corner of the screen for about six seconds while the previous channel also remains on the screen. After the six seconds, the number disappears—the circuit has forgotten it! This is a good system because an invalid number caused no disturbance (the system ignores it), and the channel number received by the tuner circuit is displayed so the viewer can check it for accuracy (and correct it if necessary).

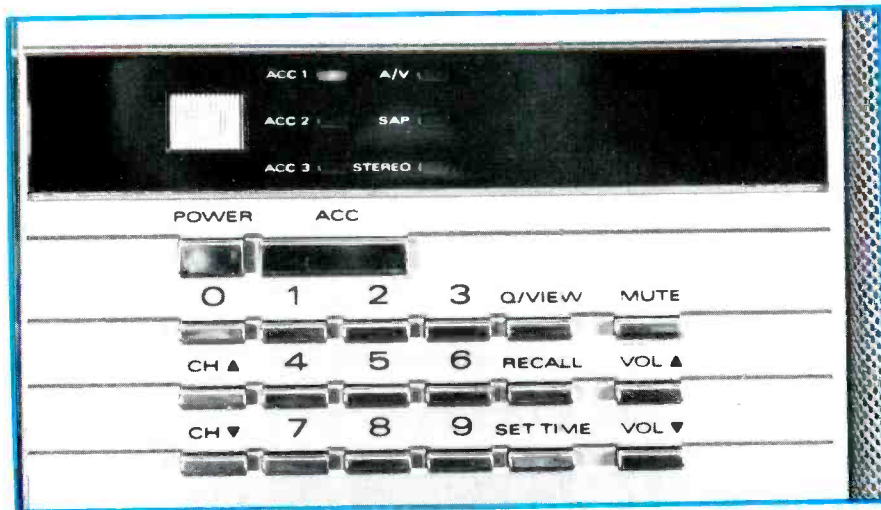
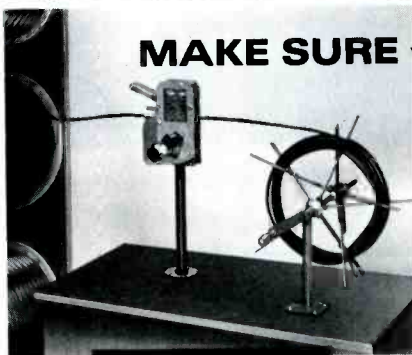


Figure 3. Some details can be seen of the sensor/indicator-light area above and the 20 push-buttons below.



MAKE SURE you get paid for every inch of wire sold

EXACT MEASURING is a must when you retail coaxial cables, audio cables, and electronic/electrical wires. You can work confidently and quickly . . . yet keep close control . . . with **HYKON WIRE METERS** and **REELS** set up on a counter or as a portable combo. Wire up to 1" diameter pulls from stock through the meter onto take-up reel for neater delivery. Write for details or call us at AREA 216 821-2320

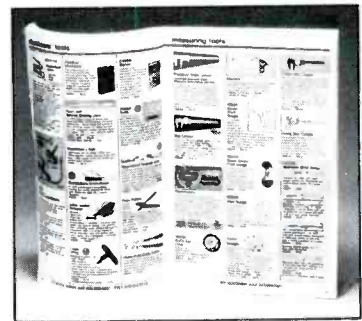
Hykon

MANUFACTURING CO.
Post Office Box 3800-ET Alliance, OH 44601

Circle (21) on Reply Card

FREE!

New Catalog of Hard-To-Find Precision Tools



Jensen's new catalog is jam-packed with more than 2,000 quality items. Your single source for hard-to-find precision tools used by electronic technicians, scientists, engineers, schools, instrument mechanics, laboratories and government agencies. This popular catalog also contains Jensen's world-famous line of more than 40 tool kits. Call or write for your free copy today!

JENSEN TOOLS INC. | 7815 S. 46th Street
Phoenix, AZ 85040
(602) 968-6241

Circle (25) on Reply Card



SINCE 1950

- LEADING SPOKESMAN
- TRADE INFORMATION DISPENSER
- WATCHDOG
- NATESA SCOPE
- STANDARDS YARDSTICK
- CONSUMER RELATIONS
- PROBLEM SOLVER
- CONCISE PRACTICAL BUSINESS OPERATIONS MANUAL
- SERVICE CONTRACT MANUAL
- CUSTOMER PLEASING PROFIT PRODUCING ORDER FORMS
- PARTS PROCUREMENT EXPEDITOR
- SERVICE BUSINESS
- DIVERSIFICATION PLANS
- TECHNICIAN DEVELOPER

6210 So. Pulaski Rd. • Chicago, Illinois 60629

There are two ways of obtaining an invalid number even when the correct buttons are pushed in the correct sequence. The receiving sensor's pick-up pattern is only about 60 degrees wide, and that of the remote-control unit while the buttons are being pushed can cause a severe reduction of infrared strength at the receiver; and the elimination of one or both channel numbers makes the entry invalid.

Another possible hazard is the slight time delay after a channel-selecting button is pressed before the circuit acts on it. Therefore, *if the numbers are pushed too rapidly, one or more might not activate the circuit.* **Remember:** Push each button firmly to the bottom of its travel. Try to keep the button depressed for a quarter to a half second. If the buttons are pressed firmly with authority, there should be no ciphers or invalid numbers.

At the lower left corner of the group of push-buttons are the channel-up and channel-down buttons, with arrowheads to show the direction. A short firm push moves the tuner up or down one channel. But if a button is pushed and held, the channels are scanned slowly at perhaps two or three per second.

If the receiver is to be used where only a few channels will be viewed, the non-favorite channels can be deleted (temporarily; they can be restored) by the *add* and *delete* push-buttons under the door

(described later). If only four channels are left active, it is quicker to scan those four than to select each by the direct-access method.

The same zero through nine buttons also are used to set the on-screen clock. After the television has been unplugged from ac power and then is plugged in and turned on, these conditions will be found: (1) channel 3 will be tuned in; (2) the sound will have minimum volume; and (3) the time digits in lower-left corner of the screen will be replaced by the letters PF, for power failure. Tune in a channel and increase the sound volume to normal. Next, set the on-screen time readout.

From another clock, notice the correct time. Press the *set time* push-button, and three zeros will appear in the time area, replacing the PF. *Do not attempt to tune in a channel now; the system is ready for time adjustment only.* Push the buttons for the correct time. If it is 11:04, push one, one, zero and four. If it is 3:50, push three, five and zero. Those numbers should appear on the screen (replacing the three zeros), but without the colon between hours and minutes. Finally, press the *set time* button again. The colon should appear between the hours and minutes digits and alternately flash on and off (Figure 4). That's all. It is safe now to use the same push-buttons to tune in TV channels.

Incidentally, I was caught by the

requirement to press the *set time* button a second time to complete the time setting and restore the channel functions. The Sylvania had just been unpacked and I was in a hurry to try it out. I pressed the *set time* button and entered the time but didn't know then about pressing the second time, so I attempted to tune in stations with the push-buttons. Neither the program on the screen nor the channel readout changed, but some strange time digits appeared before I read the instruction book and corrected the mistake.

Another button (Figure 3) is marked *Q/view* for quick-view. Assume that a viewer has been watching channel 10, and later channel 3 is selected. If channel 10 is wanted again, it is necessary only to press *Q/view* once firmly. Then a second push of *Q/view* tunes in channel 3 again. In fact, if other channels are not selected between them, pushing *Q/view* will change from 3 to 10, from 10 to 3, from 3 to 10 etc.

The *mute* button (upper right corner of the button area) eliminates all sound from the receiver's speakers. It does not eliminate the audio that is available from the jack panel at the rear.

The *recall* button brings the channel-number (in upper-right corner), the accessory-RF-number (in lower-right corner) and the digital-time (in lower-left corner)

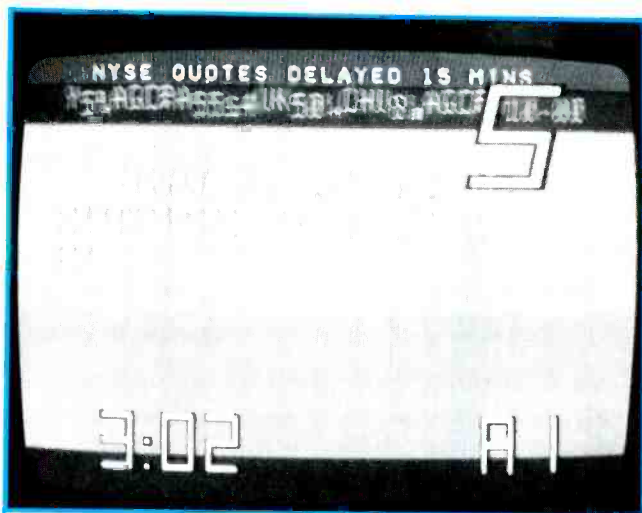


Figure 4. Pushing the recall button adds these three readouts to the picture. The time is in the lower-left corner, the channel number is in the upper-right corner, and the accessory RF input number is shown in the lower-right corner. This photograph was made from the Sylvania receiver.



Figure 5. The seldom-used TV controls and some very important switches are located under the hinged door (seen at the bottom, a bit out of focus). If the AV switch is pushed in to the *on* position, the screen will show a blank raster and there will be no sound unless external audio and video are connected to the jack panel. If the *mono-stereo* switch is moved accidentally to the SAP position during normal TV reception, the sound will be eliminated. Details are given in the text.

displays to the screen. The letters and numbers are white with a black border, so they are easily seen in the picture. Any time the recall button is pushed firmly, all three displays are made visible, with very large channel numbers at first. After about two seconds, the channel numbers begin to shrink in size and move to the left. Finally, after a total of about five seconds, all displays are blanked out. This assumes the recall button is pushed and then released. If the button is held down steadily, all three readouts will be seen on the screen (Figure 4) until the button is released, and then the previous sequence (with shrinking channel number and eventual blanking) is followed.

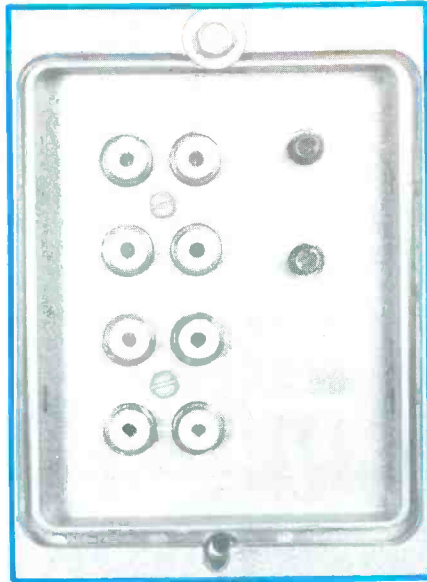


Figure 6. Phono jacks on the rear panel have a video input and output, stereo audio input and output, and right and left external speaker jacks. The video and audio inputs have gain controls marked IN ADJ. Models with internal speakers will have a selector switch beside the speaker jacks. (Note: The panel should have been dark gray, almost black. But the lettering on it was pastel, and the company that makes our photographic prints made the panel lighter so the lettering would be more distinct.) These jacks are soldered directly to the audio/video input/output board which is behind the jack panel.

Finally, the VOL-with-upward-arrowhead and VOL-with-downward-arrowhead buttons are located at the lower-right corner of the push-button area. Sound volume changes are very slow and smooth when these buttons are used. For example, about 10 seconds are required for a change from minimum to maximum, or from maximum to minimum. Just

push the proper button and keep steady pressure until the desired volume is reached before you remove your finger from the button. If you overshoot the mark and the sound is too loud or too soft, try again in the opposite direction.

Seldom-used controls—A hinged door below the push-buttons can be opened to allow ac-

cess to the sharpness, brightness, picture-contrast, tint and color-saturation controls for the television (Figure 5).

To the left of the sharpness control is a 3-position switch labeled *MONO*, *STEREO* and *SAP*. The switch is for selection of TV sound. Moving the switch to mono connects both audio channels together for monaural audio. Changing to stereo position when the TV audio is broadcast in monaural still provides monaural sound. However, *it is necessary to move the switch to the stereo position to hear the audio in stereo* when it is broadcast on

Symcures Wanted

Electronic Servicing and Technology

needs a broader variety of television Symcures. Especially needed are reports of Quasar, General Electric, Sylvania (or Philco), Sony Sears and Magnavox.

Symcures are, by definition, solutions to problems that have been encountered during the repair of *more than one* television set of the same make and model, and that may reasonably be expected to be a source of *recurrent* failure.

Please give the brand, model number, Photofact number, a brief description of the symptoms, a rough hand-drawn schematic of the area containing the defect, and a short description of the cure (including whether the defective component was open, leaky, shorted or intermittent).

ES&T editors will adapt the material to the Symcure format and have Photofact-style schematics prepared.

Send seven Symcures each time. Only six will be published, but the extra gives the editor a spare for one already printed in the past (or otherwise not suitable to the format). \$30 will be paid for each page of six actually published (remember to include full name and address).

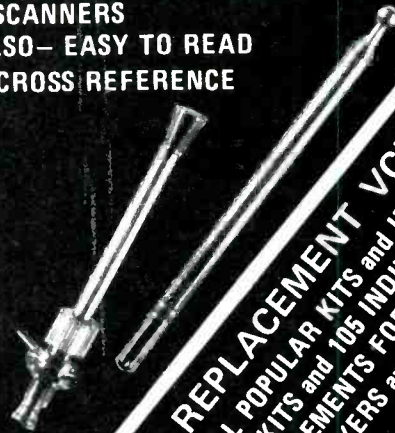
Send to: Symcure Department
Electronic Servicing and Technology
P.O. Box 12901
Overland Park, Kansas 66212

NEW MOST POPULAR ANTENNAS

FOR:

- * PORTABLE TV's
- * AM/FM CASSETTE STEREO (boom boxes)
- * WIRELESS TELEPHONES
- * SCANNERS

ALSO— EASY TO READ
CROSS REFERENCE



REPLACEMENT VCR BELTS
ALL POPULAR KITS and INDIVIDUAL BELTS.
36 KITS and 105 INDIVIDUAL BELTS; ALSO
REPLACEMENTS FOR CASSETTE and 8 TRACK
PLAYERS and RECORD CHANGERS.
ALSO— EASY TO READ
CROSS REFERENCE.

WORKMAN ELECTRONIC PRODUCTS, INC.

75 Packinghouse Rd. • Box 3828
Sarasota, Fl. 33578 • Phone: (813) 371-4242
TWX 810-864-0401 Workman Sara

CALL YOUR LOCAL DISTRIBUTOR OR
THE FACTORY FOR NAME OF
NEAREST STOCKING DISTRIBUTOR

Circle (10) on Reply Card

television in stereo. A stereo-audio TV program will illuminate the stereo light that is located at the top of the front panel to the right of the ACC-3 indicator light. If TV stereo-audio broadcasts are expected, just keep the switch in the stereo position and notice the change of sound when the stereo indicator lights.

A third position of the switch is labeled SAP for Separate Audio Program, perhaps in a foreign language. Sound will be obtained at this position *only* when the program is in stereo and when the special SAP FM carrier is added to the stereo audio. If the switch is moved to the SAP position under any other conditions (such as normal TV reception), *there will be no sound.*

The *add* and *delete* push-buttons are used with the up and down scanning of TV channels. Any unused channels can be removed easily from the up/down scanning, although they are still available via direct-address selection. Just tune in the channel that's to be deleted and then push the delete button. The accessory display will be displaced by CHC, meaning channel clear. But next time up or down scanning is used, it will jump over that channel. Any number of channels can be deleted.

In a similar method, any formerly deleted channel can be added to the up or down scanning mode. Because scanning cannot stop on that channel, you must use direct-access method with the channel push-buttons to select the channel. Then when the deleted channel is seen on the screen, press the add button. That's all.

The *normal/cable* switch needs an explanation, also, because incorrect operation can cause many useless service calls to customer's homes. There are two differences between normal and cable operation. One concerns the choice of signal sources. For normal operation, the VHF tuner is supplied from a VHF antenna or CATV cable connected to ACC-1 RF input, while the UHF tuner is supplied from a separate UHF antenna (or UHF signal from a band splitter). But when the switch is moved to *cable* position, the tuners are supplied solely from whatever is connected to the ACC-1 RF input, assumed to be CATV cable.

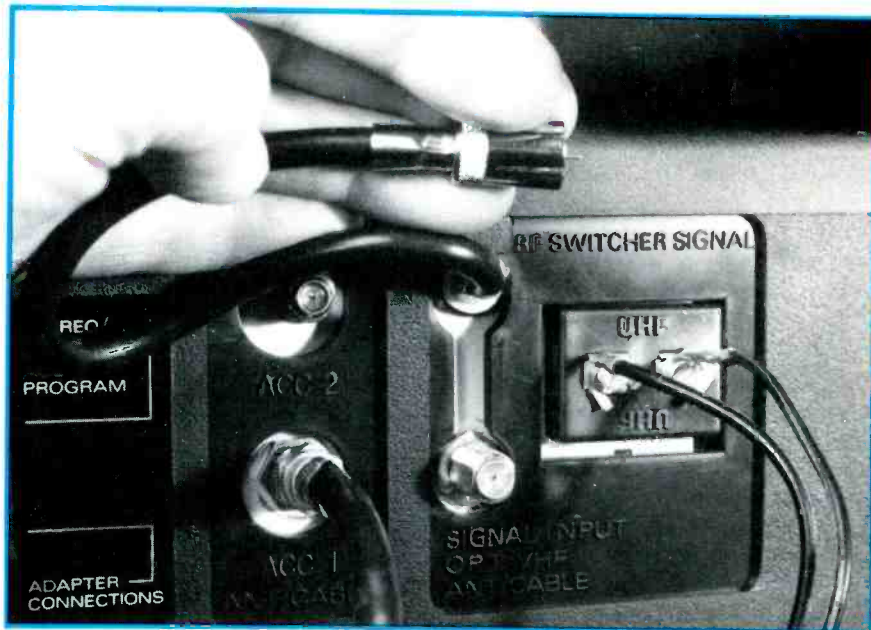


Figure 7. These accessory and signal-input coax jacks can be connected in several different ways according to need. When VHF and UHF antennas alone are used, the RF switcher-signal cable (shown held by fingers) is removed from the signal-input jack (just below it) and the VHF coupling transformer and coax are connected to the signal-input jack. The UHF downloads are connected to the two UHF binding posts. That is all. Notice that the RF switcher is not used.

The second difference is the on-screen readout in the lower-right corner. This readout normally shows A1 for ACC-1 RF input, but when the switch is pushed to *cable* position, the readout changes to CA1 meaning cable signal at ACC-1 input.

No problems should be encountered with this system so long as the customer does not misadjust the normal/cable switch. Or unless someone (such as myself) wants to operate with cable for all available cable channels plus being able to tune in UHF channels directly, without cable.

Perhaps you wonder why anyone would want cable and direct UHF. There are two principal reasons. Some cable systems convert a local UHF channel to VHF of another channel number. Problems can arise when a powerful over-the-air local VHF station is on the same channel. Under some cable disrepair or weather conditions, the UHF station on cable can have severe cross-modulation from the over-the-air station whose picture will be seen moving across the cable/UHF picture. And sometimes the UHF-on-cable sound has excessive noise from the interference.

Another reason for reception independent of the cable is to have *some* TV stations to watch during

those frequent times when the cable goes dead.

Because of the internal signal switching, some peculiar results can be obtained from the normal/cable switch when cable and UHF antenna are used. For example, if UHF channel 41 is tuned-in with the switch at the normal position, the operation is normal and the readout in the lower-right corner of the screen shows A1. But tune in any other channel, change the switch to the cable position and push 41 again. This time there is no station, only snow, and the lower-right readout says CA1 (the time and channel number are correct). Changing the switch to normal does not change the symptoms, unless normal is selected and the station channel number pushed again, which tunes in the station correctly.

Automatic time and channel—Another useful feature (not described in the Sylvania literature) is the on-screen automatic readouts of time and channel number that occur on the hour and half-hour. The time is in its usual place, but the channel number is moved to the lower-right corner. After a few seconds, the readouts are blanked until the next half-hour.

Audio/video switching—Above the color-saturation knob is a push-

button labeled A/V OFF and A/V ON. When the switch is in the out position (A/V OFF), conventional color TV reception with sound is obtained. Unless external sources of audio and video are connected (as shown later), *pushing the switch in to the A/V-ON position eliminates the TV sound and shows only a blank raster (with adjustable brightness) on the screen. This simulates a dead television.*

The in or A/V-ON position switches the receiver's video and audio circuits to receive the external video and audio signals that enter via the jack panel on the cabinet's rear (Figure 6). All eight jacks are the RCA phonograph female type. At the bottom are jacks for right and left speakers, such as the two that are supplied with the instrument. Audio from these jacks comes from a 7W-per-channel stereo amplifier, and the sound is affected by the volume, balance and tone controls that are located on the front panel.

When the A/V-OFF and A/V-ON switch is at the out (or off) position that allows normal TV operation,

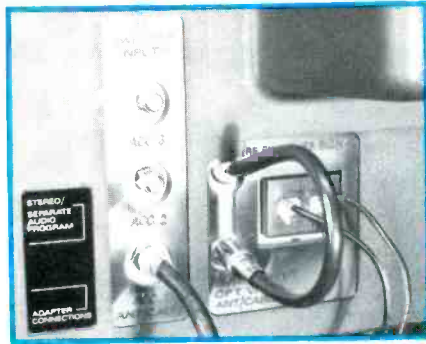


Figure 8. When the RF switcher is to be used, the cable marked RF switcher signal is pushed onto the signal-input optional VHF-input jack (as shown). The CATV cable is connected to the ACC-1 antenna/cable RF input (it can be selected from the front panel). Other audio/video devices with RF output can be connected to ACC-2 and ACC-3 and selected from the front panel. (Lighting used to bring out the almost invisible indented lettering made some areas of the picture too light.)

video for VCR recording comes from the upper-left jack marked *video out*. Simultaneously, line-level audio (monaural or stereo, according to the program) comes from the two jacks marked *audio out*.

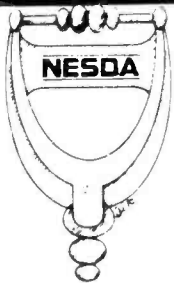
Incidentally, the audio-output signals are not affected by the front-panel volume, balance or tone controls. Nor is the audio muted during station selection.

When the direct video and audio from a VCR or a videodisc is to be brought into the receiver acting as a monitor, the video is connected to the jack marked *video in*, while the audio (either mono or stereo) is connected to the jacks labeled *audio in*. Gain controls are provided for the video and the audio signals.

Antenna/cable connections

Many different combinations of antennas, cable and several RF signals from VCRs and video games can be connected to this Sylvania receiver. For use only with antennas, as shown in Figure 7, the UHF down-lead wires are attached to the two UHF binding posts. After the shielded switcher-output cable is removed, the coax connector of an impedance-matching transformer can be pushed onto the signal-input coax connector (on the chassis), and then the VHF

Business Opportunity



It's plenty tough being an electronics sales and service dealer these days.

That's why we're working so hard to make it easier for you to operate a cost-effective business.

NESDA offers business contacts, technical and management certification, substantial savings on bank-card and insurance rates — and **that's just the beginning!**

NESDA members are kept informed about industry developments and are offered the most comprehensive managerial and technical training programs available. Besides, NESDA is your representative at the national level — including your voice to manufacturers and the agencies of the federal government.

Opportunity knocks . . . Answer it! **NESDA**
National Electronics Sales & Service Dealers Association

For more information and an application, write to:
NESDA, 2708 W. Berry St., Ft. Worth, TX 76109; Ph (817) 921-9061

Name _____

Bus. Name _____

Address _____

State _____ Zip _____ Phone _____

Member of State Local Assn. _____

CA28 UNIVERSAL PICTURE TUBE ADAPTER

NOW YOU CAN USE YOUR CRT/RESTORER/REJUVENATOR/CLEANER ON ANY COLOR CRT YOU DO NOT NEED TO BUY A NEW CRT TESTER. SAVE HUNDREDS OF DOLLARS. "THIS IS THE ONLY ADAPTER YOU WILL NEED" — USE ON NEW IN-LINE & ONE-GUN TUBES —

If your tester is the CLEANER/RESTORER type or the REJUVENATE type, you can use the function on your present machine or any Color Tube listed from a 9" to a 27", including foreign types. Checks Quintrex, Japanese Miniature Base, Japanese In-Line, Sylvania, and GE 90 Degree In-line, New Sony Trinitron, Zenith Special In-line, European 110 degree in-line, Sylvania 100 degree Color Tri-Potential, RCA 90 degree In-line, 110 degree Color, 90 degree Button Base, Large Trinitron, Small Trinitron.



In order to test the tubes presently on the market, you need 60 different sockets. At \$15 a socket, that will cost you \$900 for sockets alone.

That's a lot of money, and it still doesn't prepare you for all the new CRTs to be announced next week, next month and next year. But, what can you do?

Well, you can continue paying \$100, \$200, and \$300 a year for new sockets, and still never be totally prepared. Or, you can make a one time investment and be able to test every color CRT, now and in the future.

We will have over 9000 CRTs to test in five years.



****CHECKS OVER 2200 COLOR TYPES****
*****REPLACES OVER 60 ADAPTERS*****
B&K, BELTRON, SENCORE, REND, EICO, CONAR, HICKOK, HEATHKIT, RCA, ALL OTHERS

Call Toll Free
1-800-331-9658

A MUST FOR THE TV TECHNICIAN

CALL US OR WRITE

COD, Send Check or Money Order. CA-28 Kit \$61.95, add \$2.00 shipping and handling. Visa & Mastercard accepted. U.S. Currency only.

DANDY MANUFACTURING CO.

2323 Gibson, Muskogee, Oklahoma 74403
918-682-4286

Circle (23) on Reply Card

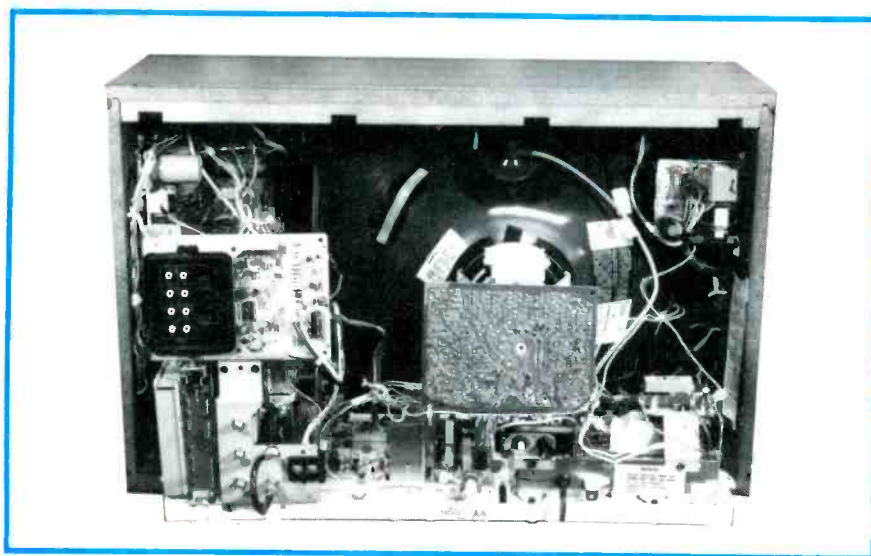


Figure 9. Three large circuit boards and up to nine smaller plug-in boards fill the Sylvania 19C4-03AA almost to overflowing.

down-lead wires connected to the 300Ω side of the matching transformer. The rabbit-ear and UHF bow-tie antennas that come with the receiver can be wired that way. Or the down-leads of UHF and VHF outdoor antennas can be connected as described.

When VCRs, video games and other accessories with RF outputs are to be added, the internal RF-switcher must be used as shown in Figure 8. Connect the RF-switcher output coax cable to the signal-input coax connector. All VHF and MATV cable signals must be connected to ACC-1 (sometimes this is done through a VCR and its switching) at the bottom. Then a videodisc player or a digital audio-disc player is connected to ACC-2 (the center input). Finally, a video game or other accessory with RF output is connected to ACC-3 (top of the three inputs).

After the wiring is completed, several pushes on the ACC button (located with the front-panel controls) increments the diode-operated RF switcher through the three inputs in turn until the desired one is reached. This is similar to operating a stepper switch with a simple switch, and must be done each time a new accessory is to be operated through the television as a monitor.

Before we leave the photograph in Figure 8, notice the unused words at the left of the RF-switcher inputs. Obviously, they are superfluous here. Previous versions of the 19C4 chassis did not

have the multichannel (stereo) sound-decoder board inside (as this one does). Instead, it was to be added later, sitting on top of the receiver where it was connected to the receiver circuitry by two multi-conductor cables and plugs. The unwanted words in Figure 8 are remnants of the previous version, and should be ignored. The present 19C4-03AA Sylvania chassis has the stereo-decoder board inside where no extra connecting cables are needed.

Comments

Circuitry of the Sylvania 19C4-03AA chassis is contained on three main circuit boards (including one with the CRT socket which is larger than most) and up to nine plug-in boards. As shown by the Figure 9 photograph taken after the back was removed, the density of boards and components is very high. This might cause some complications during troubleshooting (or during our detailed analysis of the circuits in future issues). However, the boards plug in with connectors, so removal of most boards should not be difficult.

The complexity has been reduced by electronic switching of audio and video circuits on the audio/video boards and the accessory inputs (Figure 10). Electronic switching eliminates bulky multisection rotary switches and many cables.

Color-picture quality—A few instrument tests and many view-

ing and listening tests have been made. Of special interest were the effects of the comb filter, the scan-velocity modulation (SVM) and the automatic sharpness circuits that contribute to a better picture.

Several preliminary scope tests and observations proved the SVM circuit does increase the sharpness. Although the contrast also appeared to be higher, a closer examination showed the improvement was to the narrow black and white vertical lines in the picture. These were sharper and seemed blacker or whiter respectively on the Sylvania than on an older conventional color receiver used as a standard.

Colored sections of pictures were relatively sharp, apparently from good bandwidth, and the fit was excellent with the luminance signals. Evidently the comb filter is doing an adequate job of removing the luminance from the chrominance, because only one case showed weak colored rainbows moving on a striped necktie.

When the sharpness control was advanced for better sharpness, all of the snow, grain, cross-modulation and minor ghosts that are visible on most cable TV pictures began to be objectionable. I am anxious to see the improvements when a videodisc or a good-quality

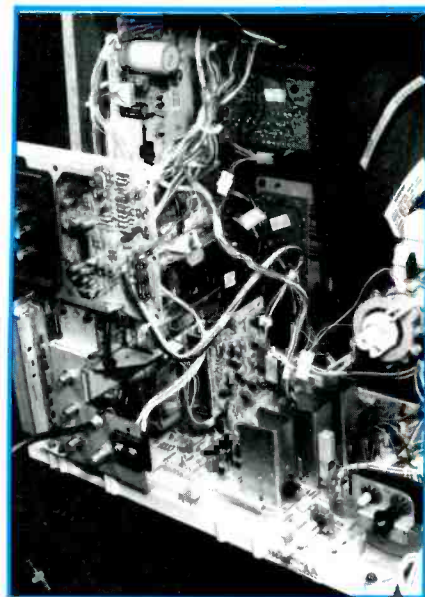


Figure 10. An oblique view shows the crowded tuning and signal side of the Sylvania receiver. The large board behind the jack panel is the audio/video input/output board, and the other board to the right above is the audio board. Other boards will be identified later in the series.

VCR tape is viewed on the Sylvania screen.

Stereo sound—When an audio-cassette tape deck was connected to the two audio-input jacks, the sound quality was more than adequate. Music through the internal stereo amplifiers and the two external speakers supplied with the machine should satisfy almost all customers. Only in direct comparison with my larger component system did it fall short. The tone controls have moderate range, and the straight-line, sideways-moving knobs show the settings at a glance.

TV-program audio from the jack panel was tape recorded several times and found to have good frequency response without problems of horizontal frequency causing beats in the audio recording.

Over the years, I have obtained audio from television's low-level stages and sent the sounds to a hi-fi system, or recorded it on tape. Usually the results are inferior. Many of the older televisions had noticeable video buzz in the sound, the high-frequency response was

non-existent, often the 15.734kHz horizontal-sweep would ride piggy-back on the connecting cable (even when shielded), and most such attempts at obtaining TV audio were unsatisfactory. When viewed against this background, the operation of the Sylvania TV audio is excellent when brought out to other equipment.

However, it is frustrating to have available a receiver with the proper stereo-decoder and stereo-audio circuits and not be able to hear TV stereo sound. None of the stations in this area (or any so far found on cable) can broadcast TV stereo audio. The wider bandwidth required makes necessary expensive extensive alterations (or aural transmitter replacement) before even network TV stereo sound can be broadcast here locally. Until that happens (or a manufacturer brings out a test generator) that feature must go untested.

In summary, I have been pleased with the performance of the Sylvania Superset Two model RX-S198WA and am enthusiastic about analyzing all the major cir-

cuits. One feature not described is the infrared remote control. It has 19 push-buttons, just one less than the receiver panel, and it can perform all the same functions, except *time set* which can be done only at the panel. This receiver could be called a *color-receiver/monitor* because it has provisions for connecting VCRs and other accessories either by RF via cables or by connecting video and audio sources directly. Of course, the versatility carries the threat that customers might operate some of the many switches wrong and thus ask for warranty service where there is no defect. These calls are not under the factory warranty. Therefore, technicians should learn all these potential problems and be prepared to solve them easily.

Next article

Circuits of the low-voltage power supplies, start-up, shut-down and the SCR-type regulator will be explained with waveforms, voltages and troubleshooting suggestions.

ES&T

PREPARE

For The Future



1985 National Professional Electronics Convention

Hartford CT • Parkview Hilton • August 5-10

Early Registration Discounts.

Also discounts for additional persons from the same family or business.

Send for more information and an application to:
NPEC, 2708 W. Berry St., Ft. Worth, TX 76109; Ph (817) 921-9061

Name _____
Address _____
City _____ State _____ Zip _____

OPTIMA ELECTRONICS

TO ORDER CALL TOLL FREE 1-800-327-0224

POPULAR VCR NUMBERS

<input type="checkbox"/> AN6300	\$ 5.25	<input type="checkbox"/> AN6344	\$ 7.25
<input type="checkbox"/> AN6320	\$ 3.25	<input type="checkbox"/> AN6350	\$ 7.95
<input type="checkbox"/> AN6330	\$ 3.25	<input type="checkbox"/> AN6361	\$ 3.95
<input type="checkbox"/> AN6332	\$ 6.95	<input type="checkbox"/> AN6677	\$ 5.95
<input type="checkbox"/> AN6341	\$ 4.25	<input type="checkbox"/> AN6912	\$ 2.25

Call and ask for our current flyer.

HORIZONTAL OUTPUT TRANSISTORS

\$2.50 ea. Min. 10,	
1 yr. Warranty	<input type="checkbox"/> 2SD900 Hitachi (Rep. ECG 89) 5 for \$15.00
<input type="checkbox"/> 1308K Sanyo	<input type="checkbox"/> PN3646 (123AP) 100 for \$10.00
<input type="checkbox"/> 2SD1341P Sanyo	<input type="checkbox"/> 3AMP 1000P IV Rectifiers 100 for \$15.00

MONTHLY SPECIALS

TRANSISTORS & I.C.'s...MIN. 10, CAN MIX

<input type="checkbox"/> 2SC1116 ... \$3.95	<input type="checkbox"/> 221-103 ... \$7.25	<input type="checkbox"/> DM133 ... \$5.95
<input type="checkbox"/> 2SC1114 ... \$3.75	<input type="checkbox"/> 221-132 ... \$3.40	<input type="checkbox"/> DA101 ... \$5.75
<input type="checkbox"/> MN8303 ... \$3.95	<input type="checkbox"/> 221-140 ... \$10.95	<input type="checkbox"/> HA1388 ... \$5.25
<input type="checkbox"/> 2SC1124 ... \$.95	<input type="checkbox"/> 221-158-01 ... \$4.75	<input type="checkbox"/> HA1396 ... \$5.50
<input type="checkbox"/> 2SD871 ... \$4.25	<input type="checkbox"/> 221-175 ... \$10.95	<input type="checkbox"/> HA1398 ... \$4.95
<input type="checkbox"/> CX101G ... \$10.50	<input type="checkbox"/> 221-178 ... \$7.00	<input type="checkbox"/> UPC1181 ... \$1.00
<input type="checkbox"/> CX103 ... \$10.50	<input type="checkbox"/> 221-179-01 ... \$10.95	<input type="checkbox"/> UPC1182 ... \$1.00
<input type="checkbox"/> CX143A ... \$10.50	<input type="checkbox"/> 221-190 ... \$10.95	<input type="checkbox"/> UPC1185H ... \$3.50
<input type="checkbox"/> UPC1368H2 \$3.95	<input type="checkbox"/> 221-193 ... \$7.95	<input type="checkbox"/> 2SC2580 ... \$2.95
<input type="checkbox"/> UPC1367C \$3.75	<input type="checkbox"/> 185-9-01	<input type="checkbox"/> 2SA1105 ... \$2.95
(Subs CX557A)	(triac) \$1.50	

STEREO #'s

GENERAL

<input type="checkbox"/> Lamp/fuse used in VCR's (#144604)	5 for \$7.50
<input type="checkbox"/> ADC-QLM30 Cart. & Needle Boxed (needle only \$2.25)	\$4.75
<input type="checkbox"/> Shure M81MC Cart. & Needle	\$6.95
<input type="checkbox"/> F59A-59U Connector Crimp-on	300 for \$30.00
<input type="checkbox"/> Beta Video Heads	\$53.20
<input type="checkbox"/> VHS Video Heads	\$48.10
<input type="checkbox"/> Panasonic Dual Antenna-Packaged (AT-19) min. 5	\$2.99
<input type="checkbox"/> TV/Game Switch (#AB21) min. 10	\$.89

Quantity Prices Available

Letters of credit and all checks placed on deposit with Bank of Hallendale, FL. VISA & Master Charge accepted. Min. order \$75. FOB Dania, FL. Catalog \$3, refundable upon order.

SEND CHECK OR MONEY ORDER TO: OPTIMA ELECTRONICS

2022 Tigerfall Blvd., Dania, FL 33004
Phone (305) 920-3550 TOLL FREE: 1-800-327-0224

Circle (24) on Reply Card

What do you know about components?

More about resistors and diodes

By Sam Wilson

Since this series started, I have received a number of letters from friends and many suggested that I discuss additional material on the subjects already covered. In this article, I'll include some of the ideas on resistors that came in the mail.

Update on resistors

Although still more carbon composition resistors are in existence, they have been replaced in new designs by carbon film resistors. The higher noise of the carbon composition type is given as one of the reasons.

The use of carbon film resistors presents some special problems. Unlike with carbon composition types, the film type does not have a specific size for a given power rating. Also, because the shape of the film types may vary from one manufacturer to another, you have to be more alert when making a substitution.

Not all carbon film resistors are classified as being non-flammable! You have to be careful not to replace a non-flammable resistor with one that isn't. Also, remember it is a bad idea to replace film types with carbon composition types. You might introduce additional (and unwanted) noise into the system.

If someone asked you to give the color codes for the following resistor tolerances, how many would you know?

± 20 percent _____

± 10 percent _____

± 5 percent _____

± 2 percent _____

± 1 percent _____

If you knew red is the color code for ±2 percent, and brown is the color code for ±1 percent, then you can give yourself a gold star. We don't even have to talk about the other three.

I'll continue to update the articles as the letters come. I sincerely appreciate your comments.

More about diodes

In the last issue, I talked about some special-purpose diodes. Because there are so many kinds, it wouldn't be possible to cover all of them in the next 40 issues.

One of the first types was made from *galena*. That's another name for lead sulfide. Early *crystal* sets used this component for a detector. Figure 1 shows its construction. To use it, you have to move

the cat whisker to different points on the surface until you (eventually) locate a spot where rectification (and detection) takes place. I know of at least one case where the patience of the operator wore out before the magic spot was located.

Today, *point contact* diodes are made with the cat whisker permanently attached to the crystal. They don't use galena to make them, but they are still made with the metal-to-semiconductor junction. Because of the very small rectifying region, they have very little capacitance, and a very low forward voltage drop. They're used mostly for detectors.

I saw the prisoners in the movie "Stalag 17" make a radio out of things they had stolen out of the kitchen. So, I decided that would be a good project for my students. In my mind, it would be impossible. As often happens with students, they can do the impossible experiments. It is the ones with Ohm's law they can't handle.

They made the diode by melting some solder. While the solder was cooling, they sprinkled sulfur onto the surface. Then, they used a very fine wire for a cat whisker. They made the rest of the parts with the same clever ingenuity. The headphones, though, were obviously from a parts supply house. "Very

good, but, how did you get those headphones?" I asked. (I wanted them to know they couldn't put anything over on me.)

"We stole them—like in the movie."

A diode can also be made by pushing the sharp edge of a razor blade against a copper wire. I'm sure you have also heard about bed-springs and dental work that get into some kind of wierd combination to make a detector and, in fact, a complete radio.

The point is, diodes range in complexity from types that can be made at home to very complex structures like the magnetron.

Load lines

All of the diodes have at least one characteristic in common: they are all nonlinear devices. Another way of saying that is: *You can't calculate the current through a diode by using Ohm's law.*

It is an easy matter to find the current graphically. The procedure involves plotting a *load line*. It will be reviewed here—not because you have to do it as part of your everyday job, but, because it will help to give some insight into the diode's character.

Consider the simple circuit of Figure 2. If you plotted every possible value of voltage across

resistor R_L , and the corresponding value of current through that load resistor, you would get the load line shown in Figure 3.

Actually, only two of the points are needed to plot that line:

$$\begin{aligned} \text{when } V &= 0, I = Va/Ra \\ \text{and, when } I &= 0, V = Va \end{aligned}$$

The resistance of a diode is nonlinear, but whatever its value it *must* lie somewhere on the load line of the circuit in which it's connected. Figure 4 shows a diode characteristic curve. If you connect the diode which has that curve across the simple circuit of Figure 2, the amount of current will depend upon the diode's resistance for that particular set of circumstances. Drawing the load line on the characteristic curve, as shown in Figure 5, will provide the information on the current through the diode and the voltage across the diode.

That's all very well for the circuit of Figure 2. But, suppose you want to connect the diode across a more complicated circuit with three or four resistors, and more than one battery?

A basic theorem in electrical theory says: *no matter how many resistors and batteries a circuit has, you can **always** simplify it to the one shown in Figure 2.* If you simplify the circuit, then a resistor across the simplified version of Figure 2 will draw the exact same current, and it will have exactly the same amount of voltage across it as it would in the original complicated circuit.

The name of that handy mathematical trick is *Thevenin's Theorem*.

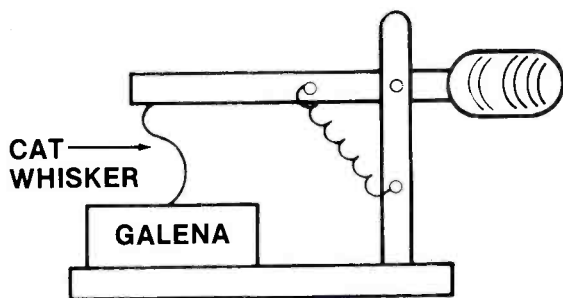


Figure 1

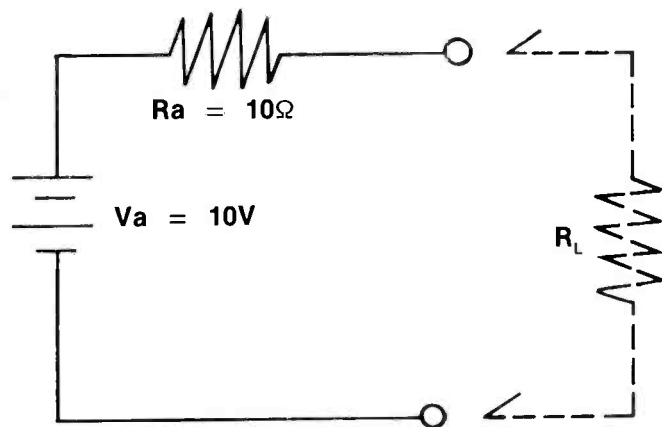


Figure 2

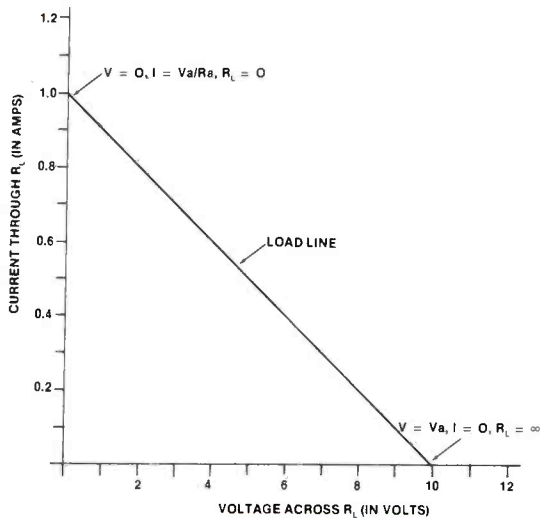


Figure 3

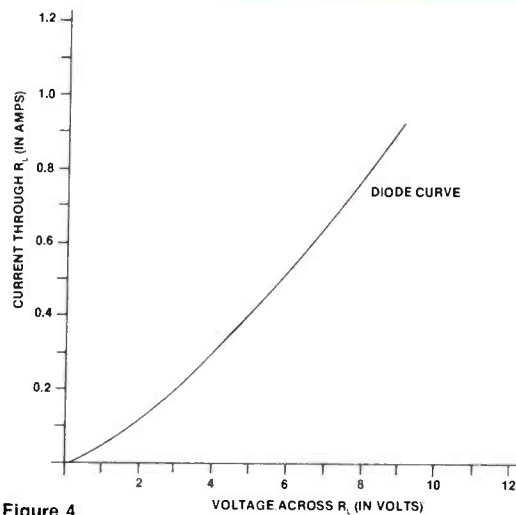


Figure 4

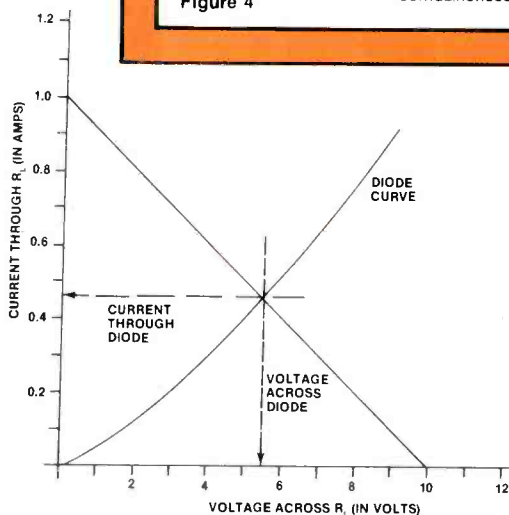


Figure 5

If you put a diode in an ac circuit, the theory is the same but the resistance becomes impedance; and, the battery becomes an ac generator.

From the procedure just described, it should be obvious that putting a different diode in the circuit will give a different solution because the characteristic curve of the diode will not be the same. So, even though two diodes look the same, and do the same kind of work, they will not perform the same in a given circuit.

Some thoughts on replacing diodes

As in the case of resistors, your best bet is to get an exact replacement. Remember some guy at the factory went to a lot of trouble working out all of the required math to get it just right, so his choice (an exact replacement) will work best.

If you try to replace a point contact diode with a junction type, most likely it won't work: the forward voltage drop across the diode will be too high. Also, the added capacitance will very likely cause a problem.

If you try to replace a hot carrier type with a junction type, it probably won't work because the reverse recovery time will be too long. Also, there will likely be small spikes of reverse voltage that can't be tolerated in the circuit where the hot carrier diode was used.

Zener diodes are rated by voltage and power. If you put the wrong one in a circuit for replacement, it can make the circuit worthless. Worse yet, it may work just long enough to get the repaired unit back into its cabinet, then burn out because it has the wrong power rating.

We'll spend some more time with diodes in the next issue. **ES&M**

Products

Videotape explains satellite TV

"The Remarkable Dish," a professionally produced videotape designed for Winegard TVRO dealers is now available from the *Winegard Company*, Burlington, IA. The 7-minute videotape explains to consumers, in easily understood terms, how satellite TV works, featuring Winegard products and installations. The tape includes a blend of NASA space clips, colorful graphics and live-action footage.

Circle (84) on Reply Card

Satellite reception electronics package

Lowrance Electronics, Tulsa, OK, announces the introduction of a state-of-the-art electronics package for satellite reception. The XP Performance Package features an LNA with a 60-80 degree low noise temperature with a gain of 47-49dB. It also incorporates a ferrite polarized feed system with less the 0.15dB loss and completely linear operation. The receiver, System 70, is recognized for its video and audio performance. The XP Performance Package includes all the equipment and cables for a complete electronics hookup. The package comes with either the System 70X mono or System 70S stereo receiver.

Circle (85) on Reply Card

Logic comparator

Jensen Tools, Phoenix, AZ, introduces the Bugtrap model 2074A logic comparator, offering logic comparison with a substantial increase in testing capability. The 2074 accurately tests the full line of 14, 16, 18 and 20 pin TTL ICs, including tri-state, bi-directional and open collector ICs, even 5V TTL RAMS and bipolar ROMS.

The Bugtrap 1074A tests dynamically, in circuit, at system speed under actual operating

conditions and requires no interpretation of digital activity. A malfunctioning IC will cause one or more LEDs to light and latch, exposing the fault line.

Circle (86) on Reply Card

PC circuit repair/modification kit

Bishop Graphics, Westlake Village, CA, introduces the E-Z Circuit printed circuit repair and modification kit. Using conductive copper tape, donut pads and copper sheets, this kit provides a quick, reliable and cost-effective method of repairing or modifying burnt, broken and lifted PCB circuitry. Each repair kit contains an assortment of adhesive-backed current conducting copper products, including tape, donut pads, a 5" x 6" copper sheet, a roll of polyester insulating tape and step-by-step application instructions.

Circle (87) on Reply Card

Telephone loop tester

Model 4 (Type 2) telephone tester, introduced by *Triplet Corporation*, Bluffton, OH, offers revised and optional programmable frequencies, plus improved frequency accuracy. The tester includes a tone generator, transmission test set, volt-ohmmeter and 8455-type capabilities to measure power influence, circuit noise, circuit loss or line milliamp checks and loop-around on telephone company or privately installed systems.

Circle (88) on Reply Card

Wriststraps

Desco Industries, Walnut, CA, offers a new line of wriststraps, grounding cords and testers for ESD (electrostatic discharge) protection devices. These wrist strap products are manufactured using the latest ESD technology. Wristbands are designed to provide maximum wearer comfort and safe reliable discharge paths for static charges. Ground cords are rugged reinforced retractile coil or straight wire cords designed to provide long life with safety.

Circle (89) on Reply Card

ATTENTION TECHNICIANS

- ★ JOB OPENINGS
- ★ MONTHLY TECHNICAL TRAINING PROGRAM
- ★ BUSINESS MANAGEMENT TRAINING
- ★ LOW COST INSURANCE
- ★ CERTIFICATION
- ★ TECHNICAL SEMINARS

All of this in a nonprofit international association for technicians

FIND OUT MORE:



R.R. 3 Box 564
Greencastle, IN 46135

MOVING?

If you're planning a move in the near future, don't risk missing an issue of *Electronic Servicing & Technology*. Please give us 6-8 weeks notice if you're planning on changing your address. Just write in your new address below and mail this coupon, WITH YOUR SUBSCRIPTION MAILING LABEL, to:

ELECTRONIC
Servicing & Technology

Subscriber Services
P. O. Box 12901
Overland Park, KS 66212

Name _____

Address _____

City _____

State _____ Zip _____

ES&T

Readers' Exchange

Readers' Exchange listings are free and are limited to three items per month. "For sale" items must be used equipment sold by individuals, not companies. Send information to: Readers' Exchange, Electronic Servicing & Technology, P.O. Box 12901, Overland Park, KS 66212.

Wanted: Model 110 40A capacitive voltage divider for use with Hewlett-Packard model 410B vacuum tube voltmeter. *Robert J. Blackwell, 2925 Riggs Ave., Baltimore, MD 21216; 301-362-6678.*

For Sale: B&K model 801 capacitor checker, \$75. Conar tube checker, \$50. *Stan Hayman 19707 Turnberry Way, N. Miami Beach, FL 33180; 305-944-5674.*

Wanted: S-meter for a Hallicrafter model SX-28 in good condition. *Paul Caputo, 637 W. 21st St., Erie, PA 16502.*

Needed: Supremes manuals TV 16 & 19 and instruction/service manual for Shintron 366 amp. *C.T. Huth, 130 Hunter St., Tiffin, OH 44883.*

Needed: Output transformer #P-42004 for NEQ-360 Nippon equalizer booster, serial No. 30209479, schematic/service manual. *Jean Ketel Mathieu, 218-20 112th Ave., Queens Village, NY 11429.*

For Sale: Conar UK231 tuned signal tracer with probes and owners manual; EICO 324 RF generator with shielded RF cable and owners manual; Radio Shack untuned signal tracer. All for \$100 or best offer, plus U.P.S./C.O.D. charge. *Mark Dawson, 233 16th St., Apt. 109, Jersey City, NJ 07302; 201-798-2084.*

Needed: Any condition recorder for Playmate size tapes as was used in defensive instrument's alarm dialer. Also schematic dealer #AT-555. *Harold Klotzle, 410 Cleveland Road, Ravenna, OH 44266; 216-297-1491.*

Needed: Pin-cushion transformer for Philco-Ford color, part No. 32-10182-1. Used in chassis 3CS90-91 or 3CY90-91. Part no longer available from manufacturer. New or from junk chassis acceptable. Anybody know if any other part would substitute. Appreciate help or information. *Gene Cheatham TV, 1938 Michigan Road, Madison, IN 47250; 812-273-2083.*

For Sale: RCA yoke fly 504, new, half-price; VTVM R/D instruments model No. 1600 B, best offer under \$50; excellent condition VCR/VHS Quasar VR1000, with two tapes, best offer under \$150. *Joe LaGuardia, 30064 SW 158 Court, Homestead, FL 33033; 305-245-1012.*

For Sale: Tektronix 2215 oscilloscope, dc to 60MHz, dual trace, dual time base, included with scope are two P6120 probes, front cover and full documentation, total run time 21 hours, \$1100. *Leon Small, Barre Road, Hardwick, MA 01037; 413-477-6083.*

For Sale: Simson multimeter model 464D; Sencore TC28 tube and transtester; B&K H.V. 44 probe; Vis-WP26A isotap; plus hundreds of

tubes and parts. Make offer on any or all. *Paul Kozlowski, 124 Fairview Ave., High Bridge, NJ 08829; 201-638-8025.*

Needed: Schematic and parts list for a stereo recording reinforcement mixer made by Technical Audio Products (Tapco), model 6200A. Will pay for the copy and postage. *Arthur R. Vickery, P.O. Box 742, Torrington, CT 06790.*

Needed: Jackson model X-100 color bar generator; Jackson color bar generator, model 700 or 712; Hickok 661 color generator; Hickok 209C VTVM with probes; Hickok 295X generator; Hickok 209A VTVM. *J.G. Shoemaker, 600 First St., Leechburg, PA 15656; 412-842-8321.*

For Sale: Sencore VA48, \$825; B&K model 467 CRT rejuvenator, \$300; B&K model 1248 color bar generator, \$135. *Advanced TV & Video Service, 19217 Watkins Mill Road, Gaithersburg, MD 20879; 301-977-6787.*

For Sale: Sencore VA48, excellent condition, all leads and manuals, \$750. *Howard Mason, 317 Dorchester Drive, Route-1, Linwood, NJ 08221; 609-927-0119.*

Needed: Schematic and parts list for Jerrold Division CATV cable converter, model No. JRX-3DIC-105. Also need schematic and parts list for EICO model No. 955 in-circuit capacitor tester. Will pay for copies and postage. *Joe LaGuardia, P.O. Box 1151, Homestead, FL 33030.*

For Sale: Leader LBO-520 30MHz dual trace scope, \$350; Sencore VA48, \$725. Both in good condition with manuals and leads. *J & S Enterprises, 3015 Clarksville St., Paris, TX 75460; 214-785-3641.*

Needed: Schematics for two old radios: Grunow, model 5L and an Atwater-Kent, model 206. I will pay for copies or any information. *Abie D. Clark, Clark Radio and TV, 3205 Tait Terrace, Norfolk, VA 23509; 804-853-3715.*

For Sale: Heathkit IO-4101 vectorscope, has pattern generator, 1-year old, make offer. *Christopher Papin, 1510 C Mews Drive, Kansas City, MO 64131; 816-941-0173.*

Wanted: A schematic for a Precision-Paco oscilloscope model ES-550B. Will pay supplier for any copying and shipping expenses. *Wesley J. Knox, 4822 Mt. Casas Drive, San Diego, CA 92117.*

Wanted: Radio and color TV course with or without the experiments. Must be reasonable. Send information to: *Daniel Seidler, 5827 S. Campbell Ave., Chicago, IL 60629.*

For Sale: Used flys, tuners, yokes from miscellaneous Admiral, Coronado, GE, Magnavox, Motorola; same parts for solid state Admiral, Quasar, RCA Sears, Zenith. Also: two manuals by Wallace's Telaides, a 1946-1954 RCA TV schematic diagrams and 1954 models Crosley, Emerson, Philco, Raytheon, Satchell Carlson, Zenith. *D.J. Ajjala, 50 Fir Circle, Babbitt, MN 55706.*

Needed: Schematic, tubes, layout and any other available service information on the Hallicrafter radio receiver model SX42, serial No. HA76511. Will buy or pay for reproduction cost. *Jean K. Mathieu, 218-31 105th Ave., Queens Village, NY 11429.*

Needed: Instruction manual for TEAC model A3340S reel-to-reel tape recorder. Willing to pay for copy and shipping charges. *Dan Maldonado, 1360 63rd St., Brooklyn, NY 11219; 212-256-6466.*

Needed: Sencore model SG165 AM/FM stereo analyzer in good condition. *Ed Klinker, 802 Rainbow Drive, Waterloo, IA 50701; 319-233-8078 (days).*

Photofact

DUMONT	
DL1947WR	2295-1
J C PENNEY	
685-2073-00	2298-1
MAGNAVOX	
BE3739SL01	2296-1
MIDLAND	
15-042	2292-1

QUASAR	
Chassis GC105	2294-1
RCA	
CTC118A, ASUB1	2295-2
Chassis CTC120A (1985 Prod.), C, D	2296-2
SANYO	
Chassis A7D-25800	2294-2
SEARS	
562.40330250/31350	2292-2
564.42040450	2293-1
564.42720450/51	2298-2
SONY	
Chassis SCC-486J-A, K-A	2297-1
TOSHIBA	
Chassis TAC8310/370	2292-3
Chassis TAC8335/385	2293-2
Chassis TAC8337/380	2297-2

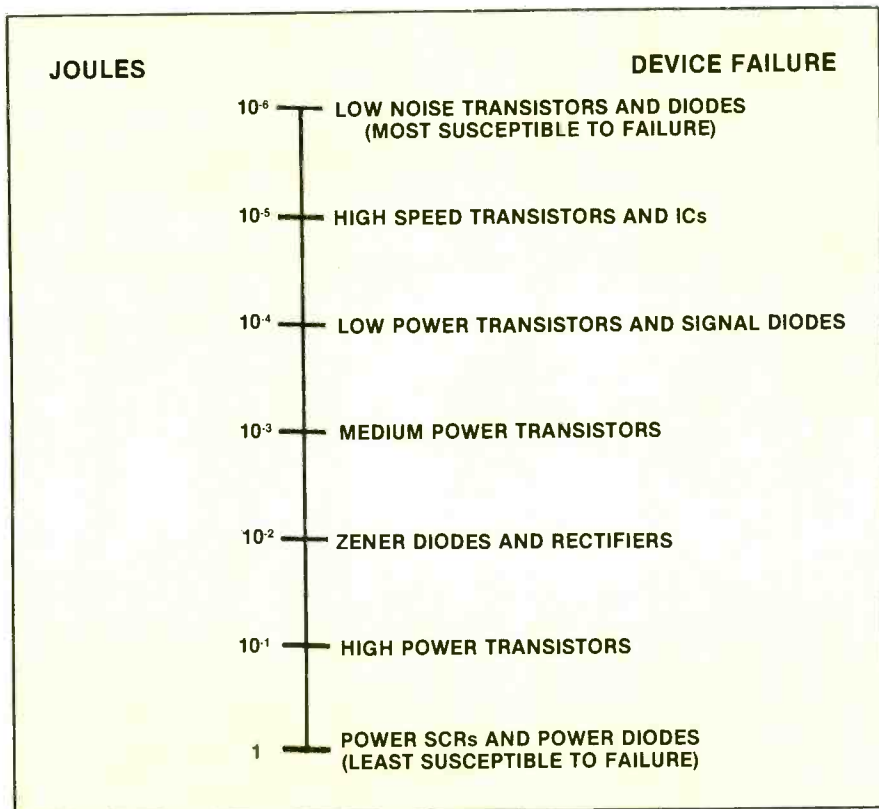


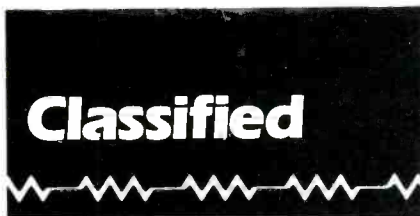
Figure 6. An estimate of the susceptibility of semiconductor devices to failure due to transient energy. A transient duration of several microseconds is assumed.

through device failure, but also due to logic state upsets. Studies have shown an upset in the logic of typical digital circuitry can occur with very low transient energy levels. Such logic state upsets can result in microcomputer latch-up, lost or incorrect data, program errors and control system shutdown.

In addition to the single-occurrence logic upset, exposure of semiconductors to a high transient environment can cause a progressive degradation of the device, which can eventually result in total failure. Figure 6 shows the energy-vs.-survival scale for several types of semiconductors. This chart clearly shows the importance of effective transient suppression.

Keeping these demons out

Manufacturers now offer a wide variety of transient suppression devices to protect sensitive home electronics equipment. The concluding article in this series, describing the design and function of some of these devices, will be published in the next issue of **ES&T**.



Advertising rates in the Classified Section are 75 cents per word, each insertion, and must be accompanied by payment to insure publications.

Each initial or abbreviation counts a full word.

Minimum classified charge is \$15.00.

For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of \$25.00 per insertion to cover department number, processing of replies, and mailing costs.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or distributor.

FOR SALE

SUBSCRIPTION TV MANUAL, covers all three major scrambling systems, only \$12.95. Includes theory, circuits, waveforms and trouble shooting hints. Save your VIDEOTEX CARTRIDGES on EPROM with out EPROM duplicator. Plans \$9.95. Catalogue \$2.00, refundable. **RANDOM ACCESS**, Box 41770A, Phoenix, AZ 85080. 1-85-tfn

AUTOMOBILE RADIO and tape replacement parts. Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469. (212) 881-9600. National (800) 223-8314, NY State (800) 446-4430. 1-85-tfn

SAMS SCHEMATICS 1100-2100 with three filing cabinets, \$300. R. Sugnet, 1204 Glendale Street, Midland, MI 48640. (517) 832-3359. 2-85-11

BOOTLEGGERS BIBLE for CB Modification \$12.95, CB Radio Repair \$10.95. Linear Amplifier Planbook \$14.95, kits, etc. Catalog \$1.00 refundable — APS, POB 263 Newport, R.I. 02840 401-846-5627. 12-84-tfn

BURGLAR ALARM Warning Stickers, bright red with white letters stating Warning Alarm System Electronically Protected. 5 for \$3.00. High Tech Installations, 442 Adams Street, Freeland, Penna. 18224. 2-85-11

COLOR PICTURE TUBE Rebuilding Equipment. In excellent condition, everything to build good tube. Training available. John Smith, Box 34, Fountain, CO 80817. 2-85-2t

INDIVIDUAL PHOTOFAC FOLDERS (Not sets) #1 to #1400 \$3.00 first-class postpaid. Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 1-85-3t

SAVE BIG BUCKS ON INTEGRATED CIRCUITS AND TRANSISTORS. WHOLESAL PRICES. LARGE INVENTORY. WRITE: JILCO INTERNATIONAL, 439 MAIN ST., SUITE 2B, EAST ORANGE, NJ 07017. 2-85-4t

SCRAMBLED TELEVISION, encoding/decoding. New book. Theory/circuits, \$9.95 plus \$1 shipping. Workshop, Box 393ES, Dept. E, Bethpage, NY 11714. 1-85-tfn

REPAIRING THE 64, A manual based on actual repairs to hundreds of Commodore 64s, \$15.95, WM Micro, Box 3287, DEPS, Dartmouth N.S. Canada B2W5G2. 2-85-2t

SERVICE MONITOR Com-Ser BR-1000, Excellent condition. \$2950.00 or highest bid. (Must be sold by Feb. 28th) Doug's Electronics, 913-364-2016. 2-85-11

VIDEO TUNE-UP PROGRAM converts C64 computer into affordable full function test pattern generator. It produces all industry standard patterns plus a completely animated alignment test. Video monitor and television tune-up instructions included. Excellent for shop, lab, home, schools. Specify disk/tape. Send \$18.95 to: SOLAS PRODUCTS, Box 665, Springhouse, PA 19477. Dealers call (215) 362-5028. 2-85-11

FULL LINE of TV converters. Wireless and manual compatible to Jerrold and Oak Systems. This month's special the Technica 140CHL stereo and video compatible out-put wireless converter. The only unit with a wireless volume control adjustment only \$159; cable 15dB Amp in-line type only \$20. **RED COAT ELECTRONICS**, new address and phone: 104-20 — 68th Dr., Forest Hills, NY 11374, Tele: (212) 459-5088. Catalogue \$3 for specials. 10-84-tfn

TUBES — Receiving, Industrial and Semi-conductors, factory boxed. Free price list. Low; low prices. **TRANSELETRONIC INC.**, 1365-39th St., Brooklyn, NY 11218E, 800-221-5802, 212-633-2800. 1-85-tfn

TV TROUBLE ANALYSIS TIPS. Over 300 symptoms/remedies by circuit area; tough ones over the years. Save time and money. Send \$12.50 to CHAN TV, 8151 Grandview Rd., Chanhassen, MN 55317. 1-85-tfn

REMARKABLE diagnostic tool. Determine operation of high voltage circuits every time. You will not be mistaken about your conclusions. Send \$4.00 to Jones, Box 693, Niceville, Fla. 32578.

MAKE TELEPHONE answering machine servicing simple & professional. Without tying up your phone lines, our ring simulator will activate any machine on the market. You can hear the outgoing message, give your message, and also have the availability to check machines that have remote capability. Send your check for \$85.00 made payable to PSI, INC. to cover cost of machine shipping and handling or call (201) 845-6669. PSI, Inc. is located at: 34, Route 17 North, Paramus, New Jersey 07652. 4-84-tfn

SONY — PANASONIC — RCA — ZENITH EXACT REPLACEMENT PARTS — SONY PARTS AND TRINITRON SPECIALISTS. LARGE INVENTORIES. CALL 516-678-1700 OR WRITE WITH PART NEEDED. GREEN-TELE-RADIO, 172 SUNRISE HIGHWAY, ROCKVILLE CENTER, NY 11570. 1-85-tfn

TUBES FOR TV AND RADIO — 35¢ ea. Washington TV Service, 1330 E. Florence Ave., Los Angeles, CA 90001. 11-84-12t

FOR SALE (CONT.)

TV TROUBLESHOOTING. Over 60 illustrated problems, solutions of difficult repairs. Also, 12 steps to easier TV repair. Send \$12.00 to Jones, Box 693, Niceville, Fla 32578. 2-85-3t

TV-VCR-AUDIO service shop. \$2,000. 20 years same location. Excellent reputation; large repeat business. Keller Audio, Norwalk, CT 203-847-3676. 2-85-1t

HELP WANTED

TV TECH NEEDED: Must be experienced on road and bench. Good pay. Incentive plan. Reply Box 894, Union, NJ 07083. 1-85-3t

FIELD SERVICE REPRESENTATIVES: If you're looking for a dynamic position with a recognized industry leader, look to Fisher Corporation. We're a national pace-setter in the manufacture of quality audio and video components, with 2 openings for Field Service Reps to cover our West and East Coast territories. Based in our Southern California headquarters, you'll travel to dealer locations within your region to resolve questions and improve service. Successful candidates will have demonstrated ability of 2 years in technical operation and 4 years in the servicing of audio/video consumer electronics. Fisher offers an attractive salary and benefits package, as well as the opportunity to join a rapidly expanding leadership company. For consideration, please send your resume with salary requirements to: Jody Shaffer, FISHER CORPORATION, 21314 Lassen St., Chatsworth, CA 91311. EOE 2-85-1t

EDUC.-INSTRUCTION

UNIVERSITY DEGREES! Economical home study for Bachelor's, Master's, Doctorate. Prestigious faculty counsels for independent study and life experience credits. Free information—Richard Crews, M.D. (Harvard), President, Columbia Pacific University, 1415 Third St., Dept. 2B82, San Rafael, CA 94901; Toll Free: 800/227-0119; California: 800/552-5522; or 415/459-1650. 2-85-1t

WANTED

PICTURE TUBE REBUILDING EQUIPMENT, working or not, write or call: Chicago Television, 633 North Semoran Blvd., Orlando, Florida 32807. Ph. 275-9543. 11-84-9t

WANTED: Old tubes and parts for tube type radios, including capacitors, coils, knobs, vibrators, Rider Manuals, etc. Antique Electronic Supply, 1725 W. University, Tempe, AZ 85281. 2-85-2t

BUSINESS OPPORTUNITIES

PICTURE TUBE REBUILDING EQUIPMENT, one man operation, full training and technical assistance. Buy with confidence from experts in the field. Call or write: Chicago Television, 633 N. Semoran Blvd., Orlando, Florida 32807, Ph. 305-275-9543. 11-84-9t



THIS SPACE CONTRIBUTED BY THE PUBLISHER

ELECTRONIC

Servicing & Technology

Advertising Sales Offices

NATIONAL SALES MANAGER

Greg Garrison
P.O. Box 12901
Overland Park, KS 66212
Phone: (913) 888-4664

LONDON, ENGLAND

Nicholas McGeachin
Suite 460, Southbank House
Black Prince Rd.,
London SE1 7SJ England

Telephones:
Central Line
(01) 582-7522
Direct Line
(01) 587-1578
Telex: 295555 LSPG

TOKYO, JAPAN

Haruki Hirayama,
EMS, Inc.
Sagami Bldg., 4-2-21, Shinjuku,
Shinjuku-ku, Tokyo 160, Japan
Cable: EMSINCPERIOD
Phone: (03) 350-5666
Telex: 2322520 EMSINCJ

ELECTRONIC SYSTEMS NEWSLETTER

Monthly publication written especially for the
Hobbyist/Experimenter. Projects, Sources, New Ideas.
FREE DETAILS.



AF Publishing Co.
Dept ST1
P.O. Box 524
So. Hadley, Mass. 01075

Circle (26) on Reply Card



7 MILLION TUBES FREE CATALOG

Includes all Current, Obsolete, Antique, Hard-To-Find Receiving, Broadcast, Industrial, Radio/TV types. **LOWEST PRICES,** Major Brands, In Stock.

UNITY Electronics Dept. E
P.O. Box 213, Elizabeth, NJ 07206



Circle (27) on Reply Card



Everyone benefits...
pricing by "The Book"

1-800-228-4338

MON. THRU FRI. 8-5 / C.S.T.

Circle (28) on Reply Card

PERSONALIZED 24-HOUR SERVICE ON OVER 7,000 ELECTRONIC COMPONENTS & PRODUCTS...

CALL TOLL FREE

1-800-558-9572 IN WIS 1-800-242-9553



PROJECTOR RECORDER BELT
200 Clay Street • Whitewater, WI 53190
TLX 4994411 PRBUSA

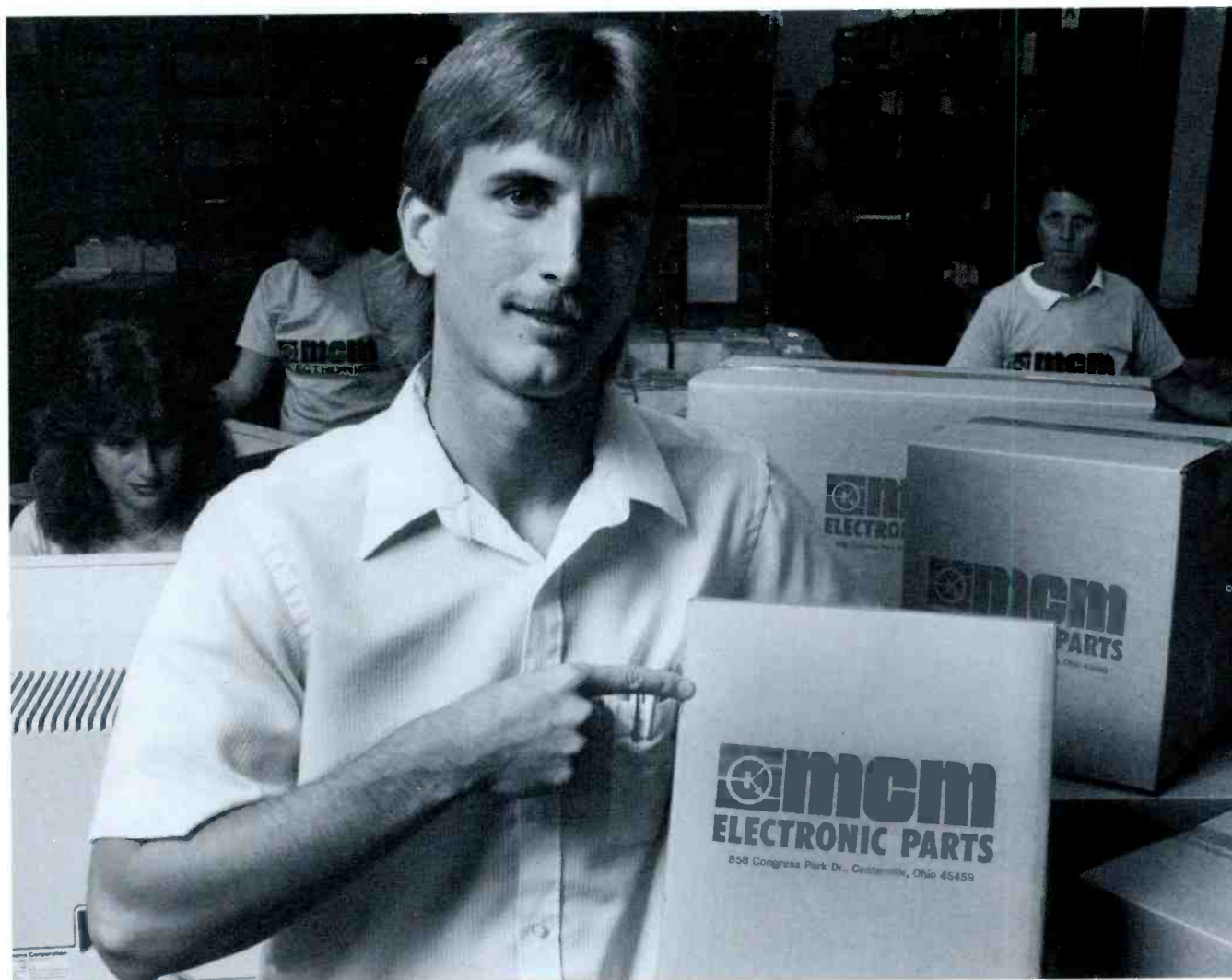
Circle (29) on Reply Card

Advertisers' Index

Reader Service Number

Page Number

- 26 A.F. Publishing Co.64
- 8 Beckman Instruments .9
- 4 Consolidated Electronics Inc.1
- 5 Cooper Group3
- 23 Dandy Mfg. Co.55
- 18 Diehl Engineering43
- 14 Electronics Book Club 23
ETA61
- 6 John Fluke Mfg. Co.,
Inc.5
- 19 Fuji-Svea47
- 15 Global Specialties
Corp.27
- 21 Hykon Manufacturing
Co.51
- 25 Jensen Tools Inc.51
- 1 MCM Electronics . . .IBC
- NATESA51
- NESDA55,57
- 13 New-Tone Electronics,
Inc.19
- 24 Optima Electronics . .57
- 11 Philips ECG15
- 9 Pocket Technology,
Inc.13
- 29 Projector Recorder
Belt Corp.64
- 17 PTS Corp.41
- RCA Distributor and
Special Products49
- 2,3 Sencore, Inc.BC
- 16 Simpson Electric Co. .39
- 27 Sperry Tech, Inc.64
- 12 AW Sperry Instruments
Inc.17
- 7 Tektronix, Inc.7
- 28 Unity Electronics64
- 30 Viz Test Equipment . .37
- 10 Workman Electronic
Products, Inc.53
- ZenithIFC



“FAST DELIVERY... YOU CAN COUNT ON US!”

At MCM we know when you need electronic parts, you need them *FAST*. That's why we have **EXPRESS DELIVERY SERVICE**. Our NEW Computer Aided Ordering System moves your order through *FAST* and *ACCURATE!*

You can count on our **EXPRESS DELIVERY SERVICE** for dependable delivery to your business, on time, every time.

So the next time you need the Right Parts at the Right Price, *Shipped Right Away...* call us at MCM! You can count on us!

**CALL OR WRITE TODAY
FOR YOUR FREE
120 PAGE CATALOG!
OVER 4500 ITEMS!
CALL TOLL FREE
1-800-543-4330**

(in Ohio, 1-800-762-4315)



mcm ELECTRONICS

858 E. Congress Park Drive, Centerville, Ohio 45459
Circle (1) on Reply Card

SOURCE NO. ES-3

The people who gave you the Video Service Standard of the 70's. Now Introduce the all new standard for the 80's—MODEL VA62.



Cut your video service time in half

The Sencore VA48 TV Analyzer, introduced in 1976, quickly became the industry standard for video service. It is now used by more than 22,000 technicians nationwide who have averaged an overall 54% reduction in service time, according to a recent survey of VA48 owners.

But Times Change: Today's video circuits include projection TV, 4-head VCRs, SAW filters, comb filters, integrated flybacks, cable-ready tuners,

and many more circuits you just can't service effectively with the VA48. That's why we now have the VA62—the only video analyzer that equips you for all of these new video circuits—and then some.

In a Nutshell: Here's what makes the VA62 unique:

- It's a TV analyzer—Fully updated for the latest circuits.
- It's a VCR analyzer—Makes VCR analyzing a snap (using two inexpensive accessories) . . . and it meets all manufacturers' requirements.
- It's cable-ready—Test all the latest digital tuners.
- It has unique patterns—Special test patterns, plus standard pat-

terns simplify troubleshooting.

- It's obsolete proof—It can be updated as needed for new circuits or formats . . . quickly and inexpensively.

Guaranteed Results: The VA62 can cut your service time in half on all video circuits—new and old. We guarantee it or we'll refund your money at the end of 30 days.

Update Today: If you're ready to update your bench to service the new circuits of the 80's, write or call toll-free today for a complete color brochure.

TOLL-FREE 1-800-843-3338

In Canada Toll-Free 1-800-665-4871
South Dakota, Alaska, and Hawaii call collect at 605-339-0100.

Please send complete VA62 details:

Name _____

Address _____

City _____

State _____ Zip _____

Phone _____

(Mail to Sencore, 3200 Sencore Drive,
Sioux Falls, SD 57107)

SENCORE

For Information Circle (2) on Reply Card
For Demonstration Circle (3) on Reply Card