ELECTRONIC™

Servicing & Technology

FEBRUARY 1984/$2.25

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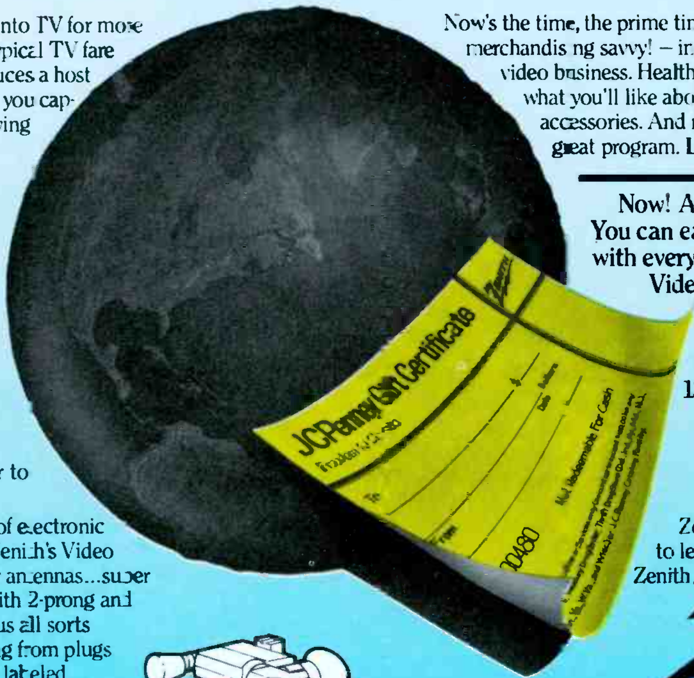
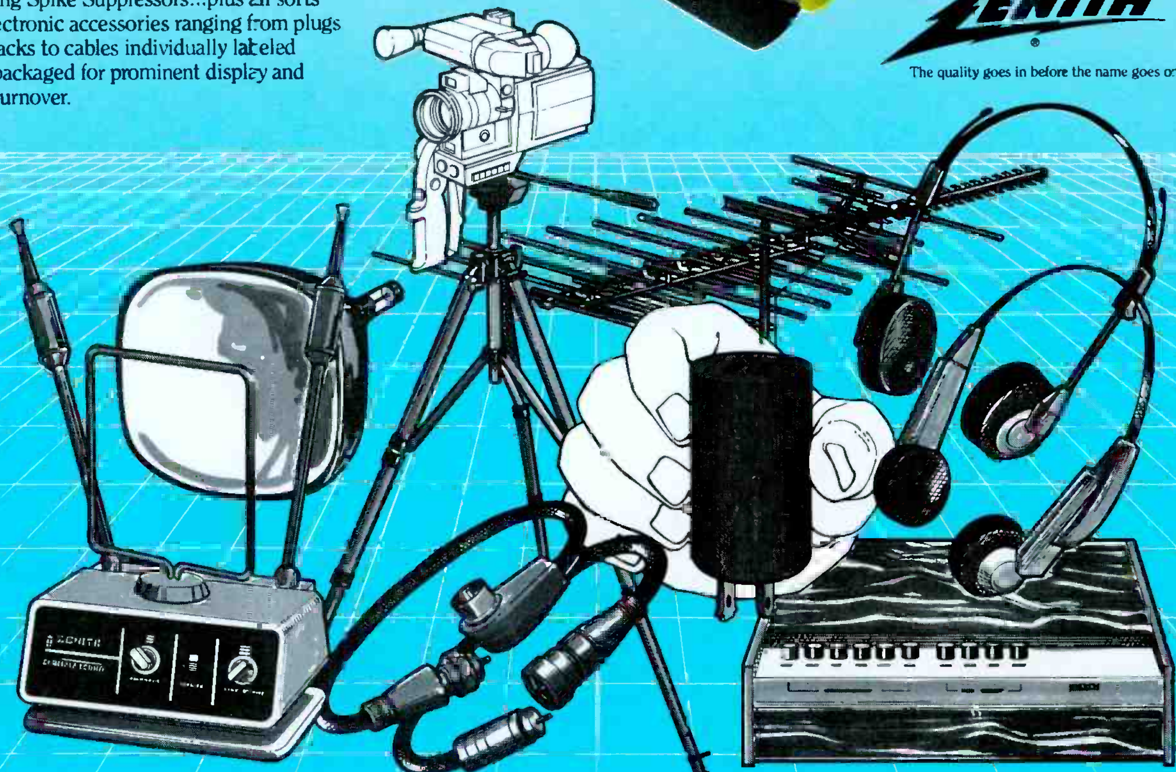
VCR basics

Chemicals in electronics





Circle (1) on Reply Card

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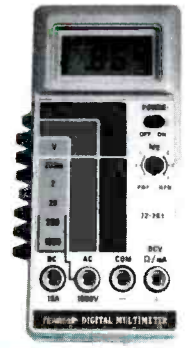

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■ 0.5" LCD display ■ DC input impedance 10M Ω ■ DC 100μV, 100mA, 0.1 ohm resolution ■ DCA up to 10A ■ Auto polarity ■ Diode & hFE transistor tests ■ Low battery indicator ■ Overload protection

SPECIFICATIONS

■ **Ranges:** DCV—200mV, 2, 20, 200, 1000V; ACV—200, 1000V; DC Current—200μ, 2m, 20m, 200m, 10A; Resistance—2K, 20K, 200K, 2M ohm ■ **Accuracy:** DCV—±0.5% (200mV), ±0.8% (2V up) of full scale; ACV & DC Current—±1.2% of full scale ■ **Resistance:** ±1% ■ **Size:** 7" x 3¼" x 1½" ■ **Weight:** 16 oz. ■ Backed by MCM 1 year warranty ■ **Power Requirements:** One nine volt battery (not supplied)

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SPECIFICATIONS

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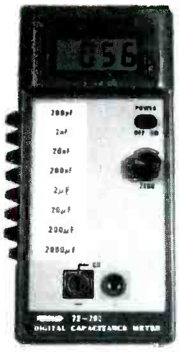
TENMA 6.5 MHz OSCILLOSCOPE

$169.95

#72-300

SPECIFICATIONS: Vertical Deflection: Sensitivity–10mV Div, **Attenuator**–1 1, 1 10, 1 100, and GND, **Bandwidth (-3dB)**–DC: DC to 6.5MHz. AC: 2Hz to 6.5MHz. **Input Impedance**–1MΩ ± 5% within 35PF, **Max Input Voltage**–600Vp-p or 300V (DC + AC peak). **Horizontal Deflection: Sensitivity**–250mV Div. or better, **Bandwidth**–DC-500KHz (-3dB), **Input Impedance**–1MΩ ± 10% within 35PF. **Time Base:** Sweep Frequency–10Hz—100KHz in 4 ranges and fine control. **Linearity**–Less than 5%. **Synchronizing**–Internal and external. **Synchronization: INT, EXT**– INT: more than 1 Div on the screen. EXT: more than 2Vp-p. **C.R.T.:** 2½" Screen. **Blanking:** G1. **Power Source:** AC115 230V ± 10% 50 60Hz. **Accessories:** Test lead Instruction manual. **Dimension:** 220(W) x 160(H) x 305(D) mm. **Weight:** 8.5 lbs.

The Tenma Model 72-300 is designed to meet a broad range of applications in designs, testing and servicing. Excellent stability with high linearity sweep. Has BNC type connectors and specifications, not commonly found on scopes in this price range. Use Tenma, the new name in precision test equipment.



DIGITAL CAPACITANCE METER

■ Measurement ranges 0.1pF to 1999μF ■ Accuracy 0.5% typical ■ 3½ digit 0.5" LCD display ■ Immediate direct reading ■ Fuse protected against accidental high voltage connection ■ 200 hour battery life

SPECIFICATIONS

■ **Ranges:** 8 ranges with full scale values from 200pF to 2000μF ■ **Accuracy:** ±0.5% of full scale ±1 digit to 200μF range; ±1% of full scale ±1 digit on 2000μF range ■ Resolution: 0.1pF **Sampling Time:** 0.5 sec. ■ **Out-of-Range Indication:** Indication of "1" ■ **Time Base:** Crystal O.S.C. ■ **Size:** 7⅛" x 3⅛" x 1½" ■ **Weight:** 10 oz. ■ Backed by MCM 1 year warranty ■ **Power Requirements:** One nine volt battery (not supplied)

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VARIABLE AUTO TRANSFORMER

■ Gives you the ability to bring up line voltage slowly to monitor problems in a TV, stereo or other electronic equipment ■ Has built-in amp meter which shows excessive current to check for shorts before they can cause costly component failure ■ This unit will easily pay for itself within months ■ Input 120V, 60Hz ■ Output 0-130V ■ Current 10A, 1.3KVA ■ Plug outlets on side

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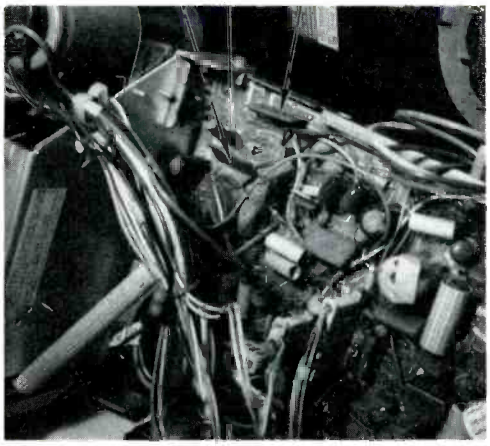
Circle (5) on Reply Card

The how-to magazine of electronics...

ELECTRONIC Servicing & Technology

February 1984
Volume 4, No. 2

The Pocket Logicscope is a combination logic analyzer and oscilloscope. See story on page 6. *(Photo courtesy of Pocket Technologies)*



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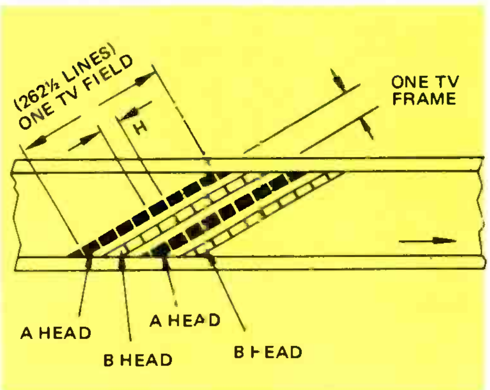

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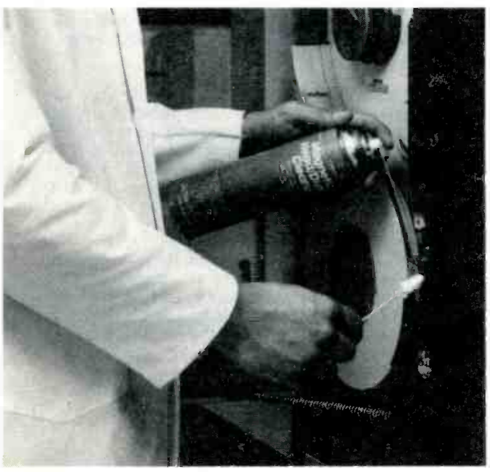

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Departments

Next month...

Sam Wilson continues the discussion of why π gets into so many electronic equations.

Electronics and chemistry, a growing bond

Electronics is increasingly chemical in nature. Fabrication of semiconductors is largely a chemical process. The manufacture of an IC, for example, requires precise formulation of dopants and careful application and diffusion throughout the semiconductor material. The colored phosphors on the TV picture tube, which create the vivid scenes and lifelike faces, are chemical compounds whose formulation has been refined through years of painstaking research. Even such things as magnetic recording tape and vinyl phonograph records are materials whose characteristics are determined by their chemical formulation, thoroughly researched and carefully controlled to provide the optimum balance among characteristics such as fidelity of playback, and durability. Some of our most recent and most sparkling innovations in the electronics field are triumphs of the chemist's art and magic: liquid-crystal displays, for example.

But, the influence of chemistry on electronics has not been confined to manufacturing production. The availability of a wide selection of chemicals for use in maintaining and servicing electronics products is increasingly evident through a glance at dealers' shelves, or paging through catalogs or ads in magazines.

This increasing application of chemicals to electronics maintenance and servicing is no doubt driven by a number of forces. Two of these come to mind, one having to do with the changing nature of chemistry, and the other with the changing nature of electronics.

Chemistry itself has produced some chemicals that just seemed to lend themselves perfectly to use with electronics. Products such as the Freons, for example, seem to have been designed just for use with electronic circuitry. Not only do they clean, degrease and provide a cooling effect, they have no deleterious effect on circuit components, and they evaporate rapidly and completely, leaving behind no residue.

The evolution of consumer electronics has created an increasing demand for chemical products to keep the electronic equipment operating at its peak and to aid in diagnosing and servicing it when it is down. Extremely high-fidelity audio equipment, for example, plays back with excruciatingly high fidelity all the clicks and pops caused by dirt particles, surface scratches and static electricity on the surface of records, right along with the beautiful music. Dirt buildup on tape recorder heads, drive wheels and other moving parts can dull music reproduction and introduce distortion. Chemicals can loosen and wash away these villains that rob the listener of hearing portions of the music he wants to.

Static-electricity has become a major problem as integrated circuitry has become susceptible to damage by static electric discharge. Once again, chemistry has come to the rescue with products that eliminate the static electric charge and/or inhibit its buildup.

The chemical toolbox for electronics maintenance and service is large and growing. The article "Chemicals in Electronics" in this issue describes a few of the many chemical products designed to help consumers and servicers get the most out of electronic equipment, and to service it when it fails.

Nils Conrad Persson

ELECTRONIC Servicing & Technology

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

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Technology

Waveform analysis in the palm of your hand

The ability of the electronics industry to shrink circuitry into ever-decreasing sized packages has brought us a host of miniature electronic products: TV sets you can hold in your hand, calculators that will fit into a wrist watch, personal computers about the size of a shoe box, to name just a few. Test equipment manufacturers have begun to follow suit, reducing the size and weight of the test equipment that technicians have to carry around.

Pocket Technologies recently introduced a product in this pint-sized category: the Pocket LogicScope 136, a combination logic analyzer and oscilloscope that operates on a 9V battery and weighs only 8 ounces. "The unit is the smallest, most powerful, hand-held instrument of its kind," said Vic Ivashin, vice president of Engineering. "The unit fits in the palm of your hand and is battery operated, yet still provides pulse performance similar to a 10MHz oscilloscope."

The unit combines many features of an oscilloscope with those of a logic analyzer and packs them into an $8\frac{1}{4}$"x4"x$1\frac{1}{2}$" package.

The display of the LogicScope is made up of four parallel rows, each consisting of 100 tightly spaced LEDs. The four rows are arranged in pairs with each row within a pair spaced approximately 0.15 inches apart. The resulting arrangement of two rows is called

Information and photo courtesy of Pocket Technologies

COOPER INDUSTRIES

The technology is advanced. The temperature stays put.

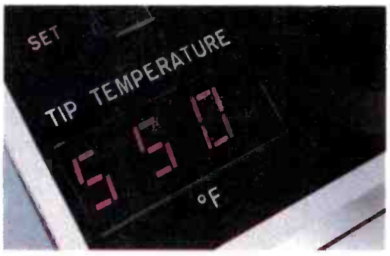
EC 1000
Dial controlled with EC1201P iron.

EC 2000
Three digit LED readout with EC1201P iron.

EC3000
Dial controlled with lightweight EC1301P soldering pencil.

EC 4000
Three digit LED readout with lightweight EC1301P soldering pencil.

All EC Series stations meet Mil-spec DOD-STD-2000-1



When you need controlled output soldering for sensitive components, you don't need uncontrolled temperature fluctuations at the work station. In the Weller EC Series, the tip temperature is maintained throughout the range of 350°F–850°F to within 10°F. In addition, an electronic system utilizes thyristor power control with zero voltage thyristor drive. This ensures that no high voltage spikes or magnetic fields will be present on the soldering tip.

These technologically advanced stations are capable of handling all the delicate soldering operations necessary, in even the most sophisticated applications. They offer the ultimate in soldering flexibility with a choice of controls and readouts to suit your needs precisely.

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a "trace," and thus with four rows of LEDs, the device has two "traces." The pairs of traces are spaced about 0.25 inches apart giving the appearance of two parallel traces similar to those that would be seen on the CRT of a conventional scope. In the case of this instrument, any signal displayed on the traces can only be in the upper or lower row of that trace, thus only digital waveforms (logic 1 or 0), devoid of actual voltage levels, can be displayed. But the unit is designed to operate in the digital world.

The resulting display, according to the manufacturer, is remarkably clear, giving the impression that there is actually a continuous waveform going across a CRT screen. Further, the display is less than 3 inches long, giving an LED or dot resolution of better than 35 LEDs per inch. The result is a display that closely duplicates that of a logic analyzer's CRT.

The display is an in-house, custom-designed LED array with an associated custom driver integrated circuit. This design encompasses not only the 400 LEDs in display generation but also includes 16 other LEDs for status indication (time base, memory and funtion). The entire assembly is mounted on a 3-inch by 1½-inch substrate with a 48-pin interface connector.

In order to generate something to show on the display, the device uses a front-end with broad capabilities. This section allows for both real time and digital stored waveforms to be displayed in respect to internal and external time bases. In the real time mode, the logic signal is displayed in relationship to a time base as it would be on a conventional oscilloscope. The internal time base covers from 10Hz to 10MHz. However, because of display brightness limitations, the practical real time display limit is 1MHz. For signals between 1MHz and 10MHz, the user can switch to the stored waveform mode. In this mode, the unit has a maximum resolution running at 100ms. This span is divided into seven ranges, each covering one decade.

In either mode, the instrument makes use of its extensive memory capabilities. This includes its first level of storage, a single-line cache buffer memory for each trace, which gives the display improved stability and readability. Beyond this are the actual display storage registers, which provide for four signals to be stored per trace for a total of eight. Any stored trace can be compared to any other trace – either stored or real time. Further, the traces can be linked together to form a continuous memory register. Also, when displayed, the memory can be scanned via the unit's cursor controls. (There are also provisions for downloading displays to the outside world via a soon-to-be-announced adapter.) Another unique feature of the Pocket LogicScope 136's front end is that the unit automatically generates and stores signatures of any received waveform. Another option that will be available in the near future will allow these to be stored, compared and displayed.

As the first in a series, the instrument is intended as a core instrument, with future devices serving as add-ons extending its capabilities. Some of the 16 planned modules include a time and signature display with a frequency counter, an ac analyzer with a DMV and an analog waveform display module. The balance of the planned expansion devices will be introduced over the next two years. This broad expandability required flexible interfacing capabilities achieved through the use of four custom ICs as follows: 1) timing control, 2) keyboard scanning and multiplexing, 3) memory management, and 4) display controller and driver.

"Auto Seek" automatically adjusts the timing to fill the display with one complete waveform, eliminating "guestimation" on the proper time base setting for the unknown signal. "Audo Trak" is an audio signal that is heard when a single logic event is captured. This eliminates looking at the screen, and enables the user to "listen to logic." Audo Trak can be used to distinguish three different logic states: logic low (a low tone), logic high (a high tone), and tristate (no tone).

The Pocket LogicScope 136 currently retails for $495, and comes complete with three probes, an ac charger/adapter with a 10-foot cord and a carrying case.

News

Standard developed for phonograph cartridges

Interim Standard No. 9 is designed to describe in practical and simple terms the conditions, procedures and the interpretation of the results of the tests performed on an electro-mechanical (phonograph cartridge) transducer. It defines methods of measurement and reports test results and not the degree of excellence.

This document was developed by the Electronic Industries Association P-8.2 Working Group on Phonograph Components and Records under the chairmanship of George Alexandrovich of Pickering and Company. The group consisted of representatives from the cartridge manufacturers, technical reviewers from the press, representatives of independent laboratories and technical centers, and record manufacturers.

The group hopes this interim standard will benefit the industry because there was no previous standard, and phonograph cartridges were tested and evaluated using various methods developed by the product manufacturers. Many equipment reviewers contributed to the effort.

Copies of the standard are $9 and are available from the Electronic Industries Association, Standards Sales Department, 2001 Eye St., NW, Washington, DC.

RCA predicts boom in wholesale consumer electronics business

The consumer electronics industry's wholesale volume is expected to top $15 billion by 1990, according to an RCA study.

In color television, the company said that sales were expected to reach 13.4 million units in 1983, up 17 percent from 11.5 million units in 1982. Black-and-white TV sales were about unchanged at 5.7 million units. Sales of VCRs reached 4.3 million units, more than double 1982's volume. Videodisc player sales were up 35 percent to 300,000 units.

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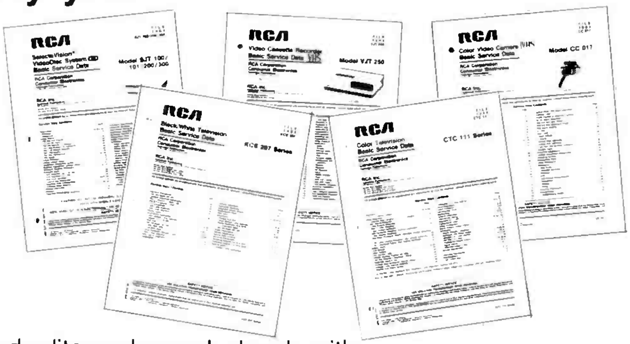
RCA SERVICE LITERATURE



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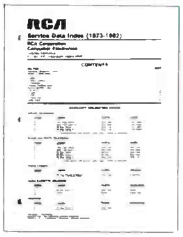

10-YEAR INDEX ALSO INCLUDED!

References RCA service literature by model, and includes Warranty Obligation Codes and a separate listing of service bulletins.

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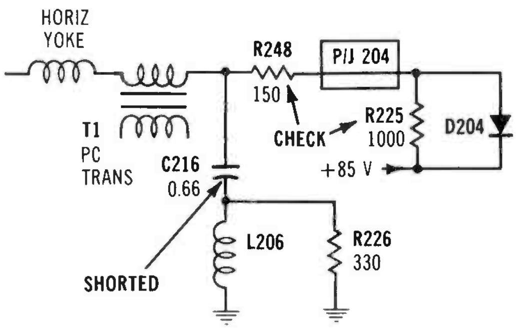
ES & T84

Symcure

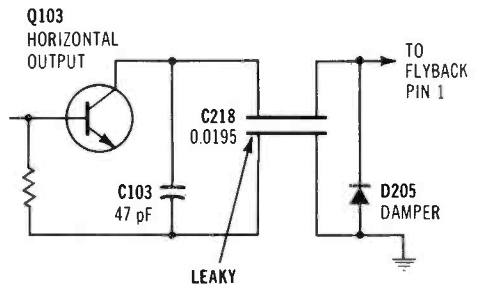
Symptoms and cures compiled from field reports of recurring troubles

Chassis – Magnavox T809 1
PHOTOFACT – 2025-1



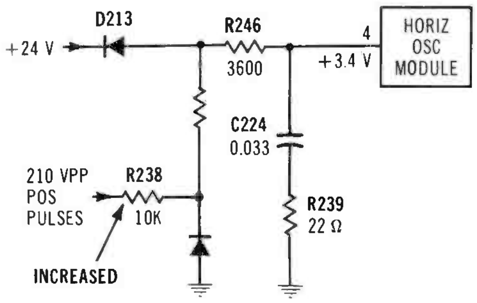
Symptom – No sound or picture
Cure – Check for shorted Q103 output; if short is there with Q103 removed, test yoke-coupling capacitor C216, and replace it if shorted.

Chassis – Magnavox T809 2
PHOTOFACT – 2025-1



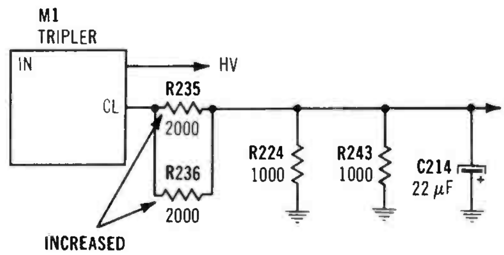
Symptom – No sound or picture
Cure – If the +85V supply at Q103 output is very low, disconnect C218 and test it for leakage. Replace it if shorted or leaky

Chassis – Magnavox T809 3
PHOTOFACT – 2025-1



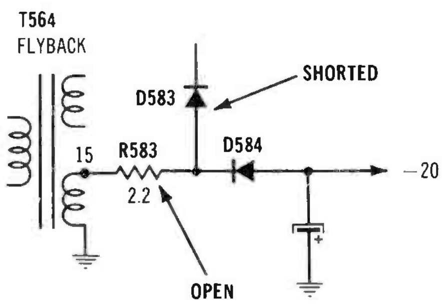
Symptom – Incorrect horizontal frequency (will not lock)
Cure – Check resistor R238, and replace it if increased in value

Chassis – Magnavox T809 4
PHOTOFACT – 2025-1



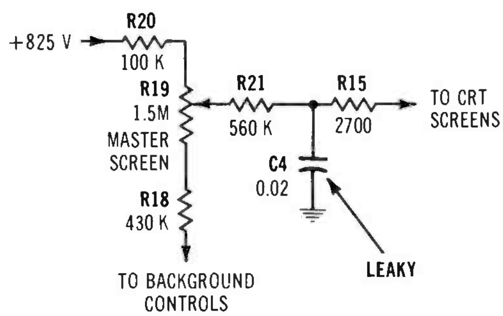
Symptom – Picture is too dark
Cure – Check resistors R235 and R236, and replace them if increased in value

Chassis – Magnavox 13C2 5
PHOTOFACT – 1940-1



Symptom – Only half height, and picture is white with retrace lines
Cure – Check D583 and resistor R583, and replace them if leaky and open respectively

Chassis – Magnavox T809 6
PHOTOFACT – 2025-1



Symptom – Picture is almost black
Cure – Check capacitor C4 on the CRT-socket board, and replace it if shorted

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Circle (6) on Reply Card

Test your electronic knowledge

By Sam Wilson, ISCET test director

These questions are similar (but not identical) to questions used on the various CET tests. All questions on the actual CET test are multiple choice, and a grade of 75% or better is required for passing. In this issue, the questions are related to all sections in the Associate-Level CET Test. (Answers on page 55.)

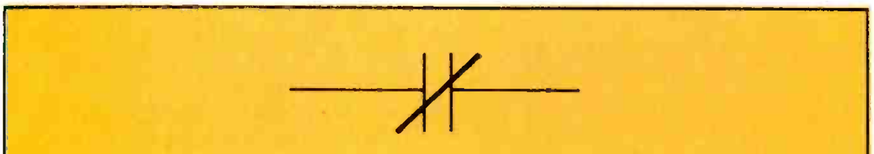


Figure 1

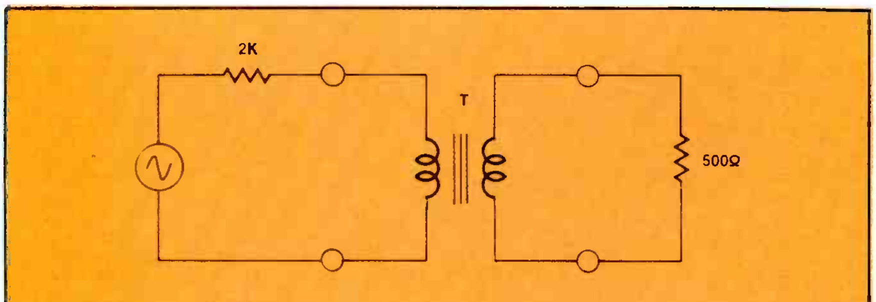


Figure 2

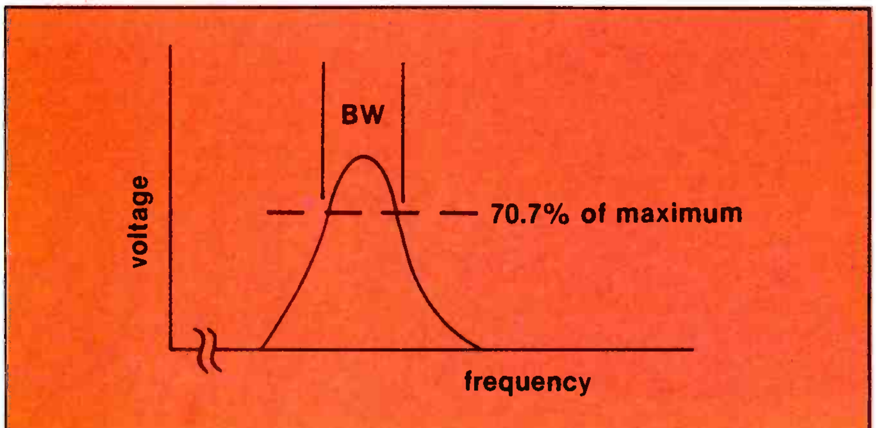


Figure 3

1. Which of the following is a unit of electric energy?
   A. Volt
   B. Ohm
   C. Ampere
   D. Watt
   E. None of these choices is correct.

2. Which of the following can be recharged?
   A. A primary cell.
   B. A secondary cell.

3. When comparing two wires of equal length and material, the greater conductance will occur in
   A. 10-gauge wire.
   B. 28-gauge wire.

4. Figure 1 shows the symbol for a
   A. relay coil.
   B. normally open switch or relay contact.
   C. normally closed switch or relay contact.
   D. shorted capacitor.
   E. None of these choices is correct.

5. If you square the value of voltage across a resistor, and then divide the result by the amount of power the resistor is dissipating, you will get
   A. the value of current through the resistor.
   B. the number of vars.
   C. the energy expended in the resistor each second.
   D. the energy expended in the resistor each hour.
   E. the resistance of the resistor.

6. To match the impedances shown, the turns ratio of T in Figure 2 should be:
   A. $N_p/N_s = 2/1$
   B. $N_p/N_s = 4/1$
   C. $N_p/N_s = 1.414/1$
   D. $N_p/N_s = 0.5/1$
   E. $N_p/N_s = 0.25/1$

7. Which of the following Class A amplifiers is least likely to have partition noise?
   A. Triode tube amplifier.
   B. Pentode tube amplifier.
   C. NPN bipolar transistor amplifier.
   D. PNP bipolar transistor amplifier.
   E. Depletion-type MOSFET amplifier.

8. The bandwidth in the characteristic curve of Figure 3 is the same as when the bandwidth is measured between
   A. power measured at the 70.7% points.
   B. half-power points.

9. Which of the following statements is NOT true regarding a diode detector stage in an AM radio?
   A. The audio is produced by heterodyning the sidebands and the I-F carrier frequency.
   B. It may be a square-law detector.
   C. It may be a linear detector.
   D. Silicon diodes work best for this circuit.
   E. The AGC voltage is obtained in this stage.

10. Which of the following is true regarding the Q of a coil?
   A. It is measured in DARAFS.
   B. It is measured in Henries.
   C. It is the ratio of inductance to resistance.
   D. It does not depend on frequency.
   E. None of these statements is correct.

ES&T

Servicing K-Mart color TV

By Homer L. Davidson

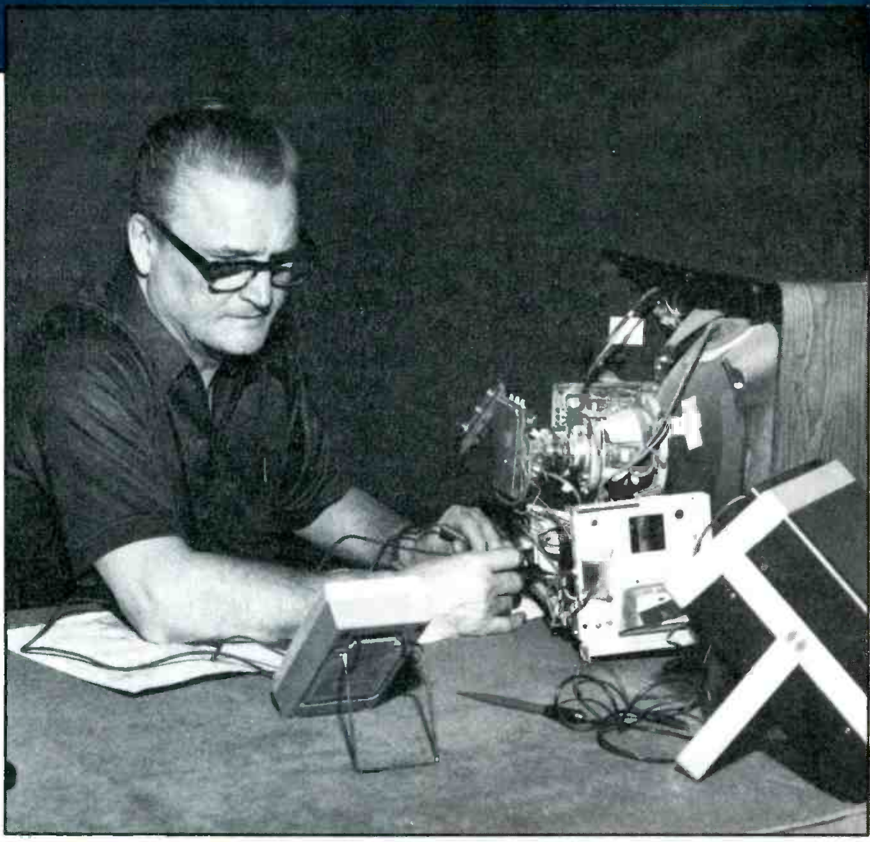


Figure 1. K-Mart's portable color receivers are no more difficult to service than are the well-known brands when good service data, such as Photofact, is available.

Many technicians refuse to service foreign-built color TV receivers. Several reasons usually are given: Good schematics are not available; the circuits are unfamiliar and difficult to trace; and appropriate components often are not available or are out of stock. The following information should help eliminate these troubleshooting difficulties in the case of one of the most popular K-Mart color portables, model KMC-1920 (Figure 1). This set is similar to the Gold Star model CN-841 (except it does not have remote control). Photofact 1942-1 covers model CN-841, which has an NT6X chassis. Other K-Mart models might have similar component failures.

No sound or raster

A common problem with K-Mart model KMC-1920 is a complete loss of sound and raster. With this model, a raster cannot be obtained unless *both* the low-voltage regulated/unregulated supplies and the horizontal-sweep/high-voltage systems operate correctly. The source of receiver power for all functions is the line-rectified dc voltage from diode CR901 (Figure 2), so the first steps in testing a no-sound/no-raster symptom are checking for a blown F901 4A fuse (it protects the 120Vac circuit) and measuring the dc voltage at the collector (metal case) of horizontal-output transistor TR704. A blown fuse indicates a serious overload that must be investigated first, while an incorrect output-transistor collector dc voltage points to a power-supply or regulator problem.

When a leaky or shorted TR704 output transistor is suspected, disconnect it from most of the circuit by removing the plug located just behind the transistor. This permits ohmmeter measurements of the transistor collector without the flyback winding (which is connected to the regulated +121V supply through a 4.7Ω resistor).

One common power-supply problem is an open TR905 power-regulator transistor. This transistor sometimes tests normal when removed from the chassis, but might open erratically when it is subjected to the full-current load in-circuit. If there is doubt, replace the transistor, which is bolted to the outside of the metal chassis at your left (when you face the rear of the chassis). Color-coded wires connect to the base and emitter leads (Figure 2). Both wires should be unsoldered when the transistor is tested.

Another power-supply component that has given problems in the past is the voltage-divider-resistor block M901 (Figure 3), which affects the regulation of

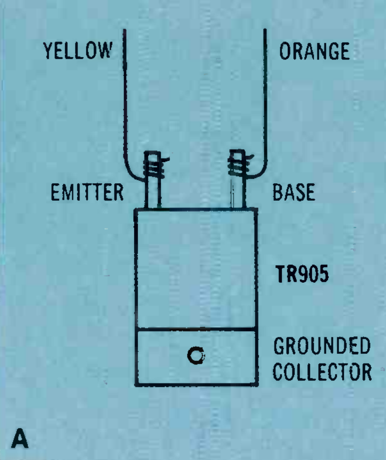
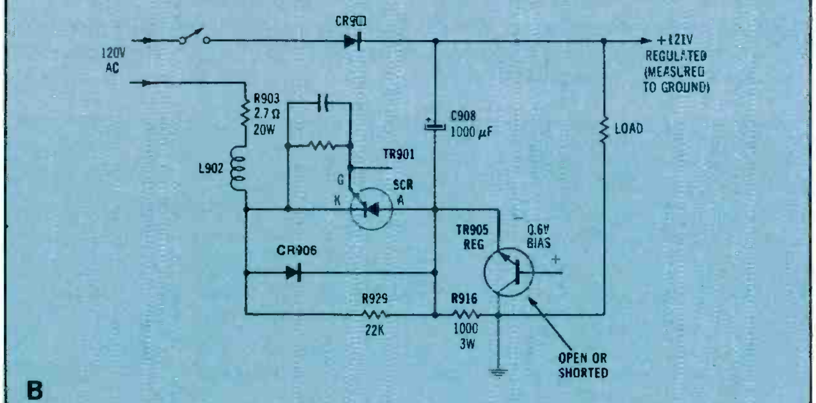


Figure 2A. TR905's base and emitter leads are soldered to color-coded wires, which must be removed before accurate tests can be made.

Figure 2B. Diode CR901 is the principal rectifier of line voltage. However, SCR TR901 varies the voltage across main-filter C908 by having its beginning of conduction varied by the phase-control transistors TR903 and TR904 (not shown). Diode CR906 rectifies the other peak. In addition, TR905 regulator transistor varies the voltage drop between the negative end of C908 and ground, thus completing the regulation.



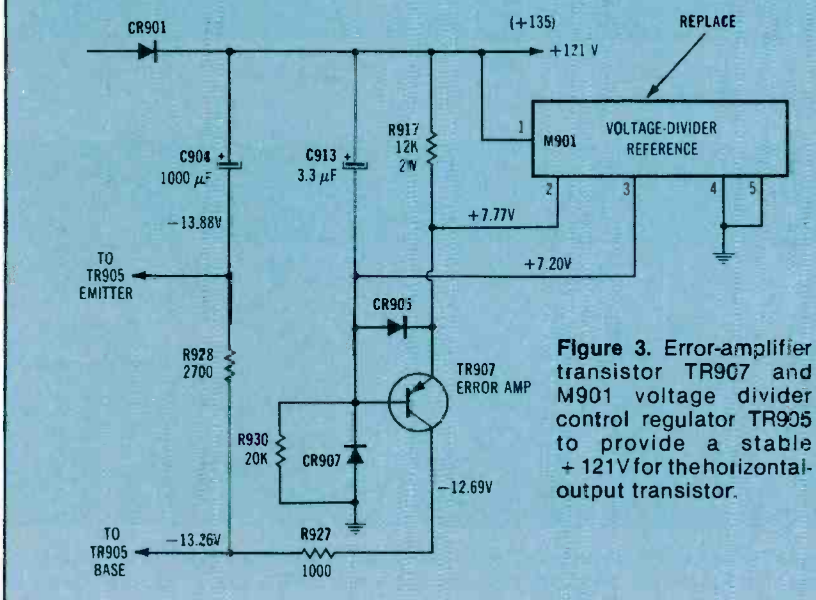


Figure 3. Error-amplifier transistor TR907 and M901 voltage divider control regulator TR905 to provide a stable +121V for the horizontal-output transistor.

TR905. Replace M901 when the +121V supply measures higher than +125V but no defects can be found. Excessive regulated voltage can produce instant shut-down.

A low voltage of about +25V at the TR704 output transistor collector can be produced when TR905 regulator transistor is open (Figure 2), or when it is biased to cut-off. An open base-to-emitter junction is proved when the forward bias measures 4V to 5V (normal bias is about 0.6V). When the original TR905 is bad, replace it with an ECG375 or a SK3219 transistor.

Check the dc voltages on the TR907 (error amplifier in Figure 3). An open transistor reduces the usual −12.7V collector voltage to about −6V. While TR907 is removed, test the protective diodes CR905 and CR907. An SK3932 or ECG323 can be used when it is necessary to replace TR907.

When SCR TR901 opens, the cathode and gate terminals have excessive negative voltages. An intermittent loss of picture and sound can be caused by bad connections at L902 current-limiting coil (see Figure 2).

Horizontal-drive problems

If the TR704 horizontal-output transistor opens or its base drive is lost, its collector voltage rises, perhaps to about +160V. Also, the voltage increase and the loss of signal drive are symptoms of high-voltage shut-down.

First, remove the plug (just behind the horizontal-output transistor in Figure 4) to disconnect the output transistor collector and its possible shorts. Measure the driver TR703 base and collector dc voltages. Disconnection of the output transistor load will increase the TR703 collector voltage; this is normal. A collector voltage equal to the actual voltage on the +121V supply line proves TR703 is drawing zero collector current, either from an open transistor, or a loss of forward bias or base-signal drive.

If the TR703 collector voltage is very low, and the R719 6.8kΩ dropping resistor develops excessive heat, suspect a leaky driver transistor (Figure 5). Replace TR703 and then test R719. Look for discoloration or bulges, for these are signs of a possible resistance change in the future. Replace R719 if it shows these signs of overload damage or if the resistance is out of tolerance.

When none of the previous tests reveal a specific defect, scope all waveforms of the driver and output stages. Remember that the TR704 base waveform will be different when the collector dc and ac voltages are not present, and the +121V source voltage will be incorrect without any horizontal power at the flyback. However, the oscillator and driver transistors should have waveforms, although of reduced amplitude. Also, test for bad connections at driver-transformer T702 and coil L702.

High-voltage problems

Loss of TR704 base drive, or an oscillator signal that is half or double the correct frequency, can eliminate all high voltage. When sufficient drive amplitude of approximately the correct frequency is present at TR704 base, but there is no high voltage, the trouble source probably is in the output-transistor/flyback area (Figure 6).

Notice that the high-voltage diodes and several focus-voltage resistors are inside the flyback where they cannot be tested separately. If the flyback becomes excessively warm anywhere, it is possible the flyback has a shorted winding, or the high-voltage

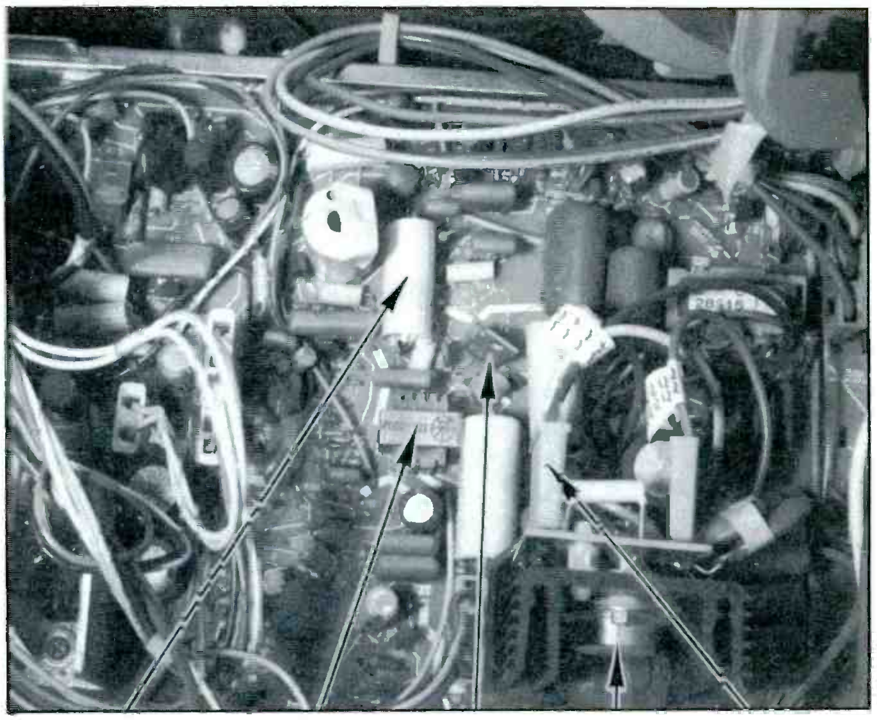


Figure 4. Arrows at the bottom identify (from left to right) these components: resistor R719, driver transformer T702; driver transistor TR703; output transistor TR704; and the plug that disconnects TR704.

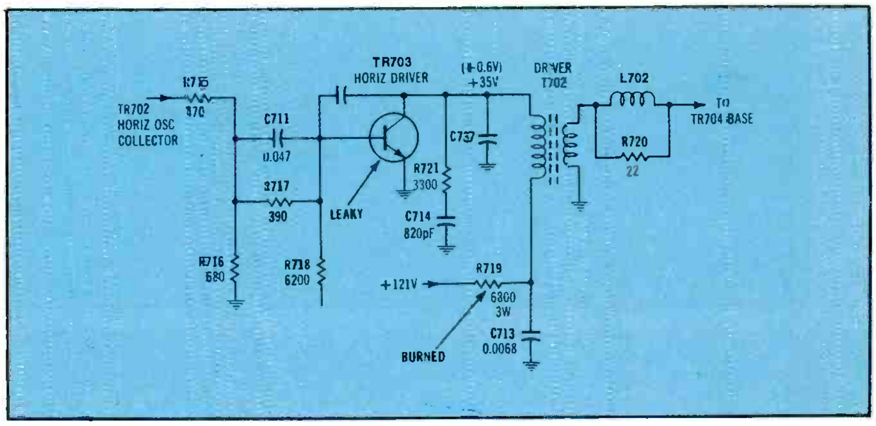


Figure 5. Arrows point to two components that fail most often in the K-Mart horizontal-driver stage.

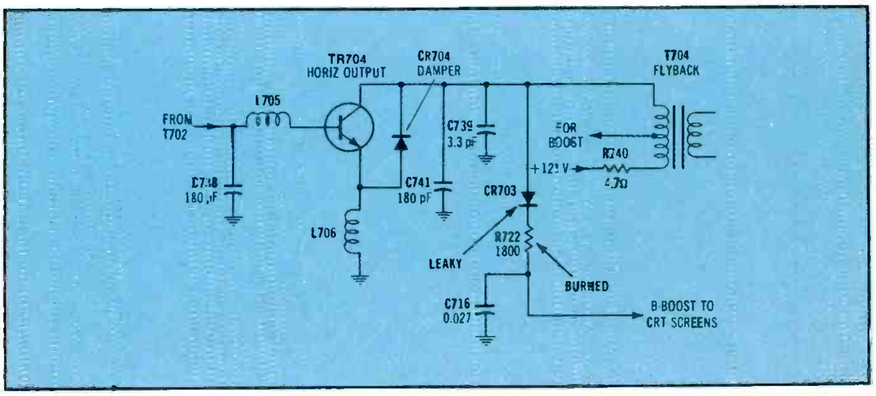


Figure 6. The K-Mart horizontal-output stage has no unusual circuits, which makes troubleshooting easier. Boosted-boost components CR703 and R722 have failed in many cases. Of course, TR704 output transistor is the first suspect when sound and raster are missing.

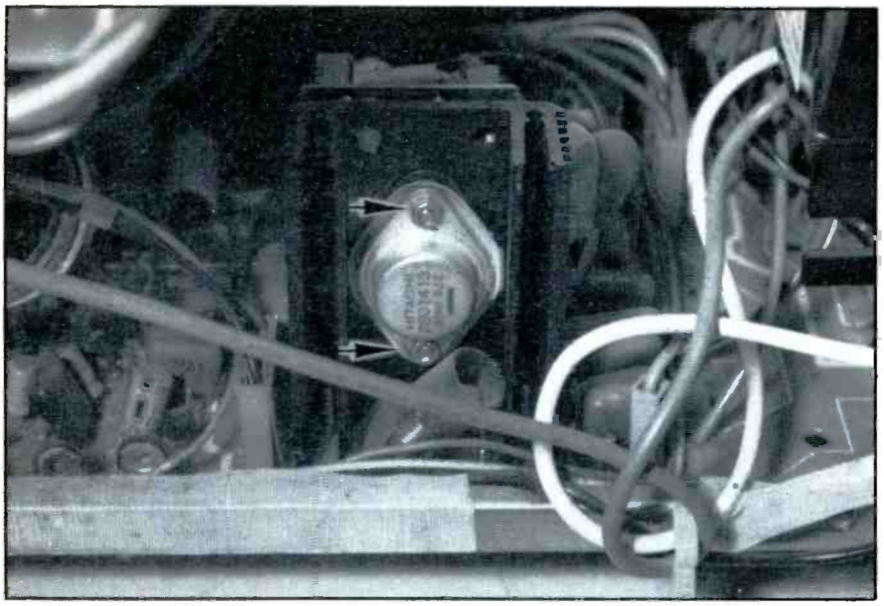


Figure 7. Two nuts (located by arrows) must be removed and the base and emitter leads unsoldered from a small circuit board before TR704 horizontal-output transistor can be removed from the chassis.

diodes are shorted. Replacement of the flyback as a test probably will be necessary.

While the ac power is removed, check the resistance from TR704 collector to ground. An abnormally low resistance could indicate a leaky TR704 or a shorted damper diode CR704. Remove the TR704 output transistor and then check the CR704 damper diode and the output transistor for opens or leakages. To remove TR704, remove the two nuts that are shown in Figure 7. Next, unsolder the base and emitter leads that are soldered to a small circuit board and remove the transistor for testing out of the circuit.

If the original output transistor has a collector-to-emitter short, it is likely that some other circuit defect caused it to be overloaded,

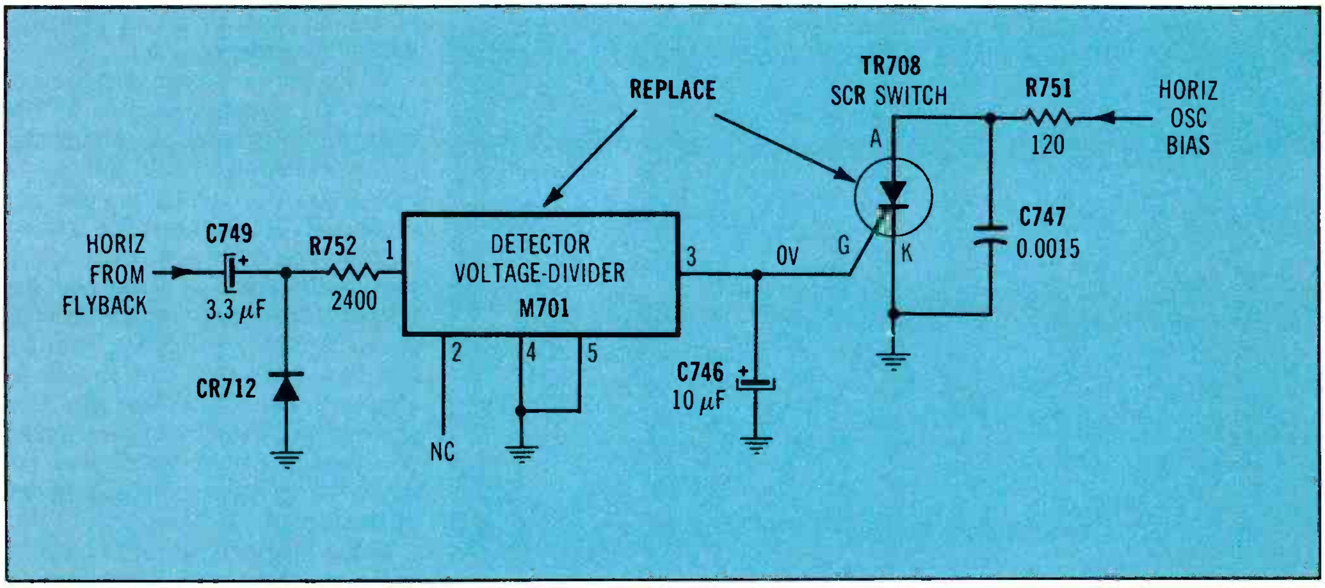


Figure 8. Failsafe circuit. Horizontal pulses from the flyback are rectified and applied to M701 detector voltage-divider component. If these pulses become excessive in amplitude, a positive voltage from M701 is applied to the TR708 gate, causing TR708 conduction, which kills the horizontal oscillator.

and the replacement will be damaged when operated at full power. Therefore, you should operate the receiver from a variable-voltage isolation transformer. Begin with a low ac voltage, such as 35Vac and listen for crackling noises from the flyback that might indicate internal arcs. After a few minutes operation with low voltage, turn off the power and feel the output transistor. Excessive heat indicates that an overload still is present, so additional tests are needed before full power can be applied safely. Incidentally, the old light-bulb test is another way to protect the new transistor. Remove the 4A fuse, connect a test 100W incandescent bulb across the fuse terminals, and apply full line voltage. The bulb's resistance prevents more than about 0.9A of current, while the bulb's brightness gives an indication about the amount of overload. If the receiver operates (perhaps with a small raster) and the bulb is not very bright, it is safe to put the 4A fuse back in for a heat-run test.

When either of these restricted-power tests indicates that a severe overload remains after a new TR704 output transistor has been installed, the flyback is the most likely suspect. Incidentally, an ECG165 or a GE-38 can properly replace a defective TR704.

Shut-down problems

A shut-down condition should be suspected when the sound comes on loudly, but a fraction of a second later disappears. One of two conditions is generally the cause of this symptom: excessive high voltage, or a defective fail-safe circuit (Figure 8). One method of determining which condition is responsible is to unsolder the anode lead of SCR TR708, opening the anode circuit. If the receiver operates normally and the high voltage is not excessive, the fail-safe circuit itself is responsible for the shutdown. **Caution:** *Be prepared to measure the high voltage quickly after receiver power is applied, while the TR708 lead is open. If the shut-down was caused by excessive high voltage, that high voltage can damage insulation by arcs or ruin the picture tube, so excessive HV demands instant removal of ac power after the HV is measured.* Re-connect the TR708 anode, and do not apply full ac power until the proper HV has been restored.

Negative-going horizontal pulses from T704 pin 4 pass through C749 (Figure 8) and the negative peaks are clamped to ground by diode CR712 conduction, resulting in a totally positive-going waveform. This positive waveform is reduced by R752 and M701 voltage divider (internal components unknown). Normal pulse amplitude produces zero dc voltage at the TR708 gate (an SCR), so TR708 does not conduct. (Conduction would kill the horizontal oscillator by removing the oscillator bias.)

In other words, the circuit does not interfere with the horizontal drive unless the flyback pulses are excessive. If a defect increases the pulse amplitude, M701 applies a positive voltage to the TR708 gate (C746 stores the voltage), triggering TR708 into conduction, which grounds the horizontal-oscillator's bias through R751, thus killing the oscillator signal. This eliminates all horizontal sweep. Once triggered, TR708 conduction continues until ac power is removed from the receiver for a time. If the overvoltage condition was temporary, normal operation can be restored by turning off the ac power for a minute or two and then on again.

In summary, the fail-safe circuit kills the horizontal sweep, eliminating all sound and raster, when the flyback pulses have excessive amplitude. The most common component failures in the fail-safe circuit are TR708 and M701, the detector precision voltage divider. TR708 can be tested the same as any other SCR. M701 or M901 (Figure 9) should be replaced only by a new one from Gold Star.

Vertical problems

Seldom do the newer vertical-sweep circuits have defects that merely degrade the linearity without affecting the total height (a common symptom with older tube-equipped circuits). Component defects usually prevent any vertical deflection (producing a single horizontal line), or show partial height with terrible linearity.

Waveforms often are not helpful for analyzing direct-coupled vertical stages. The best procedure is to check all vertical transistors (Figure 10) with an in-circuit transistor tester. Alternately, use a voltage-drop type of diode tester to verify the condition of each transistor junction. Any transistors that have questionable conditions during in-circuit tests should be removed for accurate out-of-circuit measurements.

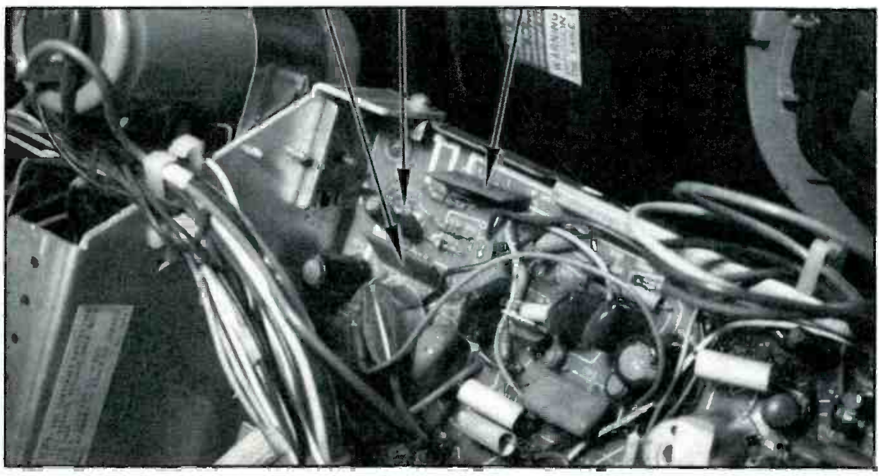


Figure 9. Arrows locate these fail-safe and power-supply components (from the left): M701; TR708 SCR; and M901.

Vertical-output transistors are the most likely components to fail, so TR604 and TR605 (Figure 11) should be tested first. Also, some failures of TR601 and TR602 have been reported. In the Figure 10 circuit, measure resistors R623, R624, R620 and R619, because they are usually the ones damaged by shorted transistors. For more accurate ohmmeter measurements, disconnect one end of each resistor. (Don't forget to restore all connections when the tests are completed.) Replace all out-of-tolerance resistors.

Measurement of dc voltages is not very informative in these direct-coupled circuits. However, the value of one dc voltage can

(continued on page 52)

What's inside your TELEPHONE?

By Christopher Kite

Most of us use a telephone several times a day, but until recently, we have had little reason to wonder what goes on inside the telephone. Obviously, there is a microphone in the mouthpiece and a speaker in the earpiece, and perhaps some kind of audio amplifier for each. Beyond that, most of us have given little thought as to what else may be involved. In the past, the local telephone company supplied the telephone along with the telephone service. If repair or replacement was ever needed, the telephone company handled it.

The recent changes in FCC regulations regarding telephone service have drastically changed this situation. There is an explosive growth in the private ownership of telephones. Repairing and replacing telephones will become the telephone owner's responsibility after 1984. In turn, he or she will look to electronic service shops with telephone expertise for testing and repair service. You will need to understand how telephones operate if you are to participate in this new segment of the electronics service industry, or even to effectively evaluate the pros and cons of getting into telephone servicing.

An old-timer in the telephone business gave me this tip, which I have found very helpful. "Remember that a telephone has five functions to perform. These are just as true today as when Molly the switchboard operator performed them 50 years ago. Almost every advance in the telephone industry involved an electronic method of performing these functions. Think about these five functions when testing telephones, and don't forget that one function may have an effect on another."

Those five functions are:

- **Supervision**—Scanning the circuits to determine when someone wishes to place a call. Molly has become an electronic switching exchange; lifting your telephone off the hook now signals "Molly," and she acknowledges by returning a dial tone.
- **Addressing**—Indicating who you wish to call. This is now the dialing function.
- **Alerting**—Ringing of the phone to announce your incoming call. This is the ringing function, little changed from Molly's day.
- **Transmitting**—Sending your voice out over the wire. Carbon microphones are no longer used but little else has changed.
- **Receiving**—Listening to someone's voice coming in over the wire. Not much about this function has changed.

Standard telephone characteristics

All telephones have a few standard characteristics making them compatible with the telephone exchange, which means that virtually all telephones are interchangeable with each other, even though there are major internal circuit differences. Fortunately, it makes the telephone a little easier to understand because a few basic characteristics are unchanged from one telephone to another.

Before examining the telephone and its circuits, a review of the most important of these standard telephone characteristics is in order. This necessarily overlaps and includes some characteristics of the telephone line and the telephone exchange. The minimum specification for some of the telephone line characteristics is established by FCC regulations. The most important characteristics are summarized in Figure 1.

• 2-wire circuit

The telephone is basically a 2-wire device. Voice audio in both directions, dc power for operating the telephone circuits, dial tone, dialing and ringing are all carried on a single pair of wires. There are normally four wires in the telephone line, but only one pair is used in standard telephones. The extra pair of wires may carry power to the night light in the Princess-type telephone, for example. Do not confuse a line having four wires with the more common definition of 4-wire circuits. In 4-wire circuits, transmit-voice is carried by one pair and receive-voice by the other pair. Externally, telephones use 2-wire circuits where transmit- and receive-voice are carried on the same pair.

• Bandwidth

Your conversation over a telephone has a distinct "telephone" sound that is considerably different than talking to the same person face to face. This is caused by the acceptable, but somewhat limited frequency response of 300Hz to 3000Hz with 6dB of the 1kHz response.

• Impedance

The typical off-hook telephone impedance is approximately 600Ω at audio frequency (300Hz to 3000Hz). The dc resistance of the telephone may be considerably lower, and is often approximately 250Ω.

• **Battery voltage**

Because there is obviously no ac power cord on your telephone and no battery to replace, power for operating the electronic circuits must be supplied by the telephone line. The telephone exchange continuously applies a dc voltage to the telephone line through a series impedance, usually −48V. The term "battery" is used because the telephone company normally supplies this power from a huge bank of parallel batteries that will continue to provide telephone operation in case of power failure.

When the telephone is on hook, it is a dc open circuit and no line current flows. When the telephone is off hook, line current flows and powers the telephone. The telephone company is required to supply at least 20mA (a value originally required for satisfactory operation of carbon microphones). The loop resistance of a long telephone line may be up to 1.5kΩ, in which case line current will probably be no more than 20mA. For shorter telephone lines, available line current may be as high as 120mA, but most telephones include compensation to automatically shunt excess line current. The voltage across an off-hook telephone is usually 5V to 12V.

When voice is present, current variations are superimposed on the dc. Typically, a voltage-regulator circuit within the telephone provides constant voltage to the electronic circuits even though line current varies.

• **Polarity**

The standard dc polarity for telephone lines is negative to "ring" and return to "tip." "Tip" and "ring" terminology is common in telephone circuits and refers to the tip and ring portions of a telephone jack or equivalent. In this context, "ring" has nothing to do with ringing of the telephone, but refers to the concentric ring on the jack which provides one connection.

• **Ringing**

The telephone company applies a highly accurate 20Hz sine wave ringing voltage of 80Vrms to 130Vrms. The most typical value is 100Vrms (280V peak-to-peak). All telephones should be capable of ringing with ringing voltage that could drop to as low as 40Vrms over a long telephone line with 1.5kΩ resistance. In some party line applications, additional frequencies are used; telephone ringers with corresponding resonant frequencies assure that only one telephone rings. The ringing signal is applied to the telephone line only when the telephone company's equipment detects a high impedance (present when the telephone is on hook). The ringing signal is usually 1½ to 2 seconds on and 4 to 4½ seconds off, for a 6-second repetition cycle.

• **Dialing**

Dialing is accomplished through either pulses (for rotary or non-tone dial telephones) or tone pairs (for tone dial telephones). Pulses are produced simply by opening and closing a set of contacts (rotary dial telephones) or turning a switching circuit on and off (push-button pulse dial). Touch Tone and other compatible dialing tones are produced by oscillators that generate tones which are mixed in pairs to form each digit. The 3x4 matrix layout of the dialing keypad selects one "row" oscillator and one "column" oscil-

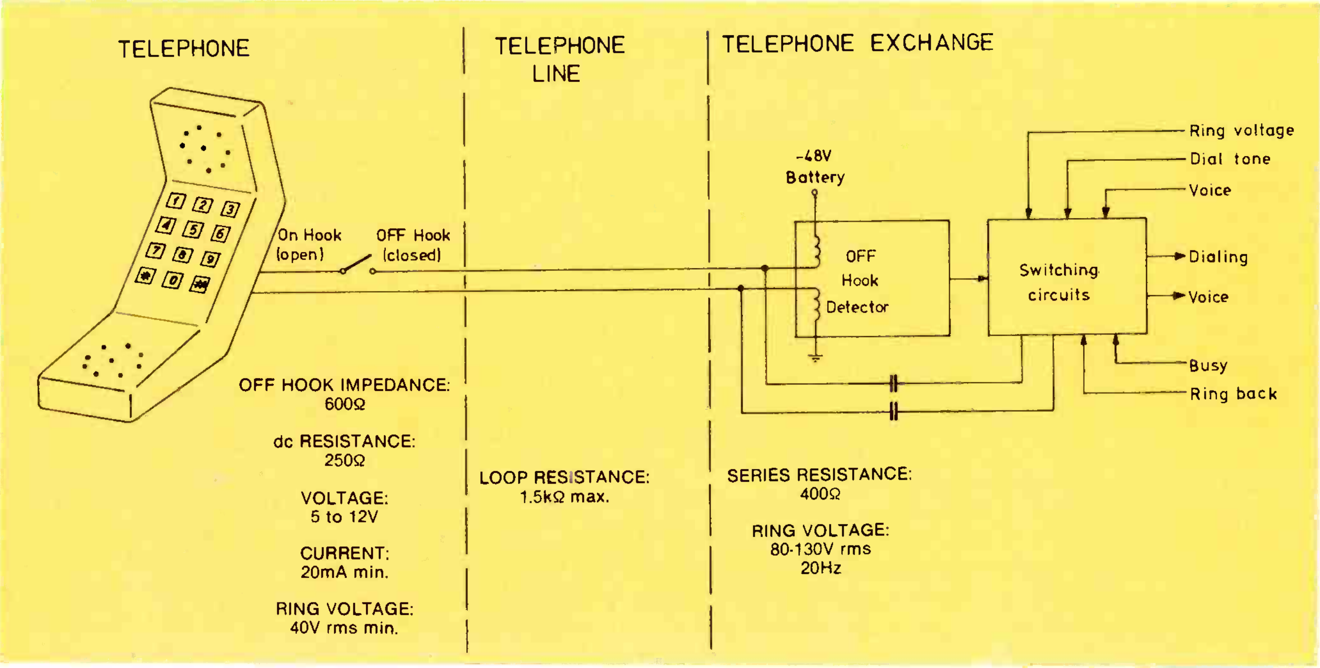


Figure 1. All telephones have certain standard characteristics so that they are compatible with the telephone system. Some typical values are shown here.

lator for each digit. This is commonly known as the DTMF (Dual-Tone Multifrequency) frequencies, (see Table 1).

Block diagram analysis

The block diagram of a basic telephone with electronic ringer (the circuits of the Cobra clock radio/telephone) is depicted in Figure 2. The ringing signal is applied directly to the electronic ringer, an oscillator and buzzer circuit, which operates at a rate of approximately 2.8kHz, interrupted at a rate of 20Hz. This causes the "chirping" sound that is heard when the telephone rings. These signals are only applied to the buzzer while the ringing signal is present. Thus, if the ringing signal is on for two seconds and off for four seconds, the chirping sound is heard for two seconds at 4-second intervals.

For standard desk telephones (those with a bell rather than an electronic ringer), the ringing signal is capacitively coupled to an electromechanical bell, causing it to jingle at its mechanical resonant frequency of 20Hz. Capacitive coupling is important; the ringer must not offer a dc path for line current when the telephone is on hook.

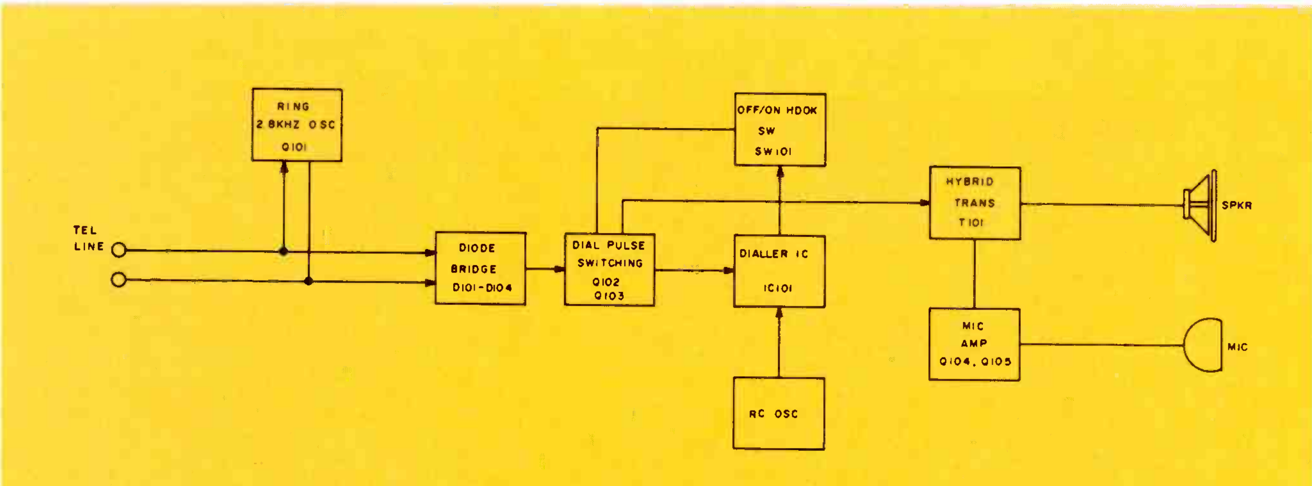
Power, incoming and outgoing audio signals, and dialing signals for the telephone are fed through a diode bridge, an on-hook/off-hook switch, and a switching circuit. The diode bridge serves as an automatic polarity corrector for the electronic circuits in the telephone, providing the proper polarity even if the dc polarity of the telephone line connection becomes reversed. When the telephone is off hook, the switching circuit applies power to the audio amplifier. The dialing chip gets power directly from the diode bridge, bypassing the on-hook/off-hook switch. This is necessary with redial and memory telephones because the dialing chip must always have power to store the redial information in the memory.

Digit (Symbol)	Frequencies (Hz)
1	697 1209
2	697 1336
3	697 1477
4	770 1209
5	770 1336
6	770 1477
7	852 1209
8	852 1336
9	852 1477
0	941 1336
*	941 1209
#	941 1477

Table 1. Standard DTMF Dialing Tone Frequencies.

When you dial the phone, an oscillator feeds into the dialing chip, which generates a certain number of pulses for each digit. These pulses cause the dial pulse switching circuit to emit the proper pulse train for each digit. The pulse train is fed through the on-hook/off-hook switch and the diode bridge and onto the telephone line. The dialing pulses are fed through the telephone line to the telephone company's equipment where they are decoded to cause the proper connection to be made.

When you talk, the outgoing audio is fed into an audio amplifier from the microphone. This amplified signal is fed to the primary of the hybrid transformer, which feeds the signal through the switching circuits and to the telephone line. The signal is also fed to the secondary of the hybrid transformer, which feeds the signal at a low level to the speaker so that you hear your own voice in the ear piece as you speak. This is known as sidetone. Without this, your conversation would sound un-



(Courtesy of Dynascan Corporation)

Figure 2. The telephone depicted in this block diagram has an electronic ringer rather than a bell.

natural. If the level of the sidetone is too high, it will cause the person speaking into the telephone to speak too softly, and if the level is too low, it will cause the person speaking into the telephone to speak too loudly. The outgoing signal that is fed through the switching circuit passes through the circuit, the on-hook/off-hook switch, and the diode bridge. The signal is then fed to the telephone line where it is connected to the telephone on the other end of the line by the telephone company. Incoming audio is fed by the telephone company through the line and into the telephone. This signal passes through the diode bridge, the on-hook/off-hook switch, and the switching circuit. The signal is then fed through the hybrid transformer and into the speaker. As can be seen from this example, an audio amplifier for the incoming signal is not always required.

Schematic diagram analysis

- **Ringer Circuit**

The ring buzzer (BZ1) and oscillator (Q101) are capacitively coupled to the telephone line. This is done to prevent the dc voltage from turning on the oscillator. A 27V zener diode (ZD101) is also connected between the oscillator and the telephone line to prevent small signals, such as dial tones or audio, from triggering the oscillator. The high-voltage ringing signal (at least 40Vrms at 20Hz) exceeds the zener voltage turn-on point and provides power to the 2.8kHz oscillator. Power derived from the 20Hz ring signal is essentially a 20Hz square wave that interrupts the 2.8kHz oscillator at a 20Hz rate. This signal is generated when the ringing signal is active.

- **Diode Bridge**

The diode bridge (D101 to D104) is in the circuit so that the polarity of the voltage applied to the dialing IC and transistors will remain the same even if the polarity of the 48Vdc provided by the phone company is reversed.

- **Dialing circuit**

The dialing keypad is connected to the IC where each digit that has been dialed is read. Because this is a pulse-dial telephone rather than a tone-dial telephone, the dialing IC releases a corresponding number of pulses for each digit. A storage device in the dialing IC allows the digits to be dialed faster than they are clocked out. An oscillator (CR101) inputs a 480kHz signal to the dialing IC so that the dialing pulses are clocked at a steady rate. These pulses are fed to a switching circuit (Q102 and Q103) that turns on and off to simulate an on-hook/off-hook condition. When the telephone is hung up, the last number dialed is

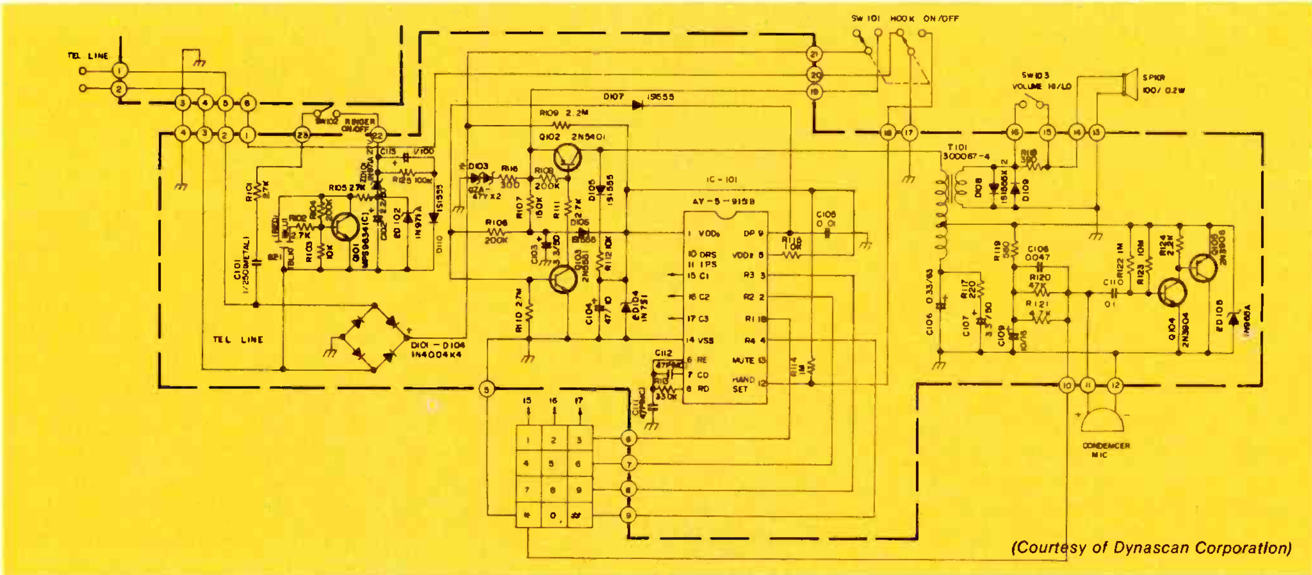


Figure 3. The schematic diagram of this phone illustrates its all-electronic nature. The IC in the center generates dialing pulses and stores the last dialed number for redial.

latched into the memory so that it can be released when the redial button is pressed.

• Hybrid transformer and microphone amplifier

When you speak into the microphone, the signal is amplified by the microphone amplifier so that it can be transmitted over the telephone line. The primary winding of the hybrid transformer acts as the audio load for the microphone amplifier. The microphone amplifier varies the current through the primary of the hybrid transformer at the microphone audio rate, and thus through all series circuits including the telephone line and the voice transformer at the telephone exchange. Some of the microphone audio is also coupled into the secondary winding of the hybrid transformer. This signal, known as sidetone, is applied to the speaker at a low level.

Incoming audio is also in the form of current variation on the telephone line. This current variation is fed through the diode bridge, the on-hook/off-hook switch, the switching circuit and the hybrid transformer. The audio variations are coupled to the secondary of the hybrid transformer and to a pair of diodes. These diodes protect the speaker from spikes that might be present by clipping off any signal above the forward voltage drop of the diodes. The signal from the diodes is then fed to a 100Ω, 0.2mW speaker.

Test equipment

Testing and troubleshooting telephones will require some special techniques and equipment. For example, because the telephone has no internal power supply, an external power source is always needed. However, in order to provide realistic operating conditions this cannot be a rock-solid filtered dc voltage connected directly to the telephone terminals. Audio and dc are both carried on the telephone line, and a series resistance must be connected between the power supply and telephone to act as audio load and to drop the voltage down to a safe level at the telephone. For testing "worst case" conditions, it is best to simulate a long telephone line. A −48V power supply connected to the telephone through a 3W, 1.5kΩ resistor is satisfactory.

Audio testing is simple and requires no special equipment (other than the power supply). An audio signal generator and voltmeter are sufficient.

To test ringing, a 100Vac rms (280V p-p) 20Hz sine wave signal is needed. A 20Hz signal at a lower level is also needed to simulate the impedance drop of a long telephone line. This is probably the most special test circuit needed; signal generators simply do not supply the amplitude required. In regard to testing techniques, ringing voltage should be applied to a telephone only when it is on hook.

To diagnose dialing problems, an oscilloscope can usually check dial pulses, while an oscilloscope and frequency counter can usually check the level and frequencies of a DTMF dialer if the individual oscillators are probed. A more convenient set-up would include a dial-pulse decoder and DTMF decoder with some type of readout to determine whether the correct digits are generated.

The B & K-Precision model 1045 telephone product tester will test telephones, answering machines, telephone dialers, and the telephone portion of cordless telephones. It also includes short circuit and continuity tests for detachable telephone and handset cords. The special test circuits described in this article are built in to eliminate time-consuming special setups. The Model 1042 telephone line tester can be used by the telephone owner to isolate between telephone and telephone line problems, which can avoid an expensive service call to the telephone company if the telephone line is not at fault. ES&T

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The LCD provides excellent resolution, 128 dots by 64 dots, for waveform displays. It measures 4-5/8 in. (118 mm) x 1-5/8 in. (42 mm). Simultaneous display capabilities let you use the scope portion of the LCD to evaluate signal characteristics while the DMM portion displays the true RMS signal value. Your measurement evaluations will be more accurate and consistent.

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An impact resistant case protects the M 2050 DSM. When open, the display angle is easily adjustable. When closed, the display and the controls are protected, the meter shuts itself off, and the tilt bail becomes a carrying handle.

Affordable and Available

The price of the M 2050 DSM is only $1,795.00 (for the optional analog output, add $200.00). Rechargeable batteries for 8 hours of portable operation are available for $35.00

BBC's M 2050 DSM and other innovative instruments are available via select distributors throughout the U.S. If your instrumentation supplier doesn't carry BBC yet, we'll gladly tell you who does. Call toll free:

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Circle (9) on Reply Card

Chemicals in electronics

By Larry S. Davis, regional sales manager, Chemtronics

Servicing technicians and consumers have available an array of chemical tools for cleaning, insulating, cooling and lubricating.

Today's electronic technician has a myriad of precision instruments and tools available to assist in the repair and diagnosis of modern, complex equipment. Some of the most misunderstood and least appreciated of these tools are the electronic chemicals found on the shelves of electronic distributors throughout the country.

Chemicals that are designed specifically for the electronics industry are as useful a tool as the frequency generator, video analyzer, multimeter, oscilloscope or screwdriver. Used correctly, the proper chemical can save the technician hours of valuable time while increasing productivity and cost efficiency.

Electronic chemicals can be classified as degreasers, solvents, flux removers, lubricants, contact cleaners, tuner cleaners, antistatic sprays, freezing agents and conformal coatings. Most of these consist of various blends of fluorocarbons and other solvents.

Generally, there are two types of fluorocarbons used in aerosol contact and control cleaners: Freon 11 and Freon TF. These are cleaning agents that dissolve oils and greases but will not adversely affect most metal contacts or common plastics. Freon 12 does not have the cleaning properties of Freon 11 or TF, but is used primarily as a circuit cooler.

At earlier stages in the development of electronics, carbon tetrachloride and trichlorethane were the most commonly used cleaners. However, both of these solvents are highly toxic and very limited in usage. Fumes from carbon tet were more than 200 times as toxic as those of modern cleaning agents. Freon 11 and Freon TF are non-toxic and stable and have no adverse effects on plastic.

Tuner cleaners

Defective TV tuners are accountable for a wide variety of problems: snowy pictures, noisy reception, loss of sound and/or picture, flashing picture and picture distortion.

Dirty or corroded contacts are the primary cause of tuner malfunctions. A good tuner cleaner and lubricant is essential in eliminating most of the problems associated with poor tuner contacts. A tuner "wash" with a blend of fluorocarbon solvents is the ideal first step in tuner maintenance. Used in aerosol form, this concentrated formula degreaser removes oil, dirt and gunk from contacts and eliminates built-up oxidation while leaving parts and contacts totally clean.

Using a tuner wash is simple. Remove the tuner, then open and carefully spray the contacts, rotating the tuner as you spray. The force of the spray alone will help eliminate much of the dust and dirt. Be certain that the tuner wash you use is a non-residue cleaner that is safe for plastic parts.

The second step in tuner maintenance is just as important as the first. An application of a good cleaner/lubricant will help keep your tuner maintenance free for long periods of time. The most effective cleaner-lubricants contain small polishing particles that remove oxidation and corrosion from contacts, leaving the tuner in like-new condition. A valuable additive to tuner cleaners is a chemically inert lubricant that protects contacts and prolongs tuner life. Tests have proved that properly lubricated tuners can last for as long as 40,000 revolutions, whereas the typical life of an unlubricated tuner is 18,000 revolutions.

Proper application of a cleaner/lubricant is similar to that of a tuner cleaner. Spray all contacts, rotate, check stator contacts to assure they press against rotor contacts with enough pressure to ensure positive contact and good cleaning action. For periodic maintenance, use a *light duty* cleaner lubricant.

Many customers who had given up on their televisions because of snowy pictures are amazed to find their sets working like new after an experienced technician has performed his "chemical magic."

Component/circuit coolers

Detection of defective components that are heat sensitive can be simplified by the use of circuit coolers. Failure of resistors, transistors, capacitors and other component parts is frequently induced by heat. A spray application of a refrigerant, usually Freon 12, cools circuits instantly to $-65°F$ ($-54°C$), in many cases temporarily restoring the suspected component. Thus, the thermal intermittent is quickly and accurately pinpointed allowing for a quick replacement.

There are other uses for component coolers as well. To locate cracks in PC boards, for example, spray the copper foil circuitry. This will cause it to frost and turn white, exposing the crack. When soldering heat sensitive components, spray and chill components before soldering for maximum protection. To prevent cold solder joints, instantly cool the fresh solder joint to prevent wire movement before the solder solidifies. Coolant spray can also be a good way to limit transformer damage. Pull the plug, then spray the smoking transformer to cool it quickly.

Another use for refrigerant includes the quick removal of adhesives. For example, chewing gum stuck on carpet will come up instantly without damage to the fiber after an application of circuit cooler.

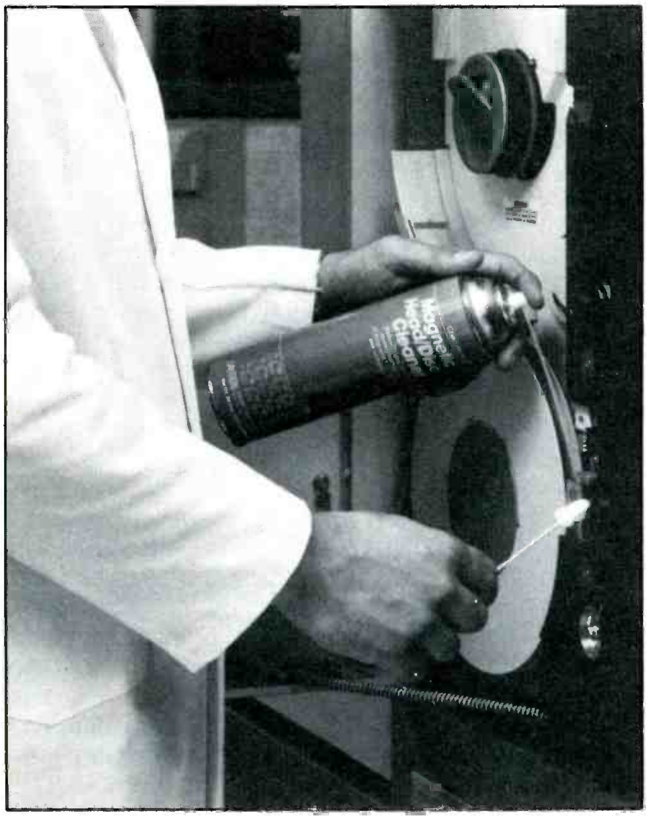
It is desirable to have a variable control valve for maximum freeze spray efficiency. If a pure Freon 12 product is used, it will be non-drip and non-residual.

Flux removers

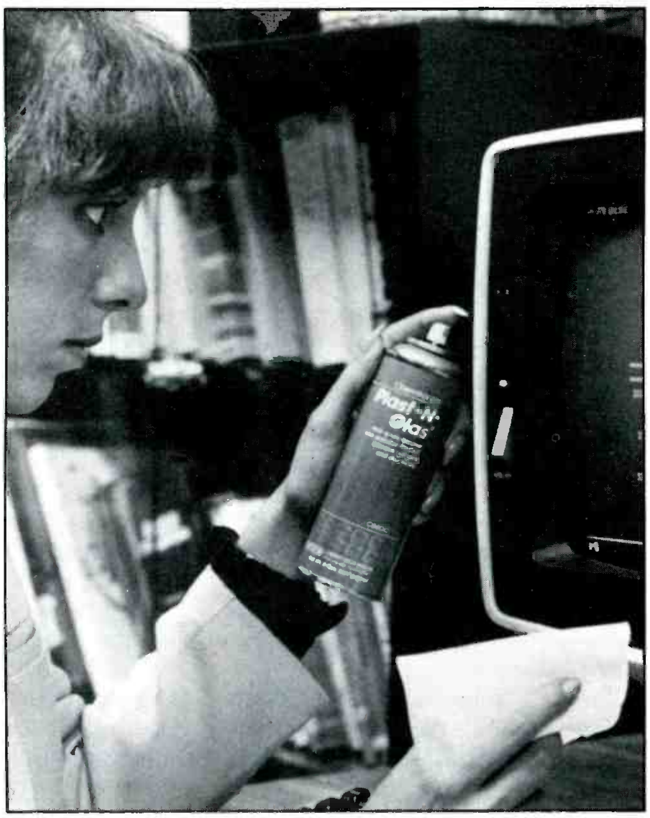
A good flux remover is an exceptionally useful product in electronic production, rework and repair. Again, a Freon solvent blend in aerosol form is ideal for removing flux after soldering. The aerosol is additionally important here, as it provides a constant supply of *fresh* solvent to prevent recontamination. This product is available with CO_2 as a propellant, helping to remove stubborn contaminants without brushing or scrubbing.

When selecting a flux remover you should consider the type of rosin to be removed, ease of application, and operator safety.

Several additional applications



Mixture of Freon TF and isopropyl alcohol under pressure of CO_2 propellant penetrates and flushes away contaminants on magnetic tape or disc heads. The cleaner dries instantly, requiring no wiping and leaving no residue.



Information of all kinds is increasingly being displayed on CRT screens. Aerosol preparations that clean, polish and remove the static charge on these screens make this information easier to read.

for flux removers include removing mounting wax on silicone wafers, removal of organic soils from PC boards and computer cores, and removal of molding compounds from miniature connections.

High voltage insulator

Another beneficial addition to the technician's tool kit is a good, all-purpose insulating spray. This differs from the previously discussed chemicals as it contains a hard, insulating acrylic resin. When applied, this acrylic coating is highly resistant to environmental extremes such as moisture, oils, acids and alkalis. It stops arcing and corona shorts, insulates against RF high-voltage leakage as high as 25,000 RF volts, leaving a protective coating that permanently restores insulation. A good, high-voltage acrylic insulator such as No-Arc is recommended for RF transformers, motors, electrical wiring and PC boards.

Audio equipment maintenance

The increase in the number and variety of audio/video products has been accompanied by an increase in audio/video maintenance. An important requirement for chemicals used in this area of electronic maintenance is *non-contact* cleaning. It is imperative that delicate magnetic heads and computer discs be handled as infrequently as possible. Magnetic Head/Disc Cleaner contains Freon solvents and isopropyl alcohol that are specially formulated and packaged in aerosol containers. When sprayed on equipment, this chemical safely removes dirt and oxide buildup from audio/video heads and computer discs. This product is non-residual, evaporates instantly, and can be used to maintain rollers, guides, capstans and tape transport components. This Freon blend is safe for use on plastics, rubber and disc coatings. Used in periodic maintenance routines, a head and disc cleaner can improve machinery performance while extending tape life.

Another product that can be used in conjunction with the above is an ultra-pure, moisture-free, inert gas for dust and lint removal from tape heads, computer discs, optics, camera lenses and electronic devices. Non-abrasive and non-residual, 70 pounds of pressurized gas is an inexpensive and time saving method that can be used by the knowledgeable electronics technician.

Desoldering braid

Desoldering braid is a pure copper braid that has been impregnated with pure rosin flux. As the wick is placed between a soldered joint and a source of heat, usually a soldering iron, the solder is absorbed by the braid as it melts. This process quickly and efficiently desolders the joint.

Desoldering braid has been found to be more efficient and convenient than conventional suction devices and is gaining increased popularity within the areas of electronic production and repair. Desoldering braid, or wick as it is sometimes called, is available in a wide variety of gauges (from 0.25-inch to 0.190-inch) and spool sizes (5 feet to 500 feet), helping to fulfill every requirement of the electronic technician. ES&T

Troubleshooting Tips

Testing diodes
All new color receivers

More and more diodes are testing normal on all our diode/transmitter testers, including those that measure the typical voltage drop produced by a constant current, although replacements prove they actually are defective.

We have found a way of identifying this kind of bad diode: by testing the diode capacitance with a Sencore "Z" meter. A good diode will show between 2 and 5pF (sometimes higher), while the bad diodes give a capacitance reading of 0pF.

Now we test all suspected diodes both ways (in a diode tester and by capacitance reading). It has saved us hours of time otherwise wasted.

Jack A. Houser
Rensselaer, NY

Editor's note: In the **ES&T** lab, we tried to duplicate these readings, but a Sencore "Z" meter was not available. Also, we had no diodes that were defective in this way (possibly opening when subjected to current pulses). A B&K-Precision model 820 digital-readout capacitance meter produced readings between 22pF and 27pF for six silicon diodes. Germanium diodes and transistor junctions evidently had excessive leakage because they activated the overrange indication. Digital capacitance meters apply a constant charging current to each capacitance for a precise amount of time and then measure the developed voltage across the capacitance. Therefore, excessive leakage or slow charge and discharge will produce incorrect readings. Perhaps this explains the results Houser obtained when using the Sencore instrument. If you have results from similar tests, write to the editor of **ES&T**.

Have you solved a difficult troubleshooting problem? Send your solution to:
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73
320.0
VAC
OFF
300mV
10A
UNFUSED
COM
75
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Report from the test lab: Fluke DMM

By Carl Babcoke, CET

Each report about an item of electronic test equipment is based on examination and operation of the device in the ES&T laboratory. New and useful features are discussed, along with tips about using the equipment for best results. Personal observations are given about the performance or other important attributes.

The model 77 portable digital multimeter is the best of the Fluke 70-series. Models 73 and 75 are similar to model 77, but with fewer functions and features. One unusual feature of all the models is a 3½-digit liquid-crystal display showing counts up to 3200 (most DMMs stop at 1999). This provides the accuracy of a 4½-digit meter for many readings. Autoranging, manual range selection, *touch hold*, a continuity beeper and a fast-acting analog display are additional features.

Fluke 70-series digital and analog readouts

Four 7-segment LCD digits make up the digital display. These digits are sharp and black with high contrast. The first digit at the left can display only a number 1, 2 or 3, while the other three digits can form any numeral from 0 to 9. These digital numbers are updated about 2½ times per second.

Model 77 from Fluke is one of three in the 70-series line. Digital readings that cover 3200 counts (vs. 1999 for most others), Touch Hold, autoranging or manual selection, and an analog indication of the digital reading are some of the features of this 3½-digit digital multimeter.

Below the digital display is the analog display, which is made up of black squares with a tall rectangle at 0 counts, 10 counts, 20 counts and 30 counts. Shorter rectangles replace squares at 5, 15 and 25 counts.

When the DMM is switched to measure ac or dc voltage, but there is no input signal, the bar graph cannot be seen. As the input voltage is increased slowly, the bar graph extends in step to the right, one square at a time (Figure 1). In other words, *the bar-graph length depends on the input voltage* (current or resistance) relative to the range in use at that time. For example, a voltage of 30V on the 32V range (3200 count) produces almost-maximum length of the bar graph. But if the same 30Vdc is displayed on the 320V range, only three or four of the bar-graph squares will be visible; the analog bar graph will be short.

Movement of the bar-graph is rapid, but not instantaneous. According to the specifications, the analog readings are updated 25 times per second. I estimate that about 0.1 second is required for the bar graph to extend (apparently) from zero to full scale, or from full scale back to zero. This is rapid enough for most continuity tests and nulling or peaking indications.

A large negative sign is provided for the digital readout, while the analog display has small positive and negative symbols. These other LCD symbols are made visible at appropriate times: a low-battery-voltage symbol; a circle with small square for *range hold* or *touch hold;* VAC for ac-voltage readings; VDC for dc-voltage readings; and M, K or Ω for resistances. Decimal position is moved automatically according to the range in use. Overrange readings activate the OL symbol, and an arrow appears at the right end of a full-length analog bar graph. See Figure 2.

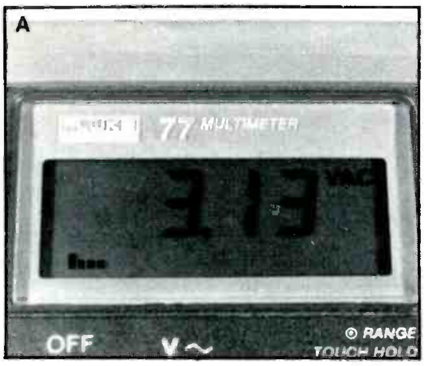
If the DMM is left turned on but without any change of readings for one hour (or 20 minutes in the diode-test mode), the display is blanked automatically, as the meter reverts to standby condition to minimize current drain on the 9V battery.

Each time the DMM is turned on after being switched off, it goes through a rapid self-test that includes displaying all LCD segments, numbers and symbols for a few seconds. If everything checks out right the meter chirps once. At this point, the appropriate symbols for the function selected are displayed, and the meter is ready for use.

Autoranging

No ranges are indicated on the LCD display or printed on the panel. (The instruction manual shows how to determine the range that is in use by the number of digits and the position of the decimal.) When the DMM is first turned on, the meter is in the autorange mode. The DMM selects the range that provides the best resolution for each measurement. During upward ranging, the display shows OL, while down-ranging blanks the digital display.

Any range can be selected manually as follows starting with the model 77 turned off, and before the test leads are connected to any signal, turn the rotary knob to the desired function (except 300mV or diode/continuity). After the self-



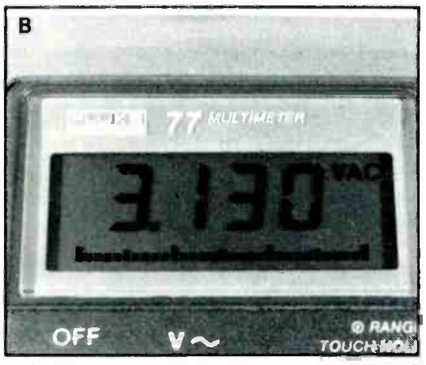


Figure 1. Length of the analog bar graph (below the digits) depends on the input signal relative to the range of the digital display. (A) A 3.13Vac signal displayed on the 32Vac range produces a short analog graph of less than 10% of a complete bar graph. A voltage of 16V should produce a 50% bar graph, etc. (B) The same 3.130Vac voltage produces a complete bar graph when the 3.2V range is selected. Notice the Vac symbol that shows the ac-voltage function has been selected.

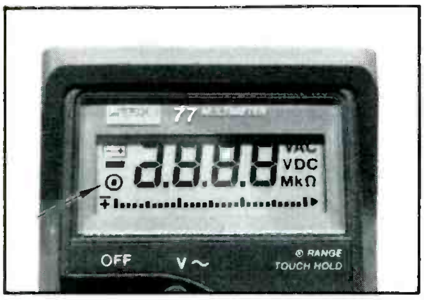


Figure 2. During the internal self-test procedure (which model 77 performs immediately after power is applied to the meter), all LCD symbols, digits, decimals and the complete bar graph are made visible. The arrow points to the manual range-advance symbol on the LCD display. The same symbol is used by model 77 to show when Touch Hold is activated.

test display has been shown and is blanked out, immediately press the button at the center of the knob. The range-hold symbol (a circle with a small center square) then appears at the left of the digital display, indicating that the range-hold is in effect on the lowest range. Try making the measurement. If a normal digital reading is displayed, this lowest range is sufficient, and the measurement is finished.

If OL is displayed instead of a reading, however, press the range button again to select the next higher range, and check the display. A normal reading stops the process. Otherwise, press the range button and observe the readout for a proper display. Continue this upranging procedure until OL is replaced by a normal digital reading.

When several measurements of approximately the same readings are needed, there is an easier method for finding and locking the best range. Use autoranging for the first measurement, notice that the desired resolution is obtained, and then before the probe is removed from the tested circuit, press the range button to lock the autoranging on that range.

After the need for manual range selection is over, you can return to autoranging in either of two ways: press on the range button for one second (the meter chirps once in confirmation) or turn the meter off and back on again.

Touch-hold feature

The *touch-hold* mode can be valuable for measurements where the probes are in a congested area that brings the danger of shorts or opens when you have to look from the probes to the meter display. With *touch hold* activated, when the probes are removed from the circuit, the most recent reading taken remains on the display until another measurement is made or the meter is turned off.

Touch hold is activated by starting with the meter switched off. *Press the range button* (at the knob's center) *while you rotate the function switch* to the desired function. The *touch-hold* symbol in the readout should become visible to indicate that the touch-hold mode is activated. *Touch-hold* measurements *always* are made in autoranging; it is not possible to select ranges manually at these times.

When probes are touched to a circuit, the digits are not shown on the display until a stable reading has been achieved. Then a chirp is heard and the reading appears. If the probes are removed from the circuit, or if they are shorted to each other after voltage tests, the reading remains frozen until another reading is made or the meter is switched off. While *touch hold* is active, the manual-range/touch-hold circle with its center square is visible to the left of the digital reading. The few *touch-hold* limitations are explained in the instructions.

Once *touch hold* has been activated, it remains operational even when functions are changed and ranges are autoranged, until the meter is turned off.

Diode tests with chirps

A diode symbol (Figure 3) identifies the diode voltage-drop test. A constant current of about 1mA is supplied to the transistor junction or diode while the *voltage drop* produced by the current is measured (up to 2V maximum). A single chirp is sounded when the reading is between about 0.100V and 0.700V. A continuous tone is heard for readings less than about 0.100V, while no chirp or tone is produced from OL readouts (open circuits).

The typical diode voltage-drop readings are less than with other brands of meters that supply 3mA or 5mA to the diode. However, the

Fluke test is valid and valuable. I strongly recommend its use with transistor junctions or diodes.

Continuity beeper

The diode and continuity tests are combined. A resistance of less than about 150Ω across the test probes produces a constant tone. Higher resistances, including open circuits, produce no tone. In addition to continuity tests of wires and switches, this test is excellent for finding intermittent opens, because the tone chirp starts and stops quickly.

Dc-voltage tests

The five dc-voltage ranges have these maximum readings: 320mV; 3.2V; 32V; 320V; and 1000V (Figure 4). The last four can be selected by autoranging or by manual ranging. All dcV ranges have 10MΩ input resistances.

Several quick tests were made to find approximately where upranging and downranging occurred. The 320mV range gave readings up to about 326mV before autoranging switched to the 3.2V range. Similarly, the 3.2V range displayed voltages up to about 3.260V before overranging to the 32V range. Decreasing the test voltage from 3.270V down to about 2.800V was required on the 32V range before the meter downranged to the 3.2V range. In other words, a large hysteresis is provided between upranging and downranging to prevent ambiguous readings or unnecessary range changes with varying signals.

Accuracy of the 320mV through 320V ranges is specified at 0.3% plus one digit, while the 1000V range has an accuracy of 0.4% plus one digit. Notice that the resolution of all readings between 2000 count and 3200 count (for example, 2.000V to 3.200V) equals the resolution of a 4½-digit meter that reads only to a 19,999 count (1.9999V, for example), because 3.200V on the 4½-digit meter would require the 200.0V range and show a reading of 3.200V – exactly the same as on the 3½-digit Fluke model 77. The VDC symbol is visible for all ranges of dc-voltage measurements.

Ac-voltage tests

Ac-voltage ranges are 3.2V, 32V, 320V and 750V. Evidently, the circuit yields the average voltage that is converted to rms for sine waves. This will produce moderate errors on many nonsinusoidal waveshapes. Overranging appears to occur at the 3200 count point, with downranging at about 2800 counts, as is true of dcV.

Input impedance is 10mΩ for all ranges, paralleled with 50pf or less. Frequency response appears to be about average for digital meters. On the 32V range, –1dB was measured at 3kHz, while the –2dB point was at 20kHz. However, the 3.2V range was not that flat. Most digital meters that have a high input resistance show similar variations of high-frequency response among various ranges. If flat frequency response over the audio band is important to you, I advise you to measure the actual response of the bands that will be used, and then make a correction chart for use later.

Resistance tests

The six resistance ranges have the following full-scale readings: 320Ω, 3200Ω (Figure 5), 32KΩ, 320KΩ, 3.2MΩ, and 32MΩ. Accuracy varies from 0.5% plus two digits for the 320Ω range. 2.0% plus one digit for the 32MΩ range, and 0.5% plus one digit for all other ranges.

These ohmmeter ranges are low-power types. It is not necessary for them to produce diode conduction, because the diode test does that task much better than any

Figure 3. The diode symbol with the audio-sound symbol identifies the combined voltage-drop diode (and transistor junction) test and the continuity indication. Both tests have an audio tone or a tone chirp under certain conditions.

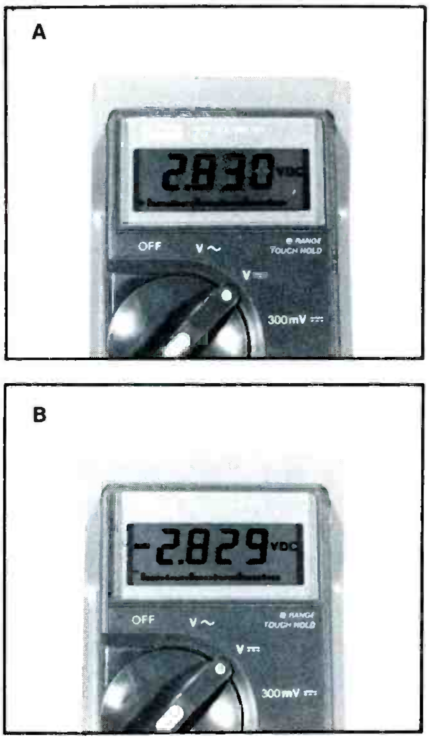


Figure 4. A positive dc voltage (notice the VDC symbol) produces a positive polarity sign on the analog bar graph (A) but no positive symbol before the digital readout. (B) Reversed test probes produce virtually the same digital readout but with negative polarity signs before the digital and analog displays. Automatic upranging occurs slightly above the 3200 count, while downranging occurs at about a 2800 count.

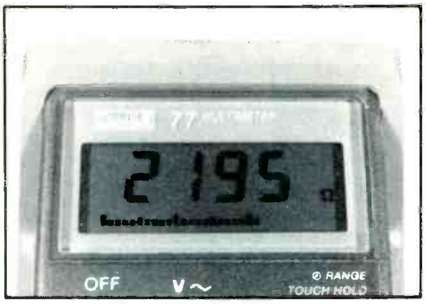


Figure 5. A 2200Ω resistor tested 2195Ω on the 3200Ω resistance range. Notice the corresponding analog bar-graph indication, and the ohms symbol at the right.

Figure 6. A handy accessory is the plastic holster that cradles the model 77 DMM. Grooves and space are provided for storage of the test probes. Two belt loops are provided. One allows the meter to be hung from the belt for transportation. The other loop, with the plastic strap that is pictured, holds the meter out straight where the readouts can be viewed. This no-hands operation is convenient when the test points are difficult to find and to touch with the probes.

ohmmeter can. Maximum voltage when infinite resistance is across the test leads checked about 2.5V, with the red lead positive. However, full scale readings had less than 0.3V at the probes. A 2200Ω resistor on the 3200Ω range had 0.243V. A 3.40K resistor on the 32K range had only 0.041V. Therefore, no significant errors should result from measuring resistances in circuits that contain transistor junctions and diodes.

Current tests

Ranges for ac and dc current are the same (32mA, 320mA and 10A), but the accuracy is different. All three ac-current ranges are rated for 3% plus 2-digit accuracy over a frequency response of 45Hz to 1kHz. Accuracy of the dc-current ranges is 1.5% plus two digits for the 32mA and 10A ranges, and 2.0% plus two digits for the 320mA range.

Fluke model 75 has the same current ranges with the same accuracy, while model 73 has only the 10A range.

Accessories

The C70 multipurpose Holster is included with each Fluke model 77 DMM, and it is optional at extra cost for models 73 and 75. This holster provides protection from mechanical shocks, holds or stores the test leads, acts as a tilt stand, clips on the belt for convenience, or, used with the neck strap, allows hands-free operation with full visibility of the readouts while the holster is clipped to your belt (Figure 6). A C71 soft vinyl case with belt loops is available. Other extra-cost options include temperature probes, RF probe, 6kV and 40kV probes for dc voltages, and two ratings of current clamps for measuring ac current to 600A.

Fluke 70-series DMMs

Fluke model 73 is similar to model 77 (described here), but has lower accuracy. Diode and continuity tests do not have an audible tone indication. Only the ac and dc 10A current ranges are included. *Touch hold* is not included. Model 75 is almost identical with model 77, but with accuracy between models 73 and 77. The *touch-hold* feature is omitted.

Comments

Operating the Fluke model 77 was a pleasure; it performed all tests flawlessly. I particularly liked the *touch-hold* feature that retains a frozen reading on the display until a new measurement is made. This mode can prevent most damage to electronic circuits that are undergoing tests. When component density is very high (as around ICs), the slightest slip of a test probe can ruin many expensive (and often hard to replace) components, and waste much time used for repairing this unnecessary damage.

Successful in-circuit tests are made possible by the combination of low-power ohmmeter voltages and voltage-drop diode tests with indicating audible chirps. It is seldom necessary to disconnect components before these tests.

Another outstanding feature is the analog display, which gives a rapid indication of the tested signal relative to the full-scale value of the range in use. The analog indication is useful for identifying erratic contacts or open circuits. Also, it makes peaking and nulling adjustments rapid and simple.

Appearance of the Fluke 70-series digital multimeters is muted, with dark gray plastic case and markings of white, red and purple.

The Fluke model 77 DMM should be more than satisfactory for all types of electronic servicing. ES&T

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Compiled by Warren G. Parker, Metairie, LA

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VCR basics

By Steve Bowden

Although audio-recording and video-recording basic principles are identical, it is more difficult to obtain acceptable video recording/playing quality. The video circuitry is more complicated, and the mechanical operations must have much tighter specifications.

Wider bandwidth a problem

One reason that video presents complications is found in the wider bandwidth compared to audio recording. The audio-frequency range is between 20Hz and 20kHz, which is slightly less than 10 octaves (one octave in music is the interval between a frequency and double or half that frequency). In contrast, the 30Hz-to-4MHz video bandwidth spans slightly more than 17 octaves (Figure 1).

Flat audio response between 20Hz and 20kHz is difficult to obtain, usually requiring a fast tape-to-head speed and large amounts of frequency equalization during recording and playing. About 10 octaves represents the *practical* bandwidth limit when recording audio or video by pulling a magnetic tape past a stationary head. A poor-quality video signal could be recorded at fast tape speed past a stationary head, but the tape reel would have to be impractically large.

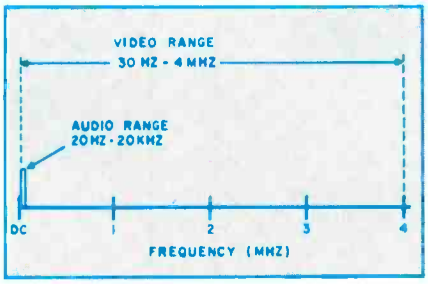


Figure 1. The problem of reproducing the 4MHz bandwidth of the video signal is solved by translating it upward in the frequency spectrum, where it occupies one octave instead of 17.

Figure 2 shows how a null (zero output signal) always results at some frequency from any combination of head gap and tape speed. This null and the falling frequency response just preceding it are the reasons that the bandwidth cannot be extended upward indefinitely by equalization alone. As explained in Figure 2, the combination of head gap and tape speed determines where the points of maximum output and zero output (null) occur. Therefore, the high-frequency response can be extended by narrowing the head gap, increasing the head-to-tape speed, or both.

The unequalized magnetic-head response is shown in Figure 3. Notice that several nulls are produced, but no amplitude above the lowest-frequency null has any practical value. Equalization can flatten out the 6dB per octave slope to the left from the maximum point, but equalization is not very effective when applied above the maximum-amplitude frequency. Only a narrower head gap or a faster tape-to-head speed can move that maximum point up to a higher frequency.

Move the range upward

An excellent solution to the large bandwidth for video signals is to move the required 4MHz range upward in the frequency spectrum so fewer octaves are needed. For example, 30Hz to 4MHz is slightly more than 17 octaves, but if this approximately 4MHz band is moved up so it occupies the space between 4MHz and 8MHz, only one octave is needed. Very little equalization is required to obtain flat response over one octave. All modern videocassette recorders incorporate this principle, although the details are different.

VHS-type recorders use a carrier that rests at 3.4MHz when there is no video modulation (Figure 4). With video modulation, the composite sync tips (blacker than black) produce 3.4MHz while maximum peak white in the video swings the frequency to 4.4MHz. Sidebands of the video require the range between 2MHz and 6MHz.

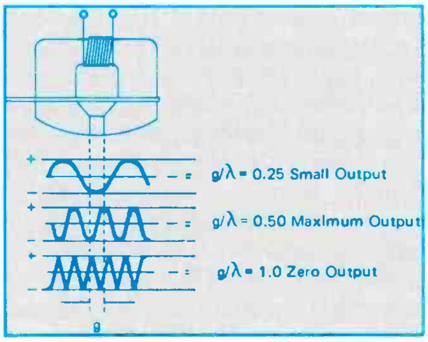


Figure 2. When recording-head current is held constant for all frequencies, the amplitude of the playback-head signal depends on flux strength *across* the head gap. This is in turn dependent on the ratio of head gap to wavelength.

Also, notice that VHS chroma is downconverted from the composite-video 3.58MHz frequency to 629kHz. This low frequency prevents beat products from forming with the varying-frequency FM carrier. Clearly, the video and chroma must be separated before each is recorded.

Helical scanning

VHS machines operate with the video tracks slanted across the tape's width. As shown in Figure 5, the two tape guides and the head cylinder are tilted (relative to the machine's base plate). Therefore, when the tape is pulled around the cylinder (by the capstan drive) and the two video heads rotate in a circle at 1800 revolutions-per-minute (rpm), a slanted track is recorded by each video head. The tape is wrapped 180° around the head cylinder, and the heads are 180° apart, so only one head contacts the tape at a time as it scans from the bottom to top of a slanted track. Of course, the heads must trace these same paths during playback.

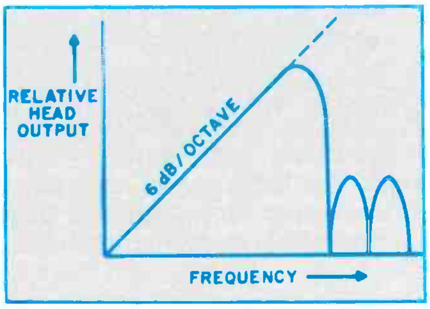


Figure 3. Without equalization, this playback response is obtained from constant-current recording. Maximum response occurs at the 2-wavelength point. For frequencies above the peak, the response falls rapidly to a null (zero output) at the 1-wavelength signal frequency.

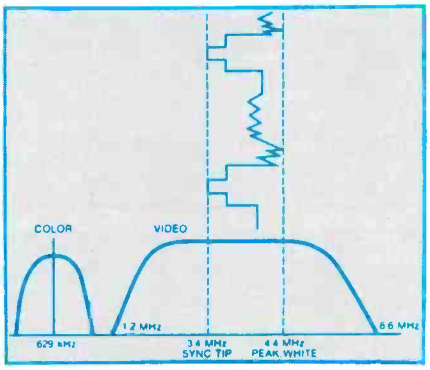


Figure 4. Equalization is made easier by moving the 4MHz bandwidth up higher in frequency. VHS machines record the luminance signal as an FM carrier whose frequency changes according to amplitude variations. The color sidebands are separated and recorded at 629kHz.

One video field is recorded (or played) by each head on each slant track. One field of 262.5 horizontal lines is placed on each 3¾-inch recorded track (Figure 6). One revolution of the head cylinder allows each of the two heads to cross the tape diagonally one time, thus one cylinder revolution records two fields or one video frame.

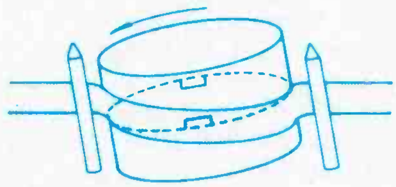


Figure 5. The tape travels parallel to the base plate, but the guides and cylinder are tilted so the tape travels around half the cylinder at an angle. When the video heads rotate, diagonal tracks are recorded. This provides a fast head-to-tape speed and records one video field per track.

Figure 7 shows a drawing of the ½-inch-wide videotape with the audio track at the top, the control track (for the 30Hz control pulses) at the bottom, and the diagonal video tracks in the center of the tape. The 30Hz pulses are placed there during recording, and they control playback synchronization.

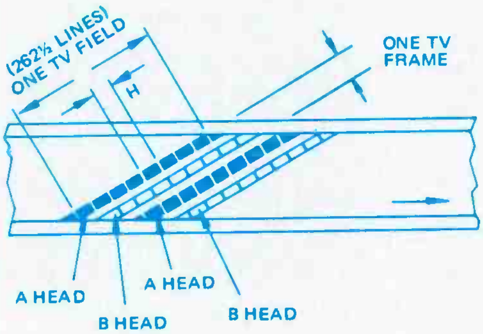


Figure 6. Each of the two video heads records a track having 262.5 lines of video. Then each pair of tracks has one complete video frame of 525 lines.

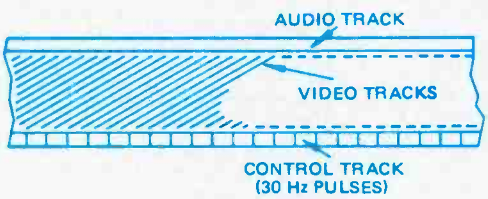


Figure 7. VHS machines record one audio track along the top of the tape, a control track for 30Hz pulses along the bottom, and diagonal tracks from the video heads over the center.

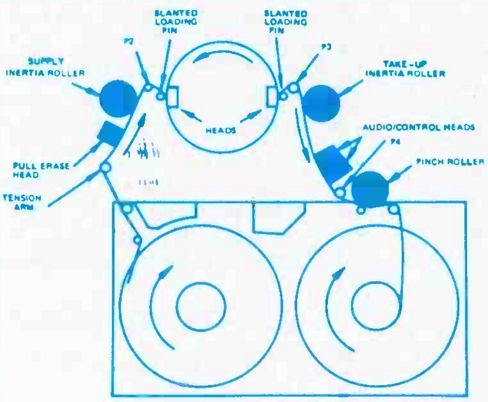


Figure 8. This drawing shows the tape path from the cassette, through the machine and back into the cassette.

The tape path through a VHS videocassette machine is shown in Figure 8. When a cassette is inserted and the machine adjusted to play or record, the slanted loading pins pull the tape out of the cassette and wrap it around the head cylinder. Posts P2 and P4 guide the tape, keeping it at the correct height and in a horizontal plane.

The tape moves from the supply hub on the left through the mechanism and on to the take-up hub in the cassette. The tension arm (at the left) provides back tension to the tape. The tape then passes the full-width erasing head where a 67kHz signal completely erases the entire tape width (including audio, control and video tracks) during recording. Two inertia rollers help maintain a constant tension on the tape. The slanted loading pins force the tape to travel around half of the head cylinder at an angle to the cylinder, but parallel with the machine's baseplate. After the tape passes around the head cylinder, it passes the audio/control head assembly, which actually contains three heads: one for audio recording or playing, another for erasing the audio, and a third for recording or playing the 30Hz control pulses. Next, the tape is pulled by the capstan-shaft/pinch-roller assembly before it is wound onto the take-up hub.

Three tape speeds are provided. They are 2-hour SP (standard play), 4-hour LP (long play) and 6-hour SLP (super long play). Only the capstan speed is changed to provide these tape-travel speeds. The heads continue to rotate at 1800 rpms.

Azimuth recording

When the SP mode is selected

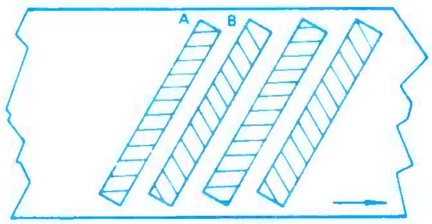


Figure 9. Crosstalk between adjacent video tracks is prevented by tilting the azimuth of one head +6° and the other −6°. At high frequencies, this prevents either head from picking up any signal recorded by the other head.

during recording, the high tape speed combined with the 1800rpm head rotation results in blank spaces between all adjacent video tracks on the tape. This prevents pickup of adjacent-track signals (crosstalk) during playback. With selection of LP recording, the tape speed is slowed while the head drum rotates at the same 1800rpm. Therefore, there is a small overlap of all adjacent tracks, allowing a weak pickup of crosstalk along with the correct signal. The situation becomes worse when the 6-hour SLP mode is selected, because the tracks overlap by about a third. Without some kind of correction, the SLP playback would have excessive crosstalk and beat patterns. These various types of crosstalk are eliminated by several methods and circuits.

Crosstalk of the FM signal is eliminated by a technique called *azimuth recording* (Figure 9). One video head has its air-gap azimuth tilted by +6°, while the other azimuth is offset by −6°. Within the high-frequency range of the FM video-recording signal, this total of 12° difference in azimuth effectively prevents either head from reproducing the track signal laid down by the other head.

Azimuth recording reduces crosstalk only at the high frequencies, such as the luminance FM signal. It is not effective at the lower frequencies (such as the 629kHz chroma signal) because the azimuth difference is not a significant factor at low frequencies. Another technique must be used for the chroma crosstalk.

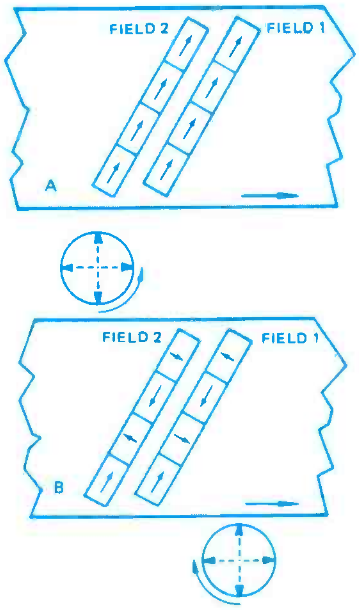
Rotary-phase recording

To cancel any pickup of crosstalk chroma signal from adjacent video tracks, *rotary-phase recording* is employed. The unwanted chroma crosstalk is picked up by the heads, but is canceled later.

If the chroma phase remained the same for each horizontal line of each recorded track, the phase could be represented vectorially as shown in Figure 10A. However, the VHS recorders rotate the phase before the chroma is recorded (see Figure 10B). The first horizontal line of field one is unchanged in phase. Line two is rotated clockwise by 90°. The third line is rotated again by 90°, making a total phase change of 180°. This goes on for the duration of field one.

Field-two line-one phase is unchanged, but line two is shifted 90°

Figure 10. VHS machines rotate (in one-horizontal-line steps) the phase of chroma. (A) the phase of the incoming chroma is the same for all horizontal lines. Each block represents one line of video or chroma. (B) For Field 1, the first chroma line is recorded with unchanged phase. Line two is rotated 90° clockwise. Line three is rotated an additional 90°. Line four phase is rotated another 90°, and so on for all horizontal lines of that field. Field 2 is manipulated similarly, but the rotation is counterclockwise.



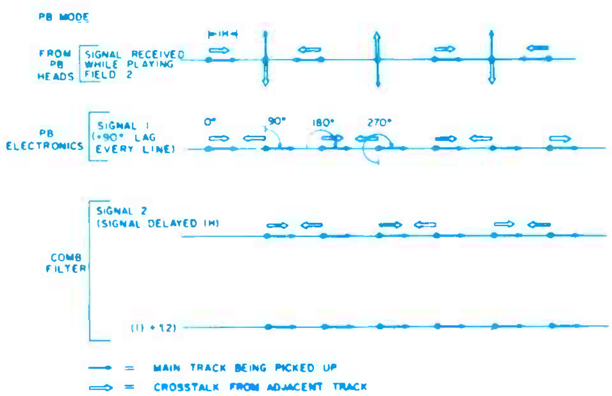


Figure 11. This chart shows the phase progression through six horizontal lines of chroma. After the chroma is sent through a comb filter and the two signals are added vectorially, the crosstalk is canceled, leaving the chroma without interference.

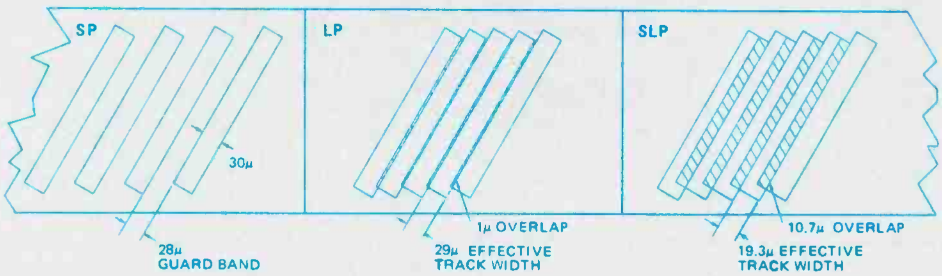


Figure 12. With standard play (SP) mode, the video tracks have a wide space between them. In LP mode, there is a slight overlap. A large degree of overlap is produced by the SLP 6-hour mode. Overlapping produces beats, unless corrected.

counterclockwise. Line three is shifted clockwise by 90°, making a total of 180°. Line four phase also is shifted clockwise by 90° for a total of 270°. This sequence is repeated for all remaining horizontal lines of field two.

Rotary-phase playback

As the video head scans field two during playback, it will also pick up crosstalk from field one. Figure 11 shows the mixed signals received during playback of field two. Solid arrows represent phases of the desired chroma in field two, while the outlined arrows represent phases of the field-one crosstalk signal that has been picked up by the overlapping tracks.

During playback, the chroma signal with crosstalk is phase rotated again with the same 0°, 90°, 180° and 270° sequence (signal 1 in Figure 11). Signal 1 then is passed through a comb filter that delays the signal by the time of one horizontal line, producing signal 2 which is vectorially added to signal 1 so the crosstalk

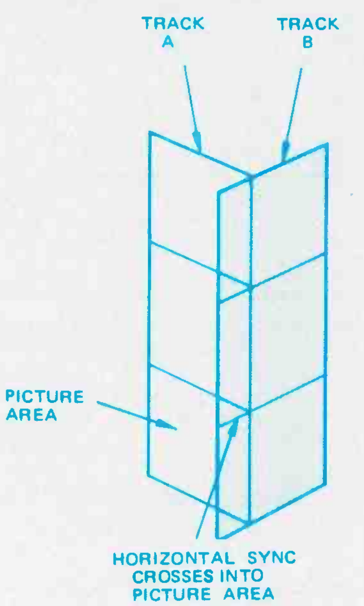


Figure 13. The most severe beat produced by track overlap is from the horizontal sync pulses in the luminance signal, because the sync repetition rate does not vary with changes of video waveform and amplitude. These beats are eliminated through interleaving.

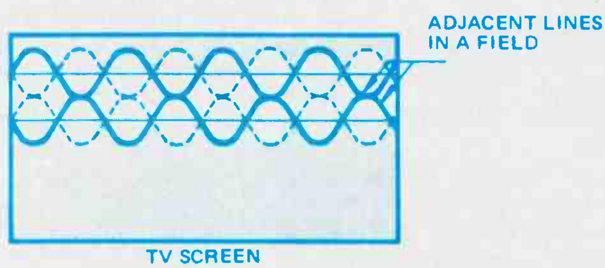


Figure 14. Interleaving chroma carriers are shown here. Remember that the top tips of the sine waves produce a brighter raster, and the bottom peaks darken the raster. Therefore, each pair of 3.58MHz sine waves averages to zero change of brightness.

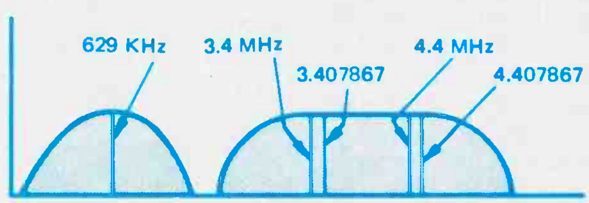


Figure 15. These are the VHS frequencies after addition of the 7867Hz frequency offset that removes the sync beats by making the interference an interleaving frequency. See the text for a more complete explanation.

cancels, leaving an output of interference-free chroma.

Eliminating beats during long-playing mode

Cost of tape for the VHS videocassette recorders is minimized by the three modes of operation that provide double or triple the recording time of standard play. A front-panel switch selects standard speed (two hours), LP for four hours, or SLP for six hours of operation.

Figure 12 shows the spacing of consecutive recording tracks during operation with those three speed modes. Width of each recording head is 30 microns. In the standard SP mode, a 28-micron guard band is produced between tracks. No beat or crosstalk is possible with such wide spacing of tracks.

When the tape speed is reduced to a half in the LP mode, the rotating video heads continue to rotate at 1800rpm. Because the tape moves more slowly past the head cylinder, the consecutive tracks overlap by 1 micron, which reduces the effective track width to 29 microns.

Selecting the SLP mode reduces the tape speed to a third of the SP mode, but the rotary heads continue the same 1800rpm rotation. Now the tracks overlap by 10.7 microns, reducing the effective track width to 19.3 microns.

Any reduction of track width theoretically should cause a reduced signal level and an increase of noise, but the visual differences between the three modes are slight. However, the overlapping tracks will cause heterodyning beat products in the areas occupied by both tracks. These beats are eliminated by special circuits.

Each block in Figure 13 represents one horizontal line of video that is recorded on tape by the luminance FM signal, which varies between 3.4MHz for the sync tips and 4.4MHz for peak whites of the video signal.

As track B is recorded, the horizontal sync portion overlaps into the picture area of the previously recorded track A. Although the entire overlapped area can produce beats, the most noticeable beat is produced by the horizontal sync, because the FM frequency representing the sync tip does not change from line to line, while the FM frequency of the picture area changes constantly. Notice carefully that the beat between the horizontal-sync frequency (3.4MHz) and the 4.4MHz adjacent-track picture is not crosstalk (the opposite azimuth tilts prevent crosstalk), but the beat is a non-harmonically related new frequency that was not present in either of the original signals. The beat results from the magnetic addition of both tracks, so it has no true azimuth and will appear in the playback of both video heads.

Interleaving is the characteristic of NTSC color television that permits the visual cancellation of any steady signal whose frequency is an odd multiple of half the horizontal-scanning frequency. Originally, this was provided to minimize picture lines caused by the 3.58MHz color sidebands (Figure 14). Fortunately, it can be used to hide other signals, when they meet the requirements.

Interleaving reverses the phase of such signals relative to the phase during the previous scanning line. In other words, the 3.58MHz-chroma phase on each horizontal scanning line is opposite to the chroma phase of the scanning lines on either side. Therefore, the interference effects of interleaving signals are reduced greatly.

Elimination of the beat produced by overlapped tracks is accomplished by making its frequency an odd multiple of half the 15,734.4Hz horizontal rate. The sync-tip FM frequency is increased by 7867.2Hz (half of 15,734.4Hz) during alternate vertical fields. Thus, channel-1, sync-tip frequency becomes 3.407867MHz while the sync-tip frequency of channel 2 remains at 3.40MHz. Likewise, the channel-1, peak-white frequency becomes 4.407867MHz instead of 4.40MHz (Figure 15). ES&T

A future article will discuss the overall technical functions and how to troubleshoot using the overall block diagram.

(continued from page 19)
predict delayed failures produced by unbalanced output transistors: the dc voltage at the common junction of R623 and R624 emitter resistors (Figure 10). Generally, this dc voltage will measure between 40% and 50% of the single supply voltage. In the K-Mart chassis, Photofact 1942-1 shows a +120V supply and about +52V at the resistors. The output dc voltage is 44% of the supply voltage, so it is within tolerance. If the output voltage is less than about +48V or higher than about +60V, the circuit should be tested carefully to find the reason, or else one transistor will operate hotter than its mate and will probably fail soon. Check this dc voltage in each vertical circuit repaired.

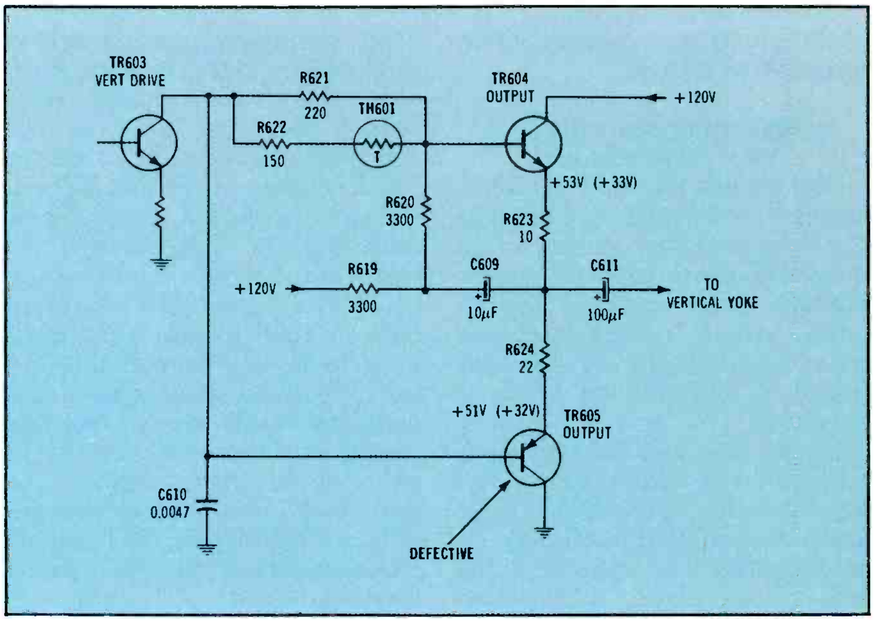


Figure 10. Driver and output stages of vertical sweep in the K-Mart model KMC-1920 resemble a complementary-symmetry audio amplifier. Dc voltages in parentheses were measured in one chassis that had an open TR605.

Loss of height can be caused in other cases by a low-voltage power-supply problem (Figure 12). Vertical-oscillator transistor TR601 is powered from the +10.72V supply, and loss of this voltage will eliminate all vertical height (plus video, sound and IF stages that operate on allied supplies). Check diodes CR709 and CR706 for both opens and shorts.

In one repair, TR605 measured 3.5V of forward bias, proving the base/emitter junction was open. (It is virtually impossible to develop more than about 0.7V of forward bias with a normal silicon transistor.) It is advisable to replace both output transistors when one is defective. TR605 was replaced with ECG292; TR604 was replaced with an ECG375 universal type.

Normal HV but no picture or sound

Usually the sound operates when the high voltage is normal because power for picture IFs and sound systems comes from rectified horizontal signal. But in one case, neither sound nor video stages were operating because nearly zero voltage was measured in the transistor video stages and at pin 5 of the audio IC401. These symptoms indicate a low-voltage power problem because both systems are powered by the +12.6V source.

No dc voltage was measured at the 13.18V, the four +12.60V supplies, or the +10.72V supply. These supplies are separated by several resistors and RF chokes. Therefore, the failure was certain to involve the ac source or the rectifier/filter components. Surge resistor R732 was normal, but rectifier CR706 was open. A new fast-recovery-type diode brought the receiver to life.

Normal HV and sound but no raster

Video stages and the picture tube are the suspects when the HV and sound are normal but there is no raster or picture. Don't overlook testing the 60Hz heater voltage (from a separate filament transformer). If the CRT heaters do not light, trace the continuity from the CRT socket back to the transformer. One fast way is to remove the CRT socket from the tube and (with power unplugged) check for continuity across the heater pins of the socket. The resistance should be only a couple of ohms or so. An infinity (open) reading usually indicates a break in the circuit-board wiring. With remote-controlled models, check for corroded or erratic relay contacts. Corroded CRT-sockets can eliminate the picture either permanently or intermittently.

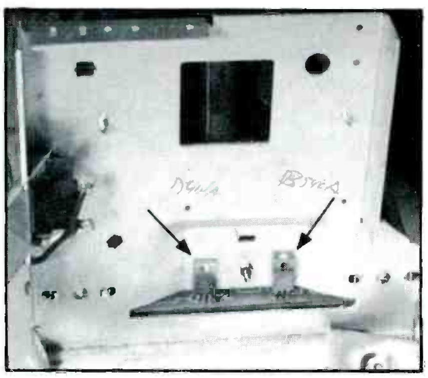


Figure 11. Arrows point to the two vertical-output transistors (TR604 and TR605) that are mounted on one end of the chassis. In fact, the chassis serves as a heat sink.

Intermittent picture

Erratic defects in any video-amplifier transistor can either eliminate the video signal at the picture tube or black out the raster by overbiasing the picture tube. Poor connections at the delay line, L303, L305 or L306 also can remove the video and raster.

One excellent method of pinpointing the source of erratic video is to attach the probes of a dual-trace scope to two points in the video system. Each time the picture blanks, the scope traces show either a video waveform or nothing. Begin either at TR301 and work toward the CRT one stage at a time (Figure 13), or start at the CRT cathodes and move back toward TR301 until the dead stage is found.

One defect found in several K-Mart receivers was traced to an erratic TR305 that blanked out the raster each time it opened. An SK3114 or an ECG290 will replace TR305 satisfactorily. Alternate applications of heat and spray coolant often trigger such intermittent transistors so they can be identified accurately.

Retrace lines

Appearances of retrace lines on the raster or picture can provide valuable information. Composite video includes sufficient amplitude of blanking pulses to eliminate retrace lines under ideal conditions. However, slight compression of the video can remove part of the blanking-pulse amplitude, allowing *white* retrace lines to be seen. To prevent these retrace lines with marginal signals, vertical-retrace blanking (and sometimes horizontal-retrace blanking) signals are injected into an appropriate video stage. These vertical-blanking pulses are produced by filtering and clipping a sample of the vertical-sweep signal. When a defect in blanking-pulse components weakens or removes the pulses, *white* retrace lines can be seen on the CRT screen under certain signal conditions. In some receivers, the ratio of video amplitude to blanking amplitude varies when the brightness control is rotated. Also, excessive CRT screen-grid voltages tend to cause *white* retrace lines because the CRT is harder to cut off.

Each red, blue and green output transistor that drives a CRT cathode must amplify the blanking pulses, or else retrace lines of that color will be formed. Therefore, a defect that reduces the collector dc voltage and the output-signal amplitude (including the blanking pulses) will produce bright retrace lines of the affected color. Some defects in a *red* output transistor stage can cause *red* retrace lines in addition to making the raster too reddish. The same problem can arise with blue and green retrace lines and screen color.

Shorted air-gap or neon-type spark gaps (connected from cathodes to ground, and perhaps mounted on the CRT socket) also can cause one color to have maximum brightness, even to blooming or perhaps loss of raster. A decrease of the +198V boost voltage supplying the three color transistor collectors can produce white retrace lines by increasing the picture brightness. White retrace lines are formed when all three color output transistors operate the same. Colored retrace lines are produced by a defect in just one of the three output transistor stages.

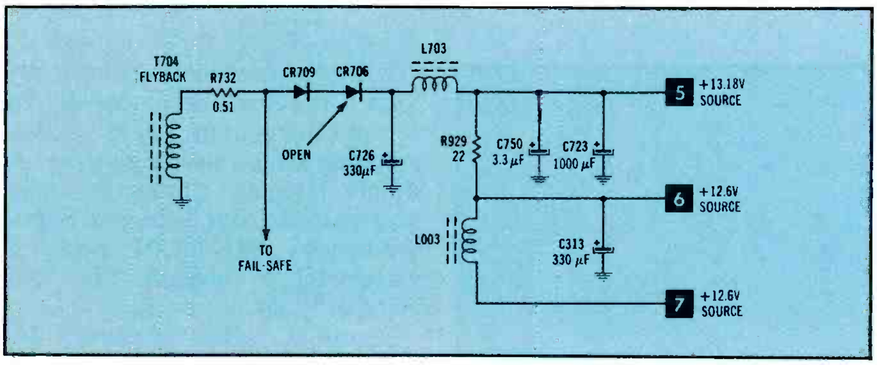


Figure 12. Six low-voltage supplies are produced by rectification of horizontal-sweep power by CR709 and CR706. The 10.72V (CircuiTrace-9) supply is taken through one resistor from the CircuiTrace-5 13.18V supply. R732, CR706 and CR709 have failed in several of these models.

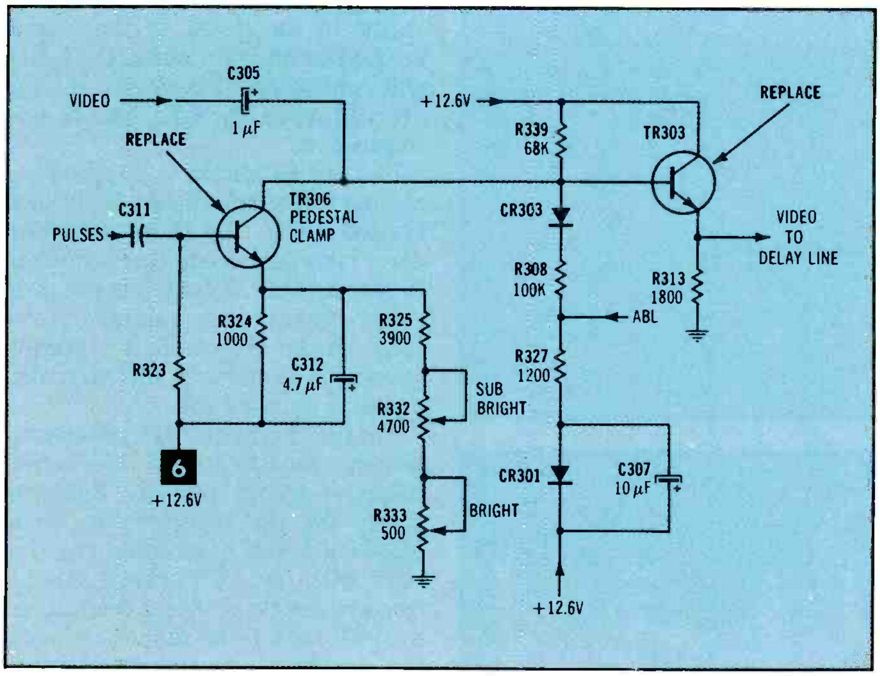


Figure 13. Video-transistor defects (such as opens in TR306, TR303 and TR305) cause most brightness problems.

Comments

K-Mart color TV receivers have been manufactured by several different firms, and it is difficult to obtain schematics for some. Those built by Gold Star for K-Mart usually are covered in Photofacts. If an exact schematic cannot be found, one with similar circuits often can be located. Universal transistors have been satisfactory for replacements. Special components (such as M901, M701 and the flyback transformer) must be ordered from the manufacturer.

Order special parts for Gold Star TV receivers from Gold Star warranty depots or from Gold Star Electronics, 3621 22nd St., Long Island, NY 11106.

Build this alarm troubleshooter

Troubleshooting device may be easily constructed in small hobby box.

By Mitchell Lee, National Semiconductor

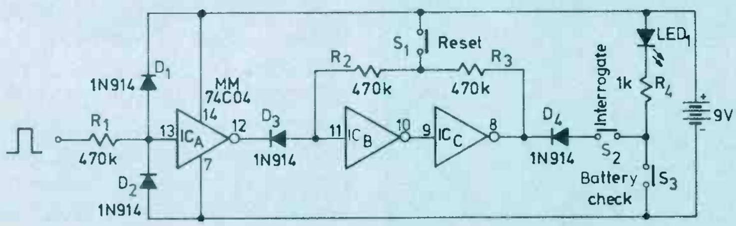


Figure 1. Three gates form a latching circuit perfect for troubleshooting alarm circuitry. This circuit latches on positive pulses.

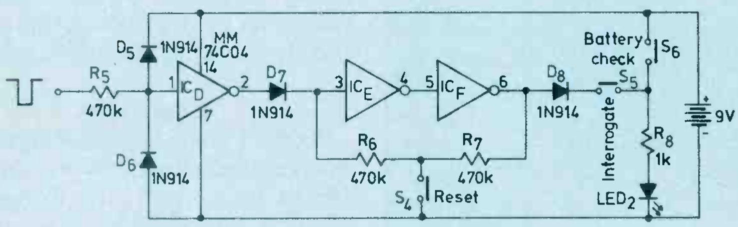


Figure 2. A few modifications result in a latch for negative pulses. If both latching circuits are built together from a single MM74C04, the 9V battery and battery check (S3) need not be duplicated.

PARTS LIST

- R1-3 – 470KΩ ¼W
- R5-7 – 470KΩ ¼W
- R4-8 – 1KΩ ¼W
- D1-8 – 1N914 or equivalent
- S1-6 – Momentary contact push-button, normally open
- ICA-F – MM74C04 hex inverter
- LED 1,2 – Any garden variety LEDs
- 9V – Transistor battery

When troubleshooting alarm circuits it is sometimes necessary to detect infrequent logic pulses resulting from false triggering. A simple latching circuit is easily constructed from National Semiconductor's MM74C04 hex inverter IC to observe and "remember" such an event.

Figure 1 shows a circuit designed to latch when a positive pulse is applied to its input. When the 9V battery is first connected to this circuit, S1 is closed to reset the gates. S2 interrogates the status of the gates. If they have latched on an input pulse, the LED will light when S2 is closed. If they are still reset, the LED will be extinguished.

Battery condition is checked by closing S3, which should result in a lighted LED. All three switches are normally open push-button types. An On/Off switch is not provided because the quiescent current drain (Iq = 0.05μA typical) results in a battery life virtually equal to its shelf life.

Figure 2 shows the necessary circuit modifications to sense negative-going pulses. Because there are six inverters in each MM74C04, both circuits can be built with one IC package. These circuits can be powered from their own 9V battery as shown, or from the supply of the circuit they are sensing. Operation is possible on 5V to 15V supplies.

Answers to quiz

(from page 12)

A. *E* *Energy* is measured in watt-hours, watt-seconds, or joules.

2. *B* Technically, recharging involves a reversal of the chemical process that occurs during discharge. In most cases, a primary cell can be rejuvenated. Primary cells *can't* be recharged.

3. *A* Number 10 wire has the larger diameter, and therefore, the lower resistance. Conductance is the reciprocal of resistance.

4. *C*

5. *E* $P = V^2/R$, so $R = V^2/P$

6. *A* $N_1/N_2 = \sqrt{Z_1/Z_2} = \sqrt{2000/500} = 2/1$
This type of calculation is primarily for the purpose of showing how impedances and turns ratio are related. There are other factors that have to be considered in practical transformer design.

7. *E* Partition noise occurs when a charge carrier has a parallel path in an amplifying device. For example, an electron may go to the base or to the collector in an NPN transistor. At any instant of time, the number of electrons that go to the collector is slightly different than the number at the next instant. These small changes in current are amplified, resulting in electric noise. It is partition noise that makes a pentode more "noisy" than a triode. Also, it makes a bipolar transistor more noisy than an FET.

8. *B* If you assume the resistance values are the same:
$P = V^2/R$, and at 0.707 x V_{max}, $P = (0.707)^2/R$ or, $P = 0.4998/R$. If 0.707 is carried out further, the result is 0.5/R, or, the half-power points.

9. *D* A silicon diode requires about 0.7V for conduction. Using these diodes for detectors would result in a very insensitive detector state.

10. *E*

Readers' Exchange

For sale: Portable antique TVs–M0T 7VTZ, M0T VT71MB–A, GE 806 (10-inch), Airline 7-inch, suitcase style. All in good shape, pre-1950. Best offer over $100 plus shipping. *Dan Steele, 205 High St., San Luis Obispo, CA 93401.*

For sale: EICO model 666 tube tester, $75; Stancour P-6415 3 outlets isolation transformer, $85; Allied 5-inch scope with probes $100, plus postage. *D. Kromphardt, K&R TV, 930 S. Warren St., Peoria, IL 61605.*

Needed: Schematic for TV set model DV535CR made by Dongnam. *Jose Varas, 306 West St., Apt. 3B, Union City, NJ 07087.*

For sale: Sencore scope PS 148, Sencore sweep and marker generator SM158, B&K analyst model 1077B; all manuals and leads included. Excellent condition. *David A. Tabor, Box 56, Killdeer, ND 58640; 701-764-5017.*

For sale: B&K 40-channel CB servicemaster model 1040; 40-channel PLL CB signal generator model 2040, $325, used very little. B&K model 1403A oscilloscope, $150 new. *A.J. Lemke, ALS Service Center, 10004 206th Ave. N.E., Redmond, WA 98052; 206-885-7445.*

For sale: Sencore VA48, mint condition with manual and probes, $800. *Robert L. Blount, 40 S.W. 8th Ave., Delray Beach, FL 33444; 305-278-1101.*

Needed: Operating instructions for Win-tronix dynamic sweep circuit analyzer model 820. *Jiranek TV, Farmington, IA 52626.*

Needed: Service manuals or schematics for Philco radio 3-band model 42-345, also Emerson stereo receiver model 7220 8-track record play system FM AM/FM multiplex. Will purchase copy or original or will copy and return. *L. Smith, 142 W. 5th St., Bayonne, NJ 07002.*

Needed: "Dead" RCA 18-inch color TV, model EQ405W, chassis CTC53A, without AFT, ACC, remote control. Also, RCA TV service data file 1971-T6. *Robert Shaw, 218 Hunting Creek Road, Canonsburg, PA 15317.*

Needed: EMC model 802 signal tracer/generator; Heath model SM-2420 or SM-4130 frequency counter; and Heath model SM-4505 oscilloscope calibrator. *Caswell Davis Jr., 601 Delmar, Apt. 2, San Antonio, TX 78210.*

For sale: Heathkit model IG-57A TV post marker/sweep generator, $135, in like-new condition. Complete with all cables, attenuator, and assembly/use manual. (Model IG-57A is identical to current model IG-5257). Will ship UPS collect. *C.A. Caputo, 7 Donna St., Peabody, MA 01960; 617-535-1091.*

Needed: Service manual and/or schematic for PACO Division of Precision Apparatus Co. oscilloscope model S-55, or company's current address. *Joe LaGuardia, P.O. Box 1151, Homestead, FL 33030.*

For sale: Bird 43 wattmeter. Perfect physically and operationally, $125. *Martin Sewecke, 1028 George St., Sharon, PA 16146; 216-539-4192.*

Needed: Used Heathkit instruments for consumer electronic servicing. Especially need an oscilloscope. Also want to purchase used electronics correspondence courses. *Cordell Olson, P.O. Box 524, Corvallis, MT 59828; 406-961-4184.*

Needed: B&K 1077B TV analyst in good condition with leads and manuals. State price and shipping costs. *Frank Manera, 137 Lynch St., Providence,R.I. 02908; 401-831-7156.*

Needed: Extra accessories/attachments for Don Bosco stethotracer test instrument for radio and TV. Call collect. *Murray Goldstein, Murray's Repair Service, 8842 Grange Hill Road, Sauquoit, NY 13456.*

For sale: Sencore CG159 color generator, $95; Sencore FE20 Hi-Lo meter, $75; Eico 150 signal tracer, $40. All in excellent condition with manuals. *Albert Nemchek, 2868 Groves Drive, Sterling Heights, MI 48077; 313-264-5881.*

For sale: Heathkit model 1M22 audio analyzer, $50; Heathkit model T2 signal tracer, $20. Both include cables, manual, schematic. Sencore FP201 and 39G89, probes, $25. *Long's TV Service, 720 Goshen St., Salt Lake City, UT 84104; 801-533-8093.*

Needed: Schematic, parts list, service or users manual for PACO model S-50 push-pull oscilloscope. Will purchase and/or copy and return. Also need graticule for above scope. *R. Beaber, 803 Euclid Way, Centralia, WA 98531.*

Wanted: Schematic and service information on a Curtis Mathes color TV model J2540RK, chassis C85-4, console 10 CL9767OHA. *William G. Reid, 5707 N. 72nd St., Milwaukee, WI 53218.*

Needed: Service information or schematic for Telectron garage door opener model RP-201, or manufacturer's address. Will pay any reasonable expenses. *Oscar H. Layman, P.O. Box 1754, Wickenburg, AZ 85358.*

For sale: Rebuilt (by PTS) RCA modules, various semiconductors, ICs. Send large SASE. *Bill Messina, 53 Railroad Ave., Norwood, MA 02062.*

For sale: B&K model 1230 digital IC color generator, used less than 3 hours, $45 plus postage. *Dave Moline, 3295 W. 149th St., Rosemount, MN 55068; 612-423-3125.*

For sale: 9 Rider manuals VGC, $25 plus shipping; Conar 251 scope L.N., $100 including all probes and cables. Will throw in Conar signal tracer with scope. *Randy Smith, Solid State Service, 2801 St. Anthony Road, Celina, OH 45822; 419-942-1688.*

Needed: Used Sylvania CR1500 or CR3000 test jig; used RCA CTC46 or 48 chassis; one set of Tekfax manuals. *Mike Shelton, Electronic Services, 2708 May Drive, Burlington, NC 27215; 919-227-2908.*

For sale: Radio and TV servicing instruments, some fairly old, some practically new, mostly Heathkit. Also numerous service manuals, mostly TV but have some Photofacts and some on specific makes. Cash only. Send SASE for list, prices and UPS shipping weights. *Joe Wunderlich, 109 Walnut St., Galesburg, IL 61401.*

For sale: Ampex FM calibrator TC-10, for FM tape recording systems, $95; CRT for Tektronix 310, RM16, 316, 535, 545, $25 each. I'll pay insured UPS. *Frederick Jones, 407 Morningbird Court, Niceville, FL 32578.*

Wanted: TAB TV service manuals in good condition for RCA Color volume 2, #578; GE color volume 2, #609; Admiral color volume 2, #641; Magnavox color volume 3, #770; Sears color #740. *Charles E. Norris, TV-Radio Service, Box 105, Airedele Road, Ridge, MD 20680.*

For sale: 220 *Electronic Servicing* magazines and 58 more from other publishers. Best offer for all. Postage paid. *Macario Garnica B., Libertad 2208 Ote., Colonia Moderna, Monterrey, N.L., 64530 Mexico.*

Needed: Service data/schematics for Oak V-26 converter, M-26 converter/decoder, N-12 decoder. Please inform of data available and the cost. I have the 34-page manual No. 3-4888-015 for the Oak T35, FT35 converter and M-35 converter/decoder, dated 7/82. Will trade data with anyone interested. *D.G. Seibel, BDSR Box 13, Tribune, KS 67879.*

Needed: Schematic or manual for Telefunken radio 2000X. Will pay expenses or cost. *Martin Houffen, 3953 Woolwine Ave., Los Angeles, CA 90062.*

For sale: RCA color test jig 10J103. Built-in HV meter and 50 adapters. Brand new condition with boxed adapters. For solid state and tube TV sets. Includes manuals. *G. Lahullier, 17 Kensington Ave., Clifton, NJ 07014; 201-473-6685.*

For sale: Heathkit TV post-marker/sweep generator, model IG-57a, $200; Color bar and dot generator, model IG-28, $60; RF signal generator, model IG-102, $35. All little used and complete with cables and manuals. Excludes shipping. *Ted Rutledge, 1800 Milford Church Road, Marietta, GA 30060; 404-422-6219.*

For sale: Pre-1970s R and TV parts, tubes (new, in boxes), and servicing equipment. Best offer. Send large SASE for list. *Otmer Basham, 214 S. Craig Ave., Covington, VA 24426.*

For sale: Sencore SM 158 sweep/marker generator with instructions and cables, $185; Sencore SS137 sweep circuit analyzer, $75; Accurate Instrument model 257 tube/picture tube tester, $35. *John Mercer, 1317 S. 94th St., West Allis, WI 53214; 414-453-0971.*

For sale: FC45 frequency counter, $500; B&K 820 capacitance meter, $100; Eico 633 CRT tester with adapters, $150. *Bill Bechtold, 7429 Frederick, Omaha, NE 68124; 402-397-2461.*

For sale: Eico 680 transistor and circuit tester; Eico 955 capacitor tester; Eico 944 flyback Xfmr and yoke tester; $30 each with manuals; all for $80. *Robert L. Soyars, 711 W. Walnut St., Johnson City, TN 37601; 615-928-8224.*

Needed: Schematic or service manual for Tennelec memory scan, model MS-1. *Irving Massa, 855 Half Day Road, Highland Park, IL 60035.*

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

Products

Oscilloscope

The 35MHz dual trace oscilloscope from *North American Soar Corporation* was designed for engineers in advanced electronics design or servicing. Some of the features include delayed trigger operation to expand a desired part of a complicated waveform, wide frequency response up to 35MHz (−3dB), 21 sweep speeds from 0.1μs to 0.5s plus X5 magnifier, variable hold-off for accurate pulse train display, single-sweep for nonrepetitive waveforms, built-in filters (HF Rej, LF Rej) for stable triggering, TV (video) sync separator, auto selection of CHOP and ALTERNATE display, 6-inch rectangular high-brightness, mesh-type CRT with 6kV of accereration, 10ns rise time for pulse observation with alternate trigger capability, and automatic trig level for reference plus LED trigger hold indicator.

Circle (100) on Reply Card

Continuity tester

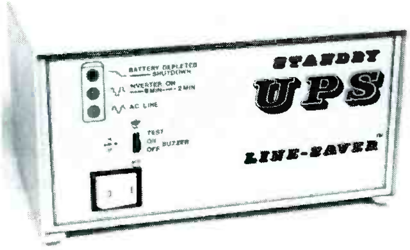
Klein Tools has added a battery-powered continuity tester to its line of professional hand tools. The tester checks the continuity of dead circuits, switches, appliances, cords, fuses, motors, control equipment, coils and panel boards. It will also test circuits for low-resistance shorts and help identify wires in multiwire cables.

The tester lead is 40-inches long with a plug at one end and an alligator clip on the other. The tester body is made of copper-nickel-plated brass with a plug receptacle on one end and an incandescent bulb on the other. A spring steel pocket clip on the body serves as a probe.

Circle (101) on Reply Card

Uninterruptible power system

Kalglo Electronics has added a new, standby, uninterruptible power system to its Aegis line of power conditioning equipment. The Line-Saver, model LS-240, is engineered to give trouble-free, standby, back-up power available in 120/240V, 60/50Hz, with 240VA, 150W capacity. The unit uses the latest Pulse Width Modulation technology to regulate the rms ac output voltage for greater efficiency to various load conditions.

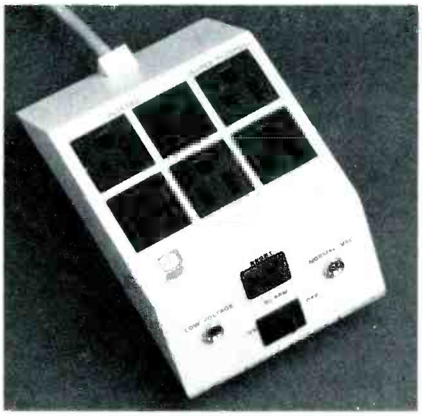


The PWM ac output will also increase battery efficiency to increase back-up time. Also the unit is furnished with an internal 12V, sealed, rechargeable battery, four Spike-Spiker voltage, surge protected and EMI/RFI filtered ac outlets, audible and visual power failure warning system, test mode indicator and switch, and replaceable external fuses.

Circle (102) on Reply Card

Surge and spike protector

PTI Industries has introduced a surge and spike protector for use with all voltage-sensitive equipment, including computers. The PTI unit offers 0.1ns response time to surges and provides complete noise filtering from 100kHz to 100MHz.



The protector is the first unit to provide brownout notification when the line voltage drops to 100V. A reset button also safeguards equipment from initial line surges that inevitably follow a blackout condition.

Circle (103) on Reply Card

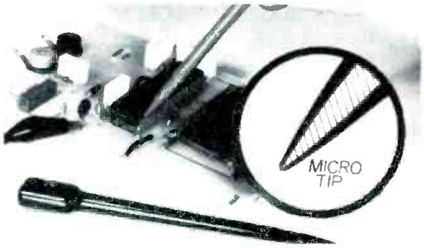
Alignment disks

A 5¼-inch head-alignment minidisk and a 3½-inch head-alignment microdisk from *Verbatim Corporation* will aid disk drive and systems manufacturers in the manufacturing, servicing, incoming inspection and R&D of disk drives and systems. The head alignment disks will be marketed under the Optima Series brand name and will provide both radial and azimuth alignment capabilities. When used with an oscilloscope and drive exerciser, both disks will perform a variety of tests, including azimuth and radial head alignment, track 00 detection and index timing.

Circle (104) on Reply Card

Non-shorting test probes

The Versi-Probe from *Versi-Corp* has a sharp point that allows piercing of insulated P.C. boards and wires. The point of the Versi-Probe is totally insulated except for the very tip, which helps prevent "shorts" even in the most crowded circuit areas.



Connection to the versi-probe is made with standard insulated alligator clips, allowing quick changes from clip to probe or probe to clip.

Circle (105) on Reply Card

Multimeter

A.W. Sperry Instruments has introduced the AWS DM-6590 Electro-Probe digital probe multimeter with autoranging. The DM-6590 is designed for reading ac voltage, dc voltage and resistance in tight, hard-to-reach areas such as crowded circuit boards.

The Electro-Probe is 6⅜-inches long by 1⅛-inches wide by ¾-inch deep and contains a built-in probe tip for 1-hand operation.

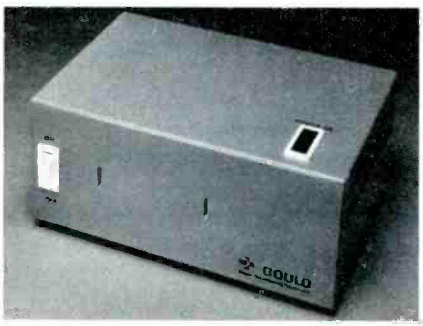
Other features include a 3½-digit display, buzzer warning system, 500 hours of continuous operation, and autozeroing. Ranges are 2/20/200/500 Vac/dc and 2/20/200/500kΩ. The multi-

meter comes with one TL-40 test lead; one AG-940 detachable, insulated alligator clip; two B-6 batteries; C-34 carrying case; operating instructions and 1-year warranty.

Circle (106) on Reply Card

Line conditioner

Gould Power Conversion Division has announced an ac line conditioner designed specifically for personal computers and other sensitive devices such as electronic cash registers. The Personal Conditioner, model PC 150, is rated at 150W and provides output voltage regulation of ±6% for line surges and sags of +10, −20%. The PC 150 filters both common mode and transverse mode noise from the



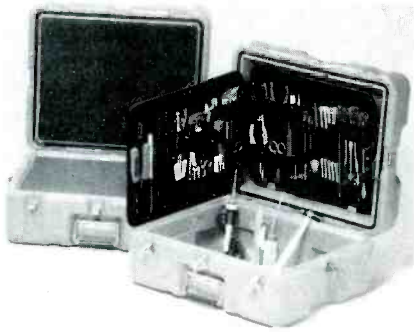
power line, the most common types of power disturbances. The conditioner also assures a clean sine wave (5% maximum distortion) even when the power line is distorted.

The Personal Conditioner is 7½-inches wide by 5-inches deep by 3¼-inches high and weighs 13 pounds. It comes complete with a line cord and receptacle for simple, plug-in installation.

Circle (107) on Reply Card

Tool cases

Survivor tool cases from *Jensen Tools* are built to take extreme abuse. The bright international orange color is unaffected by industrial solvents, Skydrol or jet fuel. These double-walled cases are rotationally molded of rugged polyethylene with corners up to 15% thicker to eliminate stress points.



Designed for use in extreme environments, the cases have full parameter neoprene gaskets to seal out dust and water, and recessed stainless steel ¼-inch turn latches that can be secured in transit with 4-inch cable ties. Survivor cases are available with polyurethane foam slabs for protecting instruments, or with two removable tool pallets.

Circle (108) on Reply Card

VHS VCR test tapes

A set of three VHS VCR test tapes that supersedes the previously available single test tape, is available from RCA. The three tapes make it easier to select the individual test signals needed. The multiburst tape, color bar tape and monoscope tape are also available individually. The tapes are used in alignment procedures and to confirm proper performance of all VHS stereo and mono 3-speed VCR instruments. They can also be used on 2-speed instruments.

Circle (109) on Reply Card

Test jig adapters

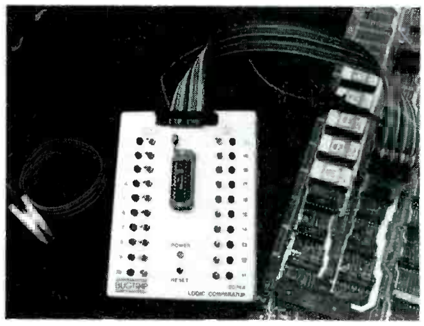
Telematic has engineered yoke and CRT base adapters for 19- and 26-inch model Sony televisions that are compatible with any make of color TV test jig. The adapters are being offered in prepackaged kits.

Kit #1 will enable the technician to service every 26-inch color model. Kit #2 will jig the most popular 19-inch sets. A master kit, combining the most popular adapters, is also available. Each Sony adapter kit is directly compatible with the RCA/Telematic color test jig, or any jig equipped to accept the 10J series adapters. Matching adapters and/or update kits are available for other makes of test jigs.

Circle (110) on Reply Card

Logic comparator

The model 2074A logic comparator from *Bugtrap Instrumentation* may be used to test the full line of digital TTL devices. The hand-held model may be used to test 14-, 16-, 18- and 20-pin ICs; 5V RAMS; tri-state; bi-directional and open collector ICs.



ICs under test are compared to "known good ICs" in circuit and at system speed. Input/output switch settings have been eliminated. Vcc and ground are the only selections required. Model 2074A comes complete and ready to use with reference manual, 20-pin test clip with cable and IDC connector, and 16-pin test clip and cable with IDC connector.

Circle (111) on Reply Card

Oscilloscope

The *Hitachi* V-134 storage oscilloscope employs a BHD (Black-Matrix Hybrid Mesh Dot Screen) direct-viewing storage tube. This tube is resistant to burnouts or shock and is capable of providing clear, high-contrast waveform observation with 50 div/ms writing speed. Advanced circuit design provides 1mV/div vertical sensitivity. The V-134 has a DC-10MHz full bandwidth as a dual trace oscilloscope with an 8 div. dynamic range (ensuring screen waveform linearity.)

Circle (112) on Reply Card

Books

*Editor's note: Periodically **Electronic Servicing & Technology** features books dealing with subjects of interest to our readers. Please direct inquiries and orders to the publishers at the address given for each book, rather than to us.*

Crash Course in Digital Technology, by Louis E. Frenzel Jr.; Howard W. Sams & Company; 198 pages; $19.95 paperback.

This book provides a solid foundation in digital fundamentals. It is not designed to be the most complete and authoritative source on the subject, but gives only the information you really need to know. The book will help you understand the operation of digital circuits, how to construct them, determine if they are operating properly, and troubleshoot them.

It covers the latest integrated circuits, such as low-power Schottky TTL, CMOS, and I^2L. It also covers up-to-date LSI circuits, such as programmable logic arrays (PLAs), and it gives complete coverage of digital troubleshooting equipment, such as logic probes, logic analyzers and signature analyzers.

Published by Howard W. Sams & Company, 4300 W. 62nd St., Indianapolis, IN 46268.

Installing your own telephones; Radio Shack; 162 pages; $5.95 paperback.

This guidebook was written to help the inexperienced person install telephones, whether existing ones are being replaced or moved, or new ones added. The book is illustrated with diagrams and photographs and gives step-by-step instructions for installing both the modular style and old-style telephones and for installing telephone cable. Business installations, prewiring instructions, accessory equipment installations, and checking and troubleshooting are also covered.

Published by Tandy Corporation/Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102.

All About Telephones—2nd edition, by Van Waterford; Tab Books; 256 pages; $16.95 hardbound, $10.95 paperback.

This book covers today's world of telephones from cordless models to computer link-ups, from answering machines and mobile units to picturephones. It discusses recent FCC rule and regulation changes and gives how-to tips for installing and connecting telephones.

For the technician, this revised and updated edition includes information on the development of telephone technology, details on how today's telephones work, and a look at analog vs. digital transmission.

Published by Tab Books, Blue Ridge Summit, PA 17214.

New Ways to Use Test Meters: A Modern Guide to Electronic Servicing, by Robert G. Middleton; Prentice-Hall, Inc.; 256 pages; $21.95 hardbound.

This easy-to-read and easy-to-follow advanced troubleshooting guide shows how to use test meters and other test equipment with greater sophistication and precision—enabling technicians to solve puzzling electronic problems in both analog and digital circuitry. The book includes numerous instructions, step-by-step procedures, charts and diagrams and covers a broad range of radio and TV troubleshooting techniques.

Some examples of included procedures are the "single digit" test for identification of transistor terminals with any ohmmeter, a distortion test probe for measuring sine wave distortion in high fidelity troubleshooting, and transresistance measurement for improving accuracy in low-level amplifier tests.

Published by Prentice-Hall, Englewood Cliffs, NJ 07632

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1N4003	3.40/100	1N4007	5.50/100

Transistor Specials

PN2222A	$8.00/100	2N3906	$12.00/100
PN2907A	8.00/100	2N3055	.65 ea.
2N3904	12.00/100		

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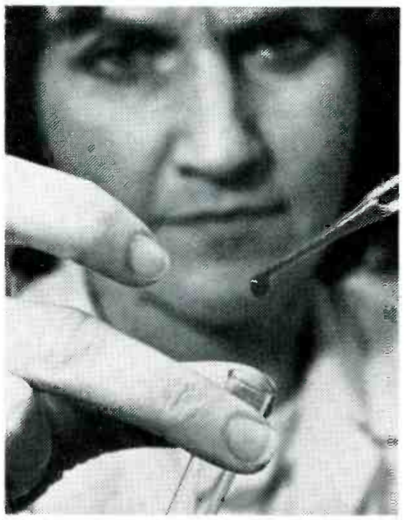

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Danny Thomas, Founder

ST. JUDE CHILDREN'S RESEARCH HOSPITAL

Literature

SGL WABER, a division of SGL Industries, is offering its Power Master Line Monitor Power Conditioner Catalog with seven new products that offer electrical spike suppression and electronic noise suppression for 2- and 3-wire applications. These units are designed for 15 or 20A, 125 or 220V applications. Models are available in plug-in, multi-outlet strip, rack- or panel-mount, console and hard-wire configurations.

These units protect solid-state electronic equipment from voltage spikes and noise interference that can cause information loss, equipment malfunction and premature circuit failure.

Circle (80) on Reply Card

A 16-page catalog from **Air-Vac Engineering Company** shows a complete line of vacuum desoldering and reflow desoldering systems. A vacuum section includes a theoretical explanation of vacuum removal of solder from individual leads, plus a full line of vacuum desoldering stations, hand-operated desoldering tools, tips, accessories and maintenance tools.

A reflow section explains the theory of reflow desoldering of multilead components, shows a complete line of printed circuit board reflow modules, and describes module utilization for selective soldering of individual components and soldering small boards.

Circle (81) on Reply Card

A 40-page catalog from **Electronic Specialists** presents numerous products designed to eliminate problems most often blamed on software. Protective devices for smooth software performance include equipment isolators, ac power line filter/suppressors, ac line voltage regulators and modem protectors. Descriptive sections outline particular software problems and some suggested solutions.

Circle (82) on Reply Card

The 160-page, 1984 edition of the **Mouser Electronics** catalog offers more than 12,000 items. It includes potentiometers, capacitors, resistors, transformers, lamps, switches, battery holders, jacks, plugs, speakers, knobs, fuses, semiconductors, hardware, tools, test equipment, relays, cabinets and meters.

Circle (83) on Reply Card

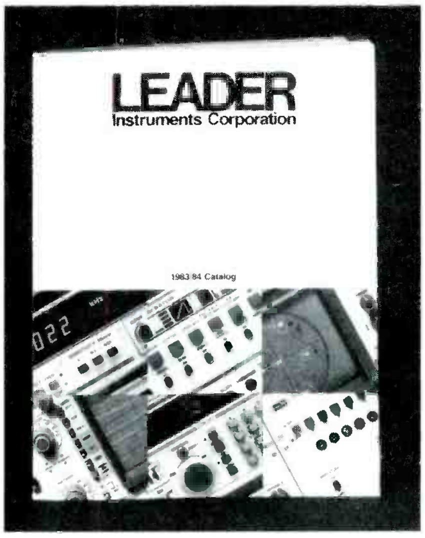
An 8-page brochure from **ACL Incorporated** contains detailed information on electrostatic charges in computer environments and describes treatments that can eliminate the glitches and system downtime often caused by uncontrolled static charge. The brochure explains the nature and cause of static charge buildup on people, equipment and materials employed in computer environments in industry, offices and the home, and it outlines a practical 2-part plan for static-proofing virtually every surface and object in the computerized work place. A table that lists the kinds of objects and surfaces that require antistatic treatments, the best application methods, and how often applications should be made is also included.

Circle (84) on Reply Card

Hexacon Electric Company is offering a 32-page catalog on soldering irons and accessories. The catalog covers more than 100 electric soldering irons from the smallest Micro-Mini Irons with a $\frac{1}{64}$-inch tip to large industrial irons with a $1\frac{3}{4}$-inch tip for heavy-duty mechanical soldering. It also includes soldering stations for accurate temperature control over a wide temperature range; soldering equipment analyzers for matching the soldering iron to the job; wave soldering gauges for accurate adjustment of wave soldering equipment, and a full line of soldering accessories.

Circle (85) on Reply Card

Leader Instrument Corporation is offering a new test and measurement instrument catalog, containing 25 new product introductions. The 80-page catalog describes oscilloscopes, frequency counters, a new NTSC waveform monitor, and several additions to the audio and DVM product lines.



Circle (86) on Reply Card

RCA has issued an updated catalog on RCA remote controls for TV, VCR and videodisc instruments. This catalog describes all remote controls, including discontinued and superseded types. A cross reference by instrument model number has also been added. Photos for visual identification and a cross reference by type number are included.

Circle (87) on Reply Card

John Fluke Manufacturing has published an 8-page brochure that describes accessories for digital multimeters. These accessories allow the user to measure additional parameters such as temperatures, currents and voltages far beyond the ratings of the instrument. Many of these accessories not only work with the company's instruments, but multimeters from other manufacturers as well. Convenience accessories such as special test leads and carrying cases are also shown.

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Classified

Advertising rates in the Classified Section are 50 cents per word, each insertion, and must be accompanied by payment to insure publication.

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For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of $3.00 per insertion to cover department number, processing of replies, and mailing costs.

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

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CABLE CONVERTERS, decoders, $1.00 Refundable APS, POB 263ES Newport, R.I. 02840. 1-84-tfn

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FOR SALE (CONT.)

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WHOLESALE—transistors, flybacks, yokes, batteries, Weller/Xcelite, VCR, computer parts. Apple Compatible computers, printers, drives, monitors, custom electronics software. More. Send for catalog. United Service Association, Old Grand Union Shop. Ctr. Rt. 9W, Stony Point, N.Y. 10980 (914) 942-2173. 1-84-tfn

TUBES—Receiving, Industrial and Semi-conductors, factory boxed. Free price list. Low; low prices. **TRANSLETERONIC INC.,** 1365-39th Street, Brooklyn, NY 11218E, 800-221-5802, 212-633-2800. 5-82-tfn

TV TROUBLE ANALYSIS TIPS. Over 300 symptoms/remedies by circuit area; tough ones over the years. Save time and money. Send $12.50 to CHAN TV, 8151 Grandview Rd., Chanhassen, MN 55317, 5-82-tfn

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. 5-81-tfn

SONY-PANASONIC-RCA-ZENITH-EXACT REPLACEMENT PARTS-LARGE INVENTORIES-SEND PART OR MODEL NUMBERS-WILL UPS OR COD-GREEN TELERADIO DISTRIBUTORS, 172 SUNRISE HIGHWAY, ROCKVILLE CENTRE, NY 11570. 5-82-tfn

FREE CATALOG, Large selection of electronic kits and telephones, alarms, intercoms and their related equipment, plus schematic. Send $2.50 for postage and handling, refundable with first order. Eppa Electronics, Box 166, Brooklyn, New York, 11204. 2-84-1t

FOR SALE (CONT.)

AUTOMOBILE RADIO and tape replacement parts: Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469. (212) 881-9600, out of New York State (800) 223-8314. 5-79-tf

COLOR PICTURE TUBES direct from manufacturer. Prices from $55 to $75 exchange. One year warranty. Send your old tube ups to ATOLL Color Tubes, 6425 West Irving Park, Chicago, Illinois 60634. Phone: 312-545-6667. We also sell equipment for rebuilding CRT's. 12-83-3t

PICTURE TUBE REBUILDING EQUIPMENT: Small or Medium Plant Operation. Production Capability—12 to 28 High Quality Tubes Daily. Call or write: TELECO, 2610 E. Busch Blvd., Tampa, FL 33612, 813-935-4002. 1-84-3t

USED RADIO-TELEVISION TUBES. All types. Working condition. 30 for $13.00 postpaid. Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 1-84-3t

COMPLETE JERROLD and Oak Wireless Cable Converters only $169.00. Beat filter trap type only $49. Compatible to master antenna systems as well. Complete microwave kits with an oak crystal down converter only $99. 1000 ft. rolls of RG59V only $39.90. Nobody beats our complete line of connectors. Special only. 2SC1172B—only $1.39; SG-613—only $5.80; 2SC8G7A—only $2.99. New Address and Phone: 104-20—68th Drive, Forest Hills, N.Y. 11374, (212) 459-5088. 2-84-tfn

FOR SALE: Electronic Sales and Service, Radio, TV, and Stereo. Established 14 years. Bldg, land, inventory, name. Partial retirement, would work for new owner, Fresno, Calif. call 209-255-1957. 2-84-3t

SAMS PHOTOFACT—COMPLETE SET #1 thru 1766. All for $3298 (early 1000 sets at $1.00, later 766 sets at $3.00). Also early Specialized Series volumes—$1.00 each when purchased in following groups, including CB-4 to 14, TR-6 to 31, TSM-24 to 105, AR-19 to 43, MHF-1 to 50. Hoffman Electronics, Box 61, Sioux Falls, SD 57101, 605-339-3801. 2-84-1t

FOR SALE (CONT.)

FOR SALE: SECO L.T.U. D.C. Motor Speed Controls. Taken from working loom. Take UPS. These units are 1st class and contain many electronic parts such as P.101KW power cube. Guaranteed to work. Also want to buy Eltex boards for Sulzer looms. Contact Edward J. Moore, Route 5, Union, South Carolina, 29379 (803-427-8284). 2-84-1t

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NORWALK, CALIFORNIA ESTABLISHED TV AND STEREO SERVICE AND SALES very busy money maker, excellent location, low rent, very good lease, 2300 square feet, 10 minutes to beaches and Los Angeles. $40,000 includes inventory, large enough for living quarters, owner retiring, phone 213-863-1919. 11-82-tfn

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NAPLES, FLORIDA—Tropical Paradise, TV Sales & Service, one man operation, long established. Busy shopping center location, priced attractively. VR Business Brokers 813-261-5646. 2-84-2t

LEARN TO REPAIR HOME VIDEO GAMES IN YOUR OWN SHOP! Did you know that more than 9 million HOME VIDEO games have been sold? Now you can learn to repair! Atari, Coleco, Intellivision, or Atari 400/800 computers in your own shop. Our courses are taught on VIDEO TAPE (Beta or VHS) and come with a manual containing all the necessary technical information you will need to do repairs. For more information or to order, call: Electronic Institute (800) 221-0834 (outside N.Y.) or (212) 377-0369 (in N.Y.) Customized live in shop training courses are also available, call for more information and price schedules. 7-83-tfn

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SPEAKER RECONING: Most makes, sizes, models. For prompt service send to Mercury Speaker Reconing, 2018 W. Division St., Chicago, Illinois, 60622; (312) 278-2211. 9-83-tfn

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WANTED FOR CASH: 50, 53, 6AF6, 6HU8, 304TL, 4CX1000A, 4-1000A, all transmitting, special purpose tubes of Eimac/Varian. DCO, Inc., 10 Schuyler Avenue, North Arlington, New Jersey 07032. Toll Free (800) 526-1270. 5-82-tfn

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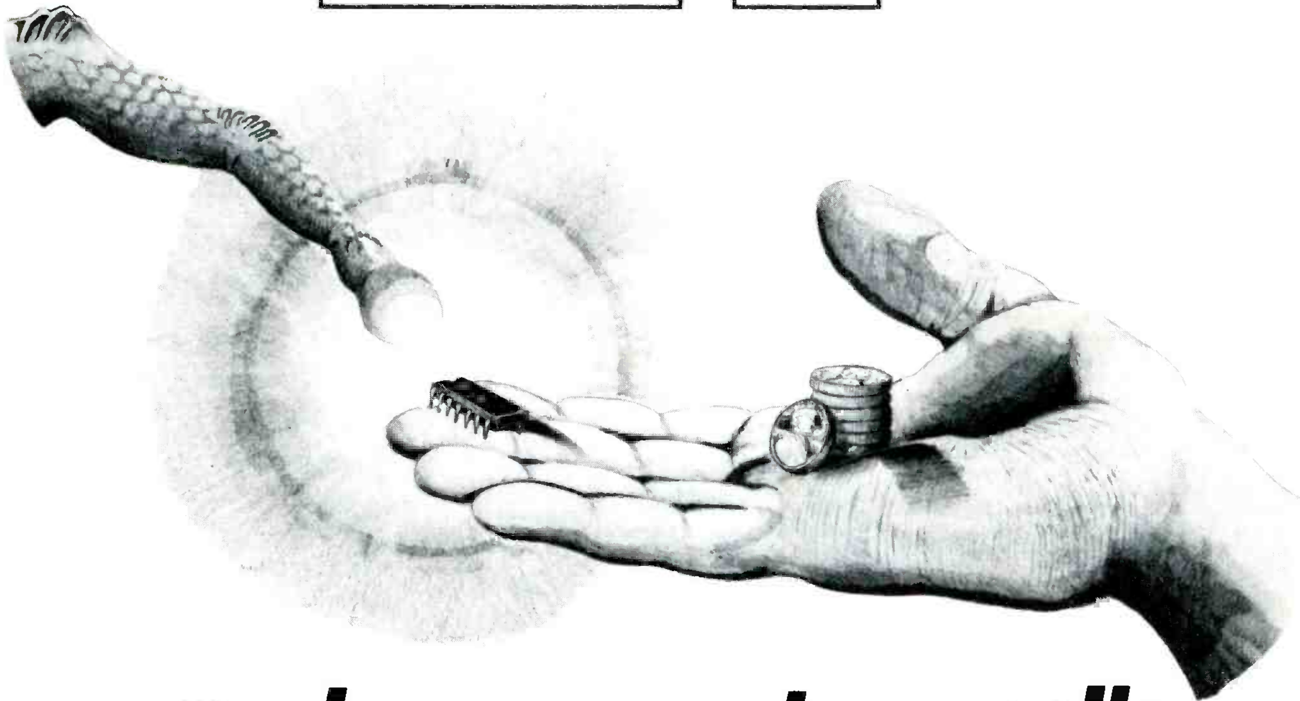

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Cut your video service time in half

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

But Times Change: Today's video circuits include projection TV, 4-head VCRs, SAW filters, comb filters, integrated flybacks, cable-ready tuners, and many more circuits you just can't service effectively with the VA48. That's why we now have the VA62—the only video analyzer that equips you for all of these new video circuits—and then some.

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

- It's a TV analyzer—Fully updated for the latest circuits.
- It's a VCR analyzer—Makes VCR analyzing a snap (using two inexpensive accessories) . . . and it meets all manufacturers' requirements.
- It's cable-ready—Test all the latest digital tuners.
- It has unique patterns—Special test patterns, plus standard patterns simplify troubleshooting.
- It's obsolete proof—It can be updated as needed for new circuits or formats . . . quickly and inexpensively.

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

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

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

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