

ELECTRONICTM

Servicing & Technology

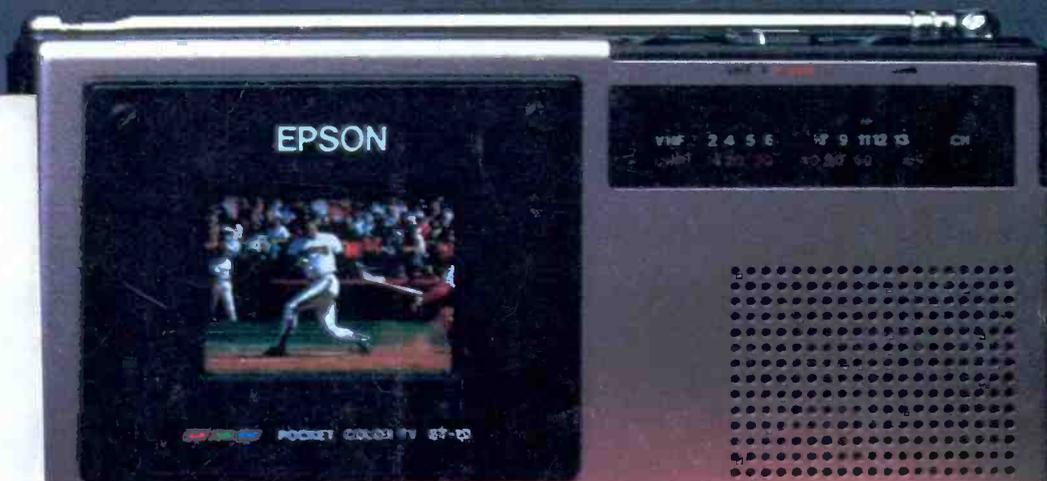
DECEMBER 1984/\$2.25

*Servicing & Technology
servicing - cordless -*

Replacing VCR head cylinders • Special-purpose diodes

Cordless telephones • Servicing K-Mart chassis

Tiny color TV





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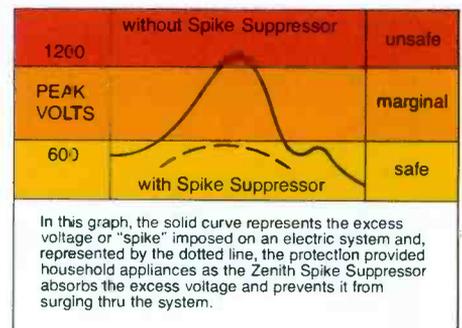
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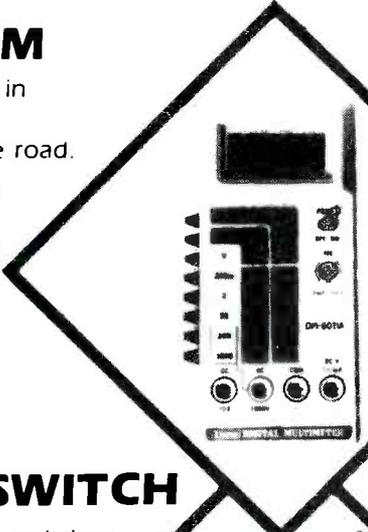
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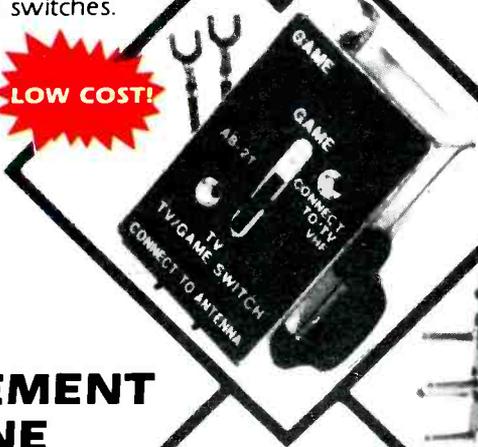
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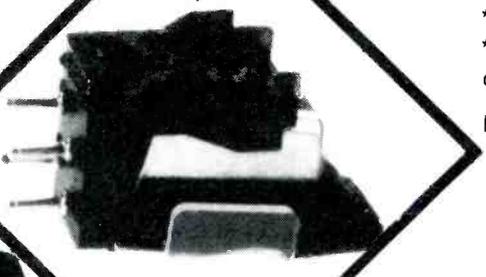
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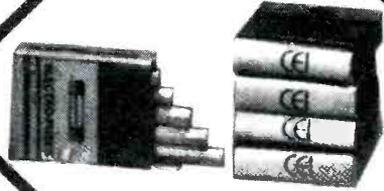
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The how-to magazine of electronics...

ELECTRONIC

Servicing & Technology

December 1984
Volume 4, No. 12



Liquid-crystal display (LCD) technology, thin-film transistors and thousands of microscopic red, green and blue filters combine to make this palm-sized color television a reality. (Photo courtesy of Epson.)

10 Servicing the 13-inch K-Mart color chassis

By Homer Davidson

Foreign built TV chassis can be a little trickier to service than domestic models because of smaller circuit boards and different circuitry placement. Using the Gold-Star 13-inch color chassis, Davidson demonstrates some servicing techniques for foreign models.

20 Emerging TV and video developments

Hand-held TV sets – what's next? Take a look at some of the recent technological advances entering the marketplace, including the LCD television, featured on the cover, the RCA remote control programmable video recorder and video multiplexers.

38 What do you know about components? Special-purpose diodes

By Sam Wilson

Focusing on a variety of special purpose diodes, Wilson discusses diacs, tunnel diodes, reverse breakdown diodes, Schockley diodes and high-frequency hot carrier diodes.

42 Replacing upper head cylinder in RCA VCR

Video problems could be the symptom of either a dirty or defective VCR head cylinder but replacing the cylinders must be done very carefully. This article explains how to distinguish a dirty head from a defective head and also details the procedure for replacing the cylinder.

50 Operation and servicing of cordless telephones – Part 2

By Paul Yost

Concluding his 2-part article on cordless telephones, Yost examines the circuitry used in the handset portion of these phones and also gives some servicing pointers.

56 Test your electronic knowledge

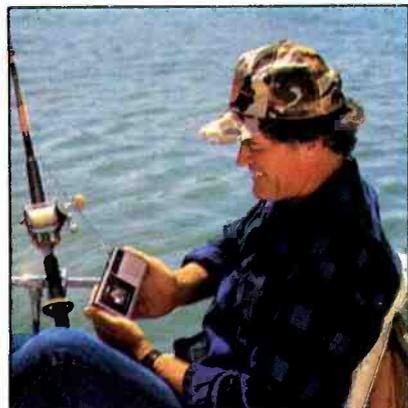
By Sam Wilson

This month's quiz asks questions similar to those used on the associate level CET exam.

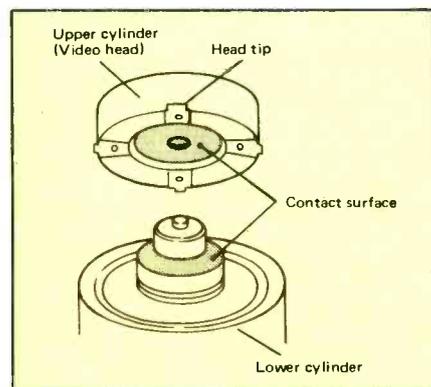
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Next Month...



The article, "**Proven techniques for troubleshooting the Sony KV 1722,**" describes the theory behind the pulse-width-modulated (PWM) power supply Sony introduced in their televisions in 1973. The article also will detail some specific procedures for servicing the extremely complex circuitry.

My word

When I wrote the editorial that appeared in the September issue of *ES&T*, I had no idea what I was getting myself into. In that editorial, I wrote about words that are familiar to anyone who's involved in electronics and wondered about their derivation. The words in particular were *Aquadag*, and *Klystron*. As it turns out, a number of readers are as interested in words as I am and considerably more informed. Three wrote me letters. One called me on the phone.

Aquadag and *Klystron*, according to information provided by these readers, are both trademarks. *Aquadag* describes a suspension of fine graphite particles in water. *Klystron*, according to one reader, comes from the Greek word for *syringe* plus the suffix *tron*. Have a look at the Feedback department in this issue for more details.

All of this information about two of the words in electronics is helpful. Thanks to the readers who wrote. Your input really is appreciated.

But now that I've satisfied my curiosity about those two words, there are several more electronics words whose meaning I have a pretty good grasp of, but no one seems to know where they came from. Take *raster* for instance. Anyone involved with TV in any way knows that it describes the way in which the TV picture is formed, and, in general parlance, means the light that appears on the TV screen when everything is working all right.

According to *Webster's Ninth New Collegiate Dictionary*, the term *raster* was coined sometime

around 1934 and means, "The area upon which the image is reproduced in the cathode ray tube of a TV set." The derivation given says that it is borrowed from German, which in turn comes from the Latin word for rake, which in turn comes from the Latin for scrape. Perhaps the idea is that the schematic representation (of the electron beam traces on the face of the tube) resembles the neat scratches made by the tines of a rake in loose soil.

In case you've come to the conclusion that this lack of knowledge of word derivation is peculiar to electronics, ask your mechanic where the word *carburetor* comes from. He'll probably look at you as if you've lost your mind. But, unless I miss my guess, he won't have any idea that it comes from the word *carburet*, meaning "to combine or mix with carbon or hydrocarbons so as to increase available fuel energy." (*New College Edition of The American Heritage Dictionary of the English Language*).

I'm not implying here that studying the origins of words is going to make anyone better at the skills of diagnosing and repairing a sick circuit. But a knowledge of the words and their origins can help to conjure up vivid and correct mental images, which can go a long way toward a thorough understanding of the subject.

Nils Conrad Persson

ELECTRONIC

Servicing & Technology

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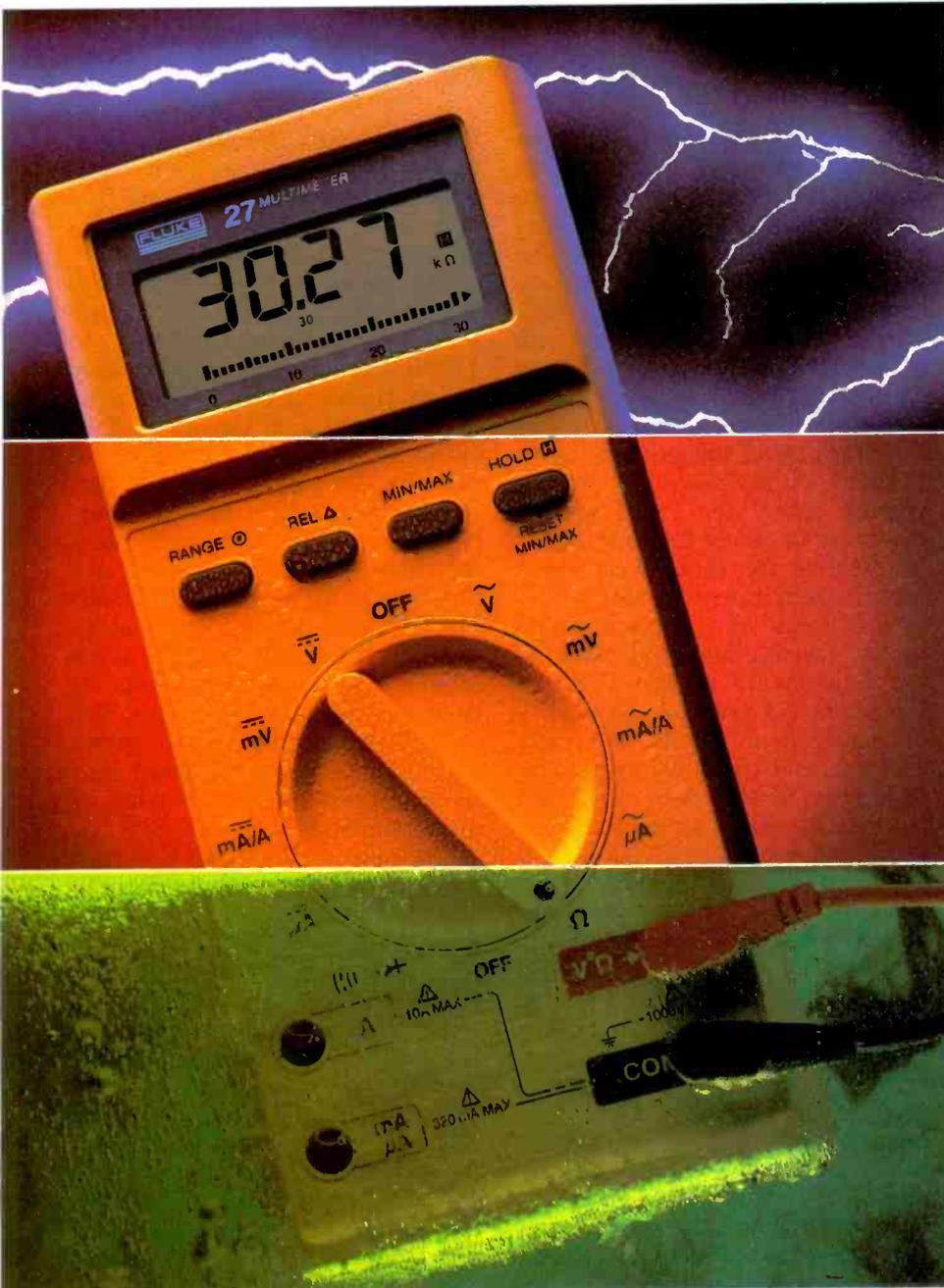
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Analog/digital display
0.1% basic dc accuracy
100 μV to 1000V ac and dc
0.1 μA to 10A, all fused
-15°C to 55°C operation
Two year warranty
Relative (difference) mode
MIN/MAX recording mode

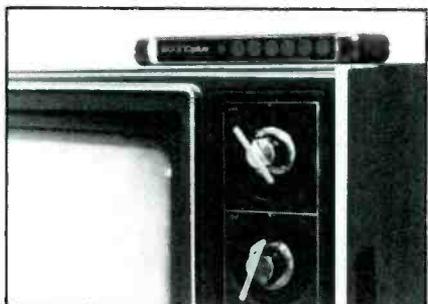
*Patent pending

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

Sound system aids hearing impaired



The Sound Plus TV listening system consists of a lightwave transmitter (upper left) and an electret microphone (upper right) that transmits TV sound to a lightweight, 3-ounce wireless headset receiver (foreground).



The compact Sound Plus transmitter, placed on top of the television, uses invisible lightwaves to send TV audio to the headset receiver.



The Sound Plus Infrared Professional Sound System employs a wide-area transmitter (shown above). It uses invisible lightwaves to send speech and sound to individual wireless headset receivers worn by hearing-impaired audience members at public assemblies, such as movies, theaters, churches and auditoriums.

A recently developed wide-area lightwave listening system allows hearing-impaired individuals to clearly hear sound from home electronic entertainment systems, as well as performances in public assembly areas, such as concert halls or movie theaters. The system, called the Sound Plus Infrared Professional Sound System by Controlonics Corporation, of Westford, MA, will produce up to 112dB sound pressure level—enough sound for those with a moderate to severe hearing loss. It is effective for those who would benefit from a hearing aid.

“The Sound Plus system brings to the hearing-impaired some of the enjoyments of life that we often take for granted—the ability to clearly hear movies, concerts, speeches and virtually any activity performed in a public center,” said George Olmsted, Controlonics vice president, consumer division.

“Sound systems are necessary because most of the hearing-impaired population—estimated at one in 15 Americans and one in three over age 60—cannot clearly hear radio, television or public performances,” Olmsted said.

Only 20 percent of those affected use hearing aids. Additionally, hearing aids tend to amplify all background noise, such as air conditioning, rattling paper and nearby conversations, to such an extent that the principal sound source may be obscured. This condition worsens where sound can reverberate off of walls and ceilings. Moreover, the acoustics of many theaters and concert halls have been designed to effectively reflect sound.

Sound Plus employs a transmitter that uses invisible lightwaves to send speech or music to individual lightweight wireless headset receivers. Transmission is confined to the room containing

the sound source because the lightwaves do not pass through walls. Sound Plus is interference free and is not affected by radio frequency signals.

The receivers reproduce high fidelity audio (100-800Hz) at personally adjustable levels up to 112dB sound pressure level. They weigh three ounces, and can be used anywhere in the room. Two speakers deliver audio directly to the ears. Two AAA (penlight) batteries, installed in the receiver, supply more than 100 hours listening time.

Although designed for the hearing impaired, the system is also an excellent product for use in areas where selective listening is desired. Its features make this system suitable for use in group settings where the broadcast may be of interest to some, but not all of the audience.

The system has been designed for fast and simple installation in churches, theaters or classrooms. Inputs are provided for connection to an existing audio system or single microphone. A single transmitter will cover up to 4000 square feet. Any number of additional transmitters may be connected by standard cables to cover a larger area or added rooms.

The transmitter sends lightwaves through an array of eight infrared LED sections. Each section is independent. If one section fails, the rest will continue to transmit lightwaves. The system also features automatic gain control (AGC) to prevent sharp increases in volume caused by sudden loud sounds.

Sound Plus is available in a home unit for use with a TV set. In this version, a small transmitter sits on top of the television and a microphone is placed in front of the TV speaker. The same headset receiver is worn by the viewer.

"THE CONIFER SYSTEM IS TERRIFIC!

IT HAS THE PICTURE QUALITY I WANT TO PASS ON TO MY CUSTOMERS."



Paul Giberti has been selling Conifer for over a year in the Whitman, Massachusetts, area and is convinced it's the best mesh system available today. Here, in his own words are the reasons why!

HOW DID YOU BECOME SOLD ON CONIFER?

"I had installed a couple of the Conifer dishes and liked them. Then, I went to a satellite show and saw the rest of their equipment and became completely hooked. The Conifer system is terrific!"

WHAT DO YOU CONSIDER THE MOST IMPORTANT FEATURE?

"From a dealer's standpoint performance is the most important quality of any satellite system. Conifer's performance is the best of any mesh satellite dish. I compare the Conifer system to competitive systems and customers want to know why Conifer's picture is so much better. As far as I'm concerned Conifer is commercial quality."

WHAT ABOUT THE APPEARANCE OF THE DISH AND RECEIVER?

"The dish looks nice. You can get it in different colors to blend into the environment. You can locate the receiver just about anywhere into any living environment. The system really fits in."

HOW ABOUT THE DURABILITY OF THE ANTENNA?

"The survivability of the Conifer dish is way up there on the list of outstanding features. We installed one dish forty feet up in the air that became

completely caked with ice during a storm. Icicles were hanging 10-feet below it. Winds were blowing 60 to 70 miles per hour and the dish was completely operational the whole time. Another dish is located 35 feet from the Massachusetts shoreline and is constantly exposed to salt spray. Its been out there for a long time and so far I haven't had any problems. The antenna construction is outstanding and the mount is extremely well-built. It has to be to survive this environment."

DO YOU HAVE ANY COMMERCIAL APPLICATIONS FOR THE CONIFER DISH?

"Yes. I've put in a Conifer SMATV system and it's working perfectly. The dish performs well in SMATV applications and Conifer has all the equipment I need for a reasonable yet good quality SMATV system."

WHAT ABOUT CONIFER'S SERVICE?

"Service is probably one of the key advantages I find when I deal with Conifer. Whenever I have a problem or need help they're right on it! All the Conifer people are that way. And, their service and repair turnaround work is great."



HOW DO YOU SELL THE CONIFER SYSTEM?

"I show my customers a demonstration of the complete Conifer home satellite TV system and ask them to compare it to our competition. They don't always know what a good picture should look like. When they see the competition and then Conifer there's no doubt about it, Conifer always has the best picture."

WHY DO YOU RECOMMEND CONIFER?

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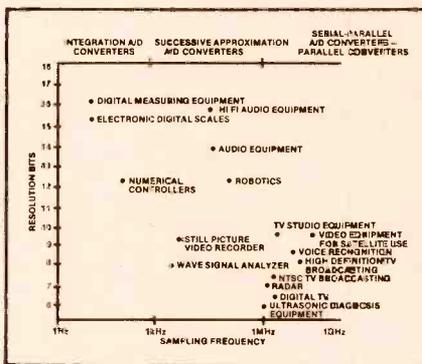


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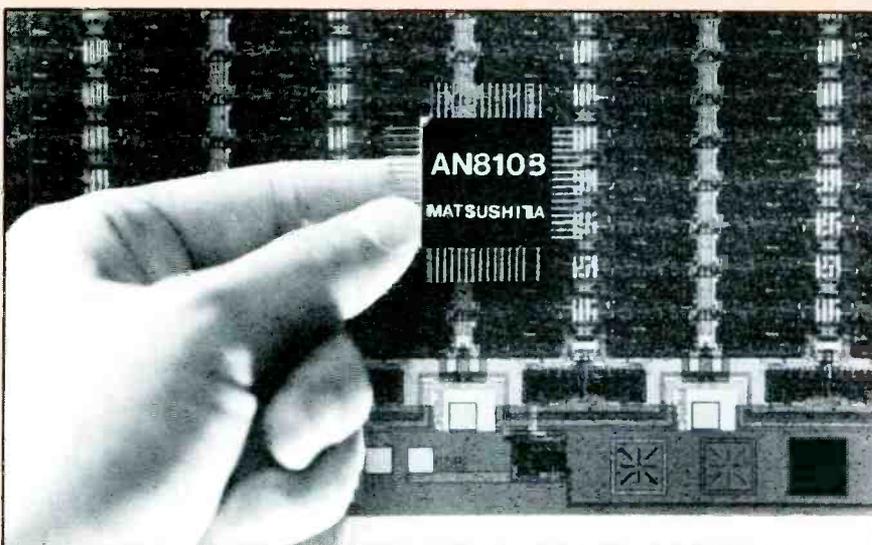
A/D converter brings high-definition TV a little closer

A recently developed, monolithic-type, ultra-high speed, 8-bit image processing analog to digital (A/D) converter can be used for high-resolution image processing equipment, high-definition television, measuring equipment and medical products, such as computer tomography equipment.

With the advent of *New Media* systems, such as teletext and videotex, the A/D converter is expected to play an increasingly important role as a data conversion device for electronic equipment with digitalized signal processing.



Uses to which A to D converters are put depend upon sampling frequency and resolution.



Eight-bit ultra-high speed A/D converter is expected to be used in high-definition TV technology.

The ultra-high speed of the A/D converter, announced early this year by Matsushita, represents a breakthrough in converter technology, according to the manufacturers. Conventional 1-chip, 8-bit monolithic A/D converters for video use operate at a speed of 30-40 million samples per second on a signal frequency of approximately 10MHz. This low speed has prevented use of the converters in high definition television, which uses a frequency range higher than 25MHz.

The new converter, dubbed AN8108, has attained a speed of 120 million samples per second, with an input signal range of 40MHz, making it suitable for high-definition picture processing. High definition television has 1125 scanning lines, compared to conventional TV pictures which have 525 lines.

The AN8108 was created through use of design technology for ultra-high speed circuitry and high precision processing technology whose features include:

- A 3-stage comparator circuit that decreases clock signal-

talking back into an analog signal at a ratio of 1:25;

- Circuitry that integrates current source of decoder section and decreased power consumption of the decoder section down to 1/7, without loss of speed;
- A high-precision, innovative double ion implantation process made possible by decreasing off set voltage to less than 0.2mV.

The new converter is a step toward digitalization of high-resolution video pictures. It will be used in high resolution studio equipment, receiving equipment, optical transmission equipment, medical equipment and in the digitalization of high performance equipment.

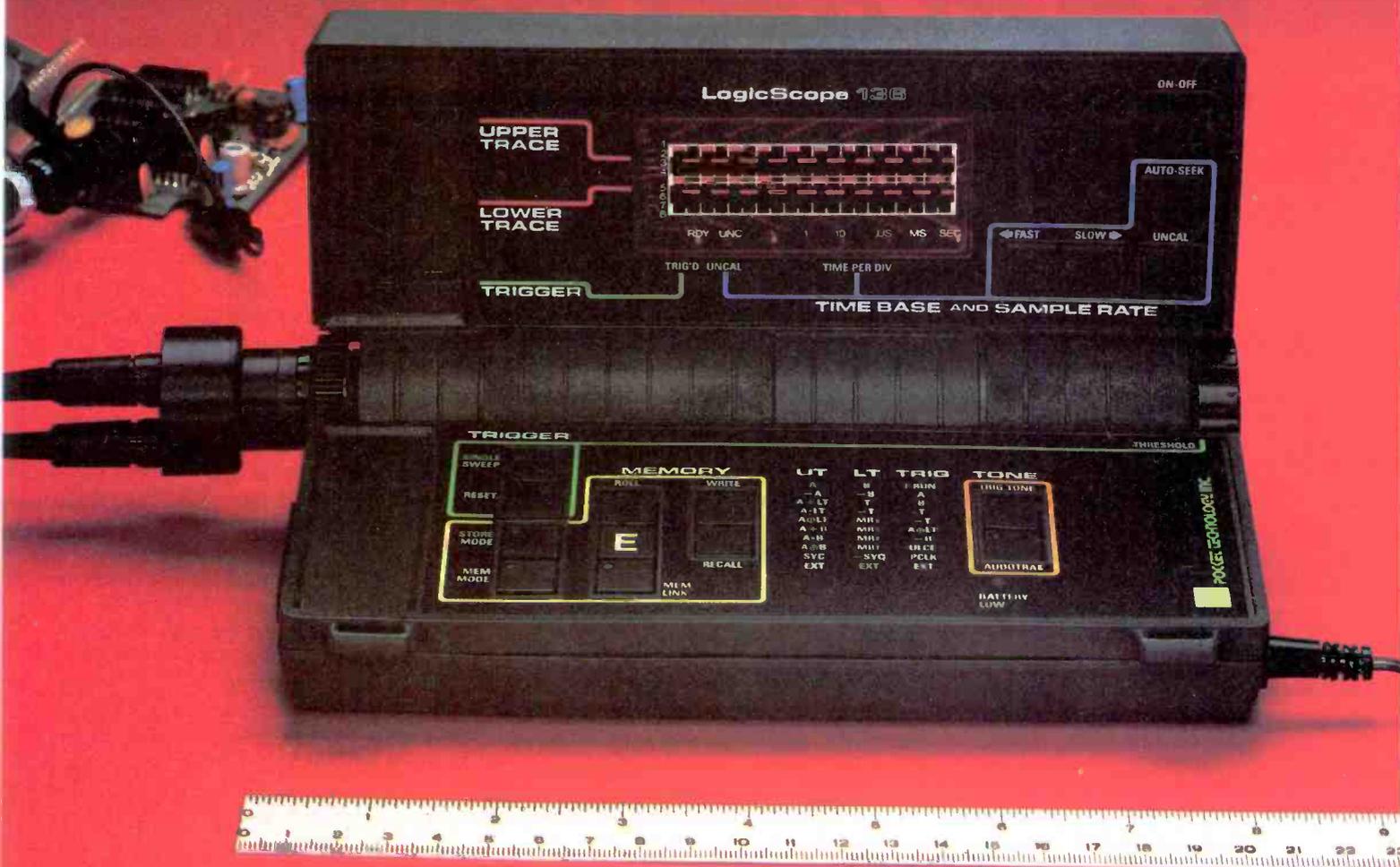
Features of the new converter include:

- Ultra-high speed, 8-bit monolithic A/D converter with maximum conversion speed of 120 million samples per second and maximum input frequency range of 40MHz.
- World's highest level of integration on an analog IC: 24,000 elements are integrated on a chip by adopting high-resolution, high speed IC technology (double ion implantation technology).
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- The 136 can be used for viewing single shot events, or repetitive waveforms. It can be operated in real time mode, or in memory mode which permits acquisition and storage of up to 24 128-bit waveforms. These can be recalled, logically compared (AND, OR, EXCLUSIVE OR) to other stored/input waveforms, or output to an external device via an RS 232 port.
- Its very low cost, convenience and ease-of-use make the LogicScope the ideal instrument, for designing, troubleshooting or repairing digital systems.

Consider its Engineering & Field Service Applications:

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

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Circle (7) on Reply Card

Servicing 13-inch K-Mart color chassis

By Homer Davidson

Repairing foreign-built color TV receivers frequently presents problems and frustrations. Working space often is crowded. Certain circuits are different from the American counterparts, and thus more difficult to understand and troubleshoot. A few components are so critical that they should be ordered from the manufacturer's representatives.

Although these problems often are real, there are solutions. First, a good schematic and suitable items of test equipment are imperative. Proper replacement components are becoming readily available. Malfunctioning tuners can be removed and sent to a tuner-repair depot for cleaning and overhaul. Universal replacements can be substituted for most transistors, ICs, capacitors and resistors.

The 13-inch color receivers sold under the K-Mart name are manufactured by Gold Star, and Photofacts 1870-1, 1993-1, 2021-1 and 2106-1 cover most circuits. Compare the actual circuits against those of the various Photofacts, and use the one that most nearly matches the one on the bench, even when the model is not covered by the Photofact.

Typical repairs of these K-Mart receivers by Gold Star are illustrated by the following case histories.

No sound or raster

Dc-supply voltages for some sound, video and chroma stages are produced by rectification and filtering of horizontal power from the flyback. A complete loss of horizontal deflection eliminates the raster and all sound. Of course, sufficient low-voltage dc voltage is required for operation of the horizontal-deflection system. Therefore, both the regulated low-voltage supply and the horizontal

system must operate correctly for the receiver to produce sound and a color picture.

One diode (D801) rectifies the 120V line voltage, producing about +156V, which is reduced to +115V by the regulator (Figure 1). If +156V cannot be measured at the regulator collector (case of Q801 regulator transistor), check diode D801, filter capacitor C807 (470 μ F), 3A fuse F2, surge resistor R802 (10 Ω 10W), or on/off switch SW801.

Both the regulated low-voltage supply and the horizontal system must operate correctly for the receiver to produce sound and a color picture.

Several model CR401 receivers (Photofact 1870-1) were found to have a bad connection of the board wiring between R802 and Q801 (see Figure 1). An open there produces a completely dead chassis, without sound, picture or dc voltages. For a dependable repair, solder a piece of insulated wire from R802 to the Q801-collector terminal.

Convenient testpoints for measuring the +115V regulated voltage are fuse F1 and the case of Q551, the horizontal-output transistor. Low voltage there might indicate a regulator problem or excessive current in Q551.

Figure 2 shows how to perform in-circuit tests of Q551 collector-to-ground leakage or junction voltage drop. Because the base and emitter have only about 0.4 Ω between them, and the emitter is grounded, they are both considered grounded during leakage

tests. Connect the ohmmeter positive probe to the Q551 collector (case) and the negative probe to ground. The reading will be in ohms or megohms, and higher readings are desirable. Usually the reading will begin at a low resistance and increase rapidly as the filter capacitors charge. Wait until the reading becomes relatively stable. A high reading proves there is no leakage. The short or leakage might be in the power supply or in Q551, so when the reading is too low, remove Q551 from the chassis for external tests.

Some digital multimeters have a special diode test that applies a constant current to the diode or transistor junction and then measures the resulting voltage drop across the junction. As shown in Figure 2, the collector/base junction of Q551 is tested when the negative probe is touched to the Q551 collector (case) and the positive probe is grounded. The reading on the meter is 0.518V, which is normal for a power-transistor junction (small silicon-transistor junction often test above 0.7). This same test usually proves conduction of the damper diode (connected between collector and emitter), but two Photofacts fail to show a damper diode on the schematic. (If a chassis originally had a damper diode, but it is removed, the operation will not be changed appreciably. However, the collector-base junction must function as a damper. If the output transistor is not designed for the heavier load, it probably will fail prematurely.)

While Q551 has been removed for external tests, the receiver should be switched on and the +115V source at F1 (Figure 1) measured. Without the Q551 load, the voltage should be higher than +115V (perhaps +150V), because it is impossible to cut-off all reg-

ulator current because R803 (180Ω) parallels Q801, the regulator transistor. This could hide a problem; a shorted Q801 will give the same no-load reading, but after a shorted Q551 is discovered and a new one installed, the supply voltage will be excessive and the new Q551 probably will be ruined within a few minutes. While Q551 is removed, one solution is to connect temporarily a 250Ω, 50W (or higher wattage) resistor from the CircuiTrace-1 +115V source to ground and measure the resulting voltage. A normal regulator

should supply about +115V to the test resistor, but a much higher reading proves the regulator is defective and must be repaired before a new Q551 is installed. Remember to remove the test 250Ω resistor.

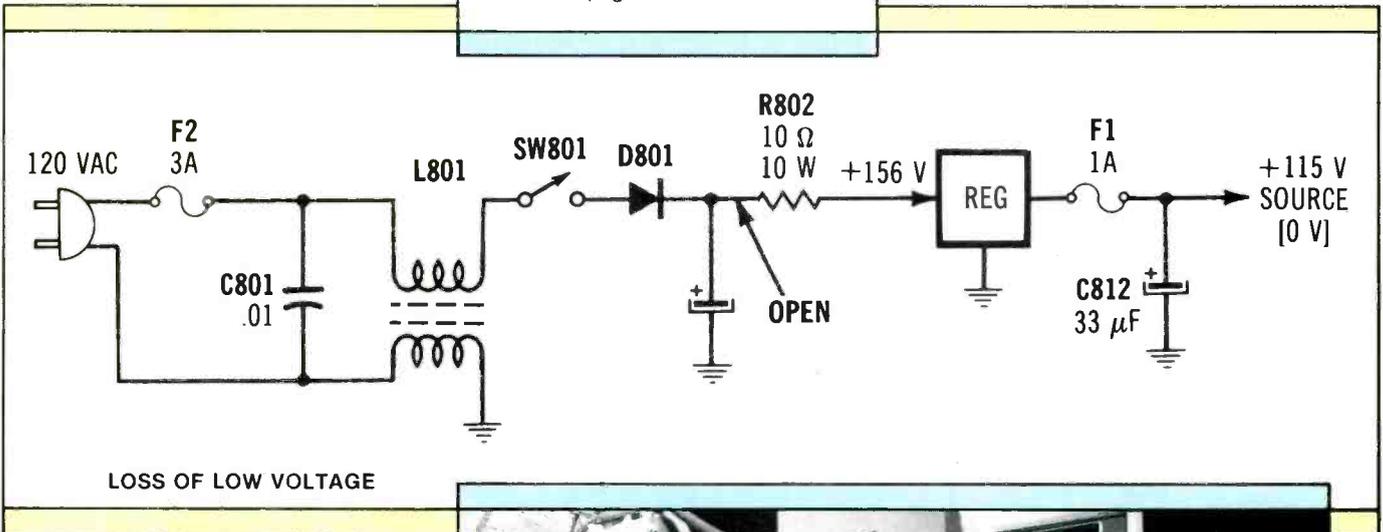
A low voltage at the +115V source, while Q551 is removed, in-

dicates a problem in the low-voltage circuit (Figure 1), or perhaps a double defect in the regulator. Be certain all these potential problems are solved before a new Q551 is installed.

Regulator problems

Regulation of the +115V supply in the Gold Star/K-Mart receivers is accomplished by varying the collector-to-emitter resistance of Q801 (Figure 3), which is placed between the regulated +156V and the regulated source voltage (Figure 4). Increased C/E resis-

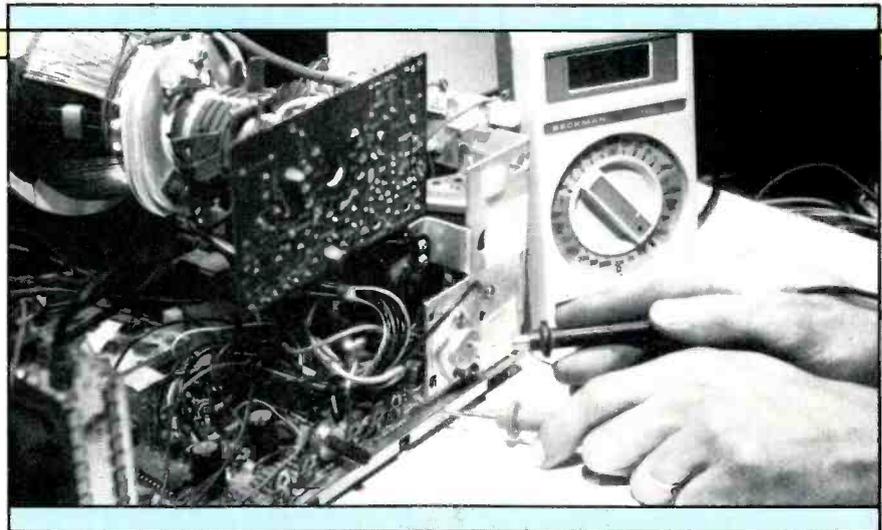
If the fuse clips have changed color...the clips should be removed and replaced with a pig-tail fuse.



LOSS OF LOW VOLTAGE

Figure 1. Each K-Mart 13-inch color receiver by Gold Star has a single diode that rectifies ac-line voltage. A series-type transistor regulator provides a steady +115V for the horizontal-output transistor. Several receivers have been found with an open circuit in the board wiring (see arrow) that eliminates the supply voltage.

Figure 2. Case of the Q551 horizontal-output transistor is a convenient point for several tests, such as the +115V supply (when power is on) or leakage and transistor tests when the ac power is off.



tance for example, will produce increased voltage drop, and this voltage drop is subtracted from the output voltage. Therefore, when Q802 and the associated components provide the correct varying base-to-emitter, bias at Q801, the Q801 C/E resistance is varied as needed to provide a steady +115V at the voltage source for the horizontal-output transistor, regardless of minor variations of line voltage and horizontal dc power. Voltage at the Q801 emitter is sampled by the R811/R812/R813 voltage divider, which varies the bias of Q802, and the Q802 collector current passes through R808 to the Q801 base. Also, the Q801 base is clamped to

an almost fixed voltage (from diode D806), so the Q802 collector current varies the Q801 base voltage enough for full regulation.

Actually, there are two allied regulation actions. The Q801 base voltage is clamped to about 40V less than the +158V that comes from C801, while the Q801 emitter voltage is the +115V source voltage that varies with the current supplied to the horizontal-output transistor. When the load current increases, the Q801 emitter voltage decreases. But the base voltage is unchanged. This is an increase of Q801's forward bias, so the C/E resistance is reduced, which lowers the voltage drop and restores the emitter voltage to

almost the same as the starting voltage. Of course, a decrease of load current raises the emitter voltage (which is decreased forward bias) and Q801's C/E resistance increases to increase the C/E voltage drop, and this in turn decreases the emitter-to-ground voltage to almost the same dc voltage as before the change of load current. This provides moderate regulation.

Q802 is added to multiply the effectiveness of the regulation, because a sample of the Q801 emitter voltage (the so-called +115V source) is applied to the Q802 base where a higher +115V-source current produces a lower Q802 forward bias. The reduced forward bias decreases the Q802 collector current drawn through R808 from the Q801 base. The reduced current from the Q802 base increases the base-to-ground voltage, which increases the +115V-source voltage. A decreased current drawn from the +115V-source increases the Q801 emitter and the Q802 base voltages. Both voltage changes increase the Q801 B/E resistance and cancel most of the previous voltage increase.

Of course, that assumes all components are perfect and the R812 115V adjustment has been properly made. Although almost any component shown in Figure 4 can affect either the output voltage or the efficiency of regulation, the troublemakers usually are Q801, Q802, zener diode D806, R802 and R804. Q801 and Q802 often open or become leaky. Zener D806 usually shows leakage by operating too warm. Replace D806 when fusible resistor R804 is found to be open. Also, visually check all soldered joints and resolder any suspicious ones.

With one Gold Star CR407 (Photofact 2021-1), the regulated supply measured too low at F1, and there was no sound or picture. Even more significant, the +12.9V source measured only about +1.5V and R508 (Figure 4) was operating very warm, indicating excessive current. The 12V source supplies the sync/horiz/vert functions in IC401, and the pins had low voltage. As a test for shorted IC, we disconnected pin 11 and the +12.9V supply increased to normal. IC401

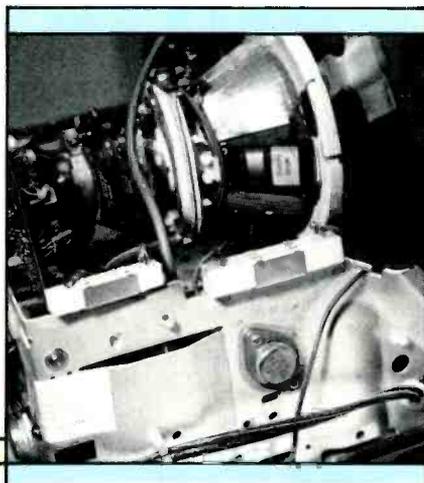


Figure 3. Regulator transistor Q801 is mounted on one side of the chassis that functions as a heat sink in this Gold Star KMC1320 model. Q801 is rather difficult to remove, so make all possible tests in-circuit before removing Q801.

Figure 4. Operation of this K-Mart regulator is described in the text. The collector-to-emitter resistance of Q801 and resistor R803 are in parallel, and the circuit varies the Q801 C/E resistance as needed to maintain a constant output voltage.

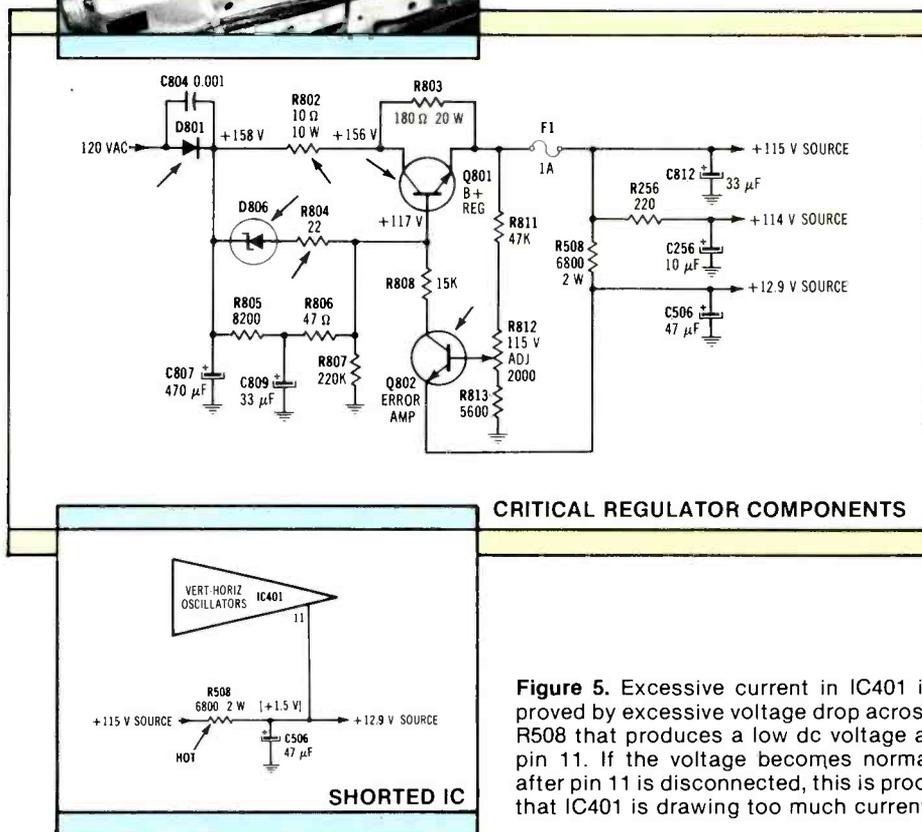
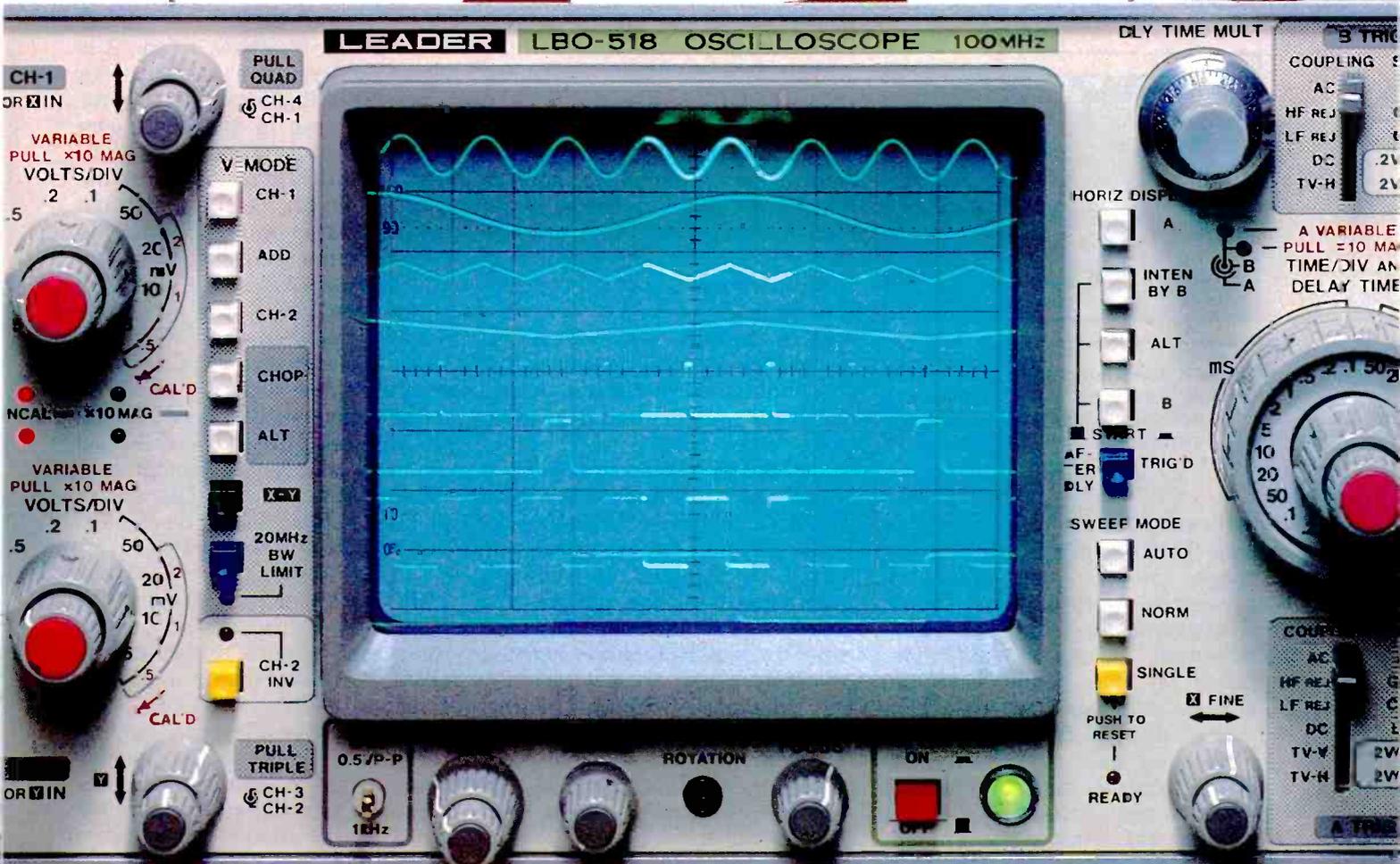


Figure 5. Excessive current in IC401 is proved by excessive voltage drop across R508 that produces a low dc voltage at pin 11. If the voltage becomes normal after pin 11 is disconnected, this is proof that IC401 is drawing too much current.

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was replaced with an SK9249 universal type, and the receiver operation was restored.

An unusual intermittent

Sometimes the Gold Star KMC1311G would operate for several hours without loss of high voltage. But sometimes a small

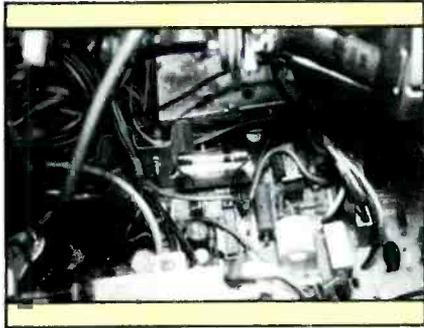


Figure 6. Some intermittents are caused by loose fuse clips. If the original clips have changed color because of heat, solder a pigtail-type fuse to the board, as shown.

movement of the chassis or tapping it with a plastic screwdriver handle would cause the high voltage to collapse. When the dc voltage at the case of the horizontal-output transistor was monitored, it was found that the voltage became zero when the high voltage disappeared.

Checking back through the circuitry proved that the picture would return when fuse F1 was touched with a test probe. *The fuse was loose in the clip.* Although crimping the end clips together sometimes will solve such intermittents, it should not be attempted if the clips have changed color. This indicates heat damage, and the clips should be removed and replaced with a pig-tail fuse that is soldered to the proper points on the circuit board (Figure 6).

Fuses blow

An overload in the horizontal-deflection system is indicated when F1 (1A) blows. Usually a defective component in the low-voltage or regulator circuit is responsible when F2 (3A) blows (see Figure 1). If F2 is open, connect a 100W incandescent light bulb across the clips. The bulb will be bright when the current is excessive and will glow dimly for a normal current.

If the bulb glows brightly when

power is switched on, turn off the power and remove F1, which protects the horizontal system. If the bulb is dim or black when the receiver is powered again, the overload is in the horizontal-sweep system. Remove the horizontal-output transistor, replace F1 and again switch on the power. When the bulb is bright, the defect is in some branch of the +115V supply, and resistance tests should be used to find the component. But if the bulb is dark, the problem is the transistor or some excessive signal load such as a shorted flyback or yoke. If the bulb continues to glow brightly with F1 removed, the defect is in the low-voltage power supply or in the regulator.

In a K-Mart KMC1311G receiver, the F1 fuse continued to blow unless the horizontal-output transistor was removed. However, Q551 tested normal when out of the circuit. F1 was replaced by a 2A fuse as a test and a 100W bulb was used instead of F2. Various loads on the flyback were removed, but the bulb retained high brightness until the picture-tube socket was unplugged. This indicated the picture tube was shorted or highly gassy, so a very quick test was used with full power. Heavy arcing was seen in the neck of the picture tube. Replacement of the picture tube restored normal operation with the correct fuses installed.

No high voltage

A few simple tests usually find the general location of the problem causing a loss of high voltage. First, measure the dc voltages at F1 and the case of Q551, the horizontal-output transistor. Virtually the same voltage should be found at both. An open in the T502 flyback primary winding or the connecting wiring is likely when the voltages are different. When both testpoints have the same excessive voltage, the Q551 transistor is open, the Q551 transistor has no base drive, or the low-voltage regulator is defective and producing excessive voltage that has forced the receiver into shut-down mode.

The following short series of tests will show which possibility is true:

- Remove Q51 and check it

thoroughly. Do not reinstall it yet.

- Scope the Q551 base terminal for amplitude, frequency and approximate waveshape (without the transistor, the waveshape will more nearly resemble a square wave). If there is no base signal, the defect probably is in the oscillator or driver stages, which should be checked in detail. If there is a proper base signal, it is likely the regulator is producing excessive voltage and the receiver originally was in the shut-down mode. As suggested before, connect a 250Ω, 50W resistor from the Q551 collector lead to ground (while Q551 is removed), power the receiver and check the dc voltage. If it is near +115V, the regulator is not defective; if it is +140V to +150V, the Q801 regulator transistor probably has a C/E short.

- After these defects have been found and corrected, finally install Q551 (either the good original or a new one as needed). Some Q551 failures ruin base resistor R517 (0.27Ω), so R517 should be checked visually and for resistance.

During scope tests, look for 1VPP square waves at pin 10 of IC401 (see Figure 7). Next, scope for strong square waves at the Q502 horizontal-driver collector. Finally, 16VPP waveforms drive the Q551 base. Failure to find these waveforms calls for dc voltage and resistance measurements to find the cause. Resistor R516 in the driver stage has a record of failures.

In one actual case, the Q551 collector voltage was very high, there was no horizontal drive at the bases of Q502 driver or Q551 output transistors, and a weak distorted waveform was found at IC401 pin 10. All symptoms pointed toward a horizontal-oscillator failure. Then about +1V was measured at B+ pin 11 of IC401. Obviously, the IC could not operate correctly with such a low supply. When pin 11 was unsoldered from the supply, the supply voltage exceeded +13V. Installation of a new IC401 brought back normal operation.

Excessive brightness

When the brightness is excessive, several retrace lines often can be seen at the raster's top. Excessive brightness is caused usually by incorrect picture-tube dc

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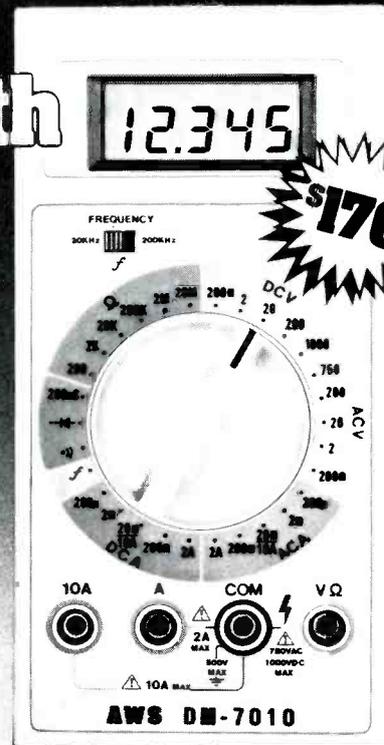
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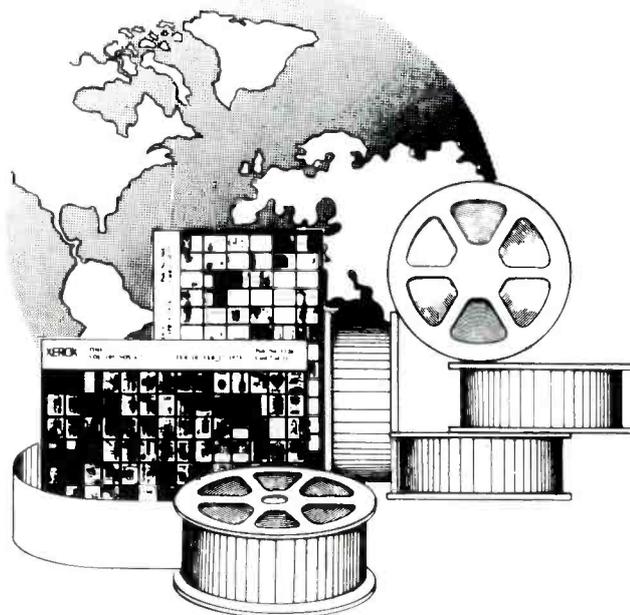
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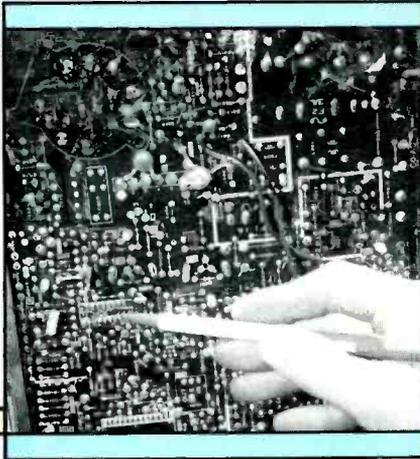
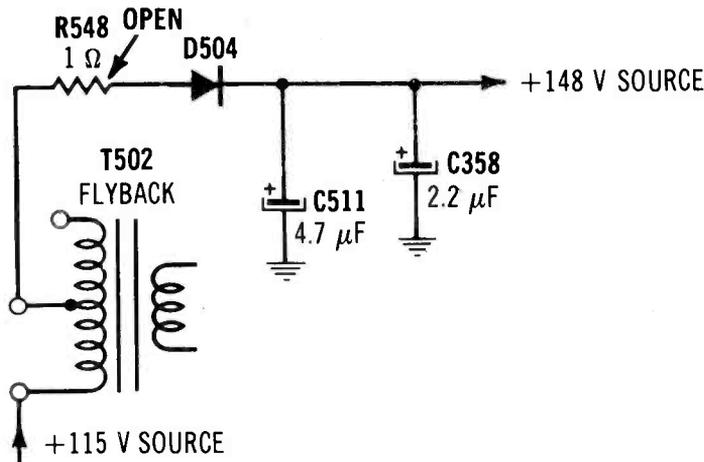


Figure 7. Scope IC401 pin 10 expecting to find horizontal-rate square waves. When pin 10 does not have the proper drive signal, measure and analyze the dc voltages at all active pins. Replace IC401 if the voltages are incorrect.

Figure 8. Loss of the +148V supply to the three color-output transistors causes excessive brightness. Diode D504 and R548 in the supply often require replacement.



COLOR-OUTPUT TRANSISTORS' SUPPLY VOLTAGE MISSING

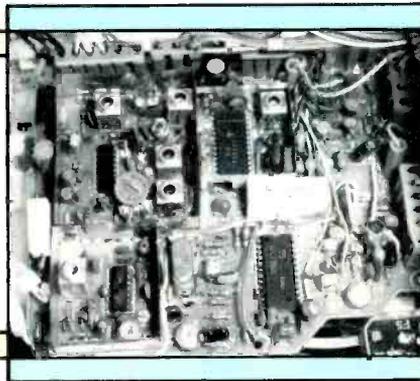
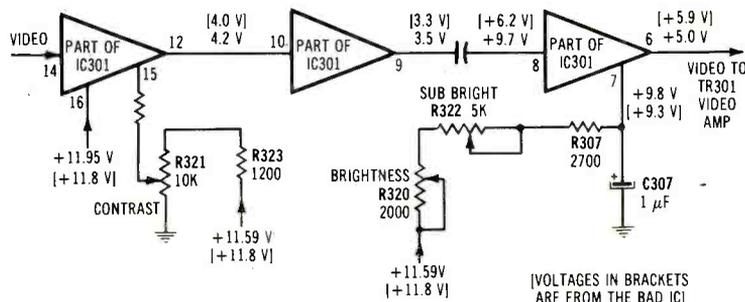


Figure 9. Symptoms of a defective IC601 video/chroma IC include excessive brightness, insufficient brightness, a negative picture or a tinted raster. IC601 is in the lower right corner of the photograph (Gold Star/K-Mart KMC-1310G model).



ERRATIC VIDEO

Figure 10. A heat-related erratic condition reduced the brightness at times. Although some dc voltages changed when the problem occurred, the most important symptom was a return to normal when canned coolant was sprayed on IC301. A new replacement IC301 stopped the intermittent condition.

voltages, a shorted picture tube or defects in a video stage. Therefore, the first step should be checking dc voltages at the picture-tube socket.

In one Gold Star CR401, the collectors of Q353, Q351 and Q352 color-output transistors measured about +40Vdc, producing insufficient bias for the picture-tube guns and causing excessive brightness with some blooming. Voltage and resistance tests located an open in R548 (Figure 8). The k+148V supply was producing no voltage. However, a low voltage was produced at the color collectors by current from the picture-tube cathodes.

Another potential cause of excessive brightness is an open or increased value in R362, a 1.8MΩ bleeder in the picture-tube screen-grid control circuit. Also, arcs in the picture tube can short diode D504 (Figure 8), or the short and arcs together might burn out R548 (mentioned before). In this receiver, replacement of R548 corrected the excessive brightness.

In a KMC1310G model, symptoms of incorrect brightness combined with a negative picture or a tinted raster might indicate a defective IC601 video/chroma IC, which should be replaced (Figure 9). Scope waveforms usually are limited to input and output video signals. Remember that a defective IC might not change the dc voltages more than 10 percent to 30 percent at some of the pins.

Intermittent picture

After a K-Mart KMC1310G operated normally for about 10 minutes, the screen became dark red and the brightness control had little effect. IC301 (Figure 10) was suspected, and dc voltages at all pins were measured during normal and abnormal operation. Although several dc voltages changed, the cause was not clear. Cooling spray was applied to IC301 while the receiver was malfunctioning, and immediately normal operation was restored. Replacement of IC301 with an ECG1164 universal IC stopped the intermittent brightness problem.

Erratic picture and sound

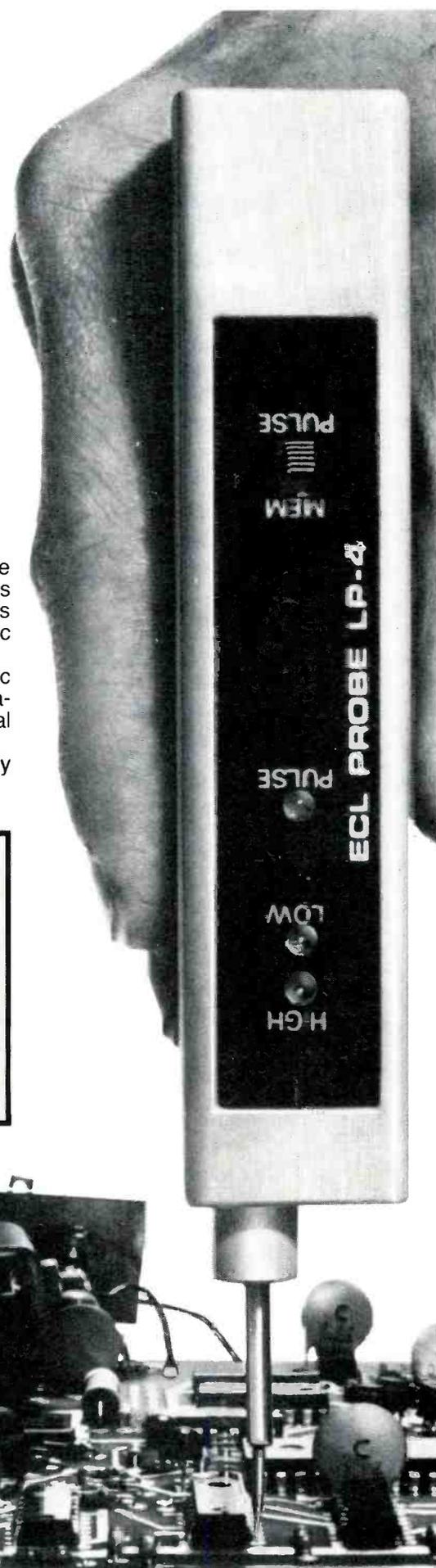
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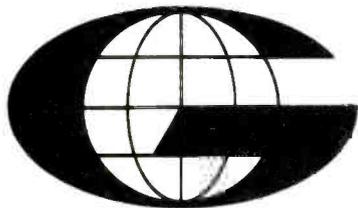
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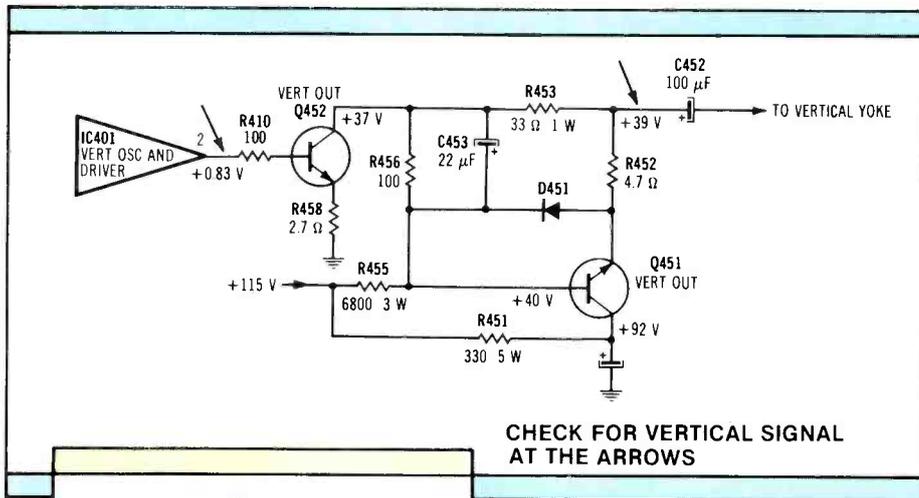
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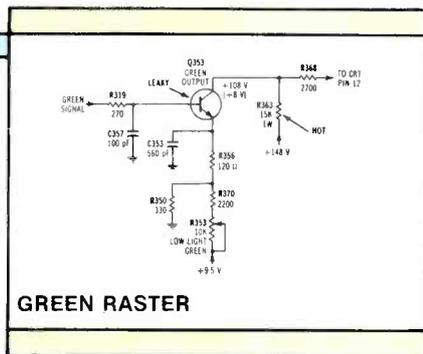
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GREEN RASTER

Figure 12. Shorted, leaky or open color-output transistors change the picture-tube cathode dc voltages (and thus the brightness of each primary color). A shorted or leaky transistor (Q353 is shown here) increases the brightness of its associated color (green, in this case) and also causes excessive heating of the collector resistor. For these symptoms, dc voltage tests should be performed first.

Figure 11. Scope the input and output points (at the two arrows) for vertical waveforms to determine whether the problem is inside IC401 or in the Q452/Q451 output stage.

Resistor R451 (330Ω, 5W) and 4.7Ω R452 often are burned open, especially when Q451 shorts. Remove Q452 and Q451 for tests out of the chassis. These flat types have a tendency to break down under load, so they might require replacements as a test, in severe cases. While the power transistors are out of the chassis, all resistors and diode D451 should be tested. This provides greater accuracy, free from paralleling loads.

Intermittent green picture

When one color is greatly dominant, or missing from the raster, suspect problems with the picture tube or the color-output transistors, which supply matrixed luminance and chrominance signals to the picture-tube cathodes (Figure 12). Leakage between collector and emitter in one transistor will reduce the associated picture-tube cathode voltage, thus increasing the brightness of that one color. An open in one transistor will increase the dc voltage of the associated picture-tube cathode, thus decreasing the brightness of that one color. Therefore, the first three measurements should be the color-output transistor collectors, which should test within 10V of each other. If one is much higher or lower than the other two, that one probably has the incorrect voltage and the defect. Shorted transistors can ruin their collector-load

resistors, so the three collector resistors should be tested for resistance. Defective color-output transistors can be replaced with GE-232 or ECG-157 universal types.

For example, one Gold Star CR407 showed an all-green screen. Q353 had only about +8V at the collector rather than the normal +108V, and R363 was running very warm. After it was removed from the picture-tube-socket board, a leakage of about 1000Ω was measured between collector and emitter terminals. Installation of a new Q353 and a new R363 (Figure 12) allowed normal gray-scale adjustments, a blue-gray black-and-white picture, and natural colors during colorcasts.

Sound problems

In these Gold Star 13-inch receivers, popping noises sometimes are heard in the speakers during the first few minutes of operation. Most such noises are triggered by temperature changes inside one of the two audio-output transistors. Usually, blowing hot air on the transistors will start the noises, and careful applications of canned coolant applied to just one transistor at a time will stop the noise when the spray reaches the culprit. Replacement of the defective transistor is the only remedy.

Weak or garbled sound can be caused by IC201, the audio IC. Replace IC201 when any of the pins have incorrect dc voltages. If all pin voltages are perfect, try adjusting sound-transformer T202 for minimum distortion.

When the sound is weak and noisy, parallel another 1μF capacitor across C208. If the sound is very weak, parallel another capacitor across 10μF C253 (that feeds the output transformer) and check R256, the 220Ω fusible resistor in the +114V supply. Replace R256, if the value has increased.

Comments

These case histories should prove that troubleshooting and repairing foreign-manufactured color TV receivers is no more difficult than the repairing of nationally known brands.

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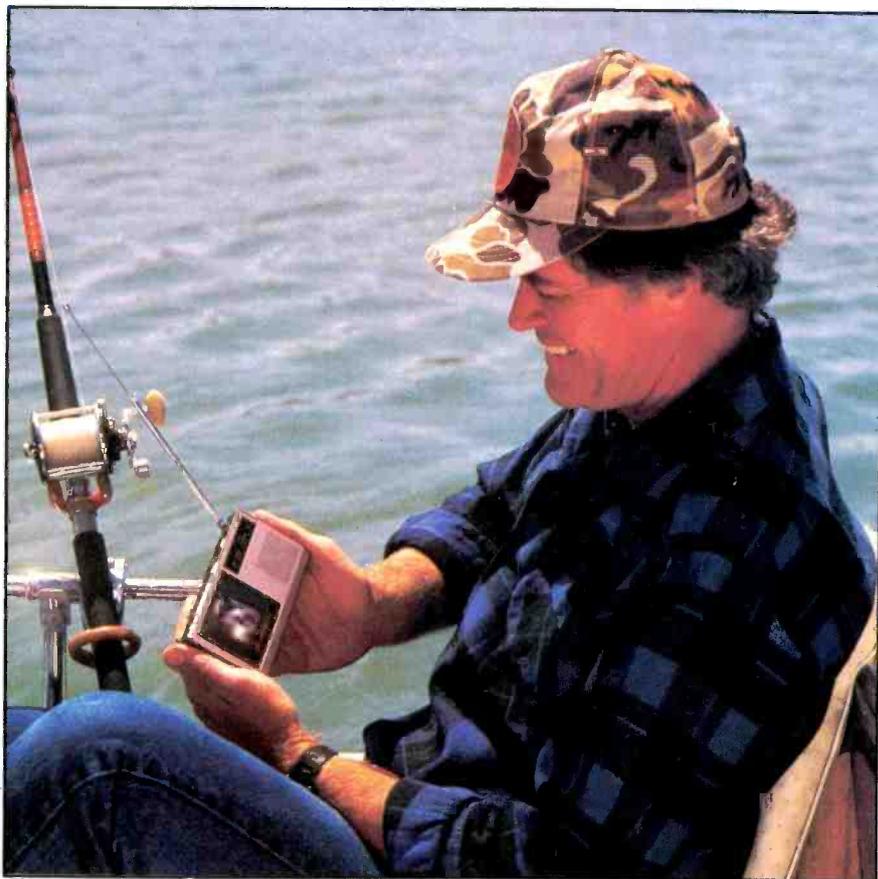
So much is happening in television and video that it's almost impossible to keep up with the changes. There's the recent addition of stereo audio capability for television (useful when broadcasters begin broadcasting stereo audio). There's modular television that allows viewers to assemble their television/video system as audiophiles have been doing with stereo for years, and even to integrate video with audio. High fidelity, stereo sound capability has been added to both Beta and VHS VCR formats.

The list of recent innovations in both the hardware and the software associated with television/video seems endless. Here are a few of those innovations.

Tiny color televisions

For years, the most significant limiting factor in TV design was the cathode ray tube (CRT). Because of its inherent characteristics, a CRT-based TV set needed high voltage, significant amounts of current and considerable depth behind the picture tube to place the neck containing the electron gun(s). Two companies, Sony and Sinclair overcame one of these limiting factors in recent years by folding the picture tube neck so that it bends and runs parallel to the picture tube face. The development of a monochrome LCD TV set two years ago was a breakthrough that dispensed with all of these limiting factors.

The big news in small television is the color LCD TV set. At the 1984 Summer Consumer Electronics Show in Chicago in June,



Tiny color television measures 6.3 by 3.15 by 1.22 inches and weighs about a pound. The screen is two inches square.

two palm-sized color televisions were displayed: one by Epson and one by Seiko, both divisions of the Hattori Seiko conglomerate. The description of the Epson Elf that follows was provided by Epson.

In an ordinary CRT, the video signal is converted into a picture by an electron gun, which emits an electron beam that sweeps across 525 lines in a phosphor-coated

CRT some 60 times per second. The beam's motions are controlled by powerful magnets on either side. The image is created by the glowing phosphors in each line.

In the Epson Elf TV, by contrast, the video signal activates a selected number of dot-like picture elements (pixels) in each row, one row at a time. Switching these pixels on or off is controlled by

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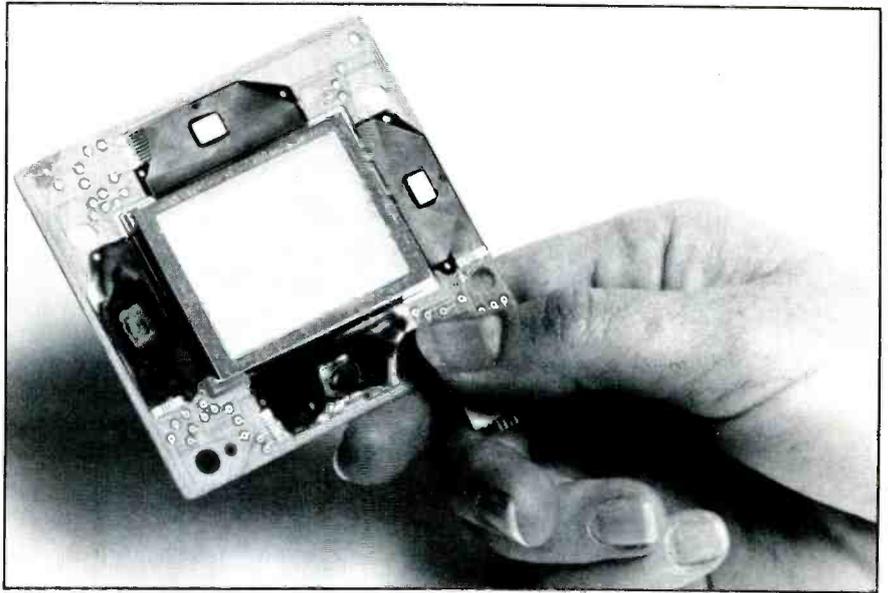
Circle (12) on Reply Card

December 1984 *Electronic Servicing & Technology* 21

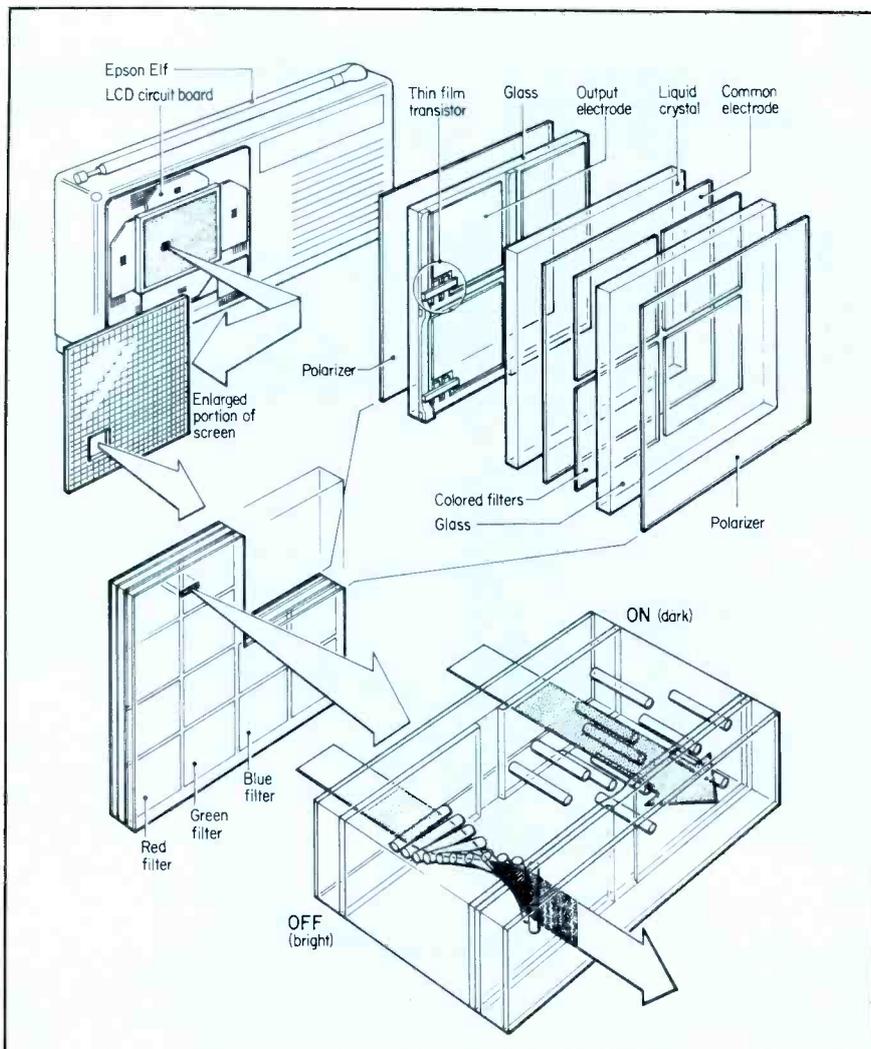
microscopic thin-film transistors (TFTs) placed at each pixel. The image is formed not by phosphors but by liquid crystals, long rod-like organic molecules respond to electrical signals from the TFTs. When a pixel is *on*, the liquid crystals block out light. When it is *off*, the molecules let light through.

The Epson Elf, the product of a 5-year research effort by the R & D group of Suwa Seiksha that serves Epson and other companies within the Hattori Seiko conglomerate, was developed to overcome certain limitations of the CRT. For one thing, the relatively high power consumption, bulk and weight of CRTs make them difficult to use in truly portable televisions. And CRTs cannot be viewed in bright sunlight.

By contrast, the circuitry required with liquid crystals is



Heart of the minuscule color television is this circuit board manufactured through what the manufacturer calls a revolutionary new process for mounting thin film transistors. The transistors are combined with sensitive liquid crystals capable of displaying a color image.



Liquid crystals, in conjunction with thin-film transistors and colored filters make up the screen of this TV set.

typically compact and lightweight; therefore, the LCD television can be held in the palm of the hand. Moreover, the low power consumption of liquid crystal eases the drain on the unit's batteries. And because the electrodes in a liquid crystal display can be made of transparent materials, the LCD screen can be back-lit with sunlight (or a built-in fluorescent light).

In developing the Epson liquid crystal color television, Suwa Seiksha's scientists and engineers had to overcome some formidable obstacles. For one thing, the liquid crystals already used in watch and calculator displays were relatively slow to respond to electrical signals—a drawback in video displays, where the liquid crystals must be turned on and off many times a second. Secondly, most liquid crystal displays LCDs were low in contrast and limited to black images on a light background.

To solve problems of slow response times and low contrast, Suwa's research team employed the TFTs to turn on and off each of the 52,800 pixels in the display. Transistors, deposited on a glass substrate, were made of polycrystalline silicon, a material known for its stability and reliability.

To understand how the TFTs improved performance, it is neces-

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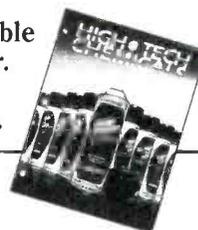
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Videocassette recorder allows user to program as many as eight programs up to a year in advance.

sary to know a little about how LCDs operate. In a *twisted nematic* display, typical of watches, calculators and the LCD television, liquid crystals are sandwiched between top and bottom polarizers, each placed at a 90 degree angle to each other. When no electric field is present, the liquid crystals have their long axes parallel to top and bottom polarizers and successive layers gradually twist through the 90 degrees between top and bottom. Light entering through the bottom polarizer gradually gets twisted through a 90-degree angle by the liquid crystal layers and exits through the top polarizer. A viewer looking down on this spot sees a light background.

In the presence of an electric field, however, the molecules stand up on their ends, parallel to the direction of the field. In this state, they can no longer rotate light. Therefore, light entering the bottom does not get twisted; instead it gets absorbed by the top polarizer. To a viewer looking down on the display, this spot appears dark.

To create the hundreds or thou-

sands of pixels needed to form an image in a LCD, the earlier (and still widely used) approach was *multiplexing*. In multiplexing, rows of electrodes are deposited on one side of the liquid crystal layer and column electrodes are deposited on the other side. The pixels are created at the junction point of the rows and columns.

To turn on the pixels, electric pulses are fed rapidly to each row while the columns are pulsed simultaneously. If the voltage at a row-column junction adds up to more than a threshold value, the liquid crystals respond.

Multiplexing has its problems, however. Because many rows must be addressed in a short time by a single electric pulse, the time-weighted average voltage ON-OFF ratio of black and white level is low, resulting in poor contrast.

These problems were solved by resorting to an approach called *active-matrix addressing*. In this system, the 240-row and 220-column electrodes of the display are deposited on a single glass substrate. On the opposite plate of the display is a common electrode. (See diagram.)

The TFTs, placed at each row and column junction, now turn on whenever a pixel is to be activated. (The driver circuitry controls which pixels are activated.)

With the TFTs, each pixel experiences the full voltage needed to turn it on, not a time-weighted average, as in multiplexed devices. The result is a very high ON-OFF ratio resulting in good contrasts.

As for the color in the LCD television, it was created by the use of thousands of microscopic red, blue and green primary-color filters placed over each pixel electrode. When a red spot is to be created, the TFTs at the blue and green filters are turned on, blocking out light there and letting light through only at the red filters. If blue is desired, the red and green TFTs are turned on; and if green is to be displayed, the red and blue TFTs are activated.

Other shades are created by turning on various mixtures of the primary color pixels. If all the TFTs in a region are turned on, no light gets through and the image appears black. If none of them are turned on all the primary colors get through and the image appears white.

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AT LAST... a single, strong, productive association, specifically designed and structured to serve all independent service dealers. The kind of organization that service dealers have been looking for for years has finally become a reality.

Over the years, service dealers have engaged in a seemingly endless string of battles to protect their businesses. Their adversaries have included both local and federal government, so-called consumer protection groups, big business interests like yellow-page publishers and cable TV operators, and even their own suppliers.

All the while they fought off threats to their survival, they had to handle the countless day-to-day tasks involved with running a profitable business: maintaining healthy parts inventories, training and motivating technicians, pricing their services to be both competitive and profitable, keeping their books, keeping their customers, and on and on.

Finally there's help! With the formation of the National Association of Service Dealers (NASD), a division of NARDA, Inc., a new era is beginning for service dealers.

NASD members get immediate access to a wide range of benefits:

- Reduced insurance costs for group coverage, business insurance, workers compensation, life insurance, and much more.
- Improved performance, productivity and profits using the unique, computerized Service Data System
- Increased parts turns, with lower investment, through a special inventory control program
- Reduced costs in handling bank card transactions with a 1.6% Visa and Mastercard program
- And the list goes on and on: a national credit union for dealers and their employees, a monthly newsletter just for service managers, extended service agreements, 24-hour electronic communication system, discounts on service books, audio cassettes, service and delivery aids, etc., etc.

Dozens and dozens of ways to save money, improve efficiency, reduce expenses, and increase profits — available, for the first time, to ALL service dealers!

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Mail the application today and start taking advantage of all your NASD benefits now! Your first 6 months membership is FREE!

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Since NASD is run by and for servicers, the various issues and problems affecting service dealers will get top priority. Now, with one strong association, representing ALL service dealers, the government, the big business interests, and the industry at large won't have to listen

hard to hear the service dealer's point of view. It will be loud and clear. And it's about time.

And that's still just the beginning. As NASD members share their ideas and input, the association will be investigating a whole new range of programs including • a parts discount program • flat rate pricing manuals for all product categories • a program for certifying appliance technicians • a service managers directory • hiring package including technician pre-employment exam • and many other projects that just weren't feasible before the formation of NASD.

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As an extra incentive to mail your application today, we'll include with all free six-month memberships, a FREE copy of "Profitable Service Management," a collection of 44 thought-provoking, profit-producing articles on the art of service management. A regular \$25 value, yours for the asking! But don't wait! Mail your application today!



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Firm Name: _____
 Individual: _____
 Title: _____
 Address: _____
 City: _____ State: _____ Zip: _____
 Phone: (_____) _____

We must have the following information to process your application.

Approximate annual service volume (parts & labor):
 under \$100,000 \$100,000-\$250,000
 \$250,000-\$500,000 over \$500,000
 Products serviced: Kitchen appl. Audio products
 Laundry appl. Computers
 Video products Other

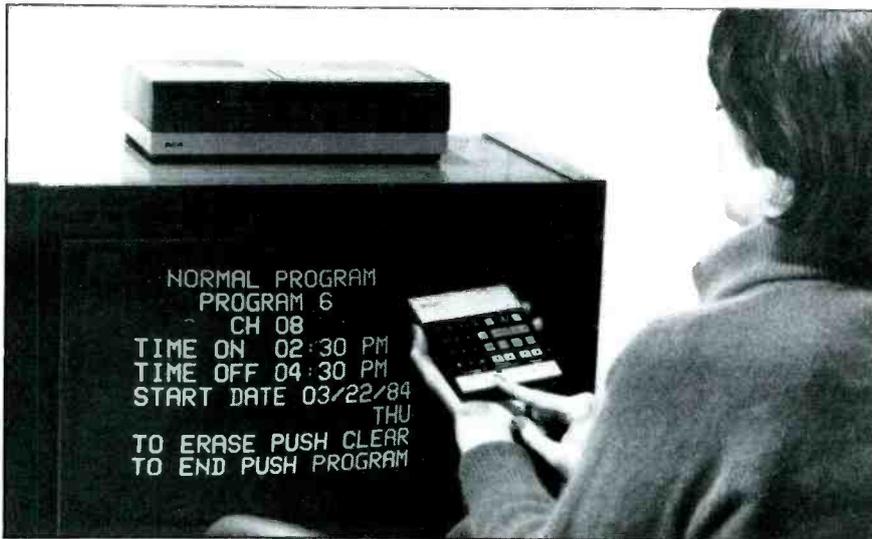
Do you have an in-house computer or terminal? Yes No
 Number of employees: technicians _____ other personnel _____
 Do you sell parts over the counter? Yes No
 Do you sell any other products? Yes No
 Numbers of years in business: _____

Mail to: NASD, 2 N. Riverside Plaza,
 Suite 222, Chicago, IL 60606

* NATIONAL ASSOCIATION
 OF SERVICE DEALERS

NASD
 a division of NARDA

Circle (13) on Reply Card



With this VCR, on-screen graphics guide the user through the programming sequence step-by-step.

Meanwhile, the company's researchers are looking at other innovative LCD products. One is a flat-panel liquid crystal television that could be hung on a living room wall. Because of the technical difficulties involved, however, such a product is still many years away.

VCR displays command on TV screen

Programming a VCR to turn on at some time in the future to record a TV program, then turn itself off when it's finished can be something of a challenge the first time or two the operator tries it.

A recently introduced VCR by RCA Consumer Electronics Division simplifies that procedure considerably. According to information supplied by RCA, the VKP900 is the first VCR using a remote control unit to set the timer-clock and preprogram as many as eight programs up to one year in advance.

The VCR's wireless infrared remote control also activates alphanumeric graphic displays on the TV screen whenever the user operates primary VCR functions or remote programming steps.

"This new convertible VCR makes programming easier than ever before," said Stephen S. Stepnes, division vice president, marketing. "Not only can all programming be set remotely from the comfort of your easy chair, but the onscreen graphics guide you

through the programming sequence step by step."

David H. Croner, division vice president, marketing operations, said with the new convertible VCR, the consumer no longer has to approach the VCR armed with instruction manual to program the unit. "The VKP900 questions, listens and responds through any TV set while the consumer simply makes choices on the remote hand unit."

To start the programming sequence from the remote hand unit, the user first pushes the *Program* button and a *menu* of options appears on the TV screen: 1) clock set; 2) normal program (for 1-time recording); 3) daily program (for programming the same time

every day Monday through Friday); 4) weekly program (used to record at the same time each week); and 5) program review.

To set the clock, the user would push 1 to bring the clock-set display on screen, enter the correct time, push 1 or 2 for a.m. or p.m., then enter the correct month, day and year. The correct day of the week (Monday, Tuesday, etc.) will automatically appear. The unit has a built-in 100-year calendar that will supply the correct day for any date through December 31, 2083. Push program to enter the time and date into the VCR's memory and to start the clock.

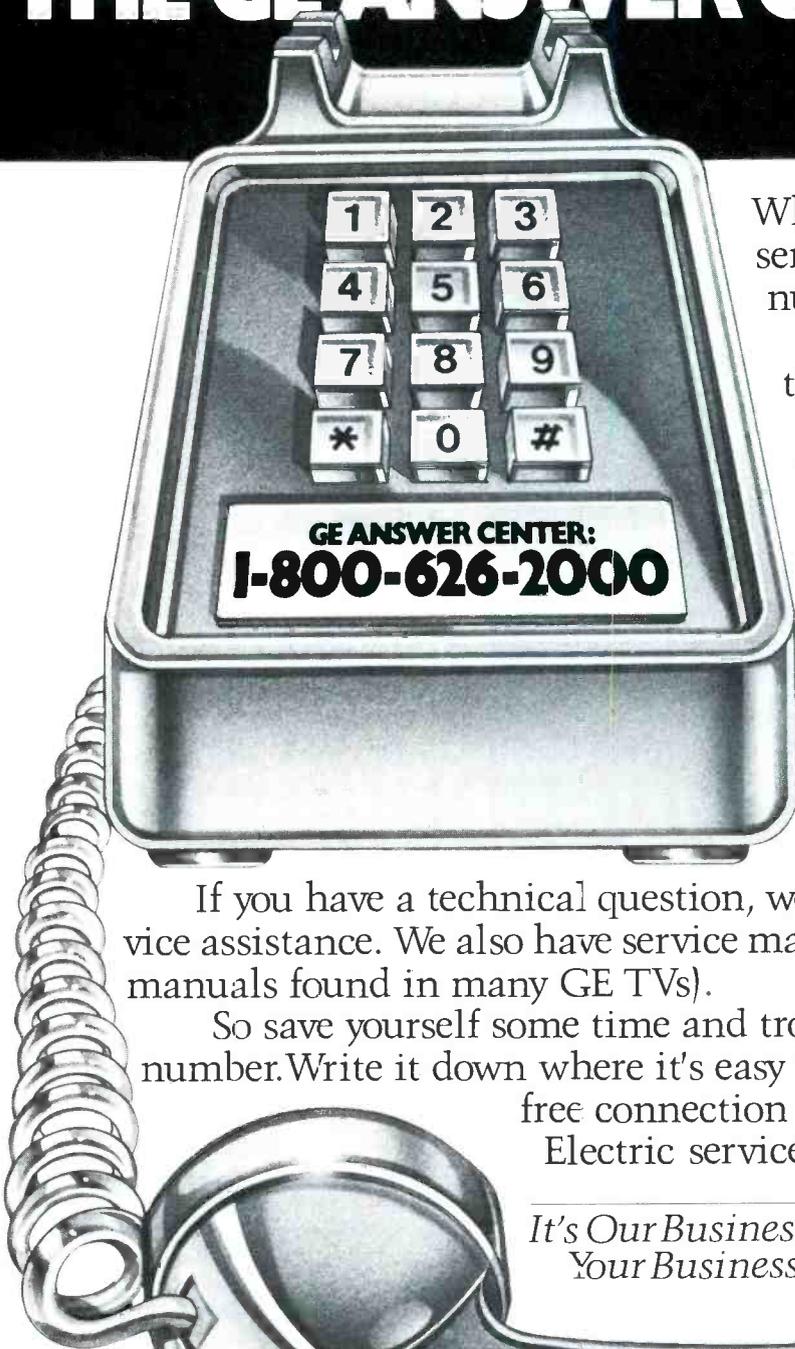
To program the VCR for unattended recording, push program again to call up the menu, then press 2, 3 or 4, depending on whether it is to be a 1-time recording or a daily or weekly program. The on-screen graphics will ask for the channel desired, time to start recording, a.m. or p.m., the time to stop, again a.m. or p.m., and the date of the desired program. Then push program to enter the information in the VCR memory.

These steps can be repeated for up to eight different programs. To review what has been programmed into the memory, press 5 the *program review* and the TV screen displays each program in the VCR's memory, pausing about 10 seconds for each. To erase one or more programs, simply press *clear* on the hand unit when the particular program is displayed.



Video multiplexer allows user to distribute home video signals to all TV sets in the home via existing antenna wiring.

WHEN YOU'RE HUNG UP, GIVE THE GE ANSWER CENTER™ A CALL.



When you need fast response to servicing questions, this is the number you'll need.

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So save yourself some time and trouble. Take the time to save this number. Write it down where it's easy to find and use. It's your toll-free connection to General Electric service support.

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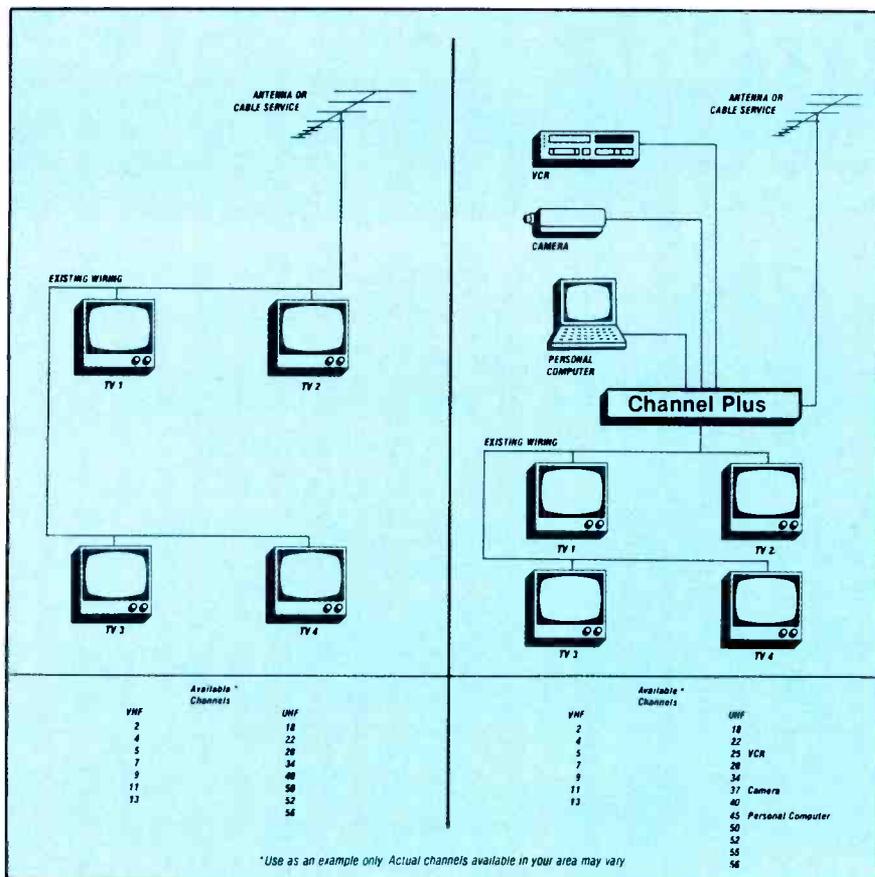
GE CONSUMER ELECTRONICS



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EST-D



Multiplexer adds channels by allowing user to assign home video sources to unused channels for distribution throughout the house.

The recorder is also compatible with the Digital Command Center remote unit introduced with RCA's color TV monitor/receivers last year. All the programming steps that can be done with the recorder's own remote hand unit can also be performed with the Digital Command Center as well.

The unit features the popular modular docking system first introduced a year ago. This system allows the portable deck to be snapped apart from the tuner base for away-from-home taping, then returned to the tuner base without the use of extra cords or cables.

Other features include 133-channel capability, a 5-head record/playback system with *field still* special effects, express recording (XPR), and stereo recording/playback with high frequency noise reduction.

Video multiplex assigns TV channels to home video sources

With a typical home video

system, if you have more than one TV set, you have to connect any home video unit, such as a VCR, directly to the TV set you wish it to play on.

A new line of video multiplexers allows users to view their home video sources on all their TV sets. According to Multiplex Technology, of Fullerton, CA, users can now watch all of their video sources on every television in the home by making TV channels with ChannelPlus. This multiplexer adds new channels right to the existing antenna or cable wires.

Any video source is compatible with the multiplexer—VCRs, video games, video disks, home computers, satellite receivers, video cameras, etc. The user assigns each video source to an unused UHF channel by turning knobs located under the decorative cover on the front of ChannelPlus. For example, the videodisc might be assigned to channel 21, the video game to channel 25 and the VCR

to channel 35.

Once the video sources have been connected and the added channels defined, the box, if desired, can be kept out of sight because there are no switches to contend with.

According to the manufacturer, the unit eliminates the inconvenience and loss of picture quality associated with conventional switchers, by using the latest high-frequency technology to solve distribution problems that switchers can't.

These multiplexers are available in six different models which differ by the number of added channels and type of input accepted. Each model accepts antenna or cable service in addition to the added channels. Mono and stereo inputs are also accepted.

When more than three video sources plus antenna or cable service are to be combined, two or more ChannelPlus units may be chained. For example, a ChannelPlus Two chained with a ChannelPlus Three provides five added channels.

Another problem inherent in RF switchers is that they defeat both remote control features and VCR programability. The convenience of a remote control is negated when a user must walk up to the switch box to select the video entertainment source. Likewise, many VCRs sold today can be programmed to record several programs over a period of time, switching from channel to channel. This feature is also negated each time the video source has to be changed. This problem doesn't exist when using a video multiplexer.

And so on

This is an exciting period for television and video; but it's also a time that challenges anyone involved with television and video to keep up with so many developments on so many fronts. The raw technology for dozens of future new and startling developments, like hang-on-the-wall thin television, stereo TV broadcasting and more, is in place. It's just a matter of time.

ESM



TECHNICIAN'S REVENGE !

We know that this situation has never happened to you (chuckle - chuckle) but, a certain technician from a "friendly camp" decided to play a trick on his fellow shop owner. He had an old RCA CTC 88 that he was about to junk out because he was convinced that it had an intermittent CRT and probably wasn't worth repairing (the price of new TV sets being what they are).

Since our prankster whom we will call "Bill" (not his real name) had coffee almost everyday with his friend and victim, whom we will call "John" (not his real name either), he saw nothing wrong with having a little fun.

On Monday morning (over coffee) Bill began telling John about this "miserable" bench job that he was working on. You can just imagine the conversation.

On Tuesday morning Bill brought it up again. This time, he told John that he had just found out that his "infected dog job" had been down at Henry's shop (another friend of theirs) adding, I just can't imagine Henry butchering a TV set like that. With a straight face he continued "the **problem** is, the TV set belongs to Henry's mother-in-law. All I'm trying to do is fix it, and get it back to her without telling her that Henry butchered it". You're not real busy John, would you consider helping me (and Henry), Bill asked. Sure, I'll help, said John.

The trap was set, John had taken the bait!

Bill went back to his shop and began surgery on his "ill fated" RCA. Here is a list of what he did:

- (1) Removed the horiz driver transistor and installed a short piece of wire across the now empty collector and emitter foils.
- (2) Shorted across the secondary winding of the start up transformer.
- (3) Shorted the base to emitter of the error amp transistor in the LV regulator circuit (MDR001).
- (4) Took a lead pencil and made a good heavy path to ground beginning at the button on the 2nd anode cap of the CRT.
- (5) Removed the B+ regulator transistor and its 47 ohm shunt resistor from the luminance module (MDL001) in order to disconnect the B+ resupply circuit for the horiz osc.
- (6) Shorted the x-ray protect transistor (E to C).
- (7) Removed the 1.8 ohm ten watt surge resistor from the LV supply.
- (8) Connected a well concealed wire across the primary winding to the flyback.
- (9) Replaced the .62 UF discharge capacitor in the horiz yoke circuit with a 5 ohm ten watt resistor.
- (10) Disconnected the emitter of the horiz output transistor then installed a .047 capacitor from emitter to floating ground.

- (11) Installed all new rectifiers in the scan derived B+ sources (backwards)!
- (12) Removed the damper diode.
- (13) Cut the pins off of the LV regulator SCR, then installed a well concealed wire on the bottom of the SCR socket (A to K).
- (14) Removed the 10 K feed resistor from the focus circuit.

The next morning Bill dropped the RCA off at John's shop. He smiled grimly, as he asked John to do what he could to fix it adding, "I'd like to stay and help you but I have jury duty!" John nodded "ok" and Bill went out of the front door in a fit of "silent" laughter. - - - He was headed for "Henry's" shop.

Bill and Henry spent the next three hours laughing. They now planned to have Henry's mother-in-law (who was a good friend of John's), call him and claim that "the set was working just fine when I gave it to Henry. All it needed was a light bulb for the channel numbers". After which, both Bill and Henry planned to call John **every day** and ask him how soon the set would be ready! With that, Bill headed back to his own shop.

When he arrived, the RCA was sitting on his front counter playing. (About a half hour earlier, John had brought it back, set it on the counter, plugged it in, put a perfectly good picture on it and collected \$180.00 in cash from Bill's secretary. He had even fixed the solder bridge in the 202v line that had made **Bill** think the CRT was intermittent).

As soon as Bill walked in, his secretary looked up and said, "You just missed John. He brought our RCA back about a half an hour ago. The bill was \$180.00. When I paid him, he started laughing so hard I thought he was crying. On his way out he said to tell you that he would buy the coffee tomorrow morning!"

John had diagnosed and corrected all 15 separate problems in less than three hours with his Super Tech computer.

You too, could have very easily done so! In case you don't believe it, we would like to send you a free operator's manual for same. The first part of the manual tells you what **not** to do. The second section explains in **generic** form how **all** start up and shut down circuits work and, the third section tells you how to operate your **Super Tech** computer. The actual test sequence itself takes only five seconds plus CRT filament warm up time. At the end of which, you know exactly where the problems is, **one defect** at a time!

After reading just the operator's manual, you will have **no choice** but to believe it. Call 806-359-1824 and ask for Super Tech Manual; they're free to any TV technician or shop owner. We'll even send it pre-paid or circle (14) . . . we'll **still** send you one.

By Sam Wilson

I can remember the time when it took two days to cover the subject of diodes in the classroom. One day of that was for review. Now, there are so many types of diodes that we need to look them over periodically so we don't get out of step with the times.

In this article, I will review some of the special-purpose types. *Breakover diodes* are considered first. They don't conduct until the voltage across them reaches a certain minimum value.

Diacs

One example of a breakover diode is the *diac*. A diac is a 3-layer diode which is basically equivalent to a neon lamp. When a voltage is placed across the diac, it will not readily conduct. This is because it is a 3-layer device and one of the PN junctions will be reverse biased. If the applied voltage is made large enough, the diode will begin to conduct due to zener effect in the reverse-biased junction. Figure 1 shows the symbol, characteristic curve and construction of a 3-layer diode. The voltage at which this conduction begins is referred to as V_{bo} , or *breakover voltage*. Breakover voltage is the equivalent to the *firing position* of a neon lamp.

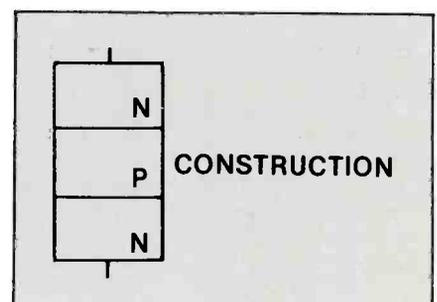
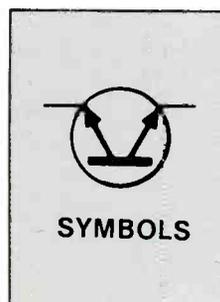
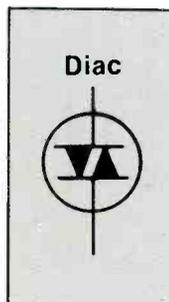
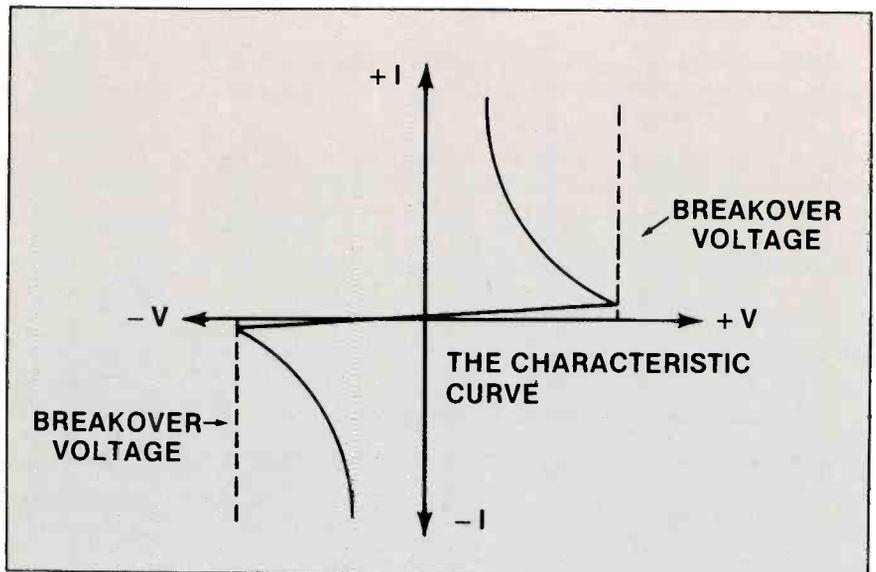
Once the diac *fires* or begins to conduct, the voltage across the diac remains nearly constant regardless of the current flow through it. It is always necessary that current in diac circuits be regulated by a series resistance.

After firing, a diac can only be turned off by reducing the applied voltage to nearly zero, or reducing current flow to a value below the minimum holding current of that particular device.

Figure 1. Diac does not begin conducting until voltage across terminals reaches *breakover* value.

What do you know about components?

Special-purpose diodes



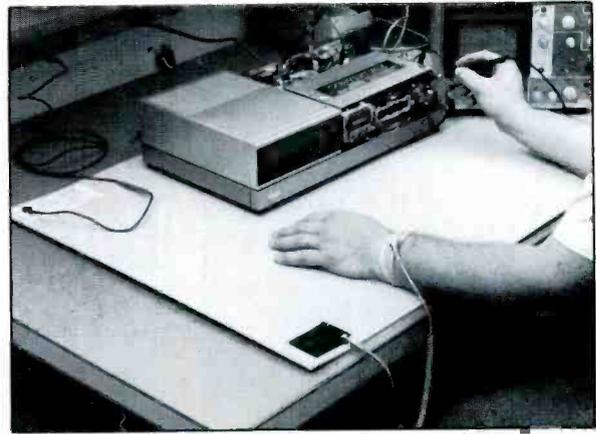
Be Sure... with RCA's Antistatic Kit.

Protect static sensitive devices from costly damage.

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

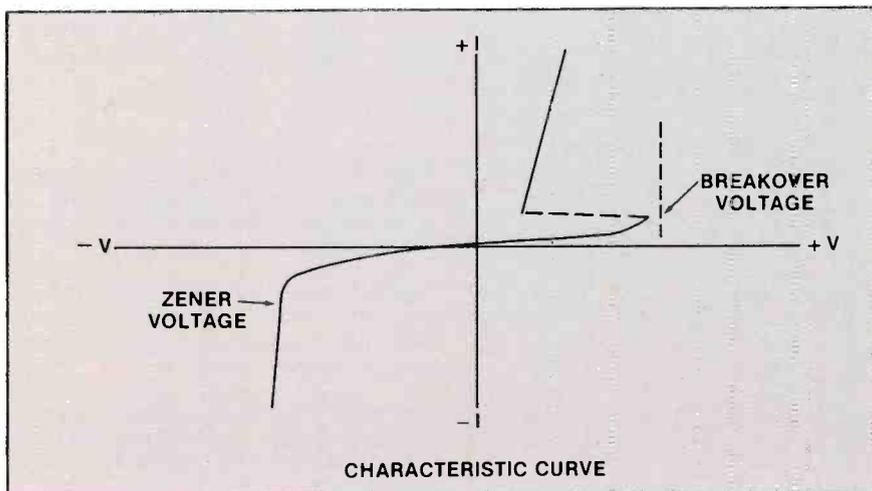
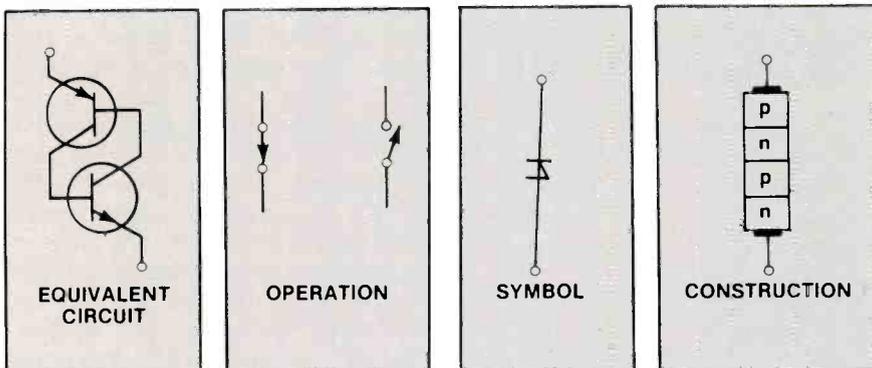
RCA's Antistatic Kit (Stock No. 162351) protects these devices from the damaging effects of static buildup. The kit consists of a static dissipative mat, a lightweight wrist strap and coil cord, and a six-foot grounding cable that safely drains electrostatic charges to ground.

No matter what kind of static sensitive



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

RCA Distributor and
Special Products Division



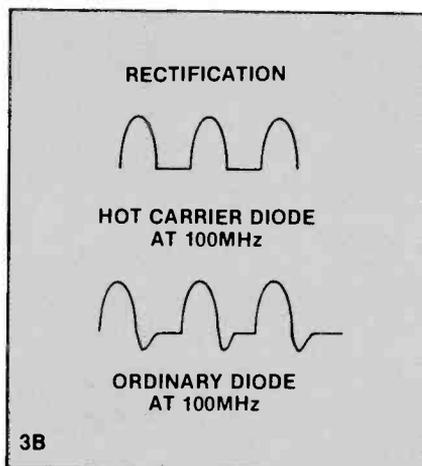
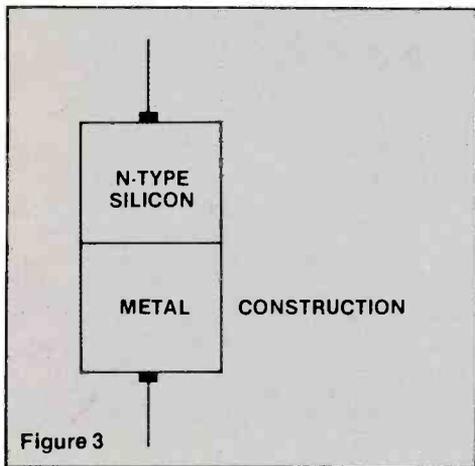
Diacs are commonly used to control the conduction angle of triacs in industrial control circuits.

Shockley diode

Another type of breakover diode is the *Shockley diode*. Figure 2 shows its symbol construction, equivalent circuit and operation. This diode is a 4-layer device, and is actually the equivalent of two transistors (one pnp and one npn). It has only two external leads, and therefore, it classified as a diode.

The operation of the Shockley diode is similar to that of a 2-transistor latch circuit (Figure 2). The diode operates essentially in one of two states, open switch and closed switch. Because there is no trigger input, the only way to close the switch (diode conducting) is to apply a voltage of sufficient value to ensure breakover. To open the switch (diode not conducting), the

Figure 2. Shockley diode is a four-layer device with operation similar to that of a two-transistor latch circuit.



current through the diode must be reduced below the diode's minimum holding current.

Unlike the diac, the Shockley diode must not be operated in a reverse direction. If the zener voltage is reached, that diode will be destroyed.

High-frequency hot carrier diodes

Ordinary diodes are able to turn on and off with little trouble at most frequencies. At very high frequencies, however, the diode can reach the point where it can no longer turn off at a sufficient rate to prevent a noticeable amount of reverse current to flow. This is a result of the ability of the PN junction to momentarily store charges. The amount of time required to turn off is referred to as *reverse recovery time*.

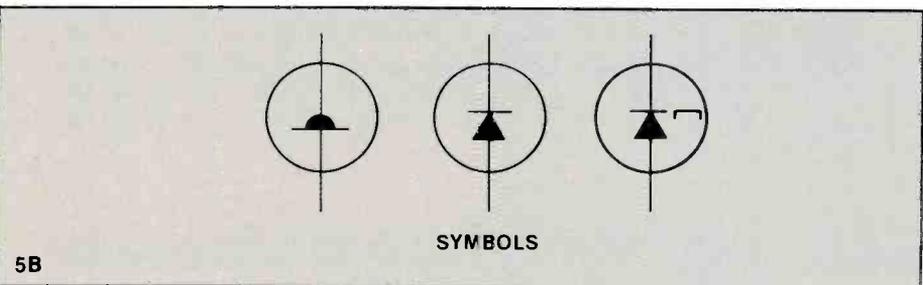
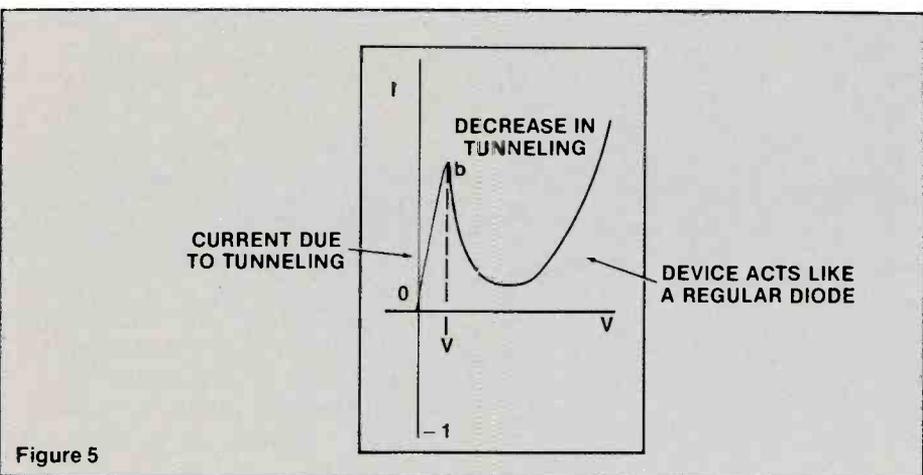
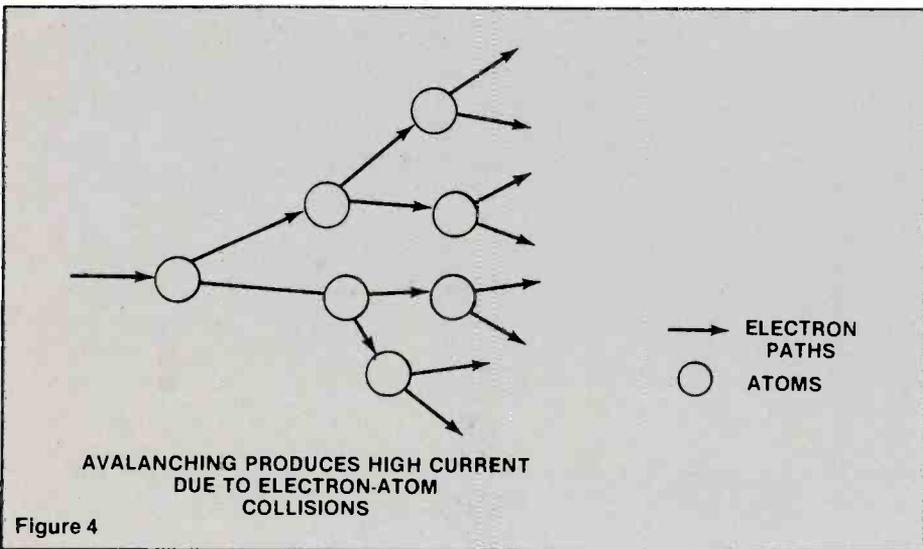
As shown in Figure 3, the hot carrier, or *Schottky*, diode uses a metal such as platinum, or gold on one side, and silicon on the other. As N material is a faster conductor than P, the silicon is typically doped as N type. The electrons of the unbiased silicon stay in a smaller orbit than those in the metal. This difference in the orbit size is referred to as the Schottky barrier. When the diode is forward biased, free electrons in the silicon material are able to gain enough energy to travel in larger orbits allowing them to cross the barrier and produce forward current flow. As the metal does not have holes available, there is no charge stored, eliminating reverse recovery time.

This lack of reverse recovery time makes the hot carrier diode

Figure 3. Hot carrier or Schottky diode eliminates reverse recovery time and so is especially suited to high-frequency applications.

Figure 4. When the reverse bias on an avalanche diode reaches the avalanche value, high current is produced because of electron-atom collisions.

Figure 5. Tunnel diode exhibits negative resistance for a portion of its characteristic curve, useful in certain applications.



especially suited to high frequency applications.

Reverse breakdown diodes

There are two basic types of reverse breakdown diodes: the *zener* diode and the *avalanche* diode.

Zener action is the result of a narrowing of the depletion region of the diode due to doping methods used in the manufacturing process. This narrow depletion region allows a very strong electric field to exist across the junction, which results in a *tunneling* of carriers through the layer. This effect is called zener action and normally occurs at around 4.5V in silicon.

By contrast, avalanche occurs in silicon at voltages of about 6.7V or higher. Avalanche is a condition brought about by mechanisms totally different from zener action.

During avalanche the field becomes so strong that an electron or hole can acquire enough energy to ionize an atom on collision, and form a new electron-hole pair for each carrier. These carriers in turn create two more pairs, which then create two more pairs etc. The avalanche condition is shown in Figure 4.

Although zener and avalanche diodes are used for similar applications, they operate on different principles. Therefore, do not consider them to be identical devices.

Tunnel diode

Another type of 2-element device is the *tunnel diode*. Figure 5 shows the symbols and characteristics curves for this device. In this type of diode, the number of donor and acceptor atoms added, due to doping, is more than 1000 times that of an ordinary diode. Because the N and P regions are so heavily doped, they have more carriers available. The forbidden band is much narrower in a tunnel diode than in a conventional diode. This is also due to the increased doping.

Initially, it is actually easier to get electrons through the forbidden band than over the barrier. When this condition exists, with electrons going through the forbidden band rather than over the barrier, it is called tunneling.

When a small field is applied from the P material, the diode conducts by tunneling. A sharp increase (between 0 and b on the characteristic curve) occurs at this time.

As the applied field is increased, the current *decreases* through the device due to a decrease in tunneling effect. At higher energy levels,

electrons find it easier to go over the barrier than to go through the forbidden band. A continued increase in the positive field will eliminate tunneling and the diode will conduct like a regular diode.

It is this negative resistance characteristic that makes the tunnel diode especially useful in certain applications.



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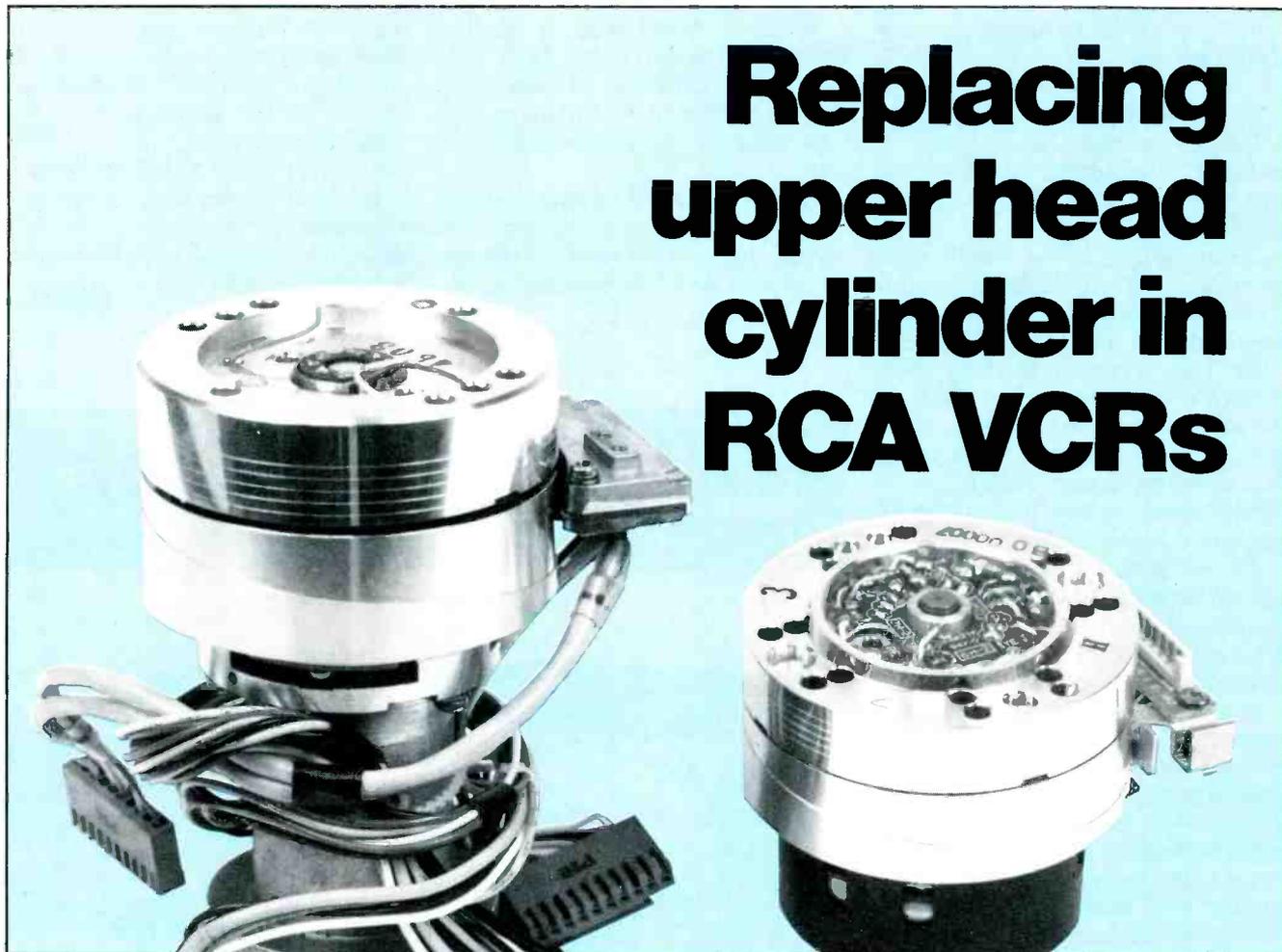


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Circle (15) on Reply Card

Replacing upper head cylinder in RCA VCRs



Faults in the playback picture resulting from a noisy video signal often are caused by a defective or dirty video head. Conversely, defects in the signal processing circuits in a VCR can produce the same symptom on the screen.

True, video heads do wear to the point where replacement is required. However, a dirty video head also can produce the same noisy picture symptom. Often, simply cleaning the video heads will cure the problem.

Changes in cylinders

Upper and lower cylinders have changed. The physical appearance of original 2-head VCR assembly is quite different from the 5-head

system. Figure 1 depicts the upper and lower cylinder combination for the 2-head VBT200, compared with the 5-head system used in the VJP900. Whether the older headwheel on the left is being replaced, or the newer 5-head type on the right, there are a few basic guidelines to follow for successful replacement.

Precaution During Replacement

We cannot overemphasize the importance of care when handling upper cylinders, especially replacements. When removing the headwheel from its carton for installation onto the lower cylinder, *do not touch the head tips with your fingers or bump them against another object.* VCR heads are of precision design, are fragile and subject to damage with just the slightest abuse. Be especially careful when starting to place the new headwheel onto the lower cyl-

Figure 1. Older VCR cylinder on left is a 2-head, 2-speed unit (model VBT200). At right is newer 5-head, 3-speed, special effects unit (model VJP900).

inder, as damage is most likely to occur at this time.

Confirmation techniques

Selecting the correct replacement is essential. However, there are several important steps you should perform before the replacement is ordered. You should recheck or reconfirm initial troubleshooting analysis to ensure that the original head is indeed defective. As stated earlier, symptoms produced by a *dirty* video head are often the same as those produced by a *defective* head.

First, to ensure the heads are clean, follow the cleaning procedure outlined in the service data. Confirm loss of head output by viewing the FM modulation envelope output from the heads as shown in the service data.

EDITOR'S NOTE: This article was adapted from the RCA Communicator (an Electronics Technicians' newsletter published by RCA Consumer Electronics).

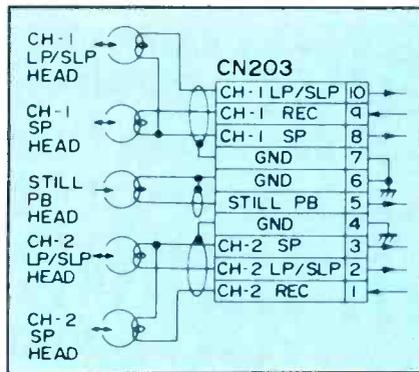
Reconfirmation techniques require that you be familiar with the model being serviced or have service data available to help answer some important analysis questions. Does the defect occur in all speeds or only in one or two speeds? What type of video head is used in the instrument being serviced—2-head, 3-head, 4-head, or one of the more recently 5-head models? Also, which heads are actually used for recording and playback?

Some conventional 4-head systems use one pair of heads for SP record/playback, and the other pair of heads for LP/SLP record and play. Perhaps the problem is occurring only in special effects. In this instance, you must determine if special effects are performed by a specific pair of heads, or by a separate head with one of the other play/record heads.

It should be apparent that with the various systems used in present day VCRs, reconfirmation of the original defective head symptom is necessary. Otherwise, misanalysis could lead to extra time being spent in replacing the head-wheel when faults may exist in signal processing circuits.

A method which gives positive identification of the type head system used in a specific VCR can be found by referring to the schematic diagram shown in the service data. The electrical representation of the video head(s) circuits usually are shown on the Luminance/Chrominance schematic diagram (Figure 2).

The electrical drawing for a 5-head machine is shown in Figure 2. Each head is identified as to channel and speed for play/record functions. This diagram is valuable in symptom analysis or reconfirmation of a defective video head. Different heads generally share the same electrical input through head preamplifier circuits. If the electronics are shared—even though the speeds and heads are different—chances are the electrical circuit(s) are in good shape, and some defect or dirt exists on one or more of the video heads. Remember that some 4-head upper cylinders use only one pair of heads for record/play, with the



other pair of heads being used only for special effects.

In addition to the schematic diagram in the service data, there are other ways to identify the headwheel systems used in various models. One example is illustrated in the photograph and simplified drawing which shows the top of the 5-head cylinder used in a

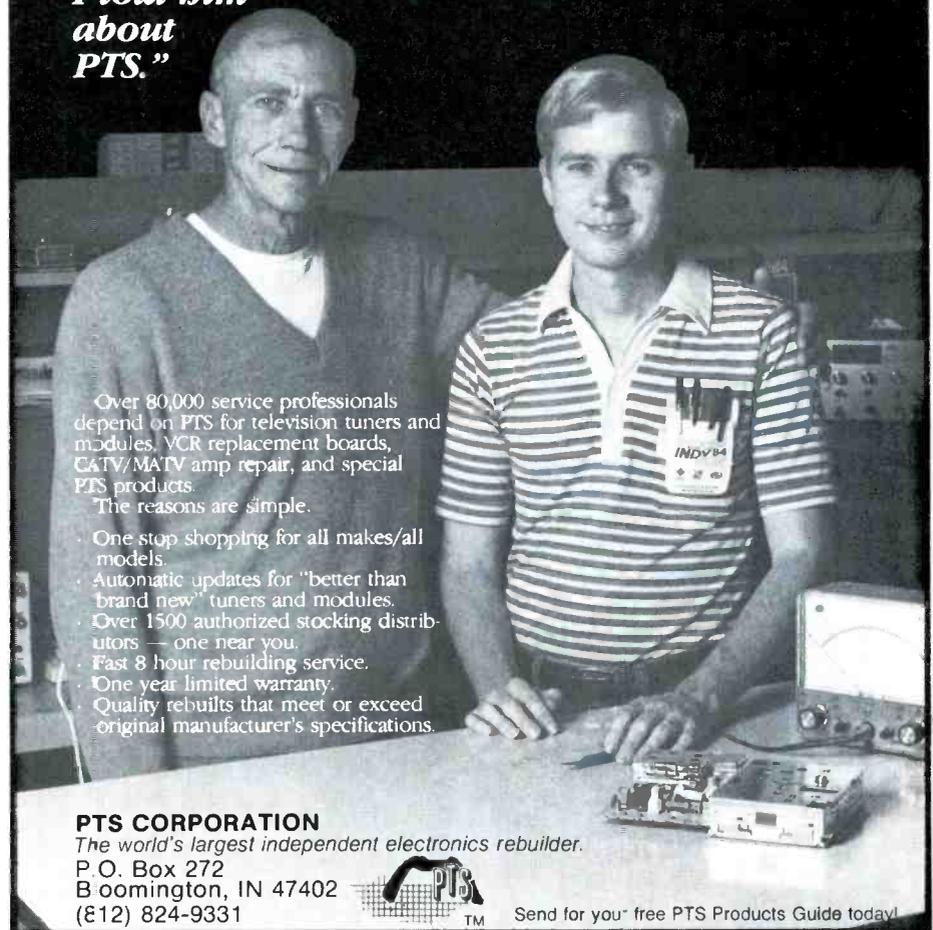
Figure 2. Electrical drawing shows functions/connections of VCR heads.

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VJP900 VCR. Notice that the video head at the top head is labeled *6H-2CH*. This indicates that this head is used for 6-hour (SLP) play/record for channel 2.

Proceeding clockwise, the next video head is labeled *2H-2CH*, indicating that this head is used for two hour (SP) play/record for channel 2. The video head at the six o'clock position is labeled *6H-3CH*, indicating that this is the *special effects* video head. Continuing around we find the SLP and SP heads for channel 1. The actual labeling on the upper cylinder printed circuit board is shown in the photograph. Although not evident in this photograph, the video head wiring is color coded as indicated in Figure 3.

Essential cleaning and service aids

Some of the tools and service aids that are essential for correct headwheel replacement and/or cleaning

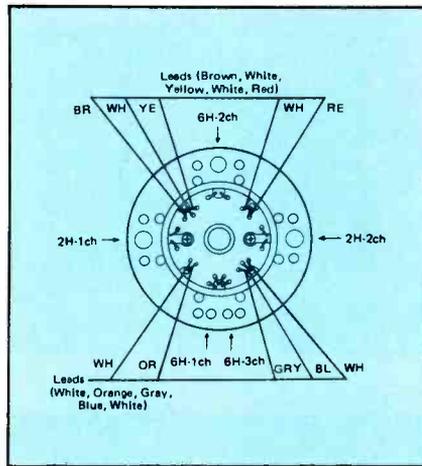


Figure 3. Drawing of 5-head cylinder shows location and functions of each of the five heads.

are illustrated in the photograph. Shown are:

- A spray can of TF solvent that leaves no residue.
- A box of lint-free cleaning tissues.

- A trio of special *sticks* with non-abrasive material for head-wheel cleaning.
- Plastic guides to aid in placing the upper headwheel cylinder onto the lower cylinder.

Techniques for upper cylinder replacement

The replacement of a defective video head begins with removal of the defective upper cylinder. *Caution and cleaning* are essential from the moment the upper cylinder head-connection wires are desoldered, to the final job of resoldering the new upper cylinder on the lower cylinder.

Remember, because the upper and lower cylinder assemblies are precision-engineered, care must be exercised at all times. Even though the original upper cylinder is defective, be careful when re-

Figure 4. Lint-free tissues, TF cleaning solvent and head cleaning sticks are needed during headwheel replacement.



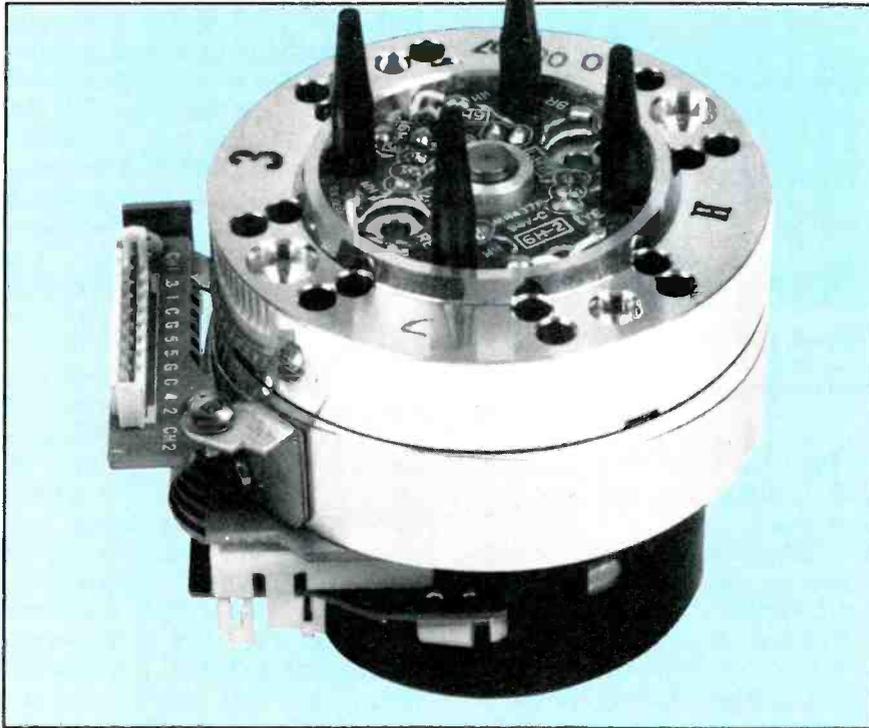


Figure 5. Wire guides facilitate removal, cleaning and reseating of headwheels.

moving it to prevent damage to internal and external surfaces of the lower cylinder. Desoldering should be performed before loosening the two retaining screws holding the upper cylinder to the lower cylinder.

RCA recently introduced a set of plastic *guides* to aid in the removal, cleaning and reinstallation of the upper cylinder of newer RCA VCRs. These plastic guides (stock No. 162350) can be purchased from an RCA distributor. They come in a package of 10.

Application of the guides is illustrated in the photograph. Here, four guides have been placed on the headwheel after the head-connecting wires were desoldered. The guides fit down over the plastic posts through which the head-connecting wires protrude. The guides should be installed before removing the upper cylinder, to prevent any dislodging of loose wire strands or solder flecks, which could drop and lodge between the upper and low cylinder mating surfaces. Also, the guides simplify seating of the new upper cylinder to the lower cylinder because they eliminate the need to tilt or joggle the upper cylinder while trying to guide the head-connecting wires through guide holes. The guides also aid in the

cleaning of the lower cylinder mating surface because the wires are captured within each plastic guide, preventing the dislodging of debris from the wiring during the cleaning process.

After removal of the defective upper cylinder, the mating surface of the lower cylinder must be thoroughly cleaned and checked to ensure there are no scratches or gouges on the lower mating surfaces, which might prevent correct alignment of the new upper cylinder. Using the special cleaning solvent and wipes, clean the mating surface of the lower cylinder. With a magnifying glass, check the mating surface for any scratches, gouges or minute foreign particles. Head tolerances for SLP operation, the most critical speed, are in the one to two micron range. (As a comparison, the average human hair is approximately 75 microns.) Because of these critical tolerances, the mating surfaces must be *completely free* of debris and imperfections to permit correct seating of the replacement upper cylinder. The mating surface of the new upper cylinder must receive the same careful cleaning and inspection

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before it is mated with the lower cylinder.

Carefully install the replacement upper cylinder, leaving the guide pins in place on the lower cylinder to simplify the operation and ensure cleanliness. Be careful not to touch or damage the video heads on the replacement upper cylinder. Alternately tighten the mounting screws to ensure correct seating. Once the upper cylinder is seated on the lower cylinder, remove the guide pins and resolder the head-connecting wires.

Performance and adjustment checks

Before checking instrument performance, carefully clean each of the video heads with solvent and the special head cleaning sticks, as outlined in the service data.

You are now ready to check instrument performance. First, check instrument operation in the SP mode with a test tape. Instrument operation in the SP mode will normally be satisfactory. If not, remove and carefully reinstall the new upper cylinder using the previously described procedures. If instrument operation still is not satisfactory, a problem other than a defective upper cylinder exists.

Because head tolerances are most critical in the SLP mode, satisfactory operation in the SP mode does not confirm correct operation in the SLP mode. Confirmation of correct SLP operation is checked best by performing the following procedure:

1. Make an SLP recording.
2. Using a dual-trace scope, apply the head-switching signal to the scope Channel 1 input, and set up the scope to trigger from Channel 1. Apply head output signals to the scope Channel 2 input.

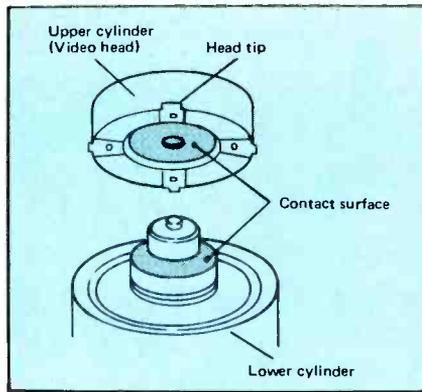


Figure 6. These upper/lower contact surfaces must be perfectly clean, otherwise poor performance will result.

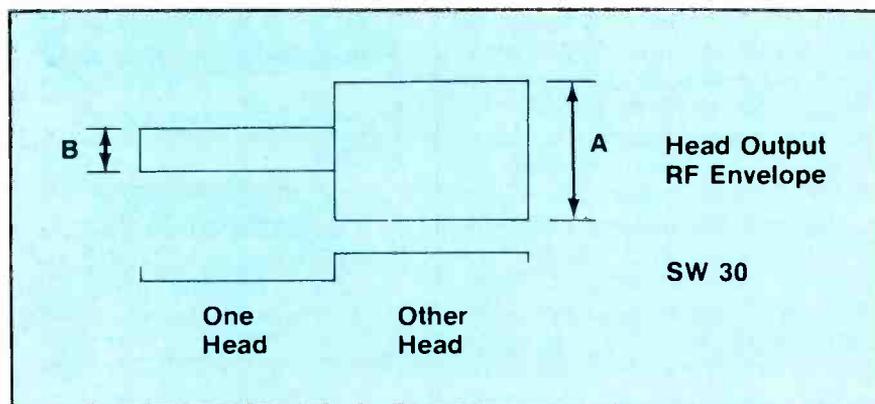
3. Play back the SLP recording and monitor the head output RF envelope.

4. Using the Tracking Control, maximize the amplitude of one head output.

5. Compare the relative amplitude of the two head output signals. See the simplified drawing of the envelope and switching signal. This drawing shows the head RF output envelope for Channel A and Channel B (Channel 1, Channel 2) and the head-switching signal. If the amplitudes of Channel A and B are within 50 percent of one another, perform the interchangeability adjustments outlined in the service data. If one head output amplitude is less than 50 percent of the other, remove and reinstall the upper cylinder using the procedures previously described under "Techniques for upper cylinder replacements."

If SLP playback is still noisy after the first replacement upper

Figure 7. On initial check, head outputs should be within 50 percent of each other.



cylinder has been removed and reinstalled twice, you should install another replacement upper cylinder and perform the previously described SLP confirmation procedure. If the second replacement does not correct the noisy SLP picture, the problem may be caused by the lower cylinder, which may be defective or incorrectly seated on the base platform. Therefore, install a new lower cylinder. It is important that the mating surfaces between the lower cylinder and the mounting base also be free of any debris which could offset, tilt, or otherwise distort the seating of the lower cylinder onto the base platform. See the photograph. Consequently, use the same cleaning procedures and precautions previously described for upper cylinder replacement. After reinstalling both the lower and upper cylinders or replacing them, perform the SLP Confirmation Procedure previously described. If the amplitude of the Channel A and B head outputs are now within 50 percent of one another, perform the interchangeability confirmation procedures and related adjustments outlined in the service data. These will optimize the head outputs. If the head output amplitudes still are *not* within 50 percent of one another, remove and reseal the lower and upper cylinders, following the procedures previously outlined.

Combination upper and lower cylinder assemblies

Because of advancements in head design and the introduction of special operating modes (*special effects*), head gaps have been made narrower for optimum performance at the slower recording speeds required for SLP and special effects modes. Head gaps for LP and SLP in recent VCRs average about 30 microns, compared to the 38 to 58 micron head gaps used for SP record/play in earlier VCRs.

Although rare, it is possible that a replacement upper cylinder will not correctly mate with the original lower cylinder. This is most probable in recent *special effects* VCRs with close tolerance heads. For certain of these VCRs, the manufacturer will make replace-

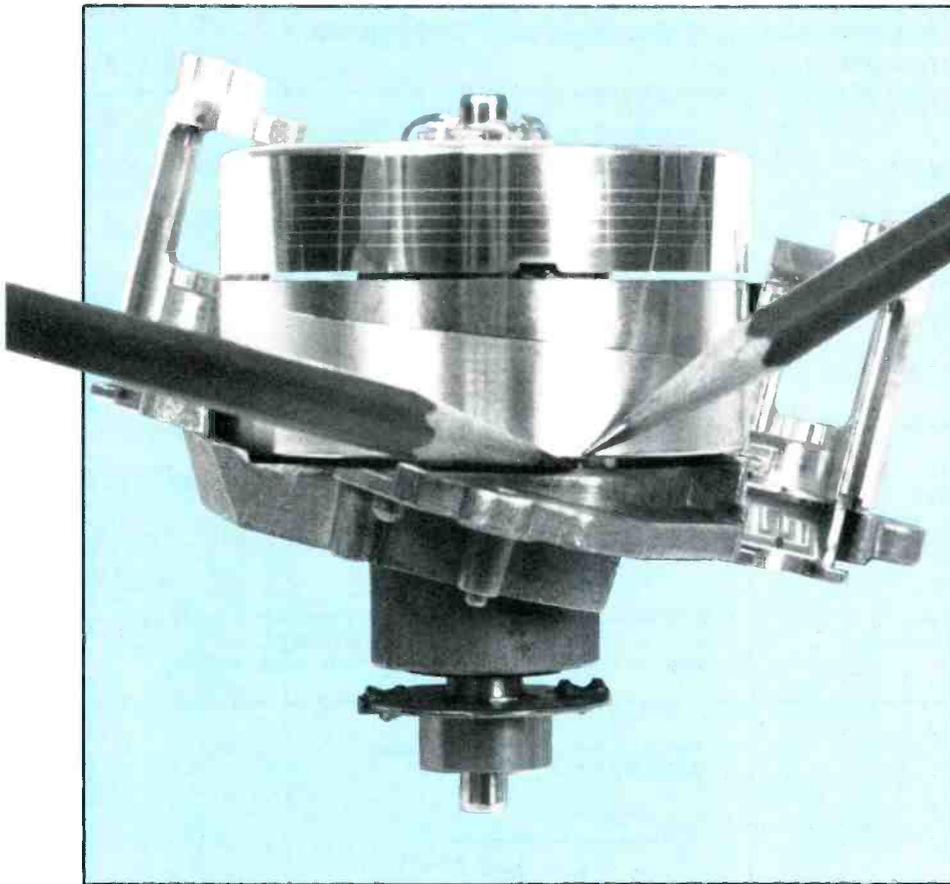


Figure 8. Clean both lower cylinder and mounting base contact surfaces.

ment upper and lower cylinder assemblies available only in matched pairs. This change is already effective for the RCA VKT550 Hi-Fi VCR. Replacement upper and lower cylinders for the VKT550 are supplied as a matched pair (stock No. 160649). Special instructions in the carton specify that the upper and lower cylinders be replaced as a combination unit. *Do not separate these units. Install them as a complete assembly.*

The matched lower and upper cylinder assemblies simplifies installation and eliminates problems caused by mismatched assemblies. Installation is reduced to carefully cleaning the lower cylinder-to-base mating surfaces and cleaning the heads as previously described. Interchangeability adjustments, as described in the service data, then can be performed without the need for the previously described SLP Confirmation Procedure.

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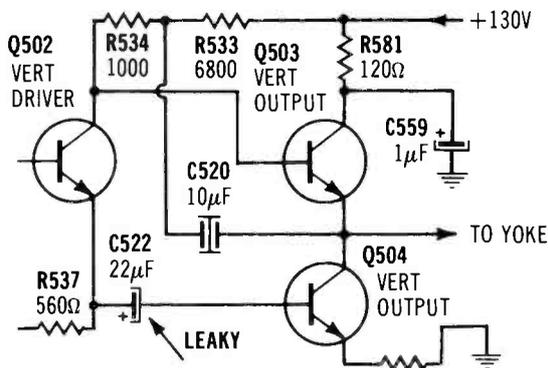
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Chassis — Sony KV-1920
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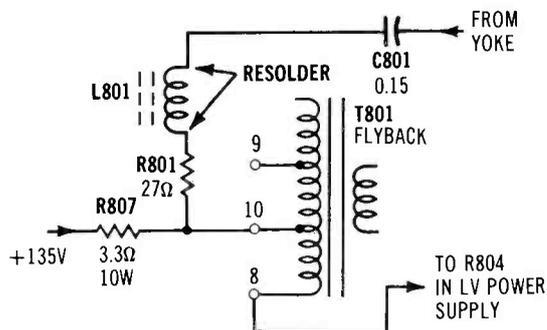
1



Symptom — Fold over at bottom of the picture
Cure — Check capacitor C522, and replace it if leaky

Chassis — Sony KV-1920-D
PHOTOFACT — 1708-2

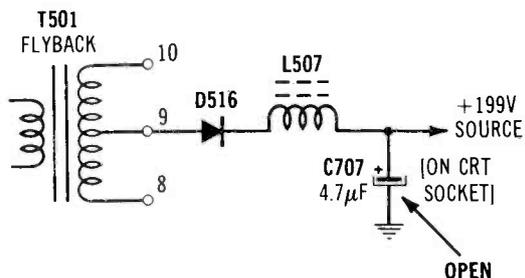
2



Symptom — A squealing noise and appearance of two pictures, but horizontal frequency is correct
Cure — Check coil L801, resolder both leads carefully

Chassis — Sony KV-1712
PHOTOFACT — 1625-2

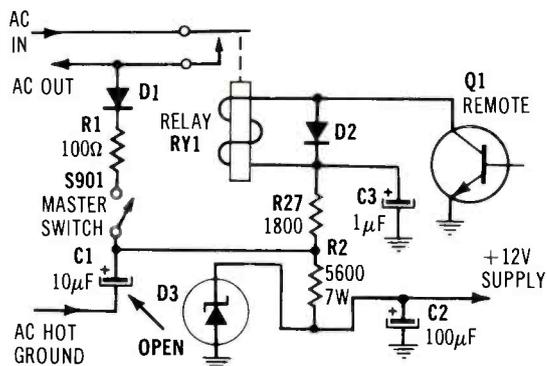
3



Symptom — Right side of picture is darker
Cure — Check filter capacitor C707 (on CRT-socket board) and replace it if open

Chassis — Sony KV-1543-Remote
PHOTOFACT — 1881-2

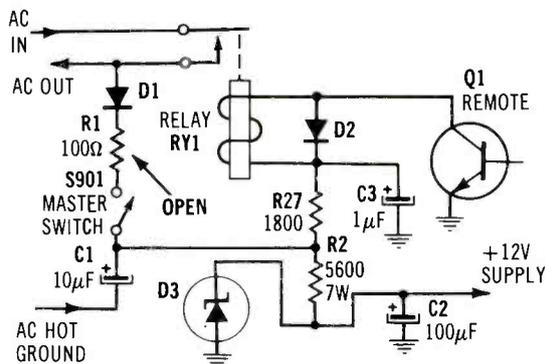
4



Symptom — No sound or picture; remote receiver's +12V source is about +9V
Cure — Check filter capacitor C1, and replace it if open

Chassis — Sony KV-1543-Remote
PHOTOFACT — 1881-2

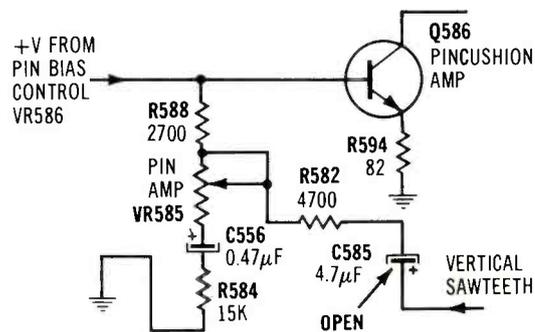
5



Symptom — No sound or picture; remote receiver's +12V source is near zero
Cure — Check surge resistor R1, and replace it if open

Chassis — Sony KV-1920
PHOTOFACT — 1455-2

6



Symptom — Picture has an hourglass shape
Cure — Check capacitor C585, and replace it if open

Feedback

Response to Watch Your Language

Nowadays dictionaries often outrun glossaries. My 1956 edition of *Merriam-Webster New Collegiate Dictionary* shows *klystron* from Greek for syringe, and *tron* as in electron, and gives a good 2-line description. The 1975 edition shows no roots but does note (fr. *klystron* a trademark) followed by a slightly different 2½-line description.

Aquadag, however, is not in the 1956 edition, but is in the 1975 volume. It is, of course, a trademark and is "used for a colloidal suspension of fine particules of graphite in water for use as a lubricant." No mention is made, however, of its non-lubricating electronics usage.

Stewart K. Gibson
Waltham, MA

And another explanation...

Your editorial of September 1984 expresses a curiosity about the derivation of the term *aquadag*. DAG is a trademark of the Acheson Graphite Company for their Defloculated Acheson Graphite, a very fine, manufactured graphite powder.

Aquadag is this DAG dispersed in a water solution so that it can be applied to such surfaces as the inside of TV picture tubes and dried in place. Oildag is a similar dispersion of DAG in an oil, and can be used for lubrication.

Your servicing magazine is interesting. I've made frequent use of both the informative articles and the Readers' Exchange.

George P. McKnight
St. Marys, PA

"Ten Dogs" tip

Using the 1979 edition of the *Merriam-Webster New Collegiate Dictionary*, I found both *klystron* and *aquadag*. I suspect the trouble may be in that this dictionary says both of the words are trademarks.

I believe the definition for *kly-*

stron can be related to microwaves. However, the *aquadag* may require a bit more imagination, but I think the basic concept, as related to a CRT still holds. Incidentally, isn't the *aquadag* coating also on the outside of the CRT, which forms the layers for the capacitor effort on the CRT?

On another subject, but from the same issue of *ES&T*, I would like to remark on Homer Davidson's article, "Ten Dogs in TV Repair," which I found quite useful and informative. He states early on (see page 12, last paragraph) that one shouldn't rotate adjustment controls haphazardly, etc. I get around this quite easily by simply marking (usually at the 12 o'clock position) the controls with white liquid correction fluid or a similar marking pen. Thus, I can return them to the original position fairly easily. One has to be careful only when the controls can be rotated for more than one complete turn, although this is usually not the case. For white-colored control shafts, use a black marker.

Michael B. Danish
Aberdeen Proving Ground, MD

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Circle (20) on Reply Card

Operation and servicing of cordless telephones

Part Two

By Paul Yost

In the November issue of **Electronic Servicing & Technology**, Paul Yost described the circuit construction and operation of the Uniden EX-3000 cordless telephone base unit. This second and final segment covers the handset portion of that telephone.

The Handset

The handset circuitry is depicted as a block diagram in Figure 1A. Its schematic is also located in the text (Figure 1B).

TR501 is the receiver's RF amplifier. Its sole purpose is to amplify the 1.7MHz signal transmitted from the base, then send it on to the mixer stage. It is important to note that the receive antenna is an internal ferrite bar and *not* the telescoping rod antenna. (The ferrite bar is similar to the type of antenna used in broadcast AM receivers.) It is the most practical antenna to use at this frequency (lengthwise) and works reasonably well.

TR502 and D510 are both used in the mixing process. Unlike the base receiver, which only uses a transistor, the handset requires the diode to aid in the mixing action. If the diode was not present, this unit would still function but only at about half its normal range.

This circuit mixes the incoming signal with the output from TR509, the local oscillator, to produce an IF of 455kHz. This IF is filtered by FL501 and then coupled through to the limiter circuitry of TR503, 504 and 505.

The purpose of the limiter circuit is to limit or clip off any AM modulation that may be present on the received signal. Any AM would be undesirable because it also would be detected and heard as interference.

All three of the limiter transistors are biased at a point just below saturation. Because of this, the incoming signal is clipped or limited on its peaks. This has the net effect of removing any AM on the signal, without in any way affecting the FM modulation.

You can actually see this effect easily on an oscilloscope. Looking at the signal at the output of filter FL501, you would see a sine wave at 455kHz (see Figure 2A).

It will appear to be vibrating some due to the FM modulation. If you place the scope probe after the limiter section (collector of TR505), the signal will look like Figure 2B; a sine wave with its peak clipped off, which is exactly what happened. This signal is then fed to the center tap of the tuned circuit, L503.

L503 is tuned exactly for 455kHz, the IF frequency. The op-

posing ends of any tuned circuit at resonance are equal in amplitude, but 180 degrees out of phase when referenced to the center tap. You might recall that this method was once used quite often to obtain the phase inversion needed for push-pull amplifiers.

The two opposing ends of this circuit are connected up to two diodes. The top end is connected to D501 and the bottom to D502. When the signal is exactly at resonance, 455kHz, the outputs from the two opposite ends are conducted through their respective diodes and meet at resistor R515. Because the outputs are equal in amplitude but opposite in phase, complete cancellation occurs and the signal output is zero.

However, cordless phones use FM modulation. This means that the IF will only be at 455kHz when no modulation is present. During modulation, the signal will vary in frequency, typically $\pm 3\text{kHz}$ or from 452 to 458kHz. In this case, because the signal is no longer at resonance, complete cancellation does not occur and a voltage output is developed across R515, this output being the voltage dif-

Editor's note. This is the second installment of a 2-part article that describes the theory and operation and some adjustment and servicing procedures for today's cordless telephones. Last month's segment dealt primarily with the base unit. The portable handset unit will be detailed in this segment.

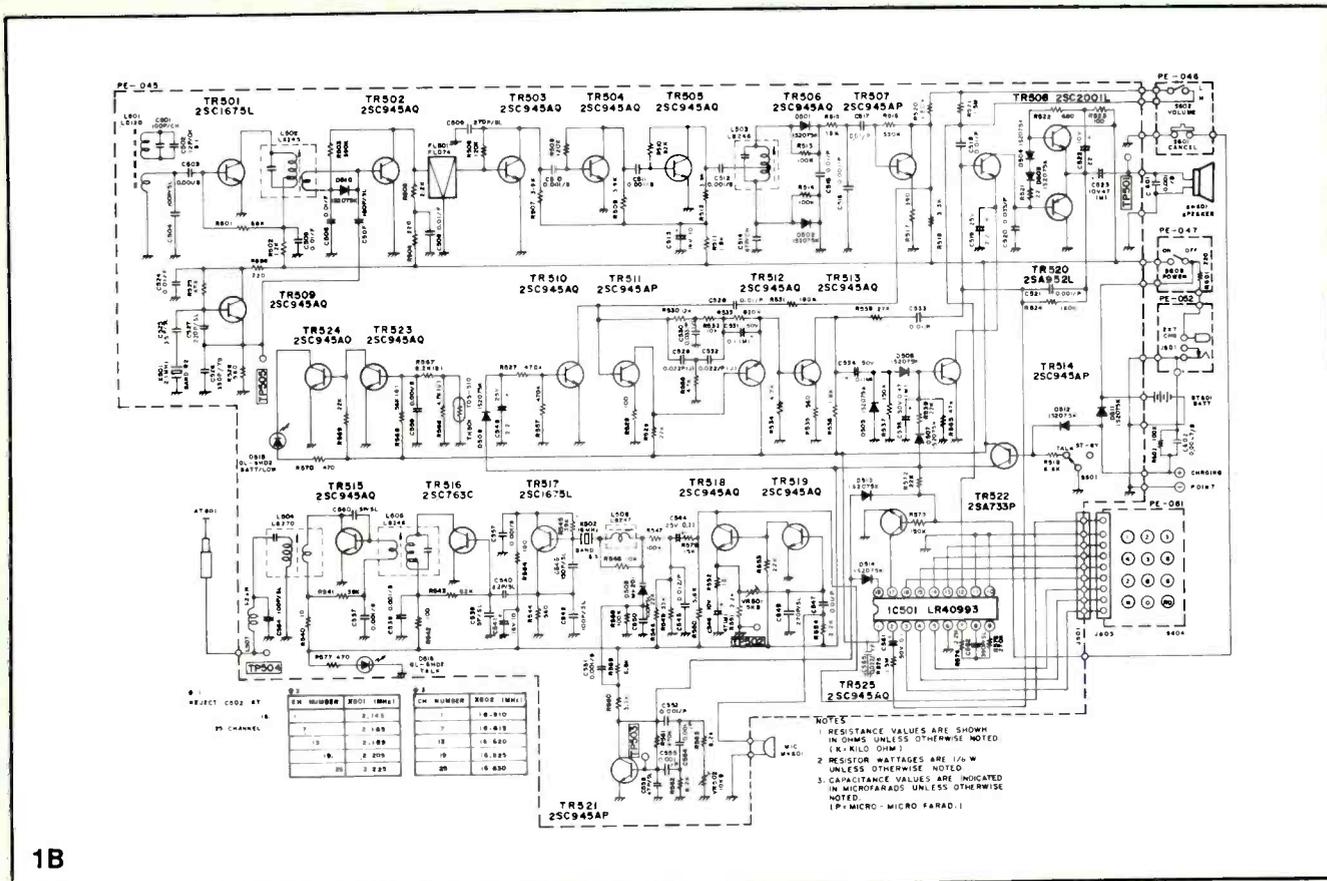
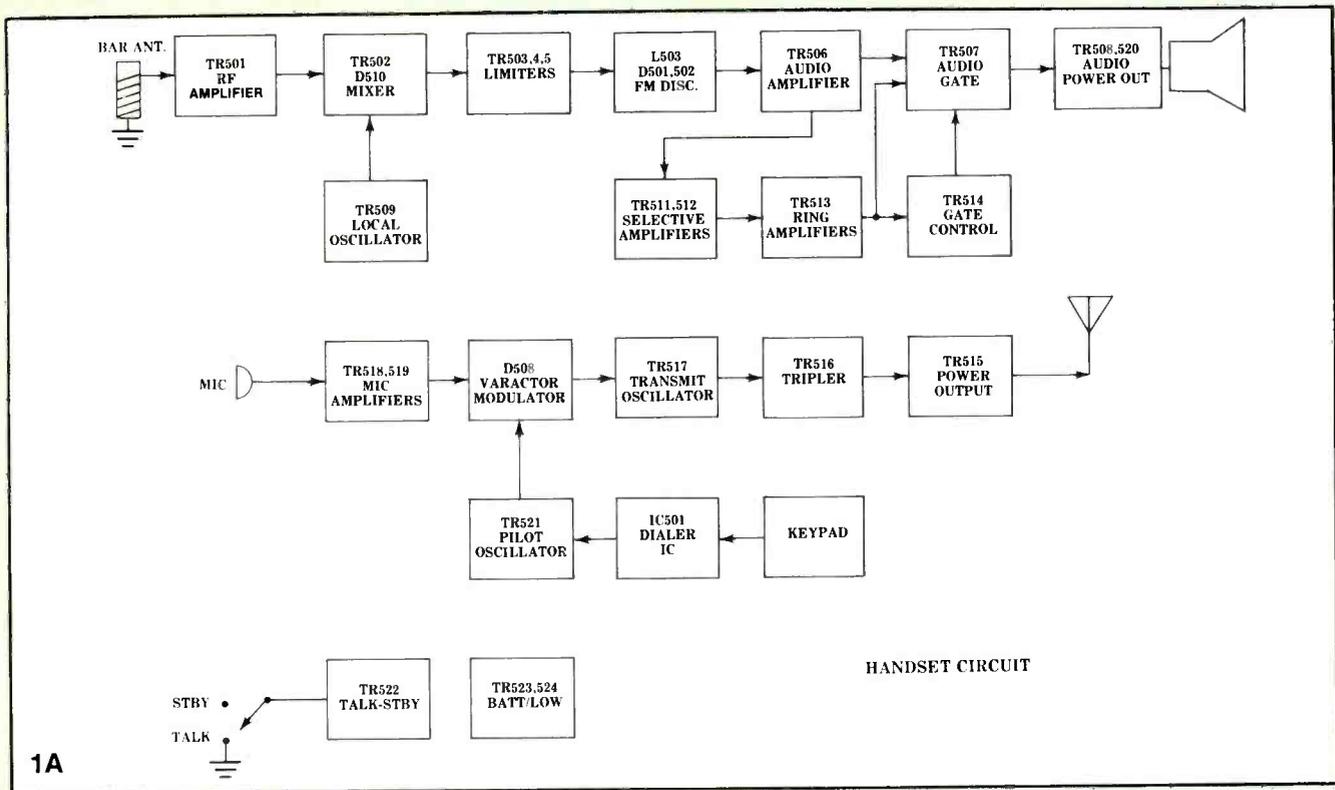


Figure 1A. Block diagram of cordless telephone handset illustrates handset function and signal flow.

Figure 1B. The cordless telephone handset contains all circuitry necessary for dialing, ringing, transmitting and receiving of voice signals, as well as the battery, illustrated in this complete schematic of the Uniden EX-3000 handset.

ference between the two amplitudes. Because the frequency is varying at the audio rate, the voltage developed across R515 is also varying at the audio rate and this recreates the audio signal. This is how the carrier is demodulated.

This audio is passed on the TR506, amplified by it, then to TR507, amplified again, then to the power outputs, TR508 and TR520, where it is amplified a final time to be heard out the speaker.

Transistor TR507 is the audio gate and it is directly controlled by TR514, the gate control. TR514 provides the emitter ground path for TR507. This means TR507 does not turn on until TR514 does. And when TR507 is not on, the audio circuit shuts off and the speaker is quiet.

When the *talk-standby* switch (S501) is in the *talk* position, it grounds the base of TR522, turning it on. TR522's emitter goes to +Vcc and its collector connects to the base of TR514 via D507. The +Vcc switched through TR522 biases on TR514, which then turns on TR507 and the rest of the audio circuitry.

In the *standby* position, the circuits are all shut off.

Receiving a ring

The ring signal from the base is received and demodulated in the same manner as described earlier, except that it cannot directly continue on to the output section to be heard out the speaker. This is because the handset is in the *standby*

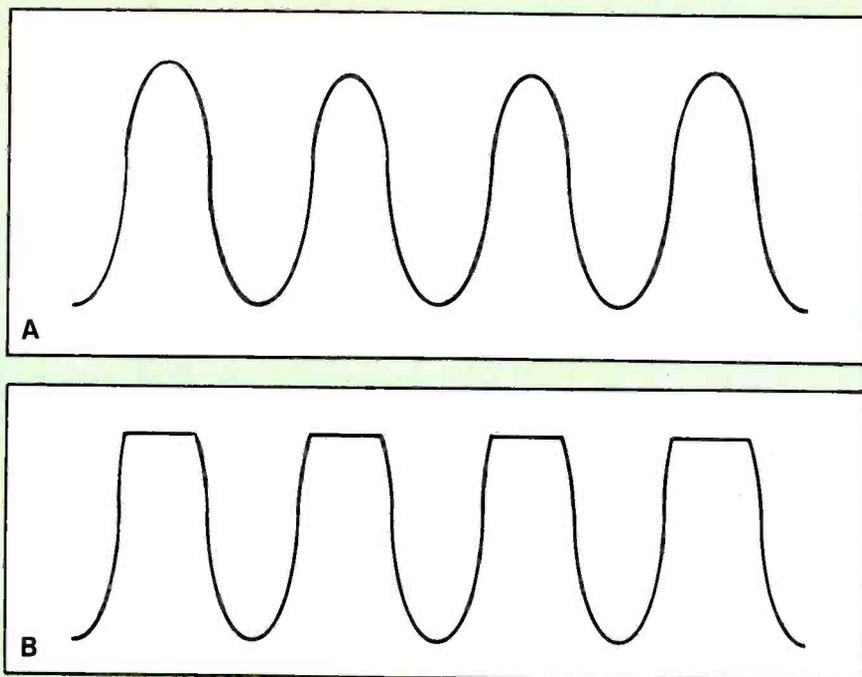


Figure 2A. Output of filter FL501 is a 455kHz sine wave. **(B)** Limiter circuit (TR505) limits or clips off any AM modulation that might be present on the received signal. Output is the 455kHz sine wave with its peaks clipped.

mode and the audio gate is not turned on.

The ring audio instead takes a second path off the collector of TR506. It travels down through R531 and C528 to the base of the first selective amplifier, TR511. TR511 amplifies all audio signals at its input, then sends them on to the second selective amplifier, TR512. The output of TR512 is coupled back to the input of TR511 through a resistor/capacitor network known as the *Twin T* Notch Filter. Because the audio signals fed back from the emitter of

TR512 are 180 degrees out of phase with those at the input of TR511, they cancel themselves out. The only exception is the frequency to which the filter is tuned. Because the filter offers a high impedance to its resonant frequency, that frequency is not fed back and canceled but continues onward to the ring amplifier, TR513.

The notch filter components are selected to create a circuit tuned to the ring or *bell* signal that is being transmitted by the base unit. This frequency will be one of the three possible choices mentioned earlier

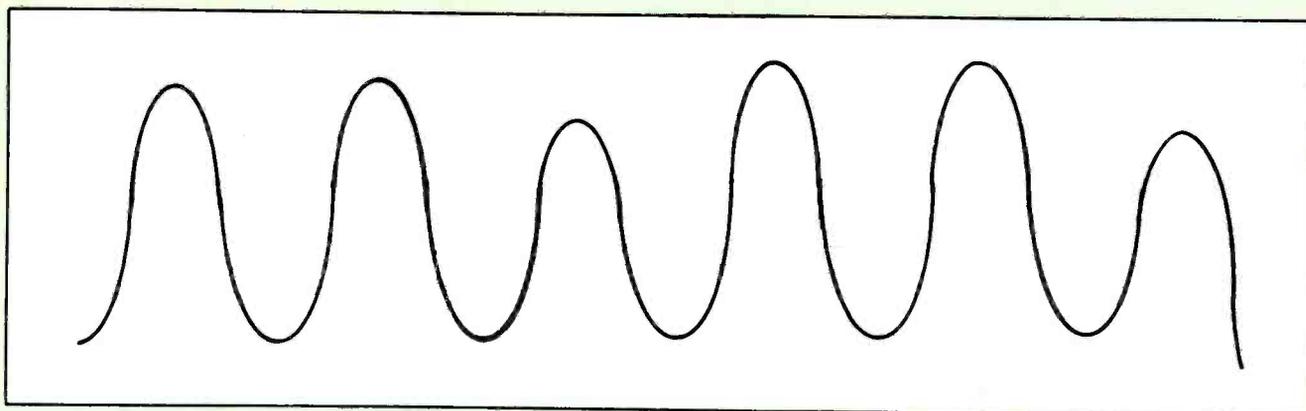


Figure 3. Output of transmitter is a signal as shown. Every third peak of the waveform will be lower in amplitude than the previous two because of the action of frequency tripling of TR516.

in the base unit text (730, 1000 or 1300Hz). It is the only signal that is not canceled.

The ring signal, after amplification by TR513, is sent to the base of TR507, the audio gate (via R538 and C533). Simultaneously, a portion of it is also rectified by D505 and D506 into a control voltage that turns on TR514, the gate control. When this occurs, TR514 conducts and provides the emitter ground path that turns on TR507. Now the ring signal can be amplified by the audio section and heard through the speaker.

The transmitter

TR517 is the transmit oscillator. Crystal X502 determines the fundamental oscillating frequency, which is then tripled by TR516, the tripler stage, to the 49.8MHz band. This tripling action occurs because the output transformer (L505) of TR516 is tuned to the third harmonic of the oscillator frequency. The final stage of the transmitter is TR515. It increases the signal strength up to the level required to drive the telescoping rod antenna.

The output signal of the transmitter as seen on an oscilloscope would look like Figure 3. The tripling action causes every third peak of the waveform to be lower in amplitude than the previous two.

Alignment of the transmitter is relatively straightforward. Adjust L506 for proper output frequency, then adjust L505 and L504 for maximum signal output. (Note: You will probably have to adjust L505 for a compromise of least signal distortion/maximum gain.)

The most accurate and convenient way to do this is by connecting the ground lead of the oscilloscope to the negative battery terminal and laying the probe next to the fully extended rod antenna. For best results, do not connect the probe to the antenna. This would load it down and change its transmit characteristics. This is why it is necessary to have a 50MHz oscilloscope. A lower frequency scope could not possibly see the transmit signal accurately.

Modulation of the transmitter is performed by varactor diode

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D508. The microphone audio is amplified by TR518 and TR519 before being applied to D508 for modulation.

When the modulating audio is applied to D508, it causes the varactor's internal capacitance to vary in step with the modulating voltage. This alters the resonant frequency of the oscillator's tuned circuit at the same rate. So the output is caused to deviate above and below the center frequency by the value of the modulating signal. Control VR501 adjusts the amount of FM modulation and should always be set for $\pm 3\text{kHz}$ deviation.

It is interesting to note that the handset only uses one varactor diode, whereas the base required two to obtain proper modulation; this is because the handset transmitter uses a tripler. Not only does the oscillator frequency get tripled, the modulation does too. In actuality, the varactor only varies the oscillator by $\pm 1\text{kHz}$. It is the tripler that multiplies the modulation up to the proper level.

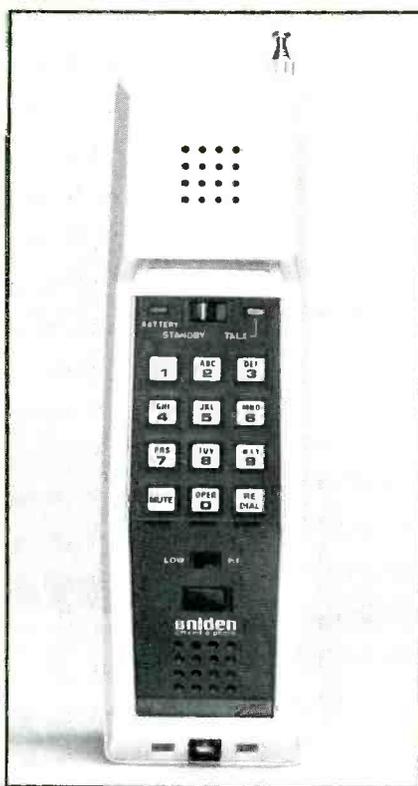
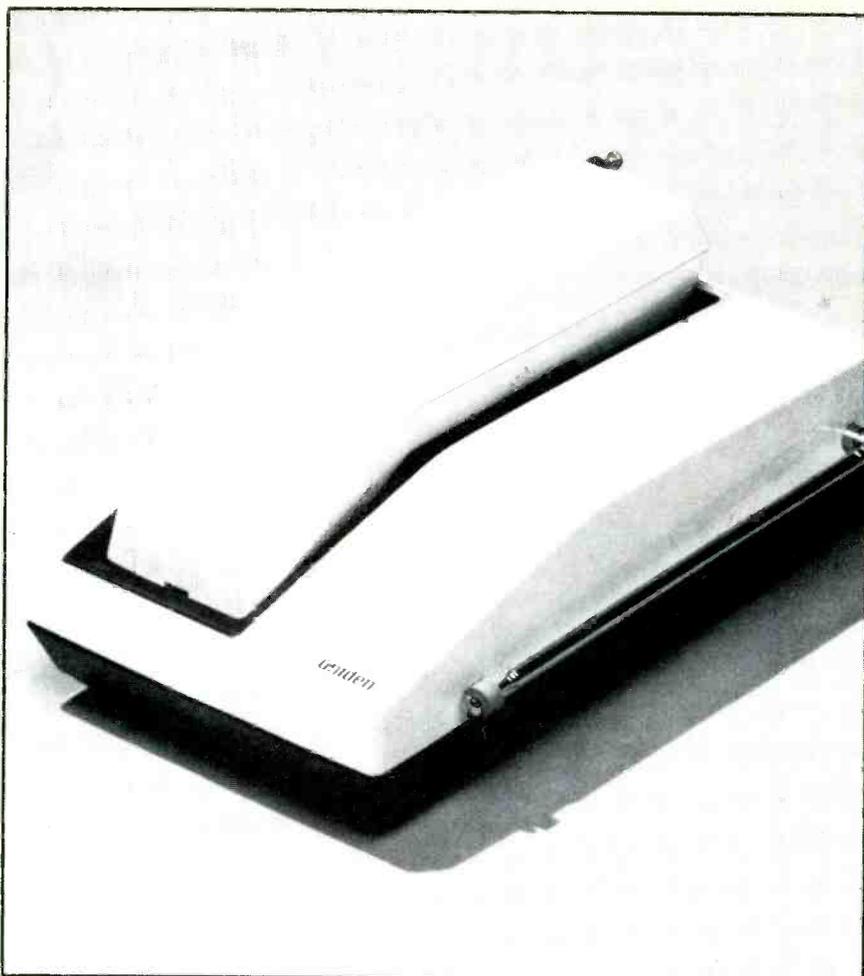
TR521 is the pilot tone oscillator and its frequency may be adjusted by VR502, but must always be matched with the base unit's tone decoder circuit. Its signal is coupled by C551 to the anode of D508 to modulate the carrier. The pilot tone modulation is always constant except when dialing is performed.

Dialing

When one of the push-buttons on the dialing pad is pressed, the internal circuitry of IC501 sends a series of timed pulses out pin 18 of the chip that corresponds to the value of the digit selected (i.e. pushing digit 7 sends out seven pulses). Simultaneously, a tone is sent out pin 2 to the audio gate TR507 to provide an audible acknowledgement of signal entry.

Each time pin 18 is brought low by a dial pulse, it grounds out the collector of TR521, the pilot oscillator, via D514, and momentarily kills the oscillation. These interruptions are passed onto the telephone line via the base unit's relay as dialing pulses.

The internal pulse rate of IC501 is determined by R574, C562 and



(Top) Cordless telephone allows user to make phone calls without a connecting cord while up to 1000 feet away from base unit. (Bottom) Handset features all necessary functions including on/off, ring, dial, transmit and receive.

R576 at pins 7, 8 and 9 respectively. External connections at pin 10 determine whether the dialing pulse rate selected is 10 or 20 pps (pulses per second). Pin 11 is involved in setting the on/off timing ratio of the pulses.

IC501 also has an internal RAM memory that is used to remember the last number dialed for the redial function. Pin 17 is the RAM reset pin. When TR525 is turned off, it disconnects this pin from ground and clears or resets the memory. This occurs whenever the cancel switch (S901) is pressed or the handset is turned back to the standby mode.

Pin 12 is used to ground or mute the audio section during dialing to

prevent the loud dial clicks generated in the base from being heard out the speaker.

Charging the batteries

The battery pack consists of three AA size nickel cadmium rechargeable cells wired in series. The complete pack is rated at 3.6V, 475mAh at full charge.

On the average, the handset has approximately one hour of *talk* time on a fully charged battery. In *standby*, the battery will last for two or three days.

Automatic recharging of the battery pack occurs whenever the handset is placed in the base unit's charging cradle. Total recharge time is approximately eight hours.

If S501 is left in the *talk* mode when the handset is placed in the cradle, the +Vcc from the base power supply passes through D512 and shuts off TR522. This has the same effect as manually returning

S501 to *standby*. The next time the handset is picked up to be used, it will automatically switch back to the *talk* mode providing the same type of operation a standard phone does.

Battery low indicator

TR523 is always turned on whenever the battery pack has a sufficient charge to operate the handset. While it is conducting, it is holding the base of TR524 at ground potential so that the transistor cannot conduct. When the battery voltage drops down to 3.2V or below, the turn on bias of TR523 can no longer be sustained, so it shuts off and TR523 turns on. When this happens, the *batt/low* light, D515, is grounded through the now conducting TR524 and illuminates. This condition will continue until the battery is either completely exhausted or recharged.

When D515 illuminates, the user only has about one minute of talk time left to either conclude the conversation or pick up on another telephone.

Thermistor, TH501, is installed in the base circuit of TR523 to compensate for any outside temperature changes the handset may be subjected to and to provide thermal stability to the circuit. A temperature increase around TR823 causes this transistor to conduct harder, possibly causing it to fail to shut off at the appropriate battery level. The resistance of TH501 decreases with a temperature increase to compensate for this and causes the transistor to always shut off correctly.

The circuitry described here is very similar to that used in most other Uniden cordless phones. Using this article as a guide, you should have little or no trouble servicing a cordless phone.

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Test your electronic knowledge

By Sam Wilson

1. In the class A amplifier of Figure 1, the polarity of the voltage at point A should be:

- (A) positive.
- (B) negative.

2. To bypass the emitter resistor in the circuit of Figure 1, use the electrolytic capacitor that is shown in position:

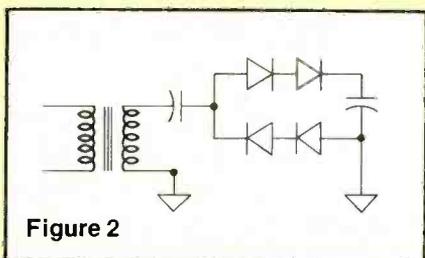
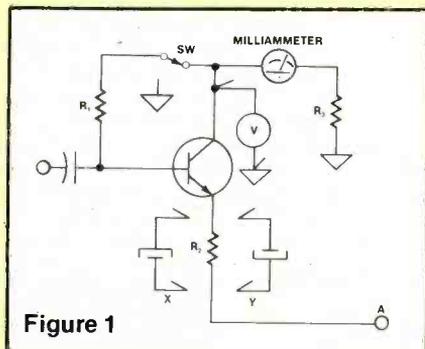
- (A) *x*.
- (B) *y*.

3. For broadband response in the amplifier of Figure 1,

- (A) connect the bypass capacitor across R_2 .
- (B) do not connect the bypass capacitor across R_2 .

4. For broadband response in the amplifier of Figure 1, switch SW should be:

- (A) in the position shown.
- (B) in the other position.



5. The milliammeter in Figure 1 will show the collector current value when its:

- (A) positive lead is connected to the collector.
- (B) negative lead is connected to the collector.

6. If you short the emitter to the base in the circuit of Figure 1, the voltmeter will indicate:

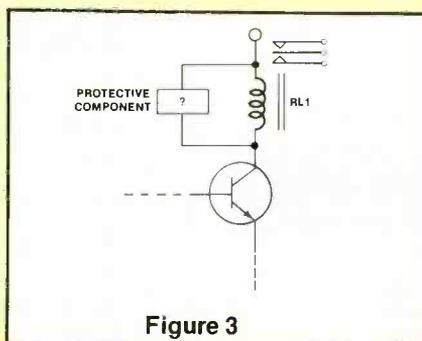
- (A) an increase in voltage.
- (B) a decrease in voltage.

7. Figure 2 shows the circuit for a:

- (A) half-wave bridge rectifier.
- (B) full-wave bridge rectifier.
- (C) half-wave voltage doubler.
- (D) full-wave voltage doubler.

8. A technician connects a VOM across the *on-off* switch of a battery operated transistor radio in order to:

- (A) measure the battery voltage under load.
- (B) measure the battery load current.
- (C) see if the battery polarity is correct.
- (D) check for excessive leakage in the power supply electrolytic capacitors.



9. Which of the following components might be used to protect the transistor in Figure 3 from inductive kickback?

- (A) tunnel diode
- (B) E cell
- (C) varistor
- (D) varactor

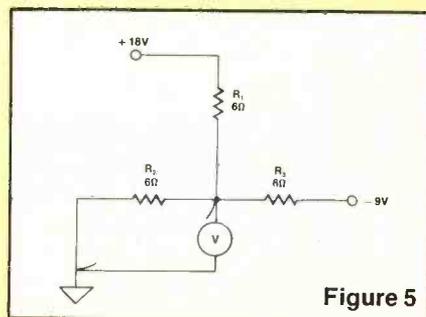
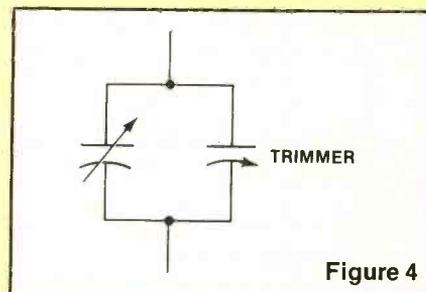
10. Figure 4 shows a trimmer capacitor. It will have its greatest influence when:

- (A) C is tuned to the highest frequency in the AM band.
- (B) C is tuned to the lowest frequency in the AM band.

Level 2

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11. What is the value of voltage (V) in Figure 5?



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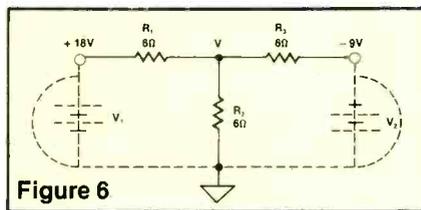
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Answers to quiz

1. (B) To answer questions like this, draw a battery between point A and the bottom of R₃. The negative side of that battery must be connected to point A.
2. (B)
3. (B) Without the capacitor, there is degenerative feedback reducing the gain, and therefore, increases the bandwidth.
4. (A) In that position, there is a negative feedback from the collector to the base. The resulting decrease in gain is accompanied by an increase in bandwidth.
5. (B)
6. (B)
7. (C)
8. (B) This measurement is a quick way to determine if the power amplifier is operating. Loss of the power amplifier results in a low current reading. The switch must be open for this test.
9. (C)
10. (A) At the highest frequency the tuning capacitance is minimum. So, the trimmer will exert its influence more at the high end of the band because it is a higher percentage of the value of C.
11. (3V) The circuit is redrawn in Figure 6. There are many ways to solve it. The superposition method is shown here. Conventional (+ to -) current is assumed. With V₂ shorted, V₁ sees a resistance of 9Ω. So, the current supplied by V₁ is 18/9, or 2A. Half of that current flows through R₂ that is due to V₁ is 1A down.



With V₁ shorted, V₂ also sees a resistance of 9Ω. It supplies a total current of 1/1, or 1A. Half of that current flows through R₂. So, the current through R₂ that is due to V₂ is 1/2A up. The actual current is the difference between the two calculated current values because they are flowing in opposite directions. In other words, the actual current is: 1 - 1/2 = 1/2A down. The voltage across R₂ can be determined by ohm's law: V₂ = 1/2 x 6 = 3V. (Answer) This voltage is positive at point V.

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Products

3½-digit hand-held DMM

A. W. Sperry Instruments, Hauppauge, NY, has introduced the new model DM-8010 rotary switch 3½-digit DMM. The DM-8010 has a built-in tilt stand, instant continuity buzzer, auto zero, auto polarity, overload protection on all ranges, 500V ac/dc protection on all resistance ranges, diode test function low power ohms for in-circuit resistance measurement, recessed safety designed input jacks and basic dc accuracy of 0.25 percent reading.

Circle (75) on Reply Card

Electronics pliers

Twenty electronics pliers and a wire stripper have been introduced by *Xcelite* in the new Superior line featuring carbon steel and double leaf-spring opening construction. This line comprises 11 cutters with a C60 Rockwell and a variety of common-use pliers at C35-45. Sizes are in the 4- to 5-inch miniature range. Box joints and heads are burnished black with blue PVC-covered cushion grip handles. Types include side, oblique, end and flat cutters; round, flat, snip and chain nose pliers.

Circle (76) on Reply Card

Voltage surge suppressor

RCA Distributor and Special Products Division, Deptford, NJ,



announced a 3-outlet voltage surge suppressor and interference filter to protect sensitive solid-state equipment against power line transients and RF or electromagnetic interference. The unit, model AH040, is especially useful to guard computers from data loss and to protect audio, television and other video equipment. Model AH040 plugs into the lower outlet of any standard duplex 125V wall receptacle and accepts up to three power cords. A built-in light indicates that the unit is functioning properly.

Circle (77) on Reply Card

Hand nibbling tool

The K-88 Hand Nibbling Tool, available from *Dawle Tech*, Fair Lawn, NJ, is suitable for the electronic engineer, technician and hobbyist. It cuts sheet metal like a punch and die. It is used for making templates, for cut-outs of radio chassis and panels, for making model parts, and causes no strain or distortion to the original form. The tool will cut mild steel up to 0.023-inch (0.6mm) or soft aluminum sheet up to 1/16-inch (1.6mm). Replacement blade K-881.

Circle (78) on Reply Card

Long-nose adapter

Rush Wire Strippers announced the availability of a special long nose adapter for their ECT-1 tool, enabling the device to be used for cleaning, polishing and burnishing in areas of limited access. The ECT-1 is portable, hand-held, rotary cleaning tool using several interchangeable insert brushes manufactured from fiberglass, stainless steel, brass and nylon for a variety of applications.

The tool is lightweight and operates from integral rechargeable batteries. Each tool is supplied with a bench stand, battery charger and several cleaning brushes. Refills of the cleaning brushes are readily available in all grades of material.

Circle (79) on Reply Card

Anti-static cleaner

Statikil, Bath, OH, introduces Statiglass anti-static cleaner which was formulated to clean,

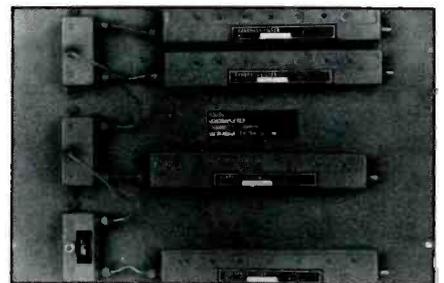
brighten and protect CRT screens. Statiglass has anti-static and anti-fog properties and it leaves no gummy residue. Dust and lint are repelled while minute scratches are covered. Fingerprints and marks on treated surfaces are easily wiped off with a dry cloth. Statiglass is used on computer display terminals, TV screens, electronic game screens and tracking station screens.

In the graphic arts area Statiglass is used on camera lens, platemakers and copiers. Other uses for Statiglass include cleaning plastic masks, shields, helmets and visors for industry and the safety forces; airplane windshields; motorcycle and boat windshields; display cases and trade show exhibits; stereo dust covers; instrument dial faces; and optical lenses—all Lexan, Lucite and Plexiglas surfaces.

Circle (80) on Reply Card

Quadraplexer

Model X3303-2/4/6/11 quadraplexer, from *Microwave Filter*, E. Syracuse, NY, combines or splits four TV channels from the total TV spectrum or combines four off-air antennas to one downlead. The quadraplexer uses



non-resistive splitting networks for low loss and has 25dB minimum mutual isolation between channels. It can be supplied for any number of non-adjacent TV channels in the 54-300MHz TV band. Impedance is 75Ω with type F connectors (F61). Units can be supplied with panels or in weather-proof casings for outdoor use.

Circle (81) on Reply Card

Portable oscilloscope

Hitachi Denshi America, Woodbury, NY, introduces the V-1070, a low-cost version of the V-1100, an intelligent 100MHz portable oscil-

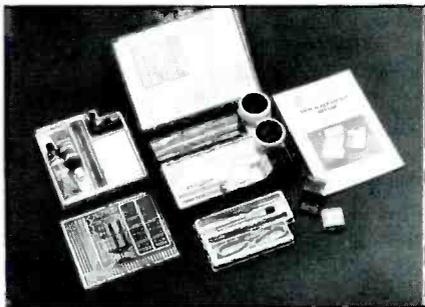
oscope with built-in frequency counter/DVM, CRT readout and ground level display.

Using the built-in micro-computer, the V-1070 displays the panel setting information on the CRT as follows: vertical deflection factors, uncalibrated warning, magnification warning, vertical input coupling, band limiter, CH2 inversion, horizontal sweep times for both A time and B time bases and trigger sources for both, uncalibrated warning for A sweep time, sweep magnification warning, delay time and 10X probe indicators for CH 1 and CH 2.

Circle (82) on Reply Card

Track repair kits

Model SRS 050 Track Repair Kits, from *Automated Production Equipment Corporation*, Medford, NY, allow the user to repair damaged printed circuit boards. The repair to the circuitry is made by using a variety of copper foil etchings, which complement the existing board circuitry. Plated through holes are repaired by



swaging and eyelet/funnelet into the board. The kit is available in four models: standard, service technician's, basic and deluxe. These kits differ in the tools supplied and all are capable of making high quality repairs.

Circle (83) on Reply Card

4-1/2-digit DMM

Beckman Industrial Corporation, Instrumentation Products Division, Brea, CA, has introduced the HD140, a new 4 1/2 digit, hand-held DMM, to its heavy-duty product line. Two features included are True RMS and the proprietary single-knob rotary switch.

Extra overload protection enhances the dependability of the HD140. All voltage ranges can

withstand transients up to 6kV. Resistance ranges are protected up to 600V, and current ranges are protected by a 2A/600V fuse. It maintains a dc volt accuracy of 0.05 percent, and measures up to 1500Vdc and 1000Vac. Other features include 10A current range, diode test capability, and Insta-Ohms quick continuity function which provides a rapid visual indication of continuity.

Circle (84) on Reply Card

Computer power conditioner

Shape Magnetronics, Lombard, IL, announces the new Personal Computer Line Tamer power conditioner, for \$99. The Personal Computer Line Tamer removes spikes, transients, common and transverse noise, provides line isolation, and protects against surges, undervoltages and overvoltages by providing constant voltage, clean power to the computer. Personal Computer Line Tamers feature four rear panel plug receptacles, a 6-foot power cord and a front panel power switch.

Circle (85) on Reply Card

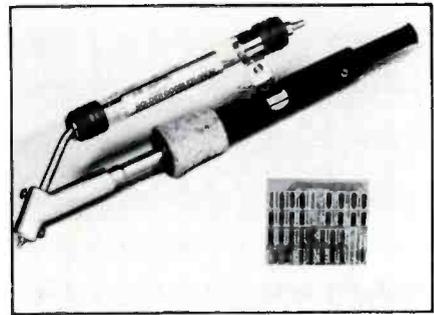
Digital storage oscilloscope

Leader Instruments, Hauppauge, NY, has introduced the LBO-5825, a 35MHz, 2-channel digital storage oscilloscope. The LBO-5825 is equipped with a 2K word memory, has a 5MHz maximum sampling rate and pre-trigger view capability. X-Y recorder output terminals are provided for use with a plotter, and simultaneous display of real time and stored waveforms are possible. Other features include roll function, memory protect, external clock provision and automatic chop alternate model select. This storage oscilloscope is suited for such applications as stress analysis, shock and vibration testing, power-line transient monitoring and computer glitch problems.

Circle (86) on Reply Card

Vacuum desoldering tool

A new lighter desoldering tool, from *Air-Vac Engineering Company*, Milford, CT, features a smaller heating element that provides both more efficient heat



transfer and a method of securing the tip that eliminates plating fracture. Incorporating a shorter vacuum passage for cleaner operation, both the heating element and vacuum passage are positioned well forward of the handle and away from the operator's hand.

Tip temperatures may be selected from 650 degrees F to 950 degrees F for efficient desoldering of any printed circuit board from 1-sided to multilayer. Available in either 120V or 24V, the tool is compatible with all Air-Vac SG series desoldering stations.

Circle (87) on Reply Card

Function generator

A multi-purpose function generator has been introduced by *Global Specialties*, New Haven, CT, a division of *Interplex Electronics*. Model 2005 provides sine, triangle, square and pulses with variable amplitude, symmetry and offset over the wide frequency range of 50mHz to more than 5MHz. A signal can be attenuated 20dB, 40dB or 60dB in 20dB steps, and there is an additional 20dB continuously variable amplitude control.

The maximum output amplitude of the Model 2005 is 20V p-p into open circuits or 10V p-p into 50Ω. Output can be continuous, gated or triggered by an external signal or by a front panel manual switch. When used as a sweep generator, an internal ramp with variable duration provides a recurring linear sweep over a frequency range of 1,000:1 (linear) to 10,000:1 (logarithmic). Dc offset is adjustable from -10V to +10V into open circuits or -5V to +5V into 50Ω. All output wave shapes can be adjusted to operational requirements using the symmetry control from 10 percent to 90 percent.

Circle (72) on Reply Card

Books

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

Understanding Electronics – 2nd Edition, by R. H. Warring; Tab Books, \$9.95 paperback.

Here is an easy-to-understand, introductory guide to electronics, which doesn't bog the reader down with formulas, yet gives in-depth explanations and examples. Information on basic circuits, circuit laws, resistors, capacitors, coils, inductances, and transformers is highlighted.

This second edition has been updated to cover the latest developments in electronics, including microprocessors, IC arrays and the basic units of electrical measurement. It also has been expanded to include chapters on amplifiers, oscillators, power supplies and even has a guide for selecting transistors. Also the various parameters of transistor performance, different types of filters for high voltage power supplies and the mysterious properties of semiconductors have been fully discussed. Illustrations and circuit diagrams are featured.

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

Semiconductor General-Purpose Replacements, 5th Edition; Howard W. Sams and Company, \$9.95 paperback.

A major problem in the replacement of semiconductor devices is determining what the proper replacement should be. Because the manufacturer may assign a stock number to a particular semiconductor, or the semiconductor may be unmarked, many times the only way to find a part number is by consulting the service literature.

This book has been designed to

give you the information you need to find a replacement part. United States, European and Far Eastern type numbers and manufacturers' part numbers (stock numbers and/or any numbers found on the part) are included. The universal general-purpose replacement semiconductors of eight suppliers—General Electric, Motorola, New-Tone, Philips, Radio Shack, RCA, Workman and Zenith are given for the nearly 226,000 devices listed in this book.

This listing was compiled from the files of Photofact analysis department; specifications and other data from manufacturers were included.

Published by Howard W. Sams and Company, 4300 W. 62nd St., Indianapolis, IN 46266

How to Become a Successful Consultant in Electronic Servicing, from Associated Technology, ATC Books, \$25.

Consulting could be the electronics professional's antidote for overcoming job stagnation or age discrimination. This book details the information you need to start your own consulting business: locating clients, fees, ethics, professional advertising, developing business plans and writing contracts. According to the author, most people in the electronics servicing field have more to offer than they realize. The real secret is knowing how to market a professional service.

Published by ATC Books, Route 2, Box 448, E. Springs, TN 37330.

Principles and Practice of Digital ICs and LEDs, by Don Inbody; Tab Books, \$12.95 paperback.

A learn-by-doing guide, this sourcebook provides information for building a wide range of useful digital devices, using inexpensive and readily available digital ICs and LED readouts. This book includes instructions for a digital logic probe (for troubleshooting digital circuits and components) and directions to build a frequency standard, producing frequencies ranging from 1kHz to 20MHz.

The fundamentals needed to understand digital logic, how and why ICs and LEDs work, how TTL and CMOS operate, the uses of

discrete and display LEDs, the construction of circuit boards, plus important safety guidelines are all explained in detail in this book.

Tips, tricks and techniques to assist in the construction of the projects are included. For example, the book tells how to properly space components on a circuit board, how close certain components should be placed on a circuit board and the fundamentals needed to understand how each digital device works.

Illustrations of finished projects are featured, along with step-by-step building instructions, complete schematics and circuit board layouts, parts lists for each project, the tools and test equipment needed and pointers about how to avoid construction mistakes.

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

CMOS/TTL—A User's Guide with Projects, by Joseph J. Carr; Tab Books, \$12.95 paperback.

Understanding and using digital IC devices may not be as difficult as you might think. This book emphasizes the two most-used modern digital devices, the transistor-transistor logic (TTL) and the complementary metal oxide semiconductor (CMOS). It includes several hands-on projects and experiments to demonstrate specific IC functions and results, showing the benefits of the TTL and the CMOS. The TTL offers low-cost and high-speed, and the CMOS provides low power consumption combined with more immunity to high-frequency noise than earlier digital IC types.

Anyone with a fundamental grasp of analog electronics should have little trouble mastering digital electronics principles as explained in this book. Technical specifics of the TTL and the CMOS, as well as other digital devices are provided. The book also gives pointers on digital theory in general and a thorough look at the various logic gates found in TTL and CMOS families, including: NOT, OR, AND, NAND and NOR.

Published by Tab Books, Blue Ridge Summit, PA 17214

ES&T

Literature

A new catalog of precision tools is offered free by **Jensen Tools**. Illustrated in full color, the 160-page catalog contains more than 3000 tools of interest to field engineers, technicians, computer and telecommunication service persons and electronic hobbyists. Major categories covered are test equipment, soldering equipment, tweezers, screwdrivers, cutters, drafting supplies, power tools, computer accessories, circuit board equipment, and miscellaneous. Also included are many new products from Jensen and more than 40 pages of service kits and tool cases for electronic specialists and technicians.

Circle (125) on Reply Card

Hamtronics announces publication of their new 1985 mail order catalog full of products for the VHF/UHF/OSCAR enthusiast. The 40-page, 2-color catalog features many new products, including a simplex autopatch kit, a repeater COR with courtesy beep, GaAs FET receiver preamps, active antennas for scanners, and repeater PA kits. Also included are the popular lines of FM and AM receivers, FM transmitters, VHF and UHF transmitting and receiving converters, repeaters, space shuttle receivers, 800MHz scanner converters, and other Hamtronics products.

Circle (126) on Reply Card

The **John Fluke Manufacturing Company** announces the availability of an 18-page color brochure, "Digital Multimeters from Fluke." The brochure provides comprehensive and colorful information on all the latest DMM developments from Fluke. This includes handheld DMMs, bench/portable DMMs and the 70 Series DMMs, which combine both digital readout and an analog bar graph in one handheld package. A full line of ac-

cessories complementing the DMM line is also featured, including convenience accessories such as carrying cases and auxiliary test leads.

Circle (127) on Reply Card

Protection and interference control products are presented in a new 40-page catalog from **Electronic Specialists**. Costly damage from lightning or power line spikes can be prevented and disruptions or interference from power line carried EMI and RFI can be controlled. Protective devices for office equipment include ac line voltage regulators and conditioners, modem and phone line surge suppressors as well as equipment isolators and filter/suppressors.

Typical protection and interference problems are described, together with suggested solutions for various electronic office machines. Catalog 841 also describes numerous applications for office equipment protection and interference control.

Circle (128) on Reply Card

Hunter Associates, division of **Hunter Products**, now offers a 68-page catalog. This catalog is filled with industrial tools, equipment, instruments, materials and technical aids, many of which are unavailable from any other source. Included are disposable electro-plating pens, low-cost micro air-abrasive units, tungsten-carbide surface application units.

Circle (129) on Reply Card

A new 65-page **Blaupunkt** booklet provides autosound installers with a detailed reference for determining the exact placement requirements for installation of Blaupunkt car radios and speakers in today's automobiles. A coded chart system tells the installer which car dashboards require no modifications when a particular Blaupunkt radio is installed, or what type of modification is necessary. Installations that require special adapter-plate kits, or situations where a radio model is inappropriate for a specific vehicle are also indicated.

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Readers' Exchange

Needed: Schematic and/or service manual for Pilot series 7000 stereo Concord 111, model 7034, serial no. 411674. Will pay expenses or cost or will copy and return. *Salvatore J. Sagolla, 528 Kipling Blvd., Lansing, MI 48912; 517-482-2405.*

For sale: Complete Sams Photofact from #454-2018, best offer. *Sy Olson, c/o Martack Corp., 1325 2nd Ave., New Hyde Park, NY 11040; 212-343-2666.*

For Sale: Sencore VA48 video analyzer, \$595. Complete with manuals and test leads, A-1 condition. Price includes shipping. *Ferrell's Electronics, P.O. Box 160, Orrstown, PA 17244; 717-532-6238.*

For Sale: Sencore-SG165-stereo AM/FM analyzer. Used one time, \$500 or trade for "Z" meter. *Robert Duncan Enterprises, 1513 Sixth Street, Eureka, CA 95501; 707-442-2794 (evenings).*

Needed: A metal cased 6L6 vacuum tube and schematic for a General Radio signal generator model #1001-A, serial no. 2581. Send a letter indicating price. *David S. Mulks, 366 Sheffield Road, Ithaca, NY 14850.*

Wanted: Manual/schematic for Knight KG-652 RF sweep generator, flyback XF for Panasonic AN-142. *Wayne A. Strahl, 20W350 Beller Drive, Downers Grove, IL 60516.*

Needed: Sams Photofact #TR-82 and Supreme's TV18, 19, 27 and R-7. *C.T. Huth, 130 Hunter St., Tiffin, OH 44883.*

Wanted: For old RCA radio 15-217, one power transformer #94119 or a good substitute. Also, one power transformer for Fisher stereo MC 3010 #4-2519-23382. Any information about where these parts may be obtained would be appreciated. *Miles E. Baker Sr., 1200 78th St., Newport News, VA 23605; 804-326-5394.*

Wanted: Sencore VA48 TV analyzer or B&K model 1077-B analyst. Also want B&K model 415 alignment generator. *Dan Pancoast, 154 Bala Drive, Somers Point, NJ 08244; 609-927-6541.*

Needed: Service manual for Fosgate Electronics model PR-2100 power amp and PR2100 preamp. Will buy or copy and return. *Richard Modafferi, R.D. 1, Skyline Drive, Vestal, NY 13850; 607-754-1885.*

Needed: Heath SM-2420 or SM-4130 frequency counter, Microcraft CS1F code star reader, EMC model 802 signal tracer generator. *Caswell Davis Jr., 601 Delmar, Apt. 2, San Antonio, TX 78210.*

For Sale: Sencore VA48, used less than 20 hours, no longer in business, must sell, \$700. *Ron Carron, 3503 Hudson Circle, Manhattan, KS 66502; 913-776-4100.*

Needed: Service manual for Sansui SR-2020 BC changer and Bohsei T-500 television. *C.T. Huth, 130 Hunter St., Tiffin, OH 44883.*

Needed: Sams Photofacts from 1100 to present. *Jack Farmer, Electronics Service Company, 110 W. Kelly St., Sylvestor, GA 31791; 912-776-2179.*

Needed: Schematic diagram and part numbers for components of a Jerrod Division CATV cable converter power supply circuit, model no. JRX-3D1C-105. *I.E.A.S., P.O. Box 1151, Homestead, FL 33033; 305-245-1012.*

Wanted: Schematic diagram or manual for Kenwood model KR-44 AM/FM stereo receiver. Will buy or copy and return. *Leonard Twigg, 514 Vance Ave., Paris, IL 61944.*

For Sale: Econo-bar sweep program (by Solas Products) which converts the Commodore 64/SX-64 computer into a low-cost, high-quality bar sweep (multiburst) pattern generator. Use to check and tune up the video response of monitors or televisions, \$35 (disk). *Mark Kruse, Box 665, Springhouse, PA 19477; 215-862-5028.*

For Sale: **Electronic Servicing** issues from Jan. 1963-Oct. 1980, \$50, plus shipping charges. *Electronic Technician/Dealer* issues from Jan. 1963-July 1982, \$50. *Rod Lindgren, 1421 Pleasure Drive, Madison, WI 53704; 608-244-5759.*

Needed: One Precision model E-310 generator; One Precision model E-200 C signal generator; also model 98 VTVM and model 78 portable VTVM. *James G. Shoemaker, 600 1st St., Leechburg, PA 15656.*

Needed: Instruction manual and schematic or copies of same of a tube tester made by Superior Instrument Company, model TV-12. Willing to pay any charge. *Gilbert Lahullier, 17 Kensington Ave., Clifton, NJ 07014; 201-473-6685.*

Trade: Yeasu FTDX 560 CB/Ham SSB radio with all modifications. Trade for Radio Shack model 1 computer system. Contact: *Scott's TV & Electronic Service, Route 3 - 3186, Pottsville, PA 17901.*

For Sale: Sams Photofact sets 109-1428 (total 142 sets), \$1 per set or all 142 sets for \$125, plus shipping. Call or send for complete list. Lafayette transistor analyzer model 223. No manual, \$20, plus shipping. Accurate Instrument utility tester model 161. Has voltmeter, ammeter, ohmmeter and checks tube filaments, operates off 110Vac. No. manual, \$15, plus shipping. *John Brouzakis, Route 3, Box 602 B, Charleroi, PA*

Wanted: Schematic for a drug-store-type tube tester, model 1050, serial #10350, made by BSL. *R. Stigney, 8400 Eastwood Road, Minneapolis, MN 55432.*

For Sale: Pilot bulbs for old radios No. 44-47-51-112, etc, 25 cents each. Fuses 20 cents each. Small speakers \$2 and up. Write to: *Al Crispo, 3225 Chipmunk Drive, New Port Richey, FL 33552.*

For Sale: 250 feet of 50 conductor ribbon cable (new) 28 gauge. Also: Antique pilot tuner with electrical drawings; miscellaneous antique telephones; Thomas A. Edison miners lamp. *Richard Jacobs, 6610 Bunker Road, N. Royalton, OH 44133; 216-237-4662.*

Needed: One Precision generator model E-400, one Precision 88 VTVM, one Precision model E-440 generator. *Jim Shoemaker, 600 1st St., Leechburg, PA 15656.*

Needed: Operation and service manuals for Lampkin Laboratories model 109 service monitor. Will buy or copy and return. Will pay shipping. **Wanted to buy:** Good used Sencore model CB42 CB tester. *Larry R. Singleton, P.O. Box 982, Lexington Park, MD 20653; 301-862-3889 (home) 301-862-8018 (work).*

For Sale: B&K model 2040 CB signal generator; B&K model 1040 CB servicemaster, plus one set of connecting cables; Sencore model CB41 automatic performance tester, plus accessory EX203, \$250 for all three. All equipment in excellent condition and include the probes or leads and instruction manuals. *Clarence G. McKee, 9516 Zion Road, Rives Junction, MI 49277; 517-569-3139.*

For Sale: Sams Photofact folders 399-2066 in six filing cabinets; also eight volumes 101 to 180. RCA, Zenith, etc. manuals. Test equipment, tubes, tools, send s.a.s.e. for complete price lists. *Maack Kunzman, Jamke TV Service, 1051 Bale Lane, Calistoga, CA 94515.*

Wanted: Sams Photofacts from 1000-up. Send list, price and cost of shipping to *Donald G. Harris, 3332 N. 57th Ave., Phoenix, AZ 85031; 602-247-7020 (after 5 p.m.).*

For Sale: Sams Photofacts, \$3 plus postage. Also Kantronics Hamssoft for Vic 20, program ROM cartridge for Hams or SWL, \$25. MFJ super CW/CB audio filter model MFJ-721, \$35. *Augustine's TV/Radio Service, 530 N. 9th St., Reading, PA 19604; 215-372-5438.*

For Sale: Great B&K equipment and other brands. All have books, cables and are in great condition. Please send for list and prices. *Leonard Elgart, 3510 Avenue H, Brooklyn, NY 11210.*

Needed: Schematics for Tektronix model 564 B storage oscilloscope and Precision apparatus model T-65 transistor and crystal diode checker. Copies are fine. *Carl Behum, Technigraphix, 33862 Lakeview Drive, Eastlake, OH 44094.*

Needed: Service manual/schematic for Akai VTS 110. Call or write to: *Calvert Electronics, 105 Buchanan, Cape Canaveral, FL 32920; 305-783-5180.*

Needed: Service manual/schematic for model KV9000U Sony color TV. Will copy and return. *Mike Kovacs, 7101 Flint Court, Middletown, MD 21769.*

Wanted: Z meter in good working order. *Gary Satko, 6042 W. Irving Park, Chicago, IL 60634; 312-794-0259.*

Wanted: Sams Photofacts between 1400 and 2000. Need not be a complete set. *Ray Brumbaugh, 118 Kaywood Drive, Statesville, NC 28677; 704-872-5742.*

For Sale: 5-inch oscilloscope, 7-inch EICO EVTVM, EICO TV generator marker. All for \$185 money order. *Dean Kromphardt, K&K TV Service, 930 S. Warren, Peoria, IL 61605.*

Coming
in...

JANUARY

Waveform tests in the horizontal-sweep section—When troubleshooting electronic equipment, an oscilloscope is a valuable tool; sometimes it is indispensable. Learn some procedures for using an oscilloscope to troubleshoot the horizontal-sweep section of a television from this article, reprinted with permission from the book, *Troubleshooting with the Oscilloscope* by Robert G. Middleton.

Troubleshooting the Sony KV 1722—Discussing the theory behind the pulse-width-modulated (PWM) power supply used in Sony televisions since 1973, this article details some specific procedures for servicing this extremely complex circuitry.

Tapoffs, droptaps and directional taps in MATV—The quality of a TV picture can be traced from the quality of the signal to the quality of the transmission medium. This article will enhance your understanding about how MATV systems are constructed, and also will provide clues as to what may cause signal degradation.

Index of 1984 articles—Warren Parker has compiled an index of all the articles published in *ES&T* during 1984. Articles will be listed both alphabetically and by topic category. A Profax schematics index is also included.

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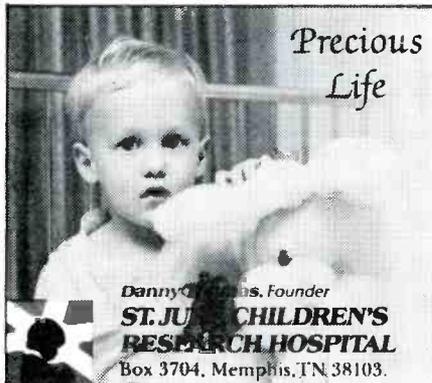
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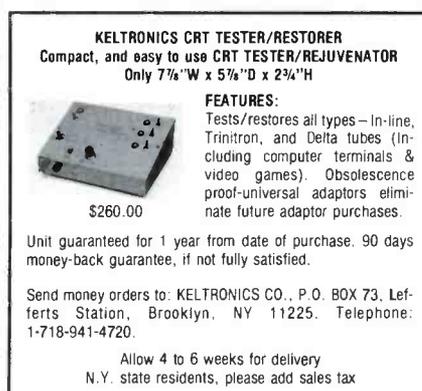


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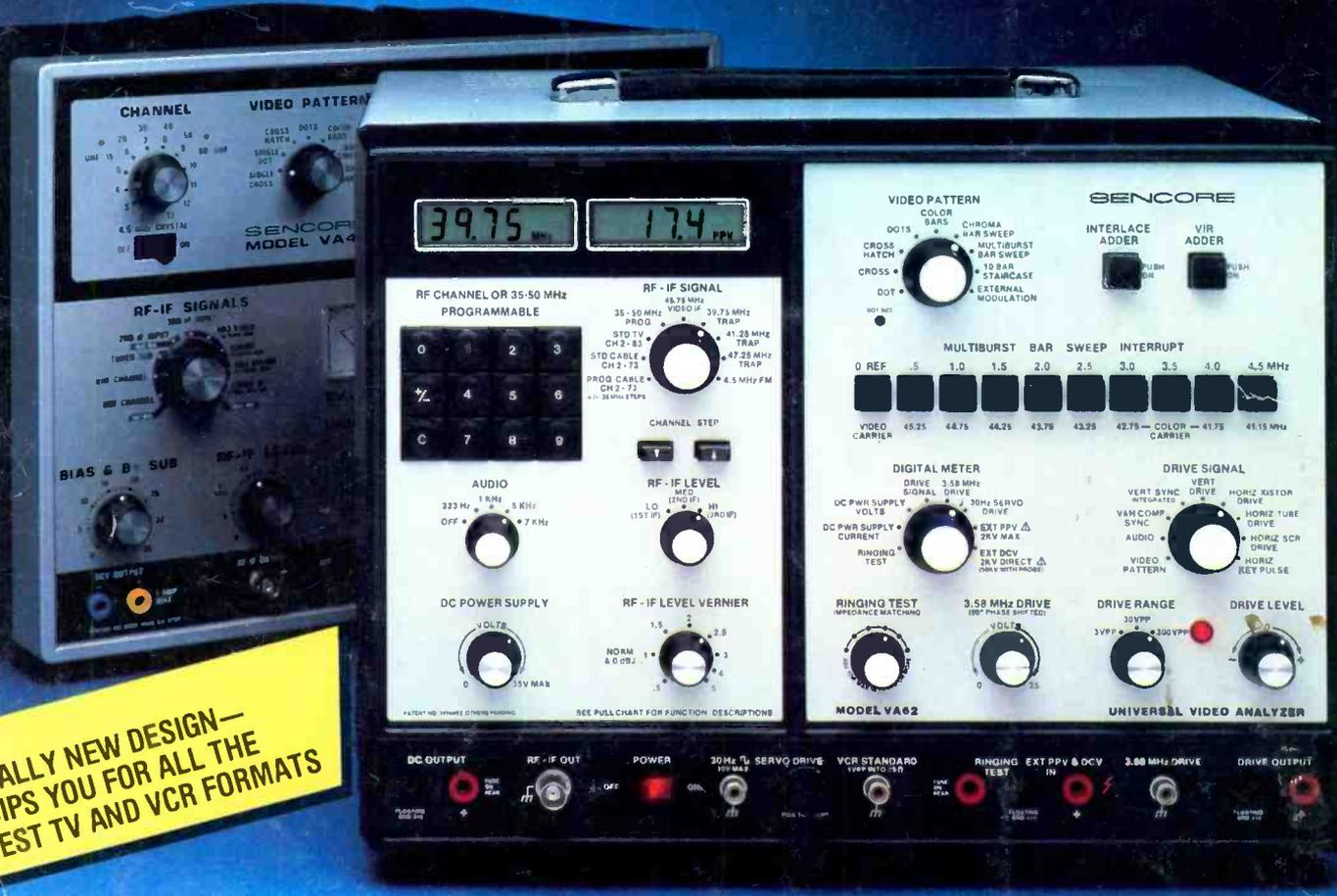
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