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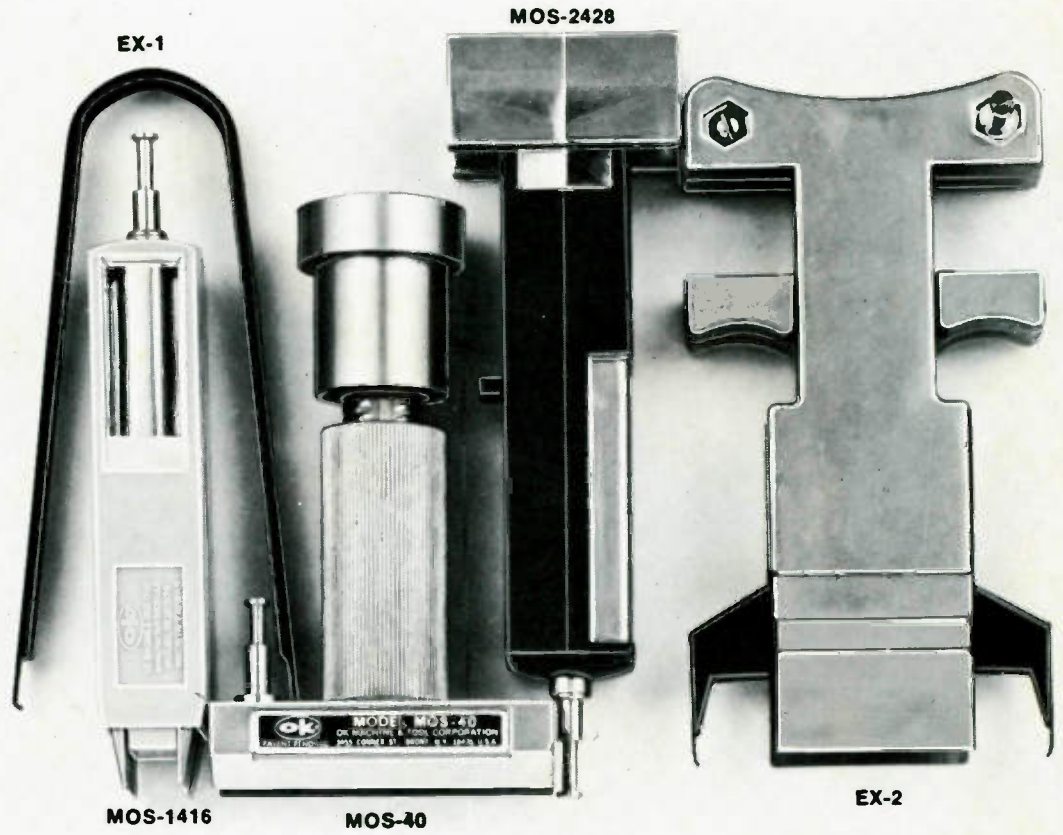


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# Electronic Servicing

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INTERTEC PUBLISHING CORP.

*For industrial maintenance and consumer servicing professionals*

# Electronic Servicing

December 1980 □
Volume 30, No. 12



## About the cover

Mike Perdaris, service manager, Electronic Contracting Company, Overland Park, KS, checks an oscilloscope. For more information on workshops, see *Planning an industrial maintenance shop,* page 5.

*Photograph by Mary Thornbrugh.*

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## NESDA resolution passes unanimously

A resolution calling for improved parts and warranty policies from manufacturers was passed unanimously at the recent annual meeting of the National Electronic Service Dealers Association in Louisville, KY.

Copies of the resolution, introduced by the Washington/Oregon association, will be sent to all major manufacturers for response on to what extent they can comply with the procedures detailed in the resolution.

Among the provisions were 5-day delivery on parts, no minimum dollar amount, manufacturer to pay freight, maintain toll-free WATS line, pay normal reimbursement rates, pay claims within 30 days and provide training sessions and technical assistance.

## Tronics 2000 sells three franchises

Tronics 2000, a new franchise organization for consumer electronics service shops, has announced the sale of three territories during its initial three weeks of operation. The territories are in suburban Chicago, Cincinnati and central Florida.

Tronics 2000, based in Bloomington, IN, is offering territorial franchises on a nationwide basis. The purchasers of these territories, in turn, offer Tronics 2000 programs in advertising, business management, technical support and volume buying to qualified individual service centers within their territories.

## EIA film receives award

The consumer electronics industry's documentary film *THE LINK BETWEEN US...Electronics* was awarded 2nd Grand Prize in a recent International Film Festival in Copenhagen. The 27½-minute film, sponsored by the Electronics Industries Association's Consumer Electronics Group, has had 2740 showings since February 1, 1980. It has reached 2.3 million viewers via 237 cable and local television airings. An audience of 95,000 people has been reached through community and public service screenings; 38,000 have seen the film in 250 theater showings and 12,000 attended 300 corporate showings.

## CES conferences change format

The Winter CES conferences will have a new format, according to Jack Wayman, senior vice president, EIA Consumer Electronics Group. In a theater-in-the-round setting, a chairman/keynoter will review each product category performance in 1980. A moderator for the consumer press will present issues and generate dialogue between two business press editors and three manufacturer executives. Audience participation will follow. Five 2-hour conferences are scheduled: *Car Audio; Audio; Video; Personal Electronics;* and *Personal Communications.*

The 1981 Winter CES will be January 8-11, at the Las Vegas Convention Center.

## GC Electronics signs 14 industrial distributors

Fourteen electronic parts outlets have agreed to participate in the new GC Electronics Authorized Industrial Distributor program. The names of the initial 14 participating companies were released by Wayne Timpe, vice president and general manager, GC Electronics.

Those entering the special distributor agreement are: Denver Walker Electronics, Denver; Dixie Electronics, Columbia, SC; Dow Radio, Pasadena, CA; Dunlap Electronics, Sacramento, CA; Electra Distributing, Nashville; Electronic Supply, Kansas City, MO; Kimball Electronics, Salt Lake City; Newark Electronics, Chicago; Ohio Valley Sound, Evansville, IN; Orvac Electronics, Fullerton, CA; Stark Electronics, Minneapolis; Van Sickle Radio, St. Louis; William B. Allen Co., New Orleans; and Zack Electronics, Palo Alto, CA.

The distributors were chosen on the basis of sales volume and potential in the industrial market. GC is providing a program of prearranged quantity pricing, sales training assistance, technical product literature and supportive advertising.

## Integrated Circuit Engineering relocates

Integrated Circuit Engineering Corp. has announced the relocation of its corporate headquarters to 15022 N. 75th St., Scottsdale, AZ 85260, telephone (602) 998-9780.

## Video product sales increase

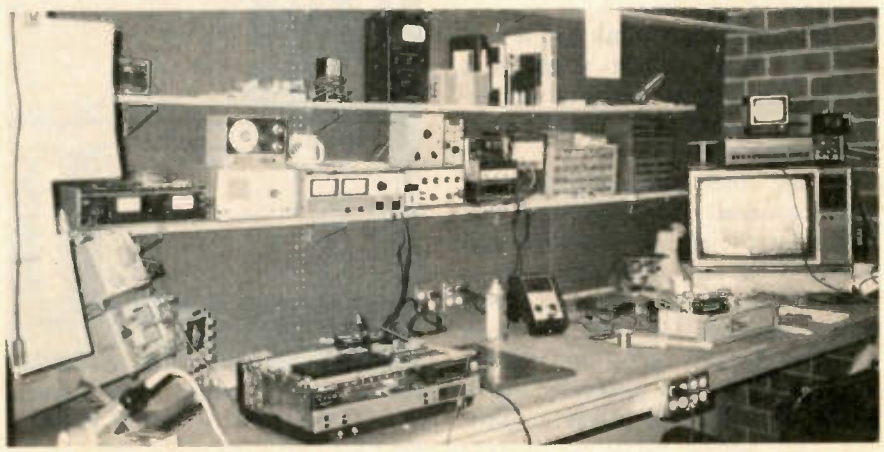
Total US market sales of video products to retailers increased in September, repeating the performance of August. According to the marketing services department of the Electronic Industries Association's Consumer Electronics Group, comparisons of sales in September 1980 and September 1979 resulted in the following statistics. Color television sales rose 13.6%. Video tape recorder sales increased by 74.4%. Sales of b&w televisions were up 15.5%. □

# Planning an industrial maintenance workshop

An interview with
Mike Perdaris, service manager,
Electronic Contracting
Company, Overland Park, KS

Designing a facility to service equipment for industry can be simple or complex, depending on the spectrum of equipment involved. No one service and maintenance shop can provide a mode for all facilities. However, such service centers share common aspects: objectives must be set, budgets established and plans executed with care. In this interview, Perdaris reviews how his company's workshop was developed.

**Mike Perdaris** pauses to answer a customer's call regarding symptoms of an ailing system. (Note the VCR in the lower right corner that's being serviced for a custom system.)



**Though** not elaborate, this service workshop is functionally laid out and equipped to handle customer service demands. Also, it can be expanded to meet the needs of a growing customer base.

**ES:** *What type of maintenance service do you specialize in?*

**MP:** We are qualified to service a wide range of audio and video equipment. However, in a more practical sense, we limit ourselves almost entirely to the systems we design and install.

**ES:** *What type of equipment do you install?*

**MP:** Our specialty is custom-built audio and visual information systems for industry. Our capabilities range from remodeling older facilities to custom designing entirely new facilities.

Typical systems which we have designed and installed are: television distribution systems, closed circuit TV systems, audio and video security systems, dial access communications, public address systems, supervised paging systems, professional equalized sound systems, sound masking systems, supervised fire alarm system, voice evacuation systems, digital and mechanical timing systems, music distribution systems, video production systems and large screen projectors.

We're involved in packaging complex turn-key systems. We're qualified to service that equipment, including television cameras and videotape recorders, when it's in one of our systems. That's the way we've built this business—keeping people happy with quality equipment that has a minimum down-time.

**ES:** *How did you select the equipment for the service shop?*

**MP:** Most of your service equipment will greatly depend on what it is you service. You've got to work on that basis. And you've got to decide early if you want to work on video or audio or both. Once you

set up your criteria then you can start choosing equipment that best suits. the situation.

I started out selected a scope—the Tektronix 465—basically because of my experience in using it for video servicing. Others might prefer a LB0515B Leader scope or a comparable unit. You may get by with a little less bandwidth, but the reason I like the 465 is the TV options it has for sync stripping, screen intensity and delay features. The delayed sweep is excellent and allows you to look line-for-line. It's a dual tray scope and is especially good if you're going to get into equipment such as time base correctors. In digital servicing you need a scope with a bandwidth of about 100 to 110 MHz.

**ES:** *Would you say that personal experience plays a key role in selection of equipment?*

**MP:** Certainly. I think you'll find that a lot of service shops that undertake video and digital servicing will want the 465 or a comparable scope.

On the other hand, selection of a signal generator tends to leave you a broader choice. We use a General Radio (GR) unit that works quite well. Basically you want a good signal, and our GR with its clean sinewave is very good for testing audio amplifiers. I generally use it to insert signal into power amplifiers and other circuits to test performance with a given signal. I also use it with my scope to test the output wattage of amplifiers into given loads.

**ES:** *What general-purpose power supplies do you use?*

**MP:** There are many good units on the market. For dc we use a B&K-Precision 1601 that serves our needs. It's not a dual power supply, but it's a 0-50V source at 2A, which is sufficient for most applications. It's especially useful when I work on the new intercom units that run at 24V. Its wide range saves me from having many different power supplies for various applications.

Our other source is a Heathkit ac variable power supply which has an auto transformer to adjust the voltage. It comes in handy for working with the security cameras, many of which are going to a 24V system. It allows me to plug the camera in without having a separate transformer. Furthermore, I can creep the voltage up gradually and see what's happening. (Just plugging them in might have the whole system burn up due to a short).

**ES:** *What do you think about component checkers?*

**MP:** My preference is the B&K-Precision 820 for a basic shop, mainly because it allows you to check capacitor in circuit with good accuracy. In certain amplifiers, especially in intercoms, one of the biggest problems you have is coupling caps going bad between stages. The old service method was to pull the capacitor out, put it on a capacitor checker, test it under load—a very time consuming process. With the 820 you can test the capacitors in or out of the circuit in a few moments.

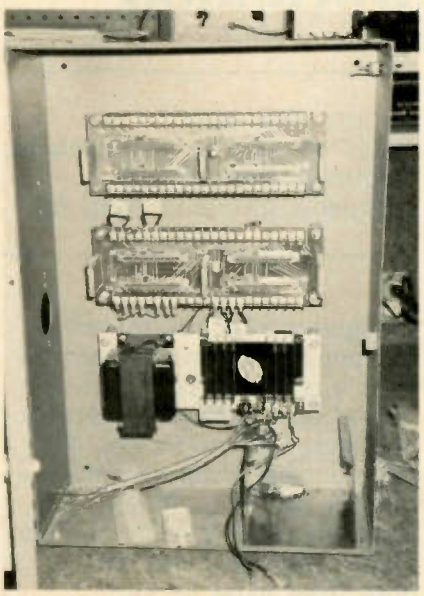
So you can see where it could be a very valuable tool in troubleshooting, and with labor costs soaring, the customer needs rapid, efficient service. You'll not only have happy customers, but your shop will be more profitable with quick turnaround.

**ES:** *What's your choice of test meters?*

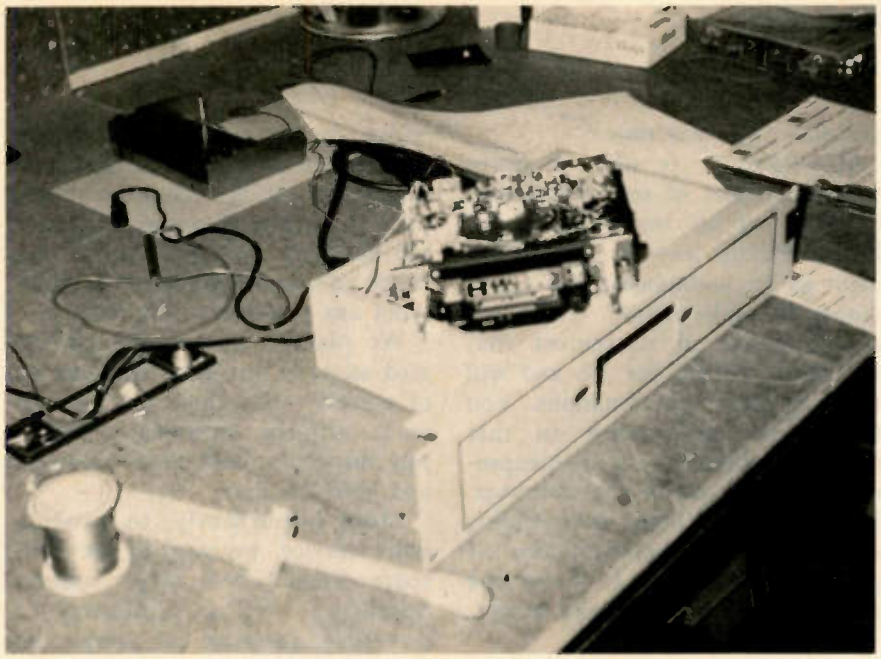
**MP:** My personal choice is the B&K-Precision 2810 digital multimeter. You'll find staunch support-

**Equipment** is stocked in preparation for assembly on a particular job. An inventory of frequently used instruments speeds turn-around time and gives a competitive edge in job bidding.


**Backup data** is needed on equipment as it is being used in custom systems and for efficient servicing later.



**This custom-designed** alarm system is designed specifically to meet an industrial customer's needs.



This tape deck is being thoroughly checked before it is assembled into a complete communications rack.

ers of both the newer digital testers and the older analogy instruments. But, I like the digital meter because when you're zipping through a circuit it's easier to note the number flashing by than it is to interpret where the needle deflects on a meter.

**ES:** *Do you think frequency counters are helpful in your line of work?*

**MP:** Most assuredly. The frequency counter is a valuable tool in repairing video equipment. One nice thing I like on our 465 scope is that it has an outlet on the back in which you can plug a frequency meter. But you can just set it up there; you don't have to do a lot of extra wiring so as to use all your test equipment. The probe, as you look at the signal, will tell you, for example, whether your local oscillator is correct without loading the circuit.

When you go through a color circuit you have to set components at certain frequencies. Also you use it in setting up some servo circuits. If a component or circuit is to be set up at a certain frequency, you can do it with a scope, but it's more time consuming.

A frequency counter is also handy when you're doing audio equalization. When you narrowband a system you can see exactly where the notch needs to be. You read the frequency direct and match it. Of course, with some of the newer equipment using active filters the manufacturer has included an on-board oscillator. You flip a switch and beat the local oscillator with the feedback you are notching and simply zero the beat, put in the right capacitors, flip the switch to notch and, you're done. It really make the job easy compared to the old method of component substition where you could spend all day completing a dozen or so notches. With this newer circuitry you can take 12 notches inside of a half hour.

**ES:** *What do you use to troubleshoot transistors in a faulty circuit?*

**MP:** I'm used to using a different type of transistor tester. Actually, you can use a digital or analog multimeter to test a transistor. If you want to check the Beta or other parameters, you will need a more dedicated piece of test equipment. I elected to use the Sencore Super Cricket, which I think is an excellent transistor checker. With most transistor testers, you have to be careful and make sure the leads are properly connected, etc. With the Super Cricket you can just hook to any wire, push your buttons, and find out whether your transistor is working. It's just a little bit faster

## Planning

and that saves you time.

However, it is also a more expensive piece of test equipment, bringing up an interesting point. People should look at test equipment as an investment: you spend money to make money. There are certain pieces of equipment that you know will do the job and will work in given test situations. You should not compromise on that investment because you are compromising on service to the customer. Because your customer is depending on you to do a competent job, it's your responsibility to have the equipment to assure quality service.

**ES:** *How do your color monitor and generator fit in?*

**MP:** For our video work we use a Panasonic color video monitor and a B&K-Precision 1250 NTSC generator. I'm considering upgrading to a newer Tektronix modular test generator but our present unit—for most applications—does a good job.

In security work, I find it helpful to have an ac/dc black and white monitors into which you can plug a modified camera that runs off a battery pack, or low voltage source. Then you can go to a remote site where the camera is hard wired in. Or, if you're working on a 24V system, you can aim the camera, adjust the focus, beam, etc., right on the spot without a lot of running back and forth. Again, you're geared toward saving time, and that looks good to the customer.

**ES:** *How about overall service? Do you plan a 24-hour service contact?*

**MP:** Only on our emergency accounts, such as hospitals. If a nurse call system or the fire alarm system goes down in the middle of the night, we can dispatch a service man quickly to take care of the problem. But, most of our systems can be taken care of during the normal working day.

**ES:** *Do you use an equipped mobile van for field testing?*

**MP:** No, not really, I prefer instrumented service cases to handle the systems we install. Of course, these include, as needed, portable scopes, an impedance bridge for testing communications lines, and a pink noise generator to insert noise at ⅓ octaves to broadband a system. However, my cases are designed to accept any of my bench equipment needed to troubleshoot any problem in the field.

We plan to add a battery-operated scope to our line. This can be of special value when you have to reach difficult locations or when you suspect ground loop problems and need isolation.

More importantly, to provide quick service, we carry in the field spare circuit boards to get systems operating with a minimum of downtime. Later we can service the faulty board back at the plant or send it to the factory for service/replacement.

We also stock a nominal amount of spare components, but this is a delicate balance of experience and judgment if you want to avoid tying up a lot of capital in component stock. You need to develop an optimum stock for your needs and good connections to distributors and the factory for less frequently needed components and complete boards.

**ES:** *What are some of the typical instrument lines that you install and service?*

**MP:** We are a factory warranty and service station for US JVC, NEC, Panasonic, Sanyo, and all systems by Dukane. Also, we're qualified to service professional audio and video equipment and related systems by Sony, Crown and Yamaha. We also handle RCA and Panasonic security systems, and virtually every facet of video production facilities.

**ES:** *What about documentation for the systems you install and service?*

**MP:** This is a critical area in providing quick, dependable, economic service. We thoroughly document each system we install, complete with circuit values service manuals, and custom circuit prints. This early work up front assures quick customer service—and that's the name of the game if you want your business to grow and be profitable. □

# Reports from the test lab

Each report about an item of electronic test equipment is based on examination and operation of the device in the **ELECTRONIC SERVICING** laboratory. Personal observations about the performance, and details of new and useful features are spotlighted along with tips about using the equipment for best results.

By Carl Babcoke, CET

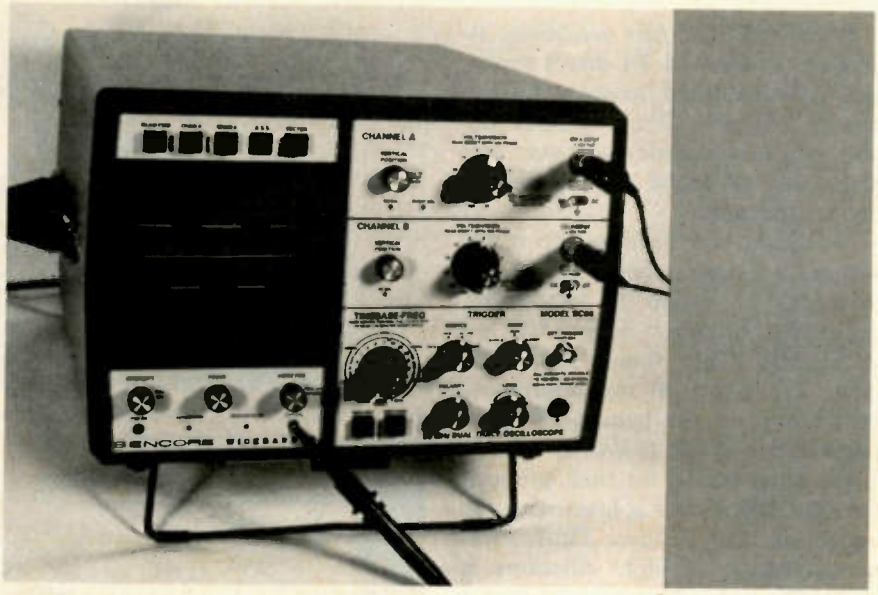


Figure 1 Sencore model SC-60 scope has a bright CRT with internal graticule, 60MHz bandwidth, a signal-delay line, preset vertical and horizontal TV and video sweep times, a beamfinder, and direct readings with the X10 probes.

### Sencore SC-60 scope

Sencore's SC-60 Widebander 60MHz dual-trace oscilloscope has several unusual features. This large scope has an attractive appearance (Figure 1) and a panel layout designed for convenient operation. Although intended primarily for bench operation, it has mounting feet on three sides and a flexible carrying handle. A pull-out chart under the front panel contains operating instructions (Figure 2). Both probes supplied can be stored in a compartment in the back of the casing.

### Vertical-channel specifications

Two identical vertical-amplifier channels are provided for dual-trace or X-Y (Lissajous) operation. Frequency response is rated at ±3dB to 60MHz, to 80MHz at -6dB and to 100MHz at -12dB. Rise time is 6ns.

A coaxial-cable type of signal-delay line in each channel eliminates the usual loss of waveform leading edges by delaying the vertical signal until the triggering begins to move the horizontal sweep.

Controls for channels A and B are in the upper right corner of the front panel (Figure 3). Each channel has a vertical-positioning control, a VOLTS/DIVISION 12-position range switch, a concentric variable vertical-sensitivity control (that must be rotated CW for calibrated readings), an ac/dc coupling switch and a connector for the shielded probe. For identification of channel A, blue bands are placed at the scope end of the cable and at the probe's ground connection.

### Probes

Two model 39G149 X10 low-capacitance probes are supplied. These probes are designed for low-cap operation only; there is no switch for X1 mode. This allows range calibrations of the VOLTS/DIVISION switches to be direct-reading. When a switch is rotated to 1VPP/division, that is the rating; it is not necessary to multiply by 10.

Figure 2 Condensed operating instructions are printed on a pull-out plastic card attached under the scope.


Figure 3 Operating controls for both identical vertical channels are in the upper left corner of the front panel. For calibrated VOLTS/DIVISION accuracy, the concentric variable waveform-height control must be fully CW. Channel A has a polarity-inversion switch operated by the vertical-positioning control.

When full 5mV/div sensitivity is needed, a standard X1 direct probe can be substituted temporarily for model 39G149. Direct probes do not require frequency-response adjustments, so probe substitution is not complicated.

Maximum sensitivity of the scope without a probe is 5mV/div. When the 39G149 probe is used, the sensitivity becomes 50mV/div (or 0.05V/div). This should be sufficient for almost all measurements. In addition to the benefit of lower capacitance at the probe tip (which is the main reason for such probes), the 10X loss allows a least-sensitive range of 200VPP/div. Thus, full-screen height of eight divisions is 1600VPP total. This is needed for tube-type TV receiver measurements.

A special resistance-type wire is used as the center lead of the probe cables to minimize ringing on waveforms having fast rise and fall edges. (No ringing was observed on any waveform viewed during these tests. Of course, care must be used in locating the best ground point for the probe.) The probes are rated for 2kV maximum (or sum of dc plus peak ac).

For most measurements, the insulated spring-loaded hook (Figure 4) is best. The hook makes secure contact and the insulation prevents shorts to nearby wires. The tip assembly can be removed (by unscrewing in a CCW direction) when a pointed and short tip is needed. The frequency-response variable capacitor is in the scope end of the cable connector. Adjustments are simple when the calibration waveform is viewed as the standard.

Figure 4 Two X10 low-capacitance probes are supplied with each SC-60. The insulated hook (shown here) is recommended for most measurements.


Figure 5 Switches and controls for triggering and horizontal sweep are located on the lower right section of the front panel, along with the external-trigger jack and a ground jack.

## Triggering and horizontal sweep

Although triggering and sweep systems are separate sections of a scope, they often are grouped together. This is true of the SC-60 front-panel controls. Figure 5 shows that the switches and variable controls for both sweep and triggering functions are in the lower-right area of the panel.

Three switches and one control determine the triggering. The SOURCE of the triggering signal can be channel A, channel B, the ac line, or a signal entering the EXT-TRIGGER jack. The MODE switch selects normal triggering (no deflection in the absence of proper triggering), auto triggering (has horizontal deflection without an input signal or when triggering is not locked), or VIDEO mode, in which the triggering signal comes from a TV-type sync separator. The POLARITY switch selects either the positive-going slope (+) or negative-slope (-) of the triggering signal. The LEVEL control determines the voltage level where triggering occurs. This control is adjusted when triggering is desired at a specific point of the triggering waveform.

The duration of the horizontal sweep is determined by adjustment of the 20-position TIMEBASE-FREQ switch and its associated variable control (small knob at the center). The longest sweep time is 100ms and the shortest is 0.1μs/div.

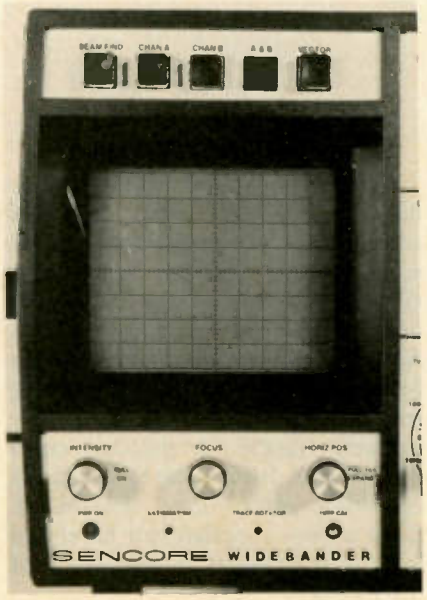



Figure 6 Display-selector pushbuttons are above the CRT, and the CRT controls are below. The CRT has post-deflection acceleration and an internal graticule. A high voltage of 6kV provides a sharp trace of high brightness.

In addition, the 10X horizontal width expansion (part of the horizontal-positioning control) gives the effect of 0.01μs/div. This displays 10 cycles of a 100MHz signal, or one cycle at 10MHz.

The timebase calibrations also include seven frequencies for comparisons. For example, 0.1ms has 1kHz beside it. This means a 1000Hz signal would have one cycle displayed across the entire 10 divisions of the CRT screen when the sweep duration is 0.1ms. If the traditional two cycles of signal are desired, the sweep time must be doubled (0.2ms in this case). For 10 cycles (one per division), the sweep time must be multipled by 10 (1ms).

**Video presets**—Two push-buttons below the timebase switch provide preset sweep times that display slightly more than two vertical fields or two horizontal lines when the timebase switch is turned to the VIDEO PRESET position. Selection of the horizontal-lines position also automatically selects output from a sync separator to give solid locking, whether or not the MODE switch is turned to VIDEO. Somewhat the same action occurs when vertical-fields are selected, except the locking is much tighter if the MODE switch is turned to VIDEO. This slight deviation is not noted in the instructions. If more than two cycles are desired, the variable timebase control can be rotated CCW from the calibrated position.

These presets can save much time for TV and video-equipment technicians.

## Display selectors and CRT controls

Above the CRT are five push-buttons for beamfinder, channel A, channel B, A&B channels (dual-trace in chopped or alternate modes), and vector (X-Y display) (Figure 6). Pressing channel-A and channel-B buttons adds both signals into one trace (A+B). Channel A has a polarity-inversion switch. With A+B and channel A inverted, the two signals subtract (B-A). Also, operation with no buttons depressed forces the scope to display channel-A and channel-B waveforms alternately.

At the lower left corner of the panel below the CRT is the intensity or brightness control. Pulling out the knob turns on the ac power. Next is the focus control, and at the right is the horizontal-positioning control, which increases the trace width when the knob is pulled out. The power-on lamp is in the extreme corner. Screwdriver adjustments are provided for the astigmatism control and the trace-rotator (leveling) control. The calibration terminal has 1VPP square-waves for probe adjustments or vertical-gain calibration tests.

## CRT features

The CRT is a 5-inch rectangular post-deflection type with P31 (blue) phosphor. When the intensity is high and the focus control is misadjusted for a broad horizontal line, a definite screen-wire pattern can be seen (Figure 7). This effect is interesting, but of no other importance because it probably is caused by focusing on the post-deflection screen rather than on the phosphor coating. An accelerating voltage of 6kV provides outstanding brightness of waveforms.

Graticule markings are the usual 8 X 10 cm (although the vertical sensitivity controls are rated in divisions rather than centimeters, and the instruction manual refers often to divisions) with 0%, 10%, 90% and 100% points indicated. These percentages are useful in measuring rise and fall times.

But the CRT's best feature is called *internal graticule*, which places the graticule lines inside the glass faceplate in front of the phosphor (Figure 8). This construction eliminates any possibility of parallax errors that can occur with separate-graticule CRTs. The internal graticue has no drawbacks when used for normal operation because the screen is recessed about 1½ inches behind the front panel to minimize glare.

## Comments

Some features of the Sencore SC-60 scope are not visible. Sencore operation and information materials describe the reasons for selecting differential amplifiers and emitter-coupled-logic integrated circuits in the triggering system. Differential amplifiers minimize certain kinds of noise, and ECL digital circuits operate faster than TTL. This is important in a scope with usable bandwidth to 100MHz. Triggering circuits have been made automatic and triggering controls have been reduced to the fewest possible without compromising performance. Special attention has been given to solid locking on digital signals.

Front-panel controls have been grouped according to functions and then placed in convenient locations. Use of large push-buttons and knobs in uncrowded layouts contributes to easy operation.

Other valuable features include an internal graticule in a CRT giving sharp and bright waveforms, a vertical-signal delay line, extended vertical bandwidth with matching shorter sweep times, preset vertical and horizontal sweep push-buttons for video signals, direct reading of the volts/div switch calibrations including the X10-loss probes, and a beamfinder button.

Performance of the Sencore SC-60 with typical waveforms and TV signals was very good, indicating its suitability for all types of trouble-shooting. □

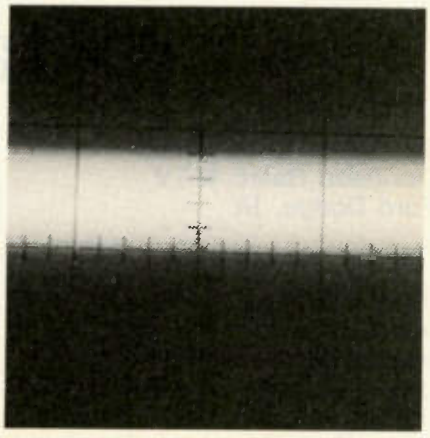


Figure 7 When a horizontal line is defocused to excessive width, a tiny crosshatch pattern appears; evidently from the PDA feature of the CRT.

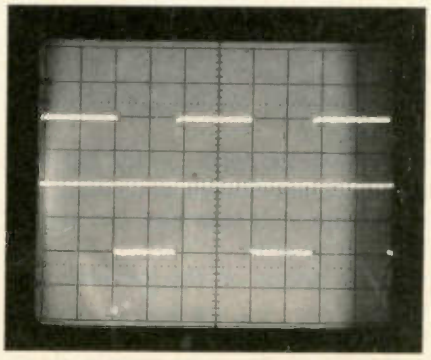


Figure 8 The SC-60 waveform shows correct probe adjustment. Black lines of the internal graticule are very legible against the blue-white trace.

Typical of many combination AM/FM/ stereo plus cassette tape recorder/player is this unit sold by JC Penney. Models without the radio tuners and power amplifiers are called tape decks.

PART 2

# Servicing audiocassette tape recorders

By Homer L. Davidson
Davidson Radio & TV
Ford Dodge, IA

*Most deluxe cassette tape-transport mechanisms are in high-performance stereo decks (those without power amplifiers) or are included in radios or radio/phono combinations. Typical mechanical problems are similar for all brands or models.*

Mechanical problems in a cassette-tape machine include these general conditions:

- reels inside a cassette do not revolve and tape does not move through the head area, but the tape is not broken or damaged by the mechanism;
- the cassette reels rotate, but the tape becomes broken or twisted;
- tape speed is constant, but is too fast or too slow;
- music played on the machine has *wows;*
- music has a flutter;
- fast forward and/or rewind slows down, stops before the tape ends or fails to move the tape;
- the mechanism is jammed so the cassette cannot be inserted or removed properly;
- at the end of forward operation or rewind, the automatic shutoff does not remove the motor voltage; and
- the pause function stops tape travel at the wrong time or a defective pause mechanism does not stop the tape at the end of each reel.

## No rotation or tape movement

Symptoms of hum or hiss at maximum gain setting (amplifier is working), lighted dial lamps (power is on) but no tape movement (when the play button is pushed) indicate trouble with the motor or its voltage supply.

The pause control button should be checked first. It might have been activated accidentally, or it could be stuck in the pause position. Next, measure the motor voltage. Usually, either 6Vdc or 12Vdc is applied to the motor.

If the motor voltage is zero, check the leaf switch that should be closed when the head assembly has been moved against the tape by pressure on the play or a fast push-button. This leaf switch—that resembles the contacts of a relay—turns the motor power on and off. Short across the switch to determine whether the motor rotates. If so, the switch is open. (In battery-operated machines, this leaf switch applies power to both motor and amplifier.)

The capstan shaft that moves the tape is fastened directly to a large heavy flywheel that is rotated by a belt from the motor shaft. If the motor shaft rotates, examine the belt and capstan-flywheel bearing for any condition that stops flywheel rotation.

If the motor has correct voltage but is not rotating, remove the belt and attempt to spin the motor shaft by hand (Figure 1). If the bearing has slightly excessive friction, the

shaft might continue to run after such a manual start. Of course, if the shaft is difficult to rotate by hand, the motor bearing could be frozen or have dried lubrication. Use care while selecting a replacement for a bad motor. Order from the original manufacturer or specify an exact replacement. Motors that do not fit the mounting can waste time.

Tape fragments from a defective cartridge used previously (and probably already discarded by the customer) can wind around the capstan shaft or become entangled with rotating components, stopping the tape movement. Always make a visual inspection for tape fragments.

### Wrong tape speed

Many defects can slow the movement of tape past the head, but few produce excessive speed.

In all cases involving wrong tape speed, the first step should be a visual examination of the capstan flywheel and capstan shaft. Look for tape that has been wound tightly around the capstan shaft or has jammed the mechanism. Sometimes the misplaced tape tightens around the capstan shaft and bearing, thus stopping the capstan rotation. More often, the broken tape around the capstan shaft gives the effect of a larger diameter capstan, which increases the tape speed. All such pieces of broken tape must be removed carefully, without denting or scratching the capstan shaft. The cassette that supplied the tape should be spliced or discarded.

Insufficient torque of the take-up reel or a defective cassette can cause this buildup of tape around the capstan.

Other conditions that can produce fast tape travel are:

- insufficient friction between capstan shaft and its pressure roller allows the tape to slip through at a faster-than-normal rate when pulled by the take-up reel torque. Ideally, there should be no slippage at the capstan;
- excessive voltage might be applied to the motor; or
- speed regulation inside the motor has failed.

Slow tape speed usually is produced by either excessive rotational friction or insufficient torque.

Dry bearings and shafts of capstan (Figure 2), supply or take-up reel, or idler wheel can increase the rotating friction and slow the tape speed.

Lubrication is so important that it should be performed on the entire mechanism every time a cassette machine is opened for inspection. Many puzzling cases of slow speed can be solved by routine oiling and lubrication. **Warning:** do *not* overlubricate or overoil. Lubrication materials on the belts or rubber tires can produce slow speed.

Remove the capstan flywheel, and clean all old lubrication from shaft and bearing using alcohol and a soft cloth. Before replacing the capstan shaft, apply *one* drop of light machine oil to the bearing. Use a clean cloth wetted with alcohol to remove undesired grease and oil from the capstan and other nearby components.

Also, use a cloth soaked with alcohol to remove the ring of oxide

from the capstan shaft and the pressure roller. Make sure the pressure roller can be rotated easily. If the mechanism has jammed before, the pressure roller might be bent to one side. Repair or adjust for the proper tension between capstan shaft and its roller.

### Erratic rotation

Dry bearings can cause erratic rotation of the cassette reels, in addition to the slow speed mentioned before. But if the erratic or intermittent rotation occurs after lubrication and examination of all bearings has been done, the belts must be suspected. Look carefully at each belt, especially the inside of any flat belts. Note whether the belt has numerous cracks (that can allow it to stretch) or whether it has unsufficient tension. Any belts that have the shine of oil should be cleaned with an alcohol-soaked cloth.

When neither dry bearings nor bad belts are responsible for erratic tape motion and reel rotation, test for corroded leaf-switch contacts or a defective motor. Because fast-forward and rewind functions involve other drives than those used for the capstan, erratic tape movement only during play or record functions indicates motor or switch problems.

An intermittent leaf-type on/off switch causes a varying dc voltage at the motor terminals, so this voltage test should be performed first. If the motor voltage is steady while the motor power is intermittent, the motor itself is probably the cause.

Erratic stopping or slowing of the cassette reels during fast-forward or rewind operations (but normal play and record speed) calls for additional attention to the spindle reels (see Figure 3). After they have been cleaned and lubricated, defeat the reel drive while turning that reel in your fingers. Notice whether the rotation requires little torque and that no binding occurs during several complete revolutions. Any such problems must be remedied before testing the performance again.

After the reel rotation has been repaired or found to be normal,

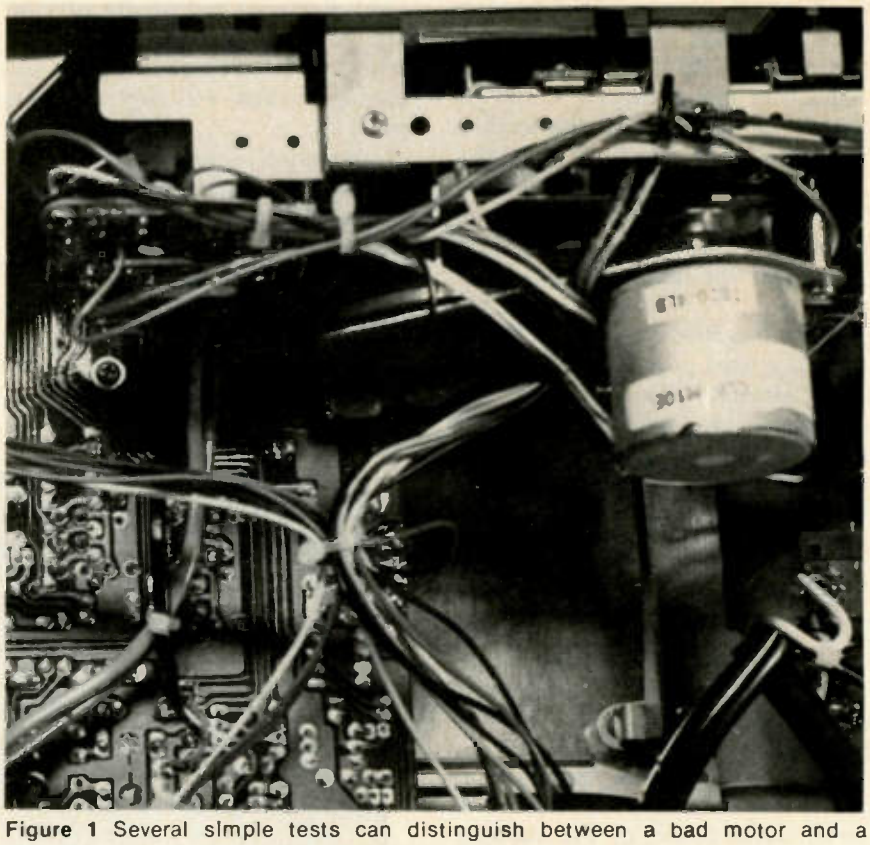


**Figure 1** Several simple tests can distinguish between a bad motor and a defective belt and drive system. Remove the belt between motor and flywheel. With power off, turn the motor shaft and pulley slowly, watching for excessive friction or erratic friction. If it turns freely, apply power and grasp the pulley so the motor stalls. Release the pulley; the motor should resume rotation. If not, it might be too weak or have gummed bearings. Apply a small amount of finger pressure to the pulley, and notice any erratic rotation (there should be none). If the motor passes these tests, any hestitation or erratic rotation after the belt is reinstalled must be caused by the flywheel or the reel drives.

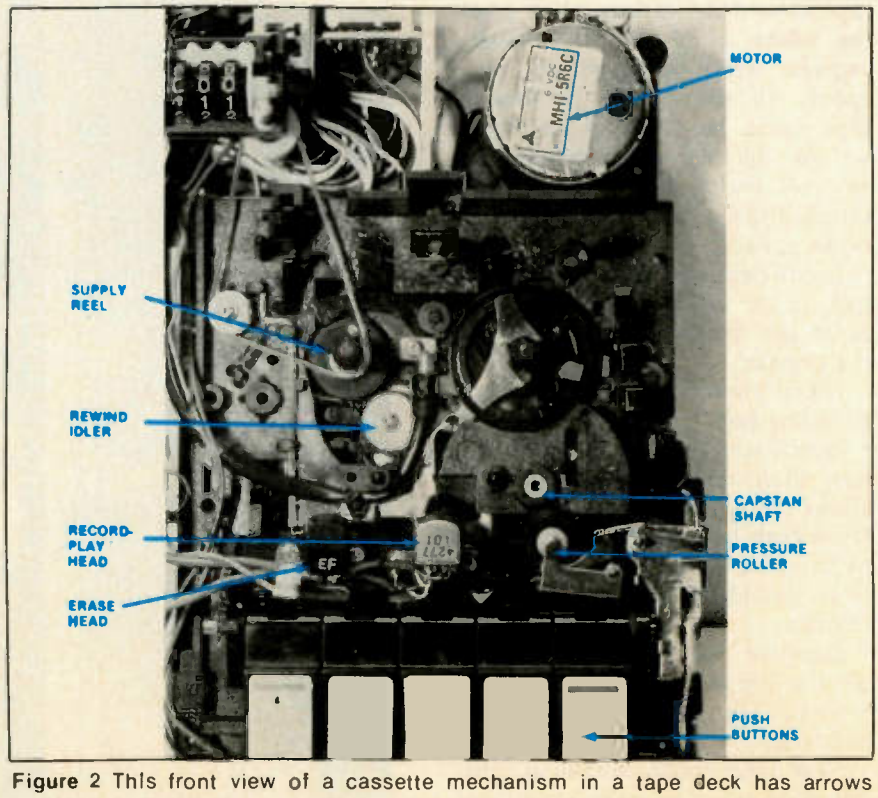



**Figure 2** This front view of a cassette mechanism in a tape deck has arrows pointing out several major components. The flywheel/capstan assembly has been removed for cleaning and lubrication.

erratic reel rotation could be caused by excessive slippage that reduces the reel-drive torque. Some machines have no adjustment for this torque. The amount depends on the tension of belts or the contact between a drum and a rubber-tired idler. These should be examined to find ways of increasing the torque (reducing the slippage).

Some spindle hubs have spider-like springs (Figure 4) that can be rotated to different levels or steps on the plastic hub. Move them to another step which applies increased bending pressure to each spring.

### Tape moves; no sound

A loss of playback sound from the tape can be produced by a defective tape head, loss of gain in the amplifier or a tape that is not touching the playback head.

For a quick test of the amplifier, turn the volume control to maximum and listen for hum or hiss. Also, while a tape is moving through the mechanism, energize a head demagnetizer and pass it near the playback head. A good head and amplifier will produce a loud hum in the speaker. Usually, it is not necessary to raise the dust cover; the hum can be heard when the demagnetizer is 2-3 inches from the head.

If these tests prove head, amplifier and speaker are normal, the loss of sound must originate from a lack of contact between tape and playback head. Perhaps a screw is missing from the head bracket, allowing the head to turn sideways, or the head might have become separated from the bracket that moves it toward the tape.

Watch the head as the play button is pushed. Does the head move toward the tape? Does the head appear to protrude sufficiently into the cassette opening? Is the tape cassette defective, causing the tape to pass *behind* the internal pressure pad where the head cannot reach it? These are typical of the questions that must be answered from visual observations while the buttons are being pushed.

Incidentally, the record/playback head should be demagnetized before a test tape (or other valued cassette) is played on the machine. Some heads become magnetized from the transients during switching from off to power-on or from play to record. A magnetized head adds a hissing noise to the playback sound, as well as removing some of the high frequencies in the music.

### Loading problems

Suspect a broken play lever or a sheared pin on the play lever when the head assembly does not move to the tape and lock into position. Broken parts must be replaced with the original manufacturer's components. Apply a coating of light grease to any surfaces that slide against others.

Many tape machines have a lever to eject the cassette when desired. If the eject lever does not return to its proper position, the next cassette will fail to seat completely. Sometimes only lubrication of the lever is needed. Or the return spring might have broken or slipped out of position. A bent eject lever should be straightened and lubricated (Figure 5).

### Automatic shut-off problems

Cassette models that have auto-

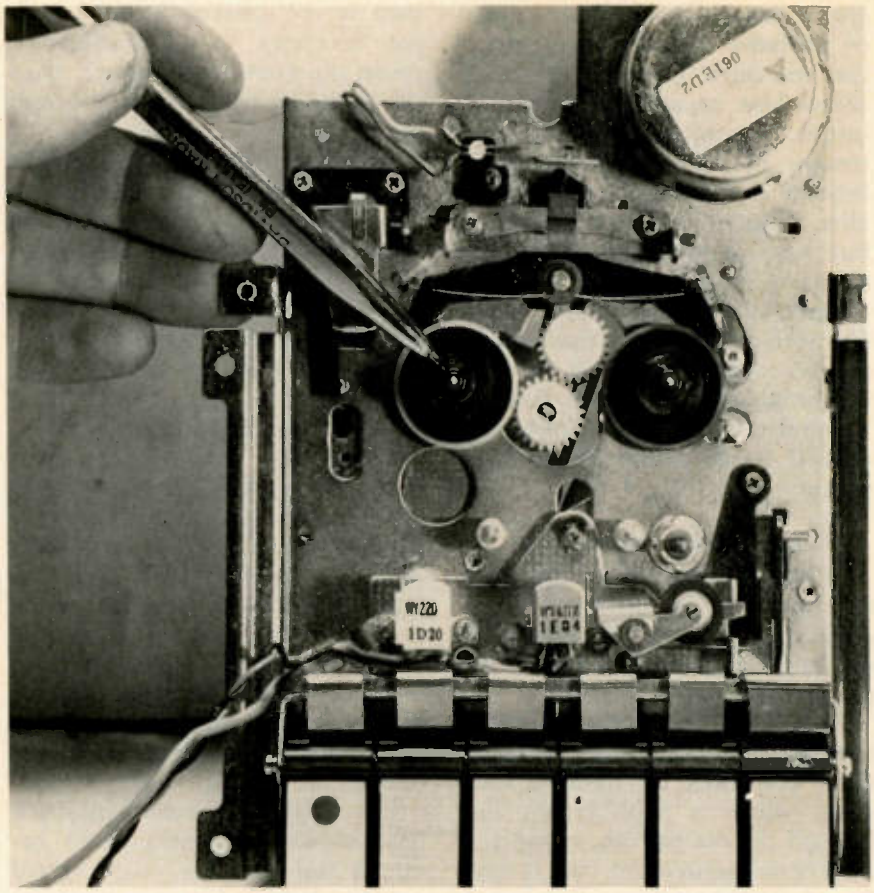


Figure 3 When either spindle reel is suspected of having dried lubrication, both reels should be removed (many have small "C" washers at the top), and cleaned thoroughly with alcohol before one drop of oil is applied to each bearing and the spindle is reassembled. As shown, it is helpful to remove the mechanism from deck or combination to permit better access to these mechanical components.

## Servicing recorders

matic program sound system circuitry or automatic shut-off functions require additional tests when they switch the power off at wrong times. With APSS systems, watch the solenoid while the unit stops. If the solenoid is not energized and the lever does not move, something is wrong in the loading assembly. But when the solenoid lever is pulled into the solenoid by magnetic force, the APSS circuitry is operating to stop the operation.

Before serious problems are suspected, the cassette should be tested to determine whether it is wound to the end or jammed.

In other models, the loading platform is designed to deactivate a few seconds after the motor stops. If the assembly unloads the cassette when the play button is pushed, suspect a defective motor or a lack of motor voltage.

### Auto shut-off fails

If the model has an automatic shut-off feature, but it fails to function, the circuitry or mechanical assembly must be inspected. In mechanical systems, tension created by a stalled take-up reel during rewind, for example, places extra tape tension against a small lever that rides against the moving tape. Increased pressure during a stall or at end of tape moves the lever and it acts to remove the motor power.

Move the lever by hand, noticing whether the assembly shuts off properly. If not, the lubrication of the lever might be dried or the lever might be bent. Clean and lubicate all sliding areas.

Insufficient torque of the take-up reel clutch can prevent automatic shut-off by not allowing sufficient pressure against the lever or pin during fast-forward operation.

### Improper take-up operation

Tape that piles up after it passes the capstan is caused by failure of the take-up-reel torque. The take-

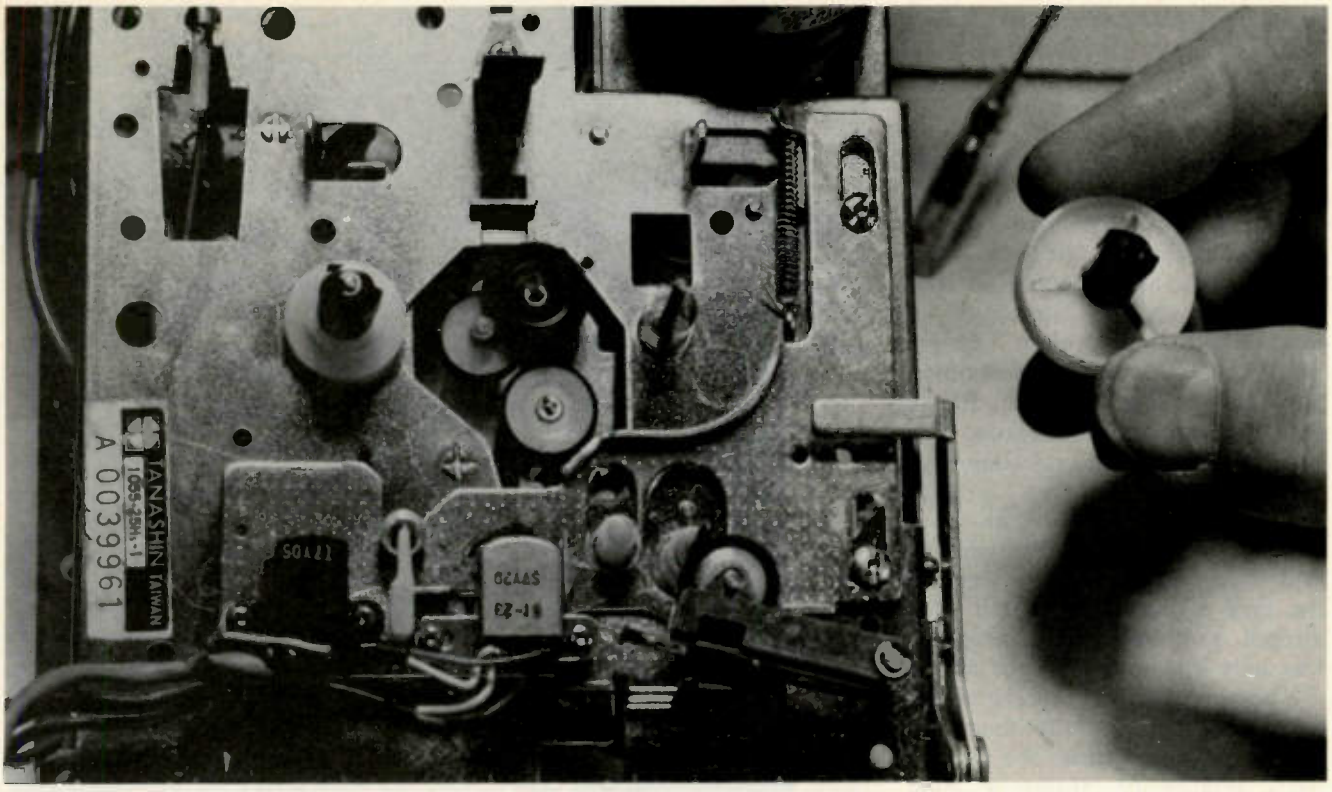



**Figure 4** Adjustment for slippage torque of the take-up reel sometimes is provided by three flat leaf springs that can be rotated to various levels or steps on the hub. Increased tension of the leaf springs gives stronger take-up reel torque. Other models have an adjustment screw or they merely depend on the tightness of belts.

up reel should slip just enough to maintain a steady pull of tape against the capstan drive for all amounts of tape on the reel. If the torque (take-up-reel pull) is not strong enough, the tape piles up inside the cassette, often winding around the capstan until something jams and breaks the tape. If the defective cassette is discarded but the tape pieces are not removed, the unwanted tape can produce wrong speed or lock the capstan.

After the broken fragments of tape have been removed, remove the take-up spindle, clean it with alcohol and lubricate it properly. Use only one drop of light oil on the bearing. Clean the pressure-roller rubber tire and the mounting assembly, and lubricate the moving parts (Figure 6). Insert a good cassette and check for tape pileup. A sure sign of pileup is rotation of the supply reel but erratic or no rotation of the take-up reel (after the slack has been taken out of the tape). Turn the machine off quickly when *either* reel fails to turn as it should.

If the take-up reel still fails to maintain proper tension on the tape after cleaning and lubrication, the torque must be increased by reducing the slippage. Some machines have a small adjustment screw near the take-up reel; others have three leaf springs on top of the take-up hub. These should be moved to the next step that provides increased spring tension. Afterward, install a good cassette and test the performance.

Another cause of tape pileup inside the cassette is improper seating of the cassette. This can bind the take-up reel and stop its rotation. A small metal clip on the head shield assists in positioning the cassette. Examine it for bending.

Individual cassettes also can produce tape pileup. If only one cassette exhibits this problem, it should be discarded. The machine should not have the normal adjustments compromised to accommodate one defective cassette.

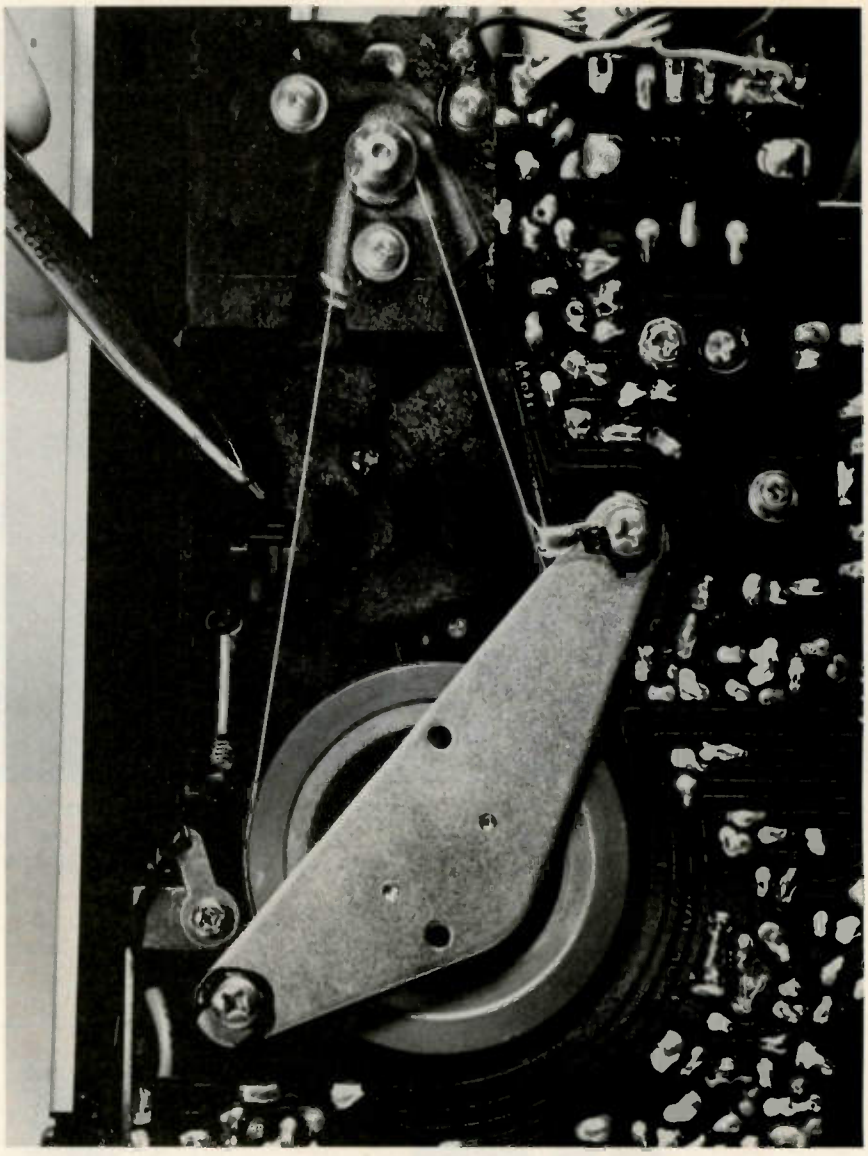


Figure 5 The pencil points to a bent eject lever that prevents the cover (or cassette door) from opening. After the bent lever is repaired or replaced, lubricate the sliding areas.

### Wow and flutter

Wow and flutter are different kinds of speed variation. Wow is a slow variation of speed that makes a sustained section of music have a constant aah-woo-aah-woo sound that is very annoying. The pitch of music changes exactly in step with the tape speed. Therefore, wow varies the frequency of music, rather than the volume or amplitude.

Flutter is a rapid change of tape speed (frequency change of the music) or of the amplitude (change of volume). It occurs several times per second, thus making a sound that is easy to identify but difficult to describe.

Wow ordinarily requires several seconds for each repetition; flutter occurs several times a second. The difference in repetition rates provides a strong hint about where these problems can originate.

In cassette machines, the most likely cause of wow is erratic torque or friction of the take-up reel, because this reel requires several seconds (the exact number varies with the amount of tape on the reel) for one revolution. In the same way, erratic binding of the supply reel or borderline slippage of the capstan drive also might cause wow.

The capstan shaft revolves several times a second, and the capstan pressure roller revolves about twice a second. Additionally, several of the rubber-tired idler wheels revolve several times a second. A lump of tape or oxide on the capstan shaft or a flat spot on an idler is the

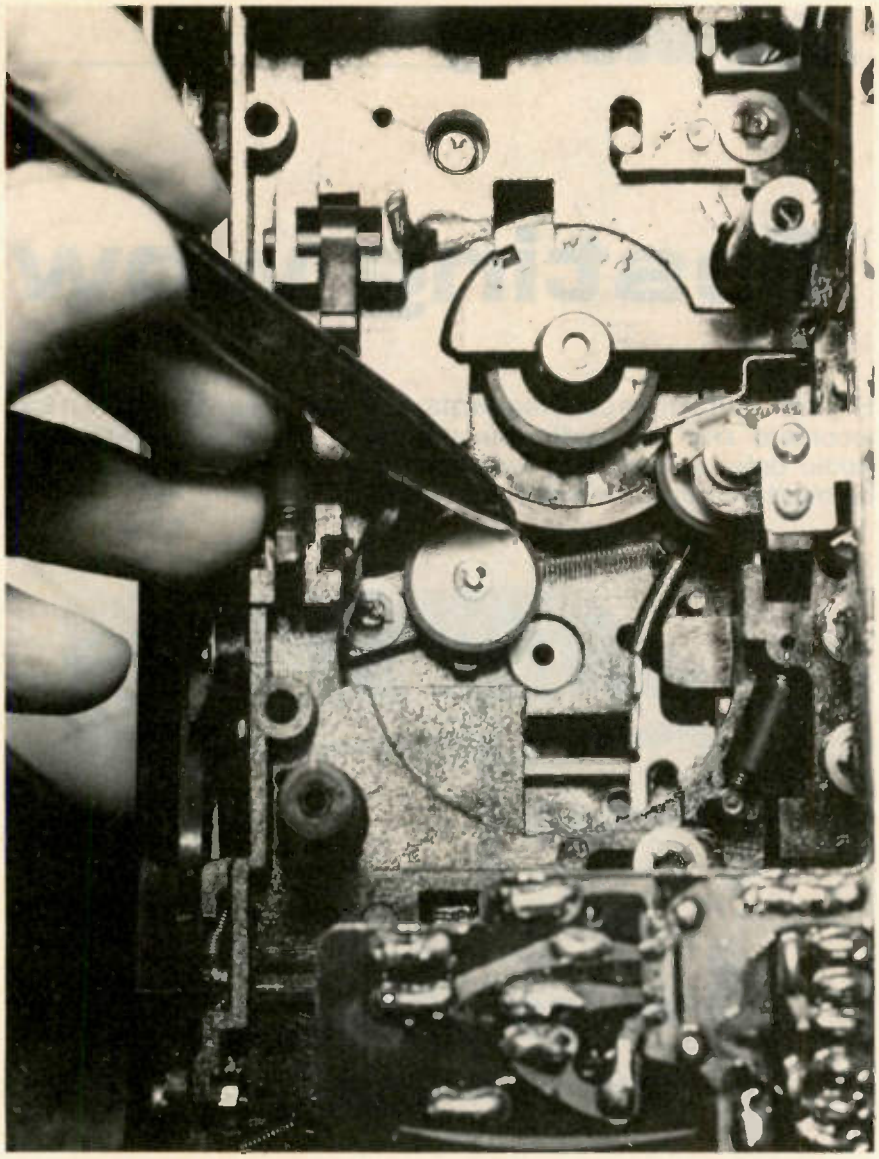


**Figure 6** Oil or grease on the take-up idler wheel's rubber tire can decrease the torque of the take-up reel and produce a pileup of tape inside the cassette. A small amount of oil can be removed satisfactorily by wiping the rubber with alcohol on a clean cloth or swab sticks. If the rubber is oil-soaked, remove the idler wheel and leave it in a pan of alcohol for several minutes before drying it with a clean cloth and reinstalling it.

prime suspect in cases of flutter.

When a customer describes the problem as "running too slow," this usually means the mechanism is producing wows in the music. Unless it exceeds perhaps 10% fast or slow, a small error of tape speed and musical pitch is not noticed by most people *so long as the speed is steady* and without rapid changes. On the other hand, *speed variations* of less than 1% are perceived easily by almost everyone when the tape speed and musical pitch varies at either wow or flutter speeds.

### Comments

The majority of service problems with cassette player/recorders (both portable or deluxe in combinations) can be solved by cleaning oxide from the heads, removing pieces of tape (perhaps wound around the capstan shaft), cleaning, lubrication and simple mechanical adjustments. The main precaution is to avoid applying excessive amounts of oil and grease. These lubricants migrate easily to other areas, causing many serious speed and jamming problems when they reach any belts or idler-wheel rubber tires where slippage cannot be tolerated. Use *clean* alcohol and a *clean* cloth or cotton sticks to remove lubricants. □

# Testing wow

By Kirk Vistain

Higher performance standards are required for audiotape recorders and the audio function of videocassette machines. Audio defects caused by variations in mechanism speed should be measured by wow and flutter meters.

All machines that employ rotating mechanisms produce speed variations of several long-term and short-term types. In audiotape machines, these speed variations degrade the signal quality by varying the voice and music frequencies (change of pitch). Large amounts of periodic frequency shifts are unacceptable to *all* listeners, although tolerance of bad sound varies from person to person. The job of audio technicians is to reduce speed and velocity errors until only a small minority of listeners is annoyed by them.

During audiotape and videocassette tape repairs, there are difficulties in assessing the amount of frequency shift unless it is measured by meters and special tapes. Not all technicians are sensitive to small percentages of wow and flutter. This is particularly true in the noisy repair-bench atmosphere.

Identification of a speed-variation problem is best accomplished by a combination of instrument readings and a technician's trained hearing. The meter readings provide a figure and the audible repetition frequency often indicates which rotating components are responsible for the problem. Also, some factory warranty requirements and critical listeners demand factual proof of performance. Only a meter reading will suffice in these cases.

### Wow and flutter

Wow and flutter are industry slang terms for two types of instantaneous speed variation. *Wow* is a very slow variation of tape speed that adds an unsteady whine to music. Intermittent wow can occur occasionally. When it happens regularly, the repetition rate is less than 6Hz (it can be as slow as once every several seconds). Look


A typical high quality wow and flutter meter is model LFM-39A from Leader Instruments. A test record and a test cassette tape are also available to enable measurement of turntables, tape decks and other recording/playback equipment. An internal 3kHz oscillator allows tests of wow and flutter in both the recording and playback functions of tape recorders. The meter requires a 3kHz Input between 15mV and 10V RMS. It tests wow and flutter in five ranges between 0.03% and 3% full scale and measures drift on a ±5% range of a separate meter. CCIR, JIS or DIN weighting is selected by pushbuttons. Recorder and scope outputs are provided.

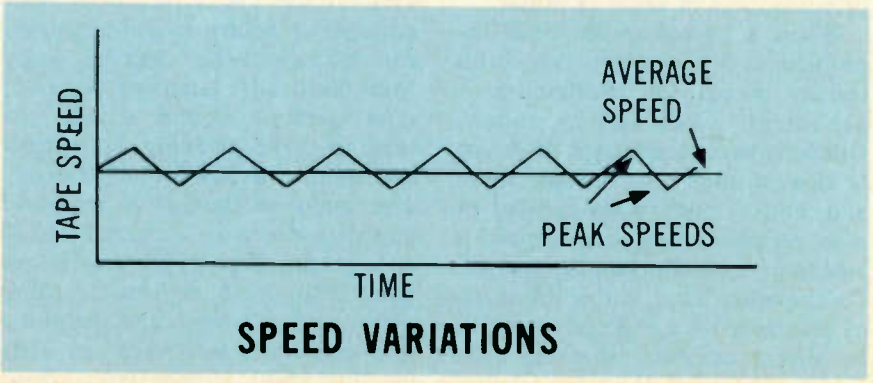



Figure 1 Wow and flutter vary around the average speed. The principal difference between them Is the time per cycle. Wow cycles are longer than six per second; flutter cycles have a repetition rate of six per second or faster. A wow and flutter meter tests for frequency shift of the reproduced audio signal by a method similar to FM demodulation.

# and flutter

for an idler or reel that rotates in synchronism with the audible wow. Listeners frequently (and incorrectly) describe wow as slow speed.

Flutter is a more rapid regular change of tape speed and has a repetition rate of at least 6Hz. Flat or damaged spots on idler wheels are a common source. Figure 1 shows how wow and flutter vary the tape-travel speed.

### Drift

*Drift* is any long-term speed variation, such as between one end of the tape and the other or between machines. Drift is not as annoying to listeners as wow and flutter are, but it should be detected, measured and eliminated.

### How a W&F meter works

A typical wow and flutter meter operates like an FM discriminator A 3kHz sinewave is recorded on the tape (or a test tape with prerecorded signal is obtained). In the test instrument, the playback audio is processed by a limiter that removes amplitude variations. Next, the limited audio is sent to a frequency counter (for drift measurements) and to the discriminator. The output of the discriminator is a waveform consisting only of variations from the average frequency (tape speed).

Switches of the mode filter select the desired frequency contour (weighting) that provides a meter reading corresponding closely to the effect on human ears. Separate wow or flutter readings, combined readings and weighted readings are available. In addition, several ranges of wow and flutter percentages are provided.

Connection of a wow and flutter meter is simple, as shown in Figure 2.

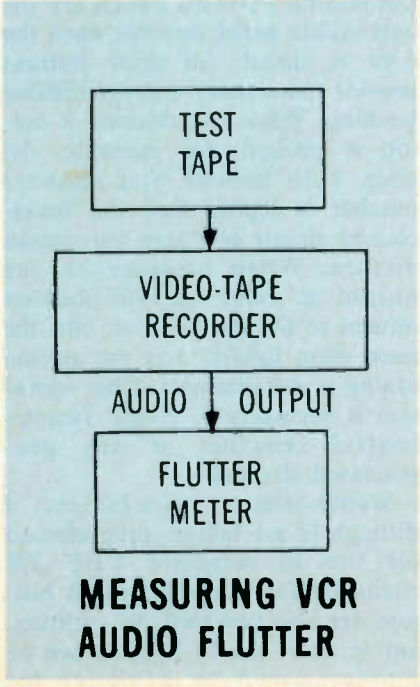



Figure 2 Measurements of wow and flutter from a videocassette recorder (VCR) are simple when a test tape is used. Tests of audiotape players are similar.

### Diagnosis with a W&F meter

A wow and flutter meter provides numerical readouts that reveal whether a machine is operating within specs. But it has other value by giving information necessary for a quick and accurate diagnosis of many defects.

This is true for both audio and videocassette recorders. Wow and flutter meters are not used for measuring video or chroma signals in VCRs. The picture provides all that information from symptoms such as picture tearing, chroma noise or snowy reproduction. However, audio tests in an ailing VCR often can isolate problems to either capstan or drum servo control.

For example, a machine has picture instability with all tapes. Associated equipment is checked and found to be normal. Next, it must be determined which servo is malfunctioning.

Install the test cassette in the VCR, find the 3kHz section of the tape and measure the wow and flutter. If the machine has wow and flutter equal to or less than the specification, the capstan motor, drive and associated circuits are normal. Therefore, the picture instability must be caused by a defect in the drum servo system.

### Locating the bad component

The frequency of the tape speed variations can often be a guide to the defective mechanical component. Slower revolution of a part produces a corresponding slow speed.

For example, wow is more likely to be caused by a problem with a slowly revolving take-up reel than with a rapidly rotating capstan shaft. This assumes, of course, that the associated electronics have been cleared of suspicion. Wow can also be caused by a thermal change in the speed-control circuits. A faster frequency variation (sounding like flutter) could be produced by a dirty tape guide (scrape flutter) or a bad inertial roller.

Also, it pays to listen to the reproduced flutter in the test signal while it is being metered. Human ears give different information than does a meter.

### Comments

Wow and flutter meters have been indispensible in audio shops for years. The need for numerical ratings and elimination of aural guesses have made them imperative.

Because of the advent of such video products as VCRs and videodiscs, precision audio measurements are also becoming essential for television repair shops and technicians. These allied repairs can keep the service bench busy, even during these times when servicing solid-state TVs has become less frequent. □

# Features and circuits of Sony receivers

By Gill Grieshaber, CET
Gill's Color TV

*Features and unique circuits of a Sony 15-inch color TV receiver are examined, including operation of the infrared remote-control system. A method is proposed for programming the microprocessor-controlled Express Tuning. Locations of major components and typical overall performances are revealed through photographs.*

Sony model KV-1543R is a 15-inch color receiver (Figure 1) with many advanced features, including a microprocessor-controlled electronic tuner system and infrared remote control. A drop-down door below the picture tube (Figure 2) provides access to the customer-operated controls. At the corner under the speaker grill are the MASTER power switch, two earphone jacks, and the model number (Figure 3). When the power cable is plugged into 120Vac and the MASTER power switch is latched *on*, dc power is supplied to the remote control at all times. On/off operation of the receiver is obtained by momentary closing of the front-panel POWER switch or the remote-control POWER switch. One earphone jack permits sound in both the speaker and earphone, while the other allows sound in the earphone only.

A cadmium-sulphide light-sensitive resistor is mounted at the upper-right corner of the front panel (Figure 4). The CdS resistance decreases when room light becomes brighter, thus increasing brightness and contrast. This Lumisponder action can be switched off.

Fourteen station-selector push-buttons, a two-position volume-control switch (rocker type), and a pushbutton POWER switch are the only visible panel controls when the door is closed. All these buttons provide momentary contact without latching. When the channel 5 button is pressed, for example, the neon bulb behind that channel number is lighted and the tuner-control circuit produces the station picture. When pressure on the button is released, the button returns to the out position, but the neon stays lighted and the station tuning is not changed. This operation is necessary to permit remote-control selection of any programmed channel.

Station-selector push-buttons 2 through 13 are factory programmed for the 12 standard VHF TV channels. Two unprogrammed buttons are also provided. In addition, any or all of the 14 buttons can be reprogrammed by a viewer for another TV channel, a videocassette recorder, videodisc player or video game. Sheets of channel numbers are provided for the remote buttons

Figure 1 Sony model KV-1543R with chassis SCC-207B-A has 42 transistors, three FETs, 11 integrated circuits and 60 diodes. The RM-503 remote control operates by radiated infrared carrier up to 23 feet.


Figure 2 A drop-down panel under the picture tube provides access to the customer-operated controls.


Figure 3 The MASTER power switch turns on and off the dc voltage that powers the remote control. Power to the television power supply is controlled by a relay on the remote circuit board. Turning off the MASTER switch stops all current flow in the TV receiver.


Figure 4 TV channels can be selected either by direct address from the 14 programmable push-buttons on the panel (without up-and-down scanning) or by direct address or up/down scanning of the remote-control unit. After channel selection by either receiver or remote, the appropriate channel number remains illuminated. However, the push-buttons do not latch. The LUMISPONDER CdS cell that controls brightness and contrast is in the upper right corner. Below it is the POWER push-button, which does not latch. A rocker-type up/down audio VOLUME switch provides a slow, gradual change of volume. It is a spring-return type that does not latch. Below the volume switch is the infrared sensor that receives the remote signal. A latch permits the door to open, revealing the programming controls.

and the TV-panel buttons, and these can be changed during reprogramming.

Station selection from the TV panel is direct access; no scanning is provided. The buttons can be pressed in any sequence.

The word ECONOQUICK below the push-buttons refers to the fast-warmup Trinitron picture tube that begins to show a picture after a few seconds. No heater power is drawn when the TV power is turned off.

A catch above the speaker grill releases the door that covers the channel-programming controls (Figure 5).

### Programming

Programming or reprogramming any channel-selector button is not complicated. Directions are in the Sony instruction book. Figure 5 lists the proper steps.

### Remote control

Infrared light is emitted from the remote-unit LED when any remote function is activated, and an LED on the receiver panel glows to indicate that the infrared signal is being received. This infrared carrier is modulated by pulses of the remote-control hand-held unit. At the receiver, a sensor accepts the modulated infrared carrier. Demodulation recovers the coded signal which activates the remote-control IC.

No programming is performed on the remote hand-held unit (Figure 6), although the numbers can be covered with others when needed. These functions are regulated by the remote-control system: a direct-access selection of 14 channels; volume up and down; audio muting; channel up and down scanning; and power on and off. Volume changes are smooth and gradual; the change proceeds as long as the button is activated. When the desired volume is reached, the viewer releases presure on the rocker switch. Channel changes in the scan mode occur about twice per second, while the scanning proceeds as long as the switch is depressed.

Operation of either the direct-access remote channel selection or the channel-scanning mode causes the corresponding number to light on the receiver panel.

One firm push is required on the POWER button to turn the receiver power on or off. Two AA batteries furnish all power for the remote unit.

### Board and component locations

Most of the circuit boards and major components are shown in Figure 7A. Because the largest

Continued on page 28

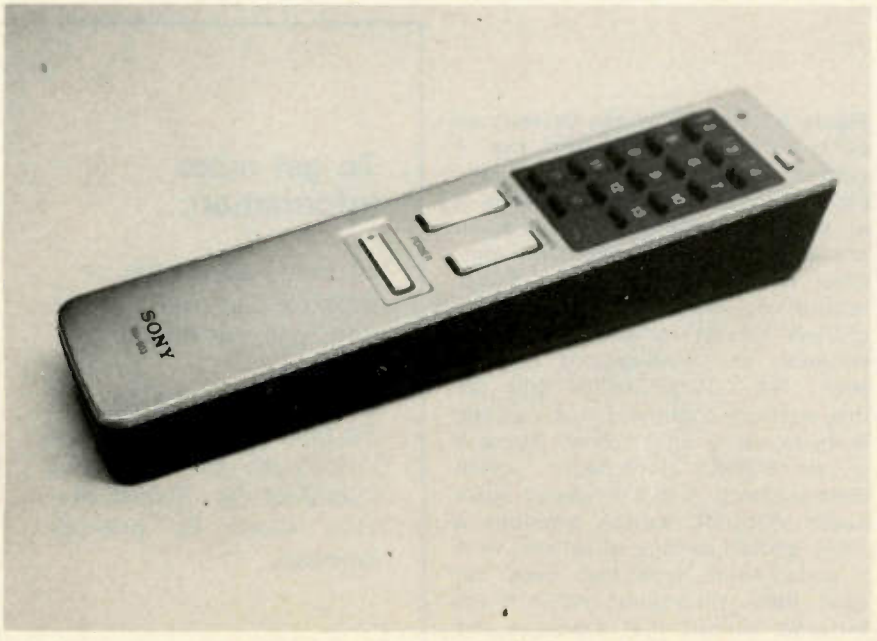
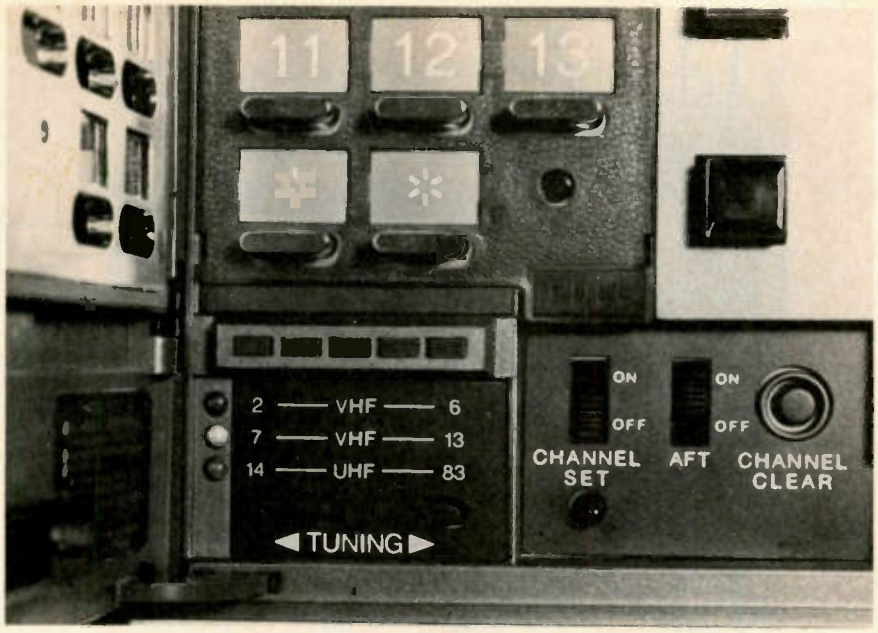



**Figure 6** Sony model RM-503 infrared remote-control unit offers 14-channel direct-access tuning, audio muting, up/down volume control, up/down channel search and power on/off.

## Programming Sony's channel selector

**Figure 5** The receiver-programming door opens, allowing access to the channel-programming switches and LED indicators. All VHF channels are factory adjusted, and two additional unprogrammed buttons are provided. Any or all 14 buttons can be reprogrammed to other channels for local TV stations or video games and VCRs. Programming can be done easily if the basic principles are understood.

A microprocessor is made to increment (count up) or decrement (count down), which produces dc pulses of gradually varying duty cycle. After filtering to remove the pulses, a pure dc voltage is formed, and it is used as the tuner-system tuning voltage. During programming, the up-TUNING and down-TUNING switches control the incrementing or decrementing that changes the tuning. Once activated, this action continues until stopped by reception of a TV signal. When the CHANNEL-SET switch is changed to its OFF position, the conditions for that tuning are committed to memory for use later. The 82 TV channels are divided into VHF-low (2 through 6), VHF-high (7 through 13) and UHF (14 through 83). The band is indicated by LEDs. When VHF-low is in use (either during programming or normal operation),




a red LED is lighted to the left of the 2. When VHF-high is selected, a yellow LED lights at the left of the 7. UHF operation is indicated by lighting of the green LED at the left of the 14 in the photograph. Above the band-indicators are the rectangular red LEDs that show the approximate tuning during programming. For VHF-lowband, channel 2 lights only the left LED, channel 3 lights the first two, channel 4 has the first two brightly lighted and number three dim, and so on until channel 6 lights all five red LEDs.

Reprogramming can be done either by pressing the CHANNEL-CLEAR button (which sets the tuning at channel 2 on lowband) and then using up-TUNING until the desired station is reached, or by operating up-TUNING and down-TUNING in small jumps to locate the station. The up or down TUNING action should be initiated by a *short* but firm push on the proper button, and the gradual tuning continues until stopped by a TV signal (or turning off the CHANNEL-SET switch). Starting at the CHANNEL-CLEAR mode, the up-tuning continues through the three bands. In other words, beyond 6 of the low band is 7 of the high-VHF band. And scanning above high-VHF brings in UHF 14. Scanning above UHF 83 switches to low-VHF channel 2, and so on. Down-tuning operates the same, but in the opposite direction.

Notice that normal operation with the CHANNEL-SET switch in the OFF position lights only the left tuning-LED and the range-LED. Changing channels causes the range-LEDs to indicate the range in use, but the tuning-LEDs do not vary. These indicate only during programming.

*It is not possible to program for a TV signal that is not being received.* Therefore, it is recommended that only a local station be used for programming *practice*.

When a TUNING button is pressed during programming, the tuning glides up (or down, according to the button selected) to the next carrier having composite video. A signal so weak that it is covered with snow is sufficient to stop the tuning. Therefore, for small changes of channel frequency, press the TUNING button once firmly and then remove the pressure. Do this as often as necessary. However, when the desired channel is far from the starting point, maintain pressure on the TUNING button until the LEDs show the desired channel is near. This saves time by not allowing tuning stops at undesired stations.

Although the programming procedure should be varied slightly according to the starting and finishing conditions, the following method is recommended:

- Press in the MASTER-power button until it latches, then press for a second and release the *television* POWER button (no programming is done at the remote unit). One of the channel numbers now should be illuminated.
- Push firmly for about a half second on the channel button that will be reprogrammed. That channel number should light.
- Open the tuning door and slide the CHANNEL-SET switch to the ON position. If there is a picture, it should not change. The tuning-indicator LEDs should respond.
- If a videocassette recorder (VCR) or video game is to be received, switch on its power and connect the RF output to the receiver antenna terminals. Remember that a video picture *must* be received by the Sony TV during programming.
- If the desired channel is nearby, press the left TUNING button to tune lower channels, or the right TUNING button to tune higher channels. Refer to previous tips. However, if the original and desired channels are far apart, and the desired one is channel two or channel three, press the CHANNEL-CLEAR button and then push the right-hand TUNING button for upward tuning.
- When the desired TV station, VCR or video game picture appears, slide the CHANNEL-SET switch to OFF position. Program other channels in the same way.

circuit board (A) is fastened at the edges in grooves, the entire wiring side is available when the cabinet back is removed (Figure 7B). Many test points, components and wiring lines are identified by printing on the board. This excellent accessibility can have great value during troubleshooting.

Figure 8 shows several circuit boards associated with the remote control and the tuner-control circuits. At the top is the L board for the Lumisponder that varies brightness and contrast according to the level of the ambient lighting. Below it (at right angles to the front panel) is the MM board that accomplishes defeat of wide AFT. The next lower board includes the infrared sensor and the preamplifier circuitry. Parallel to the panel (in a shadow) below the infrared sensor board is the M1 board that contains the programming switches, wiring, and LEDs. The large edge-wise-mounted circuit board with the shielded enclosure is M2, which contains all remaining remote circuitry and the microprocessor and associated ICs of the electronic tuner-control system.

In Figure 9, a small board (S) is attached to the combined VHF-UHF tuner. Above the tuner is a heat sink holding power resistors R902 (at left) and R901 (at right). At their right is the panel for UHF and VHF input connectors. Notice that UHF has the usual two screw-type connectors, but a single 75Ω coaxial connector is supplied for VHF. Therefore, MATV and cable systems can be connected directly without the loss and incomplete-shielding problems of using an external matching transformer. Also supplied is a cabinet-mounted adapter with twin connectors for rabbit-ear antenna (furnished) or downlead from external antenna, a balun for matching and a fitting that slides over the coaxial connector when 75Ω operation is not desired.

The C circuit board contains the picture-tube socket, the three color-output transistors and associated components.

A view of the other rear corner is shown in Figure 10. At the yoke's right is a plastic box containing a potentiometer control that adjusts the horizontal static convergence. On the chassis at the rear corner is the flyback (including the high-voltage rectifiers). Other horizontal-sweep components are at the left; the vertical sweep and horizontal oscillator stages are along the right edge of the circuit board.

If the suspected components can't be reached for testing, the entire board can be moved backward by releasing a plastic latch at each side (Figure 11). Afterwards, the board can be slid from the grooves and moved far enough to allow testing of many components without requiring disconnection of several cable plugs. Of course, the

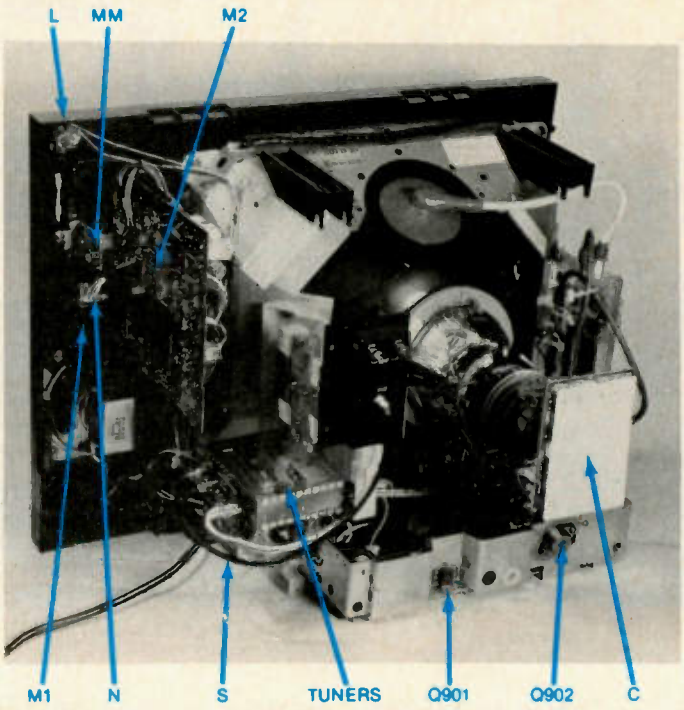



**Figure 7** (A) Major circuit boards and other large components are pointed out by arrows in this rear view of the Sony KV-1543R remote-control color television receiver. (B) The road-mapped bottom of the A chassis is accessible when the cabinet back is removed.

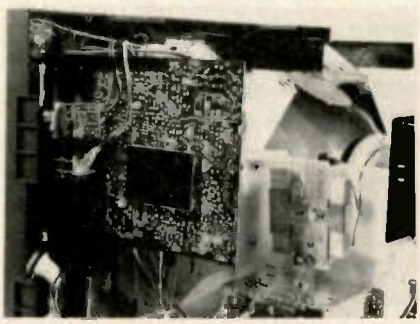


**Figure 8** The M2 circuit board has most of the remote-control wiring and components. Other boards and components are identified in the text.

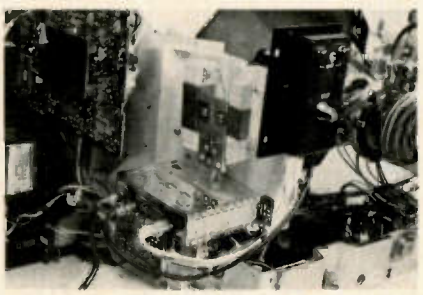
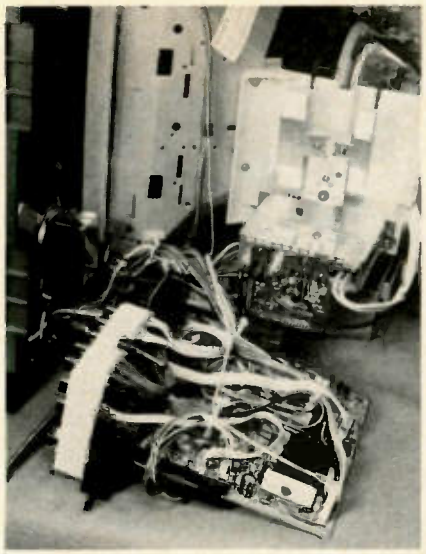
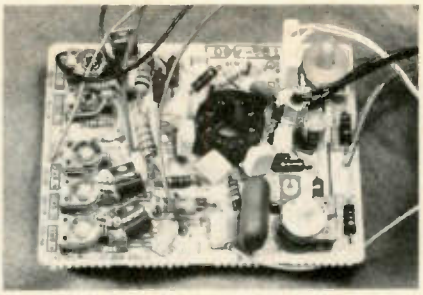


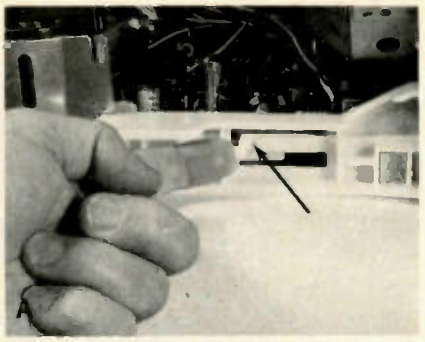
**Figure 9** Both VHF and UHF electronic tuners are in the same shield. Other components are identified in the text.



Removal of only four screws allows the tuner-control cluster of boards to be placed on the bench for testing or servicing, without disconnection of any plugs or cables.



The C circuit board has three color-output power transistors, seven adjustable controls, the picture-tube socket and other components.



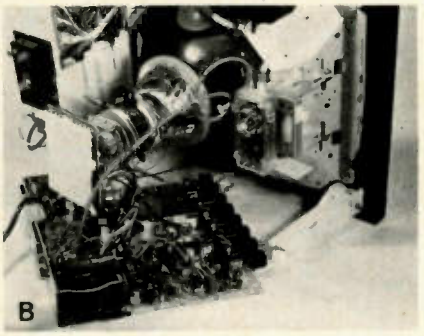


Figure 11 (A) Pulling out on a plastic tab at each side permits the large A circuit board to be slid backward for power-on tests (B).

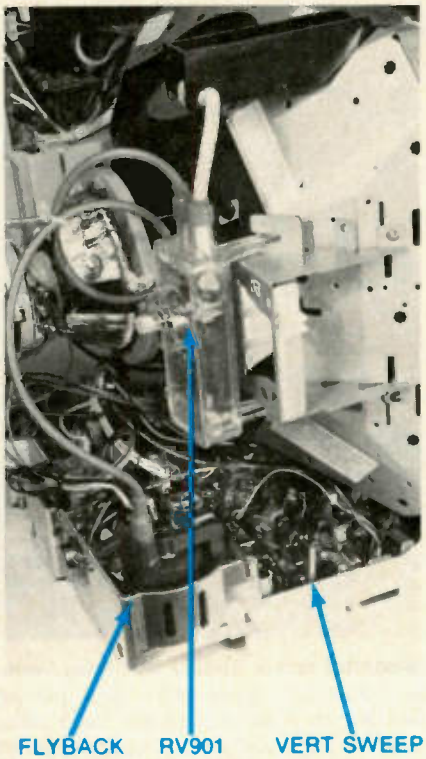
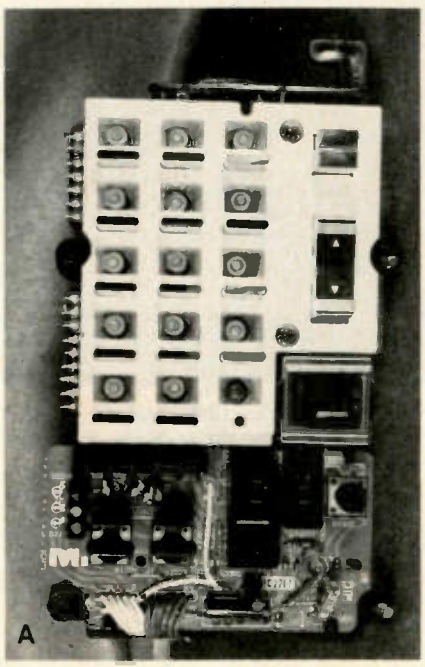
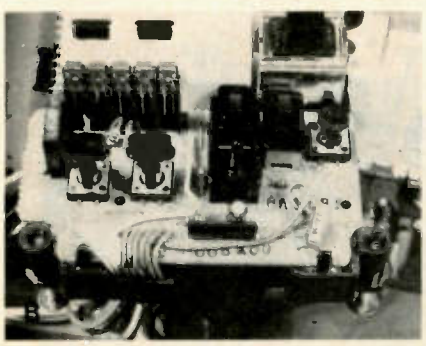



Figure 10 Above the flyback is a plastic box containing the RV901 potentiometer used for adjusting the horizontal static convergence.





(A) The front of the tuner-control cluster. (B) A closeup of the programming controls. The components can be identified by comparing with Figure 5.

entire board can be removed if necessary.

## Power-supply circuits

In the Sony SCC-207B chassis of model KV1543R, only two dc-voltage sources come from rectification of line voltage. Therefore, both are hot supplies that have a common negative terminal insulated from chassis ground (Figure 12). Diode D001 produces about +100V for the relay-driver transistor (Q001) and also +12V of regulated voltage (by R002 and zener D003) for the remote-receiver circuitry. The MASTER power switch controls only this supply, but relay RY001 (that is powered from the D001 supply) turns on and off the acV that feeds the regulated +115V supply for the TV receiver.

Both supplies are described in Figure 12. Notice, however, that all other dcV supplies in the television section are produced by rectification of horizontal-sweep pulses. In this way, the +115V regulated source for the horizontal-ouptut transistor also regulates the sweep-rectified supplies.

The photograph in Figure 13 shows many of the power-supply components.

## Sweep circuits

Integrated circuit IC501 includes the vertical oscillator and pre-driver plus the horizontal oscillator and pre-amplifier (Figure 14). Beyond those points, the sweep circuits are conventional in concepts but not in details. Important signal and dcV test points are shown in the schematic, along with several waveforms.

## Picture tube features

Figure 15 shows unique features of the Trinitron color picture tube. Horizontal-sweep power from a flyback winding lights the CRT heaters. Demodulated color and luminance signals are matrixed

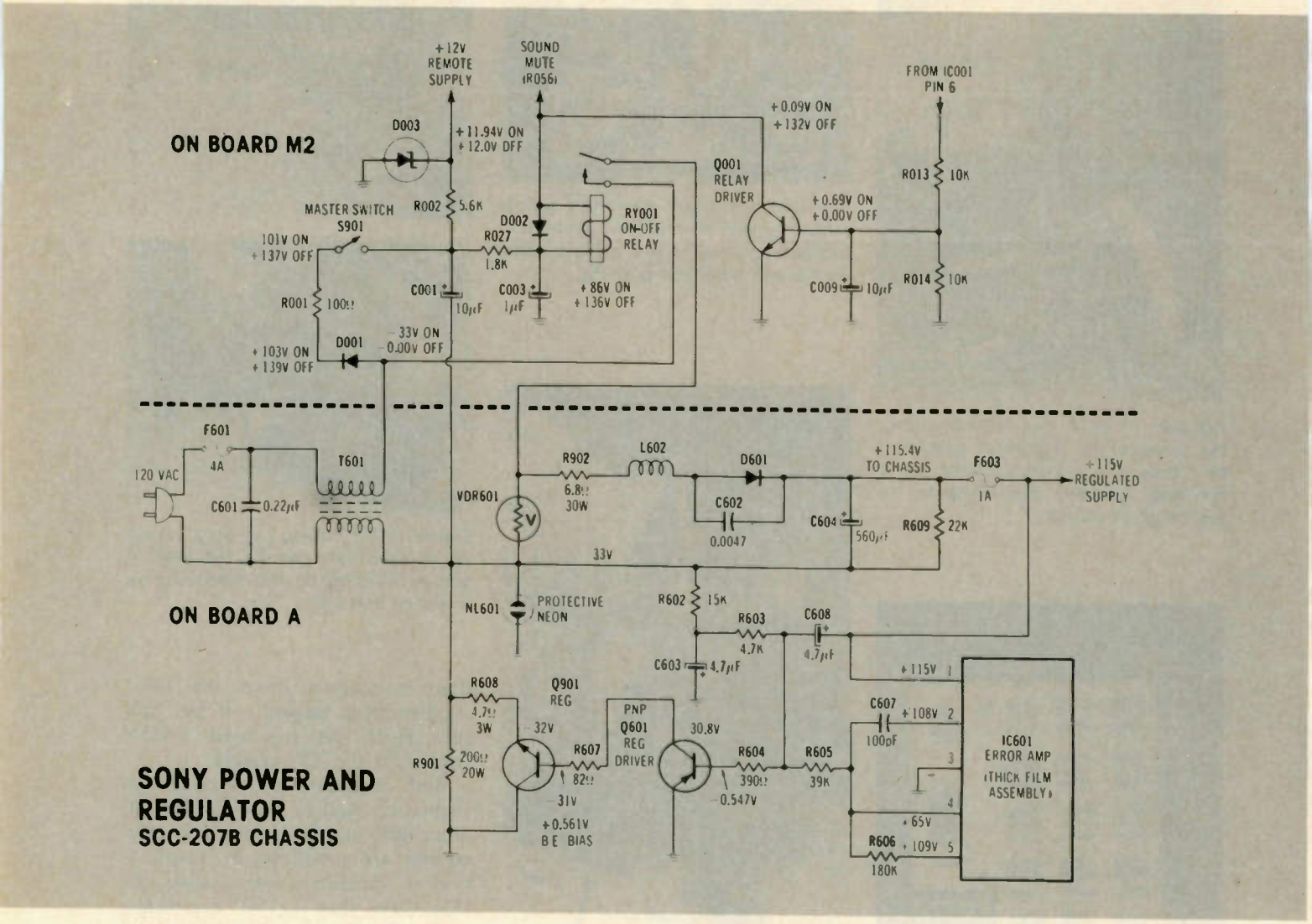
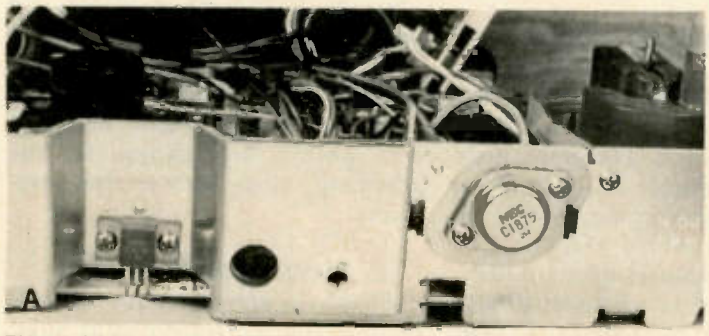



**Figure 12** This schematic shows the remote-control power supply and relay wiring, the TV power rectifier and the +115V regulator that supplies the horizontal-output transistor. Diode D001 has input acV when the power cable is plugged into an ac outlet. Master switch S901 passes the D001 rectified dcV to the D003 zener regulator (for the +12V remote supply) and to the TV on/off power relay and its Q001 driver transistor. When the remote or TV-panel POWER switch is pressed temporarily, RY001 relay is activated, and its contacts allow ac power to reach D601, the TV power-supply rectifier. Between the negative side of the supply (cold wire of the ac line) and the TV chassis ground is R901, a 200Ω20W resistor. Paralleled across this loss resistor is the C/E junction of Q901, a power transistor that is controlled by driver transistor Q601 and the thick-film component IC601. The bias of Q901 is varied by the regulator circuit. This varies the C/E resistance and, in turn, the voltage drop across R901. When the +115V supply voltage decreases for any reason, the Q901 C/E resistance decreases to reduce the R901 loss voltage and thus stabilize the +115V-to-ground voltage.



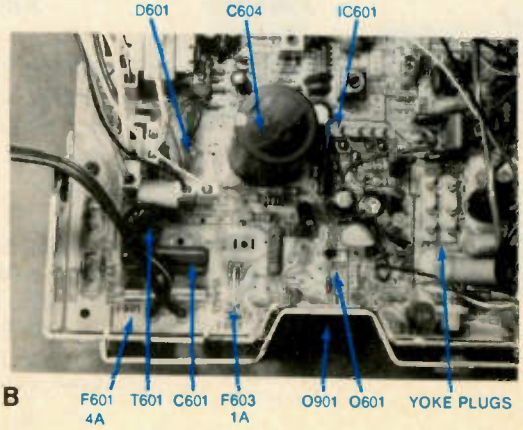
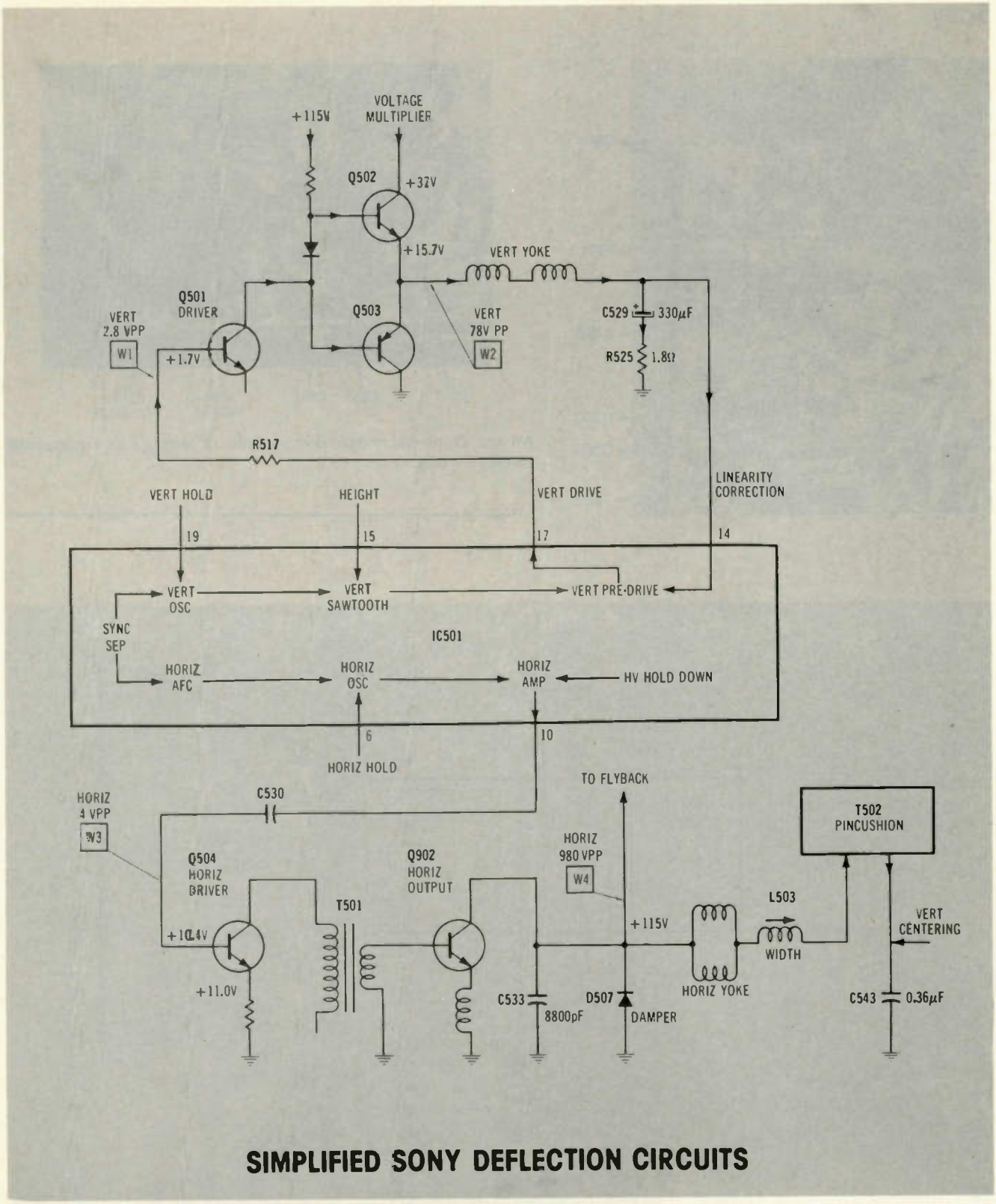
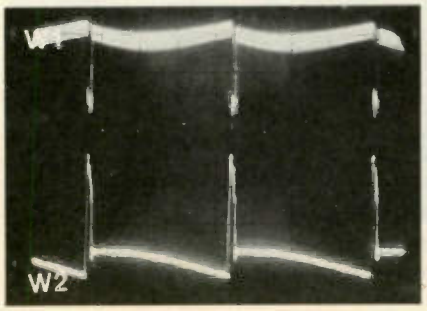




**Figure 13** These photographs show the locations of power-supply components. (A) Regulator transistor Q901 is shown at the left, with horizontal-output transistor Q902 at the right. (B) Arrows point to several power-supply components.




## SIMPLIFIED SONY DEFLECTION CIRCUITS



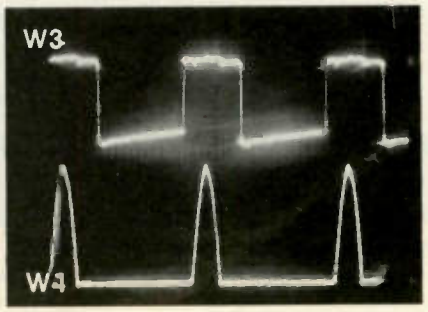
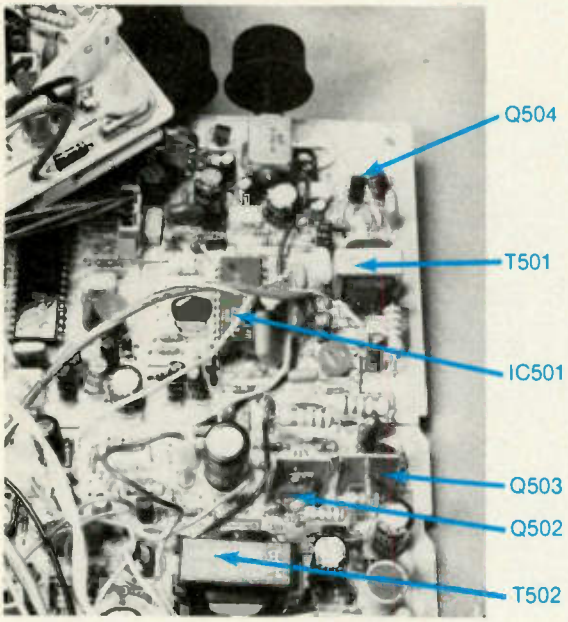
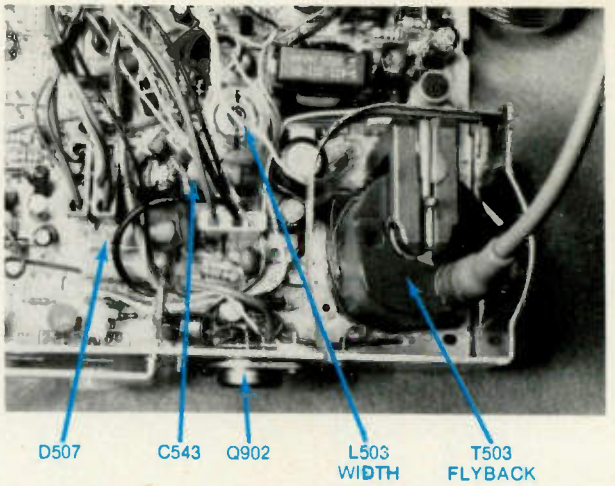




**Figure 14** IC501 incorporates several stages necessary for vertical and horizontal sweep, including both oscillators. Simplified schematics are shown for vertical and horizontal deflection stages, along with two important waveforms for each system.




Arrows point our major components of vertical and horizontal sweep circuits.

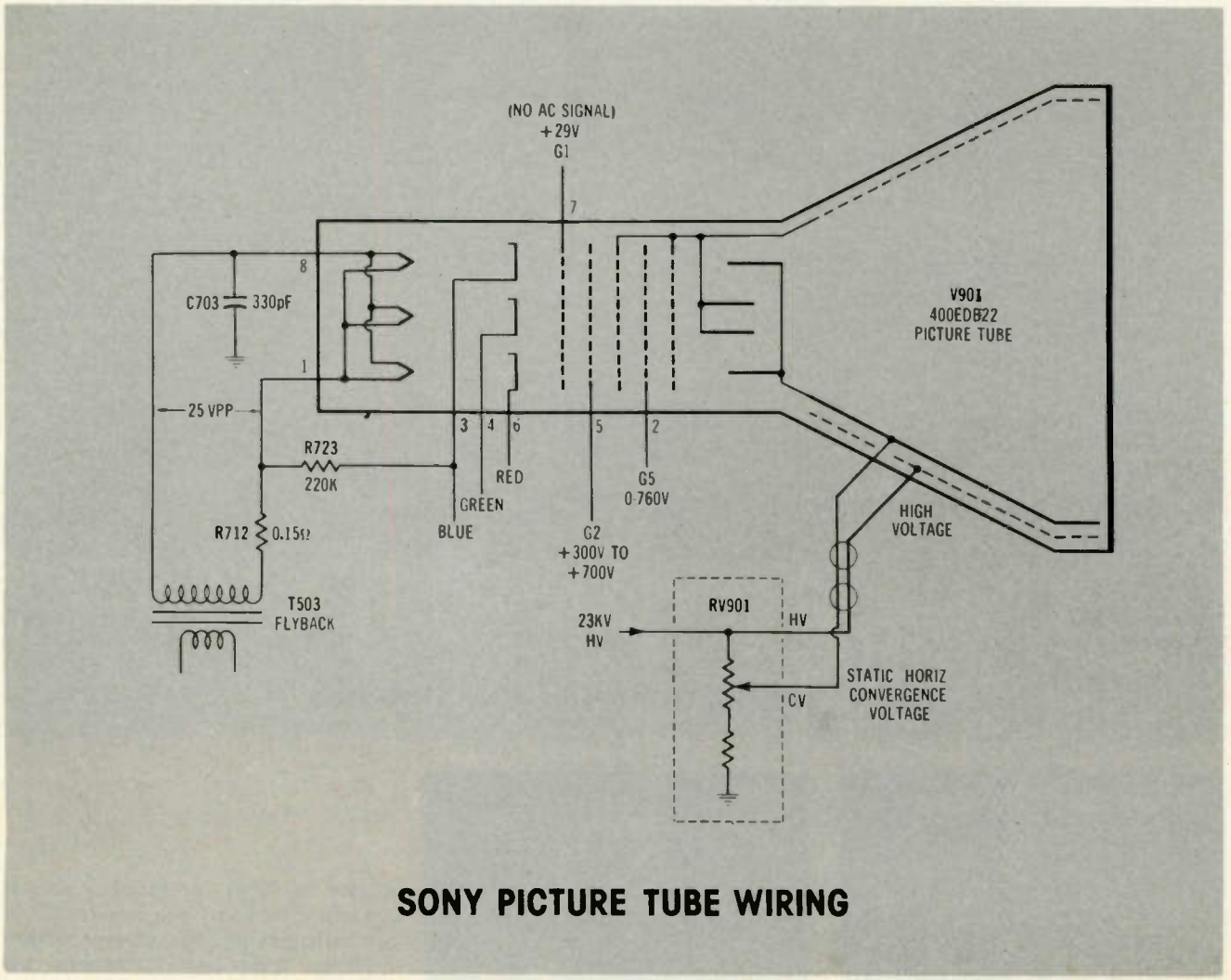



**Figure 15** The 15-inch Trinitron picture tube has electronic lenses and electron prisms that are said to provide edge-to-edge sharp focus. Notice that horizontal-sweep powers the heaters (and the fast-warmup cathodes). An adjustable high voltage is used to move the red and blue beams for horizontal center convergence.

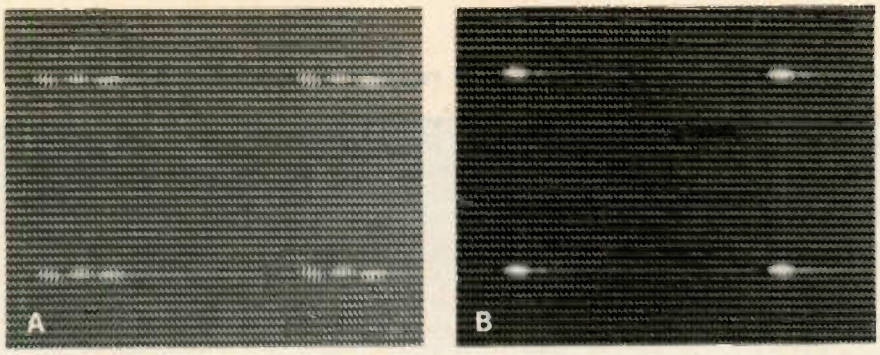



**Figure 16** Closeup photographs show horizontal center-convergence action during adjustment of RV-901. (A) Misadjustment of RV-901 moves red and blue to either side of each green dot, which does not move. (B) Rotation of RV-901 slides red and blue dots onto the green dots, giving good center convergence.

before being applied to the three cathodes. The common control grid has no intentional signal.

Two high voltages are sent to the picture tube through a special two-wire cable that ends in a unique HV connector. It is recommended that Sony part No. 7-700-768-01 be used to remove this HV connector. Damage can occur to the picture tube if the connector is removed without the proper tool and technique. One of these voltages is the usual 23kV high-voltage supply. The other is an adjustable voltage (Figure 15) that determines static convergence in the horizontal plane.

Figure 16 shows a magnified section of the Sony raster during adjustment of the RV901 convergence control on a dot pattern. The green dot does not move, and the red and blue dots move in opposite directions. Perfect adjustment occurs when blue and red dots cover each green dot.

There is no convergence board with dynamic-convergence controls. Instead, the yoke design, the picture tube and the adjustments of rotary magnets around the picture-tube neck provide the equivalent of dynamic convergence. In the sample TV, convergence was very good.

Photographs made from the TV screen (Figure 17) showed good sweep linearity and a sharp picture. □

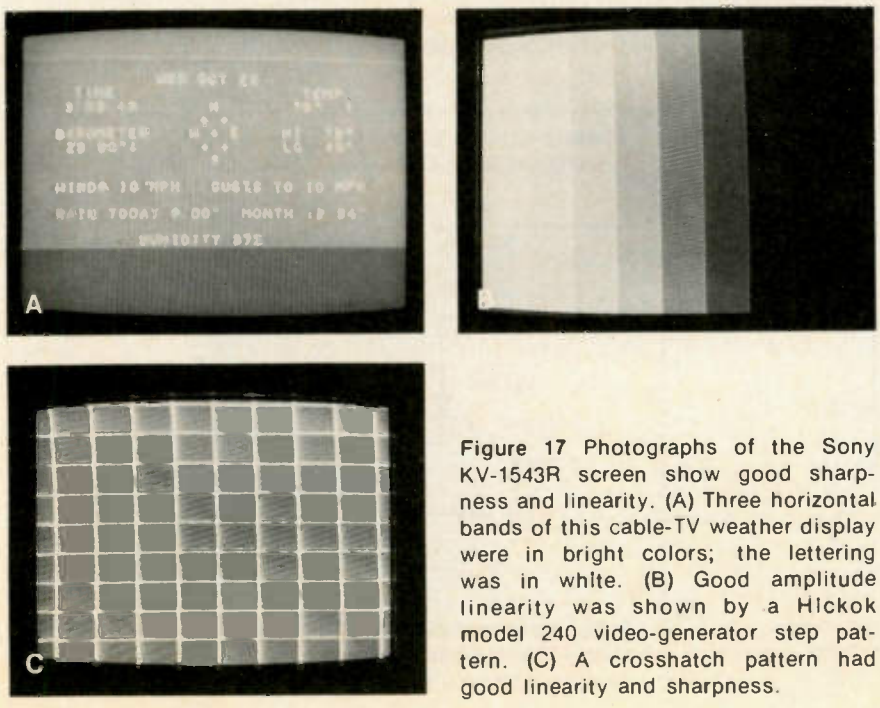
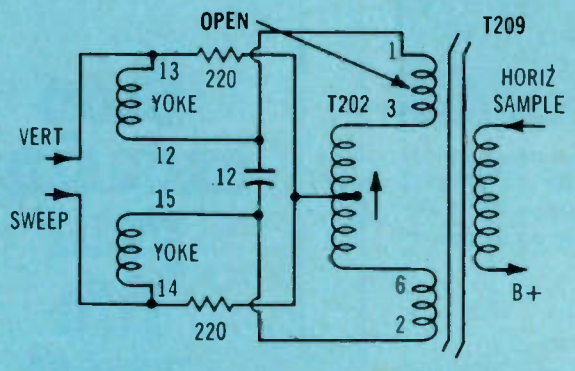



**Figure 17** Photographs of the Sony KV-1543R screen show good sharpness and linearity. (A) Three horizontal bands of this cable-TV weather display were in bright colors; the lettering was in white. (B) Good amplitude linearity was shown by a Hickok model 240 video-generator step pattern. (C) A crosshatch pattern had good linearity and sharpness.

# symcure

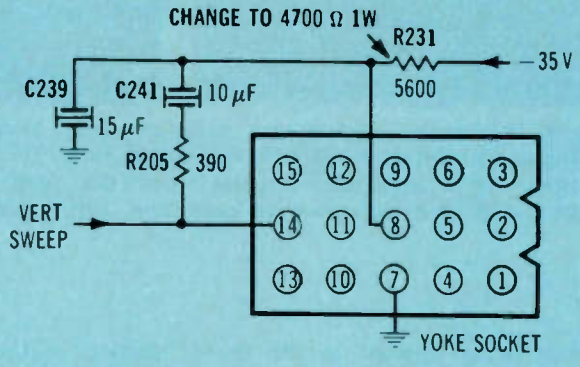
**Symptoms and cures compiled from field reports of recurring troubles**

**Chassis**—Zenith 25CC50
**PHOTOFACT**—1267-3



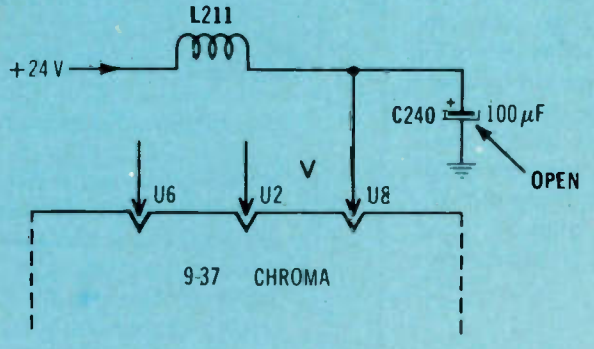

**Symptom**—Height of about 1 inch
**Cure**—Check T209, and replace it if a winding is open

**Chassis**—Zenith 23HC50z
**PHOTOFACT**—1639-2



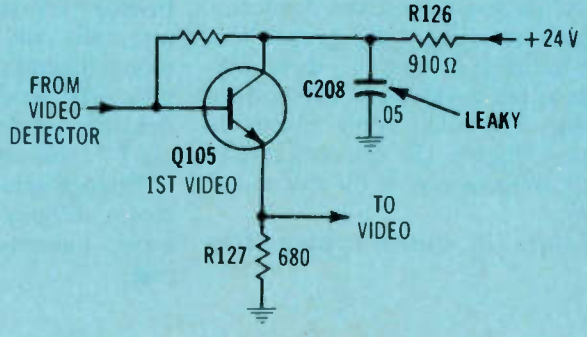

**Symptom**—Drive line during zoom function
**Cure**—Replace R231 with a 4700 Ω 1W resistor

**Chassis**—Zenith 25DC56
**PHOTOFACT**—1312-3



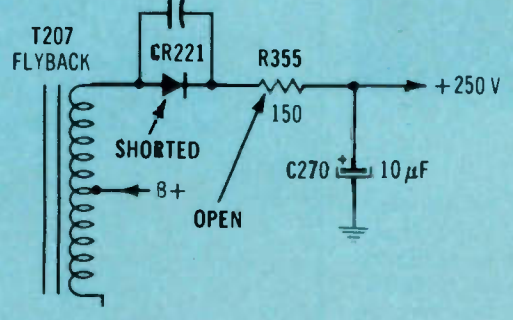

**Symptom**—No color at left edge of screen
**Cure**—Check capacitor C240, and replace it if open

**Chassis**—Zenith 19HC20
**PHOTOFACT**—1277-3



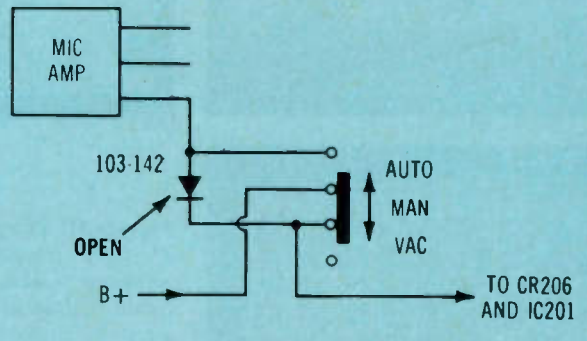

**Symptom**—Insufficient contrast
**Cure**—Check bypass capacitor C208, and replace it if leaky

**Chassis**—Zenith 25DC56
**PHOTOFACT**—1312-3



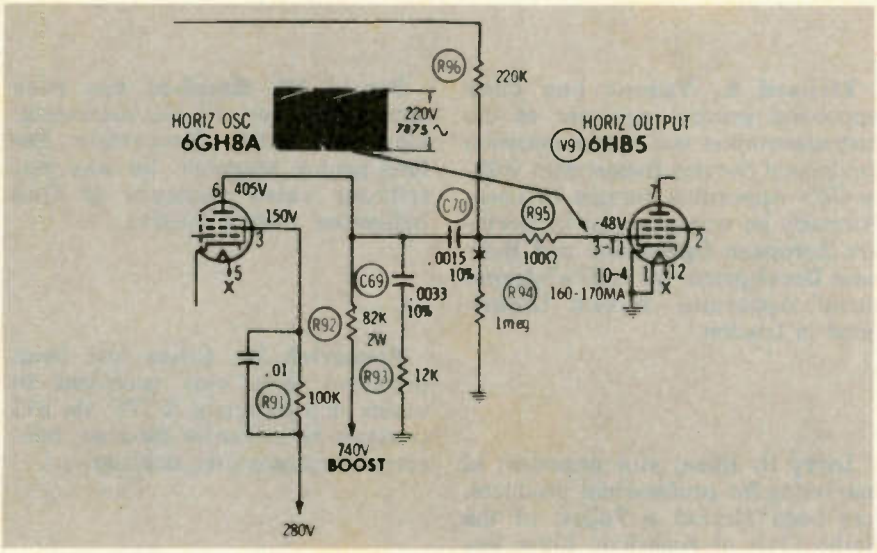

**Symptom**—Excessive brightness without control
**Cure**—Check diode CR221 and resistor R355; replace them if defective

**Chassis**—Zenith SG models with remote
**PHOTOFACT**—1547-2




**Symptom**—No remote operation; manual is normal
**Cure**—Check diode mounted on auto/manual switch; replace it if open

# troubleshootingtips




### Fading contrast
### Zenith 14B36 (Photofact 1145-3)

The 19-inch portable TV had severe picture pulling and a slightly narrow picture when first turned on. However, for several minutes the picture tearing (from AGC overload?) diminished and the width increased. Unfortunately, the picture continued to lose contrast until it was about half the usual amount.

These symptoms appeared to indicate drifting AGC, although the varying width remained a question. I began checking voltages around the 6BA11 sync-separator and AGC tube. The video voltage was weak, and several dc voltages were too low.

After searching, I discovered that the horizontal pulses at the AGC stage were about half the usual amplitude. At the plate of the horizontal oscillator, the sawtooth signal should have slightly more than 200VPP. Instead of the normal -48V at the horizontal-output grid, only about -38V was measured. Because the negative and PP sawtooth levels both were low, I blamed the horizontal oscillator. That was the wrong circuit.

Finally, I heated and cooled all components in the general area while monitoring the B+ boost circuit and the output grid waveform. By this time, the receiver was very warm, and the boost voltage and grid waveform were too low. When the cooling spray reach the defective component, these voltages *should* increase. At least, that was the plan. It didn't work that way.

After more hours than could be charged for, I replaced the 6HB5 horizontal-output tube, and *the drifting* AGC *was cured completely*. The old tube had checked perfect. Instead of the oscillator tube reducing its output signal, the gassy 6HB5 tube was loading down and thus reducing both ac and dc voltages at the grid.

A sample of the output grid's negative voltage is filtered and used to establish the AGC keyer bias. Therefore, any reduction of the grid voltage in turn increased the AGC action, thus reducing the video-detector output level and the contrast. In an effort to maintain contrast, someone had turned the AGC control to maximum. Then, when the receiver was turned on while cold, the AGC action was not sufficient to prevent overload with its picture pulling. Of course, the narrow raster during cold operation should have pointed to the output tube.

In summary, a new horizontal-output tube and an AGC adjustment brought a sharp clear picture having more than enough contrast.

Jim Sunseri, CET
Mobile Electronics
Chicago, IL

**Editor's Note:** This problem has been analyzed before, but it continues to plague many technicians. Suspect any circuit that uses a sample of the negative horizontal-output tube grid voltage, because this voltage is subject to excessive variations.

### No picture and no sound
### RCA CTC62A (Photofact 1345-2)

The CTC62A-chassis RCA was completely dead, without sound, picture or channel-lamp illumination. Usually, these symptoms indicate some overload that has blown fuse F102.

Ohmmeter tests showed rectifier CR101 was shorted, thermistor RT101 was ruined and fuse F102 was open. When these components were replaced, the color TV performance was normal.

However, several precautions were taken according to facts learned in previous similar repairs. Thermistor RT101 becomes very warm in standby operation. It should be dressed away from the chassis and other components. Fuse F102 is a slow-blow type of 1-1/8A, 1-1/4A or 1-1/2A rating. A 1-1/4A value appears to be very satisfactory.

When CR101 does not have a dead short, thus giving a large overload, the 7A fuse and the 3A circuit breaker probably will not function to open the circuit. Therefore, fuse F102 opens to relieve the overload. Check it first.

Joseph Rotello, Jr.
Communication Services
Tucson, AZ

### Buzz in sound
### Panasonic CT-329

The complaint described a low-level buzz coming from the TV-receiver speaker when the power was turned off by the remote control. I noticed that T801 (the remote-receiver power transformer) was mounted very near the T251 audio-output transformer. Of course, the remote power transformer is operated at all times, and the speaker always is connected to its output transformer. One transformer can pickup by induction some signal from another transformer when the windings and core are aligned alike.

To check this possibility, I removed the one screw holding T801 and moved it farther than T251. The hum from the speaker was gone. It was easy to remount T801 a couple of inches from its original location, and the complaint was solved.

Frank Ferrell, CET
Square Sales & Service
Bala-Cynwyd, PA
□

# people in the news

**Richard R. Turner** has been appointed general manager of the Instrumentation and Communication Equipment Service Department within GE's Apparatus Service Division. Formerly he was manager of Northern European Operations and Business Development for ASD's International Apparatus Service Department in London.

**Larry H. Kline**, vice president of marketing for professional products, has been elected a Fellow of the Radio Club of America. Kline has been active in radio communications for more than 35 years.

**Richard W. Lay** has been appointed director of operations for Tronics 2000. He was the editor of Electronic Technician/Dealer magazine for 3½ years.

Also at Tronics 2000, **Larry Menaugh**, a consumer electronics service industry executive with RCA, Sony and Admiral for more than 20 years, has been named vice president/director of franchising.

**Chris R. Kline** has been named director of engineering development for Radio Shack's research and development department. Kline had been the electronics development manager for Tandy Systems.

**Lennox Lee**, manager of market research and analysis, Sprague Electric Company, has received the 1980 EIA Marketing Services Award of Excellence.

**Joann Doherty** has been appointed sales service manager of A. W. Sperry Instruments. She was formerly assistant sales service manager.

**Ronald W. Pitchford** has been named manager of sales/marketing, Magnum Electric Corporation. Before joining Magnum, he was distributor sales manager of Oak Industries' Switch Division.

**Frederick W. Gibbs** has been promoted from vice president to senior vice president of ITT. He will continue as executive director, telecommunications and electronics.

**Charles M. Jones** has been appointed to the new position of vice president-planning and administration for GTE Communications Products. He had been director of planning for the group since 1976.

**Robert O. Wilson** has been appointed vice president of Dranetz Engineering Laboratories.

Wilson had been a product marketing manager.

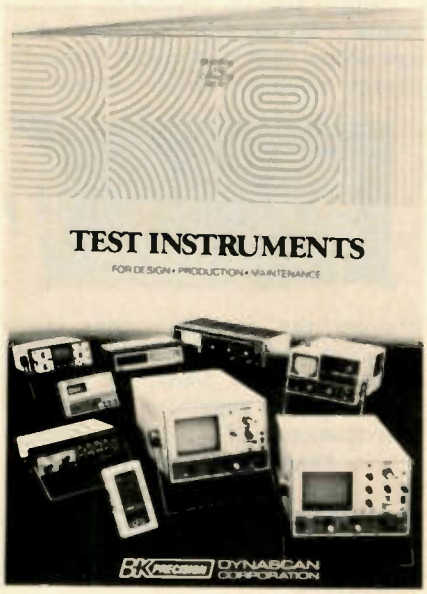
**L. Wayne Oliver**, vice president and director, marketing and business development for ITT Cannon Electric, North America, has been elected president of this division of ITT. Oliver will replace **James H. Anderson** who has been promoted to assistant group general manager.

Also at ITT Canon, **Robert J. Trivison** has been promoted to senior vice president and director of operations. He had been vice president.

TRW Semiconductors has appointed **Chuck Thompson** divisional marketing manager for long-range planning. Thompson was manager of power operations for TRW Semiconductors. He was succeeded by **Majid Basy**, former diode products manager. □

# catalogs literature

The 44-page BK-81 general line test instrument catalog is now available from **B&K-Precision**. The catalog features more than 50 test instruments including oscilloscopes, frequency counters, digital and analog multimeters, function and RF signal generators, capacitance meters, digital and pulser probes,




semiconductor testers, power supplies and two-way radio and television test instruments. Each product description includes a specification section and suggested applications. Also included is a complete line of instrument probes, connecting cables, carrying cases and other accessories.

Circle (20) on Reply Card

The 1980-81 Portable Meters and Probes catalog from **Extech** offers descriptions, photographs and specifications of their line of equipment. Price lists and ordering information are also included.

Circle (21) on Reply Card

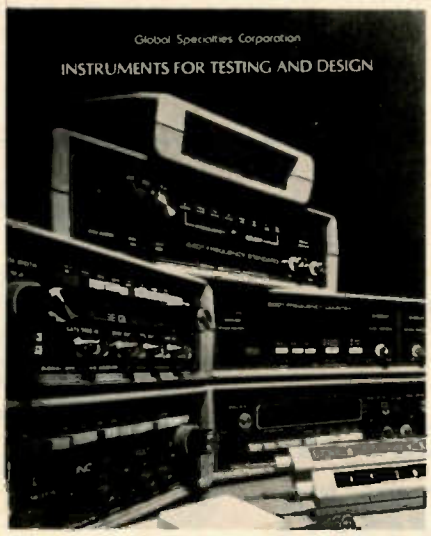
Catalog supplement #FSG from **Industrial Devices** covers new panel-mounted LED assemblies, leaded LEDs, bare LEDs and LED lenses. Also included are omni-glow neon flasher indicator and a "relampable" mini-slide indicator assembly for incandescent lamps. The four-page supplement features photographs, dimension drawings, mounting information, specifications and ratings for all the indicator lights shown.

Circle (22) on Reply Card

**Panasonic Video Systems** has published *A New Eye on Your Business...Closed Circuit Television Systems*, a 16-page brochure that describes the basic Panasonic CCTV system, CCTV components, CCTV camera and camera lenses, camera mounts, multiple camera monitoring systems, CCTV monitors and time-lapse video recorders.

Circle (23) on Reply Card

**Global Specialties** has announced the availability of their Fall 1980 catalog. The catalog features bench-top instrumentation, frequency




counters, logic probes and solderless breadboards. Product descriptions and instrument specifications are included.

Circle (24) on Reply Card

A 24-page **Catalog of Chemicals** describes more than 50 spray chemicals and accessories available from **Tech Spray**. Chemical specifications and military specifications are listed.

Circle (25) on Reply Card

A six-page brochure from **Kikusui** describes its line of Kik-scopes. The brochure contains complete specifications on 10 scopes, ranging from 10MHz to 50MHz, including single and dual trace, standard and storage models and x-y monitors.

Circle (26) on Reply Card

**TRW Power Semiconductors** has published Catalog 100E, a 20-page short-form catalog. The booklet con-


tains basic specifications for 465 power devices including switching transistors, Darlington transistors, switching diodes, Schottky rectifiers, Zener diodes, and Varicap varactor diodes.

Circle (27) on Reply Card

**Radio Shack's** 176-page 1981 catalog features computers, stereo components, electronic toys and games, and parts and accessories for home entertainment.

The catalog includes the TRS-80 microcomputers, Realistic stereo components, CB equipment, radios, tape recorders, 13 new electronic calculators, six digital clocks, 17 electronic games, Archer antennas, Micronta test instruments and ArcherKit and Science Fair hobby kits.

Circle (28) on Reply Card

**The Antenna Specialists'** catalog No. SD-621 describes more than 250 land mobile antennas from low band to 800MHz. Technical specifications and radiation patterns are included.

Circle (29) on Reply Card

□

# test equipment report

**Programmable DMM**

The model 192 programmable DMM is **Keithley Instruments'** first systems/smart bench DMM. It offers 0.005% accuracy, 1V sensitivity,

6½-digit resolution, front-panel math functions and data storage capability. Additional features include fast autorange and one-button zero.

The 192 is priced at $995.

Circle (30) on Reply Card

**Oscilloscope/component tester**

The **Hameg** HM307 is a single trace scope with a built-in component tester that tests common semiconductors and passive components in circuit. The HM307 changes from a scope to a component tester with a push of a button while the scope settings are left undisturbed. Accessories for the HM307 include X1 probes, X10 probes, X100 probes, demodulator probes, test cables, viewing hood, carrying case, and a scope cart. The unit features a one year warranty and includes operating and service manuals.

Circle (31) on Reply Card

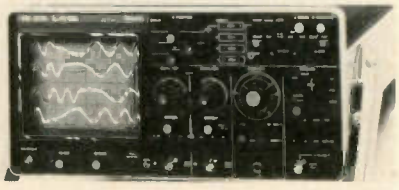
**Temperature measurement probe**

**Weston Instruments** has introduced a temperature probe to expand applications of its Roadrunner 3½-digit LCD audio response DMM. The measurement probe can be used with analog VOMs and DMMs. Weston's accessory unit includes a switch that enables users to go back and forth between Celsius and Fahrenheit. Typical uses of the probe include hot-spot troubleshooting of circuits, determining heat rise of transformers and motors, calibration of thermostats, PC board testing and checking true-RMS instruments.

Circle (32) on Reply Card

**Digital storage scope**

**Philips Test & Measuring Instruments'** PM3310 50MHz digital storage scope uses a profiled peristalic charge coupled device which in-



creases the sampling rate while reducing cost. The PM3310 has a clocking rate of 50MHz, a 60MHz bandwidth for repetitive signals and four memories.

Circle (33) on Reply Card

# product report

### Technicians service kit

**Caig Laboratories'** service kit No. C-405 contains products designed to clean, lubricate and preserve all electric contacts and connections. The contents of each kit is: Cramlin


spray R, Caeon spray No. 27, Cramolin red fluid, Cramolin special blue fluid, Cramolin paste, a lint-free cloth, lint-free paper, foam swabs, instructions and technical fact sheet for applications. Addition-items are available.

Circle (34) on Reply Card

### Feed-thru capacitor

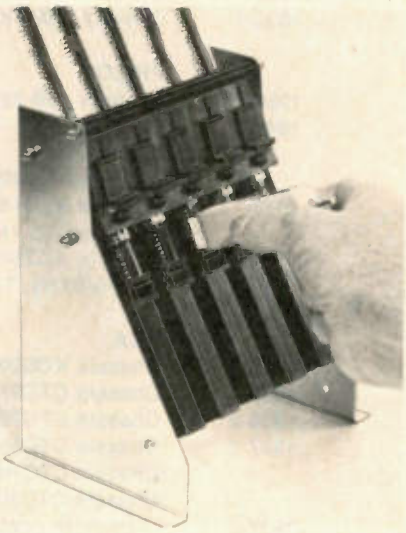
**RMC-Radio Materials Corp.** is marketing a feed-through capacitor that is a combination of a feed-through insulator and by-pass capacitor in one component. The capacitance is 1000GMV and the

voltage rating is working 500Vdc and test 1300Vdc. Each capacitor is .250" OD at its widest dimension, tapering to .177 OD at the narrowest diameter. The overall length is .390". Each capacitor is copper plated and flux coated.

Circle (35) on Reply Card

### IC dispensers

**O.K. Machine and Tool** has introduced its MDD series of DIP IC dispensers for MOS and CMOS and for standard devices. Each channel accepts any standard IC shipping tube and can accommodate any standard IC from 2 to 64 pins on



.300, .400 or .600 centers. The dispensers feature adjustable guides and gravity feed.

The MDD-1 (1 channel) is priced at $21.95. The MDD-5 is $83.43 and the MDD-10 is $160.45.

Circle (36) on Reply Card

### Can opener

**B&G Enterprises** has introduced the MC-1 multiple can opener that is designed to open semiconductor can packages without damaging components inside. The MC-1 can remove any size can from TO-3 to TO-46.

The unit features a chrome-plated driver body, bronze bearing stand and hardened tool-steel cutting blade and replacement wheels. A larger model (MC-5) is also available.

Circle (37) on Reply Card

### Solder tool holder

Designed for the Loner soldering instruments (models 940 and 950), the **EDSYN** IRO89 and IRO88 idle-rest tool holders are intended for te traveling service technician. The

units fold compactly for tool box storage and allow a hot Loner soldering instrument to be inserted and locked into place. The holders feature a built-in safety lock and integral thermal insulation.

Circle (38) on Reply Card

### Mini substitute tuner

**The Tuner Service Corporation** has developed a miniature 300 VHF testing replacement tuner. The Mini-Substi-Tuner comes with 1F


connector cable, plug and is powered with two 9V batteries. It features 12 VHF channels, an on/off switch, AGC control and LED indicator.

Circle (39) on Reply Card

# photofactbulletin™

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19B041H-70C ..... 1939-1

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**GOLD STAR**
Chassis NT6X ..... 1942-1

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# reader's exchange

There is no charge for a listing in *Readers Exchange* for items "Needed," but we reserve the right to select and edit all copy. Due to the limited amount of space for this department, "Needed" listings must contain no more than *three* items. If you can help with a request write directly to the reader, not to **Electronic Servicing**. "For Sale" listings will be charged for and included in the regular classified section of **Electronic Servicing**. Please consult that section for price and ordering instructions.

---

**Needed:** Emerson model 757 series D high voltage flyback transformer. Original No. 738067 or replacement (Stancor #A8130; Merit #HVO-7; Chicago #TFB-5; Triad P-14 and Thordarson Fly-13) *Raymond A. Nielsen Jr., 8039 E. 4th Ave., Mesa, AZ 85208.*

**Needed:** Operating manuals and schematics for Hewlett Packard model 520 high speed decode sealer, Hewlett-Packard model 500 BR frequency meter, and Sweep-Systems model 950 scope. Will buy or copy and return. *Stan Boler, 116 S. Washington, Knightstown, IN 46148.*

**Needed:** Power transformer for Harman-Kordan model SR300B stereo receiver, part No. 10121417; and current tube data for Hickok model 600A tube tester. *Charles R. Well, 2085 Barcelona Dr., Florissant, MO 63033.*

**Needed:** One good used 16CWP4A or equivalent picture tube. Please quote price including shipping. *Dan Miller, Old Town Audio, 621 Madison Ave., Covington, KY 41011.*

**Needed:** Lectrotech scopes models TO-50 or TO-60 *Kenneth Miller, 10027 Calvin St., Pittsburgh, PA 15235.*

**Needed:** Schematics for B&K-Precision digital multimeter and Roberts DS-6011 8-track car stereo. *Clifford Hayes, P.O. Box 104, Alplaus, NY 12008.*

**Needed:** Schematic for a B&K-Precision Series E-400 sweep generator. *Walter J. Fess, 1620 W. 33rd Ave., Denver, CO 80211.*

**Needed:** Capstan for Ampex model 1200 series tape recorder, part No. 04-0316. *Robert Nash, 33 Woodbine Ave., Stony Brook, NY 11790.*

**Needed:** Power transformer for a Philco 19-inch portable TV, model C 1900FBE, chassis 5CS51, transformer part No. 3210216-3; and VHF tuner shaft, or complete VHF tuner for a midland 19-inch portable TV model 15-229. Tuner No. TNV-245. *Harvey Rousseau, 6 Longview Dr., Milford, MA 01757.*

**Needed:** Service information for Audio Kaleidoscope model 3A, manufactured by Acousticolor, Inc. *Frank Dickinson, Stony Point TV, 33 N. Liberty Dr., Stony Point, NY 10980.*

**Needed:** Service information on Jackson scope model CRO-2. *George D. Bottrell, 1014 Peters Rd., Trey, OH 45373.* □

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

## Help wanted

**ELECTRONIC TECHNICIAN**

If you'd like to switch from soldering iron to typewriter and have a good command of the English Language, tell us all about yourself, including past education and experience.

Location, Western Mass., with nationally-known manufacturer. Position involves preparation of data sheets, engineering bulletins, technical manuals, etc.

**Electronic Servicing**
Dept. 524
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Overland Park, Kansas 66212

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**TECHNICIANS WANTED:** Television-Audio-Communications, excellent fringe benefits, salary depends on experience. Miller's Electronics, Highway 24, Rt. 1, Box 120, Goodland, Kansas 67735, 913-899-2386 12-80-2t

**EXPERIENCED TUNER TECHNICIAN** needed in the Fort Worth/Dallas area. $5.00 per tuner to start. Minimum of 3 years experience required. (817) 834-8201. 11-80-2t

**TELEVISION TECHNICIANS**—Experience necessary, top pay, medical benefits, paid vacations. Enjoy a new "Life Style" in a beautiful, friendly, smog free, full service desert community. Send your resume to 225 E. Ridgecrest Blvd., Ridgecrest, California 93555. Telephone 714-375-1361 ask for Service Manager. 3-80-tfn


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## For Sale

**SYLVANIA CK 3000 TV TEST JIG** with many extra adapters, B&K 1077B Analyst, plus other equipment, all in mint condition. David N. Willis, 801-W. Humphrey, Rock Falls, Ill. 61071 12-80-1t

**OEM DELCO and PHILCO AUTO RADIOS.** Complete stock last 20 years. Also Delco, Philco, Motorola, Bendix parts. Write for prices and availability. ARC, P.O. Box 8160, New Orleans, LA 70182, or call 504-282-3882 12-80-1t

**PRINTED CIRCUIT** boards from your sketch or artwork. Affordable prices. Also fun kit projects. Free details DANOCINTHS INC. Dept. ES, Box 261, Westland, MI 48185. 5-80-8t

**GOLDCOAST COMPUTER RENTAL CLUB,** has thousands of programs, free. Also TV management programs for the Apple family and the TRS 80 Model [], for free deetails send (SAE) to: Box 181 Bremen, KY 42325 12-80-3t

**AUTOMOBILE RADIO** and tape replacement parts: Delco, Chrysler, Philco-Ford, Motorla, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469, (212) 881-9600, out of New York State, (808) 223-8314. 5-79-tf

**TV & RADIO TUBES,** 36 cents EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92104. 8-76-tf

**ELECTRONIC SURPLUS: CLOSEOUTS, LIQUIDATIONS!** Parts, equipment stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-011, Box 762, Plattsburgh, N.Y. 12901. 6-78-tf

**TV PIX TUBES—2 YR. WARRANTY.** 25XP22 color at $45.00. Free price list on request. CRT Sales. 1314 Hamilton Ave. Telephone 1-216-431-4608 Cleveland, Ohio 44114. 12-80-1t

**FOR SALE: TV TROUBLE ANALYSIS TIPS.** Over 300 symptoms/remedies by circuit area. Tough ones I found in years of servicing. e.g. Poor sync—C66 shorted—Wards—GEN12349A—SAMS 995-2. Save time and money. Send check for $12.50 to CHAN TV, 8151 Grandview Rd., Chanhassen, Mn. 55317. 12-80-1t

**FOR SALE: SAM'S PHOTOFACTS**—1 thru 560 in hard binders (a few missing). $500 plus shipping takes all. CHAN TV, 8151 Grandview Rd., Chanhassen, Minnesota 55317

**TUBES** approximately 1,700 from 30's until present. No list, best offer over $700.00 plus shipping. R. Nelson, 1801 Nelson Road, Westminster, Md. 21157 12-80-1t

**TELEPHONE CALLS** recorded automatically, unattended, build yourself for less than $10.00. Detailed plan $2.50. Garrett Electronic, 6451-A Imperial Ave., San Diego, California 92114 8-80-6t

**19" COLOR TV's,** used commercial models, RCA XL-100 and others. 10 lot minimum. Kamcor, 88 So. Washington Ave., Bergenfield, N.J. 07621. 10-80-3t

**SCRAMBLED TELEVISION,** encoding/decoding. New book. Theory/circuits, $9.95 plus $1 shipping. Workshop, Box 393ES, Dept. E, Bethpage, N.Y. 11714. 7-80-tf

**B&K 415 GENERATOR** $300.00 Sencore TC-162 $100.00, other items—S.A.S.E. excellent condition. Plus postage. Miller, 10027 Calvin Street, Pittsburgh, Pa. 15235 12-80-1t

**ZENITH TV PARTS** and modules. 146 pieces, call or write for list. Ken Post, Rte. 2, Zumbrota, Minn. 55992, (507) 732-7216 after 6:00. 11-80-2t

## Business Opportunity

**RETIREMENT FORCES SALE OF HIGHLY SUCCESSFUL SERVICE BUSINESS:** Rare business opportunity in TV service business. Am retiring, have reluctantly decided to sell my established 24 year old company. Strip mall location in center of fast-growing, high rent Miami suburb. Approx. $250,000 projected gross for 1980. Three reliable technicians; late model panel truck, many scopes, meters, soldering stations; tools, ect and complete bookkeeping equipment. Almost $60,000 in inventory alone. Top independent shop in South Florida. Excellent income, neighborhood, weather. For oetails call A. C. Williams, owner, at 305-235-1772. 12-80-1t

**TV TECHNICIAN!** Increase your income up to $60,000 yearly. Rent-lease-sell TVs new-used, even from comfort of your home. Basic Preliminaries $4.00. Perrys TV Systems, Hwy. 181, Box 142, R1, Bremen, KY 42325 12-80-tf

**ESTABLISHED TV REPAIR SHOP** for sale, good reputation. Plenty of business. P.O. Box 16268, Jacksonville, FL 32216. 11-80-5t

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# UNIVOLT'S DT-810 DIGITAL MULTIMETER

***The unique space age digital multimeter with transistor gain (hFE) measurement capability should be the only multimeter you own.***

Ora Electronics has offered in the past many fine Digital Multimeters (D.M.M.'S). We still sell the famous D.M.M.'S such as Beckman, Fluke, Hickok, and others. We have always followed the advance in technology used in D.M.M.'S, and we always wanted to supply our many good customers with the most Ideal Multimeter, at a price they can afford. In the past we had to sell good, but expensive Multimeters, expensive but "fair" Multimeters, and plain "cheap" Multimeters.

## WE FOUND IT!

Several months ago, a famous Test Equipment Manufacturer, walked in to our headquarters with a Prototype of a Digital Multimeter. We were very impressed it had almost everything we wanted plus a bonus, the only question remaining was "how expensive is it?" When we heard the answer, a big smile appeared on our faces. After several improvements we are proud to offer it. After you read the features (and price) I am sure you are going to order one or more, of these fine D.M.M.'S that we call the "UniVolt".

## LCD DISPLAY.

The unit has a 3.5 Digit liquid crystal display. The sharp digits are 14mm high and have a viewing angle of 140°.

## HIGH ACCURACY.

The basic D.C. accuracy of the UniVolt is 0.5% of reading +1 digit, which makes it one of the more accurate instruments in its class. The input impedance is very high, 10 mega- Ohms (10,000,000) Ohms, which helps in measurements of low voltage and high frequency signals.

## MEASUREMENT RANGES.

The UniVolt has D.C. voltage range of 100uv to 1000V in five steps, A.C. voltage range of 100mV to 1000V, current measurement range of 100mA to 10A (DC) and resistance range of 1 to 2,000,000 Ohms.

## CONTINUITY & DIODE TEST.

A fast and accurate continuity test mode utilizes a built-in buzzer to indicate continuity. The same mode is used to check diodes and their approximate forward voltage.

## EASE OF OPERATION.

The UniVolt is small, it measures 6½" x 3⅜" x 1¼". It's light weight, only 9.87 oz. including battery! It utilizes push buttons, for easy one-hand operation and the front panel has a unique color coding for reduced errors.


## OVERLOAD PROTECTION

The unit has an extensive overload protection on all ranges. On D.C. current ranges it uses a .5A GMA type fuse. A spare fuse is supplied with the unit at no extra cost.

## MAINTENANCE FREE

The heart of the UniVolt Multimeter is a 40 pin L.S.I. chip; the Intersil ICL710G. This space ages chip has proven to be one of the most sophisticated and reliable micro-electronic circuit in use, it is supported by minimum amount of external parts, which are over specified to insure failure safe instrument. Of course, Ora Electronics stands by this instrument and guarantees it for one year (See specific warranty information).

## OTHER FEATURES

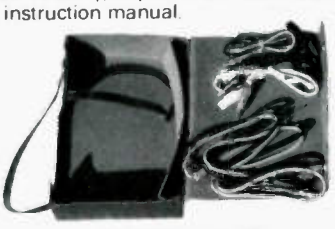
It uses one 9 volt carbon battery (included), which last approximately 200 hours of continuous use. Its sampling time is 0.4 seconds, operating temperatures of 30°F to 104°F, and operating humidity of less than 80% R.H.

## BONUS!!

We left the best to the end. The UniVolt DT-810 has something unique. It has a **transistor gain (hFE) measurement mode!** This unique feature enables you to measure hFE values of 0-1000 of either P.N.P. or N.P.N. transitors.

## SPECIAL PRICE

We had originally decided to sell the unit for $119.95, but in order to promote the new advancement in D.M.M. design, represented by the UniVolt, for a limited time only you can buy this incredible unit for only $99.95 including: standard red & black test leads, a fresh 9v carbon battery, a spare 0.5A GMA type fuse and an instruction manual.



## FREE CASE

We have worked long on the UniVolt project and we hate to see scratches or bad looking units. So we decided to go all the way, when you buy the UniVolt DT-810 Multimeter (and for a limited time only!) we will give you absolutely free a hard vinyl leatherette, carrying case, with felt padding and a compartment for your test leads. The regular selling price for this case mode CC-01 is $8.00.

## ACCESSORIES AVAILABLE.

The only two accessories available are: UP-11, hFE probe with special plug and 3 color codes alligator clip, and the UP-12 I.C. clip adaptor, which will help you hook your multimeter to any I.C. pins. (You can buy both probes for only $6.00, but only when you purchase the UniVolt DT-810 now.)

## ORDER NOW!

It's very easy to order your UniVolt DT-810 multimeter. Send $99.95 (California residents add 6% sales tax) plus $2.50 delivery charge to the address below, if you want the optional accessories, please add $6.00 (California residents add 6% sales tax). A cashier check or money order will help speed your order. Credit card holders (master card or visa) can call our toll free number **(800) 423-5336**, in California it's **(800) 382-3663**. C.O.D. orders will be accepted, but you must pay by cash or money order and a C.O.D. charge of $1.40 will be added. If you decided to buy another brand of Multimeter, please call us too, we carry many other types of multimeters and test equipment at low prices.

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# DON'T DILUTE.

When you service a Zenith in or out of warranty and require a replacement module, tuner, channel selector or sub-assembly, it simply makes good sense to insist on a Zenith repaired and reconditioned part.

Then you can be certain of a replacement from people as knowledgeable as those who made the original—a replacement not only repaired, but one reconditioned and serviced for reliability by Zenith with no dilution of the original quality.

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Ask your distributor, too, for Zenith's latest pocket-size module cross-reference and suggested retail pricing guide.

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