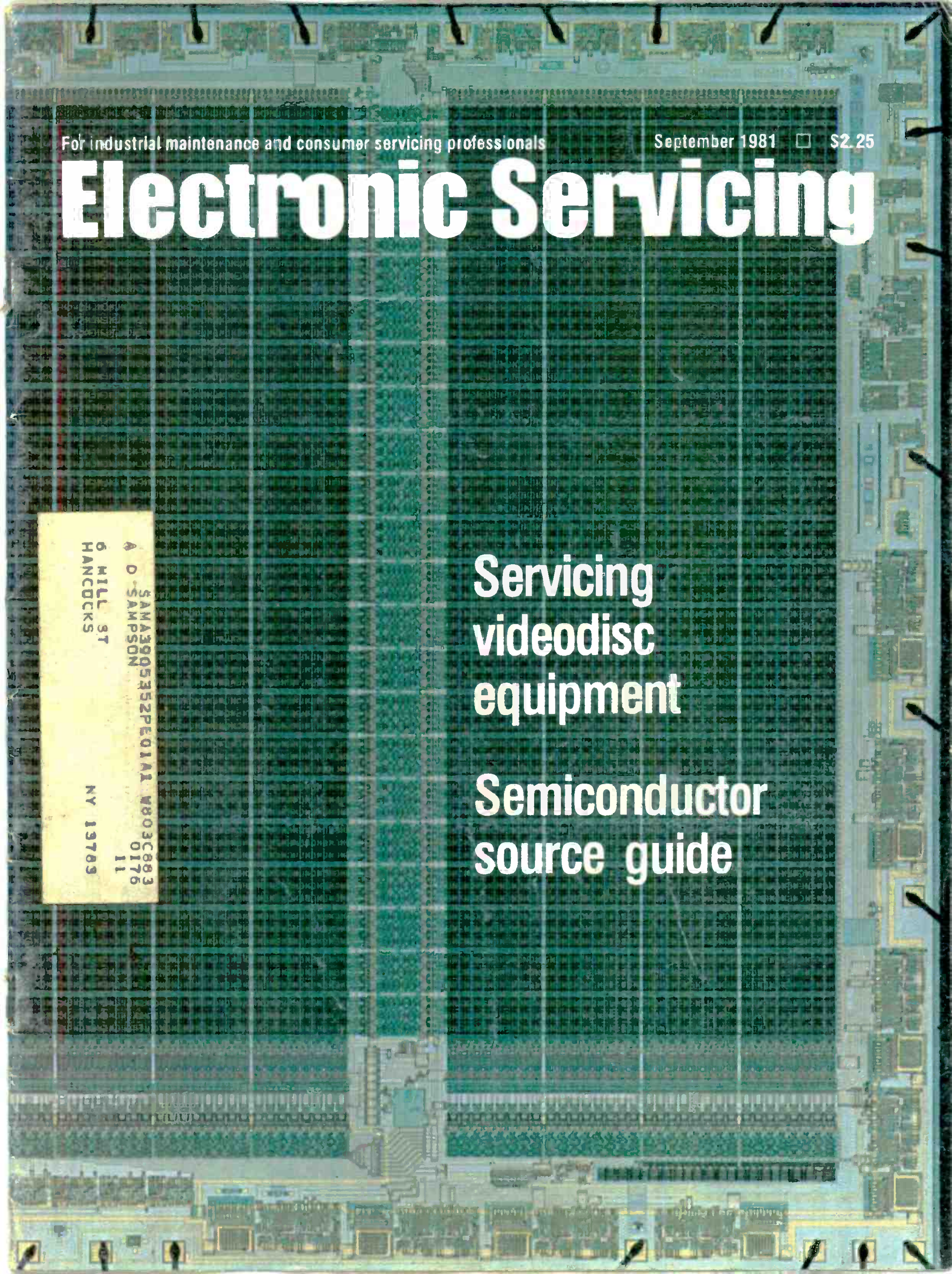

For industrial maintenance and consumer servicing professionals

September 1981 □ $2.25

Electronic Servicing

Servicing videodisc equipment

Semiconductor source guide

Electronic Servicing

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Electronic Servicing

September 1981 ☐ Volume 31, No. 9

Features

Departments

About the cover

This integrated circuit, a Harris 16K CMOS random access memory chip (enlarged 50 times) contains 100,000 circuit elements including transistors and other components. (Photo courtesy of Harris Corporation)

people in the news

George Savage, CET, of Doniphan, NE, became ETA's third chairman as the association completed its annual convention July 12, 1981, at Iowa State University in Ames, IA.

Savage, married and the father of four teenagers, has served as vice chairman and secretary of ETA in addition to being membership chairman for two years. He was instrumental in establishing a local chapter of ETA in central Nebraska and has participated in the association's technical training seminars on several occasions by lecturing on improved troubleshooting methods.

Savage has a long career as an electronics technician and service manager in the consumer electronics field. Recently he switched to the industrial area and is now serving as an engineering technician for the International Sensor Corporation, located in Aurora, NE. International Sensor produces integrated circuits and MSI chips.

Industry veteran **Herb Horowitz** has been named president of Rotel of America. Founder and former president of Empire Scientific, Horowitz also has served as president of the Institute of High Fidelity, Ortofon USA, as special projects director for Harman International and, most recently, as executive vice president of Acoustic Research.

Lam Research Corporation has named **Adrian "Bick" Hohn** its national sales manager, a new position. Hohn will report to **Dr. David K. Lam**, president.

Hohn brings more than 15 years of direct sales and sales management experience to his new post. Prior to joining Lam Research, he managed western regional sales for Cobilt (now a division of Applied Materials).

Hohn's sales experience substantially relates to semiconductor production equipment and materials. Besides his 3-year tenure with Cobilt (alignment/exposure systems), he has served in sales positions with Thermco (diffusion furnaces) and Applied Materials (wafer process systems).

Charles R. Stoyer, senior product specialist, has been promoted to product manager, customer tooling, for ITT Cannon Electric. Stoyer joined this division of International Telephone and Telegraph Corporation in 1976 as field-based product specialist for the east coast. Previously, Stoyer worked for AMP, Inc., and Moore Business Forms, both of Harrisburg, Pennsylvania.

The Regency Electronics Inc., board of directors has elected **Floyd O. Ritter** as chairman of the board and chief executive officer, and **Joseph E. Boone** as president and chief operating officer. Ritter was formerly president and Boone was executive vice-president.

Edwin J. Sommer, who had been board chairman, will continue as a company director.

Shure Brothers Inc., Evanston, IL, has announced the promotion of **Robert B. Schulein** to chief development engineer and head of the company's Electromechanical Development Department.

Schulein joined Shure in 1966. His previous position was chief development engineer—acoustics.

Audrey Griffin has been appointed executive producer for VHD Programs Inc., Los Angeles, CA, the company that is launching VHD (video high density) videodiscs in the United States. She is responsible for working with outside producers to create participatory and entertainment programming, and will report to **Paul B. Foster**, vice president of program development.

Most recently Griffin was director of special programs for RCA SelectaVision Disc, working in development and acquisition of general audience programming.

electronic scanner

New York judge rules on repair shop inspections

Relying upon a series of United States Supreme Court holdings, a State Supreme Court justice has declared unconstitutional a New York City law authorizing warrantless inspections of radio and television shops licensed by the Department of Consumer Affairs, according to the New York Law Journal, June 9, 1981.

Justice Anthony T. Jordan, in a test case brought by a television dealers trade association, ruled that without the consent of a shop's owner, the inspectors could not demand entry to books and records unless they had obtained warrants and provided written notice before the date of the inspection.

Jordan issued his findings in *Matter of Glenwood TV Inc. (Ratner)* a decision filed recently in Kings County, Supreme Court, Special Term, Part 1, in which he ordered the department to reinstate the licenses of two shops suspended when they refused to permit inspectors to see their records. The requirements for a warrant dealt only with routine annual inspections, not with cases where there has been a complaint or some emergency situation.

The justice based his ruling upon a number of Supreme Court decisions which voided warrantless searches of residences or regulated business, with specific exceptions that he found did not apply to the matter before him, such as closely regulated industries or those subject to "pervasive regulations." These businesses were liquor stores or firearms dealers.

Also cited was the recent High Court ruling that barred warrantless inspections by inspectors under the Occupational Safety and Health Act of 1970 unless they were carried out "in a manner that satisfies the Fourth Amendment."

"With none of the above-enumerated exceptions being applicable," Justice Jordan wrote, "the court must conclude that the respondent had no constitutional authority to conduct a warrantless inspection of the petitioners' premises or penalize the petitioners for their refusal to allow such inspection.

"Sections B32-472.0, subd. 5, and 773-13.0 of the New York City Administrative Code . . . are therefore unconstitutional insofar as they purport to authorize periodic inspections of the type involved herein without a search warrant. . ."

It was at this point that the court laid down standards for inspectors to follow in conducting "reasonable" inspections. They included written notice of at least a week before an inspection was planned, with the repair shop owner being advised of the purpose and "a description of the things to be inspected," given an opportunity to arrange "a more convenient appointment" and alerted that the owner had the right to "insist upon a search warrant before any inspection."

Hipot tests save lives, property

Fires and electrical shock have resulted from failure to spend a few seconds making an electrical leakage test of repaired audio-visual equipment, according to the Association of Audio Visual Technicians.

The association warns that skimping on the simple high potential or "hipot" test can result in serious hazards to users of AV equipment and damage the reputation of repair technicians.

"Even though an equipment repair has nothing to do with the electrical circuitry the test should be performed because of the possibility of a pinched wire, rearrangement of parts, or even an undetected problem present before the repair," says Elsa Kaiser, executive director of the association.

The principle of a hipot test is to provide more than normal voltage to the equipment, to be as certain as possible there will be no hazard in normal operation. Before the hipot test is performed, check for electrical continuity between the ground of the 3-wire plug and the metal case or mechanism plate of the equipment. Use a simple continuity light or ohmmeter to do this. There should be continuity. If the equipment has a 2-wire cord, the grounding wire from a dielectric tester is attached to the metal case or mechanism.

To make the hipot test, the dielectric tester is connected to an ordinary electrical outlet, and the unit being tested is connected to it. For safety's sake, it is important that the service technician *not* touch the equipment while the high potential is being applied.

Generally a satisfactory test for AV equipment is to apply 600V RMS for 10 seconds to the line-voltage wiring. During the 10 seconds, the leakage current should be no more than 2.5mA (0.0025 A). Greater leakage current may indicate a short, breakdown of insulation, damaged components, or other problems which should be corrected before the equipment is returned to use.

1982 Winter CES bound for success

Applications for space in the 1982 Winter Consumer Electronics Show, January 1-10, indicate that it will be the largest ever, with many major 1981 WCES exhibitors requesting increased space and more than 100 companies exhibiting for the first time.

This increased demand will be accommodated by utilizing the 40,000 square feet of new exhibit space in the Las Vegas Convention Center, bringing the show's total size to more than 500,000 net square feet with a potential of 900 exhibitors.

"We attribute this strong support for the show," said Jack Wayman, senior vice president of EIA/Consumer Electronics Group, sponsor and producer of the Consumer Electronics Shows, "to a combination of factors, namely:

- The rapid growth of technology in consumer electronics, as evidenced by the hundreds of new products that will be introduced at the show.

- The changing patterns of distribution that result from the new market needs in all product categories in consumer electronics.
- The importance of Las Vegas as a location that attracts many from the Western U.S. who do not always attend the SCES in Chicago.
- The show becoming an important international event for companies who market their products worldwide.
- Use of the show as a vital forum for manufacturers' sales meetings, the establishment of sales quotas, new promotions and merchandising techniques.

"Obviously, the 1982 WCES satisfies the needs of our industry," Wayman said.

In conjunction with the show, the National Association of Retail Dealers of America (NARDA), the industry's retailer group, will hold its annual convention.

EIA conference set for October 19-20

The Electronic Industries Association's 57th annual Fall conference will be held Oct. 19-21, 1981, at the Fairmont Hotel in San Francisco, CA.

Included in the tentative schedule is a meeting of the Antennas, Towers and Accessories Committee, the Electronic Industries Foundation Board of Trustees, the car audio subdivision, and the Audio Division Board of Directors. A spouses program is also available.

In addition, a symposium, "The DOD Electronics Market—Impact of the Administration," sponsored by the Government Division's Requirement Committee, will be held Oct. 27-29, 1981, Hyatt on Union Square, in San Francisco.

Conferences scheduled for 1982 include the EIA Spring conference March 29-April 1, at the Shoreham Hotel in Washington, D.C., and the Fall conference, scheduled for Oct. 11-13 at the Century Plaza Hotel in Los Angeles.

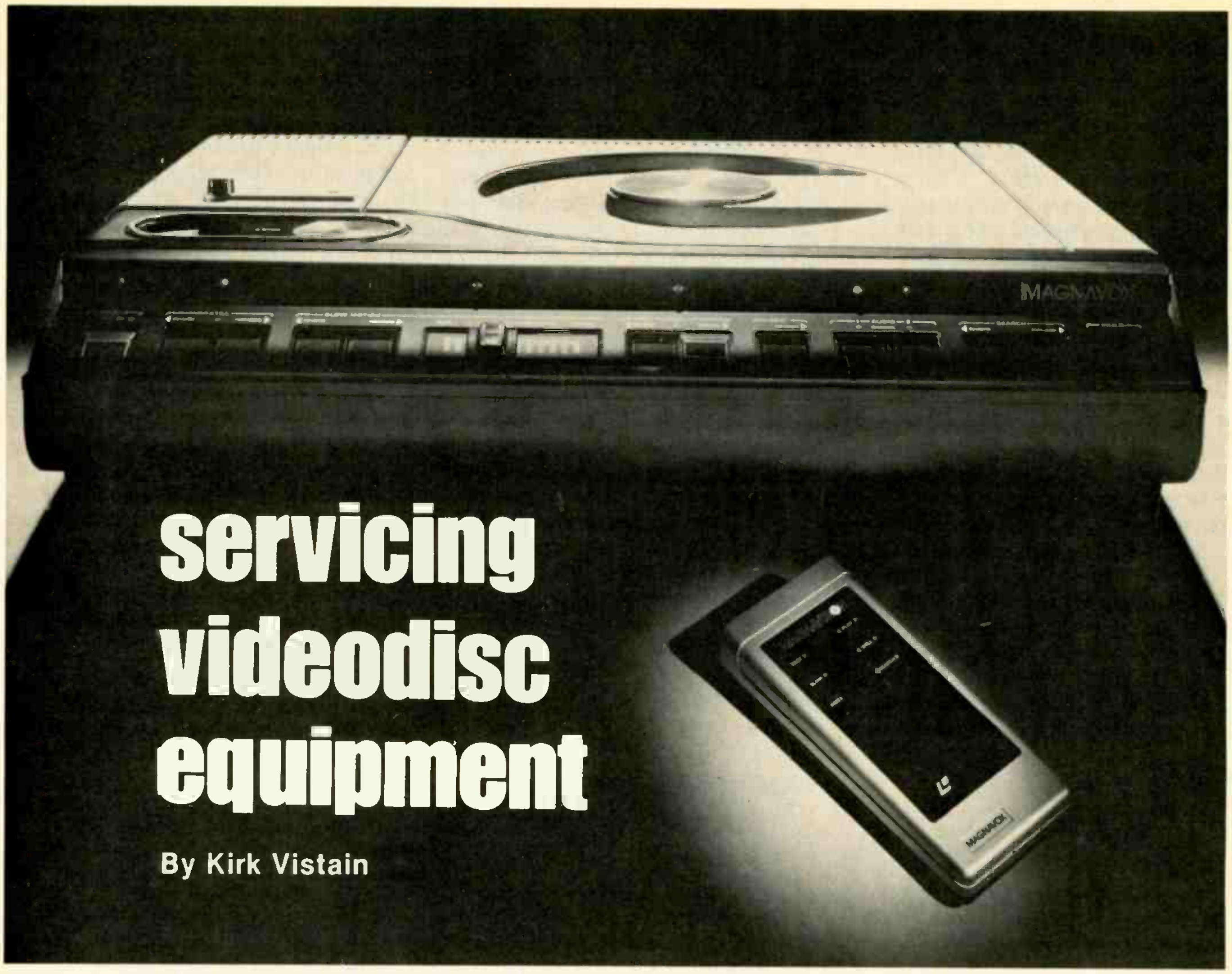
Video products sales surge

Total U.S. market sales to retailers of major consumer video products—color and monochrome TV receivers and videocassette recorders—increased substantially in the first half of 1981, compared to the same period last year.

According to industry figures compiled by the Marketing Services Department of the Electronic Industries Association's Consumer Electronics Group, color TV sales in the first six months increased by 20.3%, monochrome TV was ahead by 13.4% and first half videocassette recorder sales gained by 89.6% over the first half a year ago.

Sales to retailers of color TV sets in the 26 weeks, year-to-date, rose to 5,143,615 units, up 20.3% over 4,275,463 units sold in the first half last year. Color television receiver sales in June 1981 amounted to 1,007,584 units, up 8.9% over 925,187 units sold in the same month a year ago.

Videocassette recorders (VCR) sales in the first half of 1981 climbed to 543,473 units, an increase of 89.6% over 286,601 units sold in the first half of 1980. Sales of VCRs in June jumped to 109,375 units, a gain of 110% over 52,076 units sold in the same month a year ago. □



servicing videodisc equipment

By Kirk Vistain

Newest Magnavision videodisc player from Magnavox is equipped with a wireless remote control unit.

The popularity of videodiscs and videodisc players is beginning, and this brings a valuable opportunity to those technicians who prepare for it by learning the circuits and repair techniques.

Videodisc players probably will be the next home-entertainment electronics product to enjoy tremendous sales acceptance from TV viewers. All these players are designed to be viewed on standard B&W or color TV receivers.

Magnavox offered the first laser-optical videodiscs and videodisc players on an extremely limited basis (one city) in December 1978. Distribution increased gradually until it covered all major areas of the United States. The supply of Magnavox machines and videodiscs, however, remains tight in many cities.

Pioneer markets a similar optical videodisc player under its VP-1000 model number, with most sales apparently made in audio-specialty stores. Kenwood and Gold Star also have exhibited similar compatible optical videodisc players.

In late 1980, RCA released the SFT-100 videodisc player and a variety of discs for its Capacitance-Electronic Disc (CED) type of machine. Several years of engineering development preceded the CED system. Zenith now markets a similar machine, while Radio Shack, Sony, Hitachi and others have announced that they will employ the CED system. CED machines have grooves and a stylus.

A third videodisc system awaiting introduction is the JVC Video High Density (VHD) machine, which operates on a capacitance signal-pickup principle without grooves. General Electric, Panasonic, Quasar, Thorn EMI, Sansui and Hitachi have stated they will market the JVC VHD-system videodisc players, probably in the first quarter of 1982.

There is no compatibility between these three types. A disc intended for one type cannot be placed on another's turntable. If forced to operate in a mismatched machine, a disc would not produce either sound or picture.

Although this incompatibility is detrimental to efficient sales and servicing processes, it is a technical disagreement that apparently must be solved by the buying public. No valid prediction can be made about which system will emerge victorious. Therefore, technicians should learn to diagnose and repair *all* videodisc players.

It is not practical to cover all of the small details of videodisc-player circuitry in a magazine, because of the huge volume of material. For example, the RCA SFT-100 Player Technical Manual contains 84

COMPARISON OF VIDEODISC SYSTEMS

	CED	LASERDISC	VHD
MAJOR SUPPLIERS	RCA, ZENITH, ETC.	MAGNAVOX, US PIONEER, ETC.	JVC, GE, ETC.
FEATURES	F/R RAPID ACCESS, PAUSE, F/R VISUAL SEARCH	SAME AS CED, PLUS: F/R SLOW MOTION; STILL; F/R STEP; FRAME SEARCH (PIONEER ONLY)	SAME AS LASERDISC, PLUS 10-SEGMENT PROGRAMMABILITY
DISC TYPE	GROOVED, CAPACITANCE READING	GROOVELESS, LASER-OPTICAL	GROOVELESS, CAPACITANCE READING
MAX PLAYING TIME PER SIDE	1 HOUR	1 HOUR	1 HOUR
VIDEO CARRIER	5MHz	8.1MHz	6.6MHz
CHANNEL 1 AUDIO	716kHz	2.3MHz	NOT AVAILABLE
CHANNEL 2 AUDIO	NOT AVAILABLE	2.8MHz	NOT AVAILABLE
LUMINANCE BANDWIDTH	3MHz	3.5MHz	3.1MHz
AUDIO RESPONSE	20Hz-20kHz	40Hz-20kHz	20Hz-20kHz
CHROMA FREQUENCY	BURIED 1.53MHz SUBCARRIER	STANDARD 3.58MHz SUBCARRIER	NOT AVAILABLE
DISC ROTATION	450rpm	1800rpm FOR CAV. 600 to 1800rpm FOR CLV	900rpm
PICKUP TRAVEL ACROSS DISC	OUTSIDE TO INSIDE	INSIDE TO OUTSIDE	NOT AVAILABLE

Table 1 This listing shows the comparative specifications and operating features of the three types of videodiscs and videodisc players.

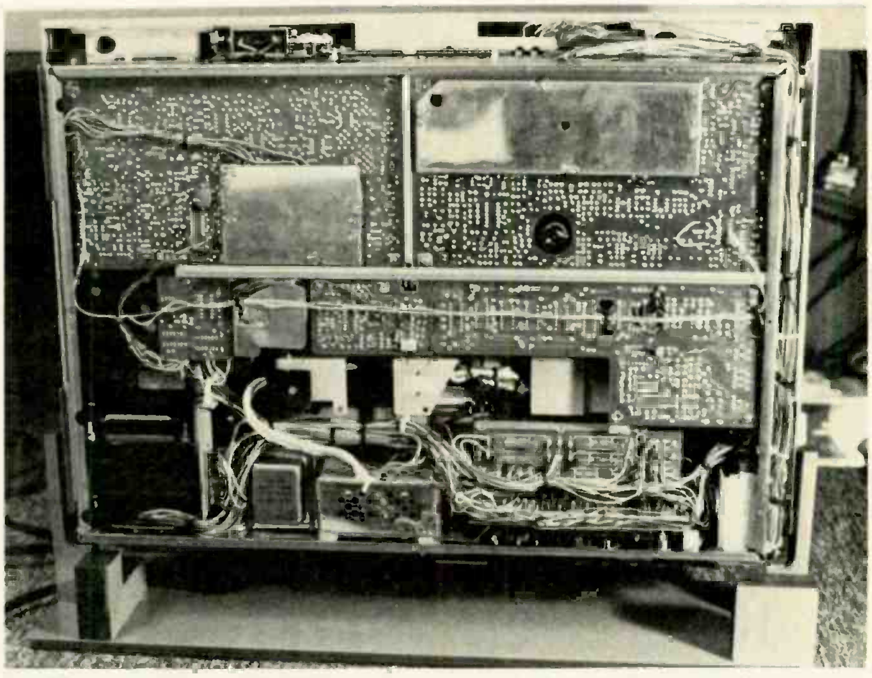
pages, plus large schematics. Even so, the RCA coverage seldom extends beyond the block-diagram and simplified-explanation format. Therefore, only the basics and generalities are covered in this article.

Comparisons

Specifications in Table 1 show the major technical differences between the three types of videodisc players. Magnavox and Pioneer discs have no grooves, but the audio and video signals are stored in an FM variation of pits placed in a groove-like spiral, starting at the disc's inside and ending on the outside. Variations in pit spacings are read by a laser beam and decoded into individual audio and video signals. Thus this is a grooveless, laser-optical, light-reading videodisc system.

The RCA CED videodisc is a grooved, capacitance-variation-reading type with a continuous spiral groove (outside to inside stylus movement), having vertical depth variations spaced according to the FM signal. A diamond stylus with a tiny deposited-metal capacitance plate follows the grove; a mechanism assists the movement of the large stylus-pickup assembly.

Fewer details are known of the



Servicing of a Pioneer VP-1000 begins by removal of the bottom, and placing the unit in a 90° vertical test rack. All circuit boards are shown in operating positions.

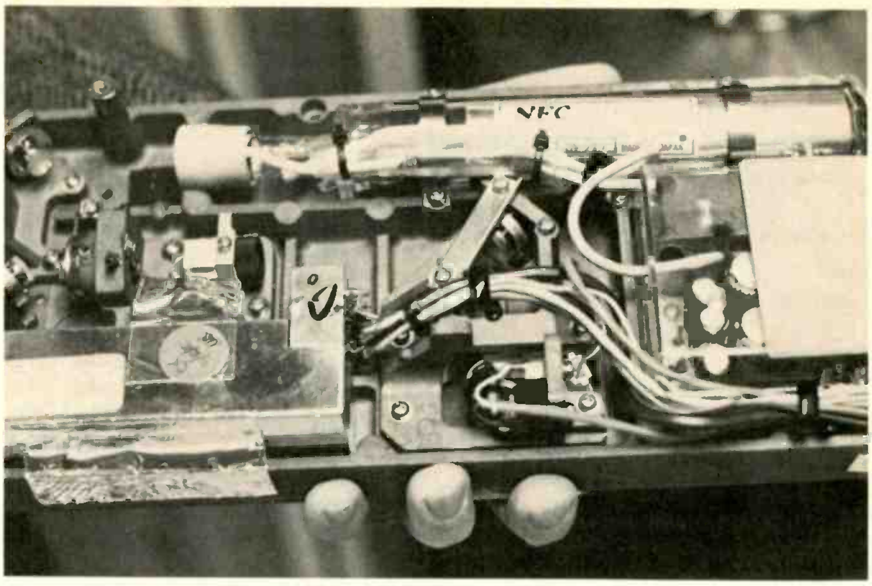


Figure 1 Slider assembly of a Pioneer model VP-1000 is shown here. At the top is the HeNe laser tube.

JVC and GE VHD system. The VHD discs have no continuous grooves, but the signals are encoded in the FM placement of pits arranged in a spiral-groove pattern. FM capacitance variations along the groove pattern of pits are sensed by a metal plate on the stylus. The stylus rides on the disc surface, but is moved by a servo system so that the metal pickup plate is exactly over the spiral of pits. The VHD can be called a grooveless capacitance-reading system.

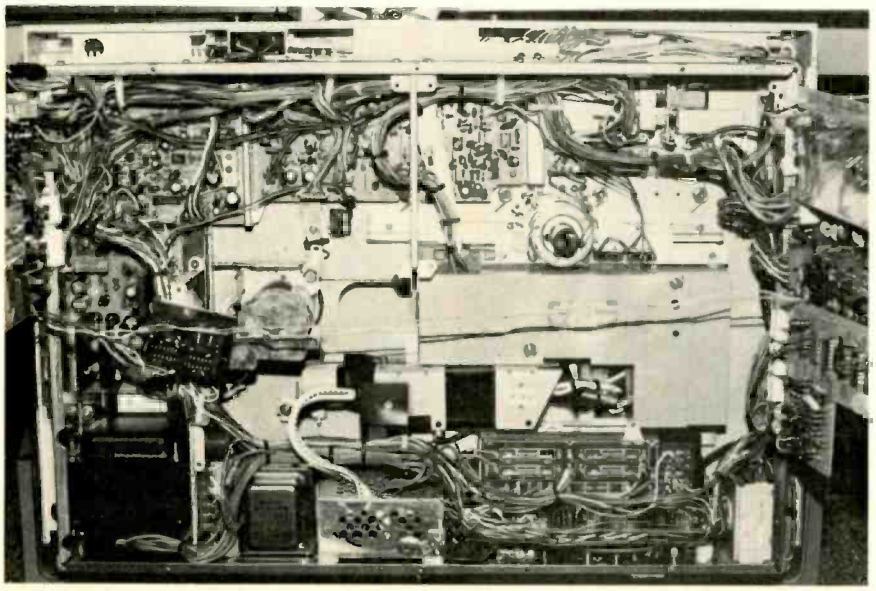
One similarity between the three systems is that they supply audio and video signals from decoding an FM carrier previously recorded on flat, round discs strongly resembling conventional audio phonograph records.

The systems cannot record programs, although it is rumored that Pioneer is investigating a method of adding recording.

Features common to all three types include: forward and reverse rapid access, forward and reverse fast play, and pause. Because of the more sophisticated servo drive and the arrangement of video fields on the disc, the grooveless models can also provide stop-motion and frame-search functions. The frame-search feature allows the viewer to select continous playback of any of the approximately 54,000 frames on one side of the disc.

Only the laserdisc and VHD systems have stereo sound, although RCA may introduce this in newer models.

All three systems have microprocessor controls of functions, plus readouts or displays of the video-frame number or the elapsed time. Picture and sound qualities are much better than those broadcast by TV stations.



While the Pioneer VP-1000 is in the vertical test rack, two circuit boards can be rotated, exposing other wiring below the mechanism.

Optical laserdisc

Signal information of a laser-type videodisc is recorded on a single "track" that makes thousands of widening spirals as it circles from the disc's center to the end at the outside edge. This appears to be similar to the old commercial "inside-outside" phonograph records. These tracks, however, are not amplitude-variation audio grooves, but rather a series of pits or indentations in the base material.

After the properly located pits are pressed into the transport plastic base of a half disc, a thin layer of reflective aluminum is placed (by evaporation in a vacuum) on the surface, followed by a protective coating. Finally, two sides are sandwiched together to form a single 2-sided videodisc.

During play, the laser beam that is used to track the line of pits (Figure 1) is simultaneously intensity-modulated by the pits. Brighter light is reflected from the surface between the pits than from the pits, and this varying level follows the FM carrier recorded on the disc.

Nothing but the laser light beam touches the disc during playback, so there is no wear or other alteration of the disc. Also, slight scratches or smudges on the surface do not interfere with retrieval of the FM signal, so extreme care during disc handling is not required. Of course,

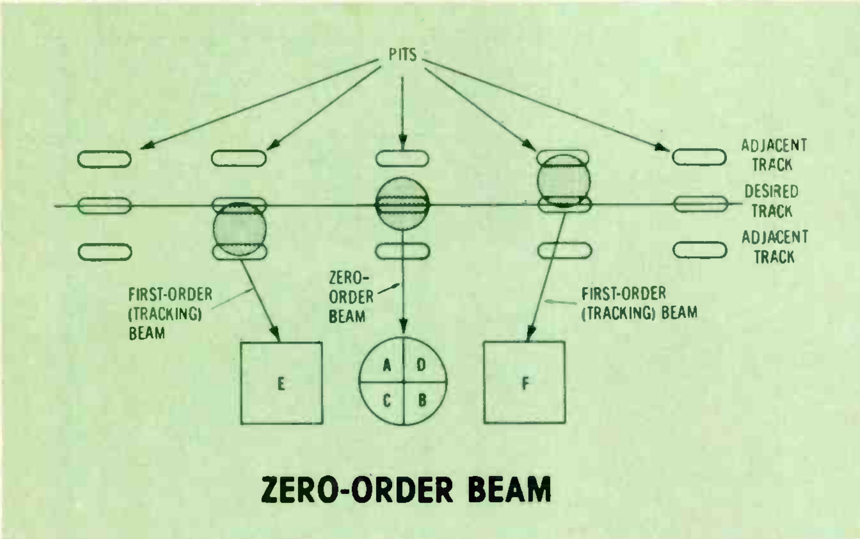


Figure 3 The center "track" of any three adjacent pit "tracks" is scanned by the zero-order beam, the one that handles the video/audio signal. The two first-order beams scan the adjacent "tracks" at right and left of the signal track. These first-order beams are used to correct any radial misplacement of the zero-order beam. Proper operation produces equal signals from the E and F photocells that monitor the light reflected from the adjacent "tracks."

gross damage can degrade the picture.

FM signals—Signal information encoded on the laserdisc is the result of these three FM signals:

- 8.1MHz carrier that is frequency-modulated by composite video (including normal NTSC chroma);
- 2.3MHz carrier, frequency-modulated by the channel-1 sound; and
- 2.8MHz carrier, frequency-modulated by the channel-2 sound.

In contrast, most videocassette recorders (VCR) separate and down-convert the chroma to a low frequency during recording, followed by up-conversion and recombining with the luminance signal during playback. This process can degrade the signal quality; a possibility that is eliminated in the laserdisc by handling the chroma without separating it from the luminance.

Frequency modulation of the sound channels provides better frequency response and a higher signal-to-noise ratio than is obtained from VCR's using direct recording on the tape.

Discs

Two types of discs are available for playback on optical machines. The *standard-play* type (also called CAV, for Constant Angular Velocity) requires a constant disc rotation of 1800 rpm with each revolution of the disc carrying one frame of video. Sync pulses are aligned similar to spokes of a wheel with these CAV discs. This makes possible special effects such as frame-by-frame advance, slow-speed playback and random search, which are not possible with CLV discs. CAV discs play for 30 minutes per side.

Extended-play (or CLV, for Constant Linear Velocity) discs play one hour per side, double that of the CAV types, but the rotation varies from 1800 rpm at the inside start to 600 rpm at the edge of the disc. The varying rotation prevents use of some special effects, as described before.

The laser beam

Figure 2 shows a simplified drawing of the beam paths when playing laserdiscs. The helium-neon gas laser emits a beam of red light having a wavelength of 632.8nM. First, the beam passes through two

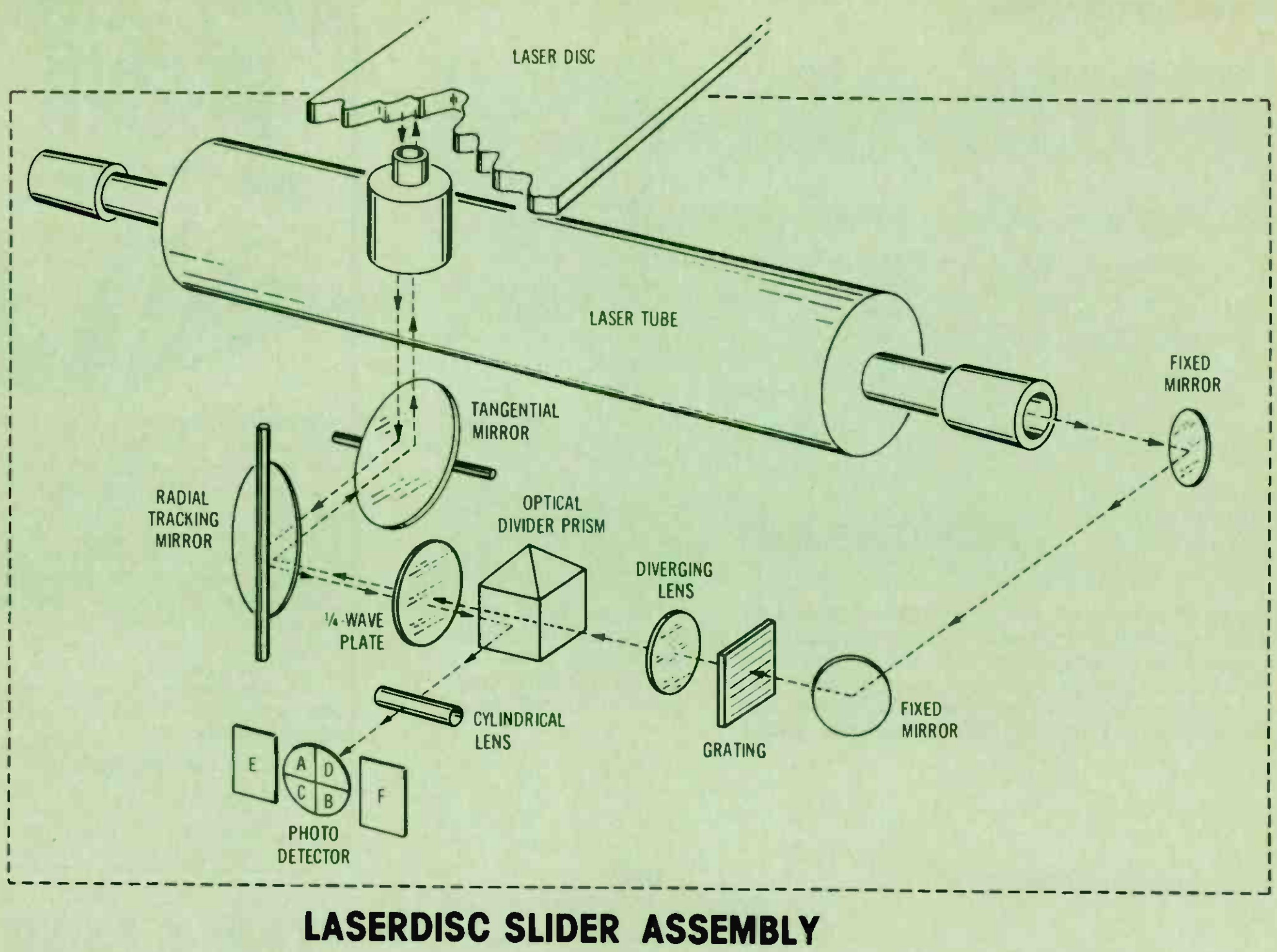


Figure 2 These components on the laser slider unit focus and move the laser beams as required for proper reading of the disc "tracks" of pits.

Servicing videodisc

direction-changing mirrors that bring the optical axis to the standard position on the slider. Next, the beam passes through a grating that splits it into a number of beams. Only the center (zero-order) beam and the two first-order beams adjacent to it are used, although more are formed. From the grating, the beams pass through a number of optical components, from the tracking and tangential mirrors, through the objective lens and onto the disc.

From the disc surface, the beams are reflected in varying degrees of brightness, depending on the recorded information. Coming back along the beam's previous path, the returning beams are diverted by the optical divider prism and cylindrical lens, finally reaching the photo-detectors. These photo-detectors change light-variation levels into varying electrical signals that are used to control the servo system, and also to provide the video signal after demodulation.

Beam-guide servos

The motor-driven platform holding the optical components is called the **slider** assembly. Its purpose is to track the line of pits, thus providing faithful reproduction of picture and sound. The slider assembly has about the same function as the tonearm of a record player.

The servo systems that move the slider system are described separately.

Focus servo

The purpose of the focus servo is to minimize divergence of the laser beam on the disc's surface. Manufacturing tolerance of the discs allows some deviation from perfect flatness, and this varies the distance between the objective lens and the disc surface.

The focus signal is generated by sampling a portion of the laser beam that is reflected from the disc and passing it through a special cylindrical lens. The beam from the lens is focused on a 4-quadrant photodetector (Figure 3). When all four quadrants are equally illuminated, the beam is in proper focus. Any imbalance of illumination indicates focus error, and a corrective signal (Figure 4) is generated to operate a coil (surrounding the objective lens) and move it up and down to improve the focus.

Radial tracking servo

Control of radial tracking (sideward movement of beam) is accomplished by two servo mechanisms: tracking and slider. The purpose of the tracking servo is to maintain accurate centering of the beam on the appropriate track. The first-order beams are used to read the tracks adjacent to the one with the desired video/sound signal. A separate photodetector is used for each beam (E and F photocells in Figure 4). When both photocells receive equal light levels from the two adjacent tracks, the radial-error signal is zero, and the zero-order signal beam *must* be correctly centered.

If the zero-order beam drifts to either side, the E and F first-order beams are not balanced, and the radial-error signal drives the tracking mirror electromagnetically in the direction that corrects the imbalance.

The accuracy of this system depends on equal spacing between tracks of pits in the disc, which requires precision in the recording and manufacturing processes.

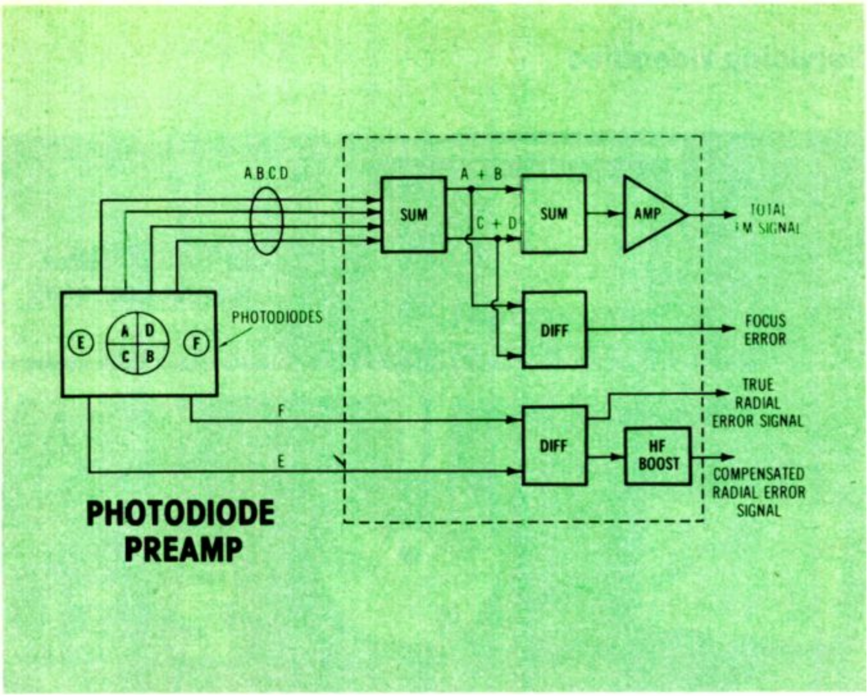


Figure 4 In the photodiode preamplifier circuit, several summing and difference circuits provide the total FM signal, a focus-error signal, the true radial-error signal, and the compensated radial-error signal that are sent to the proper following stages.

Slider servo

Maximum correction by the tracking servo is limited by the rotational angle of the tracking mirror. Therefore, it is necessary to provide another control mechanism that increases the tracking-mirror range. This is accomplished by the slider servo.

Dc voltages of the tracking-error signal are extracted and used to control a motor that moves the slider assembly. For example, the tracking mirror is tilted to move the beams nearer the outside edge of the disc as it is played. Finally, the mirror reaches the limit of its range. Further moving of the track of pits toward the disc edge generates an error voltage that activates the slide-drive motor, which then moves the slide assembly outward, thus allowing the tracking mirror to again perform delicate adjustments from a position nearer the center of its range.

Therefore, the slider and tracking servos operate as a team to control the radial movements of optical components that recover the desired signals from the videodisc.

Speed control

Proper reproduction of color and luminance in the TV pictures demands that the playback signal be free from timing errors. This is not possible from any kind of direct uncontrolled motor drive. Therefore, two servo systems accurately control the disc's rotational speed.

Gross speed control is the responsibility of the spindle servo. First, the circuit applies power to the motor when the sensors reveal that a disc is on the turntable and the lid is closed, bringing the motor up to approximate operating speed by referring the actual speed against a preset reference. Action of this spindle servo is sufficient to eliminate time errors at frequencies below 30Hz. To reduce errors above 30Hz, the tangential-mirror servo is used.

An accurate control of relative track-to-beam speed is imperative, because even small errors of rotational speed can produce tint changes, loss of color, or other picture degradations. It is not practical to control the *turntable speed* with the required degree of accuracy, because of turntable inertia.

An ingenious tangential-mirror system provides the small degree of rapid compensation needed to correct the relative speed between disc and laser beam. An error signal is produced by the comparison of an internal reference against a signal derived from the chroma burst coming from the disc playback. The error signal electromagnetically moves the tangential mirror to vary the beam landing ahead or behind on the track of pits. This compensates for instantaneous speed variations.

Servo summary

The focus servo provides the radial-tracking mechanisms (slider and tracking) with signals that minimize beam divergence. This also insures best pickup of the encoded FM video and audio signals.

Turntable speed and time-base accuracy are determined by the spindle servo, which references the turntable speed to an internal standard, and the tangential-mirror servo that compensates for small variations in track speed by comparing playback chroma burst to an internal reference.

The previous explanations apply to Pioneer and Magnavox machines, although the terminology may differ slightly. Although the operation explanations were not given in detail, they are sufficient for some repairs. Technicians who plan to do many videodisc repairs, however, should seek additional training from the manufacturers and other sources.

This test bench is equipped for servicing Pioneer VP-1000 videodisc players, and it includes these instruments: scope; digital multimeter; video test disc; TV receiver; and an audio amplifier with speakers for stereo tests. A test rack and hand tools are also shown.

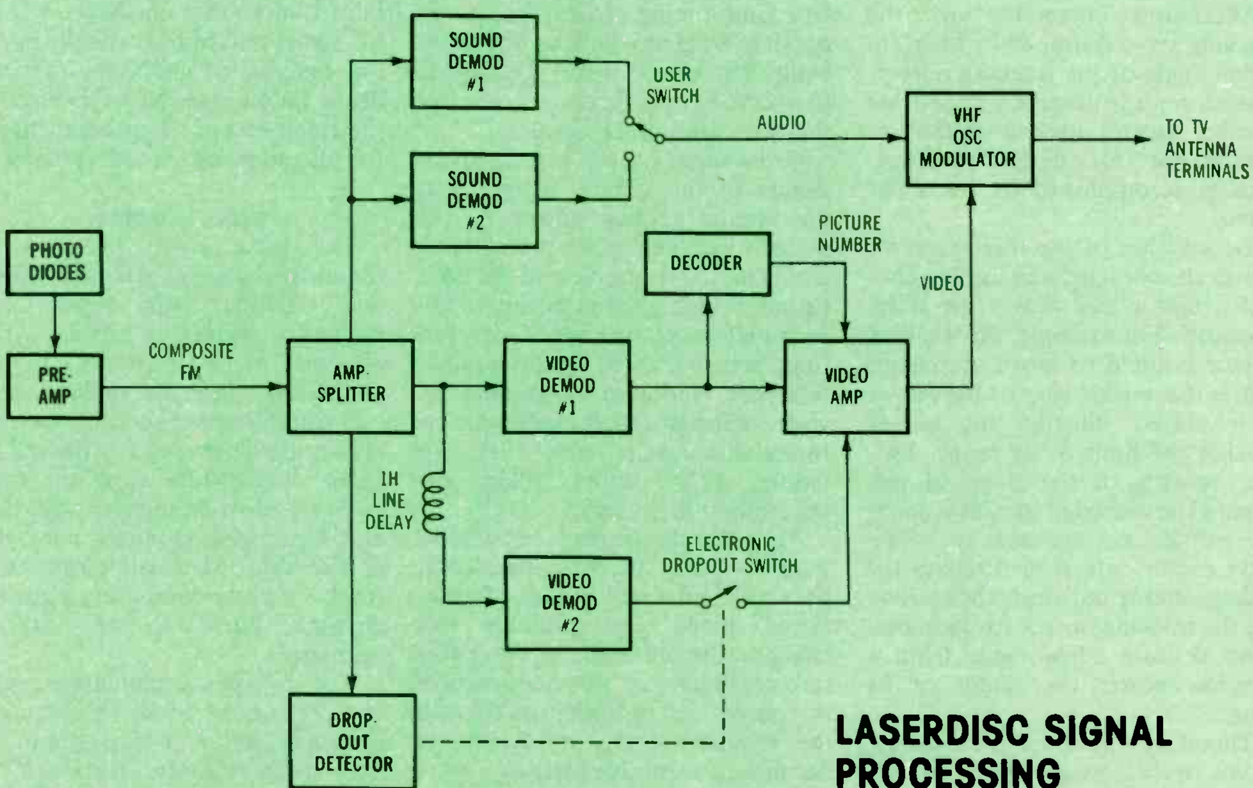
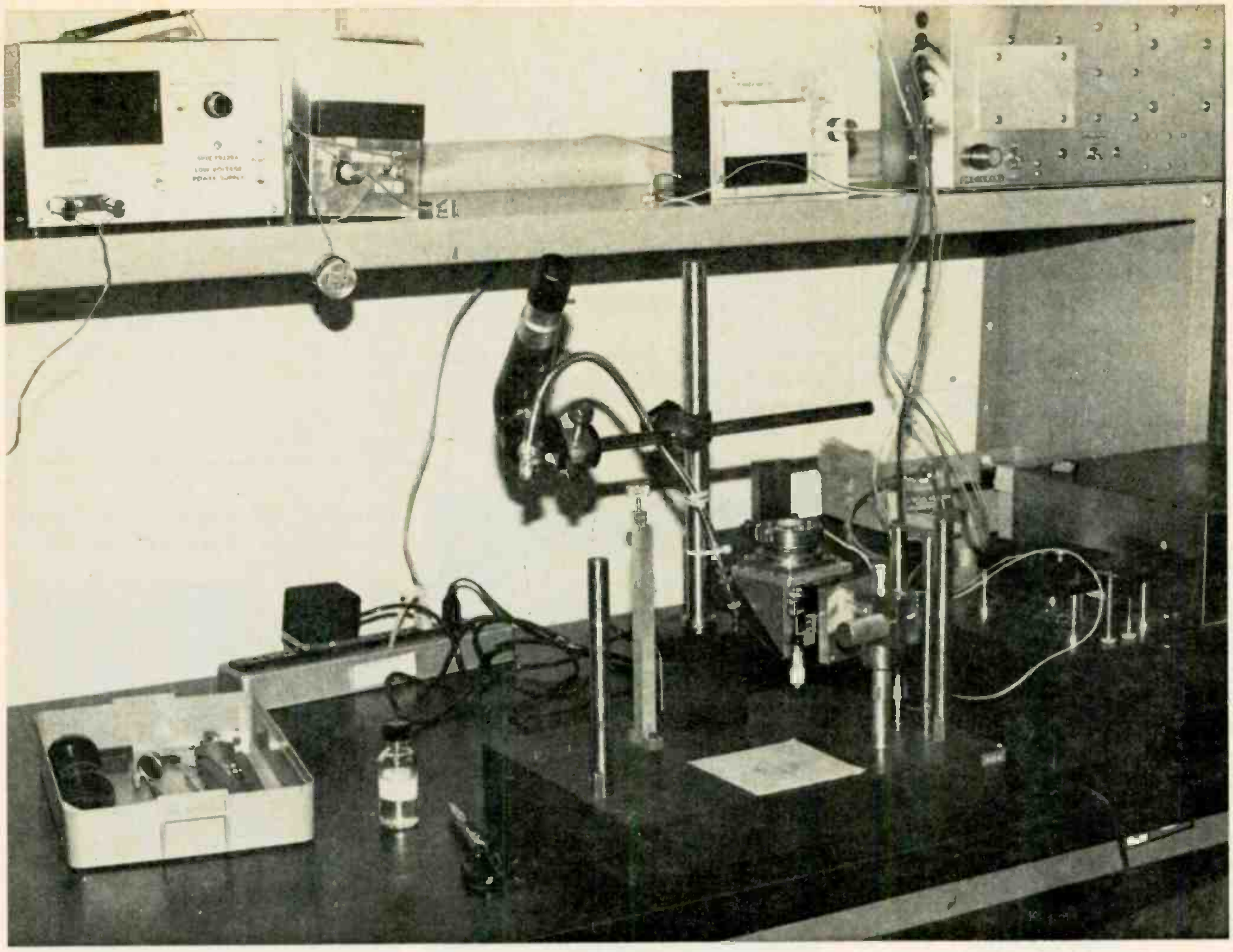


Figure 5 Operation of the signal processing circuits in laserdisc machines is shown by this block diagram.



The optical test and adjustment bench at the Pioneer factory-service facility is shown. Slider assemblies are shipped here from independent service centers for repair and alignment.

Signal processing circuits

Outputs of the photodetectors (Figure 4) are sent to a preamplifier that also supplies negative bias to the diodes.

Diodes A, B, C and D are illuminated during normal operation by reflected light of the zero-order beam. Signals A + B and C + D are summed and distributed. These are summed again (producing A + B + C + D) to form the total FM signal containing video and audio informations.

The A + B and C + D signals also pass through a difference stage to produce the (A + B) – (C + D) focus-error signal.

Outputs of photodiodes E and F are subtracted to yield a radial-error voltage that controls the tracking and slider servos. The true radial-error voltage is used only during scan or jump functions, while the compensated radial-error signal (with increased high-frequency response) operates the servo system during normal playback.

From the preamplifier, the total FM signal is sent to a combined filter and high-frequency amplifier circuit (Figure 5), which divides the sound FM from the video FM. The sound FM signal is supplied to two tuned frequency-sensitive detectors, producing the channel-1 and channel-2 audio signals that, after channel selection by the viewer, are applied to the VHF oscillator/modulator unit.

The separated 8.1MHz video-FM signal is sent to a demodulator, which recovers the composite video. The video then is routed to a clipper/decoder that extracts the frame-number information. This frame-number data and the demodulated video are fed to an amplifier, whose output signal goes to the VHF oscillator/modulator unit that supplies the TV-receiver antenna terminals.

Dropouts are instantaneous loss of the 8.1MHz carrier because of minor irregularities or damage of the videodisc. Dropouts are corrected by delaying the video-FM signal by the time of one horizontal line and recovering the video in demodulator #2 (Figure 5). A dropout-detector monitors the level of the 8.1MHz carrier and outputs a pulse when the carrier disappears. The detector output pulse activates an electronic switch, which then substitutes the composite video for the normal video from demodulator #2. In other words, dropout loss of video is corrected by substitution of a previous line of video that has been delayed for the purpose. Usually, dropouts are not noticeable when properly corrected. □

Semiconductor source guide

The demand for semiconductor replacement parts has given rise to many catalogs of cross-referenced parts. A brief description of some of these sources follows. Books, catalogs and cross-reference pamphlets are included.

Some cross-reference materials are free, but most are available for a small fee. To receive additional information, circle the appropriate number on the readers service card.

Codi

The CODI brand of rectifier bridges and discrete diodes are described in a *Product Summary* folder with additional specification sheets.

Diode types include zener, temperature compensation, variable capacitance, ultra-low leakage diodes, and sharp-knee low-noise zener diodes. Silicon rectifiers and bridges are available in most ratings.

Circle (35) on Reply Card

D.A.T.A. Inc.

The D.A.T.A. electronics book information series is an extensive index to semiconductor devices and specifications. It consists of a 22-title semiconductor/IC selection system involved in the R/D, design, engineering and purchasing of high technology electronics components.

The book series includes *Transistors, Discontinued Transistors, Diodes, Discontinued Diodes, Thyristors, Discontinued Thyristors, Consumer ICs, Microprocessor ICs, Microcomputer Systems, Optoelectronics, Discontinued Optoelectronics, Microwave, Discontinued Microwave, Type Locator, Discontinued Type Locator, Digital ICs, Linear ICs, Interface ICs, Memory ICs, Discontinued ICs, Power Semiconductors* and *Application Notes.*

Each book contains a master index of devices, manufacturers and detailed technical sections that tabulate characteristics, connections and outline drawings.

These books can often be found at distributors' and at manufacturers' regional offices.

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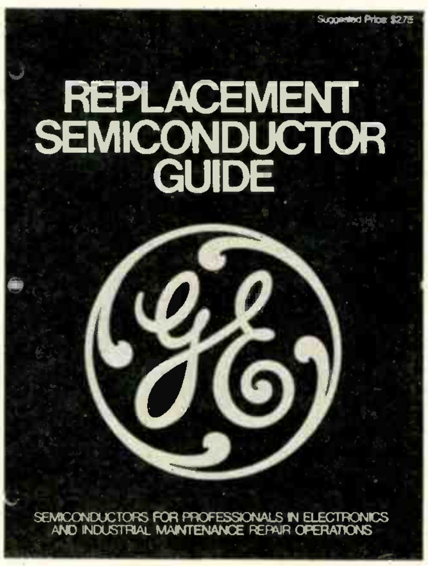

General Electric

General Electric *Replacement Semiconductor Guide* no. ETRM-4311T has 546 pages of technical information about semiconductors and an extensive cross-indexing system.

Products include silicon and germanium transistors, diodes, rectifiers, voltage regulators, MOV, focus resistor assemblies, transient protectors, ICs, SCRs and triacs.

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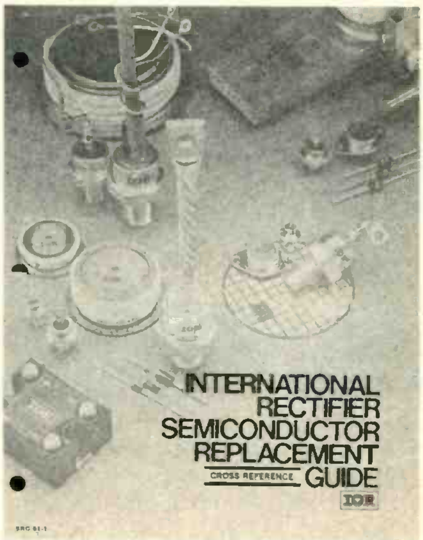
International Rectifier

The International Rectifier Semiconductor Replacement Cross Reference Guide is designed to provide data on the complete line of IR products.

The IR replacement numbers indicate the nearest IR equivalent and, in most instances, provide the user with an exact replacement device, or one of greater current and/or voltage rating. The user must qualify the replacement acceptability by reviewing the electrical, mechanical and thermal characteristics of the



specific devices involved.

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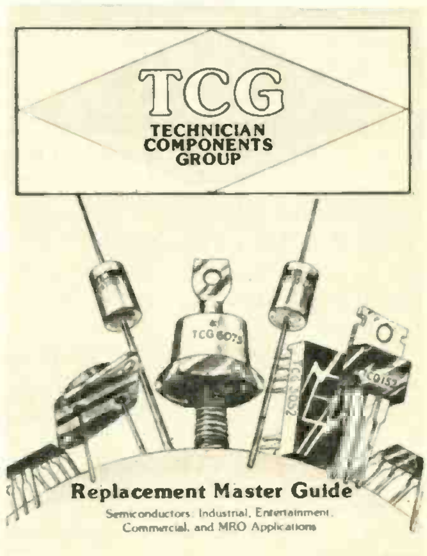

New-Tone Electronics

New-Tone Electronics is offering

its new *TCG Replacement Master Guide* to MRO, service dealer and OEM purchasers of replacement devices through the company's distributors.

The guide consists of more than 450 pages of listings on 1700 TCG replacement semiconductors, cross-referenced to over 170,000 replacement equivalents.

Each page provides specifications and diagrams on TCG replacement devices, as well as an extensive cross-reference matching them with replacement equivalents. The guide contains over 600 TCG devices not previously listed.

Circle (50) on Reply Card

Philips ECG Inc.

The *ECG Semiconductor Master Replacement Guide* lists more than 2500 Sylvania solid-state replacement devices used as substitutes for domestic or foreign units in entertainment, commercial and industrial equipment.

The 432-page book contains more than 350 new types, including high noise immunity logic families, microprocessor devices and random access memories. Also included are additions to existing lines of bipolar and RF transistors, industrial rectifiers, silicon-controlled rectifiers, high voltage devices, linear ICs and CMOS and TTL digital ICs.

The technical section also includes data on transistors, diodes, rectifiers, thyristors, linear and digital modules, and ICs.

Circle (38) on Reply Card

The Transistor Transistor Logic Data Manual contains data on more than 250 TTL devices in the semiconductor replacement line. Each information sheet contains all the pertinent dc and ac information for that replacement part.

The Selector Guide section contains information about buffers/inverters, Schmitt Triggers, registers, latches, arithmetic functions, memories, counters, multiplexers, decoders/demultiplexers, drivers and transceivers/receivers.

The Product Information section includes general ratings and circuit characteristics, design considerations, power supply decoupling data, and a CMOS-74C series.

Circle (39) on Reply Card

Radio Shack

Semiconductor Replacement Guide catalog no. 276-4005 from Radio Shack has 88 pages of specifications about Archer display devices, ICs, diodes, transistors, SCRs, triacs, optoelectronic devices and general information. Also, there are about 200 unnumbered pages that cross-index 100,000 semiconductor substitutions.

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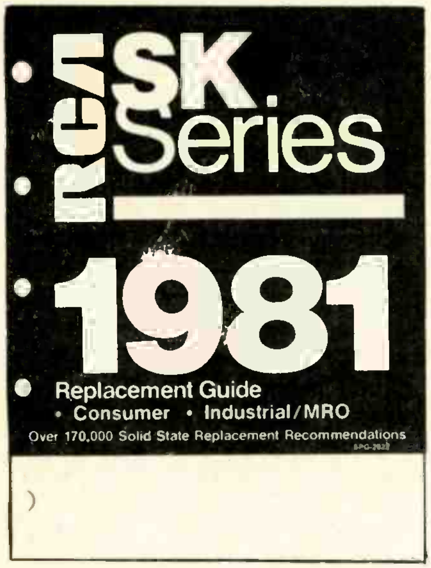

RCA

The 1981 SK Top of the Line Solid-State Replacement Guide lists more than 1300 solid-state replacement devices that replace more than 170,000 domestic and foreign types.

The 408-page guide shows the SK stock number along with the stock number of the numbering system used by ECG (GTE Sylvania), REN and TM, to help locate the correct solid-state device. The guide offers information on the complete line of RCA transistors, rectifiers, thyristors, ICs and high voltage triplers, including many MRO replacements.

Circle (40) on Reply Card

The RCA MRO Solid-State Manual for JEDEC and Commercial Replacement devices is a new 64-page manual that offers abridged data on 2800 JEDEC and commercial devices.

One feature of the manual is a cross-reference listing of 11,580 additional JEDEC and Commercial types. The manual also eontains data on 12 axial-lead rectifiers for industrial use and 26 full-wave bridges from RCA's SK series replacement line.

Circle (41) on Reply Card

RSM Sensitron

A 12-page specification booklet is offered by RSM Sensitron. It covers power rectifiers, bridge rectifiers, three-phase bridges and NPN silicon power transistors.

Circle (42) on Reply Card

Semikron International

Semikron International offers a 38-page *Condensed 1980 Catalog* featuring physical and electrical specifications for diodes, rectifier bridges, high-voltage diodes, MOV transient protectors, heat sinks and SCR thyristors.

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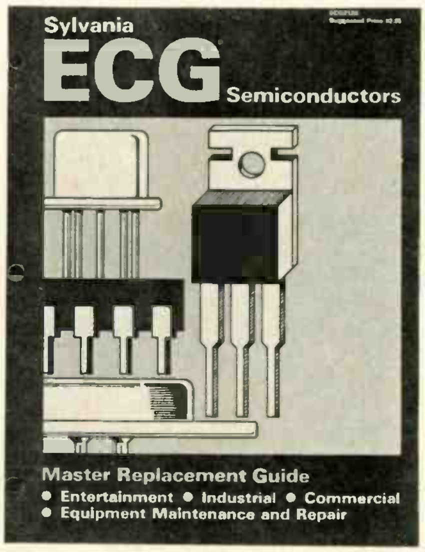

Sylvania

Sylvania is offering their 11th edition *ECG Semiconductors Master Replacement Guide* for the entertainment, industrial, commercial and MRO markets.

The guide features more than 350 new products and more than 27,000 new crosses. Included in the 434-page catalog is information on transistors, high voltage devices, diodes and rectifiers, zener diodes, and more. Also included is a list of accessories and a replacement directory. The catalog includes an alphabetical and numerical product index.

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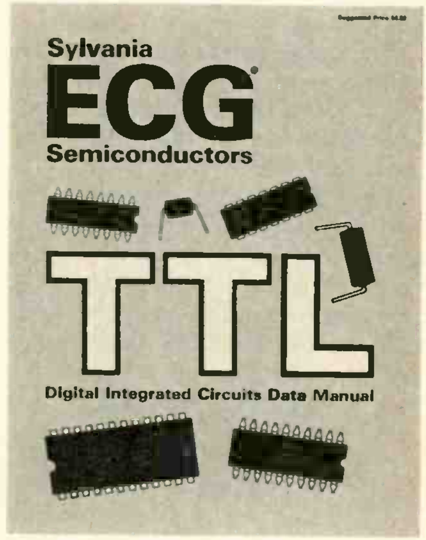
Sylvania's *ECG Semiconductors Digital Integrated Circuits Data Manual* contains product information for the more than 285 TTL devices in the ECG semiconductor replacement line. Each individual data sheet is self-contained with all



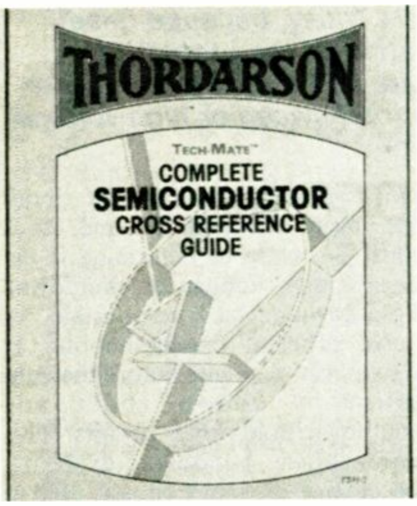
pertinent dc and ac information for that device type.

The logic devices described in this manual differ widely in funciton, complexity and performance, but their electrical input and output characteristics are similar and are defined and tested to guarantee compatibility. The data sheets that make up this book cover the major categories of TTL circuits.

Circle (52) on Reply Card

Thordarson

Tech-Mate *Complete Semiconductor Cross-Reference Guide* no. TSH-3 from Thordarson has technical tips, product data and cross-reference information for transistors, SCRs and SCSs, thyristors, diodes and rectifiers, zeners, voltage multipliers and ICs. Universal replacement semiconductors cover



service requirements for more than 100.000 devices.

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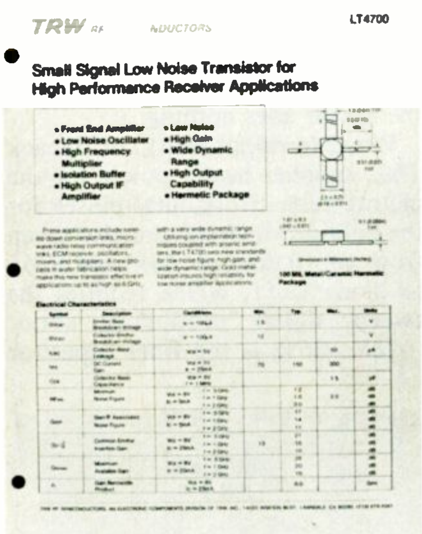

TRW Semiconductors

A 4-page data sheet describes TRW Semiconductors' LT4700 small signal, low noise microwave transistor that features a 6 GHz gain-bandwidth product (F_t) and a minimum noise figure (NF_{min}) of 1.6 dB at 1 GHz.

The data sheet, *Small Signal Low Noise Transistor for High Performance Receiver Applications,* provides the following charts: typical noise figure and associated power gain vs. frequency, noise measure vs. frequency, noise figure vs. collector current, gain-bandwidth product vs. collector current, insertion gain vs. collector current and output power vs. collector current. Also included in the data sheet is a tabulation of "s" parameters vs. frequencies from 100 MHz to 2 GHz. In addition, noise parameters are tabulated for 0.5, 1.0, 1.5 and 2.0 GHz.

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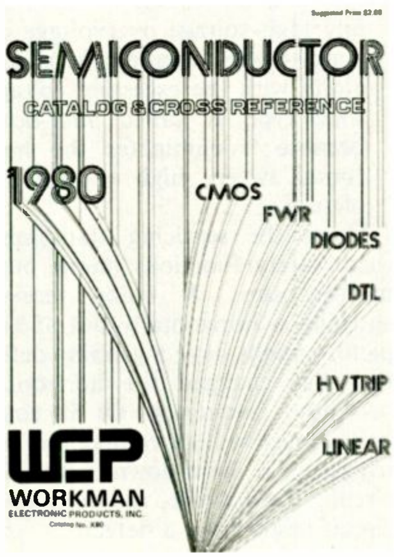

Workman Electronic Products

The Semiconductor Catalog and Cross Reference Guide from Workman offers more than 160,000 listings. This guide, with more than 250 pages, provides device descriptions, device usage data, symbols and nomenclature background, competitive cross reference and specifications.

Listings include PNP and NPN silicon and germanium transistors, RF transistors, HV Triplers, switching transistors, color TV ICs, zener diodes and silicon diodes. One new device is the Sil-Pad, which replaces mica insulators under power transistors without requiring silicone heat-transfer compound.

Circle (46) on Reply Card

Zenith

Specifications of Zenith universal-replacement semiconductors, a competitive cross-reference to GE, RCA and Sylvania, and a full cross-index for industry numbers are in the Zenith Radio Corporation's *Universal Semiconductors* guide.

The guide lists a line of semiconductor devices which replaces more than 158,000 devices now used in electronic products. The guide is

composed of a 1-number system of exact and selected semiconductor replacement parts.

Use of the guide permits a service technician to use Zenith semiconductors in a wide range of consumer electronic products such as color and black-and-white TV sets, stereo systems and radio, and personal and business computers.

Circle (48) on Reply Card

This month's semiconductor source guide is a sampling of product catalogs based on information supplied by those companies to **Electronic Servicing.** *Other companies that provide similar catalogs may be written to directly.*

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Servicing shutdown circuits

Troubleshooting color receivers containing shutdown or hold-down protective circuits can be very tricky, because false operation of the protective circuits can simulate defects in horizontal-sweep or high-voltage sections.

By Homer L. Davidson

Several years ago, in response to pressure for safer TV receivers, TV manufacturers devised several methods of disabling any color receiver that developed excessive high voltage, which can produce soft X-rays in the picture tube.

These safety circuits usually operate using one of these two basic actions:

- The overvoltage condition activates the protective circuit, which produces an out-of-lock picture that is either vertical or horizontal, but usually horizontal. The erratic slanted or rolling picture discourages the viewer from further operation of the receiver. Also, the erroneous horizontal-sweep frequency is in the direction that reduces the high voltage. This type of safety operation is called *hold-down* because it reduces but does not eliminate the high voltage and picture brightness.
- Most newer color receivers incorporate a safety circuit that kills the horizontal sweep when any high-voltage overvoltage occurs, thus eliminating the picture along with the excessive voltage. This type is called *shut-down* because it eliminates the horizontal sweep, high voltage and picture.

From the servicing standpoint, these safety functions mimic other malfunctions. A color receiver showing a horizontally out-of-lock picture might have a genuine defect that has changed the horizontal-oscillator frequency. Or it could have excessive high voltage that has triggered a hold-down protective circuit. Even worse, the hold-down circuit might have a defect.

Similarly, a genuine horizontal-sweep defect might have killed the high voltage and picture. Or excessive high voltage could have activated a shutdown safety circuit that eliminated the sweep.

Therefore, the first step in analyzing a symptom that *could* originate in the shutdown or hold-down circuit is proving whether that circuit has been activated. Second, tests must be made to determine if excessive high voltage or shutdown/hold-down defect is responsible.

No efficient troubleshooting or repairs can be made before the condition is known about any shutdown/hold-down circuits. This sometimes becomes difficult because of the many circuits used in various models, and the lack of information about disconnecting the protective circuit.

A simple hold-down circuit

The Sharp color TV portable model 13D38 (Photofact 1934-2) has an uncomplicated hold-down circuit (Figure 1). Unless the high voltage rises above the design level, the circuit does nothing.

Pins 2 (ground) and 10 of flyback T602 supplies heater power for the picture tube. Horizontal pulses for the hold-down circuit are also taken from pin 10 through R653 and R655 to diode D651, which rectifies the sweep signal producing about +16V. C652 is the filter capacitor

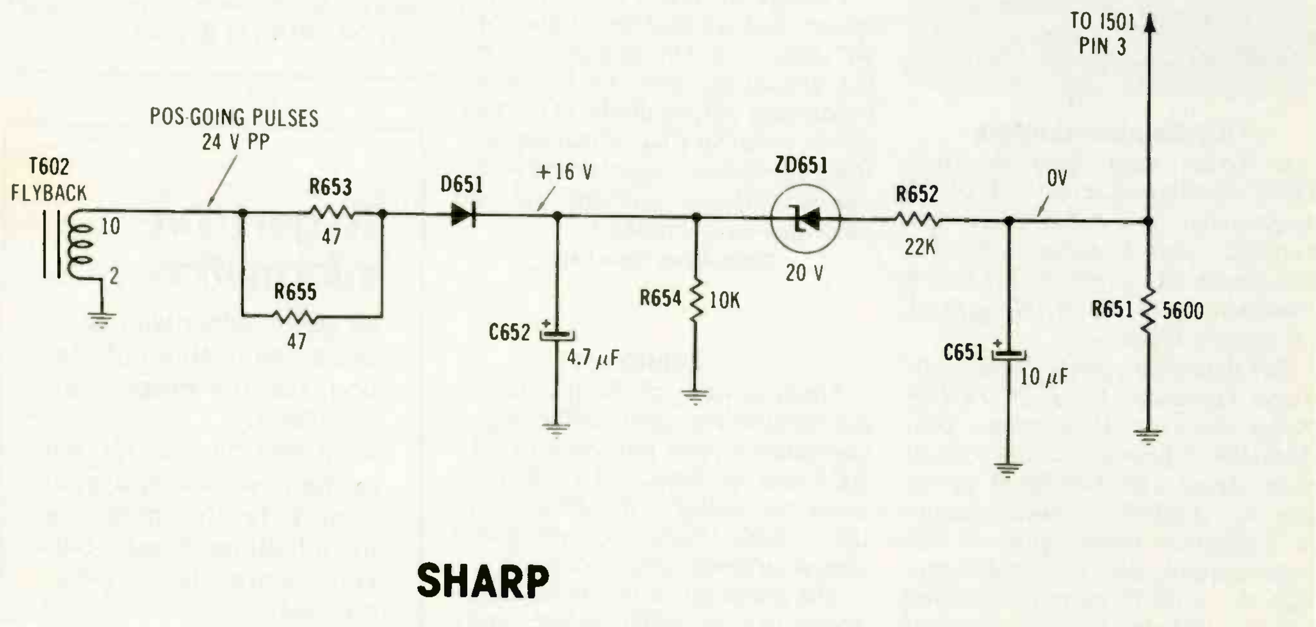
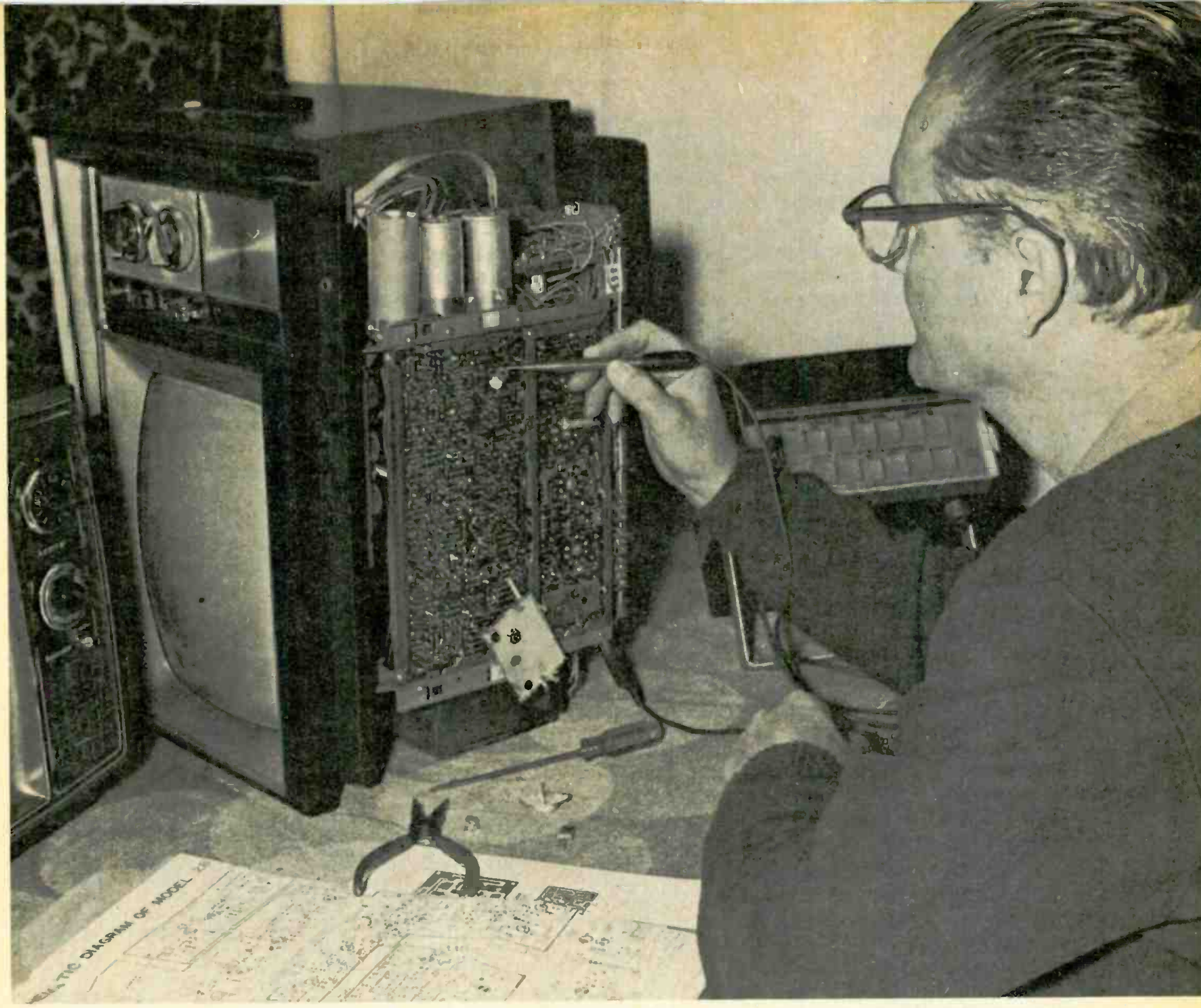


Figure 1 A zener (ZD651) blacks dc voltage produced by rectification of flyback pulses until the voltage is larger than the zener rating. Then ZD651 passes positive voltage to IC501 pin 3 to change the horizontal frequency.



A technician is shown testing voltages with a digital meter in the horizontal stages of a color receiver that includes a shutdown circuit. Also needed are a good scope and high-voltage meter.

that makes the rectification peak reading, while R654 is the normal load.

A second load is the series connection of zener ZD651, R652 and R651. The zener has a rating of 20V, however, which means it will not pass any appreciable current or voltage until the zener voltage is exceeded. Any condition in the horizontal-sweep circuit that produces excessive high voltage also increases the nominal +16V (at ZD651 cathode) above the 20V rating. This places a positive voltage at pin 3 of IC501, and the IC changes the horizontal frequency enough that the horizontal-hold control cannot restore proper locking.

Integrated circuit IC501 is multipurpose, providing sync separation, horizontal oscillation, B+ regulation, vertical oscillation, AFC detection, and safety control of the horizontal-oscillation frequency.

Testing the Sharp

Disconnecting the hold-down circuit in this Sharp is easy. Either disconnect one lead of D651, or short across R651 (IC501 pin 3 to ground). If the horizontal frequency changes and then can be locked normally to a station, then the hold-down circuitry was causing the previous out-of-lock condition. This test is based on the fact that the hold-down circuit does nothing unless the high voltage is excessive. Therefore, disconnecting the hold-down stage should not interfere with normal horizontal locking.

A second step is vital when the test shows normal locking with the protection stage disconnected, but not with it connected. The high voltage must be measured immediately and reduced to normal if it is excessive. The receiver should never be operated for more than a minute or two with the safety circuit disabled, because if the high voltage is too high it can damage other components or the picture tube.

In cases in which the high voltage is normal but the safety circuit has a defect, do not merely disconnect it. Instead, repair and reconnect it.

Measure the dc voltages in the Figure 1 safety circuit and then test all resistors and diodes. Zener diode ZD651 can be disconnected and tested for forward conduction and reverse leakage. If both tests have normal results, the zener is probably not defective.

If disabling the safety circuit does not correct the out-of-lock horizontal, IC501 should be replaced.

RCA shutdown circuit

A 2-stage overvoltage protector circuit is included in RCA and J. C. Penney CTC101 chassis (Figure 2). When this circuit is activated, perhaps from excessive high voltage, it kills all gain of the horizontal-drive transistor. How this momentary elimination of drive triggers shutdown of the entire receiver is an interesting story.

All low-voltage power supplies in the CTC101 (except the line-rectified raw power at the regulator SCR) are produced by rectification of horizontal-sweep pulses. A start-up circuit provides a pulse of positive dc voltage to start the oscillator and driver each time the line power is switched on. Any interruption, even for less than a second, triggers shutdown that eliminates all dc voltages except the line-rectified supply. Without horizontal sweep and high voltage, there can be no picture or sound.

Safety circuit operation

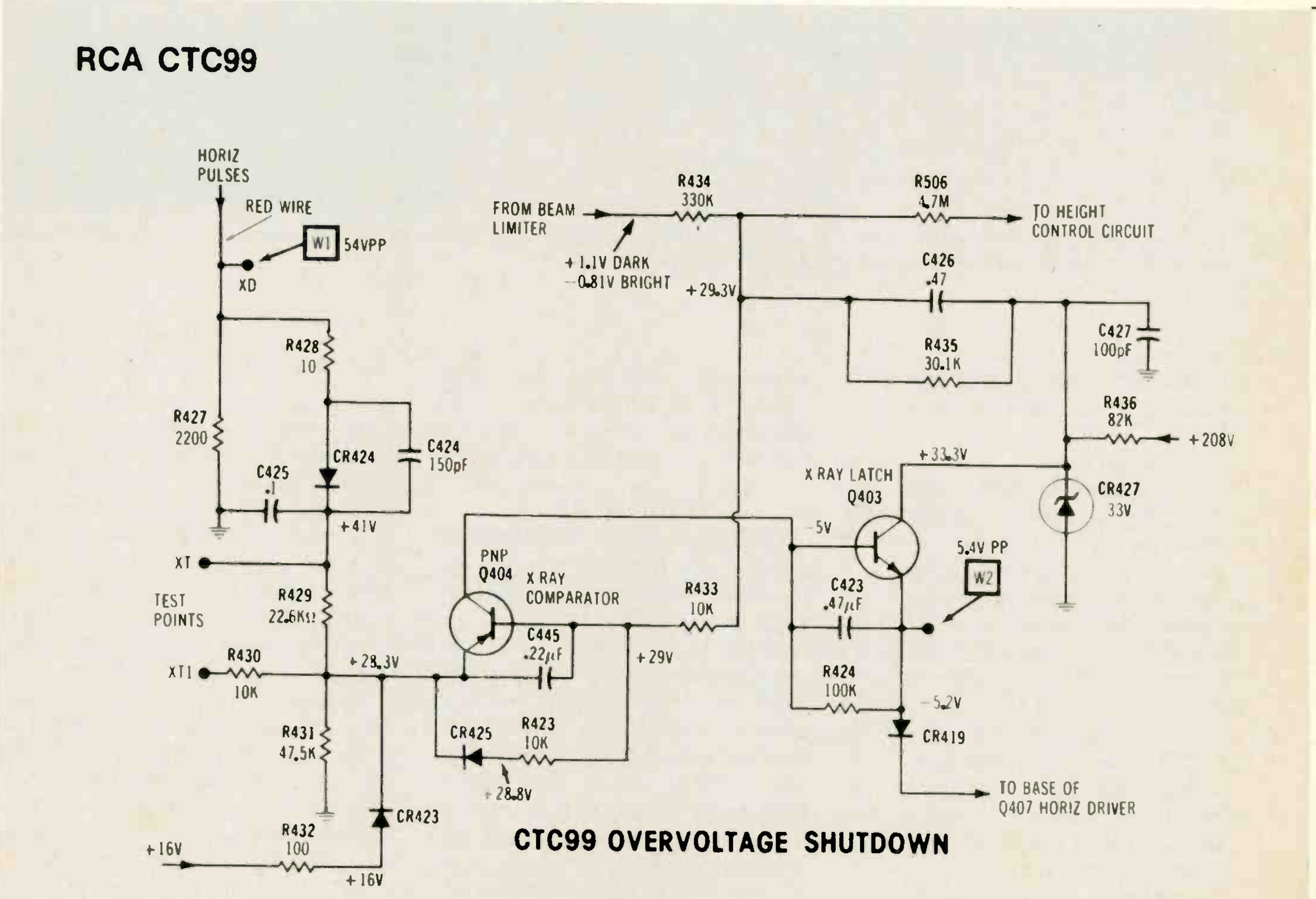
Successful servicing of the safety shutdown circuit requires a knowledge of normal circuit operations.

Positive-going pulses from the red wire of the flyback are rectified by diode CR424, producing about +41Vdc at testpoint XT (CR424 cathode). The dc voltage falls or rises in step with amplitude of the flyback pulses. This is also true of the high voltage, so they vary in the same percentage. The shutdown circuit operates only from dc voltages.

A sample of the +41V varying voltage is fed to the Q404 emitter, while the Q404 base has a regulated dc voltage derived from the +33V supply that is stabilized by zener CR427. Thus the Q404 forward bias changes according to the +41V variations.

Notice that Q404 is a PNP polarity, so an increase of emitter positive voltage (from the +41V) is increased forward bias. In normal operation when shutdown is not called for, the B/E is reverse biased, so Q404 is cut off.

The Q404 collector is direct coupled to the Q403 base, while the Q403 emitter is connected through switching diode CR419 to the base of Q407 horizontal-driver transistor. In normal operation, the Q403 emitter measures about -5V, produced by CR419 rectification of



CTC99 OVERVOLTAGE SHUTDOWN

the Q407 base squarewaves.. An R424, 100K resistor returns the Q403 base to its emitter, and the only other base connection is to the Q404 collector. Because Q404 is nonconductive, Q403 has about zero bias, so it too is cut off and does not interfere with the Q407 drive signal.

If the +41V supply increases, Q404 has sufficient forward bias to conduct some of the emitter positive voltage to the collector, making it positive. This collector is connected to the Q403 base, so Q403 also has forward bias. Q403 conducts part of its collector positive voltage to the emitter, where it passes through diode CR419 and applies a saturation overbias to the Q407 base. The Q407 saturation positive bias eliminates most Q407 gain. Therefore, the drive drops below the level needed to sustain horizontal sweep, and the entire sweep circuit is instantly turned off.

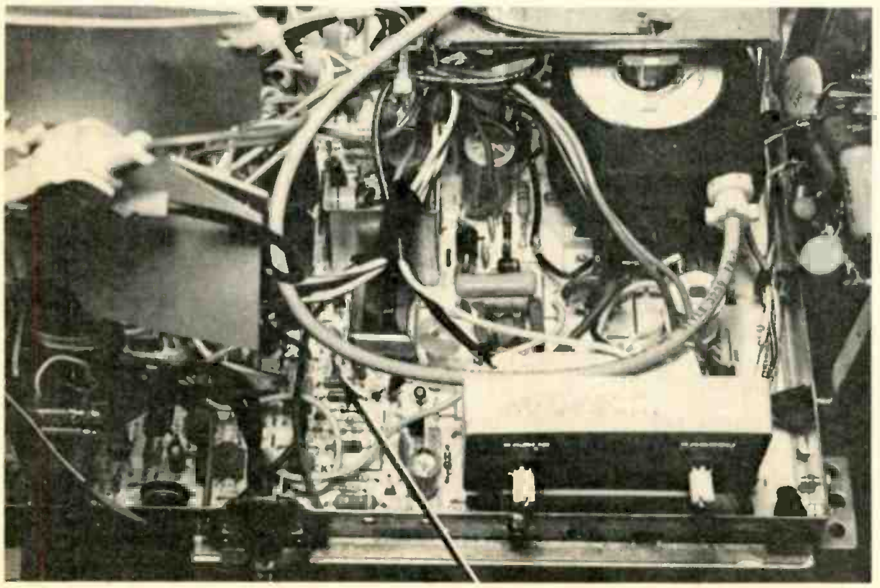
Without a start-up voltage (not present except at switch-on), the receiver remains dead. No latching action is required in the shutdown circuit, because the horizontal cannot be restarted until the television is turned off and most of the voltage has drained from the main raw-B+ filter capacitor. When the receiver is switched on after that waiting period, start-up will occur. If the shutdown circuit defect or the excessive high voltage has not been corrected, another shutdown will occur instantly. But if all is well, the receiver will operate normally.

Troubleshooting

During shutdown, there are no dc voltages in the receiver except in the +155V supply, which because of the light load will measure about

Figure 2 RCA CTC99 and CTC101 chassis have a protective circuit with two transistors that monitor dc voltage rectified from horizontal sweep. When the dc voltage rises abnormally, both transistors conduct. Q403 conducts positive voltage to its emitter, then the voltage passes through switching diode CR419 to kill the gain of the Q407 horizontal driver. This shuts down all but the +155V raw line-rectified supply.

Figure 3 The arrow indicates testpoints XT and XT1 in RCA CTC99 and CTC101 chassis. As a test, these points are connected together to product shutdown. If shutdown does not occur, the shutdown circuit is defective and must be replaced.



+165V. This can be a symptom either of failure to start or normal start-up followed by shutdown.

The easy way to test for a shutdown circuit that is defective and thus causing its own shutdown operation is to disconnect either end of diode CR419. Warning: If the receiver then operates while the shutdown circuit is defeated, the high voltage might be dangerously high. Test it immediately when a picture is obtained, then instantly turn the television off if it is excessive. But normal high voltage indicates a defective shutdown circuit, which must be repaired before it is reconnected.

First tests in the shutdown circuit should include leakage checks of both transistors. Next, the presence of +33V at the cathode of zener diode CR427 must be verified. Test switching diode CR419 for leakage, also.

After the shutdown circuit has been repaired or found to be normal, it should be checked for proper operation. Short testpoint XT to testpoint XT1 (Figure 3) while the receiver is operating correctly. Shutdown should occur instantly. Remove the short and wait with power off for two or three minutes to allow the filter to discharge before switching on the ac power. Normal operation then should be obtained.

The RCA shutdown protection circuit has not caused any large number of servicing problems, but it is covered in detail here because of the potential for much wasted time if a technician tests circuits that are not defective.

A Japanese hold-down circuit

In Samsung model CT-332D portable color receivers, the hold-down trigger is activated by the precise boost voltage (Figure 4).

Resistors R709, R711, R712 and R713 form the top leg of a voltage divider, while R704 is the bottom leg. The voltage divider reduces the +850V boost voltage to less than 1V at the Q702 base and Q701 collector. The Q702 emitter positive voltage is stabilized by zener D701 with load current from R705. In normal operation, Q702 is nonconductive because of insufficient bias.

If the boost voltage rises, the Q702 base voltage rises in step. Thus, excessive sweep and high voltage conditions cause enough increase of Q702 forward bias to produce a small C/E current, which reduces the Q702 collector voltage.

Notice that the Q702 collector is connected to the Q701 base, so the reduced dc voltage there produces a small C/E current in Q701, because Q701 is a PNP type. The Q701 C/E current brings positive voltage from the emitter to the collector, making it measure more positive.

That is not the end of the action, for the Q701 collector is direct connected to the Q702 base. Therefore, Q702 has increased forward bias, which in turn increases the negative forward bias of Q701 and thus raises the C/E current, which in turn increases the Q702 C/E. This action continues with each transistor's current increasing until both transistors are saturated (C/E resistance is almost zero ohms).

The two transistors form an electronic switch with action similar to that in an SCR. Once the circuit is triggered and both transistors become saturated, the conditions remain fixed until power is removed. This resets the circuit; it is ready when needed in another overvoltage situation.

When the Q701/Q702 electronic switch is activated, the circuit is completed through R506/R527, R701, Q701 E/C and R704 to ground. This reduces the positive voltage at the base of the Q501 horizontal oscillator and increases the horizontal frequency. The effect is identical to a similar resistance connected in parallel with R508 and the horizontal-hold control. The receiver is out-of-lock and cannot be locked with the hold control, which discourages the viewer from operating the machine before it is repaired. Additionally, the higher sweep frequency somewhat reduces the high voltage.

Operation of the hold-down circuit can be tested when there is no overvoltage by shorting together terminals D11 and D12 on the sweep board. The picture should become out-of-lock diagonal lines. Remove the test short, switch off the TV power and wait a few seconds, turn on the TV power and expect a normal picture. If the receiver does not respond as described, the hold-down circuit is probably defective.

To disconnect the hold-down circuit for a short test, disconnect either end of resistor R701. If the receiver cannot be locked until the hold-down is disabled, but it works afterward, the hold-down circuit needs repair.

Normal troubleshooting procedures should be adequate to find any defective components in this hold-down circuit.

SCR shutdown

An SCR is employed in the Montgomery Ward model GGY-16217B color receiver to kill the horizontal sweep when shutdown is needed because of excessive high voltage (see Photofact 1838-1).

Horizontal pulses from the T400 flyback are clamped by zener diodes SC434 and SC433, with the unclamped part of the pulses rectified by diode SC435 (Figure 5). With normal high voltage, the pulse amplitude does not exceed the clamping level, so little positive voltage is produced by SC435. R436 is the load, and C432 is the peak-reading filter capacitor for the SC435 rectified voltage that is applied to the gate of SCR430.

The anode and cathode of SCR430 are connected between the B+ load resistors (R430 and R438) and a point that is almost ground (R998 and R999). Therefore, when the SCR430 gate becomes sufficiently positive (about +1V) than its cathode, the SCR conducts and removes the B+ supply voltage from IC400 pin 15. This eliminates the squarewave drive to the Q400 driver transistor base and kills the horizontal sweep.

The SCR430 cathode has a small negative voltage from the automatic brightness-limiter (ABL) circuit. Increased current through the picture tube increases the negative voltage. Therefore, excessive CRT current *and* excessive high voltage (or either separately) can trigger the SCR and kill the horizontal sweep and high voltage.

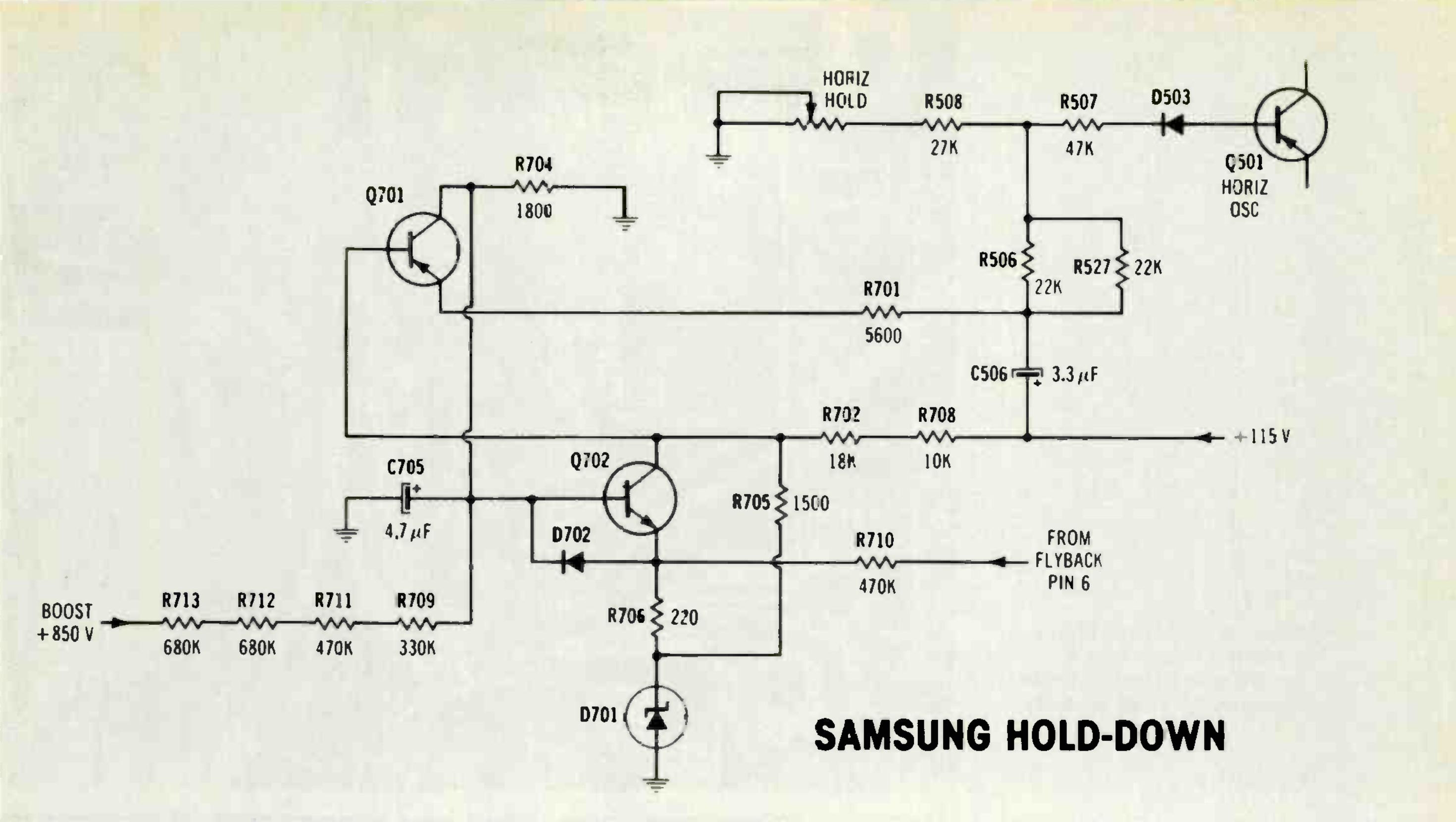
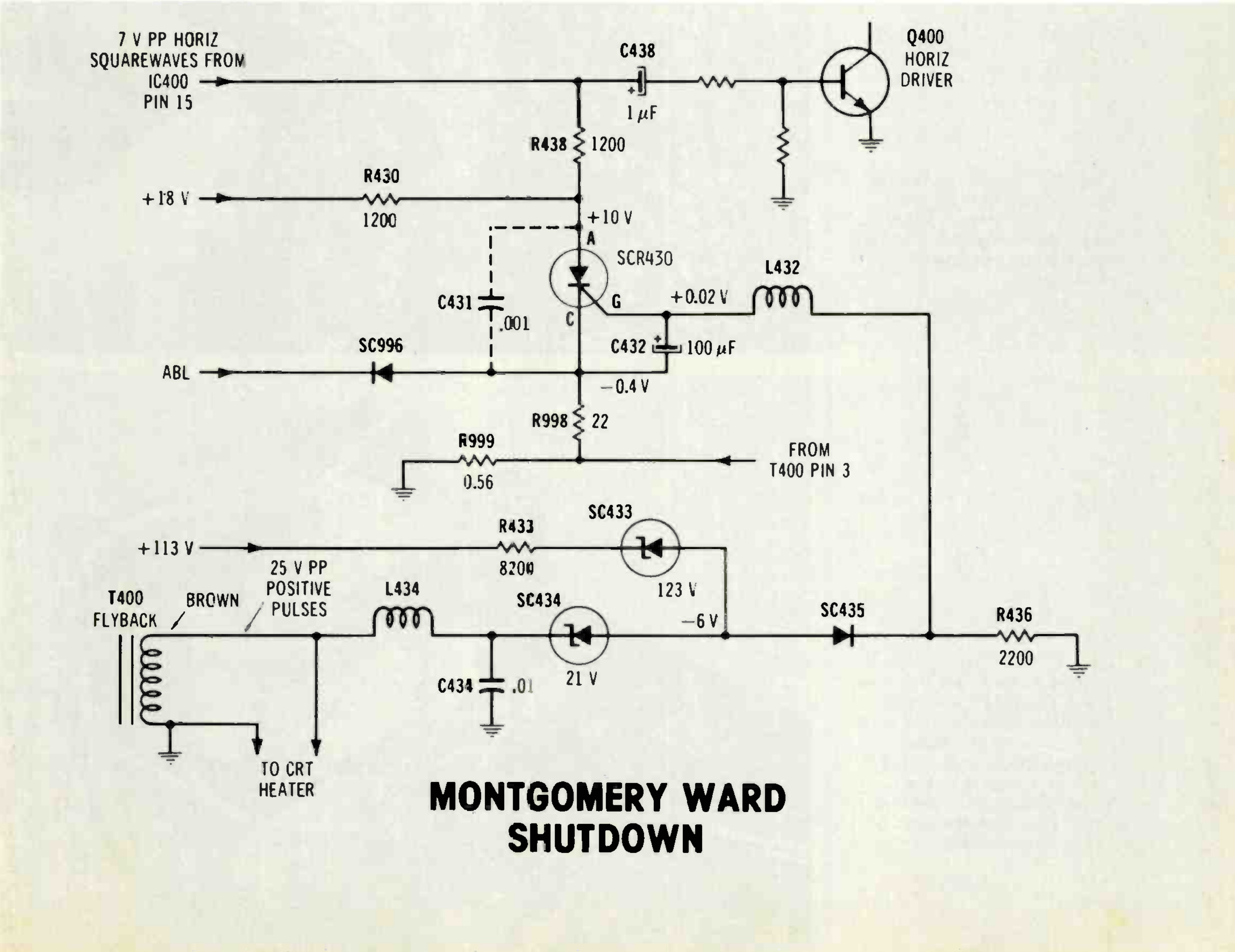


Figure 4 A Samsung hold-down circuit latches to produce an out-of-lock picture.

Figure 5 Excessive high voltage or CRT current in a Montgomery Ward TV triggers SCR430, which kills the drive to Q400 horizontal-driver transistor, shutting down the horizontal sweep and high voltage.



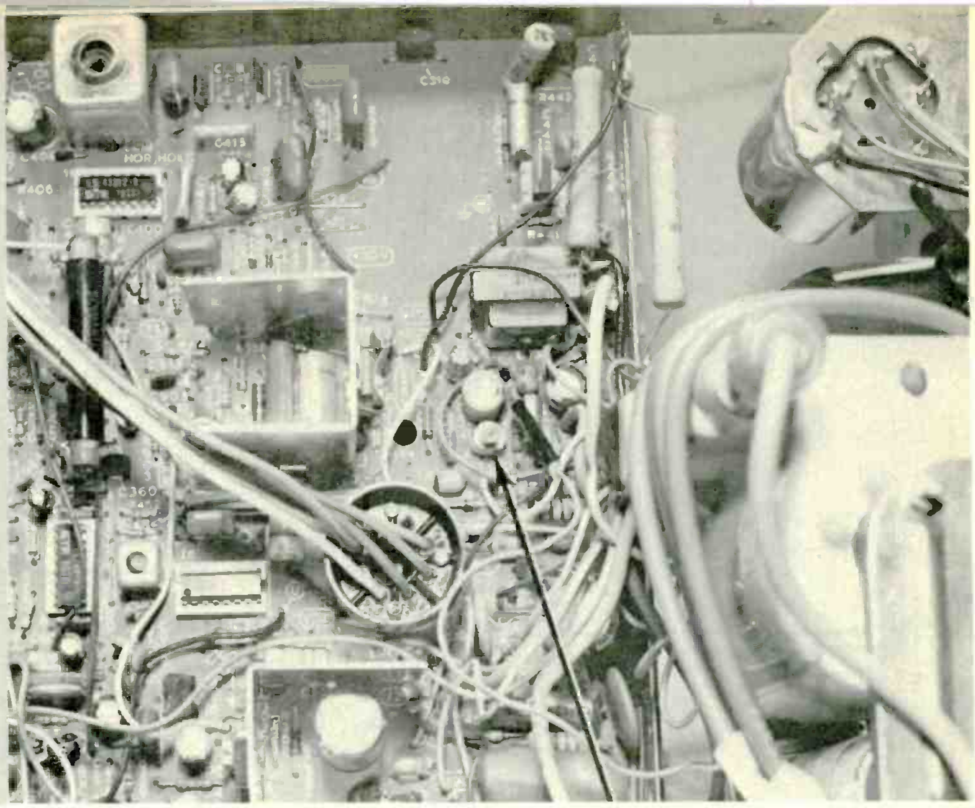


Figure 6 SCR430 of Figure 5 schematic plugs into a socket (see arrow) so it can be easily removed for tests.

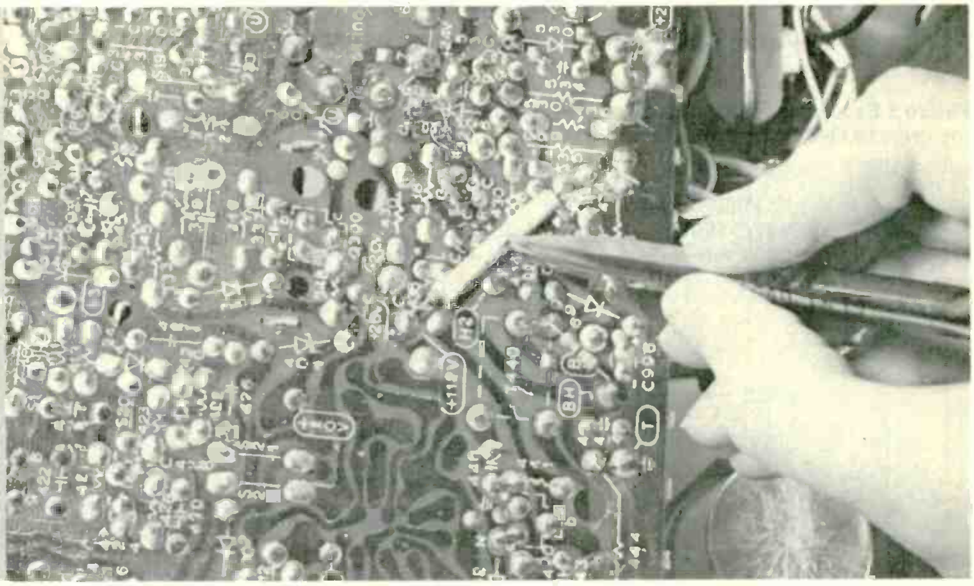


Figure 7 The pin tip points to diode SC433 and R433 of the Montgomery Ward receiver in Figure 5. They are covered by insulating spaghetti.

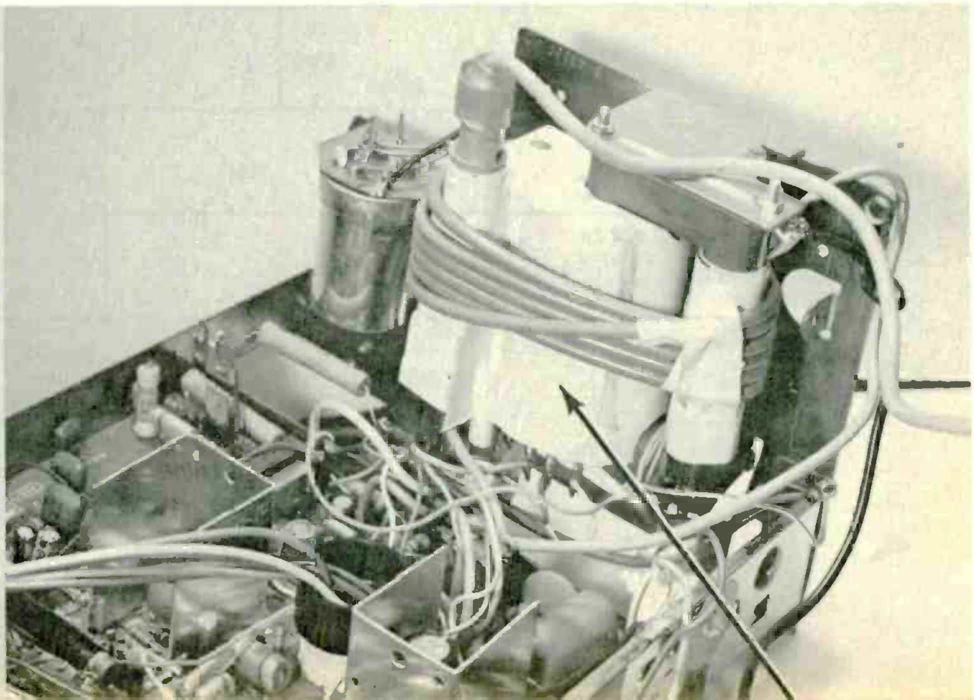


Figure 8 Many new flybacks have several high-voltage rectifiers encapsulated with the HV windings. Make certain the flyback is bad before replacing it; the shutdown circuit might be mimicing the symptoms of a defective flyback.

Shutdown circuits

After the shutdown circuit is triggered, it remains in that condition because the SCR430 A/C current does not drop to zero. It can be reset by turning off the ac power and waiting a minute or two before reapplying the power. If the cause of the previous shutdown has been repaired or is not active at the moment, the receiver should operate with normal sweep.

Check for shut-down condition by measuring the dc voltage at the junction of resistors R430 and R438. If the voltage is near zero, the SCR is conducting, probably from shutdown.

It is easy to prove whether the SCR is conducting. SCR430 is plugged into a socket (photograph in Figure 6), and it can be unplugged while the performance is observed. The SCR, strongly resembling a small transistor, can be tested while it is unplugged. If the receiver is in shutdown with the SCR but has a picture with it unplugged, the SCR was conducting.

When the SCR is proved nondefective, the next step is to measure the gate-to-ground voltage. If this is excessively positive, work back through rectifier SC435 and the two clamp zeners to find the source of the voltage.

Zeners SC434 and SC433 have been known to break down under circuit load, but test normal out of the circuit. SC434 is rated at 21V, and SC433 is rated at 123V. Replace both if their condition is in doubt. SC433 is difficult to locate, because it and R433 are inside insulating spaghetti on the bottom of the circuit board (Figure 7).

Servicing shutdown/ hold-down circuits

Successful troubleshooting of color receivers that have protective shutdown or hold-down circuits requires extra awareness that those safety circuits are in the receiver. The technician must also know what the protective circuit is supposed to accomplish after it is triggered, and also what conditions trigger the action. Several basic circuits have been analyzed here to provide the fundamental principles.

For example, the first thought many technicians have when confronted with a color receiver that has no high voltage or horizontal sweep, is that the problem is in the horizontal/high-voltage section, and probably involves the horizontal-output transistor, the flyback, or the HV tripler. This could be disasterous to the production schedule, if the receiver has excessive high voltage or a defective safety shutdown circuit.

Circuits that shut down the horizontal sweep usually do so by removing the drive waveform at the base of the driver transistor or the output pin of an IC that provides the same function. Therefore, the first test should be for a proper waveshape and amplitude at the collector of the driver transistor. If these are not dangerously below ratings, it indicates the problem is located farther downstream, and not in the shutdown circuit.

When the driver base and collector waveforms are found to be substantially reduced, the shutdown circuit must be suspected. The fastest test is to disconnect the safety shutdown where it connects to the active circuit, such as the driver base. If proper operation is obtained, there are two remaining questions: (1) Is the high voltage excessive, and triggering the shutdown, or (2) does the safety circuit have a defect that triggers itself?

The next step, therefore, is to monitor the high voltage. If it is too high, make repairs before the safety shutdown is reconnected. If the high voltage is normal, the shutdown circuit must be repaired.

Procedures for hold-down circuits that force the oscillator out of horizontal lock are similar, but the safety circuit should be disconnected to determine whether the receiver then can be properly locked. If it cannot, the basic problem is in the horizontal oscillator, and not in the hold-down stage.

Causes of excessive HV

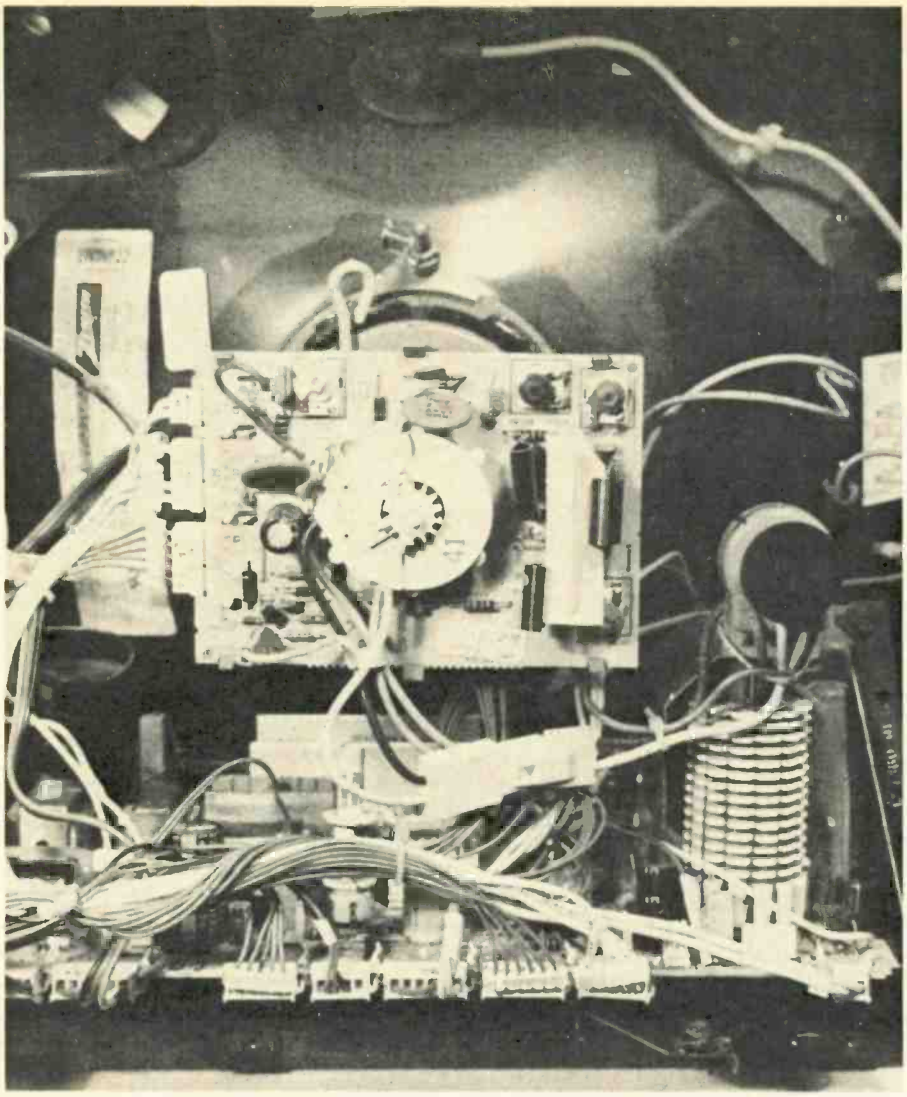
Few defects can increase the high voltage by a significant amount. Some receivers regulate sweep and high voltage by regulating the dc-voltage supply that is applied to the output-transistor collector. Often the regulating element is a power transistor that can become shorted between collector and emitter. The higher B+ supply produces an increased high voltage. This is also true for those models that use an SCR to regulate a B+ supply.

Most models using a TO-3 type of output transistor have one or more capacitors connected approximately from collector to emitter, or across the damper diode. These capacitors tune the yoke/flyback inductances during retrace (pulse time). Therefore, any significant reduction of this total capacitance increases the high voltage, almost in direct ratio. One of these capacitors usually is larger than the others, perhaps between 0.01μF and 0.02μF, and if it opens, the high voltage might climb to around 50kV—extremely dangerous to technicians and components. These capacitors should be the first components suspected and tested. Remember, these *must* be types designed for high-current pulse circuits and having a high voltage rating.

An excellent technique with many newer all-solid-state models is to make preliminary tests while the line voltage has been lowered by a variable-voltage transformer. Most of these receivers will operate with a small and dimmer picture down to about 70Vac of line power. This is a good starting voltage for tests of receivers that persist in ruining output transistors or other expensive components during power-on tests.

With receivers that trigger into shutdown or hold-down conditions, it often is informative to begin the line voltage (measure the voltage) and notice which minimum ac voltage produces shutdown or hold-down action. During subsequent tests, the receiver can be operated at slightly below the triggering ac voltage.

Don't replace flyback (high-voltage) transformers without strong proof that they are defective. Many present-day models include several HV diodes inside the flyback assembly (Figure 8). Any service-type ohmmeter will indicate such diode/winding combinations as open, whether the diodes or the winding is actually open or not. □



The M10 module (below) is the largest Zenith System-3 module. It also is the only one mounted horizontally. M10 contains both line-operated power supplies, all scan-rectified power supplies, the pulse-width modulator, two horizontal drivers, one large horizontal-output transistor with heat sink, regulator and high-voltage transformers, the shutdown safety circuit, and pincushion-correction components.

By Carl Babcoke, CET

zenith power and horizontal sweep part 1

The Zenith horizontal sweep and all scan-rectified power supplies on the M10 module are regulated by a unique circuit. No power transformer is needed, but all voltage supplies (except the raw line-rectified source) are isolated from the power line.

M10 module number 9-160 is the largest plug-in module in the new Zenith line of System-3 color TV receivers. M10 contains the ac-line-rectified non-isolated power supply (Figure 1), one isolated dc-voltage supply for startup of the horizontal, an overvoltage-shutdown safety circuit, an IC that varies the drive-pulse width for sweep regulation, two horizontal driver transistors, components for sweep-linearity and pincushion correction, and a high-voltage transformer with several additional windings that feed rectifiers to produce several isolated low voltage power supplies.

Although M10 modules are included in all System-3 models, the high voltage and other voltages are not the same in all. This requires several changes of component values along with accompanying variations of module numbers. M10 numbers used for the 1981 Zenith line include 9-160-03C, 9-160-05, 9-160-06 and 9-160-03D. The sample receiver used during this series

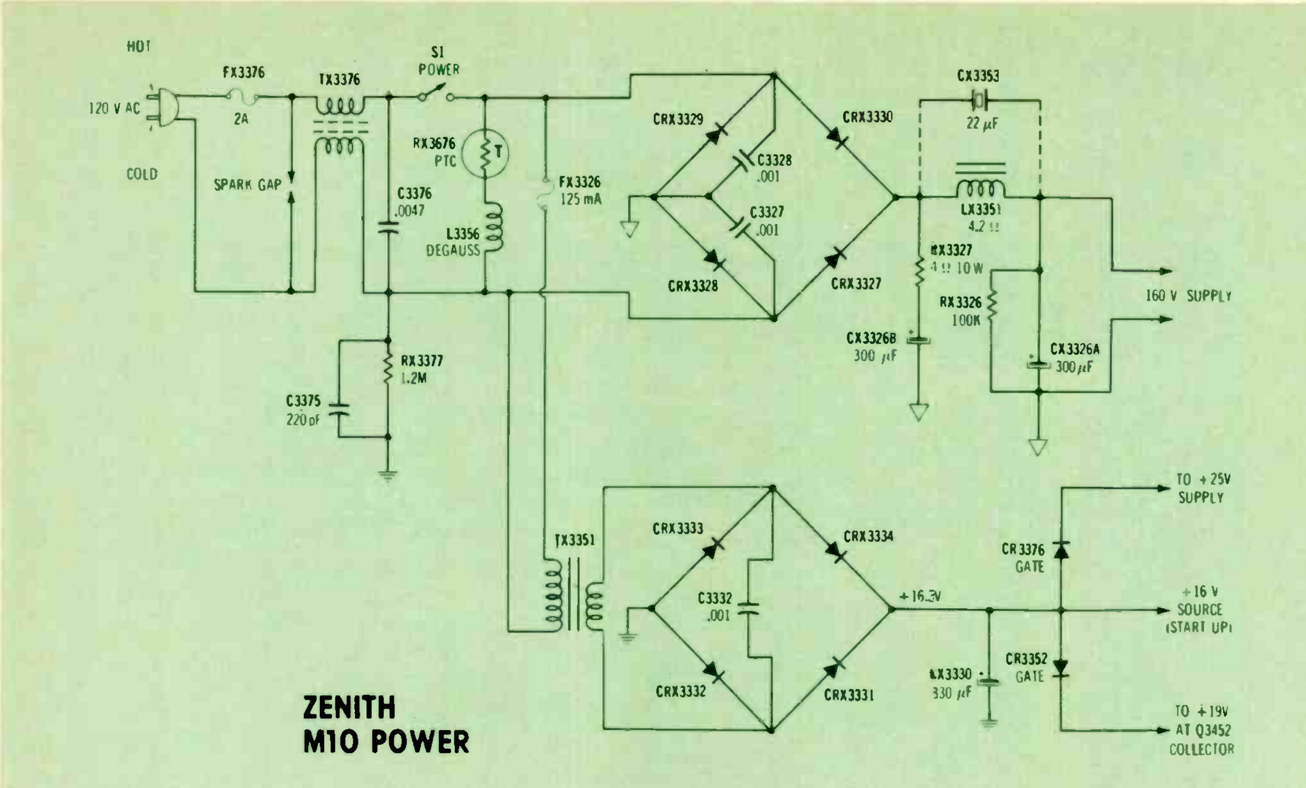


Figure 2 These are the only M10 power supplies that operate from 120Vac line voltage. Notice that the 120Vac wiring is insulated from all grounds, and that the +160V supply is not connected to cold ground. Hot grounds are indicated by the triangular symbol. The +160V supply provides power only for the horizontal-output transistor, while the isolated +16V supply provide startup voltages. A convenient point to measure the +160V supply voltage is across RX3326. Late-production modules have a spark gap across RX3377 to prevent circuit damage if the HV transformer fails.

has a 9-160-05 M10 module. Therefore, voltages and resistance values in a few areas are slightly different than those in other modules.

Line-voltage rectification

The Figure 2 schematic shows components and wiring of the two dc-voltage supplies that operate from line voltage. The CRX3327-through-CRX3330 bridge rectifier provides about +160Vdc with 120Vac line voltage at average picture brightness. This voltage rises to about +170V if any defect removes the current normally consumed by the horizontal-output stage. Failure to start up removes all dc voltage except the raw voltage, now +170V. A defect in the +16V supply, such as a shorted bridge diode or an open FX3326 fuse, produces these symptoms. Raw rectified voltage can be easily checked by connecting the dc-voltmeter lead across 100K resistor RX3326, located near the module's edge at the left of fuse FX3326.

Caution: The corner of M10 shown in Figure 1 has several components and wires that are connected to line voltage. To protect both equipment and technicians, it is recommended that an isolation transformer be added between the wall plug and TV power cable. Even then, care should be used when measuring anything in this area.

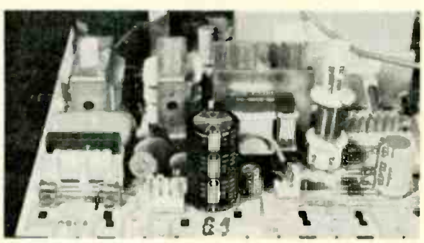


Figure 1 This corner of the M10 module has two line fuses and other components of the +160V non-isolated power supply and the +16V isolated startup supply. Both sides of the +160V supply measure about 55Vac to earth ground, so care must be used to prevent shocks to people or damage to test equipment.

Notice the triangular symbol used several times in the Figure 2 schematic. It indicates a hot ground for the +160V non-isolated power supply. The same triangular symbol also is used around the horizontal-output transistor, the yoke and flyback return paths, and a few others.

The +160V non-isolated power source has no regulation. Its only load is the horizontal-output transistor where regulation occurs.

Ac-line power is applied to the primary of transformer TX3351 (Figure 2), but the secondary winding and the remainder of the +16V supply is referenced to cold ground (conventional ground sumbol). Startup requires the +160V supply and the isolated +16V supply.

When the TV switch is turned on, dc power from the +16V supply flows through forward-biased diodes CR3376 and CR3352 to two voltage sources that supply the horizontal-drive stages. Because the QX3326 horizontal-output transistor has normal collector dc voltage from the +160V supply, the start of base drive at QX3326 allows the horizontal sweep to begin full operation. This sweep operation brings normal voltage to the +25V and +19V supplies, which reverse biases CR3376 and CR3352 so they become open circuits that disconnect the +16V startup supply. Thus CR3376 and CR3352 operate as voltage-controlled switches during the startup procedure.

Power supply

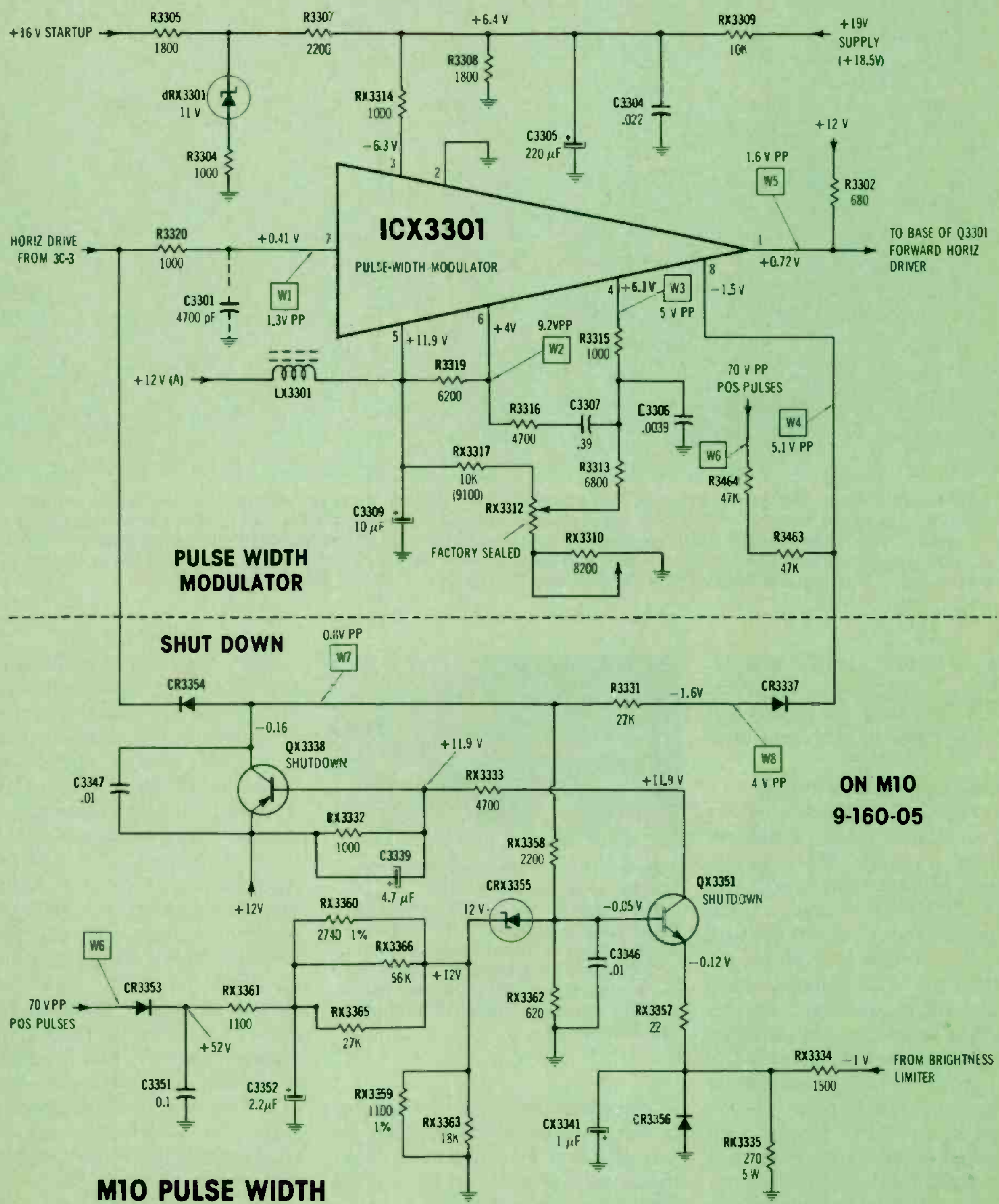
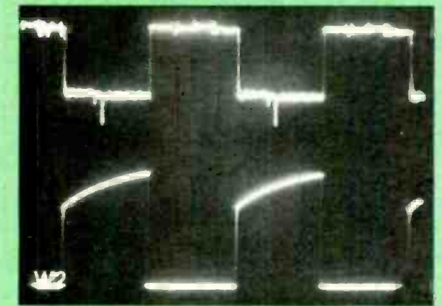
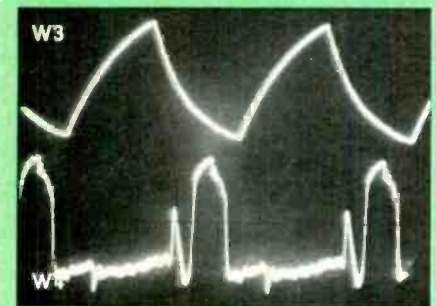
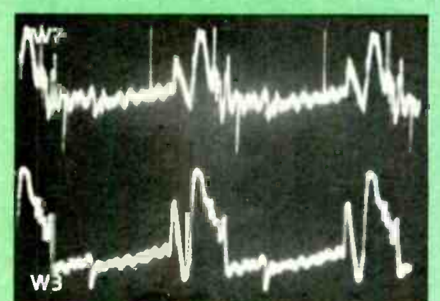


Figure 4 Circuitry around ICX3301 is for the pulse-width function of sweep regulation. The shutdown circuitry with QX3338 and QX3351 makes up a positive-feedback switch (similar to an SCR) that kills the horizontal drive at ICX3301 pin 1 when overvoltage or overcurrent occurs. Notice that the base of QX3338 is connected to the collector of QX3351, while the base of QX3351 is connected to the collector of QX3338. If supplied with forward bias and coupling capacitors, the circuit would be a multivibrator oscillator. Voltages and waveforms were recorded when the picture had normal levels of brightness and color. (Waveforms W7 and W8 are not important.)







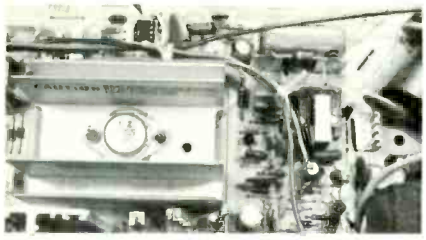


Figure 3 Pulse-width modulator ICX3301 (top arrow) is mounted behind the QX3326 output transistor (on heat sink). The lower arrow points to transistors QX3338 and QX3351 of the shutdown circuit. Other shutdown components are nearby.

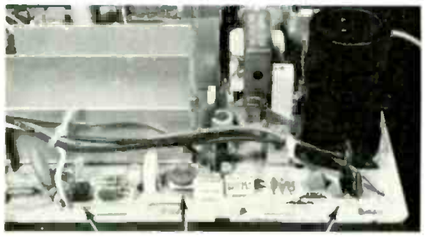


Figure 5 This backside view of the M10 module shows ICX3301 (left arrow), factory-adjusted control RX3312 (center arrow), and Q3301 forward horizontal driver (arrow at right).

Pulse-width regulation

ICX3301, which varies the drive pulse width, is located at the rear edge of M10 module (Figure 3). ICX3301 performs several functions. It amplifies the horizontal squarewave signal coming from the countdown circuit on the M2 module to ICX3301 pin 7, with the output signal appearing at pin 6. This squarewave signal is filtered to produce a triangular waveshape at pin 4 (Figure 4 schematic).

A factory-adjusted RX3312 control adds a certain dc voltage to the pin 4 triangular waveshape, and this combined signal is compared inside ICX3301 to a dc voltage at pin 3 that varies with line voltage and the +19V supply. The comparison determines the duty cycle of the drive signal exiting from ICX3301 at pin 1, and the duty cycle in turn determines how soon during each horizontal cycle the horizontal-output C/E current begins to flow. The current is eliminated at the same point of each cycle. Therefore, more output transistor power is obtained when the conduction occurs early in the cycle, while lower power results from a later beginning of C/E current.

Waveforms and dc voltages in Figure 4 were measured during normal brightness. ICX3301 is near the left in Figure 5, and driver transistor Q3301 is at the right.

Figure 4 also has the shutdown safety circuit with transistors QX3338 and QX3351. Flyback pulses are rectified by diode CR3353, producing about +52V, which is filtered by RX3361 and C3352 before it is applied to a factory-selected voltage divider (RX3360, RX3366 and RX3365 as top leg, with RX3359 and RX3363 as lower divider leg). Various values are used in other 9-160 modules, so these are correct only for 9-160-05 modules.

Output of the voltage divider is about +12V, which is applied to zener diode CRX3355 (12V rating). Zener CRX3355 has no significant current, so the QX3351 base voltage is about zero. Actually it measures slightly negative, because diode CR3337 rectifies the small-amplitude pulses at its cathode.

The QX3351 emitter has a small negative voltage coming from the brightness-limiting circuit at the low end of the high-voltage winding. QX3351 has approxomately zero B/E bias and, therefore, has no C/E current.

Transistor QX3338 has +12V at its emitter and +11.95V at the base. Because it is a PNP type, this is forward bias, but only about -0.05V; far too small to cause C/E conduction.

During normal operation without shutdown, QX3351 and QX3338 are inactive. But notice that the QX3338 base is fed through RX3333 from the QX3351 collector, while the QX3351 base is connected to the QX3338 collector through RX3358. The circuit is a regenerative switch waiting to be triggered.

If increased pulse amplitude at CR3353 raises the QX3351 positive base voltage or the picture-tube current increases above normal and drives the QX3351 emitter more negative, QX3351 will be forward biased. QX3351 conduction reduces its collector voltage, which in turn forces the QX3338 base voltage to a less positive voltage. This is forward bias for QX3338, so it draws collector current, thus producing a positive collector voltage. The positive collector voltage passes through RX3358 to the QX3351 base, where it increases the forward bias. Increased QX3351 conduction in turn increases the QX3338 conduction, and so on. The end result is saturation of both transistors.

Perhaps you recognize the previous action as a regenerative or positive-feedback dc switch which either is *open* (neither transistor drawing current) or *closed* (both saturated). After this switching is activated, it continues until power is removed, including power loss from shutdown.

When shutdown switching occurs, the QX3338 collector has almost +12V (from emitter) which travels through diode CR3354 to pin 7 of IC3301 and through R3331 and

Power supply

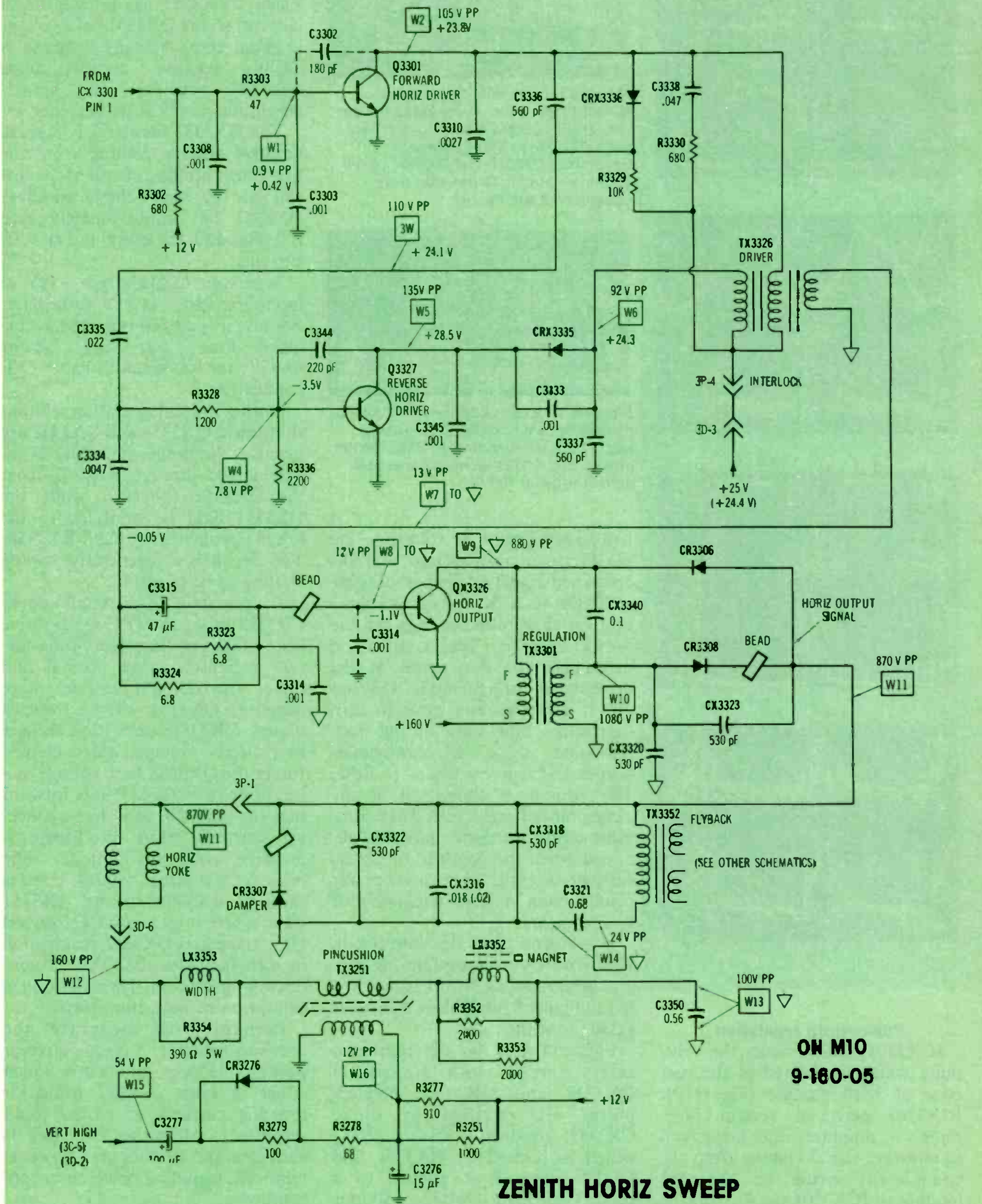
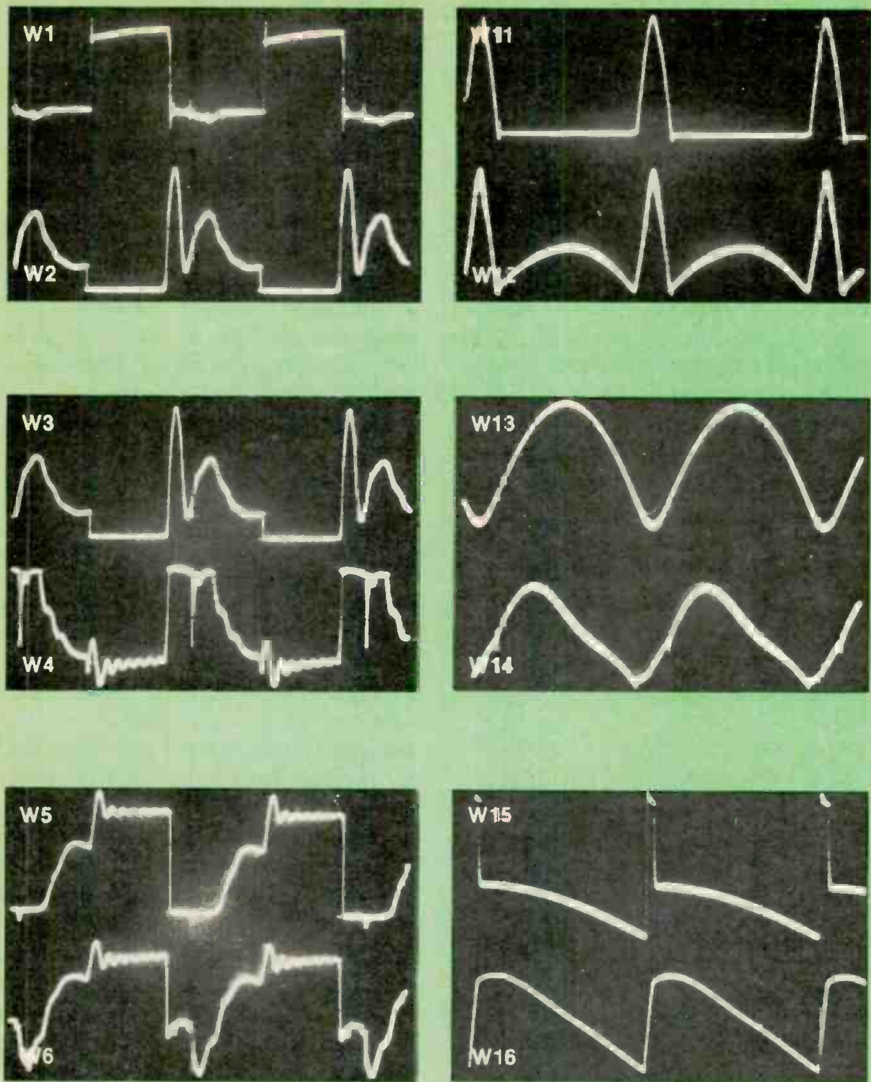
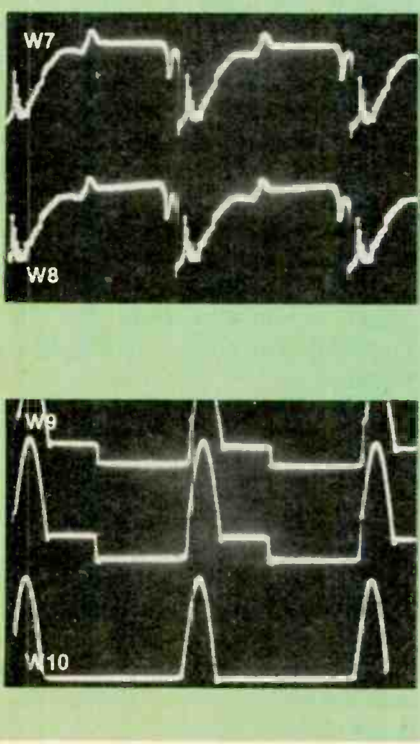


Figure 6 Measured dc voltages and peak-to-peak waveforms are shown on this schematic of the horizontal-output stage on the M10 module. All waveforms have the same phase except W15 and W16, which are at vertical rate, and were photographed with a normal picture of moderate brightness. Many of these waveforms change with brightness and line voltage variations.





CR3337 to pin 8 of ICX3301. The IC then eliminates the pin-1 base drive that is amplified to drive the horizontal-output base. Therefore, the horizonal sweep is eliminated by the shutdown operation. Indirectly, this also stops all sound and picture functions, because the sweep signal powers many low-voltage supplies.

When power is turned off for a short time, the +12V that maintains the shutdown condition disappears. Switching on the power activates the startup cycle, bringing horizontal sweep and operation of all scan-rectified power supplies. If the problem causing the previous shutdown is now gone, the receiver operation can be normal. Any remaining overvoltage or overcurrent conditions, however, will produce another shutdown.

Horizontal drive and output

The schematic in Figure 6 has important waveforms and voltages for these stages: forward and reverse horizontal drivers; output transistor; regulator (chopper) components; yoke and pincushion-correction components; and primary wiring of the high-voltage (flyback) transformer.

When the schematics were checked against the actual module wiring, several mistakes were found, both in the Zenith schematic and a similar Photofact. (No Photofact for Zenith SM1973P has been re-

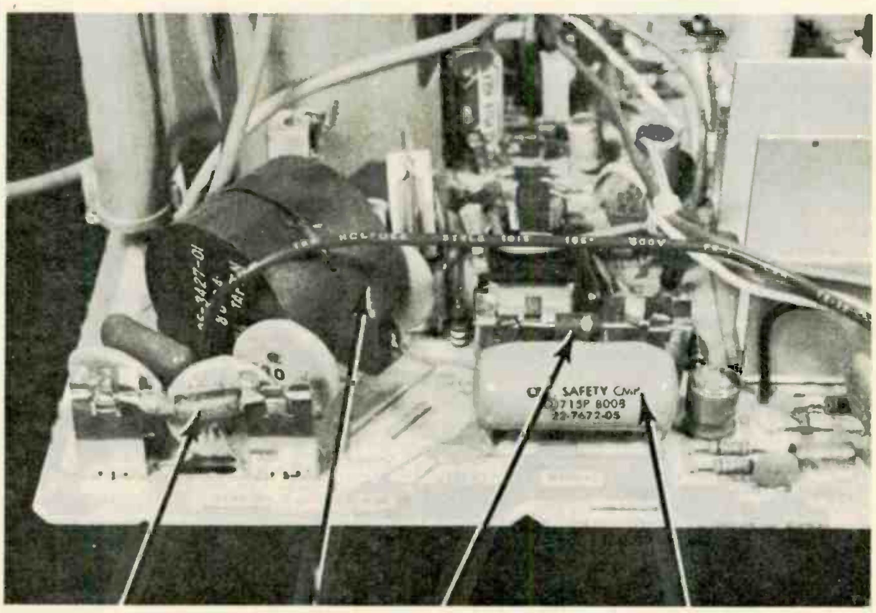


Figure 7 On the M10 module behind the high-voltage transformer are these important components: CR3307 damper diode (arrow at far left); TX3301 regulation (chopper) transformer (second arrow from left); CR3306 pulse-switching diode (third from left); and sweep-tuning capacitor CX3316 (at far right).

leased at this writing, but 1966-2 applies to many sections.) The Photofact, for example, showed the usual cold-ground symbol rather than the triangular hot-ground symbol for C3350, C3314 and CX3320. Also, the polarity was reversed for diode CRX3335 in the reverse-driver stage.

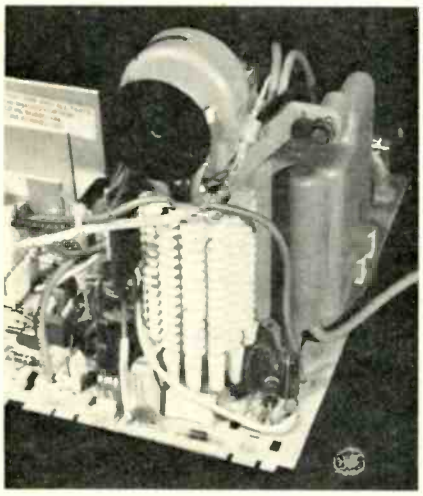


Figure 8 High-voltage transformer TX3352 has internal rectifiers. Focus control is mounted above the HV transformer.

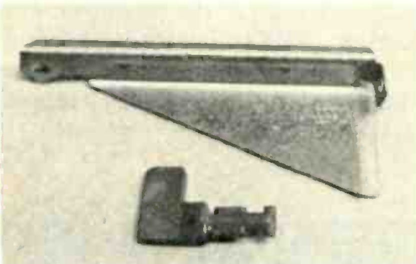


Figure 9 Before the M10 module can be slid out of its mounting tracks, these two parts must be removed. The bracket (at top) is bolted to the focus-control mounting and the cabinet's main framework. The key (below) must be rotated and pulled upward to remove it from the module.

Notice that Figure 6 waveforms are referenced against two grounds. All are referenced to cold ground except W7, W8, W9, W10, W11, W13 and W14 which have the scope ground connected to hot ground. Remember the safety precautions: Use an isolation transformer for the receiver ac power, or float the scope from earth ground (not recommended except for emergencies).

Although a conventional general sequence of driver, output transistor and yoke/flyback is followed in Figure 6, the details show many variations from past circuits.

Two driver transistors are required for starting the QX3326 output-transistor C/E conduction sooner or later in each horizontal cycle. QX3301 forward driver is shown in Figure 5 and QX3326 reverse driver is shown in the overall-location photograph. This adjustable output current is the first step of regulation, but a special *chopper* transformer, TX3301 shown in Figure 7, and two switching diodes in the output-pulse circuit also are required.

Figure 8 shows the TX3352 high-voltage (flyback) transformer with the focus control mounted above. Four diodes for focus and high voltage are integrated with the high-voltage windings.

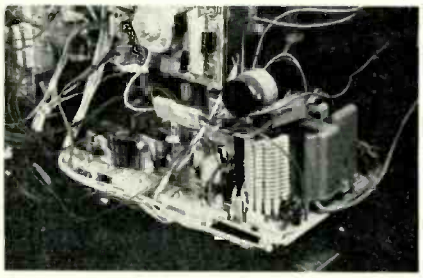


Figure 10 This is the television's appearance after the M10 module is removed, wired to the edge connectors and placed on top of the framework about 3 inches to the rear of the former position. Many tests and measurements can be made while the module is in this position.

Testing the M10 module

As described in previous articles, Zenith module M1 or M2 can be tested with full power and under normal conditions by removing the edge connectors, sliding the module out of its mounting grooves, and then reinstalling the edge connectors while the module is hanging behind the receiver. Cable lengths are sufficient. This is not necessary with module M5, because it usually can be tested without removal from the picture-tube socket.

Unfortunately, this method was not successful when tried with the M10 power-supply module. Removal of the edge connectors and one metal bracket (near the flyback) did not allow the module to be slid backward out of the mounting grooves. That was the first snag. It was solved by the friendly Zenith service manager who described a plastic key (Figure 9) near the 3N socket. After the key was rotated 90° and lifted up out of the hole, the module could be slid out of the grooves.

But the only position of the module that allowed all cables and edge connectors to be reinstalled was on top of the plastic framework and about 3 inches farther to the rear that it originally was (Figure 10).

The new position allowed many tests to be made on the M10 circuitry, although the space remained crowded.

Use of a 6-inch insulated-hook type of probe (such as the Pomona *Maxi Grabber)* is highly recommended. With the ac power off, connect the long probe to the desired terminal with the other end of the test lead connected to meter or scope. After all connections are secure, the power is turned on and the measurement made. Then the power is turned off while the test probe is removed. Use this method for each individual measurement. Often a reading can be made before the picture tube warms enough to show more than a soft faint picture, so little time is wasted.

Measuring IC voltages can be difficult unless a test clip (such as a Pomona *Dip Clip)* is used to bring each pin's voltage and signal up to pins at the clip's top. Alternately, a test lead can be connected to some resistor or capacitor wire that in turn contacts the desired IC pin.

Above all do *not* allow any shorts between wires or pins. It's possible for a split-second short to ruin many ICs or transistors.

Also, observe the precautions stated previously about the hot grounds and other dangerous points.

Zenith flatly states in a bulletin: "In the event of a failure involving the M10 module, exchange it; do not try to repair it in the customer's home." This admonition has the force of law for warranty repairs, but it probably is a wise procedure for most out-of-warranty repairs as well. One strong reason is the difficulty in finding all the test points and components while the module is in the cabinet. □

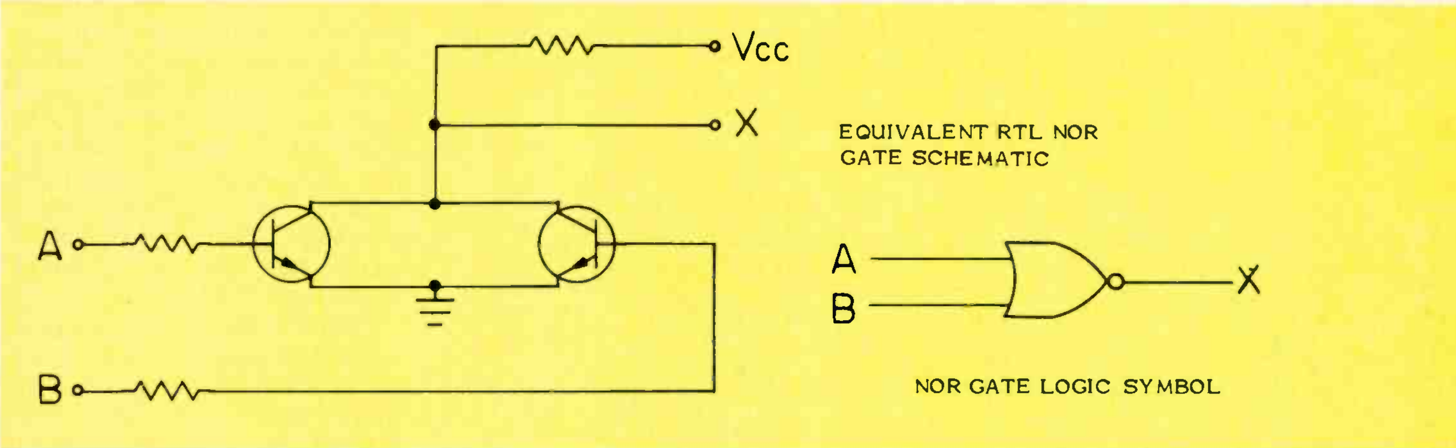


Figure 2

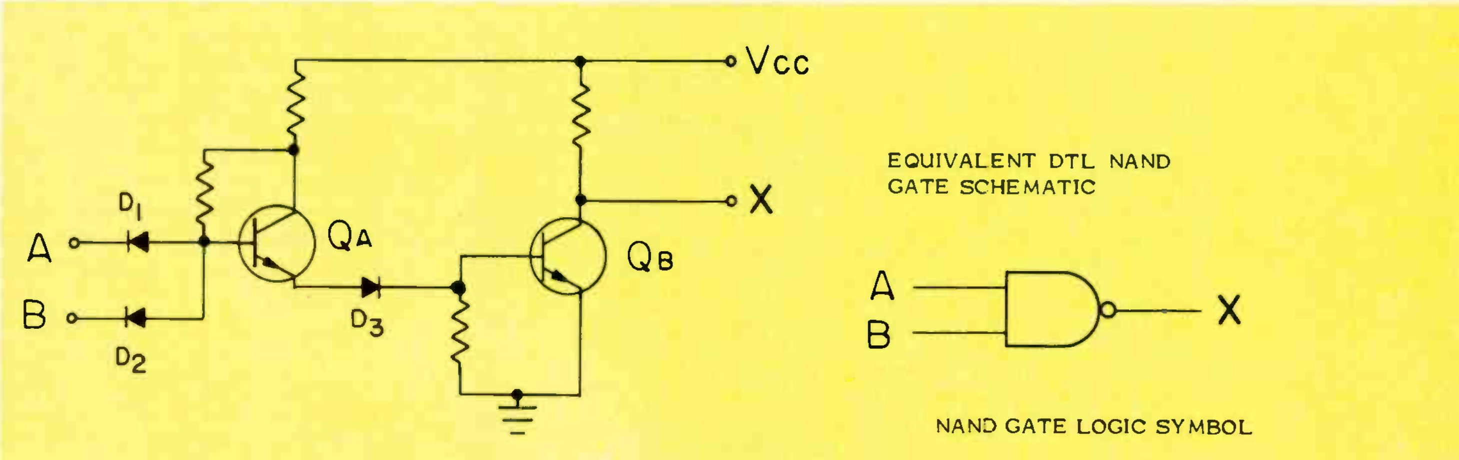


Figure 3

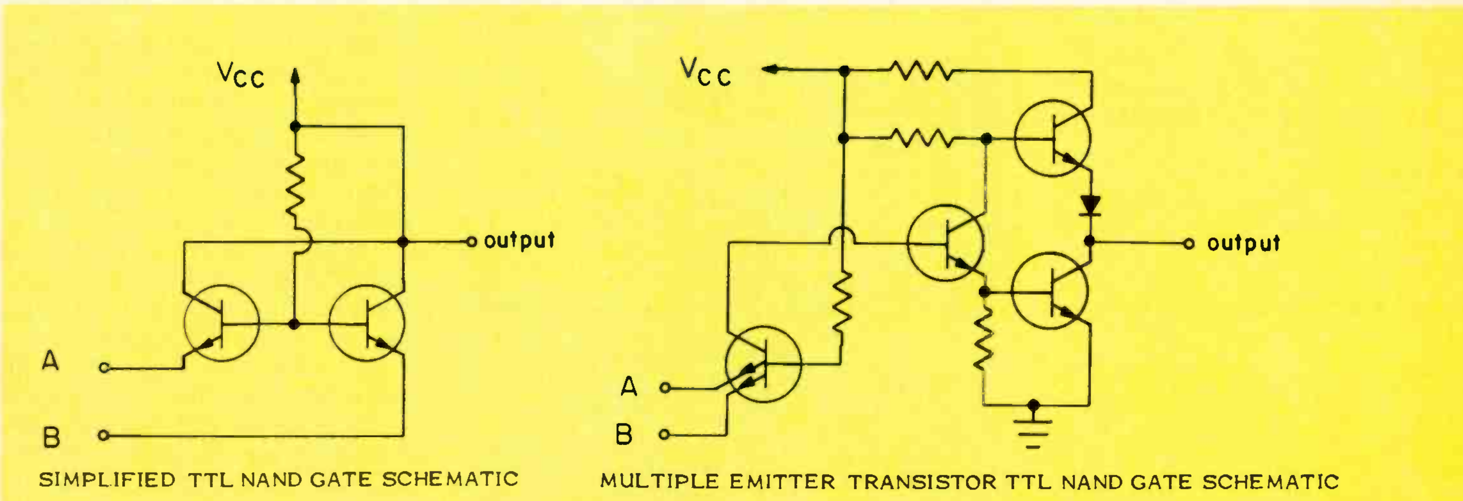


Figure 4

the output can supply logic voltage to 10 gates.

RTL circuits

Resistor-Transistor-Logic (RTL) ICs are usually designated by series 9900 chips. RT Logic was the earliest form of solid-state logic, consisting of direct coupled transistors and resistors. RTL circuits are primarily constructed as NOR gates.

Most RTL chips come in the 8- or 10-pin H package, which is the round transistor-like package shown in Figure 1. With the 8-pin chips, pin 8 is usually V_{CC} and pin 4 is the reference. With the 10-pin package, pin 10 is usually V_{CC} and pin 5 is the reference.

The required supply voltage is low, usually about 3.6V. Logic levels require 1V for a high level and less than 0.4V for the low level state.

RTL chips usually do not amplify. They are characterized by slow switching speeds because of saturation, and a low level of noise immunity, meaning they are easily triggered by noise. Fan-out is about 5, and anything more causes the high logic output voltage to drop rapidly. The main advantage of these chips is that they are simple to manufacture and require only a single supply voltage.

The RTL chip also has the disadvantage of being a "current sourcing" type circuit, which means that the gate trigger must supply current to forward bias the input gate transistors. This describes the mode needed to activate the gate.

The equivalent circuit for a basic RTL NOR gate is shown in Figure 2.

RTL chips are available as NOR gates, buffers, shift registers, type D, T and J-K flip-flops, inverters and adders. A survey of parts catalogues reveals that the RTL chips are on their way out. RTL chips, although still in use, are rapidly being put to pasture by newer chips.

DTL circuits

The Diode-Transistor-Logic (DTL) family is based on the NAND gate. The DTL family of ICs are designated by 9000 series and 9930 to 9963 series by most manufacturers.

The DTL chips are manufactured in the type A, B or N, with 14 and 16 pin DIP configurations. With the 14-pin chips, pin 14 is the supply and pin 7 is the reference. With the 16-pin package, pin 16 is the supply while pin 8 is the reference.

The DTL chip requires a 5V supply and logic levels the same as for the RTL chip, i.e., high level equals 1V, low level is less than 0.4V.

DTL chips provide gain, and because diodes are used in the circuit, faster switching speeds and a slightly higher noise immunity is realized. DTL circuits operate in the "current sinking" mode, which means that the forward current necessary to ac-

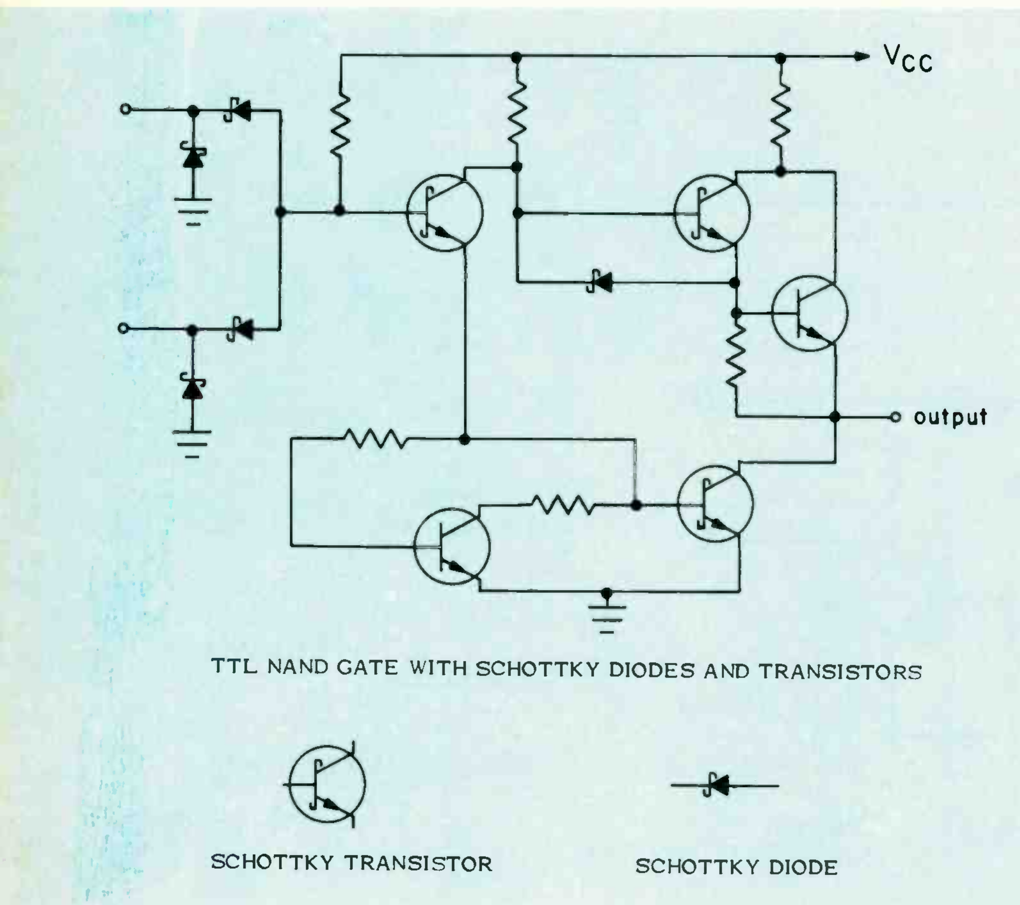


Figure 5
TTL NAND gate with Schottky diodes and transitors

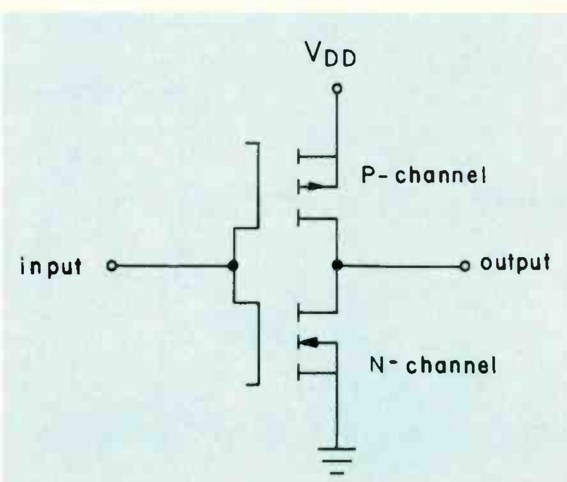


Figure 6
Basic CMOS inverter circuit

tivate the gate transistors is supplied internally. Fan-out for this type of logic is usually a maximum of 8.

Figure 3 shows the schematic equivalent circuit for the basic DTL NAND gate. Q_A is an emitter follower with the base-emitter junction always forward biased. This in conjunction with D_3 sets the voltage level which a noise pulse must overcome to falsely trigger the gate, thereby providing a higher noise margin than the RTL circuit. QB acts as the inverter for the NAND function and also provides amplification.

In addition to the NAND gate, DTL chips are available as AND gates, OR gates, hex inverters, R-S and J-K flip-flops, exclusive OR gates, quad latches and monostable multivibrators.

Like the RTL chips, DTLs are used less frequently because newer technology is pushing them into the background.

TTL circuits

The Transistor-Transistor-Logic (TTL) family is also based on the NAND gate. The TTL family (also called T^2L) of ICs are designated by the 5400 or 7400 series chips, the most commonly used.

The TTL chips are manufactured in the same A, B or N, 14 and 16 pin DIP layouts as the DTL family, and the same pin connections for supply and reference.

The supply voltages and logic levels required for TTL chips are about the same as for the DTL ICs. Fan-out for the typical TTL chip is usually about 10.

TTL circuits are characterized by multiple emitters on the input gate transistors. The TTL transistors within the IC could be considered as two or more transistors with their bases and collectors wired together to form the basic NAND gate (Figure 4). TTL circuits also operate in the "current sinking" mode.

TTL chips are available in almost every type of digital logic circuit imaginable and are carried by nearly all the major electronic component distributors.

Schottky diodes

A whole new family of TTL ICs was developed with the advent of the Schottky Barrier Diode. The addition of the Schottky diodes to the TTL configurations increases the switching times of the TTL circuits by decreasing the transistor turn-off times. The Schottky diodes prevent the transistors from operating in saturation.

Schottky ICs are designated by 54S/74S or 54SL/74SL series ICs. Packaging is the same as for TTL ICs.

The supply voltage requirements for Schottky ICs are more critical than normal TTL circuits. The supply voltage range is limited to 4.5 to 5.5V. Noise immunity and fan-out are slightly better than the standard TTL circuit. Switching times are approximately one-third that of the standard TTL circuit. Figure 5 shows the TTL NAND gate with the addition of both Schottky diodes and transistors.

Schottky ICs are usually available in the same circuit configurations as the TTL ICs, although at a slightly higher price.

MOS and CMOS ICs

Both MOS and CMOS ICs are based on the Field Effect Transistor (FET) instead of the junction transistor. In MOS transistors, an insulating layer of oxide is positioned between the metal gate of the FET and the semiconductor silicon material. Thus the name Metal-Oxide-Silicon, or MOS.

The advantages of this process are simpler fabrication of Large Scale Integrated circuits (LSI) and lower power losses. The main disadvantage of MOS ICs is that they require both positive and negative power sources.

This disadvantage was overcome with the development of CMOS devices. CMOS devices simply use both P and N channel FETs to form a Complementary MOS or CMOS circuit. Both MOS and CMOS digital ICs differ from the other digital ICs in that the basic circuit is not derived from a gate but from an inverter. As with the gates, all other logic circuits can be constructed from the basic inverter.

MOS and CMOS ICs are designated by 4000 or 40,000 series chips, and are produced in 14, 16 or 24 pin DIP style packages. V_{dd} is the label given to the positive supply while V_{ss} is the reference lable. V_{dd} is usually the last pin (14, 16 or 24) while the reference is the half-way pin, i.e., 7, 8 or 12.

Supply requirements allow most MOS and CMOS chips to operate between 5 and 18V. Logic input levels are not specified as they are with TTL chips. Instead, manufacturers data lists a Voltage Transfer Characteristics curve, because the logic levels will depend upon what supply voltage is used. For many applications, however, a logic high state is 5V while the low state is zero volts, using a 5V supply.

CMOS chips provide gain, have a high noise margin (typically 1V or greater), and have switching times rated in nanoseconds (10^{-9}). Fan-out is 50 or greater when feeding other CMOS circuits. The discrete equivalent circuit for the basic CMOS inverter is shown in Figure 6.

CMOS chips require special handling due to their extreme sensitivity to static electricity. The technician must be more conscientious with CMOS circuits, but the many advantages of CMOS ICs make their use attractive in spite of the tricky handling required.

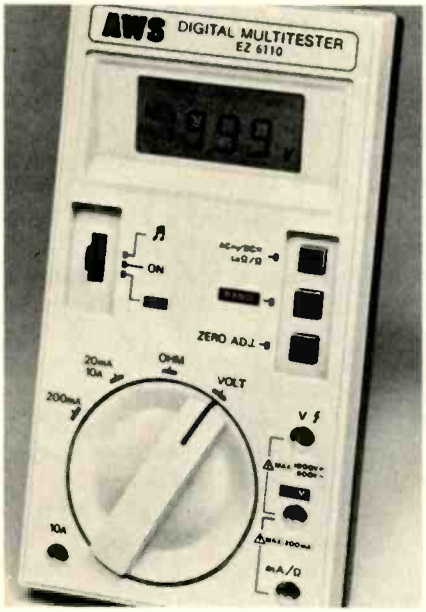
ECL ICs

Emitter-Coupled-Logic (ECL), although it provides the fastest switching speeds possible, also requires relatively high operating currents. The high current draw of ECL circuits makes it difficult to package this type of logic in ICs. ECL chips are usually specialized and not commonly available unless they are in-house parts manufactured by the larger corporations for their own equipment. ECL chips may be found primarily in large computers.

HTL ICs

HTL or High-Threshold-Logic is a specialized form of the DTL circuit. HTL circuits employ a zener diode and an extra transistor to provide an extremely high noise margin. HTL chips are used in specialized applications and have limited appreciation. □

productreport



Digital multimeters

A. W. Sperry Instruments Inc. announces the introduction of two new digital multimeters—the AWS EZ-6110 and the AWS EZ-6220.

The two units feature full measurement capabilities—ac/dc volts, ac/dc mA and ohms—plus a 10A ac/dc range. A 5-year limited warranty accompanies both units.

Features include autoranging on volts and ohms, 3½-digit display, 10mm-high numerals, automatic indication of units and signs, autopolarity, overrange indication, safety fused on ohms and mA, low battery warning, audio tone continuity buzzer (EZ-6110), normal and low power ohm ranges, range hold (EZ-6110), shock-resistant ABS plastic housings, pocket size, and up to 300 hours continuous use. Ranges are Vdc 0-200mV, 2/20/200/1000; Vac 0-2/20/200/600; ac/Adc 0-10; ac/dc MA 0-20/200; ohms 200/2K/20K/200K/2000K; low power ohms 0-2K/20K/200K/2000K.

Units come fully equipped and ready to use with safety test leads and special clip for 1-hand lead operation, and with batteries and fuse installed plus one spare. Model C-30 Ever-Ready carrying case is optional.

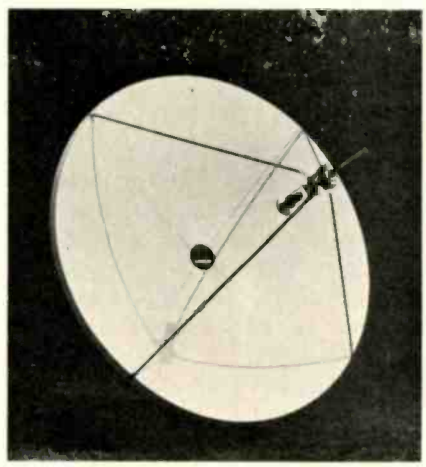
We regret that A.W. Sperry was inadvertently omitted from the July 1981 digital multimeter roundup.

Circle (10) on Reply Card

Home satellite TV products

Downlink Inc. has announced two home satellite TV products, the Skyview IV parabolic antenna and the Skyview IV system.

The Skyview IV is a lightweight, 11-foot fiberglass parabolic antenna designed for low-cost shipping, expandability and ease of operation. The dish is constructed in four sections, so it can be easily shipped anywhere or transported by pickup truck. It is expandable to 13 feet (4 meters) by adding extender panels.



No training or special tools are required for assembly and installation. Installation requires only a simple 3-foot-square concrete pad and four holes.

The antenna has better protection against the wind (125-mile-load survival rating), rough handling and weather than conventional aluminum construction. The antenna weighs 400 pounds, including mount.

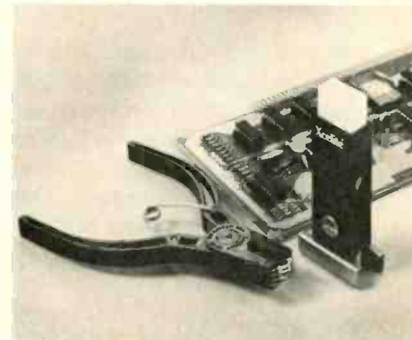
The antenna is also easy to operate. It can be shifted from satellite to satellite with a hand-crank adjustment, and can receive all North American communications satellites.

Circle (11) on Reply Card

Integrated circuit tools

The XD series of extraction and insertion tools has been introduced by *Xcelite* for efficiency and precision operations on integrated circuits.

The series includes eight insertion tools of aluminum and stainless steel construction with varying pin capacities featuring an adjustment for IC tolerance variations. These long wearing tools are safe for MOS and CMOS devices and insert without stress on lead seals.



The 1-hand XD-16 extractor removes 4 to 48 pin DIPs, will not bend leads, and eliminates the problem of flying solder.

Individual tools are packaged in vinyl hang-up pouches imprinted with use instructions.

Circle (12) on Reply Card

Earth station modulator

Blonder-Tongue Laboratories Inc. has available an earth station modulator designed for operation with Television Receive Only (TVRO) satellite terminals where the audio and video are provided as separate base band signals. The ESM-4928 is available for VHF channels 2-13 and Mid Band channels A-I.

The modulator is a vestigial sideband audio/video modulator with extremely accurate crystal-controlled visual and aural carriers that minimize color beats and audio distortion. The unit has a calibrated video modulation meter and a true peak-reading LED audio overmodulation indicator to ensure precise modulation control. The audio indicator permits adjustment for optimum sound quality.

A video low pass filter in the ESM-4928 rejects unwanted subcarrier frequencies of secondary satellite services, preventing adjacent channel interference.

Circle (13) on Reply Card

photofact bulletin

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PANASONIC
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PHILCO
Chassis A22-2 (Code 01/02, Run 01 thru 08) 2013-4
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Chassis CS-19T 2017-1

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reader's exchange

Needed: Scott stereo model #2560 service manual. Will copy and return. *S. Rosenzweig, 2818 W. 8th St., Brooklyn, NY 11224.*

Needed: Schematic and service data for a Boman model TC-9-MK2-FM (AM-FM) auto radio. *Max Friedman, 81-47 260th St., Floral Park, NY 11004.*

Needed: 820 or 830 B&K capacitor tester, CK3000 Sylvania test jig. State condition and price. *Phil Schrock, 84343 Hilltop, Pleasant Hill, OR 97401.*

Needed: Sencore model #YF33 ringer, variable line voltage transformer 0 to 120V (5A), and Philco power transformer for stereo #H1714. *D. Bernard Fritz, 3210 St. Lawrence Ave., Reading, PA 19606.*

Needed: Audio IF coil, Magnavox part #36B043-6, used in Magnavox TV chassis T 932. *Norm's TV, 79 Pond Road, Lewiston, ME 04240.*

Needed: Complete chroma board PC unit PW329C part #23141204 for Toshiba TV model C7A NLA. *J. Hofslund, 1011 S. 10th St., Manitowoc, WI 54220.*

Needed: Remote control unit and information for Philco radio 39-116. Also need Sam's tape recorder manual TR19. *James Humphrey, CET, Room 212, 1006 E. 28th St., Los Angeles, CA 90011.*

Needed: Model 465 B&K CRJ tester. Reasonable price. *H. D. Stevens, 31 Second St., No. Arlington, NJ 07032.*

Needed: 24 DP4A, 16 CWP4A and 17 CFP4 B&W picture tubes. *Joseph J. Mehalko, 324 4th St., Blakely, PA 18447.*

Needed: One high wattage isolation transformer. Will trade good, used Sencore CRT checker, model CR143. *Mike's Repair Service, P.O. Box 217, Aberdeen Proving Ground, MD 21005.*

Needed: Power transformer for Webcore model WFX 257 stereo, part number 710001A. Sam's number for stereo is MHF-39. *John Osborne, Winthrop Electronics, Town Hall Lane, Winthrop, ME 04364.*

Needed: RCA workshop manuals 1 through 18, and other troubleshooting tips. *Calvin Logue Jr., 923 Washington Rd., Westminster, MD 21157.*

the marketplace

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ZENITH CHROMATENNA II

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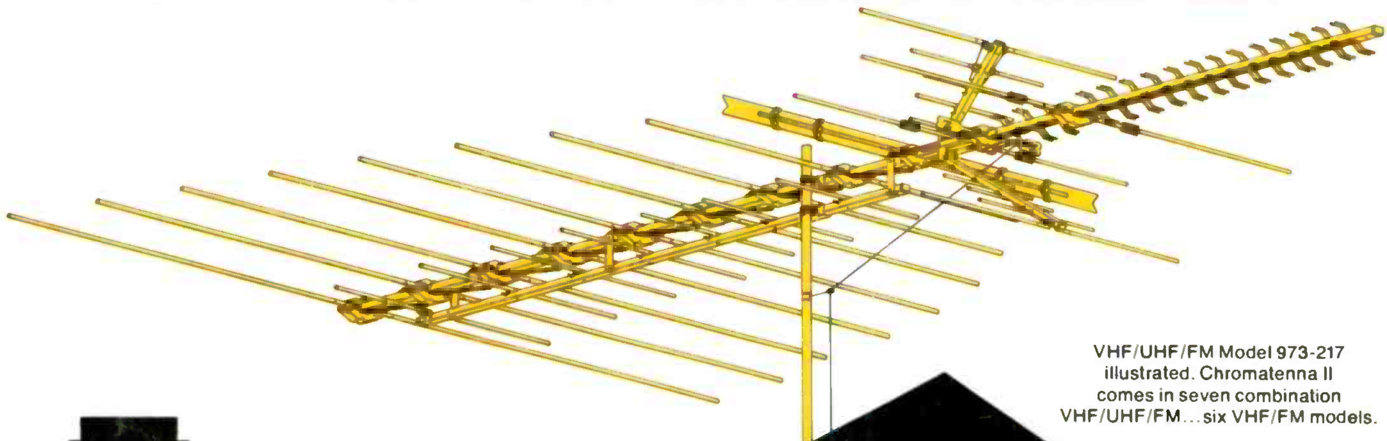

VHF/UHF/FM Model 973-217 illustrated. Chromatenna II comes in seven combination VHF/UHF/FM... six VHF/FM models.

Transmission Line Termination bleeds off static charges thru antenna system ground. Terminal stub improves front to back ratio on lower channels.

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