

ELECTRONIC

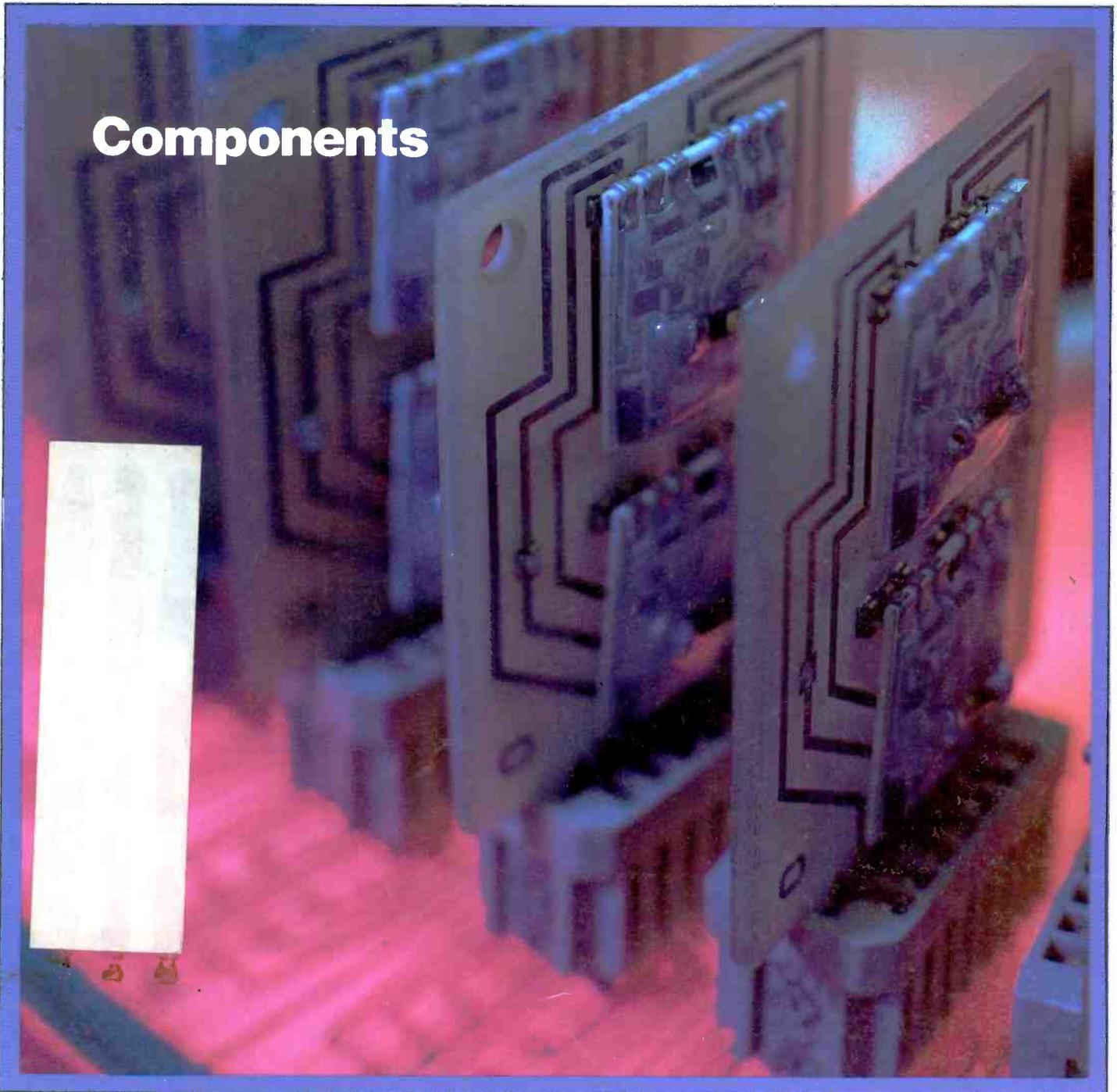
Servicing & Technology

AUGUST 1984/\$2.25

Test lab report: Sencore VA62 • Servicing NAP C3 chassis

TVRO waveguide and LNA • Cooking on cool surfaces

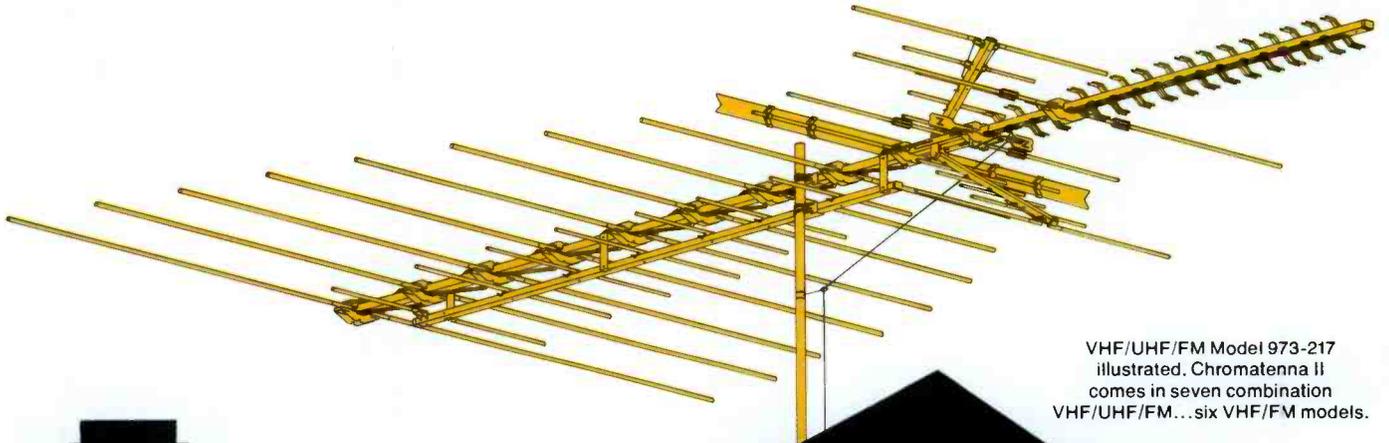
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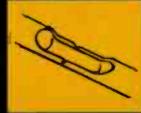
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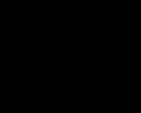
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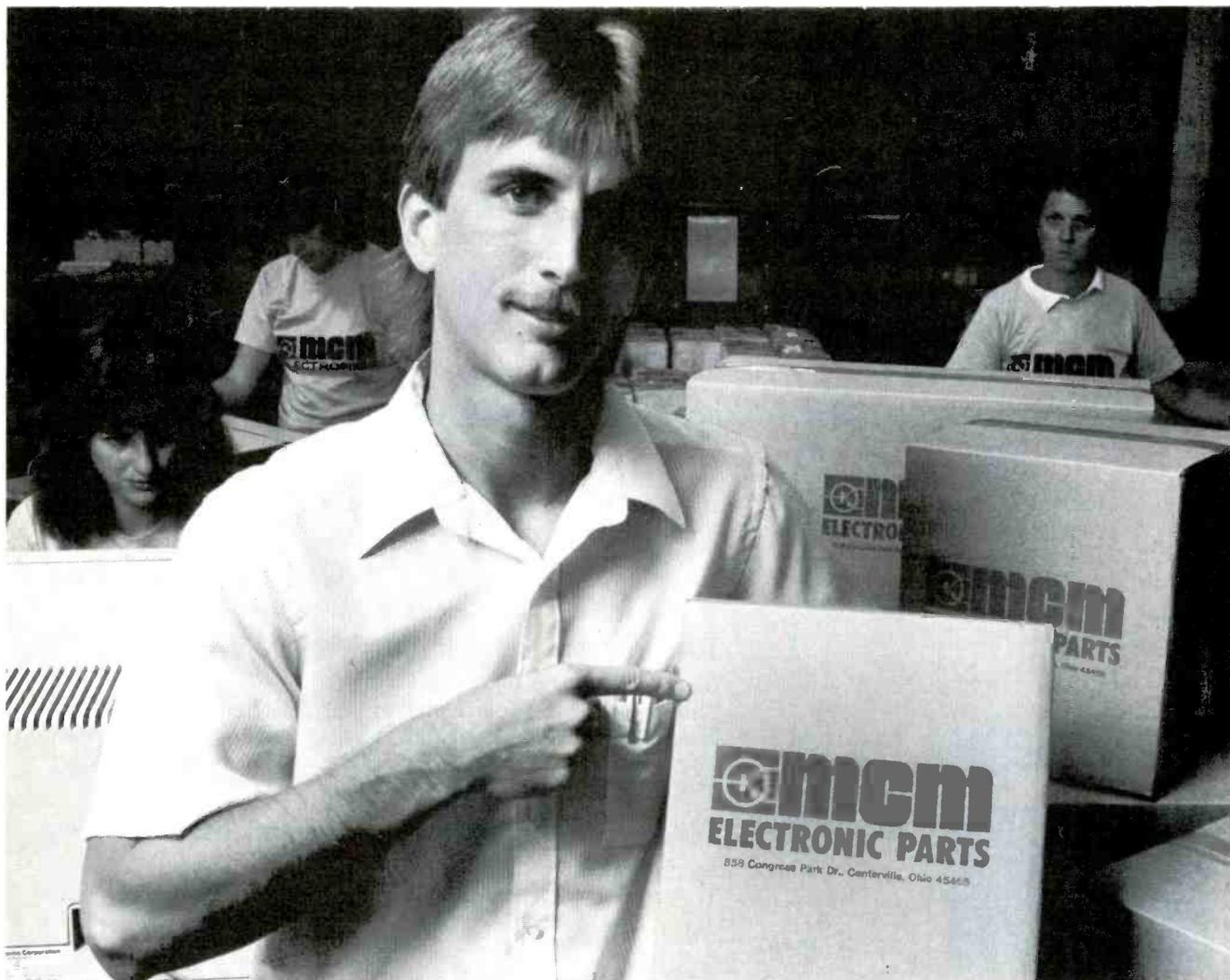


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The how-to magazine of electronics...

ELECTRONIC

Servicing & Technology

August 1984
Volume 4, No.8



Resistors and capacitors in hybrid microcircuits are silk-screened, thick-film components. Even though they don't resemble their traditional counterparts, their characteristics are the same.
(Photo courtesy DuPont Magazine)

12 Report from the test lab: Sencore VA62

By Carl Babcoke, CET

A large state-of-the-art instrument, the Sencore VA62 has functions of a phase-locked video generator, a TV signal-injection analyzer with IF and drive signals, a VCR analyzer and a dc and peak-to-peak voltmeter.

24 What do you know about components?

By Sam Wilson, CET

This article discusses components and their use in fundamental circuits.

28 Test your electronic knowledge

By Sam Wilson, CET

Questions on this month's quiz cover a variety of components and circuits.

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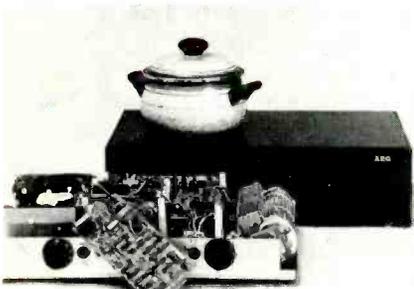
By Stan Vittetoe

The NAP C3 chassis features some unique circuitry, which, except for a few components, is located on a single large circuit board. This article describes the theory of operation of some of this circuitry and suggests troubleshooting methods for defective sets.

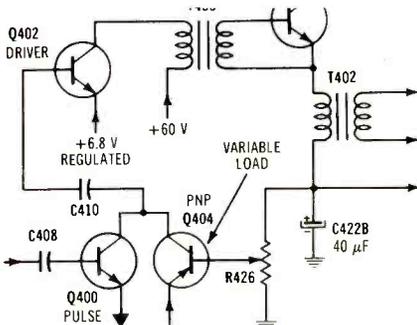
50 TVRO waveguide and LNA

By Martin Clifford

In a TVRO system, the waveguide conducts the microwave energy collected by the dish to the antenna probe. The signal is then amplified by the LNA. In this installment, the author describes some characteristics and problems peculiar to these portions of satellite receiving systems.



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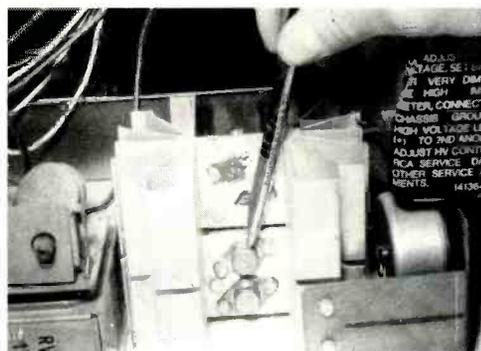
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**Next month...
Ten dogs in
TV repair —**

Difficult to diagnose TV problems can waste a lot of time. Ten actual case histories are explained in one of next month's articles to illustrate various troubleshooting techniques.

The More Things Change, The More They Stay The Same

Every time you turn around, the electronics industry comes up with a new application of technology, or an improvement on products using existing technology, or a brand new technology. The past few years have witnessed a mixed bag of developments including stereo sound for video, personal computers, pocket-size color televisions, home satellite TV reception and cordless telephones. The electronics industry, more than any other, has been convulsed by change, improvement and revolution.

Many factors have contributed to this frenetic rate of change: for one, the sheer determination of the industry to innovate, to improve, to change. Another is the strong competition that forces companies to innovate, because they know that other companies making the same products are working on a new, improved product.

Fueling these changes are the rapid developments in basic technology. The introduction of the transistor, followed shortly by integrated circuits led to all the battery-powered, lightweight, portable electronic products we take for granted today. LEDs gave manufacturers a small, low power consumption method of reading out information, then someone invented LCDs to do the job even better, leading ultimately to pocket-sized LCD-screen television.

The list of changes, innovations and improvements stretches out endlessly and new items are constantly being added. But it's important to keep a healthy perspective on all of this. Some things do not change. The fundamental principles that define how electronic circuits operate are still exactly the same as they always have been. An amp is still an amp. A volt is still a volt. An ohm is still an ohm. It doesn't matter if a resistor is wirewound, carbon film, carbon composition, thin film or thick film; if you place one volt of electrical potential across a 1Ω resistor, it will cause 1A of current.

Sometimes in the headlong rush of current events, people lose sight of the basics. For that reason we've been running a series in **ES&T** about electronic components; describing their function and exploring some of their applications. The circuits on this month's cover are thick-film circuits, with resistors, capacitors and circuit traces fabricated right on the ceramic substrate. They're tiny and allow the buyer to manufacture extremely small, lightweight products. But they still obey Ohm's law.



ELECTRONIC Servicing & Technology

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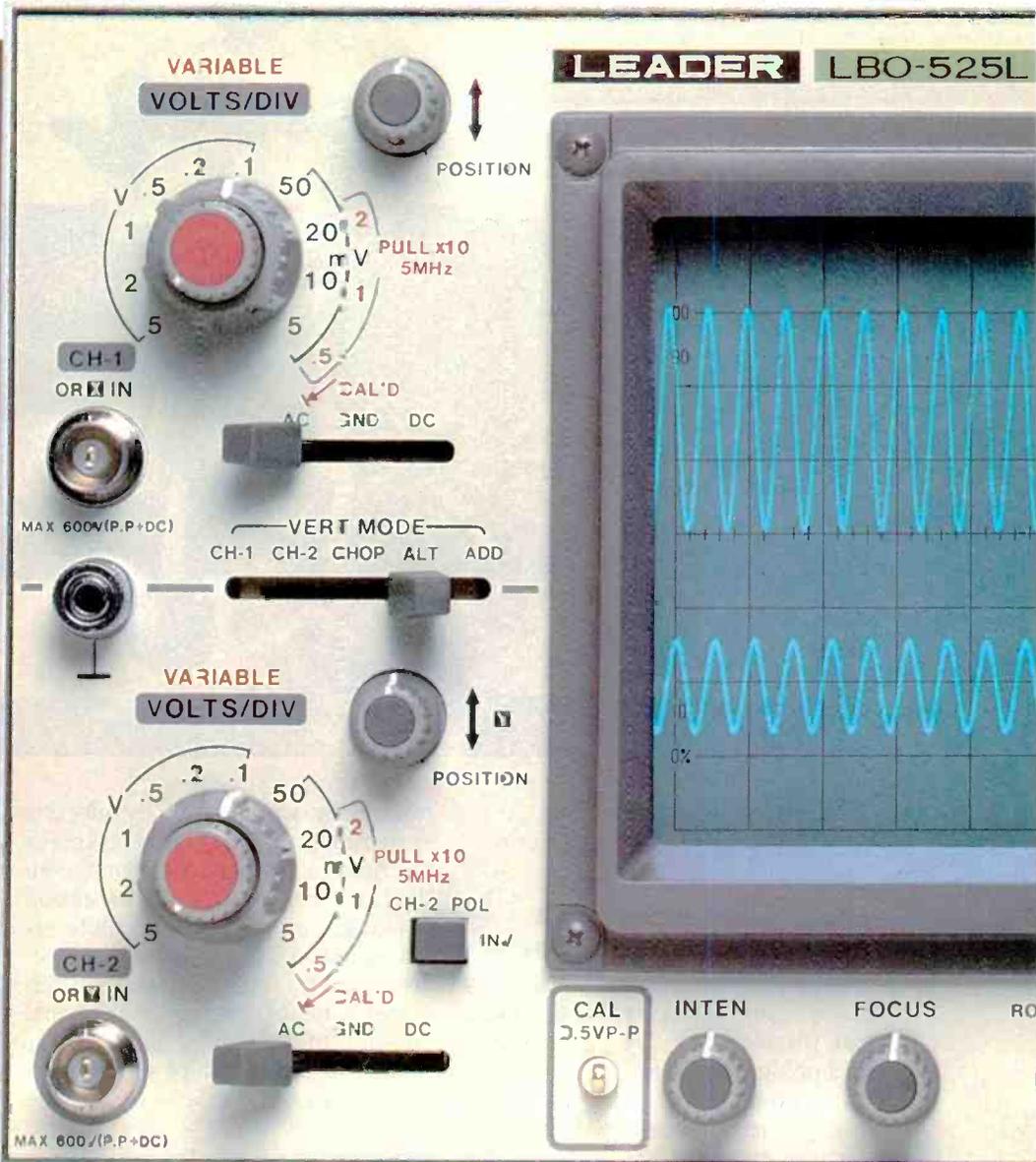
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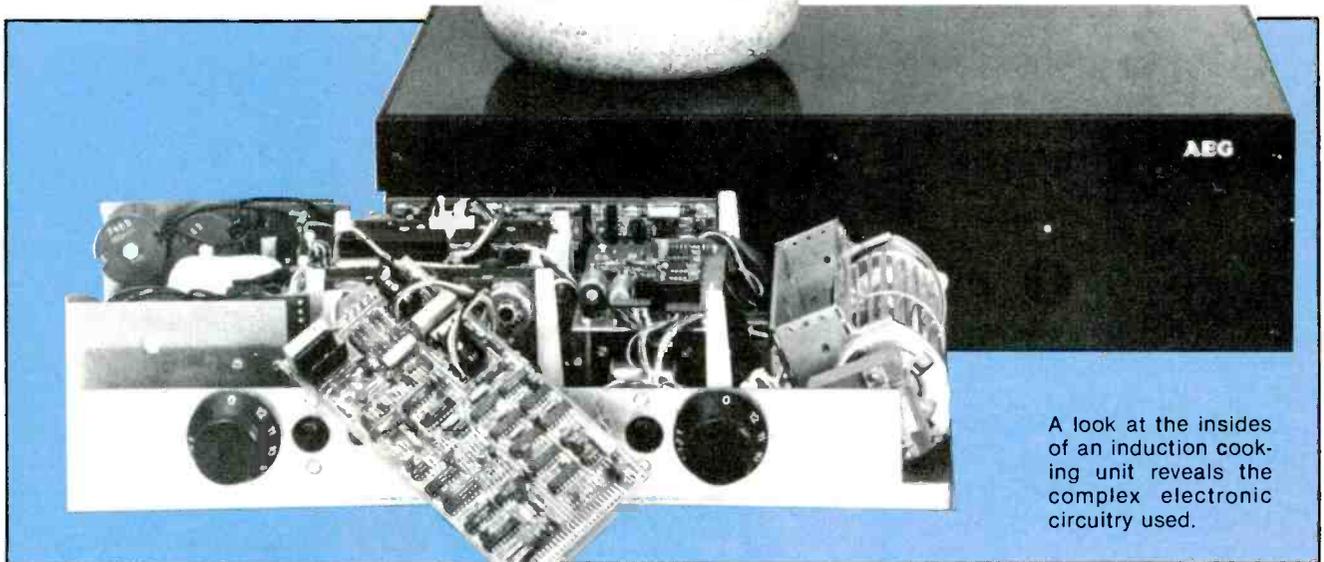
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Cooking on Cool Surfaces



A look at the insides of an induction cooking unit reveals the complex electronic circuitry used.

The induction method challenges traditional modes by combining energy efficiency with time saving approaches

It already has been several years since the culinary arts were revolutionized by electronic technology in the form of the microwave oven. Integrated circuits, microprocessors and magnetrons replaced the gas jets and electric elements of conventional ovens to speed up and change our way of roasting and baking, while leaving the kitchen cooler.

The world of electronics has done it again, and chefs and homemakers soon may be boiling, frying and sautéing on electronically powered surface cooking units that heat the pan and its contents through magnetic induction, while remaining cool. And for individuals who are involved with electronics, here's some new circuitry to understand.

What is the difference?

Traditional cooking surfaces are

hot. They are heated by electric resistance and basically transfer the heat to the pan by thermal conduction. In the case of induction cooking, however, the hotplate remains more or less cold. An electromagnetic alternating field induces a heat-generating electrical current in the metal base of the pan. The temperature of the hotplate rises only as a result of the

heat transferred to it from the pan. Hence the term *cold cooking*.

Figure 1 illustrates the basic design of an induction cooker. The pan is placed on an electrically and magnetically non-conductive plate underneath which there is a flat, spiral-shaped induction coil. This coil generates an electromagnetic field in the base of the pan. The induction coil produces a resonant

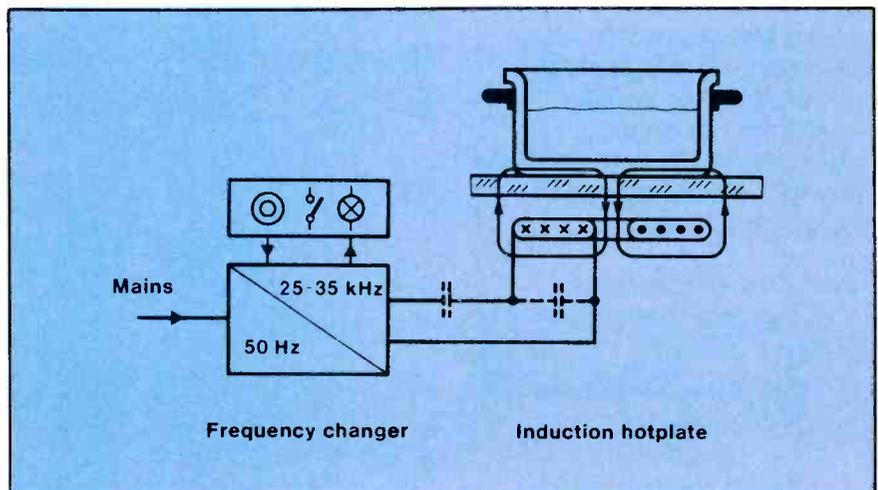


Figure 1. Induction cooking heats pan through induction.

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circuit with a capacitor connected in series or in parallel. A frequency changer converts the utility's power to a higher frequency and supplies this to the resonant circuit damped by the pan. The energy supplied to the hotplate can be regulated without losses via the controls.

Inductive heat generation

The metallurgical industry has used inductive heat generation for more than 50 years. The effectiveness of this process depends on the frequency of the electromagnetic field and on the electrical and magnetic conductivity of the metal body to be heated. The frequency must be matched to properties of the metal and to the dimensions of the body to be heated. In the case of pans with thin sheet steel bases, the optimum frequency is in excess of 10kHz. Because this frequency creates audible mechanical oscillations, it is increased to between 25kHz and 35kHz and thus beyond the audible range of humans and domestic animals.

A major difference between the primary and secondary sides is to be found in the conductor cross section through which the current flows. The current flows through numerous individual conductors in the induction coil which distribute it uniformly over the entire cross

section. The electromagnetic field and the induced electric current penetrate the dense pan bottom only to a limited extent, in accordance with Maxwell's rule. The current density decreases exponentially from the maximum on the outside of the pan bottom, inward. The mean penetration depth at 25kHz is 0.004 inch in the case of ordinary sheet steel and 0.02 inch in the case of copper. If the maximum current density in copper is considered to be one, the maximum value in sheet steel will be five times as high, because only one-fifth of the cross section is available at the lower penetration depth. Furthermore, because resistivity of sheet steel is approximately eight times greater than that of copper, the thermal output of the steel bottom will be roughly 40 times greater. This is why pans with only sheet steel or cast iron bottoms can be used for efficient induction cooking.

Pros and cons of induction cooking

The advantage of induction cooking is that the heat is generated in the thin pan bottom directly below the food. Induction hotplates do not have large heat accumulators and thermal resistances like iron or ceramic glass hotplates. This means con-

siderably shorter heating-up times with the same energy output. For the same reasons, the cooking process can be regulated much more rapidly by turning the energy supply up or down. Milk, for example, can be prevented from boiling over by switching the heat off at the right moment.

For heating-up purposes, the heat accumulated in traditional electric cooking surfaces is lost as heat discharged to the sides and downward by the hot surface. Induction hotplates use the electrical energy more efficiently, as shown by the better heating-up efficiency.

The virtually cold hotplate poses no danger of burning, nor will any spillage burn. Low-cost enamelled sheet steel pans are extremely suitable, because induction cooking does not require particularly flat pan bottoms. This new method of cooking is not widespread as yet because of the complex electronics required and the related high purchase price.

A different kind of induction cooker

AEG-Telefunken recognized the technical problems of induction cooking at an early stage and has largely overcome them by developing an independent concept.

The heart of each appliance is its frequency changer. As a rule, it consists of a rectifier supplied by an ac power supply and a downstream inverter which generates the higher-frequency alternating current. Figure 2 shows the basic circuitry of this transistor-inverter without the regulating control elements.

Unlike most other systems, in which the induction coil lies in a series resonant circuit, the induction coil L and the capacitor C form a parallel resonant circuit in this case. The design advantage is that sudden voltage jumps do not occur in the induction coil when power semiconductors switch. Such voltage jumps and the related coil voltage and coil current harmonics cause radio interference. As can be seen in Figure 2, the voltage V_L in the induction coil has a sinusoidal profile, and the harmonics in the sup-

Continued on page 56

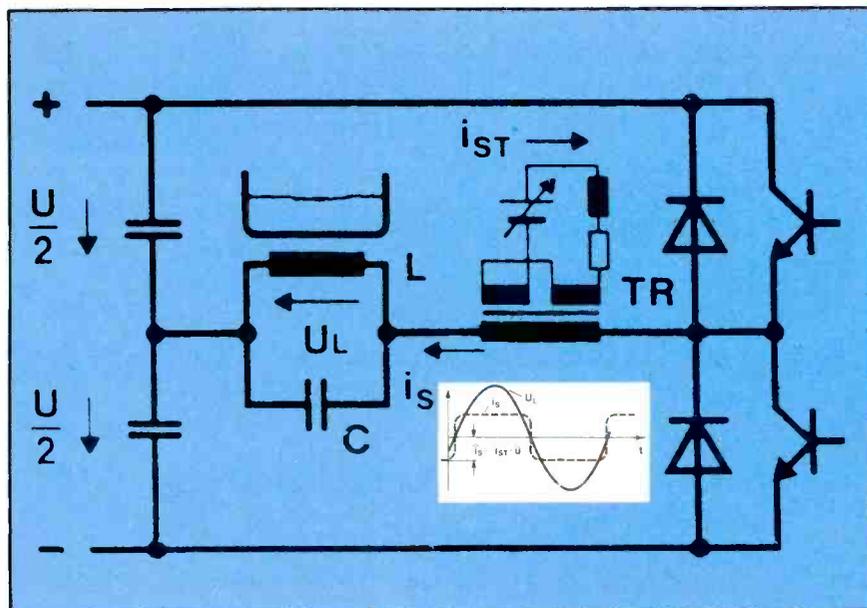


Figure 2. Induction cooking unit circuit consists of an inverter with parallel resonant circuit and transducer.*

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Our exclusive extruded rib and locking system has simplified assembly, eliminating the need for hundreds of bolts, nuts, washers and fasteners. Every time you attach a bolt, screw or fastener to a dish you add another stress point, distorting the shape. With Winegard's extruded rib and locking system, the stress is uniform across the dish, maintaining its true parabolic shape and integrity.

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Not only is the Winegard perforated aluminum dish lightweight and easy to handle, but it is extremely rugged, durable and well constructed. You can actually see through the perforated petals which are constructed of .040-gauge anodized aluminum. The extruded aluminum main ribs, which provide the basic structural support, are 1/8" thick. The locking ribs are .070" thick and lock the perforated aluminum petals tightly in place. A double-walled outer rim provides an area to insert rim splices at all joints for perfect alignment and additional strength.

Wind-loading capabilities are outstanding with a wind survival rate of 125 mph. And, because the perforation eliminates 36% of the surface area, the dish diffuses solar heat, decreasing amplifier noise.



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Reports from the test lab:

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

Sencore model VA62 is difficult to describe in a few words because it performs dozens of diagnostic functions in many categories. Sencore calls it a *Universal Video Analyzer*. That name falls short of being an adequate description. The older Sencore VA48 performs many similar functions, but is far outstripped by the new VA62, especially for VCR testing.

To illustrate the large number of diagnostic functions made possible by the Sencore VA62, consider the size of the *Operation and Application Manual*, which devotes 31 large pages to the description and operation of this instrument, 41 pages for tests of TV receivers and monitors, and 11 pages about testing VCRs. Obviously, it will not be possible to supply all that information in this article.

Sencore has designed the VA62 to be as immune to obsolescence as possible. The major functions are compatible with the FCC-specified signals for television and composite video, and thus can be applied to all basic electronic blocks regardless of what type of active components are used. In other words, the signals can be used with tubes, transistors, all kinds of integrated circuits and any successors to ICs, if any are developed.

Simply stated, model VA62 is a signal generator for signal-injection or signal-substitution

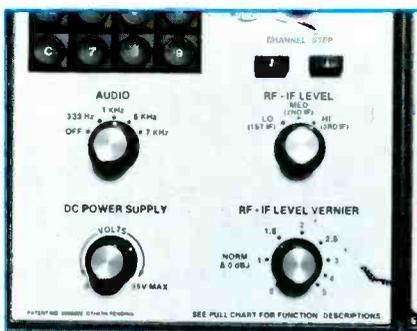


Figure 1 On the left side of the VA62 panel are the two LCD readouts (photograph A), the 12 push-buttons for the programmable channel and IF frequencies, and to the right is the selector knob for RF and IF functions. Below the knob are the up-and-down channel-stepping push-buttons. In the lower part of that panel (photograph B) are the audio-tone selector, the RF/IF level switch, the level vernier for the RF/IF signals, and the voltage-adjusting knob of the internal power supply.

tests in televisions or VCRs. But that's like calling a 747 just an airplane! Most diagnostic tests are made by signals from the VA62 that are injected into the television or video circuits, while the results of these tests are viewed on a scope or the screen of a TV/monitor. That brief statement cannot convey the broad range of possible tests, the convenience of operation, the excellent accuracy of the signals, or the hours of technician time saved because the tests can proceed without the need for additional instruments with

their accompanying clutter of test leads.

As I read the *description and operation* sections of the manual, I noted the number of separate instruments that would be needed to replace a VA62. Here is the list:

- An RF/IF amplitude-modulated signal generator.
- A simple audio generator.
- An alignment generator for televisions.
- A generator for converging color pictures.
- A video generator.
- A test power supply.
- A *Ringer* for testing TV flybacks and yokes.
- An autoranging dc and peak-to-peak-ac voltage digital meter.
- A generator of controllable-amplitude vertical and horizontal deflection waveforms.

Even this list of nine instruments does not account for all VA62 features. And, of course, the VA62 does not incorporate *all* features and functions of those nine separate instruments. But it does have those necessary to fulfill its purpose.

Sencore describes the VA62 as having five general sections: (1) the video-pattern generator; (2) the microprocessor-controlled RF/IF generator; (3) the drive-signal generator; (4) the digital meter; and (5) the special analyzing test section.

RF/IF generator

All RF and IF signals for injection in color receivers before the video detector exit the VA62 via one attenuator, one output jack and one shielded cable. This minimizes any clutter that might come from several cables.

Digital electronics and phase-locked loop (PLL) circuitry provide quartz-crystal accuracy and freedom from drift. At first, I had nightmares about having to look

Sencore VA62

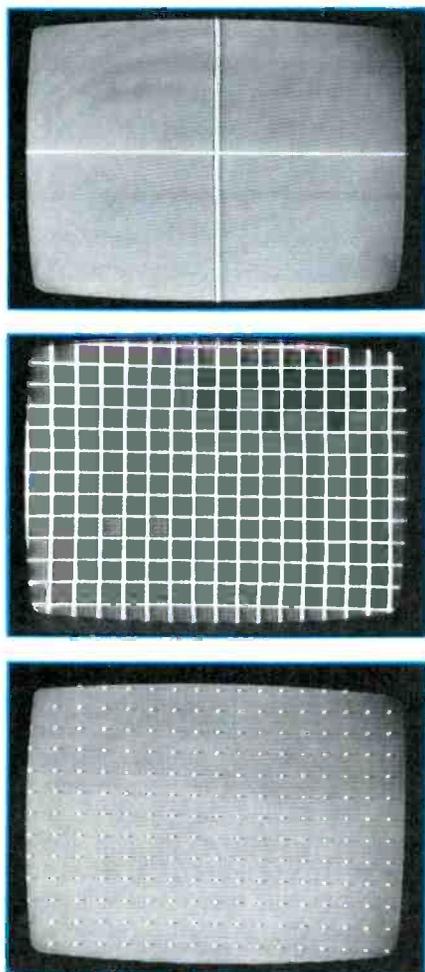


Figure 2 These four patterns are for adjustments of color-TV receiver convergence and purity: one centered dot (not pictured); (A) one centered cross; (B) a crosshatch that makes squares; (C) a full-screen dot pattern.

up the precise frequencies of TV and cable channels before setting those frequencies manually. I should not have been concerned, for all TV VHF and UHF channels and all mid-band, super-band and hyper-band cable channels have been digitally preset and are selected by channel number (not frequency). For example, if VHF channel 3 is needed for a color-bar pattern, you can push zero and three and immediately have that

channel. Also, two *channel-step* buttons allow selection of higher or lower channels one at a time. If the generator readout says "5" but you want channel three, just press the channel-down button twice to get to channel three.

The channel number is displayed on the LCD readout just above the programming buttons (see Figure 1). A total of 142 channels can be selected without using manual programming. Incidentally, *all preset channels can be amplitude modulated by any of the video patterns.*

The standard over-the-air assigned channel frequencies can be increased or decreased to match any frequency offsets used by cable companies.

A microprocessor controls the levels at the RF/IF attenuator so all channels have the same signal level when the attenuator is adjusted to the same point.

IF frequencies in 10kHz steps between 35MHz and 50MHz can be obtained by manual programming, with the frequency displayed on the LCD readout. The selected carrier can be modulated by any of the four audio frequencies (not by the video patterns).

When the 45.75MHz video-IF mode is selected, the crystal-controlled carrier is 45.75MHz that can be amplitude modulated by any of the video patterns. Also, an audio-modulated 4.5MHz FM carrier is added to the 45.75MHz carrier. Therefore, the IF stages can be injected with a signal that has all the important characteristics of a broadcast monochrome TV program, with the advantage that the waveforms do not move.

A choice of three crystal-controlled trap frequencies (39.75MHz, 41.25MHz or 47.25MHz) is provided. The selected trap carrier can be modulated by an audio tone or un-

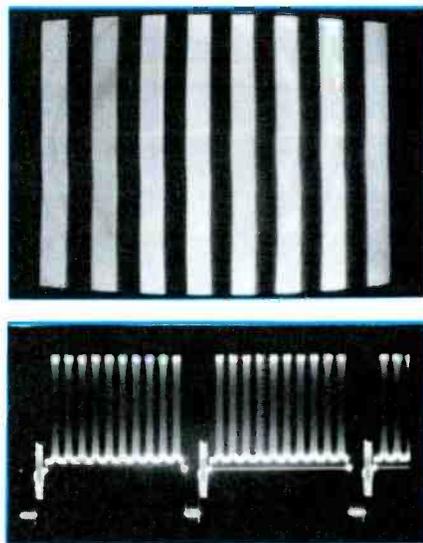


Figure 3 Keyed-rainbow color bars are generated by the VA62. (A) When photographed in black-and-white from a color television, the bars appear white or gray with black between them. (B) The VA62 color-bar waveform was scoped at the VCR jack. Notice the sharpness and the square corners of bars and bursts. The line connecting the bar bursts (just above the blanking level) adds the black background between bars.

modulated, as desired. Also, the trap carrier is mixed with a video-modulated 45.75MHz carrier, to simulate normal IF-signal conditions.

For testing sound IFs, there is a 4.5MHz carrier that can be unmodulated or frequency modulated by one of the four audio tones, as desired.

These previous functions and signals are selected and controlled by buttons and knobs on the left 40% of the front panel (Figure 1).

Video patterns

Nine video patterns are generated by the VA62. When selected, one pattern at a time will appear at the *VCR standard* jack, and the *drive output* (when the drive selector is rotated to the *video-pattern* position), or it can be

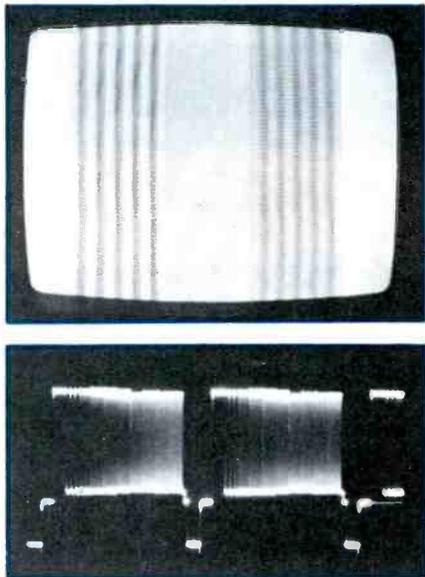


Figure 4 The chroma-bar sweep of the VA48 has been improved by making the center bar 75 percent saturated cyan (NTSC requirements), while the two edges are 100 percent white video. (A) From the left are these; a white video bar; a 3MHz chroma bar; the 3.58MHz color subcarrier (cyan); a 4MHz chroma bar; and a white video bar. (B) The chroma bar sweep waveform shows the color burst (necessary to activate the receiver chroma circuit), the three bursts of chroma and the two white video bars (at top on each side of the chroma bars).

used internally to modulate the RF and IF generators. These are the video patterns: a single *dot*, perfectly centered; a single *cross*, also perfectly centered; a *crosshatch* pattern that forms squares; a *dot* pattern (Figure 2 shows the cross, the crosshatch and the dot pattern); 10 standard keyed-rainbow *color bars*. (Figure 3); a 3-bar *chroma bar sweep* (Figure 4) for chroma adjustments; a *multiburst-bar sweep* with 10 bars for testing frequency response (Figure 5); a 10-bar *staircase*, for testing linearity (Figure 6); and external modulation for signals from NT64 (Figure 7) and VC63 accessories.

Below the knob that selects the video pattern is a row of ten pushbutton switches (Figure 8). These switches turn on or off the various frequency bursts of the multiburst-bar sweep (and the three chroma bar sweep bars) as desired. Above each switch is the video frequency, and below each

switch is the equivalent IF frequency for each video frequency (when used to modulate the IF carrier). If a receiver defect has badly distorted or removed part of the multiburst pattern, it is easy to identify each frequency by turning it on and off alternately.

As shown by the video-waveform photographs, the video patterns have excellent sharpness and rocklike stability.

Interlace adder

NTSC television composite video is interlaced, and some television receiver digital-countdown vertical circuits select either interlaced (for broadcast signals) or progressive scan (for video games and most color-bar patterns). Also, some VIR-controlled color receivers cannot properly identify the VIR signal unless the video is interlaced. Good generators should have interlace as an option.

The VA62 provides interlaced or non-interlaced video at the push of the *interlace adder* switch (under the word *Scorec* on the front panel in Figure 8).

VIR adder

Another pushbutton near the interlace switch adds a VIR waveform to line 19 of each video field (Figure 9). In VIR-controlled color receivers, the color intensity and tint are monitored and corrected constantly by the amount of phase shift and other degradation that has occurred to the VIR waveform in the television system anywhere between the original video camera and the receiver.

Thus, the VA62 VIR waveform can prove whether or not the receiver's VIR system is functioning correctly. Prepare the VA62 with color bars but VIR off, misadjust the receiver's manual color and tint controls for poor colors, then switch on the VIR adder and notice if the correct tints and colors are produced by the VIR operation.

Drive signals

Waveforms for driving vertical and horizontal output devices are essential in any complete signal-substitution system. The VA62 has

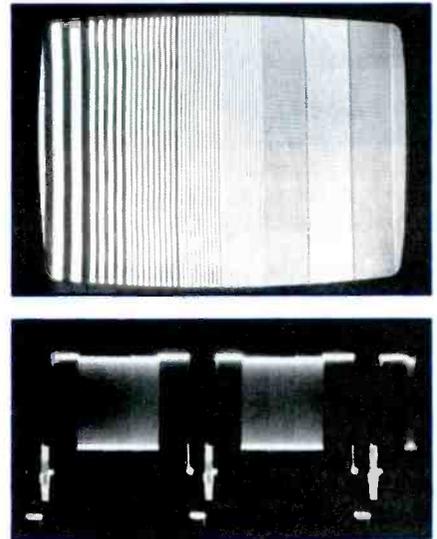


Figure 5 Nine bursts 0.5MHz apart up to 4.5MHz comprise the multiburst-bar sweep waveform. Photograph A shows how they look on a typical color-receiver screen. Good response was obtained up to the 3MHz burst, but no appreciable amplitude could be seen on the 3.5MHz, 4MHz and 4.5MHz bars. This is normal performance. The individual cycles in these bursts are visible as an alternate black and white vertical lines. The scope waveform in photograph B shows amplitude variations of less than 5 percent in the various bursts (at the VCR plug).

one universal vertical-drive waveform that is suitable for driving either transistor or tube vertical output stages. The amplitude is fully adjustable in positive and negative polarities by the *drive level* control (Figure 10A). It is not likely that this waveform will produce perfect linearity (after all, good linearity with many circuits is possible only by feedback of a yoke-current waveform to a driver stage, which cannot be done here). But that is not important. If the receiver previously had no height, and injecting the vertical-drive signal produces nearly full height regardless of linearity, the following point has been proved: the output stage and yoke are not defective, and the problem is in a circuit before the output stage.

These other drive waveforms (Figure 10) are provided: (B) base of a horizontal output transistor; (C) grid of horizontal output tube; (D) pulses for keying or SCR triggering; vertical and horizontal composite sync; and integrated vertical sync.

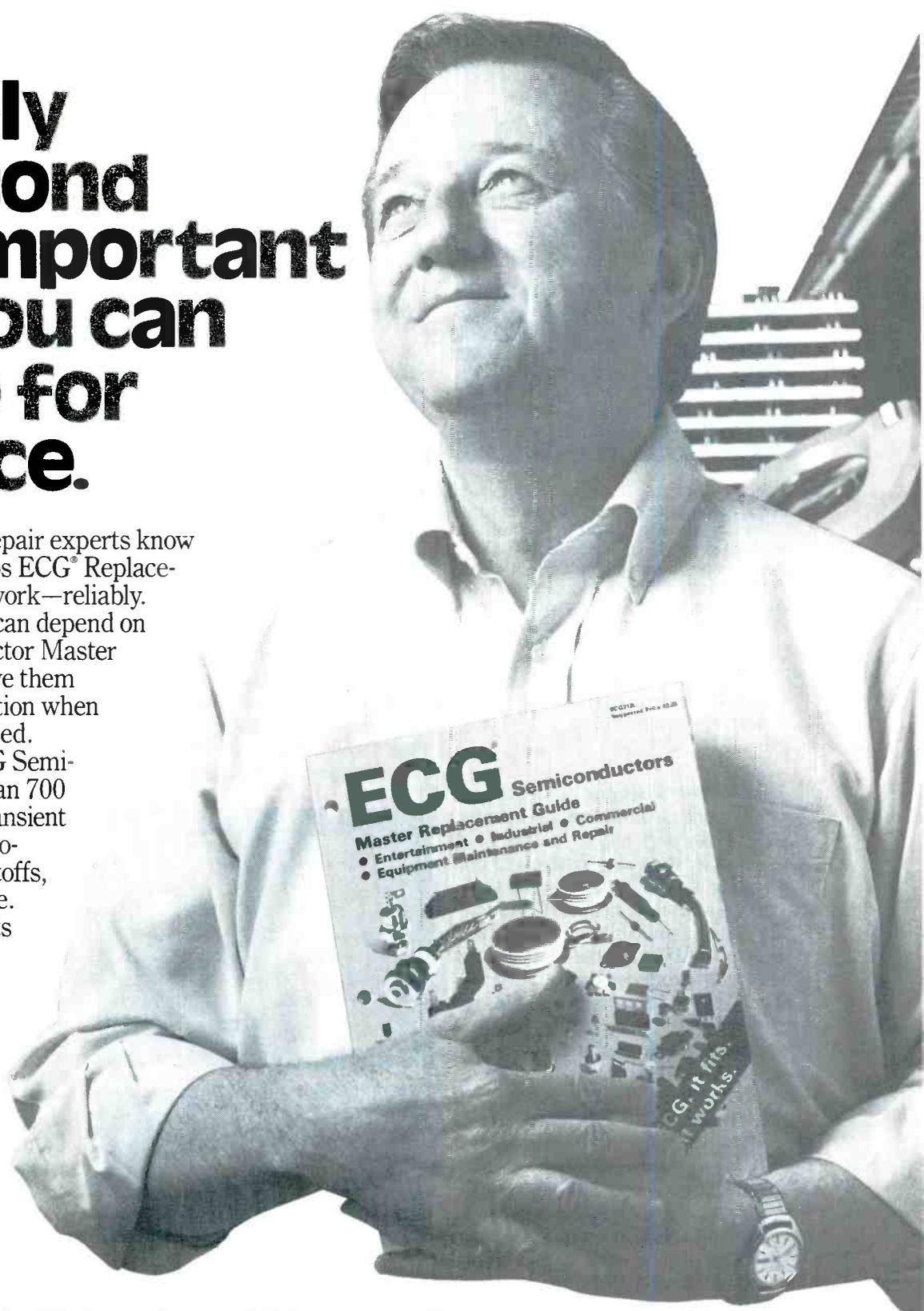
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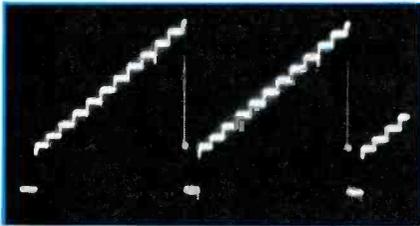
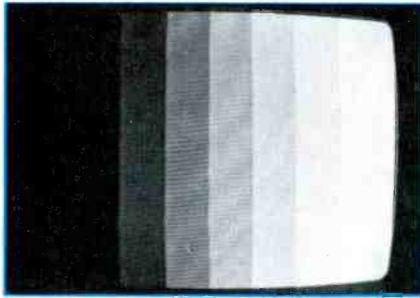


Figure 6 Amplitude linearity of audio and video amplifiers can be tested by the 10-bar staircase pattern. When it modulates an RF or IF carrier, the staircase pattern helps in the correct alignment of synchronous video detectors. (A) Excessive receiver contrast has obscured some of the darker staircase steps in this picture from a TV screen. (B) Each scope staircase begins at blanking (black) level and ascends until it is white. Notice there is no color burst on the back porch.

Two other positions on the drive-signal knob produce an audio tone and whatever video pattern is selected by the video-pattern knob.

Notice that *all these waveforms* (except audio) *are phase locked* to the videopattern waveforms (Figure 11). Therefore, when height is produced by a vertical-drive signal, the picture will be locked to whatever video waveform is modulating the RF signal that is injected at the antenna terminals. This feature has great value, for it eliminates much of the guessing otherwise forced on technicians by non-synchronized signals that obscure the injection-test results.

The *drive-range* switch (Figure 12) has three positions providing maximums of 3VPP, 30VPP and 300VPP of drive output signal when the *drive-level* control is fully CW or completely CCW. Of course, the control can reduce the output to virtually zero. When the *digital meter* selector knob is turned to the drive-signal position, the autoranged ac peak-to-peak function of the internal meter is con-

nected to the drive-output jacks. Therefore, any precise drive voltage can be preset before the signal is connected to the receiver. This not only saves time, but it prevents damage from excessive signal being applied to sensitive transistors and ICs.

Digital meter

An internal two-function digital meter measures dc voltages and peak-to-peak voltages, both internal voltages and external ones through the external-input jacks. The LCD readout has sharp high-contrast digits, and the autoranging makes a range switch unnecessary. All 3½ digits are available for dcV measurements, while fewer digits are used for the acPP readings (except those over 1000V). Lowest reading is 0.1V and the highest is 1999V.

The 8-position *digital-meter* knob (Figure 12) selects whether the internal meter measures dc or peak-to-peak voltage and whether the voltage is internal or external to the *drive-output* jacks. Specifically, the knob selects the following measurements: number

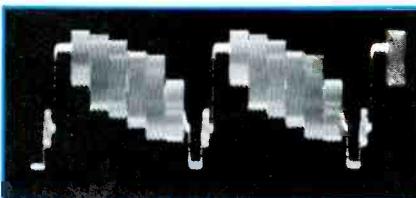
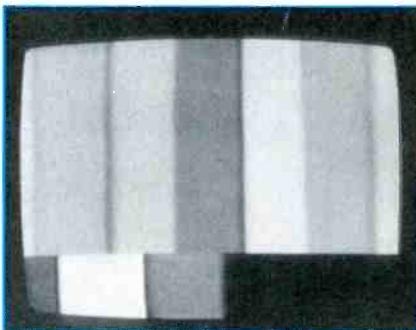


Figure 7 When an NT64 NTSC pattern generator is connected to a VA62 and the video-pattern switch turned to external modulation, the VA62 RF/IF cable can have a TV channel signal modulated by a full-field or split-field NTSC (EIA) color display. Of course, the same NTSC color-display waveform appears at the VCR jack. (A) The NT64 split-field color display was photographed from the screen of a color receiver. (B) This scope waveform is the full-field NTSC color bars taken from the VCR-signal jack.

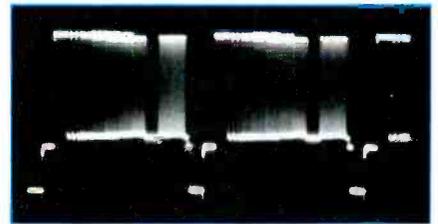
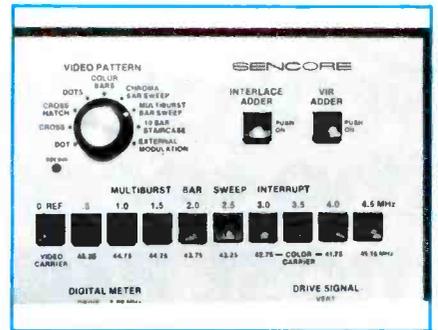


Figure 8 Photograph A shows the upper right corner of the VA62 panel with the *video-pattern* selector knob, the *interlace-adder* button, the *VIR-adder* button and (below) the 10 *interrupt* switches that activate or remove the individual frequency bursts. The scope waveform in photograph B shows the *multiburst-bar* sweep with the 3.5MHz burst removed. Three of the switches and bursts are used also for the chroma-bar sweep pattern.

of rings during the ringing test; current of the internal test power supply; voltage of the internal test power supply; drive signal PPV; 3.58MHz drive PPV; 30Hz servo PPV; external PP volts; and external dc volts.

Although the interconnection of these various switches and controls is very efficient, and the controls are well marked, it is possible for operator mistakes to occur. So, if you obtain a zero reading for one of the previous functions, *check the position of this digital-meter switch*.

Optional extra-cost probes are available for 10kV and 50kV.

Special drive signals

A phono jack below the *drive-range* switch has the 3.58MHz drive signal. This 3.58MHz carrier is phase locked to the other chroma signals but is shifted 90° so it can be used for quadrature demodulation. A separate drive control permits adjustment of carrier level between zero and 25VPP (Figure 13).

Of special value for servicing VCRs is the 30Hz *servo-drive*



Ad

Photo: Peter B. Kaplan

If you still believe in me, save me.

For nearly a hundred years, the Statue of Liberty has been America's most powerful symbol of freedom and hope. Today the corrosive action of almost a century of weather and salt air has eaten away at the iron framework; etched holes in the copper exterior.

On Ellis Island, where the ancestors of nearly half of all Americans first stepped onto American soil, the Immigration Center is now a hollow ruin.

Inspiring plans have been developed to restore the Statue and to create on Ellis Island a permanent museum celebrating the ethnic diversity of this country of immigrants. But unless restoration is begun now, these two landmarks in our nation's heritage could be closed at the very time America is celebrating their hundredth anniversaries. The 230 million dollars needed to carry out the work is needed now.

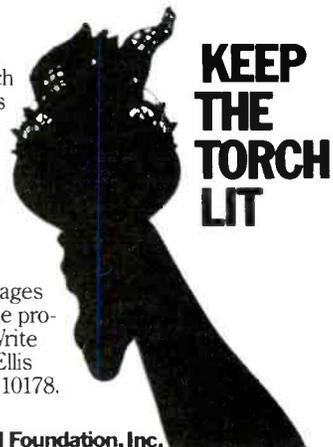
All of the money must come from private donations; the federal government is not raising the funds. This is consistent with the Statue's origins. The French people paid for its creation themselves. And America's businesses spearheaded the public contributions that were needed for its construction and for the pedestal.

The torch of liberty is everyone's to cherish. Could we hold up our heads as Americans if we allowed the time to come when she can no longer hold up hers?

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You are invited to learn more about the advantages of corporate sponsorship during the nationwide promotions surrounding the restoration project. Write on your letterhead to: The Statue of Liberty-Ellis Island Foundation, Inc., 101 Park Ave, N.Y., N.Y. 10178.



Save these monuments. Send your personal tax deductible donation to: P.O. Box 1986, New York, N.Y. 10018 **The Statue of Liberty-Ellis Island Foundation, Inc.**

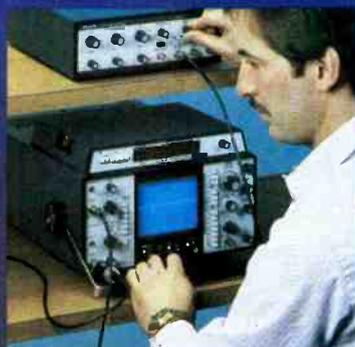
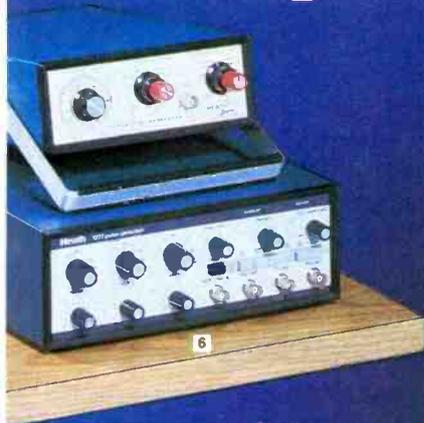
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- ❑ **IO-4205 Dual-Trace 5 MHz Scope**. Low cost, 10mV/cm sensitivity.
- ❑ **IT-2232 Component Tracer**. Checks parts and circuits without energizing them.
- ❑ **IP-2718 Power Supply**. One fixed 5 VDC and two adjustable 20 VDC supplies.
- ❑ **IG-1271 Function Generator**. Sine, square, triangle waveforms. 0.1 Hz to 1 MHz.
- ❑ **IG-1277 Pulse Generator**. Pulses from 100 ns to 1 sec width.
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- ❑ **IM-2264 DMM**. True RMS readings of AC voltages. Analog metering, too.
- ❑ **IM-2420 Frequency Counter**. 5 Hz to 512 MHz. 25 mV RMS guaranteed, 1 to 15 mV typical. Opened oscillator. Has period and frequency modes, too.
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- ❑ **IT-2250 Capacitance Meter**. 199.9 pF to 199.9 mF. 0.2% basic accuracy. Auto ranging.
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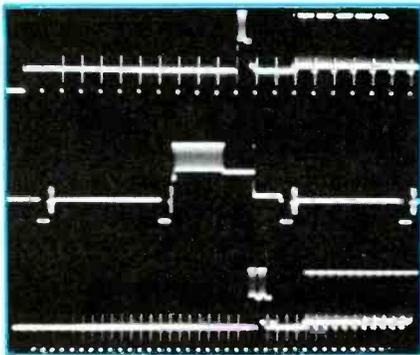


Figure 9 A VIR waveform can be added to line 19 of each video field (normal scope waveform is shown by the top trace, while the center trace has been expanded by the scope). Or *interlace* with or without VIR can be switched on. The bottom trace shows VIR on both interlaced video fields.

square wave (Figure 14). A small uncalibrated black knob (beside the phono-type jack) adjusts the servo-drive amplitude between zero and 30VPP. Pulling out the knob inverts the square wave's phase, when that is needed.

Ringing test

An excellent ringing test for television yokes and flybacks is included in the VA62. The YF33 Ringer was the first Sencore instrument to feature this type of ringing test, but it had an analog meter to display the number of rings plus drive peak-to-peak volts and high voltage dcV. Later the VA48 (introduced about 1979) also included a similar ringing test with an analog readout.

A ringing test with meter or digital readout is the best method of identifying shorted turns in any deflection flyback or yoke that has a powdered-iron core. Under ideal conditions, it can be infallible. In fact, the only limitations are those of the flybacks and yokes themselves. For example, there is little magnetic coupling between the two horizontal yoke coils. Therefore, shorted turns in one horizontal yoke coil will produce a lower (not zero) reading, while the good coil probably will test normal. For other helpful hints, refer to the article "Testing Sencore VA48 performance" on page 54 and 55 of the September 1979 issue of *Electronic Servicing* and to the VA62

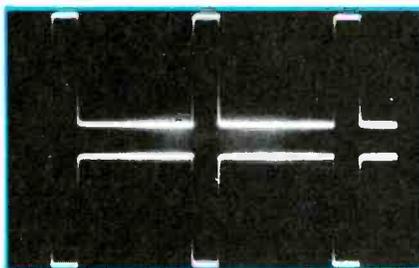
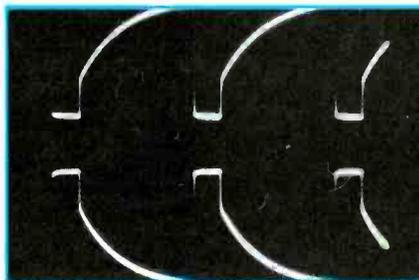
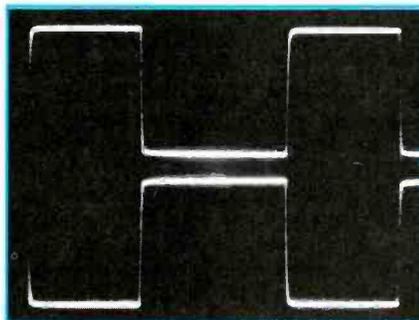
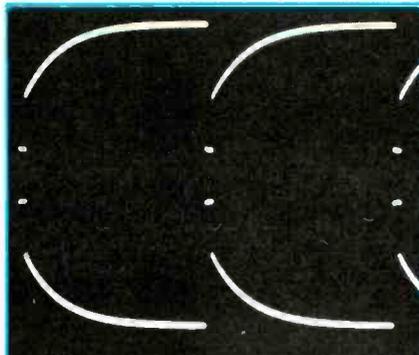


Figure 10 These are some deflection drive-signal waveforms: (A) the universal vertical-drive waveform is shown in positive (top trace) and negative (lower trace) versions (the fast-rise-time leading and falling edges of the pulses are invisible); (B) the base-drive waveform for horizontal-output transistors is wide pulses of about 40 percent duty cycle, shown in positive (top) and negative (bottom) polarities; (C) rounded sawteeth are the grid-drive waveform for horizontal-output tubes, in positive and negative versions; and (D) horizontal pulses for AGC keying or SCR triggering, also shown in positive (top trace) and negative (bottom trace) polarities. Other available drive signals are audio (with choice of frequency) composite sync, integrated vertical sync, and any of the video patterns.

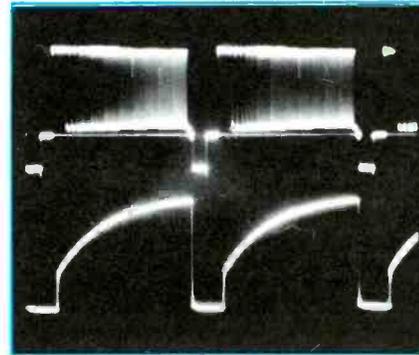


Figure 11 All VA62 drive signals (except audio) are phase locked to all the video patterns. In turn, all of these digital video patterns are phase locked to each other. The photograph is dual-trace, showing perfect phase between the horizontal sync pulses in the multiburst-bar sweep pattern and the falling edge of the sawtooth intended to cut off the horizontal-output tube. Therefore, when a video pattern is used with vertical or horizontal drive, the TV picture will be locked correctly.



Figure 12 This photograph shows the controls in the lower right corner of the VA62 front panel. These include: the digital-meter selector; the drive-signal selector; the ringing-test impedance selector; the 3.58MHz drive amplitude control; the 3-position drive-range switch knob; and the zero-center drive-level rotary control.



Figure 13 All VA62 cables exit along the lower part of the front panel which is black with white lettering. Jacks in this lower-right-corner area include those for the ringing test, the external PPV and dcV tests, the 3.58MHz drive, and the drive-output. Notice that the ringing, meter and drive-output jacks are isolated from ground.

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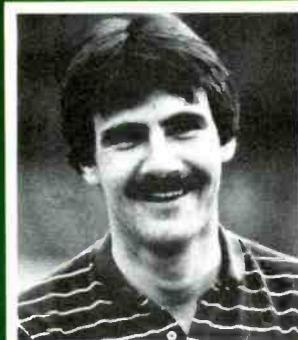
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Owner — Harbour Audio/Video
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Figure 14 Signals exiting from jacks near the lower center of the panel include the 30Hz servo signal (with its amplitude control at the right), the VCR standard video patterns, and the ringing flyback-and-yoke test.

Universal Video Analyzer manual pages 43, 44, 45, 46 and 47.

To test such an inductance, turn the *digital meter* knob to the *ringing test* position. Connect test leads from the *ringing test* jacks on the panel to the yoke or flyback winding under test. Then rotate the *ringing test impedance-matching* six-position knob to find the position giving the highest ringing reading on the LCD digital readout that is used for voltage measurements. If the reading is higher than 10, the component is considered to be without shorted turns. Few tests can be any more simple.

Power supply

An adjustable dc power supply can be very useful as a test substitute for a dead power supply. Or it can supply a missing dc voltage to make a direct-coupled circuit operate. The VA62 has such a desirable 0-35V variable supply with a maximum current rating of 1A. In fact, an electronic circuit limits the short current to that value. The output jacks (in Figure 15 below the adjustment control) are isolated from ground, so either polarity can be obtained by reversing the test leads.

Voltage or current of the internal test supply can be measured by the internal meter, and displayed on the LCD readout, when the digital-meter knob is adjusted for the desired mode.

Comments

The Sencore VA62 manual shows how to adjust SAW filters, synchronous detectors and comb filters. Also, it explains how to test HV triplers and integrated-flyback diodes. Obviously, this type of information is of great value.

Three separate grounds are used with VA62 instruments. One is for RF/IF signal injection, the VCR-standard signal, the 30Hz servo drive and the 3.58MHz drive. Another ground is floating (not connected to case or chassis) for the ringing and external-voltage tests. The third ground is for the drive-output signal. It floats so the signal can be injected regardless of the circuit's dc voltages. Incidentally, the hot drive-output jack has an internal blocking capacitor to remove all dc voltages from the drive signals. Therefore, these signals can be injected without upsetting the bias and other circuit dc voltages.

The Sencore VA62 deserves nothing but praise for its new features and also for its improved old features. Many of these improvements are giant steps above the older VA48 (which still is a good and useful instrument). Especially noteworthy are the interlace and VIR functions and the additional frequencies of the multiburst bar sweep. The digital meter and the phase-locked-loop (PLL) RF-channel and program-mable-IF frequencies provide convenience of operation and accuracy. I was glad to see the Ringer flyback/yoke testing feature retained and improved. In the VA62, the readings are digital and continuously updated.

External accessories were mentioned before, but not sufficiently. In each VA62 rear compartment is an accessory jack (a 15-pin type D computer jack) where one of the major accessory instruments can be plugged in for power and signals.

Two accessory instruments now are available. Model NT64 produces an NTSC (EIA) full-field or split-field color pattern. Figure 7 shows a TV screen with the split-field pattern (color bars at top with I, Q, white and black below) com-



Figure 15 Jacks at the left bottom corner are for the internal dc-voltage supply. The RF/IF output jack is next, with the on/off power switch at the right.

ing from a NT64 that was plugged into a VA62. The Figure 7 scope waveform shows the six full-field NTSC color bars from the NT64.

Model VC63 generates the essential VHS and Beta waveforms including one that simulates video-head signals.

An EX231 expander jack adapts the VA62's single accessory jack to four jacks, so one, two, three or four accessory instruments can be operated at once. Evidently additional accessory instruments are planned, since Sencore states that four stack to the height of the VA62.

These accessory instruments allow specialized or newly designed functions to be added to a VA62 without need for internal changes. This gives flexibility since a technician buys only the instruments he needs, while the VA62 does not become obsolete. All signals from these accessory instruments are phase-locked and sync locked to all other VA62 signals, so they are compatible.

Sencore model VA62 performed perfectly all functions that were tried or tested. It appears to exceed the Sencore claim that it is: a phase-locked video generator; an all-channel, cable-ready RF generator; a television analyzer with IF and drive signals and signal measuring; and a VCR analyzer.

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What do you know about components?

By Sam Wilson

Capacitors are frequently misunderstood components. I am convinced that one reason capacitors are not well understood is that they are taught on the basis of models rather than on what actually happens when a capacitor is charged or discharged in a circuit. Models are valuable for learning to recognize circuit behavior. Unfortunately, students aren't always told that the model is being used. When a technician encounters a circuit where the model doesn't hold up, the result is confusion.

Here are some examples of circuit models:

- A capacitor will pass ac but not dc.
- A capacitor is charged because there are more electrons on one plate than on the other.
- The only thing that determines the voltage across a capacitor is the difference in the number of electrons on the plates.

Although these statements are useful for describing the operation of a capacitor in certain circuits, they are only half-truths. To demonstrate this, I once developed a quiz with four questions that couldn't be answered on the basis of the above models. I offered a free gift to anyone who sent the correct answers. Of the 43 replies that I received, I only had to give away one gift.

Here are those questions and the correct answers.

1. In the circuit of Figure 1, the capacitor is new and it has never been charged. What is the voltage between terminals x and y?

A surprising number of people thought the voltage should be 0V.

I'm sure that's because they are taught that capacitors will not pass dc. That model of capacitor behavior does not apply in this case. If the capacitor is not charged, then the voltage on the left plate must be the same as the voltage on the right plate. Therefore, the output voltage must be the same as the battery voltage: 120V.

2. Which of the capacitors in Figure 2 has the higher voltage across it?

Because the same current flows into each series capacitor during the charging period, it follows that they receive identical charges. In other words, the charge (Q_1) on C_1 is the same as the charge (Q_2) on C_2 : $Q_1 = Q_2$.

A basic equation that relates charge, capacity and voltage is:

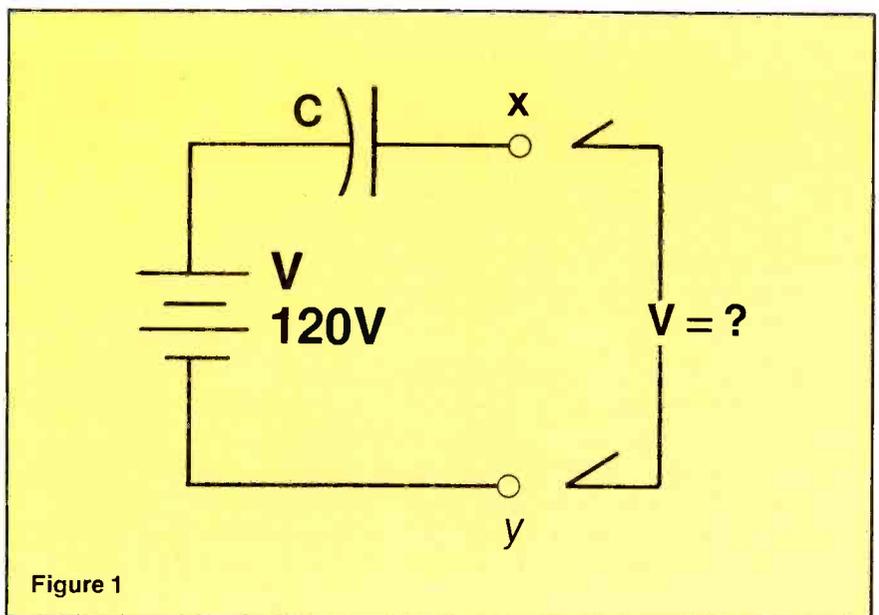
charge = capacity x voltage ($Q = CV$). Because $Q_1 = Q_2$, it must be true that:

$$C_1V_1 = C_2V_2$$

Because C_1 has a higher value than C_2 , it must be true that V_1 is a lower value than V_2 . Otherwise, it would not be possible to get both sides of the equation equal.

I used this question in a practice test that has been appearing in this magazine for some time, and I have received three letters from readers saying that the capacitors could not charge. The two capacitors could be replaced with a single equivalent capacitor having a capacity of

$$C_{eq} = C_1C_2/(C_1 + C_2)$$



Thick-film components are no different

Only the packaging has changed

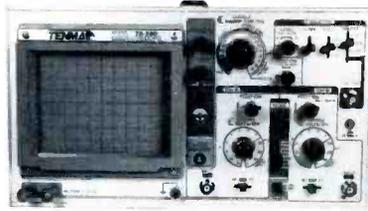


Components don't always look like components. These GE hybrid microcircuits are manufactured for use in mobile radio communications. The resistors and capacitors in these circuits are so-called *thick-film* devices. These components are fabricated from paste-like compositions that are silk-screened onto a ceramic substrate, and then fired in an 850°C furnace. The conductor tracks are fabricated in a similar manner. Additional components are then soldered onto the substrate to complete the hybrid microcircuit.

It doesn't matter, though, whether they're thick-film or made by conventional methods because components, such as resistors and capacitors, still exhibit the same classic characteristics. And, an understanding of electronics requires a knowledge of those characteristics. (Photo courtesy DuPont Magazine)

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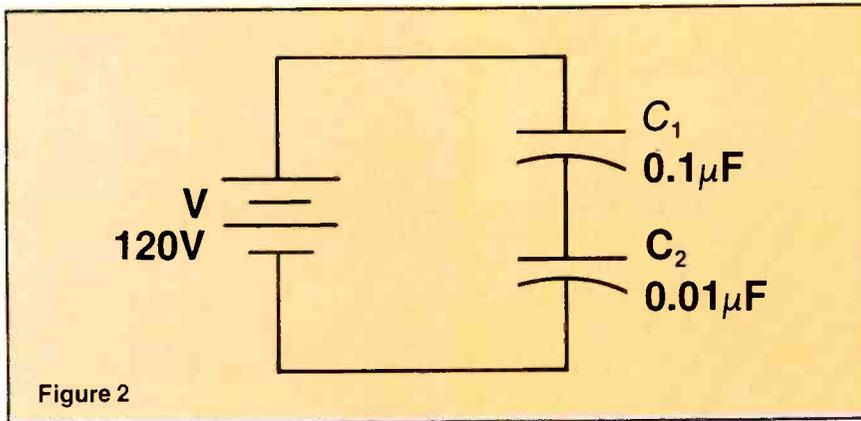


Figure 2

If you placed a capacitor in the circuit having that capacity value, it would surely charge. Because that equivalent capacitor behaves similar to the two capacitors it replaces, it is reasonable to expect that there will be a charging current in the circuit of Figure 2.

3. The experiment illustrated in Figure 3 was proposed by Ben Franklin. I have performed it a number of times in the classroom. The two outside metal pails are separated by an insulating pail in the middle. When they are assembled as shown in the drawing, they form a capacitor. Assume that capacitor is charged to 150,000V, and then the pails are carefully separated. The metal pails are touched together. (To the student's surprise, there is no spark when this is done.) Then, the pails are reassembled as shown in Figure 3. The voltage across the capacitor is now (zero or maximum).

Of course, the reassembled capacitor has about the same full charged voltage across it. Many technicians cannot answer this question because they believe the charge on a capacitor is caused by the difference in the number of electrons on the plates. That idea completely ignores the role of the dielectric in a charged capacitor.

Energy in a charged capacitor is stored in the dielectric. That is why capacitors are often identified by their dielectric materials. (Examples: mica, mylar and air) The dielectric material is a direct factor in determining the capacity of the component.

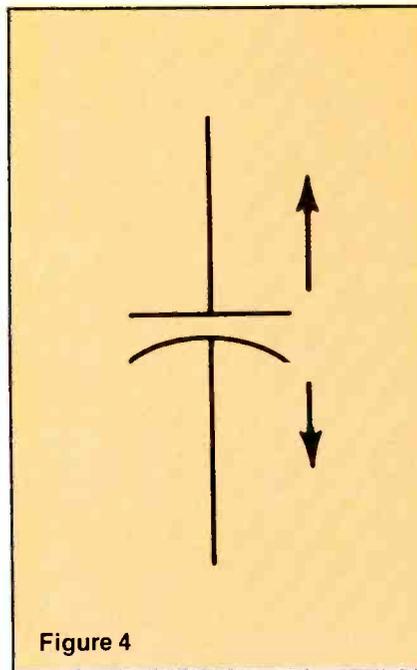


Figure 4

4. The capacitor in Figure 4 is charged, and then the plates are moved farther apart. The result is that the voltage across the capacitor

- A. increases.
- B. stays the same value.
- C. decreases.

The correct answer is choice A. Voltage is a unit of energy—not force. When you move the plates apart, you must do work. In other words, you must exert a force through a distance. That means you are storing energy in the system. That energy shows up as an increase in voltage across the capacitor.

The principle illustrated by this question is important. It explains how a parametric amplifier works. In that device, an ac voltage is applied across a capacitor. At the instant the voltage reaches its peak value, the plates of the capacitor are moved apart. That increases the amplitude of the voltage, so there is a voltage gain.

A varactor diode is used to make the parametric amplifier. The plates are moved apart by increasing the reverse voltage across the diode.

Don't throw away the models!

These are not trick questions. Each serves to give a clearer picture of how a capacitor works in a circuit. There is absolutely nothing

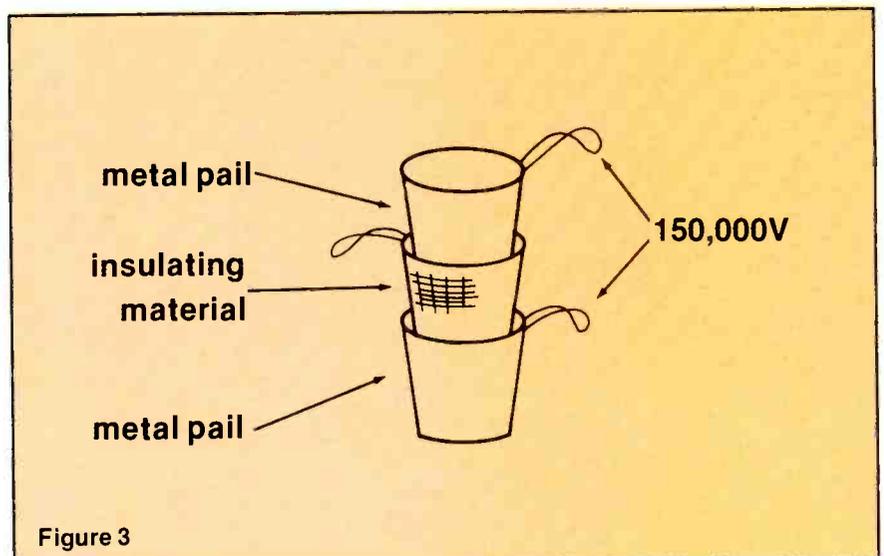
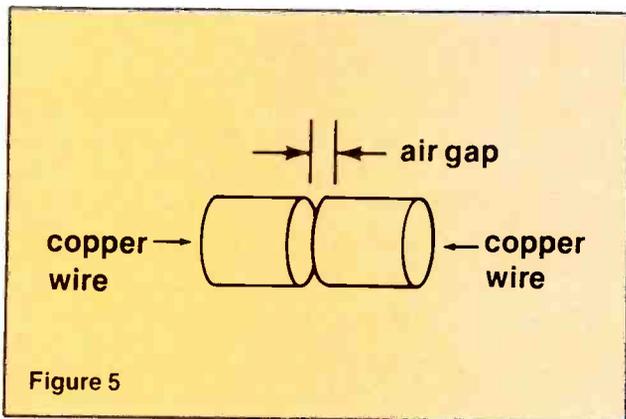


Figure 3



wrong with using models for teaching capacitors. However, it should be made clear that they are models so there will not be an emotional crisis when the model fails.

Many of the letters I get on this subject are strongly (almost too strongly) worded. Technicians feel compelled to defend the ideas they were given about capacitors, and they are not always receptive to changes in those ideas.

Return of the one million farad capacitor

A few years ago, I wrote an article about a one million farad capacitor. It appeared in this magazine. As I reviewed that article recently, I noticed that I never explained why it didn't cause any changes in the way capacitors are made.

To understand this capacitor, you must remember that the capacity of a capacitor is increased as the plates are moved closer together. To make the one million farad capacitor, two pieces of solid copper wire are placed end to end as shown in Figure 5. The air gap between them serves as the dielectric. By moving the plates closer and closer, a point will eventually be reached where the capacity is one million Farads. (It can be shown mathematically that the capacity becomes infinite if they are allowed to touch, but I want to stop short of allowing them to actually come together.)

Nothing is technically inaccurate about the above statements. But, obviously, something is wrong with the idea of making capacitors this way. A few readers took the time to write and explain the problem. Even though the capacity is high, the breakdown voltage is measured in picovolts. Before anyone rushes out to patent another version in which a high-voltage coating is used on the ends of the wire, let me point out that the thickness of that coating will reduce the capacity to picofarads.

My next article will describe what really happens inside a capacitor when it is charged and will discuss some practical applications.

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Test your electronic knowledge

By Sam Wilson, CET

These questions are similar to questions used in the associate-level CET test. All questions in the actual CET test are multiple choice, and a grade of 75 percent or better is required for passing. This month's questions are about basic circuits and components.

1. A certain light-emitting diode is conducting and producing light. The voltage drop across the diode should be
 - A. somewhere between 0.5 and 0.7V.
 - B. somewhere between 1.4 and 1.6V.
2. Which of the following is *not* a characteristic of an emitter follower?
 - A. good current gain
 - B. good isolation between the input and output circuits
3. The circuit of Figure 1 is called
 - A. bootstrap.
 - B. cross-coupled.

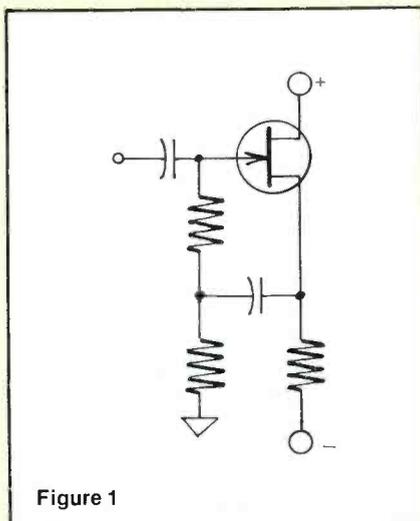


Figure 1

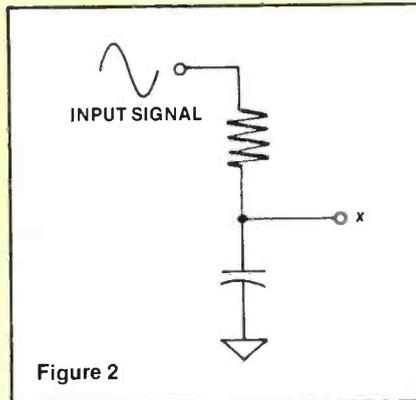


Figure 2

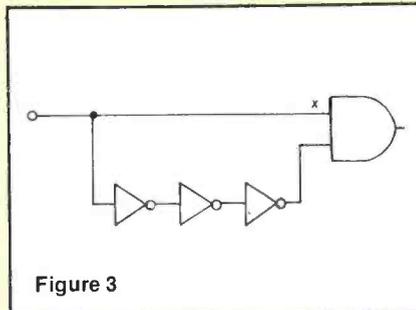


Figure 3

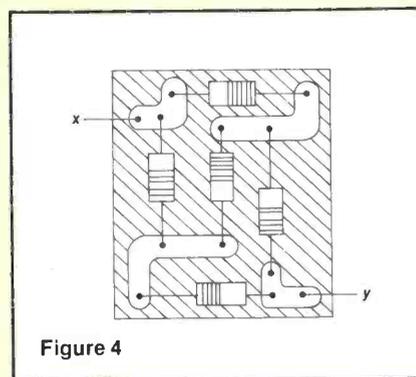


Figure 4

4. In the circuit of Figure 2, the voltage at point *x* will be
 - A. a sine wave that leads the input signal.
 - B. a sine wave that lags the input signal.
 - C. (neither choice is correct)

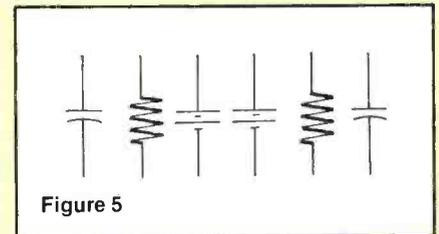


Figure 5

5. Two different types of batteries are used in various memory systems for standby power. Which of these is a primary type of battery or cell?
 - A. nickel cadmium
 - B. lithium
6. Which of the following could not be a number in the octal system of counting?
 - A. 1010110
 - B. 45678
7. Integrated circuit memories have one or more terminals marked CE or \overline{CE} . The letters are an abbreviation for
 - A. Code Erase.
 - B. Chip Enable.
8. The circuit of Figure 3
 - A. will produce a glitch.
 - B. will have a logic 1 output at all times.
 - C. will destroy the AND gate.
9. All of the resistors in the circuit of Figure 4 are 1000Ω . What is the resistance (in Ω) between points *x* and *y*?
10. Draw lines in Figure 5 to show how wires can be connected to make a positive and negative supply for an operational amplifier.

Servicing NAP C3 TV chassis

By Stan Vittetoe

After introduction in 13-inch Magnavox models in May 1982, the C3 chassis now is used in 13- and 19-inch versions of NAP Consumer Electronic Corporation Magnavox, Philco and Sylvania brands. All circuitry for the C3 is located on one large printed-circuit board, except for the RGB transistors, a black-level bias circuit and the focus control which are located on the picture-tube-socket board (Figure 1).

One of the unique circuits is the *switched mode* voltage-regulator system that not only supplies regulated +130V for the principal power, but also simultaneously drives the base of the horizontal-output transistor. Large-scale integration (LSI) integrated circuits (ICs) are employed where possible.

Two sources

As shown by the Figure 2 block diagram, most of the low-voltage supplies are produced by diode rectification of horizontal-sweep power. The +317V output of the voltage doubler (produced by rectification of ac-line power) supplies appropriate voltages for the regulator-circuit and its horizontal-drive stages, and +10V for the horizontal oscillator during start-up.

Other models furnish start-up dc voltages to the horizontal oscillator and the driver, but these are not used after the other supplies become operational. In the C3, only the +10V start-up voltage is superseded by another power source following start-up. All other dc voltages for the regulator circuit come from the +130V regulated supply.

From the switched-mode Q410 power transistor stage comes regulated +130V for the horizontal-output transistor, base drive signal for the same horizontal-output transistor, and enough 15734Hz power that it can be rectified to produce +20V for the sound-output IC. In other

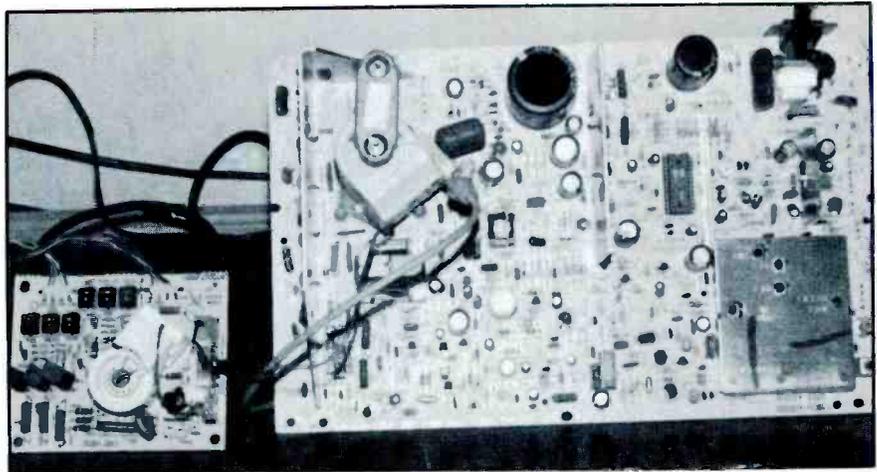


Figure 1 All components (except tuners) of the NAP C3 are located on one large main circuit board and one smaller board that contains the picture-tube socket and other related components.

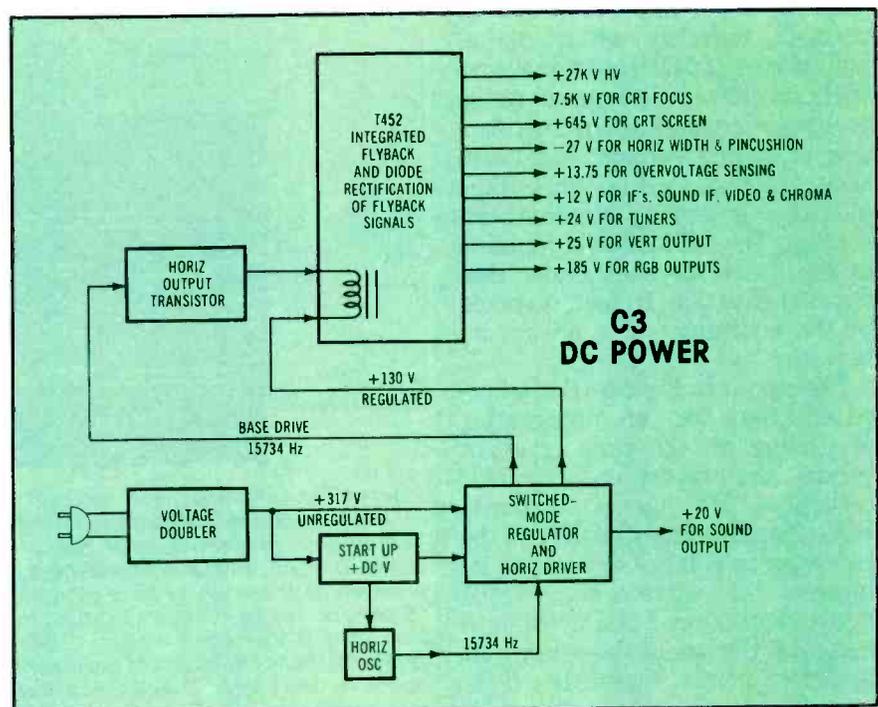


Figure 2 A voltage-doubler circuit rectifies line voltage, producing about +317V unregulated. Resistors from the +317V supply furnish about +10V of start-up voltage to the horizontal oscillator. Other resistors supply about +60V to transistor Q410, which functions as regulator and as driver for the horizontal-output transistor. These two dc voltages are absolutely essential for proper start-up of the receiver. The +317V supply also goes to the regulator where it is reduced to +130V regulated that is sent to the horizontal-output stage. The +20V source for the IC202 sound output IC is rectified from a third winding of T402 (which supplies base drive for Q452 output transistor from the second winding). All other dc-voltage sources are produced by rectification and filtering of horizontal-sweep power from the flyback.

words, +130V and +20V are produced by the regulator circuit, while all other dc-voltage supplies come from rectification of power from the T452 flyback transformer. These facts are vitally important for troubleshooting the power-supplies or the horizontal-sweep systems.

Locations of many power-supply components are shown in the Figure 3 photograph.

Duty-cycle voltage adjustments

Voltage regulation in the C3 chassis is accomplished by varying the duty cycle of dc pulses that then are filtered into a relatively ripple-free dc voltage. Many other brands and models have regulation that is based on the same electronic laws, although specific details of the circuits are quite different.

Figures 4 and 5 show basic principles from simple integration to non-synchronized regulation using dc pulse-width variations. All good dc voltmeters give an average reading of dc-voltage pulses. One easy but important test of the dc-voltage function of a digital multimeter (DMM) is to measure 60Hz unfiltered 1/2-wave dc peaks produced by single-diode rectification of ac line voltage. Failure to show the true average dc voltage indicates a serious meter shortcoming. The DMM should function as an integrator even under that unusual situation. In fact, it should be the equivalent of a no-loss integrator.

The circuit in Figure 4B is a low-pass filter (or an integrator, depending on the time constant versus the repetition rate). If resistance R1 has a moderate value (perhaps 10K to 20K) and the capacitance is large enough to integrate the waveform, a 10M input-resistance DMM should measure the same dc voltage at both test points, before the filter and after the filter. Therefore, this important point has been proved: *An integrator or low-pass filter does not change the average dc-voltage level of waveforms.* A waveform measuring zero before the filter tests zero at the filter's output. A waveform that measures +5V at the filter's input also

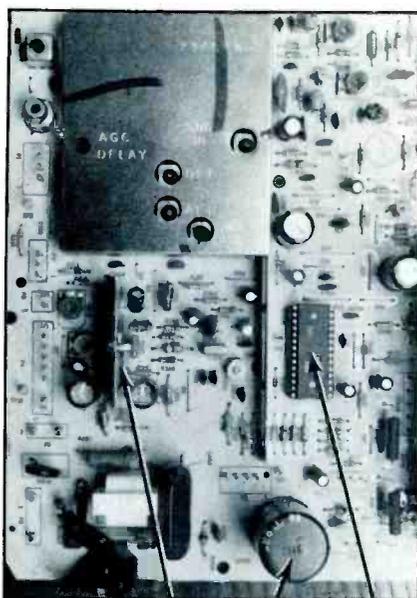


Figure 3 Arrows point to IC202 sound IC (at left), doubler filter capacitor C402 (at center) and video/chroma IC300 (arrow at the right). The large shield at the top covers the IF system.

measures +5V at the filter's output.

For the C3-chassis regulator, the voltage (amplitude) of the regulating power is relatively constant while the voltage is applied in dc voltage/current pulses that are almost square waves. Then regulation is accomplished by variation of the *on* time relative to the *off* time (duty cycle). The Figure-4A waveforms illustrate (by exaggeration) the variations of duty cycle. The base line of all three waveforms is zero voltage, while the solid horizontal line across each waveform represents the average dc voltage. In the top scope waveform, the *on* time is about 15 percent of each cycle, and the horizontal line shows the average dc voltage is approximately 15 percent of the total pulse amplitude.

Square waves are shown by the center Figure 4A waveform. The

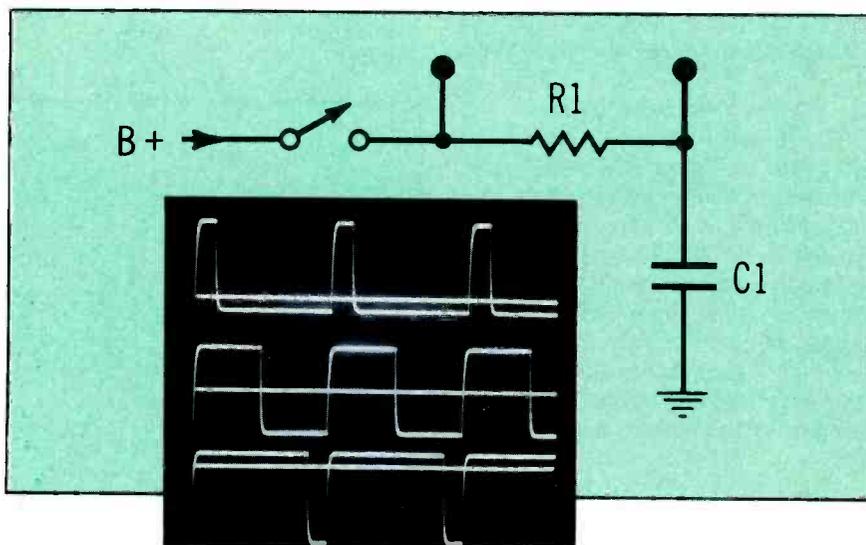


Figure 4 The switching-mode regulator in the NAP C3 regulates by varying the width of dc-power pulses, which then are filtered to form regulated pure dc voltage. (A) These waveforms are dc, with zero at the bottom of each and positive voltages above. The horizontal line across each waveform represents the average voltage. In other words, these are slices of dc voltage. The *on* time of the top waveform is about 15 percent, the dc voltage according to a DMM also is about 15 percent above the zero point. In the middle waveform, the *on* time of the square waves is 50 percent, a DMM reading is 50 percent of the maximum, and the average-voltage line is squarely on the vertical center. The *on* time of the bottom waveform is about 86 percent, of the maximum voltage, a DMM measured about 86 percent of the maximum, and the average-voltage line appears to be about 86percent from the zero point at the bottom. These previous experiments prove that the average voltage from pulses of dc voltage is determined by the duty cycle (when the amplitude is held constant), and there is a direct ratio between duty cycle and average voltage as measured by a very high-impedance dcV meter, such as a DMM. (B) When the previous pulses were passed through this simple low-pass filter, the dc voltages (measured by a DMM) were the same at both testpoints; the filter did not change the dcV component. Notice that these waveforms were not taken from a C3 or any other TV receiver. Instead, they were used in an experiment showing how duty cycle affects average voltage.

average voltage of square waves is 50 percent of the total amplitude, and the horizontal average-voltage line is located there. In the Figure 4A bottom waveform, the *on* time is about 86 percent of each cycle, and the horizontal average-voltage line is located approximately at the 86 percent amplitude point. Incidentally, these average-voltage lines were added easily by the scope.

If the Figure 4A amplitudes are 100VPP, measuring the top waveform with a DMM should produce about +15V at both test-points. The center waveform should measure about +50V, and the bottom waveform should measure about +86V at both test-points relative to ground. The DMM and the principle allow excellent accuracy, but the duty cycle is not known precisely.

Although Figure 4 proves the basic principle is correct, the Figure 4B circuit cannot pass much current without excessive current drop across the R1 resistor. Figure 5A solves the problem by substituting a filter choke for resistor R1. Remember that either a resistor or an inductance is necessary. If both are missing, the circuit no longer is a low-pass filter; instead, it is a capacitor-input peak-reading circuit. Supplying voltage and current to C1 without R1 or a choke charges C1 to the input voltage, regardless of the duty cycle. Therefore, if the filter choke develops shorted turns, the regulator's output dc voltage will be almost as high as the input supply voltage, while the regulator will be ineffective.

A non-synchronized regulator

Figure 5 shows one method of designing a voltage regulator for a TV receiver. A comparator circuit compares the fixed reference voltage against a sample of the regulator output voltage. Any voltage difference between the reference and the output sample voltages causes the duty-cycle circuit to vary the duty cycle. A lower output voltage calls for the relay to apply source voltage to the low-pass filter choke for longer periods of time during each operating cycle. Conversely, an excessive out-

put voltage forces the circuit to reduce the duty cycle time.

Although the Figure 5 circuit could produce adequate voltage regulation, it has several limitations. Relays are limited (usually) to operation cycles of only several hundred cycles because of their considerable inertia. Therefore, regulation could not follow nor correct rapid variations of load

voltage. Relays often have a short contact life when breaking power of this magnitude, and the clicking noises can be heard unless each relay is placed in a soundproof compartment.

Synchronized regulator with horiz drive

Figure 6A block diagram shows how NAP has solved the problems with the Figure 5 regulator. A

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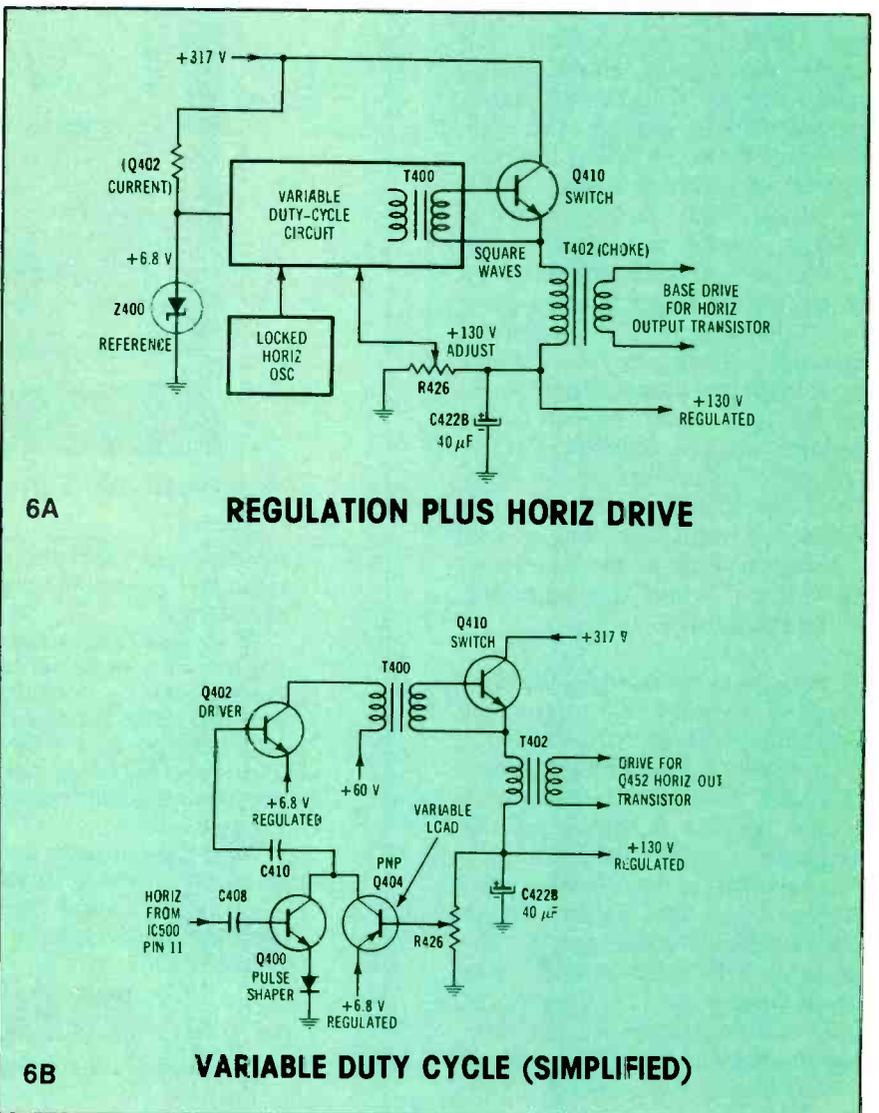
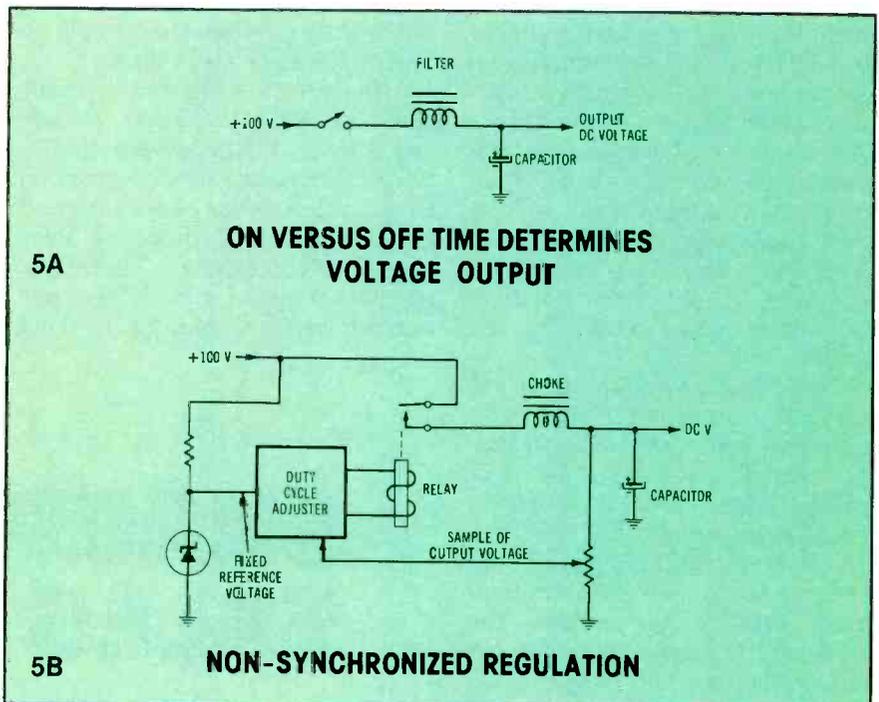
locked-to-station-sync horizontal oscillator supplies drive to the variable-duty-cycle circuit which (through T400) turns on Q410 switch transistor at the desired times (once during each horizontal cycle). The Q410 collector has the +317V line-rectified and doubled supply that is passed to T402 low-pass-filter choke when Q410 is biased into conduction. From T402 choke, the pulses of dc power go to C422B, the low-pass-filter capacitance, which is the source of +130V regulated. R426 brings a sample of the +130V regulated supply for comparison against the 6.8V reference voltage from Z400 zener diode.

T402 (the inductance of the low-pass filter) has two additional windings. One supplies base/emitter drive for Q452 horizontal-output transistor. Output of the other winding is rectified and filtered before becoming the B+ for one sound IC.

Figure 6B shows some of the previous circuits, but adds the pulse-width wiring. Horizontal-rate sawteeth from the IC500 horizontal oscillator are amplified by Q400, producing positive-going sawteeth at the Q400 collector. Q404 is used as a variable-resistance collector resistance for Q400, according to the voltage between the Q404 emitter (which

Figure 5 A description of how various duty cycles changed the average dc voltage and the filtered voltage was given in Figure 4. However, the low-pass filter shown cannot supply much current without excessive voltage drop in the resistor. (A) This schematic shows how a filter choke can be substituted for the resistor of a low-pass filter when higher currents are needed. Voltage at the filter capacitor varies directly with the duty cycle. (B) A relay and a duty-cycle adjusting circuit could function as a pulse-width regulator. However, as explained in the text, it has several drawbacks.

Figure 6 The NAP C3 has this regulator, shown in simplified block diagrams. (A) All major elements were shown here. Notice that the low-pass filter choke T402 has a second isolated winding for driving the horizontal-output transistor. A third winding (not shown) has a rectifier and filter to produce +20V for the sound-output IC. (B) Some details of the varying pulse-width circuit are shown here, and explained in the text.



goes to +6.8V through 330Ω) and its base, which receives a sample of the +130V regulated voltage through R426 control. The amplitude of the Q400 collector sawteeth varies according to the controlled Q404 C/E resistance, and the varying sawteeth amplitude at Q402 base determines when (during each cycle) Q402 driver transistor produces a leading edge of each near-square wave at its collector. T400 passes the near-square waves that determine the beginning and ending of Q410-switch emitter current.

Doubler, regulator and shut-down

The combined doubler, regulator and safety shut-down circuits are shown in the large Figure 7 schematic. All explanations are placed with this schematic so the schematic and the comments can be viewed at the same place.

Voltage-doubler operation

Rectifiers can be analyzed by charts that show electron flow and the resulting voltages during several stages of the ac cycle. There is an easier method, particularly for doubler circuits. In Figure 8, think of the C1/D1 stage as a video dc restorer. Usually video dc restorers are used to maintain the sync tips (or the blanking level in sophisticated designs) at a specific voltage as the video level changes. In this rectifier circuit, diode D1 conducts at the tip of the negative peak, thus shifting the zero-voltage point from the vertical center of the waveform to the negative tip. Therefore, *the entire sinewave is positive and passes easily through D2*. Refer to Figure 8 for the remainder of the explanation of a voltage doubler that does not double the frequency of its ripple.

Location of Q452 horizontal-output transistor and Q410 regulator switch transistor is shown in the Figure 9 photograph.

Horizontal-oscillator operation

IC500 contains the solid-state devices for sync processing, horizontal oscillation, vertical oscillation and vertical drive (Figure 10).

Q506 is called a horizontal-centering transistor. It could be replaced with a resistor except it also functions as an easy-on switch. During start-up, IC500 cannot handle a large horizontal-centering current into pin 14 without possible damage. When power first is applied to the receiver, approximately +10V from the start-up circuit is applied

to pin 16 of IC500 and to the Q506 base. The +12V supply is not operating yet, because it is produced by rectification of horizontal-sweep power. The Q506 emitter, therefore, is zero while the base has a positive voltage. To the PNP transistor, this is reverse bias, so Q506 has no collector current and IC500 pin 14 has no inrush of current. After the horizontal os-

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cillator and the remainder of the horizontal-sweep system begins to operate, the +12V supply applies a higher positive to the Q506 emitter than is present at the base (from the start-up +10V voltage). Now Q506 has saturation forward bias that applies the +12V emitter voltage to the collector, R570 and IC500 pin 14. Therefore, pin 14 has been protected against any current during start-up.

The Figure 11 photograph shows several horizontal-sweep components on the circuit board.

IF circuits

C3-chassis IF circuits begin with a 47.25MHz adjacent-sound trap (Figure 12). One IF-amplifier transistor (Q130) amplifies the IF signal before it is applied to a SAW filter that supplies tuned IF signals to amplifiers inside IC100. The surface-acoustic-wave (SAW) filter is a piece of piezoelectric material with the input and output transducer electrodes plated to it. Lengths and shapes of these elec-

trodes determine the range of frequencies that will pass through. Thus, the bandpass curve is determined during manufacturing of this component; no adjustments are possible in the field. One SAW filter replaces two or three tuned IF transformers.

A synchronous video detector is supplied, rather than the usual diode detector. Diode detectors have several disadvantages including non-linearity to low-level signals (thus sometimes requiring considerable amplification before the detector), beat interference when the diode is operated on a non-linear portion of its curve, and the ability to detect any signal applied to it, such as noise or adjacent sound or video.

Synchronous detectors are called *synchronous* because detection occurs only with signals that are in phase with the IF signal. Thus, adjacent-channel video and sound signals are eliminated, along with most noise since it seldom would be in phase with the

carrier. Because the synchronous detector has gain (usually it is made from a bridge of four transistors), fewer IF stages are necessary. Also, beat interference is not a problem, and weak signals can be detected without distortion.

IC100 also contains a white-spot inverter and a noise inverter. Noise pulses have the same polarity as horizontal sync, so their effects can be minimized by inverting the noise pulses and feeding them back into the video, where they cancel. White-spot noise has the opposite polarity, so it does not affect the sync or the stability of locking. Its visual effects are minimized by inverting the spots and feeding them back into the video where they nearly cancel.

Sound circuits

Sound IF is brought through a 4.5MHz ceramic transformer in some versions, or through a tunable coil in others. IC200 performs sound IF amplification and FM detection, while gain and

Figure 7 This complete schematic shows all components of the regulator plus those of the voltage doubler (described in detail later) and the shut-down protection circuits. First, locate the four resistors that supply the start-up voltages. R406 and R408 are 27K resistors (shown just below the voltage doubler) that supply about +10V to IC500 pin 16 during start-up to activate the horizontal oscillator. R410 and R412 also are 27K resistors (near Q402 horizontal driver) supply the Q402 collector with about +60V at all times. Q402 drives the base of Q410 which acts as an on/off switch (shorting between its collector and emitter) to bring pulses of the +317V supply to T402. These pulses are integrated by T402 and C422B so wider pulses of voltage produce a higher +130V regulated supply and narrower pulses reduce the +130V supply voltage. Actions of the pulse-width-variation circuits with Q400 and Q404 are explained in the text. Notice that the horizontal signal begins at IC500 pin 11, goes to the Q400 base, exits Q400 at the collector (where the amplitude of the sawtooth is varied by the Q404 collector resistance according to the needs), goes to the Q402 base, appears at primary and secondary of driver transformer T400, drives the base of Q410, while the emitter current and voltage variations produce an 8VPP drive signal from one T402 secondary for the base of Q452, the horizontal-output transistor. Of course, the Q452 collector has the usual high-amplitude pulses. **Shut-down operation** Latch transistors Q406 and Q408 are connected with both bases connected to the other transistor's collectors. Of course, this makes them susceptible to positive-feedback oscillation, when properly triggered. Normally, Q406 has zero bias and Q408 has a small bias. Pulses from the T452 flyback are rectified by D456, filtered by C458, the dc voltage divided by R455 and R453 so Q412 has a small reverse bias (note that Q412 is a PNP type). The base bias is clamped by zener diode Z402 so it is stable. When the pulse amplitude rises to a dangerous level, the Q412 emitter becomes more positive, thus increasing the forward bias and producing collector voltage and current that becomes positive forward bias for Q408. Promptly, Q408 begins to draw current that forces the Q406 base less positive (since it is also PNP, this is increased forward bias) and Q406 begins to draw current that brings some of the 6.8V supply voltage to the Q406 collector and to the base of Q408 (NPN) where it is increased forward bias. Conduction of each transistor increases the conduction of the other in a regenerative action that ends when both are saturated, with both C/E junctions virtually short circuits. The saturated transistors now forward bias diode D404 and ground the Q400 base dc and horizontal signal, so the Q400 collector has no signal. Also, the 6.8V regulated supply is grounded through R436, Q406 E/C junction, Q408 B/E junction and R444 (1 Ω). Therefore, the pulse-width variation circuit has no horizontal drive signal and little B+ supply, and the entire horizontal sweep system ceases all operations. When the ac line power is turned off and certain capacitors discharge, the shut-down circuit is reset and ready for the next turn-on. If the cause of over-voltage now is gone, the receiver will operate when switched on. If the defect remains, the receiver next time immediately goes into turn-on to start-up and to shutdown, sometimes appearing not to achieve start-up. Your tests must determine which condition is occurring. The shut-down circuit also protects against excessive current of the +130V regulated supply. The back EMF of an inductance is in direct proportion to the amount of current being drawn when the circuit is opened. This makes it possible for D410 and L406 to trigger the shut-down circuit. When the +130V current is normal, the back EMF from T402 (when current is zero) is rectified by D410 and passed through L406 to the Q408 emitter. This voltage is only about -0.2V so it is not sufficient for Q408 conduction. However, an increased current raises the negative voltage at the Q408 emitter, forward biasing Q408 sufficiently to trigger the regenerative actions that eliminate the horizontal-sweep via shutdown. Operation of the line-rectified voltage doubler circuit is explained in the next figure.

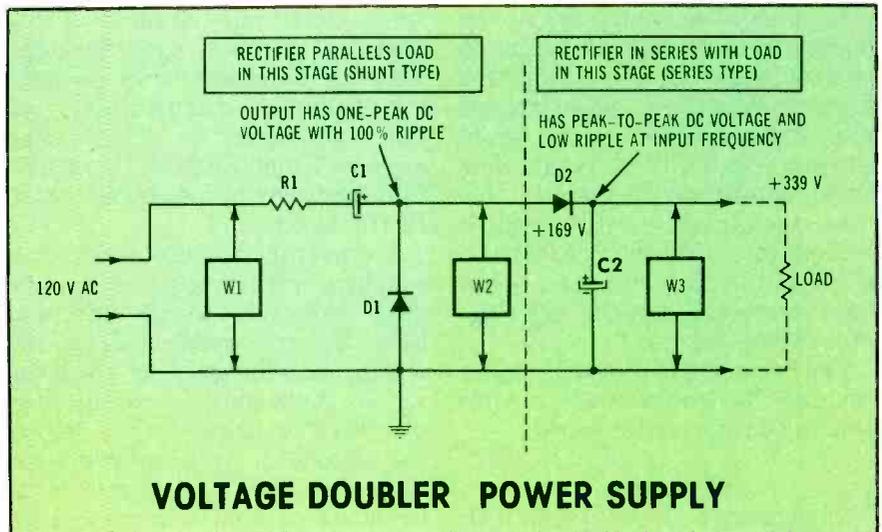
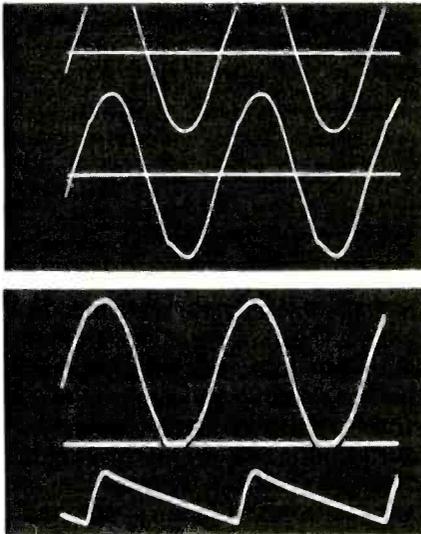


Figure 8 The C3 line-voltage-rectified voltage doubler is made up of two sections: a shunt rectifier; and a series rectifier, as shown on the schematic. A shunt rectifier does not merely pass the sinewave's tips and reject the remainder of each sinewave, as series rectifiers do. This can be made clear by examining actual waveforms with zero-voltage horizontal lines added by the scope. Waveform W1 is the input 120V 60Hz line voltage. The horizontal line through the center proves no dc voltage is present. The next waveform is 120Vac between R1 and C1. It is identical to W1 except for slight distortions from diode actions. And waveform W2 would be identical to W1 if diode D1 were removed. Coupling capacitor C1 (it is *not* a filter capacitor) separates any rectifier dc voltage from the line voltage while it passes the necessary large 60Hz current with almost zero voltage drop. D1 conducts only at the tip of the negative peak (notice the anode is grounded). This grounds each negative tip through the conducting diode. Therefore, as shown by waveform W2, *the negative tip is the zero-voltage point of the waveform, and the remainder of the waveform is positive.*

At the D1 cathode, the waveform is a sinewave (ignore the flat tip for now) and the entire waveform is positive with zero at the bottom tips. What is the peak-to-peak voltage of the waveform? It is 2.828 times 120V or 339.36VPP. What dc voltage will be displayed by a DMM? It is 1.414 times 120V or +169.68V. The dc sinewave is symmetrical, so the average voltage (the kind a DMM measures) is a line 50 percent between positive and negative peaks. And half of 339.36V is 169.68V. When the doubler has no load at its output, the two dc voltages are almost exactly +169V and +339V less only the diode voltage drops when the input is 120Vac. Real line voltage varies so much that it is impossible to obtain higher accuracy.

From the information presented until now, it might seem the shunt rectifier produces +169V and the series rectifier also produces +169V making a total of +338V (in round numbers). This is not quite correct. The D2/C2 combination is a series peak-reading rectifier circuit that will rectify the positive peak of an input signal and produce a dc voltage equal to the peak voltage. Remember that the +169.68V at the anode of D2 is a sinewave (not a steady dc voltage) having an amplitude of 339.36VPP. With its negative peaks shorted to ground, *the whole sinewave is a positive peak.* Therefore, D2 will rectify the whole waveform producing a dc voltage equal to +339.36V (less certain losses related later). So, it is a voltage doubler.

power are supplied by IC202 that drives the speaker. Notice that IC200 is powered from +12V supply, and IC202 obtains power from the +20V supply (produced by rectification of the T400 drive signal).

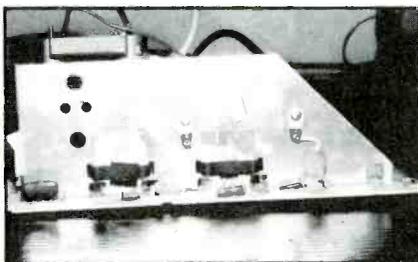


Figure 9 The large heat sink at the horizontal end of the chassis has two power transistors, Q452 the horizontal-output transistor at the left and Q410 the regulator switching transistor at the right in the photograph.

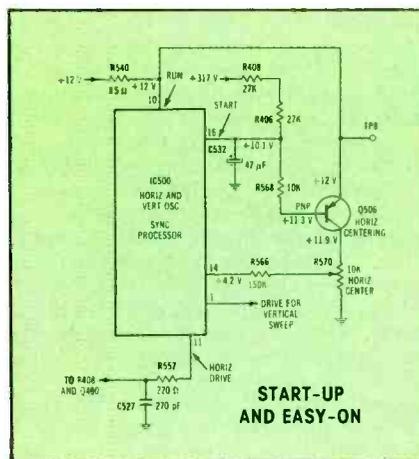
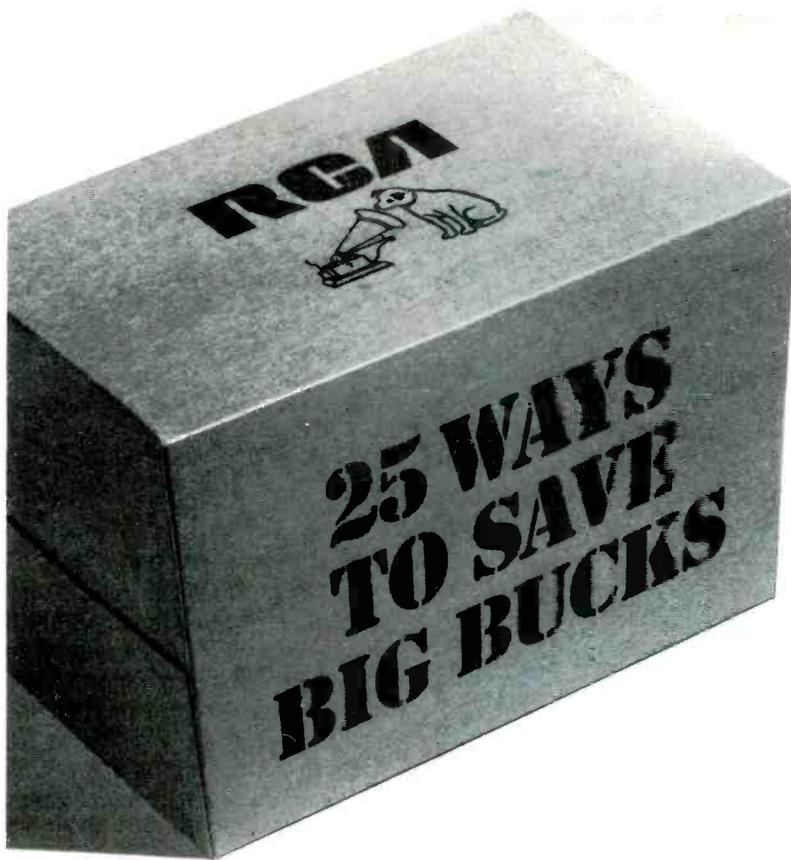


Figure 10 IC500 has the sync separator, horizontal oscillator, vertical oscillator and other stages including the horizontal phase detector. Q506 is included to delay application of voltage to IC500 pin 14 until the horizontal-power-rectified supplies reach their operating voltages.

Video and chroma processing

All major video and chroma processing is performed by IC300 (Figure 13). Composite video passes through a sound trap and then is split into two paths. One path is through a chroma trap, a video amplifier and a delay circuit to the luminance channel in IC300. The second path is through a chroma peaker to IC300. Inside IC300, the chroma is demodulated and then matrixed with the video to form red, blue and green signals that are amplified by power transistors before reaching the picture tube cathodes.

Adjustments of the picture control, acting through Q300, determine gain of the contrast amplifier inside IC300. Beam-current limiter Q302, also acting through



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Q300, provides some contrast tracking with beam limiting.

CRT-socket board

On the CRT-socket circuit board are the three RGB power transistors and their controls, a focus control, and a black-level bias circuit (Figure 14). This black-level bias circuit places about +2.5V at the low end of the drive controls to match the nominal +2.5V placed

at the high end of the drive controls. Therefore, adjustments of the drive controls can vary the amplitude of ac signals without affecting any of the dc voltages (which could change screen color).

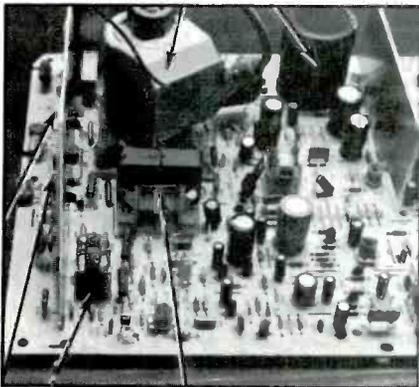


Figure 11 Arrows point out several important components on the NAP C3 chassis. At the top left is the flyback, and filter C422 is to the right. First along the left in the photograph is Q452, the horizontal-output transistor on the heat sink. Next, is Q410 the regulator switching transistor, also on the heat sink. T400 driver transformer is near the corner, while T402 is the large transformer near the flyback.

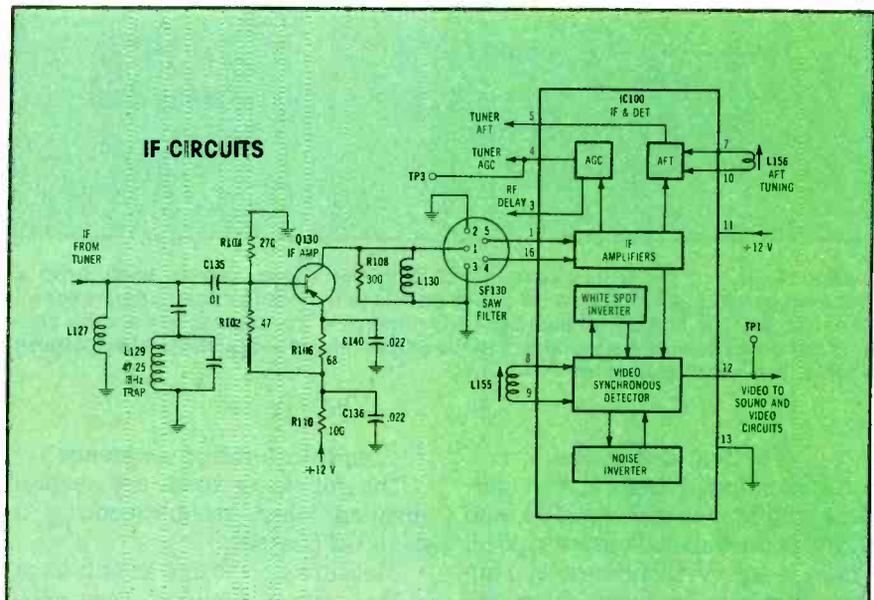


Figure 12 A SAW filter replaces almost all tuned circuits in the C3 IF system. Notice the synchronous detector and the twin noise inverters.

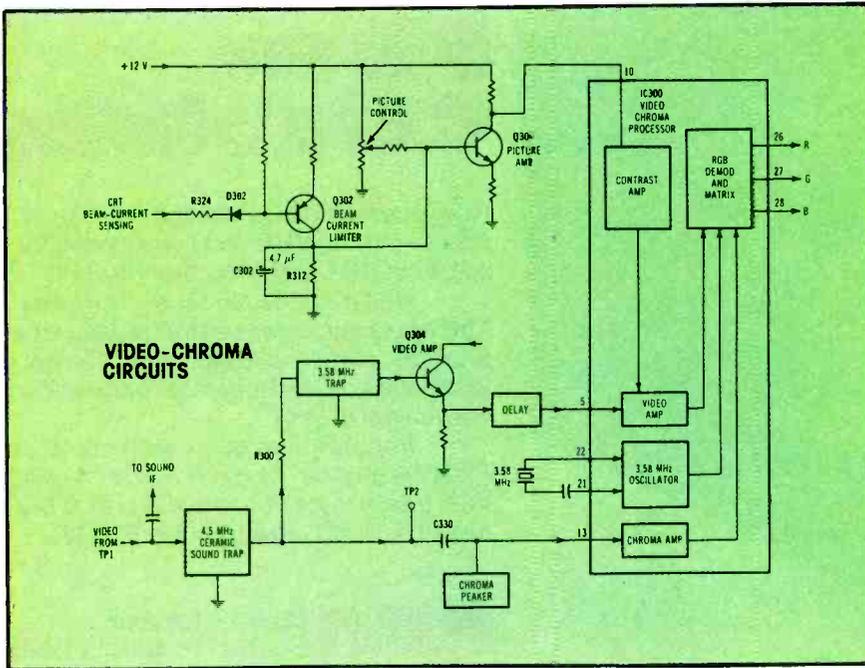


Figure 13 This is a simplified schematic of the video and chroma stages. Most functions are performed by IC300.

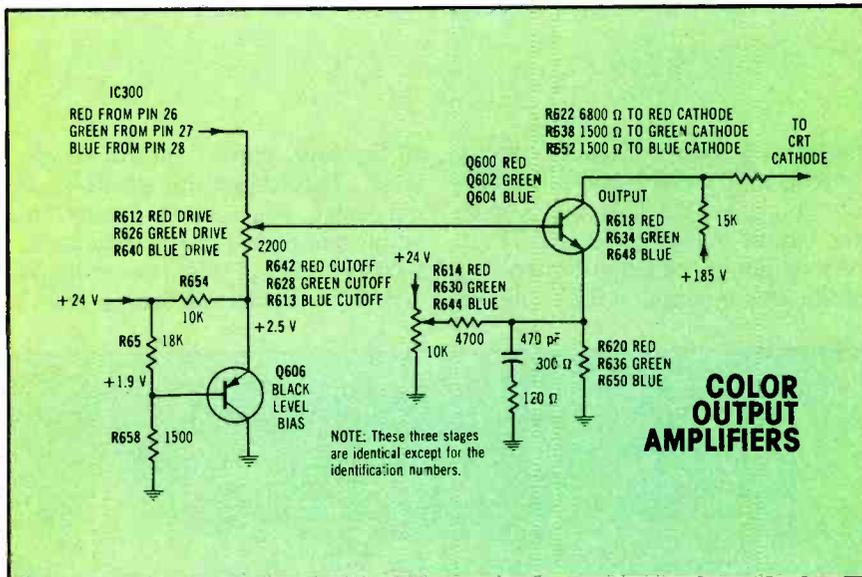


Figure 14 One of the color-output power amplifier stages (which, each, drive a picture-tube cathode) is shown here with component identification numbers for all three stages. The black-level bias circuit maintains at the low end of the drive controls the same dc voltage found at the top ends. This prevents shifts of brightness when adjustments are made.

Vertical deflection

As mentioned before, the vertical oscillator is inside IC500, and IC502 is the vertical output device. There is no vertical-linearity control. Instead, feedback from the yoke current is amplified by Q504 and sent to IC500 pin 3.

Troubleshooting sequence

The following tests are recommended when troubleshooting a dead C3 chassis:

- Measure dc voltage at output of the voltage doubler. Zero voltage indicates trouble in the voltage doubler, perhaps an open

F400 fuse or defective D400, D402, C402, C422A or 1.8Ω R402. Normal voltage is +310V to +318V, although a good supply without any load can produce up to +336V.

- Check for +7Vdc to +10Vdc at IC500 pin 10. Without this start-up voltage, the horizontal cannot start operation.
- Check for about +60V at the Q402 collector. This collector voltage is necessary for operation of the +130V regulator. The previous IC500 pin 10 voltage and the Q402 collector voltage are start-up voltages that are essential to production of the +130V regulated supply, which in turn is necessary for horizontal deflection, and horizontal deflection is necessary for voltage to be produced in the various low-voltage power supplies (see Figures 2 and 7).
- If the two start-up voltages are present, check for 2VPP to 6VPP at IC500 pin 11. This is the horizontal oscillator signal that is sent to the regulator circuit.
- Measure the dc voltage at Z400 zener cathode. The regulator will not operate correctly without +6.8V there.
- Check for +130Vdc at the emitter of switched-mode regulator Q410, and at filter C422B. If not there, the regulator is dead; if there, the regulator is operating.
- Check for an 8VPP drive signal at the base of Q452, the horizontal-output transistor.

If the voltage doubler +310V and the two start-up voltages are normal, but there is no horizontal drive at the Q452 horizontal transistor base, the chassis probably is in shut-down. A tic-tic might or might not be heard from the horizontal system, depending on the reason for the shutdown. Flashing horizontal lines also might be seen on the screen.

Defeating the shut-down circuit for testing can be done safely, if the following procedure is used. Improper methods might cause severe damage to the receiver.

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remove R436 (see Figure 7) to defeat the latching circuitry. Finally, jumper R406 to provide sufficient start-up voltage with the low line voltage. About 12kV of high voltage should be produced in a normal receiver. Scope the IC500 pin-11 waveform; it should be a 7VPP sawtooth. Also, the horizontal-output transistor collector should show an undistorted pulse of about 500VPP. Distortion or extra pulses between the proper pulses indicate defects in the integrated flyback.

Initial field reports indicate few failures of the integrated flyback, but a short or excessive current on one of the scan-rectified supplies will distort the collector waveform. Check for shorted rectifiers or supply shorts when extra lower-amplitude pulses appear about midway of the usual pulses at the output collector.

A dead receiver can be caused by defects in Q400, Q402, Q404 or Q410 that eliminate drive to the horizontal-output transistor. If Q410 switch resistor is found with

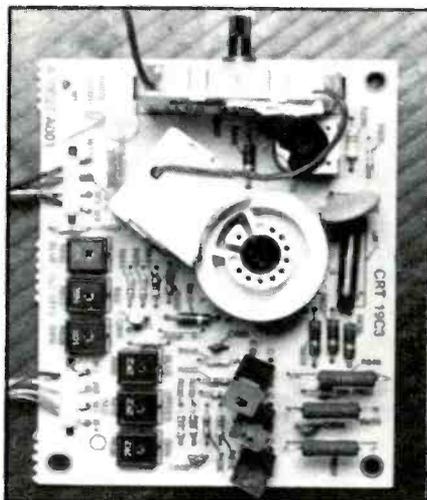


Figure 15 All components of the picture-tube-socket circuit board are shown in this photograph. Two sets of adjustment controls and the focus control are included along with the three color-amplifier transistors.

a collector-to-emitter short, always test all resistors in the B+ adjusting circuit (R424, R426, R428 and R432 in Figure 7). If one of these resistors has been

overheated so the resistance has changed, it can cause intermittent shutdown later unless it is replaced now.

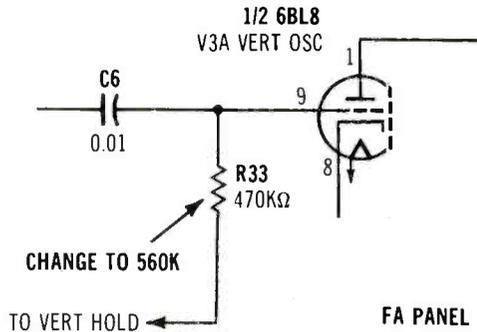
Shutdown, intermittent or otherwise, can be triggered by a defect in either latch transistor (Q406 or Q408) or in overvoltage-sensing transistor Q412. Of course, symptoms of no sound and no raster can be caused by more common failures, such as a defective IC500 oscillator IC or Q452 horizontal-output transistor.

Width or pincushion problems can originate in Q500 or Q502 and their associated circuitry. Also, don't overlook the possibility of a defective diode D464 or D466. Loss of -27V from diode D652 can narrow the width.

Loss of picture and sound, or a snowy picture, can be produced by a defective SAW filter in the IF circuit. A number of strange symptoms have been caused by soldering-flux residue on the circuit board. These symptoms include loss of height, loss of vertical locking, color problems, static in

CHASSIS – Quasar with FA panel
PHOTOFACT – 1476-1, 1460-1 and others

1

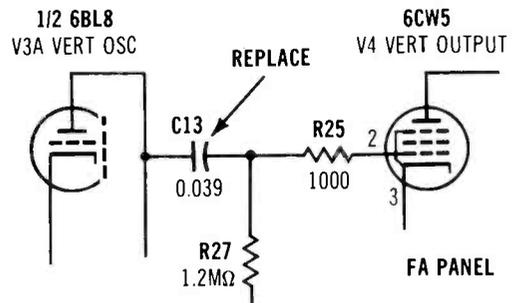


SYMPTOM – Vertical-hold control at end of rotation for locking

CURE – Check R33, and if it is 470K, replace with 560K 1W resistor

CHASSIS – Quasar with FA panel
PHOTOFACT – 1475-1 and 1460-1

2

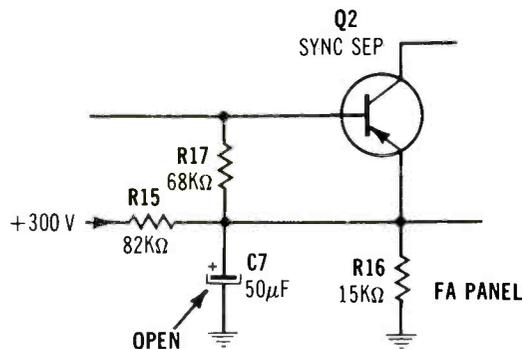


SYMPTOM – Vertical linearity stretched at top and compressed at bottom

CURE – Replace C13 with good-quality 0.039μF

CHASSIS – Quasar with FA deflection panel
PHOTOFACT – 1476-1 and 1460-1

3

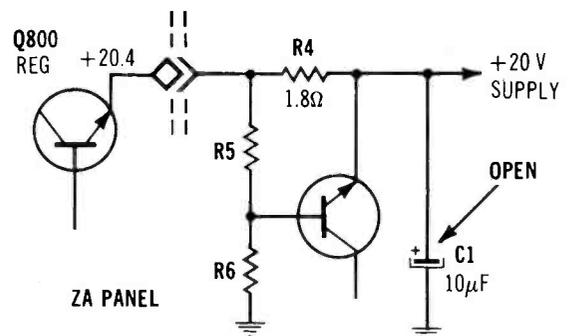


SYMPTOM – Poor locking, or soft vertical locking with loss of color

CURE – Test capacitor C7, and replace it if open

CHASSIS – Quasar with ZA power panel
PHOTOFACT – 1476-1

4

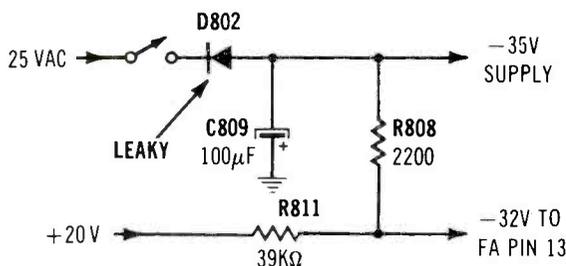


SYMPTOM – Erratic rolling and soft vertical locking

CURE – Test capacitor C1, and replace it if open or reduced capacitance

CHASSIS – Quasar with ZA power panel
PHOTOFACT – 1476-1

5

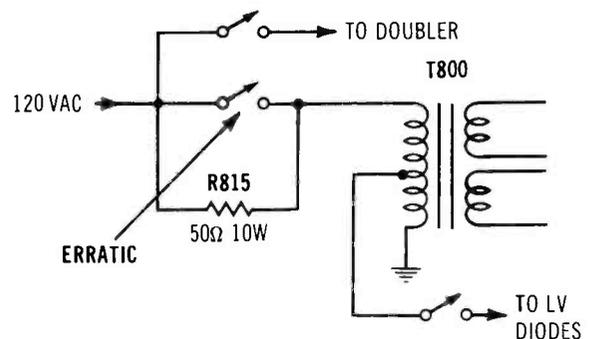


SYMPTOM – Insufficient height or faint bar moving upward in picture

CURE – Check diode D802, and replace if it is leaky

CHASSIS – Quasar with 4-section on-off switch
PHOTOFACT – 1476-1

6



SYMPTOM – Height decreases and rolls erratically, then becomes normal

CURE – Check switch across R815, and replace it if continuity is erratic

the sound and loss of video. It is advisable to remove the flux residue by mixing a solution with 30 percent water and 70 percent isopropyl and applying it with a stiff-bristled brush. It is important to dilute the alcohol because an undiluted solution will leave its own gooey residue on the board.

A dark or blacked-out picture will result from a defective Q606 black-level-bias transistor (located on the picture-tube-socket board) that removes the +2.5V at the drive controls. One of the two sound IC's should be the first suspect when the sound is distorted, weak or missing. An open or nearly open C220 (that couples the audio to the speaker) can produce weak sound or loss of bass frequencies. Remember that the +20V for the IC202 output IC is rectified from a winding of T402, the regulator transformer.

IC300 handles both video and chroma; therefore, it can produce either color or video problems. A defective Q300 picture amplifier can reduce the contrast or prevent control of contrast. Open or shorts in the three RGB color-output transistors can produce a multitude of symptoms, including an all red, blue or green screen of extreme brightness or missing red, blue or green from the picture. A bad C511 can cause non-linear vertical deflection.

When making resistance and voltage tests on the C3-chassis circuitry, remember that the picture-tube aquadag is not grounded (as done in the past). Instead it is connected to the +22V supply. Convenient grounds for test equipment are the large heatsinks of the vertical-output and horizontal-output transistors.

Also, NAP C3 is a hot chassis type requiring operation from a 120Vac isolation transformer during testing to prevent damage and electric shocks. **Warning:** input filter capacitor C402 discharges very slowly (when power is switched off) through the degaussing thermistor and the degaussing coil. You must use care when handling the wiring and the circuit board because the capacitor can give a painful shock if your hands complete the circuit.

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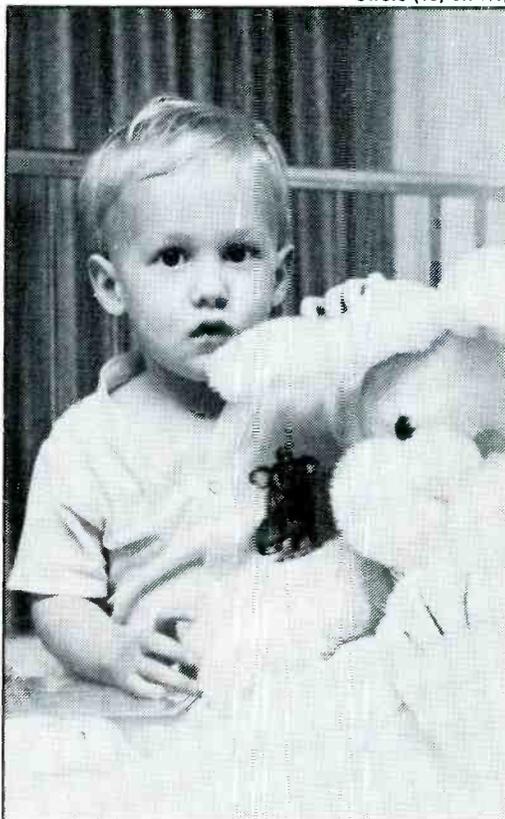
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M12X1	X1	30MHz	36.00

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The TVRO Waveguide and LNA

By Martin Clifford—
Consultant, Technical
KLM Electronics

Despite its impressive size and appearance, an installed TVRO dish is nothing more than a microwave signal energy collector and reflector. It concentrates the signal, along with some electrical noise, onto the opening of a short section of waveguide. This waveguide, having either a rectangular or round shape, is known as the *feed* because it feeds or delivers the satellite signals to an antenna probe at its far end. Sometimes the word *feed* is used simply to indicate the entrance to the waveguide. The front end of the waveguide may be equipped with a series of concentric rings whose purpose is to help gather as much of the

signal as possible, concentrating it at the feed opening.

Waveguide characteristics

A waveguide belongs to the family of transmission lines, such as coaxial cable or 2-wire line (twin lead). Like these other lines, waveguide is a passive device and suffers a certain signal loss, called insertion loss. For this reason, its length in a TVRO system is kept quite small. For microwave frequencies, however, waveguide is much more suitable than either twin lead or coaxial cable. Unlike these two other types of transmission lines, the dielectric in waveguide is air, which has reasonably low losses at microwave frequencies.

Another reason for using waveguide is the existence of a phenomenon called the *skin effect*. This skin effect is the tendency of high frequency currents to move in a thin layer near the surface of a conductor rather than flowing through its entire volume. For this reason, having a solid waveguide would serve no useful purpose. The metallic shell of the waveguide not only confines the electromagnetic energy of the satellite signals, but also acts as a shield against external interference. In this sense, it works somewhat like the flexible metal shield braid of coaxial cable.

Waveguide can be either rigid or flexible. It can be straight, curved or twisted. Its only function is to conduct the concentrated microwave signal at its entrance to the antenna positioned at its other end. The feed and its antenna probe are considered as part of the dish structure, and so the dish is sometimes referred to as the antenna.

Like coaxial cable or twin lead, waveguides have a certain value of impedance. Because signal energy exists at the opening end of the waveguide and it is exposed to the air, the impedance is known as its open air impedance. Sometimes impedance matching is obtained by

Satellite dish is merely a device to collect low-level signal energy from the satellite over a large area and concentrate it at the antenna feed located at the dish's focal point.



flaring the open end of the waveguide; an arrangement called a horn or horn antenna. The dish is called an antenna for the same reason. A flared section of waveguide could be considered as a transformer, matching the impedance of the open air to the impedance of the waveguide. Waveguide flares can be rectangular, or have a shape in the form of a pyramid or a cone.

Waveguide is not simply a randomly selected piece of pipe. Its dimensions must be carefully chosen to be about a half wavelength, with an upper and lower limit to the frequencies which can be conducted. In this respect, waveguide is much more critical than either twin lead or coaxial cable.

The antenna probe

The antenna probe, positioned near the far end of the waveguide, like any other antenna, is a broadly tuned resonant circuit and the tuning is done by the physical size of this probe. The higher the frequency, the shorter the length of the antenna. In the GHz region, as you might expect, antennas are extremely short; in this case about 1 inch. Although the antenna's small size may look insignificant, both its size and shape are important because it must be capable of responding to satellite signals as well as rejecting noise.

Signals transmitted by satellites equipped with 24 transponders are either vertically or horizontally polarized. For a 24-transponder satellite, 12 of the transponders are vertically polarized and 12 are horizontally polarized. All of the signals from the transponders of a satellite, regardless of polarization, are delivered to the feed and from the feed to the antenna probe. Signal selection (or selectivity) begins at this probe. To pick up horizontally polarized signals, the probe would need to be in a horizontal position and for vertical signals in a vertical position.

There are two ways of handling probe positioning: mechanical or electronic. One technique is to use a servomotor system; an arrangement that consists of two motors; one at the probe, the other in the

home. When the shaft of the in-home servo is rotated, the shaft of the probe servo rotates an equivalent amount. Only the probe turns as the feed and the LNA remain fixed. The servo in the home has a marked plate to indicate the position of the antenna probe at any moment. The problem with the mechanical method is the possibility of overshoot and the time delay in getting a correct antenna setting.

Another method, now more widely used is the ferrite polarizer. This technique is based on the principle of Faraday rotation, which results when an axial magnetic field is applied to a waveguide containing ferrite material. The ferrite method is used with circular waveguide. A coil of wire is wound around some ferrite material and an electrical current is sent through the coil. The effect of the magnetic field around the coil is to change the polarization of the received signal. The waveguide output is oriented at 45°. Applying a positive current to the coil produces one polarization while a negative current produces an opposite polarization. The drive current is less than 100mA for 45° rotation. Unlike mechanical rotation, the ferrite method is fast and positive.

Still another method is to use a switch. In this case, two probes are used, mounted permanently at right angles to each other. The switch consists of a pair of semiconductor diodes, made to conduct or not conduct through the use of suitable biasing voltages. The problem with this arrangement is that the mounting of the two antenna probes is quite critical.

The electromagnetic field in which the antenna probe is positioned induces a voltage in that probe. It is this voltage, the signal voltage, which must now be delivered to the input of the following component, the low-noise amplifier (LNA). The ground terminal of the LNA is connected to the metal shell of the waveguide; the *hot* terminal of the LNA input is connected to the antenna probe. This is similar to the usual 2-terminal input arrangement for any other component.

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Many satellite dishes are constructed in sections and assembled at the site.

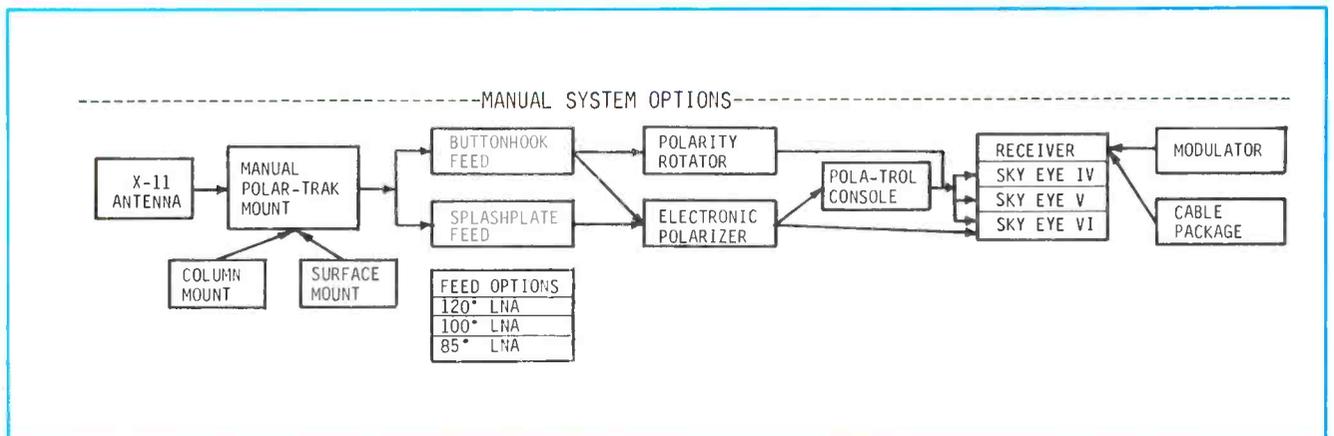
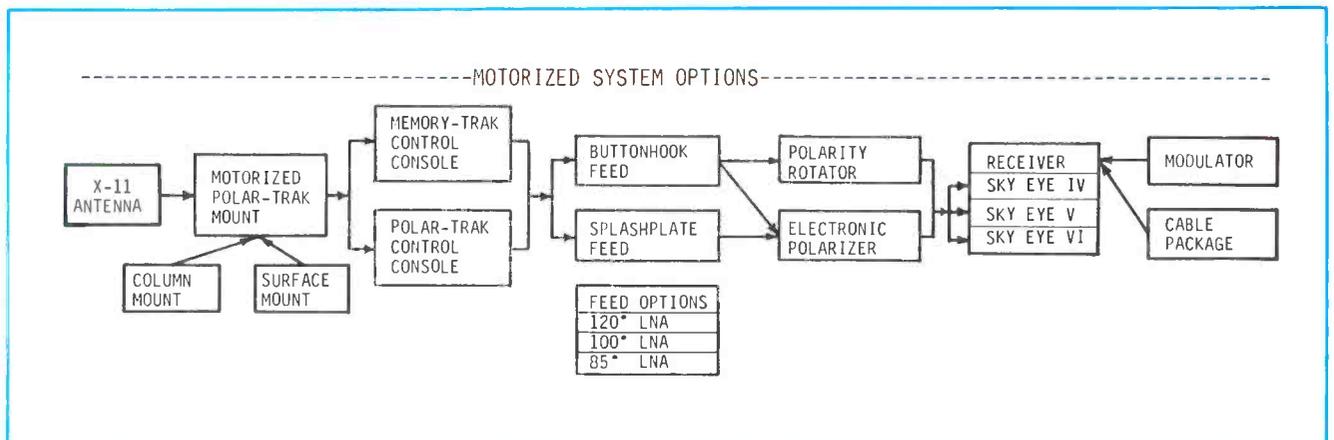
The noise problem

All TVRO systems have one fundamental problem: to achieve the best possible signal-to-noise ratio. Because the TVRO signal is so small, noise must be minimized.

The noise can be thermal, caused by molecular agitation in the earth, or structures, because of the heat of the sun. Electrical noise can also come from other signal sources such as telephone micro-

wave transmissions, or it can be generated directly in the LNA. The amount of electrical noise produced by an LNA is measured in Kelvins. The higher this figure, the greater the noise level. Most LNAs used in a TVRO system have a specification level of 120 Kelvins. Temperature in a TVRO system is measured in Kelvins, not degrees Kelvin (although that designation is used quite often), and begins at absolute zero, the temperature at which all molecular motion stops. **Zero Kelvins** is equivalent to -273° Celsius (centigrade).

The LNA generally uses two types of transistors: a GaAsFET, referred to as a gasfet, while the other is bipolar. The gasfet is composed of gallium (Ga), and arsenic (As), while fet is an abbreviation for field effect transistor. Gallium arsenide is the doping substance giving the almost 100 percent pure silicon of the transistor certain desired characteristics. The gasfet



Block diagram shows one manufacturer's satellite TVRO installation, including options.

behaves more like a tube than a transistor because it is a voltage, not a current amplifier. It has good linearity and its impedance is stable.

There are several types of LNAs other than the usual one in the average TVRO. One is the uncooled parametric, also known as an electronically cooled paramp or noncryogenically cooled preamp. This amplifier is desirable where the signal input level is low. The other preamp is the cryogenically cooled parametric. Expensive and requiring an external cooling supply that will take the amplifier down to absolute zero (-273°C), this is a complicated unit and demands constant attention. These amplifiers usually are used in industry or by the military.

LNA specifications

The LNA not only amplifies its input signal, but any electrical noise that accompanies that signal. And, like other electronic

components, the LNA will also generate some electrical noise of its own. A comparison between the amount of noise and signal is written as G/T, known as the figure of merit. The noise produced by an LNA can be designated in Kelvins or dB. Typically, an LNA rated at 120 Kelvins has a noise level of 1.5dB. The lower the temperature rating, the lower the noise. Thus, an LNA at 110 Kelvins could have a noise level of 1.4dB. In this case, 1.4dB indicates the amount of noise added by the LNA.

Another LNA spec is its gain, expressed in dB, and for most TVRO LNAs is 50dB. This indicates that the output is 50dB greater than the input, a power ratio of 100,000: 1. The noise level doesn't affect gain, which is more dependent on frequency, and can vary as much as 5-6dB from one end of the signal range to the other.

The noise factor (f) of an LNA is the ratio of the signal-to-noise at

the input compared to the signal-to-noise at the output. It isn't the system noise figure but contributes to it.

The LNA and the dish have an electronic relationship. The best arrangement from the viewpoint of signal strength is to have a dish that has as large an aperture as possible (i.e. large diameter), dish gain is dependent on its aperture, and an LNA having the lowest temperature rating. Both of these can be expensive approaches. A larger dish diameter can mean more costly mounting structure as well as a higher price for the wider diameter dish, while a low temperature LNA compared to the usual 120 Kelvin tape also means a higher cash outlay. A more practical approach to determine exact site requirements is to use a portable on-site TVRO system to determine if picture signal strength and quality are adequate using the dish/LNA combination chosen.

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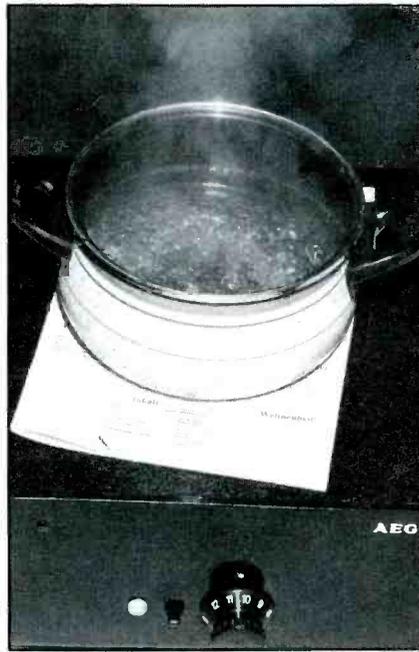
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Continued from page 8

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In addition to a large power regulating range, these units feature power regulation in proportion to the pan surface area and a pan monitoring function. If the coil area of a hotplate is only partially covered because a small pan is used or the pan has been moved aside slightly, the power is automatically reduced in proportion to the coil area covered by the pan. If the pan covers less than a set minimum area of the coil, the power is automatically switched off by the electronics and a flashing light indicates that a hotplate has been switched on but is without a pan. If a pan is placed



Because cooking unit heats pan by magnetic induction rather than heat transfer, cooking surface stays cool even when it is boiling water.

on the hotplate within one minute, the power is automatically switched on again, but if the hotplate remains unused, power is switched off completely.

Saves time and energy

Tests compared the thermal characteristics of hotplates made of iron or ceramic glass and of the newly developed induction hotplates. Figure 3 shows the temperature profile over time when heating two liters of water

on the three types of cookers with an energy consumption of 1800W each. The initial water temperature was 20°C. The cookers were switched off when the water temperature reached 80°C. On the induction hotplate, the water temperatures increases linearly almost immediately and reaches the switch-off temperature after only 5.7 minutes.

The advantages of induction cooking become quite clear when the pan is only partially filled. With this method, it takes just 2.2 minutes to heat half a liter of water from 20°C to 90°C. The same process takes about 3.7 minutes on a ceramic glass or iron hotplate. The heating-up efficiency of 64 percent on an induction cooker is considerably better than on conventional cookers, where it is only 37 percent. As a result, we have an energy and time saving of 43 percent on the induction cooker. This advantage is still approximately 18 percent in the case of two liters water. The time and energy savings decrease if the food has to be cooked or kept warm for longer periods.

Future prospects

The prototype equipment has been undergoing tests for more than a year. It has successfully passed all the practical tests. Series production and marketing will commence in two or three years, but a few problems still have to be solved. For one thing, the cost of induction cooking must be reduced. Cooker designs satisfying market requirement are also of major importance. Built-in cooker tops with two to four hotplates, free-standing cookers and table-top cookers are the main products. It must be possible to integrate induction cooking into these designs.

Advances in the field of semiconductor technology created the prerequisite conditions for using inductive heat generation in the home. The process developed by AEG-Telefunken improves the major advantages of this method of cooking, namely easily regulated heat output, plus time and energy savings, to the user's benefit.

AEG

*Transductor is another term for saturable-core reactor (or inductor): the basic circuit of a magnetic amplifier. In this device, a small ac signal is used to cause a large change in the impedance of the output windings, thus resulting in a large change in voltage across the load.

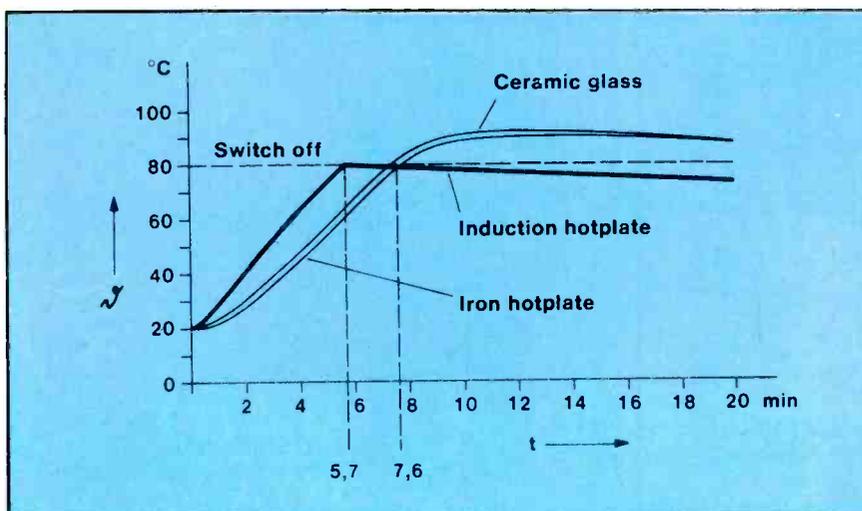


Figure 3. Comparison of temperature rise of water heated by induction cooker with performance of iron hotplate and ceramic hotplate. Induction heats faster, more steadily with no temperature overshoot.

Products

Desoldering pump

A compact, low-cost spring-powered desoldering pump has been introduced by the *Ungar Division* of Eldon Industries, Compton, CA. The Ungar 7870 desoldering pump can be operated with one hand, leaving the other free to hold the soldering iron that melts the solder. A spring-loaded piston is set with the thumb and released by push-button for maximum spring force. The vacuum created by a piston stroke of less than 2 inches instantly removes molten solder. The thumb tap is recessed into the handle to prevent eye injury during close-tolerance desoldering. A plated interior rod cleans the tip each time the pump is used. The pump comes blister-packed on a peg-mountable card.

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Telephone line analyzer

With the introduction of a low cost Telephone Line Analyzer, *B&K-Precision*, a division of the Industrial Product Group of *Dynascan Corporation*, Chicago, has developed an inexpensive alternative to an expensive telephone service call. Telephone line analyzer model 1042 is designed for non-technical users to verify the condition of the telephone line and to isolate a problem to the telephone or the line. For the customer who is having problems with telephone products, sockets or wiring, model 1042 could save the cost of a service call.

Model 1042 performs the following functions: a line test, polarity test, ring test, loop test and cord test. Results of the tests are shown on a large meter which indicates whether or not the line, ring, loop or cord are working without any confusing quantitative measures.

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Logic analyzer

Addtrace I, a low-cost aid to microprocessor machine language programming and troubleshooting is introduced by *BMH Company*, Reno, NV. Essentially a 16-bit digital comparator, Addtrace I monitors the address bus, enabling the user to trace the path of a program. Hexadecimal thumbwheel switches and LEDs reveal all coincident address lines so that programming errors can be located and corrected rapidly.

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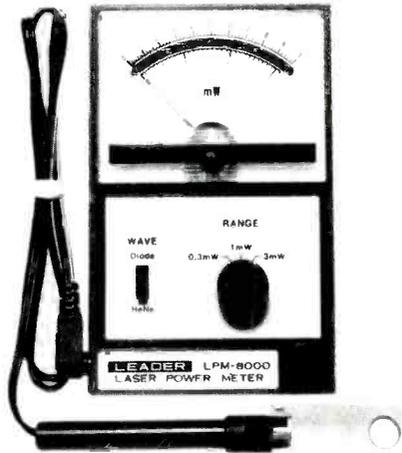
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Laser power meter

Leader Instruments Corporation, Hauppauge, NY, introduces the LPM-8000 laser power meter. This instrument provides a new method of measuring the power output from laser devices used in many compact audio disc and videodisc players.



Two wavelength and three power measuring ranges are available on the LPM-8000, allowing this instrument to be used in servicing the equipment of many laser disc manufacturers. The unit, which consists of a main body and a separate sensor connected by cable, boasts small size, light weight and battery operation for portability. The LPM-8000 allows the service technician to instantly verify power output from the laser device of disc players.

Circle (104) on Reply Card

Logic probe

GC Electronics, Rockford, IL, recently added the GC logic probe to its circuit-related product line. The probe is designed for quick checking and servicing of logic circuits. Multilamp LED displays indicate logic levels.

The probe also features a pulse detection function. Single pulses with a duration of 5ns or greater will illuminate the *pulse* indicator at a rate of 3Hz. In *memory* mode, the *pulse* indicator lights up (until reset) in response to a single pulse.

Other GC circuit-related products include a mogul base exposing stand with a removal print frame, a new larger-sized exposing frame, sunlamp bulbs, printed circuit drafting patterns, positive art kits and more.

Circle (107) on Reply Card

Combination DMM/DCM

MCM Electronics, Centerville, OH, introduces the Tenma Combination DMM/DCM with hFe transistor gain tester. Users can read voltage, current, resistance, capacitance and hFe on the clear 1/2-inch 3 1/2-digit LCD display. This meter eliminates the use of both a conventional capacitance and a multimeter.

Lightweight and compact for use in the field or on the bench, the meter's inline push-buttons allow for 1-hand operation. Capacitance measuring socket gives direct measurements of capacitors, along with a transistor hFe. The color-coded panel allows users easy identification of function and range settings.



Safety features include input overload protection, single fusing (with spare fuse inside), and stress relief test leads. The meter comes in a convenient carrying case, with alligator clip hFe leads and has a 1-year warranty.

Circle (105) on Reply Card

Short-depth panel meter

Non-Linear Systems, Solana Beach, CA, recently released its short-depth panel meter into the market of analog meters. Model X-32 Thriftmeter is a small, lightweight digital panel meter which is only 0.50 inch deep behind the bezel of its DIN/NEMA case. This 3-digit, 1000-count meter features a highly visible 0.500-inch-high LED display, programmable decimal point location, overload indications, $\pm 1\%$ or $\pm 0.1\%$ accuracy and automatic zeroing.

This DPM can measure any physical quantity that can be expressed as an analog voltage or current—for example, temperature, light flux, concentricity, angular position, rpm, weight, sound intensity, phase angle, force or displacement. The X-32 is suitable for use in scientific



analytical equipment, medical equipment, test and process control equipment and projects for hobbyists and electrical experimenters.

Circle (106) on Reply Card

Mini-satellite dish

KLM Electronics, Morgan Hill, CA, has introduced its Mini-X satellite TV antenna, a parabolic dish with an 8-foot diameter to meet the needs of home or commercial users with limited space. Mini-X is the third entry in KLM's line of modular, radar-mesh, parabolic dishes. Its modular design permits easy assembly even by amateurs. The smaller, lighter, Mini-X can be assembled by two people in one and one-half hours or less by one person in about two hours.



The Mini-X employs the same basic modular design as KLM's X-11 and X-16 antennas with the same survival capabilities against the elements—including the capability of withstanding 100 mph winds. It has 16 ribs compared to 24 for the 11' x 11'.

The Mini-X operates at 55 percent efficiency like the X-11. Its f/d ratio is 0.34 compared to 0.47 for its larger cousin. It is available with a manual-type mount or with a KLM polar mount and tangential drive compatible with KLM motor drives.

Circle (108) on Reply Card

Answers to quiz

(from page 28)

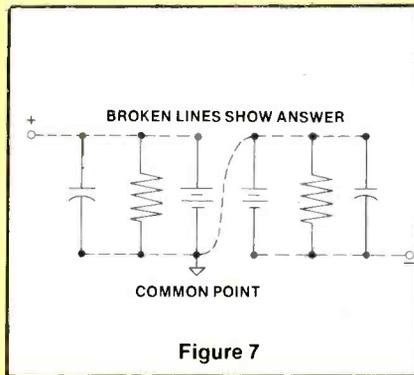
1. *B* Light-emitting diodes are not made of silicon. If they were, choice A would be correct. Instead, they are made of gallium arsenide and the junction voltage is about 1.5V. That is the **rated** voltage. As with other types of semiconductor diodes, it is possible to produce a higher or lower voltage across the junction if it is passing more or less than the rated current.

2. *B* The **voltage** gain of a follower circuit is less than 1.0 but the current gain can be high. Of the three amplifier configurations (common emitter, common base and common collector) the common collector—usually called emitter follower—has the poorest isolation between the input and output circuits.

3. *A* The purpose of the bootstrap circuit is to increase the amplifier's input impedance. That, in turn, reduces the load on the previous circuit.

4. *B* The circuit is commonly used in SCR circuits.

5. *B* A primary cell can't be recharged. A very important feature of the lithium cell (or battery) is that it lasts for years in the standby condition.

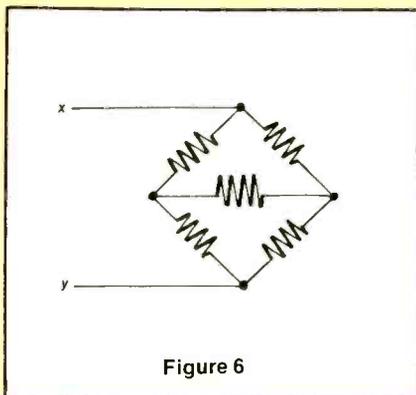


6. *B* There is no number 8 in the octal system.

7. *B* Using the Chip Enable terminal, a microprocessor can select one memory out of a group—or “page.”

8. *A* This is a good circuit to build to see if your oscilloscope can be used for observing glitches. The slight delay in the signal passing through the inverters causes both AND inputs to be at a logic 1 level for a very short period each time the signal at *x* goes positive. The scope used to observe the glitch must have a good high-frequency response. A sweep expander is very useful. If your scope won't display the glitch, try adding two more inverters.

9. 1000Ω The resistors form a balanced Wheatstone Bridge (see Figure 6). No current flows in the center resistor, so it is a virtual open circuit. In other words, the center resistor can be removed without affecting the circuit resistance. So, there are two parallel branches—each having a resistance of 2000Ω . The parallel resistance is 1000Ω .



10. See Figure 7.

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Readers' Exchange

Wanted: A schematic for Precor model 810 AM/FM portable radio. Also, Denon TRC-162 ED cassette deck. *David Kursin, 43 SW Forrester St. Washington, D.C. 20032*

For Sale: One set Ryder Radio manuals and one set of Ryder TV manuals. Make offer. *Paul Ashour, 4017 Carolyn Road, Fort Worth, TX 76109; 817-923-9088.*

For Sale: Sencore DVM 38. Like new. \$425. *Daniel C. Lee, P.O. Box 42, Osakis, MN 56360; 612-859-2851.*

Needed: Schematic for A Tennelec Memoryscan model MS-2, Scanner monitor receiver. Will pay for the schematic or cost of copying. *Bill Tipton, 6712 Rolling Road, Springfield, VA 22152.*

For Sale: B&K model 1077B TV analyst, tube type unit, \$625. B&K model 1250 NTSC generator, like new, \$699. Delco model 10420 dc variable power supply 0-16Vdc, at 8 amps max., \$145. *Mike Terrick, 809 Amity St., Homestead, PA 15120; 412-462-8720.*

Wanted to Buy: Good used 19VDKTC-02 color picture tube. Must have the cemented on yoke assy. *G. Heldenbrand, 620 SE 4th St., Willmar, MN 56201.*

For Sale: VTVM. Heath-kit IM-13 \$80. Color generator, \$50. TV alignment generator, \$80. All in good condition and with manuals. *Jose Navarro, 6101 N.W. 5th St., Miami, FL 33126; 305-266-5153.*

For Sale: Complete TV/stereo repair business, equipment and inventory. Quitting business due to new venture. Wholesale value of test equipment, \$7175.00. Wholesale value of inventory, \$27585.00. Will sell all for \$17500.00. *A.W. Cook, P.O. Box 725, Livingston, MT 59047; 406-222-1392.*

For Sale: Ryder's Radio manuals (old radios and changers), Volume 1-5 (abridged) and 6 through 21 with indexes. Also, record changers and P.A. I manuals. Make offer. *Albert Balzum, Route 1, Box 303, Pequot Lakes, MN 56472.*

For Sale: Sam's Auto Radio Repair manual, 141 totals to 292. \$1 each plus shipping. *Billy Walters, P.O. Box 186, Inola, OK 74036.*

Needed: Service manual/schematic for Hughes Memo-Scope 104D. Will buy or copy and return. *Don Von Gunden, 21175 Dodd Blvd., Lakeville, MN 55044.*

For Sale: 101 Sam's most complete sets of 500's; 600's; 700's; some sets of 800's, 900's. \$3 for each folder, plus shipping. For complete list, send s.a.s.e. or call 715-526-9588. *Gary Utke, 822 S. Washington, Shawano, WI 54166.*

For Sale: Sam's 38 to 700. \$300 plus shipping. Sencore TF151, checks regular transistors and field effect transistors, \$100 plus shipping. B&K 1076 TV analyst, \$125 plus shipping. *Paul S. Funk, 607 E. Cherry Lane, Souderton, PA 18964; 215-723-2355.*

For Sale: Heath color generator, model IG-5240, \$35; Heath CRT tester, cleaner, rejuvenator, IT-5230, \$75; Sencore CA 122 color circuit analyzer, \$35. All in good working order with manuals. Other equipment also. Consider trade for ham gear. *Dennis Jaques, WD80UO, 235 Hull St., Coldwater, MI 49036.*

For Sale: Sencore sweep and marker generator, SM 158, used once, in original carton, \$175; Sencore CRT tester CR 168 with 16 sockets, \$125. *V. Granzella Jr. Box 190, Wheatland, MO 65779; 417-282-6506.*

For Sale: PACO model S-55 wideband oscilloscope, \$75; Conar 224 tube tester, \$65; Sencore 39A19 high voltage probe for FE-14 meter, \$12. *Don Horne, 114 West Olive St., Bridgeport, WV, 26330.*

Needed: Schematic and service manual for autosonic 100 alarm and phonemate model 910. Will pay. *Al Potter, 2 Buttonwood Drive, Parlin, NJ 08859.*

For Sale: B&K 820 Capacitance meter, \$75; Conar tube checker, \$75. *Stan Hayman, 19707 Turnberry Way, N. Miami Beach, FL 33180; 305-944-5674.*

For Sale: B&K model 1077B TV analyst, manual and cables, like new, \$300; Eico model 460 Oscilloscope, manual, probes and cables, \$100; Sam's Photofact Folders, 3 to 1000, 240 sets, \$175. All prices include UPS shipping. *Duane M. Gage, P.O. Box 202, North Truro, MA 02652.*

Wanted: Lens for Sony KP-4000 color video projection system, will pay \$150. plus shipping costs. Call before shipping. *Edward L. Millerd, P.O. Box 292, Barber Point, HI 96862; 808-672-9748.*

Needed: Head cover for Teac A2340, new or used. (Not available from Teac) *J. Konney, 3155 N. Long, Chicago, IL 60641.*

Best offer: Sencore VA48, SC61, TF46, LC53, PR57, accessories, scope cart, books, used less than 10 hours. Send s.a.s.e. for details. *Matt W. Leach, Shepherd Tapes and Electronics, Box 93, Milo, IA 50166; 515-942-7759.*

For Sale: B&K 1077B, 177, 277, 281, 801; Sencore FE14, 16, PS43; Sams' CB Series 1-50 and misc. TAB and Sams'. Also wanted to buy: Sencore SC61, TF46, LC53, PR57, DVM56A. Send for a list or call 617-775-4289. *Al Eisenhaur, 9 Rachel Carson Lane, Centerville, MA 02632.*

For Sale: Approximately 691 sets of Sams' Photofacts; 238 sets between 23-889; 453 sets between 1005-1696. All for \$250 or best offer. Send s.a.s.e. for complete list. *Leo B. Heinz, 730 N. 81st, Lincoln, NE 68505; 402-464-0197.*

Wanted: RCA sales literature, brochures and price sheets for color TV and stereo consoles, years covering 1960-1975. *Danny Sertich, 4377 Roswell Road, Atlanta, GA 30342.*

For Sale: High voltage probe with carrying case, \$25 plus shipping. 110Vac to 12Vdc power pack, \$25 plus shipping. Sencore resistor-capacitor substitution box, \$50 plus shipping. *John Brouzakis, RD 3, Box 602 B, Charleroi, PA 15022; 412-483-3072.*

Needed: 19V JCP22 or 510JVB22 or 510JVB22 picture tube for Sears model 546.4220700. Also have radio tubes for sale. Will pay shipping or exchange. *Dan Boshart, 316 E. Ave., "E", Hutchinson, KS 67501. 316-662-1868.*

Wanted: Adaptors for tube tester Hickok 539B for newer tubes, compactrons, etc. Also updated instrument manual and tube manual. For sale or trade: Almost complete set of Ryder TV manuals (for pick up only). *Art Abbott, 377 Roberts Drive, Somerdale, NJ 08083.*

Needed: Tube chart and diagram for Mercury model 880 picture tube tester. Will copy and return or purchase. *Pivens E. Davis Sr., Circle D. Company, P.O. Box 215, Elgin, SC 29045.*

For Sale: Tektronix 5440 oscilloscope with 5A48 dual-trace and 5B42 delayed-sweep plug-ins. Current price \$5200. will sacrifice for \$3000 firm. Sylvania CK 3000 test jig with adaptors. \$225. Both items in mint condition. *Great Northern Video, 133 Loudon Road, Concord, NH 03301; 603-228-0412.*

For Sale: Sams' Photofacts in intermittent sequence, from #10 through #700, total of 300 folders, \$150. Send s.a.s.e. for listing. *Andy Burwell, 1727 White Ave., Knoxville, TN 37916.*

Needed: Flyback transformer #70F3081 for Fleetwood TV chassis #E08-2. *Archib Wharton-M.O.E. P.O. Box 2066, Bramalea, Ontario, Canada L6T 3S8; 416-791-1095.*

For Sale: Sams' Photofacts, #100 to 699 at 10¢ per package or \$60 for all. plus shipping. *Clark's TV, Union Road, R.R. Box 128, Wales, MD 01081; 413-245-9652.*

For Sale: Sencore SM 158 sweep/marker generator with instructions and cables, \$130. Sencore SS137 sweep circuit analyzer, \$55; Sprague semiconductor curve tracer model A by Jud Williams, with cables and instructions. \$25. *John Merdcer, 1317 S. 94th St., West Allis, WI 53214.*

Needed: Schematic or service manual for Magnovox stereo model VD1001. B&K 21 chassis-R 315 Sams' MHF 42 or 72-73 manual. Will buy or copy and return. *Calvin S. Logue, Jr., 17 J Washington Lane, Westminster, MD 21157.*

For Sale: 19CVP4 B&W picture tube, unused, \$35 plus shipping. Heathkit IG-72 audio generator, excellent condition, \$35 plus shipping. Send s.a.s.e. for list of excess manuals, video, audio and radio equipment and parts for sale. *Michael Ames, 7 Hyatt St., Courtland, NY 13045.*

For Sale: B&K DMM model 283, bench style; Triplet 5-inch vacuum tube multimeter; Powona 30KV probe; Universal DM25 portable DMM. all \$115. *J.L. Bachelor, 2538 Tam O'Shanter, Cleveland, TN 37311.*

Needed: Schematic, calibrating instructions, etc. for Hewlett-Packard VTVM model 410B. *Robert Blackwell, 2925 Riggs Ave., Baltimore, MD 21216; 301-362-6678.*

Fast growth seen in flat panels

Impressive reductions in prices, coupled with improvements in size and image quality, are driving the flat-panel market rapidly upward, and flat panels are now challenging traditional CRT display technologies in many applications. According to a new 232-page research report from *International Resource Development*, a Norwalk, CT, market research company, large-configuration flat-panel displays are now being used in more than a dozen major applications, accounting for annual shipments of more than \$200 million. Portable computers represent one of the major growth areas for flat-panel displays; even in the non-portable computer and terminal market flat panels are gaining ground over CRTs, particularly at the high end of the market.

Flat-panel TVs

Among several rapidly growing consumer uses for flat-panel displays will be large-screen wall-mounted televisions which will compete with today's projection televisions. Large, wall-mounted flat-panel displays will also be used for teleconferencing; the report hints at the possible emergence of 3-dimensional displays using a "sandwich" of multiple (and normally transparent) flat panels. Such a 3-dimensional display (providing full life-size images) may form the basis of a teleconferencing system which would provide extremely life-like "telepresence," thus helping to overcome the widespread resistance by users to today's NTSC TV-based or Picturephone-based videoconferencing systems and services.

Flat-panel technology is also used in small portable pocket and wrist televisions. Seiko, Casio and others have already introduced wrist TVs based upon the use of LCD technology, and Suwa Seikosha has demonstrated prototypes of a color pocket LCD tele-

vision. Flat panels compete in these applications with flat-screen CRT configurations, such as those used in Sinclair's pocket television (soon to be available in the United States for less than \$100) and in Sony's Watchman pocket television. The IRD report predicts "widespread use" of flat-configuration televisions within a year or two, with penetration into more than 20 million U.S. households by 1990.

U.S. Electronic sales

U.S. shipments of electronic equipment and components surged to an all-time high of nearly \$144 billion in 1983, representing a growth rate of 13 percent over 1982 shipments, according to the Electronic Industries Association.

Computers and industrial electronic products, with sales of \$56 billion, accounted for almost 40 percent of total U.S. electronic sales in 1983. The greatest increase over 1982 sales levels, however, was recorded for consumer electronic products, with nearly a 20 percent jump in factory sales. The communications equipment and electronic components industries recorded sales increases of 12 percent and 15 percent, respectively. Of the \$143.8 billion in sales for 1983, \$42 billion, or 29 percent, represented the electronic content of Department of Defense expenditures.

Total employment in the electronic industries increased 8.6 percent, to a total of more than 1747 million workers at the end of 1983. Employment increased most dramatically in the electronic components industry with a gain of nearly 15 percent. Employees in that sector made up 37 percent of the total electronic industries workforce in 1983. After several years of declining employment, the consumer electronics industry showed a substantial employment gain of 6.6 percent.

The Electronic Industries Association annually reports statistical information on the electronic industries and publishes the *Electronic Market Data Book* containing detailed information on the production and sales of the many diverse products of the industries, as well as related data on world trade, employment and R&D trends.

Extended warranties

Consumers are willing to pay up to 12 percent of the purchase price annually for extended warranties on home electronics products. This was one of the findings of an independent survey of recent purchasers and planned purchasers of home electronic products such as personal computers, videocassette recorders (VCRs), video cameras, televisions and telephones. The survey was conducted by Pace Research and Analysis, Melville, NY, for Warrantech Corporation, an independent service company. It confirmed consumer interest in extended warranties, the impact of warranties in the purchasing decision and the particular benefits of extended warranties that are most important to the consumer.

Two-thirds of the public are aware of extended warranties, a fairly new concept whereby parts and labor are covered for an additional specified period of time after the manufacturer's warranty has expired. About 75 percent of all consumers indicated interest in purchasing an extended warranty for one electronic product or another.

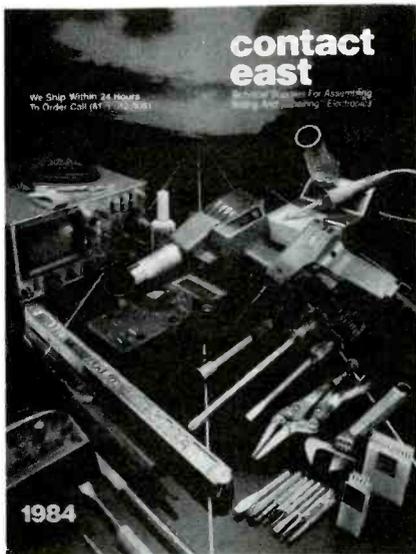
The study found that most consumers believe that regular manufacturers' warranties are too short to be of much use, yet they will not buy an electronic product without one. Nearly three-quarters of recent and planned purchasers claim that the manufacturer's warranty plays the second most important role in their purchasing decision. An attractive purchase price was the most important factor for nearly 90 percent of those interviewed.

The higher the retail value, the survey found, the greater the interest in protecting the item with an extended warranty. Most often mentioned were items such as home computers, videocassette recorders (VCRs) and video cameras; the higher-priced home electronics products. Most recent purchasers of these types of items say that it doesn't really matter who gives them the coverage—manufacturer, dealer or independent service company—as long as they get it.



Literature

Contact East, Burlington, MA, is offering an electronic tool and test instrument catalog, featuring more than 5000 quality technical products for assembling, testing



and repairing electronic equipment. Products include precision hand tools, test instruments, tool kits, soldering supplies and static control products. All products are fully illustrated with photographs, and detailed descriptions, and prices are included.

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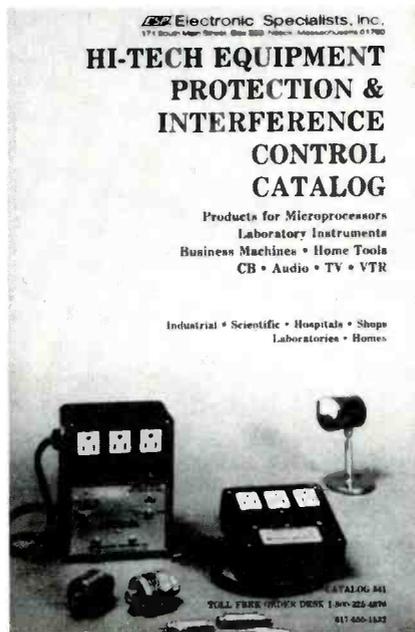
Electronic and electrical test accessories are detailed in a catalog introduced by **Mueller Electric Company**, Cleveland, OH. The 20-page catalog contains product photographs, engineering drawings and details product descriptions, specifications and applications. The catalog also features Mueller Electric's new lines of electronic test accessories, including test clips and laboratory-grade test leads and prods.

Circle (111) on Reply Card

A 144-page catalog from **Electronic Tool Company**, Pleasantville, NY, is a comprehensive buyer's guide illustrating and describing hundreds of hand tools, tool kits, test equipment and related products. An expanded section covers a complete line of tool kits for anyone involved in repair, maintenance and servicing of electronic and electro-mechanical equipment. Prices, illustrations and specifications for many name brand tools and pieces of test equipment are included.

Circle (112) on Reply Card

Protection and interference control products are presented in a 40-page catalog from **Electronic Specialists**, Natick, MA. 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 microcomputer equipment include ac line voltage regulators and conditioners,



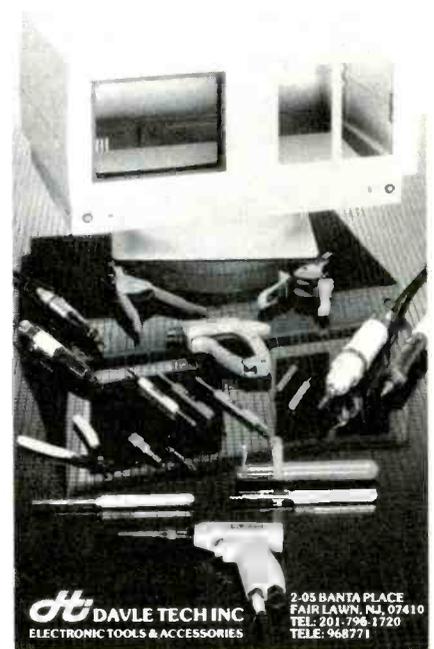
modem and phone line surge suppressors, equipment isolators and filter/suppressors. Typical protection and interference problems are described along with suggested solutions for various microcomputer installations.

Circle (113) on Reply Card

A 192-page catalog of hand tools and occupational protective equipment is available from **Klein Tools**, Chicago. This catalog describes pliers, wrenches, screwdrivers, bolt cutters, cable cutters, pocket knives, socket sets, hammers, tape measures, saws, drill bits, chisels, levels, gloves, tool boxes, padlocks and tool pouches. It also covers a broad selection of specialized tools for electrical, electronic, CATV, telephone and other industries. All tools and equipment are illustrated with photographs and drawings. Descriptions, specifications and application information are included.

Circle (115) on Reply Card

A full-color catalog of electronic and other assembly tools is available from **Davle Tech**, Fair Lawn, NJ. The 36-page catalog describes soldering/desoldering products, PC board assembly tools and fixtures, electronic bench tool instruments and packaging products, enclosures, card frames and fans.



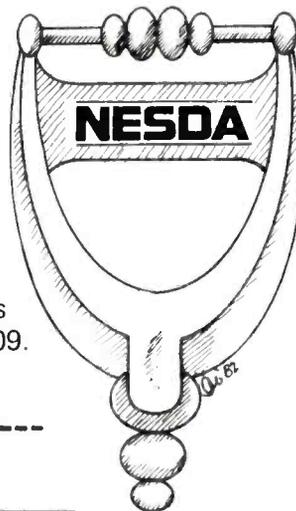
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AUTOMOBILE RADIO and tape replacement parts. Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469. (212) 881-9600, out of New York State (800) 223-8314. 5-79-tfn

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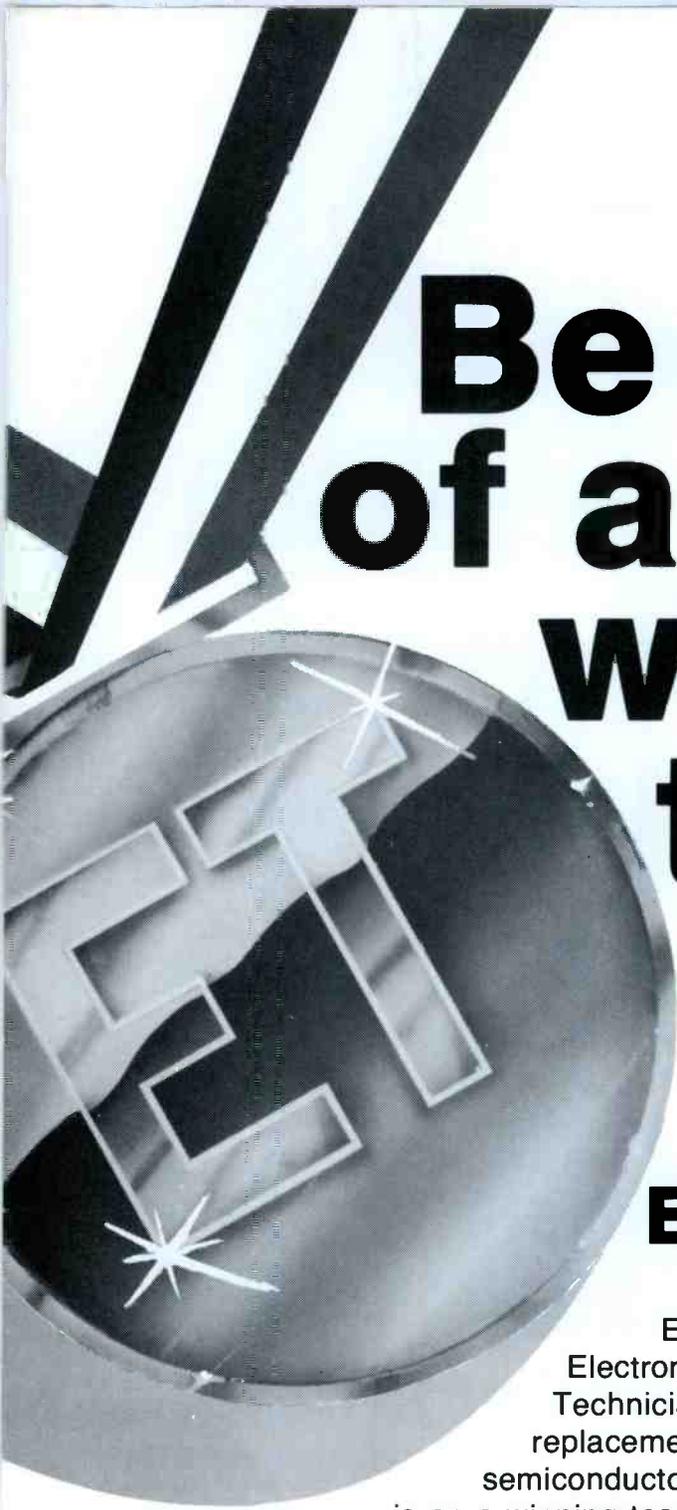
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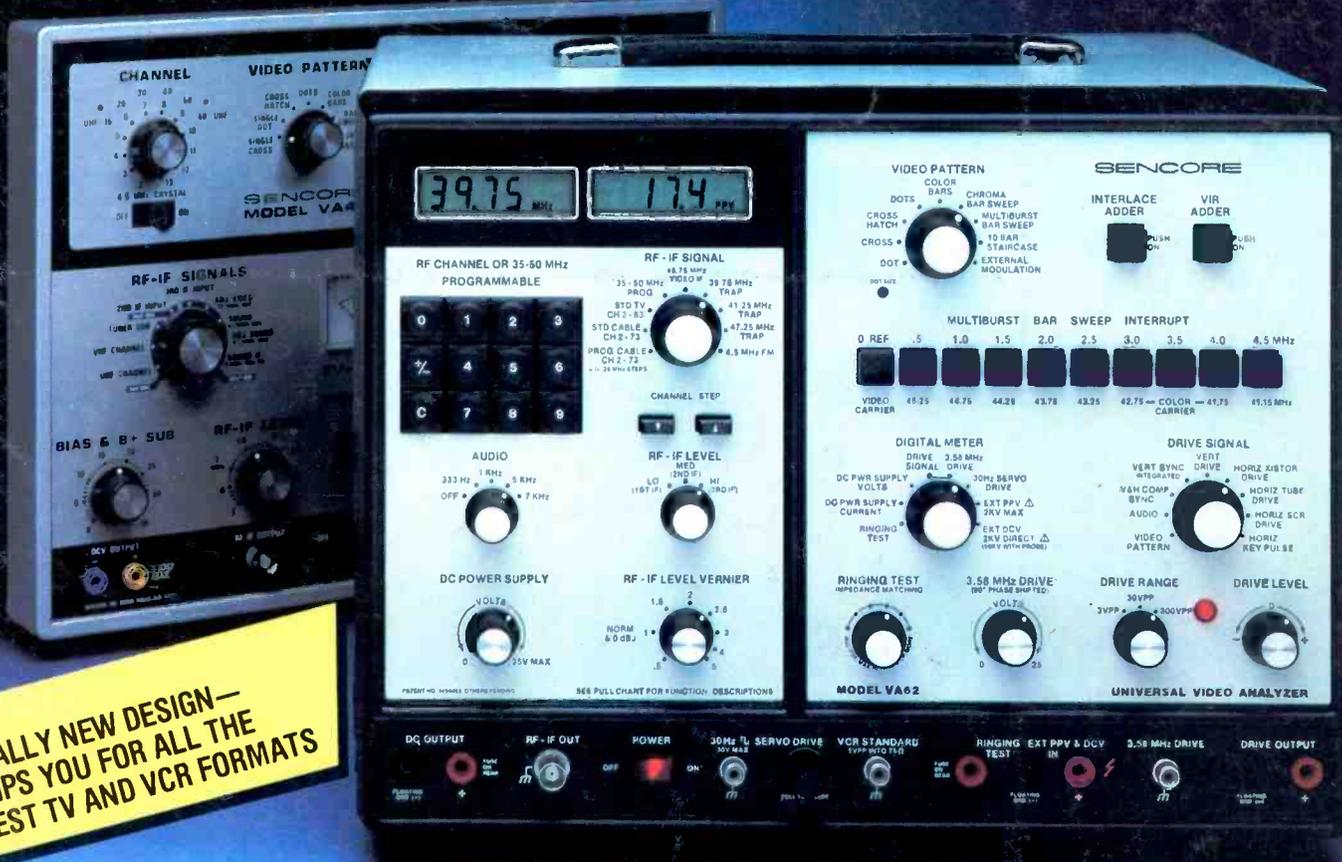
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