

# SENCORE NEWS

FEATURING

RC24 PARTS PAK  
"The Tube Caddy Janitor"

3200 SENCORE DRIVE, SIOUX FALLS, SOUTH DAKOTA 57107

HOW TO WITH INSTRUMENTS THRU *PIX FACTS*

*World's Largest Technical Publication — 500,000 Per Month*

WRITTEN BY  
SENCORE FIELD ENGINEERS  
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# RC24 PARTS PAK

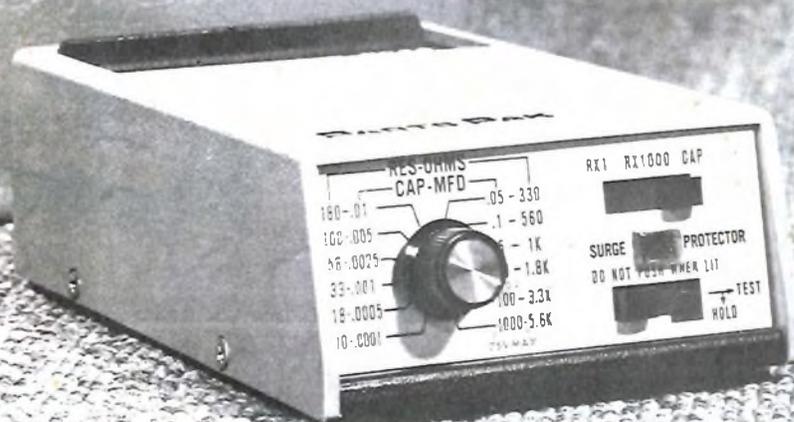
OR  
VICE

*"the tube caddy janitor"*

ES and  
SISTORS

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**RC24  
PARTS PAK  
\$38**



Norm Pedersen

This issue introduces another great service aid for your caddy, the RC24 Parts Pak. The RC24 Parts Pak is here now, ready to take its place in your tube caddy and help clean up that awesome mess of substitution parts that somehow always ends up scattered all over the caddy. This compact, self-contained parts storehouse gives you an assortment of the common parts needed for substitution, right at your fingertips.

Another important feature in this issue is more operation and interpretation information on scopes, the subject about which we receive most questions and letters.



Bart Herheim  
(Project Engineer)

The scope article takes you completely throughout the operation of the PS163 Dual Trace Oscilloscope and KEY WAVEFORMS found in a color receiver. Each of the key waveforms is explained and the important areas to watch are pointed out. Must reading if you have questions on scope usage and interpretation.

Now our feature instrument, the RC24 Parts Pak - "the tube caddy janitor".

- 2 - 450 volt (+100 -20%) electrolytic capacitors: 10 and 100mfd
- 1 - 75 volt (+80 -20%) 1,000MFD electrolytic capacitor
- Size: 6½ X 4¼ X 2¼
- Weight: 2 pounds
- Price: \$38.00

The Parts Pak also boasts two Sencore exclusives; a Surge Protector to prevent arcing and healing of electrolytics and an Overload Indicator to protect the low voltage electrolytic. The extra long test leads tuck neatly away inside the lead storage compartment so there are never any messy, tangled leads in the caddy. The tug-proof test leads are permanently attached to the unit so you will



Long test leads put the substitute part where you need it - fast!

always have them with you. The Parts Pak is designed for tough, day-to-day use with an unbreakable PVC Acrylic case on a 20 gauge vinyl-clad steel chassis, just like Little Henry. The Parts Pak is truly a Tube Caddy Janitor; keeping the caddy neat and clean and being your handy man for every substitution need.

### WHAT'S THIS SURGE PROTECTOR?

The Surge Protector is a special switching circuit used to prevent arcing and healing of electrolytics when making substitution. Here is why it is used.



Exclusive Surge Protector makes electrolytic substitution a sure and reliable servicing procedure.

You have probably experienced the unnerving situation of substituting an electrolytic in an

## RC24 PARTS PAK - YOUR TUBE CADDY JANITOR

The Age of in-home service is upon us! The industry wide trends toward modular construction of receivers and the use of plug-in transistors and integrated circuits are causing many changes in the service field. The increasing number of units requiring service has caused many dealers to look toward ways of doing more in-home service rather than bringing the set to the shop. The increased emphasis placed on in-home service by the replaceable panel or module has caused more thinking along the lines of "fix it in the home" on all other home entertainment equipment as well.

This trend has caused Sencore to take a long look at what type of equipment is needed and desired for this type of service. The answer to some of these needs has led to the design of the CG22 Caddy Bar Jr., color generator and the FE23 Little Henry Portable Field Effect Multimeter.

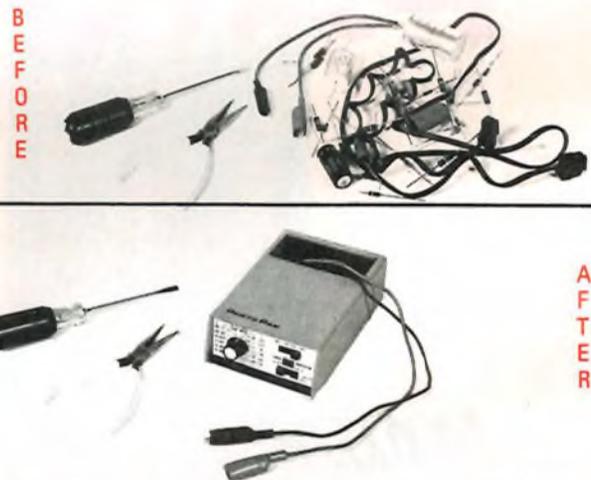


The beginning of a new generation of test equipment designed for your caddy; FE23 Little Henry and CG22 Caddy Bar Jr.

Each of these instruments has been designed to fill the needs of in-home servicing. These portable instruments allow you to do more troubleshooting in the home, conveniently, than ever before.

There is a need, however, for a readily available supply of components for substitution checks. The large shop units made for this purpose are generally cumbersome and awkward to carry along on call. Another alternative is to keep a supply of these small parts in your caddy to use when the need arises. However, this can often create more problems than it solves. Loose parts in the caddy, many which must have long leads attached for substitution, can create a mess beyond belief! Picture for a moment your normal caddy items of tools, cheater cords, tubes, replacement transistors and other miscellaneous parts and then throw in about 35 assorted resistors, capacitors and electrolytics to find their home among the other items. Now try to find what you want! You would need a full time janitor just to keep the caddy organized.

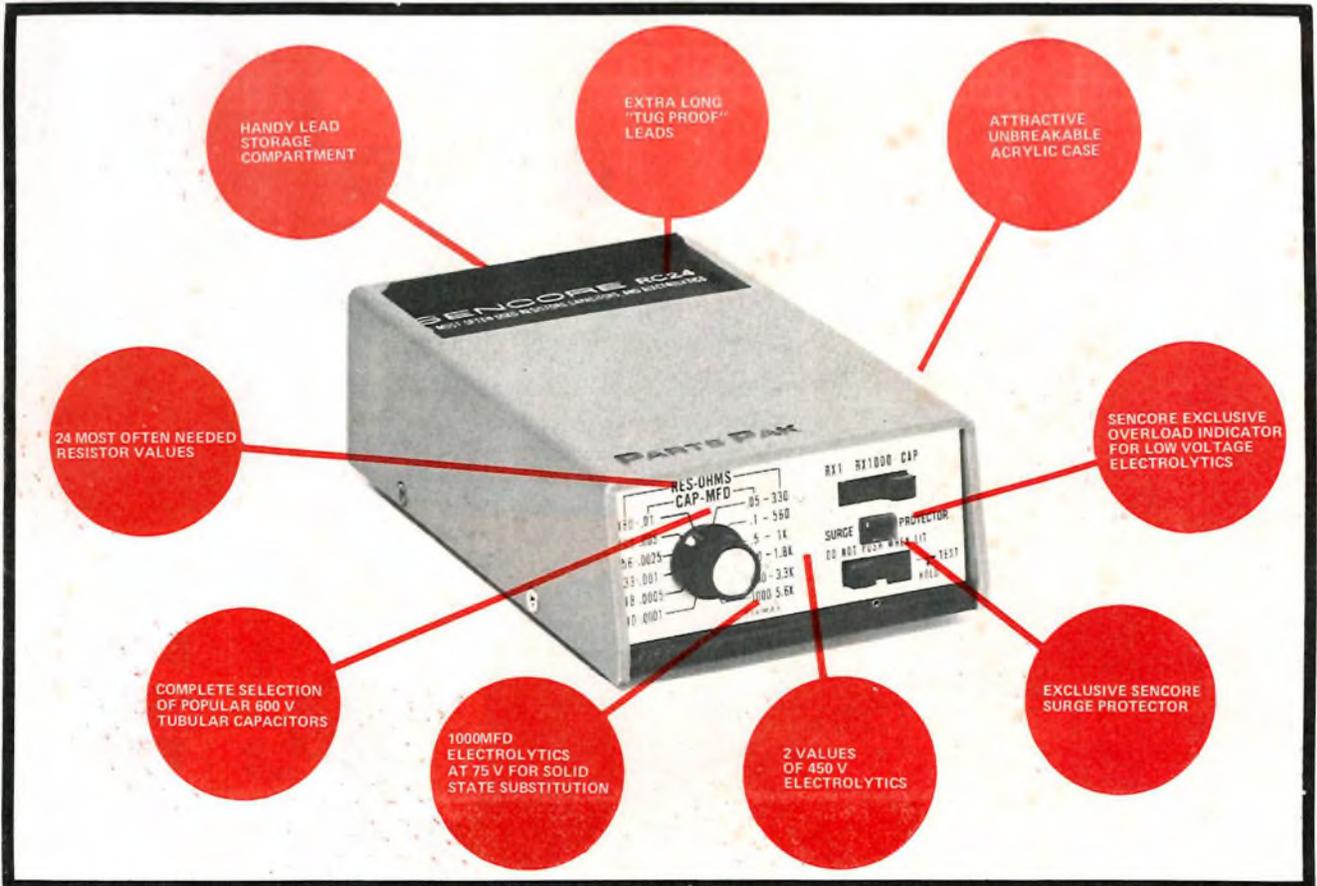
Here is your Tube Caddy Janitor! The Sencore RC24 Parts Pak is our answer for your need of a



Parts Pak will help clean up your caddy and make your work easy. ready source of in-home substitution parts, without cluttering up your tube caddy. This small, handy package will drop right into your tube caddy to provide you the 36 most often needed resistors, capacitors and electrolytics.

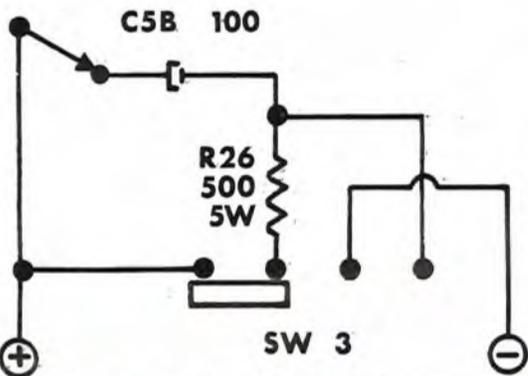
### SPECIFICATIONS

- 12 - 1 watt, 10% carbon resistors: 10, 18, 33, 56, 100, 180, 330, 560, 1K, 1.8K, 3.3K, 5.6K
- 12 - ½ watt, 10% carbon resistors: 10K, 18K, 33K, 56K, 100K, 180K, 330K, 560K, 1Meg, 1.8Meg, 3.3Meg, 5.6Meg
- 9 - 600 volt, 20% tubular capacitors: .0001, .0005, .001, .005, .0025, .01, .05, .1, .5mfd



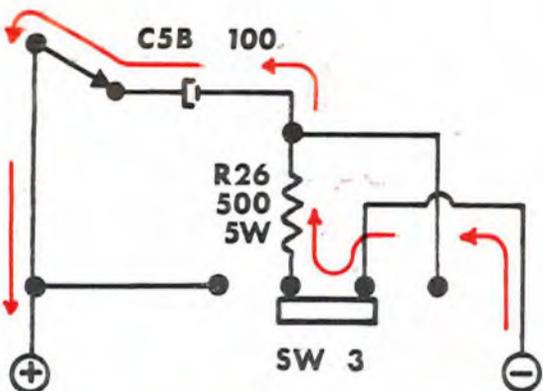
attempt to locate the trouble in a receiver, only to find the trouble gone when you remove the substitute part. This leaves you completely at loose ends as to what to do. You can either wait for the trouble to reoccur, which may take from minutes to months, or you can replace the electrolytic you subbed and hope that it was the cause of the problem. It is normal to assume that the capacitor to which you were connected is the one "healed" by the substitution, but this is not always the case. The surge current drawn when the substitute capacitor was connected could have temporarily healed another component in the set.

The Surge Protector is incorporated in the Parts Pak to prevent this kind of situation. The electrolytic being used for substitution is not connected to the circuit until the Surge Protector switch is moved to the TEST position.



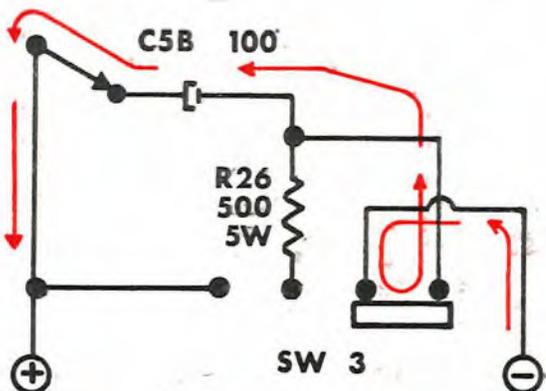
Capacitor is not in circuit until SURGE PROTECTOR switch is moved to TEST position.

When the electrolytic connection is made with the Surge Protector switch, a 500 ohm 5 watt resistor is temporarily connected in series with the capacitor to prevent the large, healing surge of current in the circuit. A 56 ohm 1 watt resistor is used as the surge limiting resistor for the 1000mfd capacitor.



Surge limiting resistor is added in series with capacitor as SURGE PROTECTOR switch is moved to test position.

These resistors are large enough to allow an RC charge of the capacitors rather than the sudden, high charging current that would be present without the surge limiting resistors. When the Surge Protector switch is moved fully to the TEST position, the resistors are switched out of circuit to prevent any interference with the test being made.



Surge limiting resistor removed when SURGE PROTECTOR switch is in TEST position.

The HOLD position on the Surge Protector switch allows the substitute electrolytic to be left in the circuit for additional tests or troubleshooting.

## RX1 RX1000 GAP



## SURGE PROTECTOR

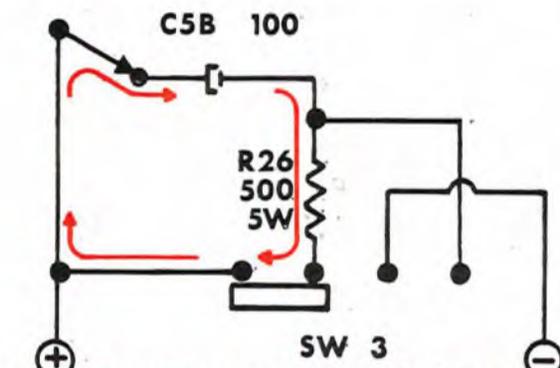
DO NOT PUSH WHEN LIT



TEST  
HOLD

HOLD position of SURGE PROTECTOR switch allows capacitor to remain in circuit for tests.

The Surge Protector also automatically discharges the electrolytics when the spring loaded switch is returned to the normal "out-of-circuit" position.



Capacitor is discharged when SURGE PROTECTOR switch is returned to normal position.

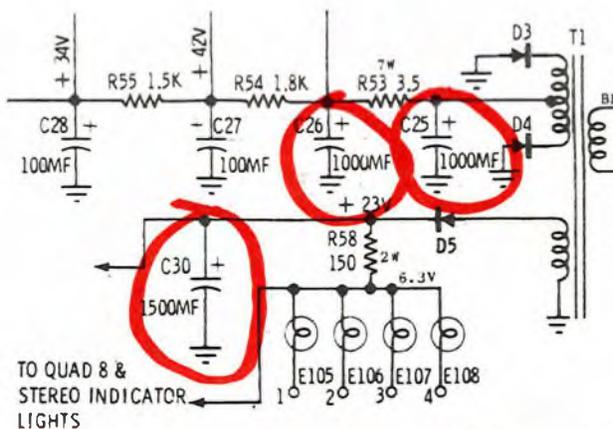
This eliminates both the shock hazard normally present with electrolytic capacitors and also the possibility of applying a large potential stored in the electrolytic to another circuit operating at a lower voltage. The spring loaded switch assures removal of the electrolytic from the circuit when the switch is released and fully discharges the capacitor at the same time. This keeps you from experiencing a shocking surprise the next time you pick up the test leads. The Surge Protector is, in many ways, your protector.

## WHY THE BIG 1000MFD ELECTROLYTIC?

The 1000mfd capacitor has been included to permit substitution of electrolytics in solid state circuits.

Solid state circuits typically operate at low voltages and require better filtering than do tube circuits. The solid state devices used as amplifiers, detectors, oscillators, and the like, are far more susceptible to ripple in the power supply than are their tube counterparts.

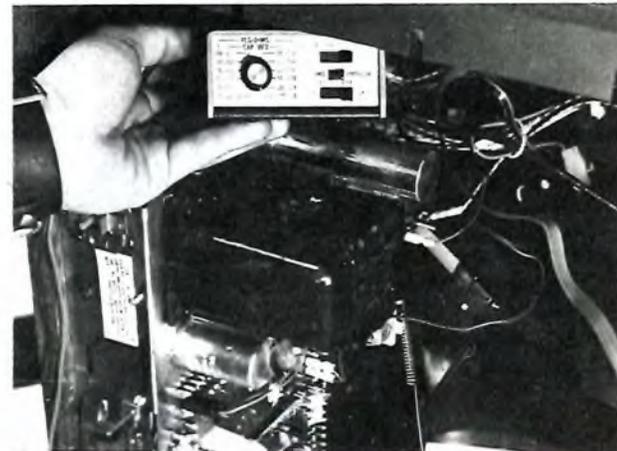
The lower voltage used in these circuits allows the manufacturer to design in larger capacitors



Solid state equipment uses many large value, low voltage electrolytics.

for better filtering. The large capacitors are also used frequently in coupling applications, especially audio amplifiers, to better the low frequency response. In order to completely check power supply and coupling circuits in this solid state equipment, the technician needs some way to isolate defective electrolytics.

The 1000mfd 75 volt capacitor is included in the RC24 Parts Pak to make in-home checks by substitution of these parts. The value used has been selected as an average value which will provide sufficient capacity for all applications. If hum is present, or a bad coupling capacitor is suspected, just grab the Parts Pak and you have the capacitor



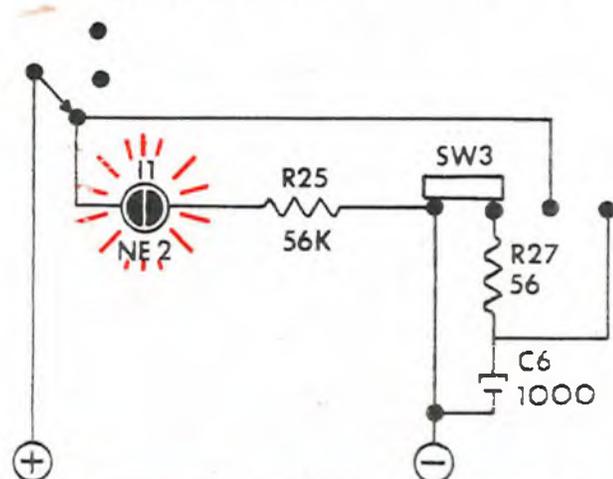
1000mfd electrolytic in PARTS PAK means easier troubleshooting in the home.

you need for the job. Locating and replacing these easy-to-change parts in the home can save valuable time for the technician. Customers will also be more satisfied when the set does not have to go to the shop for service. The Parts Pak lets you win in both ways.

## WHAT IS THE OVERLOAD INDICATOR FOR?

The red Overload Indicator light warns you if an unsafe condition exists when you are using the 1000mfd, 75 volt capacitor.

The biggest problem that you encounter when substituting low voltage electrolytics is the possibility of circuit or component damage. This can occur if the connection is made to a point with a voltage present that is higher than the rating of the capacitor. Typically, voltages in solid state circuits are 75 volts or less.



Exclusive OVERLOAD INDICATOR shows immediately when circuit voltage exceeds 75 volt rating of capacitor.

The Overload Indicator on the Parts Pak is a safety circuit to warn you when the voltage applied to the Parts Pak leads, with the selector set for the 1000mfd electrolytic, exceeds the 75 volt rating of the capacitor. The indicator is a neon lamp with additional circuitry to preset its "fire" point at 75 volts. This red "stop" light alerts you to the fact that the voltage present at

## RX1 RX1000 GAP



## SURGE PROTECTOR

DO NOT PUSH WHEN LIT



TEST  
HOLD

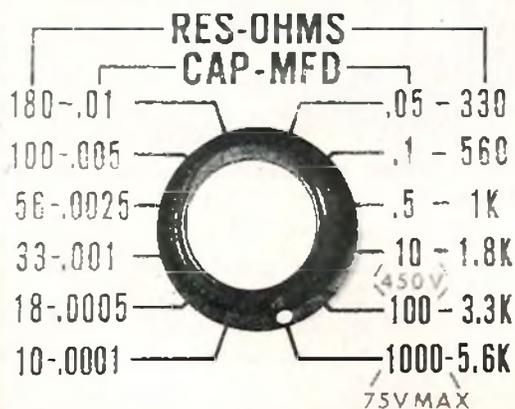
Red "stop" light glows brightly to warn of high voltage on test leads.

the point to which the test leads are connected could be damaging to the electrolytic. This safety feature helps prevent accidental overload of the capacitor.

The Overload Indicator is another Sencore feature to give you better and safer servicing instruments, and to protect you and the equipment you are working with.

## WHY RESISTORS AND CAPACITORS?

The full complement of components supplied in the Parts Pak gives you ready resistors and capacitors for any substitution need you may have.

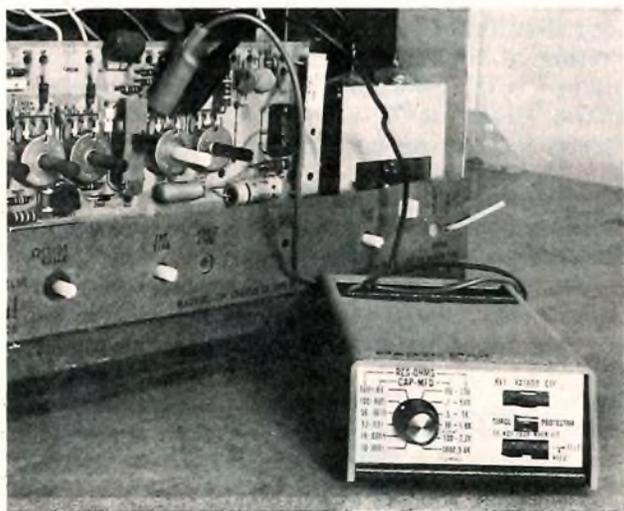


Simply turn the switch and you have the common values of resistors and capacitors ready for substitution - anywhere.

Many problems in a set can be quite obvious in the home and still the set is taken to the shop for repair. This is usually done when substitution parts are not handy to isolate the problem. Example one: TV set with very narrow vertical sweep. Vertical linearity control has no effect. Height control will vary sweep somewhat. Suspect vertical linearity control open. Set pulled to shop for repair. Example two: No video, visibly charred resistor in video amplifier circuit. Set pulled to shop for repair. Example three: No sound on one channel of a solid state stereo; no output hum when input is touched with screwdriver. Transistors check good in-circuit. Set pulled to shop for repair.

These three situations are typical of many which occur every day that could be resolved in the home with a minimum of time and troubleshooting effort. Let's put the RC24 to work with its full stock of resistors and capacitors and see what we can do.

Example one: Vertical linearity problem. Clipping the resistor section of the RC24 across the suspected bad vertical linearity control shows a marked change in the vertical sweep. Adjusting the RC24 for a value of 100K returns the sweep to a nearly normal raster. Vertical linearity pot definitely bad. Inform customer of situation and bring correct part to complete job during calls next day.

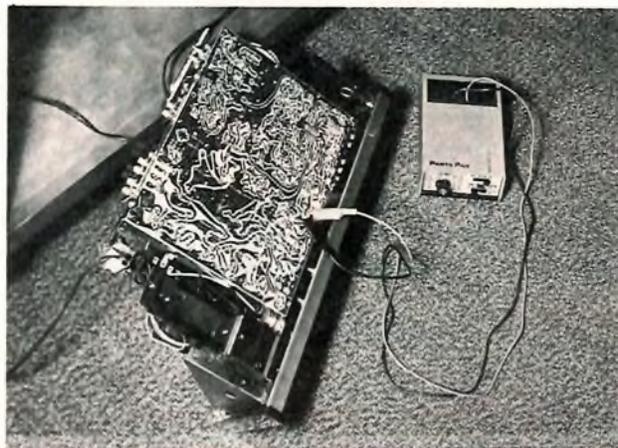


Verification of a defective control in the home saves hauling the chassis to the shop - and saves your back.

Example two: No video and charred resistor. Checks determine the video amplifier tube good. Ohmmeter shows very low resistance to ground from one end of the charred resistor. Bypass capacitor lifted and checks shorted. Value of the

screen resistor unknown. Call the shop and have the value of resistor looked up on schematic. Check set operation with substitute resistor from Parts Pak before making any final changes and picture returns. Install screen resistor and new bypass capacitor and the problem is licked.

Example three: Stereo with no sound on one channel. Thumb-on-the-screwdriver method of signal injection on base of pre-driver and pre-amp produces hum from the speaker. No hum from top of volume control. Quick check with Little



Your Parts Pak and a few minutes time solves the simple ones in the home!

Henry Multimeter shows normal voltages on the pre-amp compared with other channel. Open coupling capacitor? Dial the proper value on the Parts Pak and connect across capacitor between volume control and pre-amp. Normal sound returns. Replace the coupling capacitor and you're on your way. Another one done.

Many other similar examples could be shown to point out how a simple substitution resistor or capacitor can find the problem and help you get the set going in the home. It takes just a few minutes longer than finding and replacing a bad tube or transistor, but is far less time than would be involved in removing the chassis and taking it to the shop for repair. Even after it is repaired in the shop, another trip to the home is necessary to reinstall the chassis. This takes time and usually raises the bill for the customer. If it happens to be a chassis from a theater, often the customer is without any form of entertainment until the chassis can be worked into the shop schedule and returned. The RC24 Parts Pak can definitely pay big dividends by reducing the shop load on these simple problems, and by obtaining greater customer satisfaction.

## HERE'S HOW THE RC24 PARTS PAK CAN PAY

We will use one of the examples just mentioned to show how the RC24 Parts Pak can add to your profits; Example three: the stereo amplifier.

## SENCORE ANNOUNCES NEW 5 YEAR RUST-PROOF WARRANTY

R. H. Bowden, Sencore President, has just announced a new, exclusive 5 Year Rust Proof guarantee on all Sencore Test Instruments effective January 1, 1973. This new warranty covers all current Sencore instruments, including those presently in distributor inventory.

In making the announcement of the Rust Proof warranty, Mr. Bowden stated that Sencore continually strives to provide the service industry with the finest quality instruments, professional in both performance and appearance.

"Much of the public image of the service industry is based on the first impression of the technician and his equipment. The use of attractive, durable, rustproof materials in the manufacture of Sencore equipment is our contribution to enhance the image of the service industry."

Mr. Bowden further stated that the professional appearance of Sencore equipment is maintained by using

materials that are completely rustproof for cases, panels and trim. These materials include new PVC Acrylics, aluminum, vinyl clad steel and specially finished metals. The internal parts such as brackets, supports, and mounts are also manufactured from special, rust-proofed steel.

### HOME REPAIR

SERVICE CALL = \$12.50 (for 30 minutes)

TROUBLESHOOT AND REPLACE PART = \$5.00 (for additional 20 minutes)

PICKUP AND DELIVERY = No cost

TOTAL CHARGED CUSTOMER EXCLUDING PARTS = \$17.50 (Time: 50 minutes)

TECHNICIAN WAGES @ \$4.00/hr. = \$3.35

TOTAL INCOME = \$14.15

INCOME PER HOUR = \$17.00

### SHOP REPAIR

SERVICE CALL = \$12.50 (20 minutes spent in checking and removing chassis)

TROUBLESHOOT AND REPLACE PART = \$10.00 (Minimum charge, time - 30 minutes)

PICKUP AND DELIVERY = \$2.50 (normal charge) distance 5 miles one way. Time: 60 min.

TOTAL CHARGED CUSTOMER EXCLUDING PARTS = \$25.00 (Time: 1:50)

TECHNICIAN WAGES @ \$4.00/hr. = \$7.35

TOTAL INCOME = \$17.65

INCOME PER HOUR = \$9.60

The customer receives a much lower bill, the profit on the service is higher, and the shop workload is reduced. These are all good steps to greater profits. (The cost for the part and cost of operating the service vehicle for the initial call have been omitted since these would be the same in both cases.) Another profit factor that could also enter in but was not figured is the volume of shop output versus profit if the simple problems are corrected in the home.

We have learned many things working with Sencore and one is that we have become better businessmen. The figures here look like good business and all it takes is a small stock of some of the commonly used or common failure parts in the truck, and a Parts Pak. The Parts Pak can pay for itself in just a few calls by increasing the overall efficiency of your men on the road. Your distributor has them in stock; stop in and pick one up and give it a try. See just how big an asset the tube caddy janitor can be.

The new warranty states that if any part of any Sencore unit purchased after January 1, 1973, develops rust, regardless of climatic or environmental conditions, it will be replaced without charge. The 5 year rust proof warranty is in addition to the standard 90 day Sencore Warranty on parts and service.

As a close to his announcement, Mr. Bowden promised "Sencore will continue in our efforts to provide the service industry with the highest quality test equipment. We believe instruments that maintain their professional appearance throughout many years of rugged day-to-day use speak highly of this quality."

Mr. Bowden further stated that the professional appearance of Sencore equipment is maintained by using

## KEY WAVEFORMS -

### YOUR KEY TO FASTER COLOR SERVICING

One of the test instruments that has been around the longest and is often the least used is the oscilloscope. The usual causes for this lack of usage of one of the best troubleshooting tools available to the service industry are difficulties in operation, and interpretation.

The first of the two areas is the easiest to overcome. The oscilloscope can be likened to a combination of the television receiver and the VTVM or FE meter. The vertical input controls are the equivalent to the FE meter, allowing range adjustment for varying levels of input signal. The display controls are very similar to their television receiver counterparts. Intensity, focus, positioning and sweep controls all have direct counterparts in the television receiver. This comparison, as you look at the controls and their function on the PS163 Dual Trace Triggered Sweep oscilloscope, should help simplify the operation of a scope. Let us take a close look at the PS163 and its controls to point out their purpose.

The function of the majority of the controls should be quite easy to follow, since they correspond to the "convenience" controls of the television receiver. The sweep controls are usually

the ones to cause some concern for those who have not had a great deal of experience with the scope.

The CRT display is usually adjusted to obtain one to two cycles of the waveform to be checked. This is done by adjusting the sweep controls to a frequency equal to (for one cycle) or one-half the frequency of the input signal (for two cycle display). Sync polarity is normally set to correspond to the polarity of the input signal being displayed, negative if the sync pulses or other pulse information is negative going and positive for signals containing positive going information. Sync level controls are then adjusted for a stationary display. The PS163 Dual Trace Triggered Scope used for the waveforms in this article makes moving up to a triggered sweep scope very easy for you. With the free running sweep capability, you can always go back to the system you know if you should encounter difficulty in the triggered sweep mode. A little time spent in becoming familiar with the scope and you will be using it like a pro.

The oscilloscope was designed to allow observation of the effects of electron flow in circuits.

Every circuit has some characteristic signal present and observation and measurement of this signal will tell you many things about the circuit performance. Let us look at what we call 10 KEY WAVEFORMS in a color receiver. We will try to point out for you some of the key points associated with these waveforms to help you improve your utilization of the scope in troubleshooting.

The waveforms shown were taken with the PS163 Dual Trace scope, combined with a scope camera. The PS163, designed specifically for the television service industry, provides the stability and sharp, clean traces needed for fast troubleshooting. The waveform photos used here are vivid proof of the capability and performance of the PS163. The receiver used was a Magnavox T950 hybrid color chassis. The KEY WAVEFORMS found in other color receivers, whether tube or solid state, will be very similar, with the only major difference being in the polarity or amplitude. The service literature supplied with the receiver will give the normal amplitude of the various signals to aid you in troubleshooting the receiver. Station signals were used for those waveforms most often viewed with the transmitted signal present. Signals taken in the color circuits were obtained with the Sencore CG159 Color King III color bar generator as the signal source.

(Continued on page 6)

**VERTICAL INPUT SWITCHES:** Select the input to be displayed on the CRT and the manner in which dual inputs are presented. A and B pushbuttons provide single trace display of channels A and B respectively. Dual Alternate and Dual Chopped select the dual trace modes, a must for accurate comparison of time and phase relationships in color circuits. Dual Alternate mode is for dual display of higher frequency inputs by alternating the sweep between the inputs to be displayed, and Dual Chopped to display lower frequency signals. The Dual Chopped mode switches between the two input signals at a 100KHz rate to provide steady display of low frequency signals and eliminate trace "blinking". Vector - A&B Inputs switches the B channel input to the horizontal amplifier to convert to an X-Y or Vectorscope for vector troubleshooting.

**VERTICAL INPUT ATTENUATORS:** Calibrated switch positions allow adjustment of the height of the display for convenient viewing and also make possible accurate peak to peak voltage measurements. Peak to peak measurements made directly from CRT graticule for easy waveform checks. Vernier control in center of switch permits uncalibrated adjustment of signal level between fixed position of switch.

**AC-DC COUPLING SWITCH:** Chooses AC or DC coupling of the input signal to the vertical amplifiers. AC used most for viewing and measurement of AC signals, DC used to make quick DC voltage checks while observing waveforms. Ground position used to remove signal input while adjusting reference position of the trace for DC measurement.

**TRACE POSITION:** Provides vertical positioning of both channels during operation as a single or dual trace oscilloscope and horizontal positioning of B channel when in Vectorscope operation.

**SCALE ILLUMINATION:** Light switch for graticule illumination. Choose lighted 10 X 10 centimeter grid, lighted vector grid, or no illumination with the flip of the switch.

**FOCUS:** Adjusts beam spot size to provide sharp, clear displays.

**INTENSITY:** Adjusts brilliance of CRT display for convenient viewing.

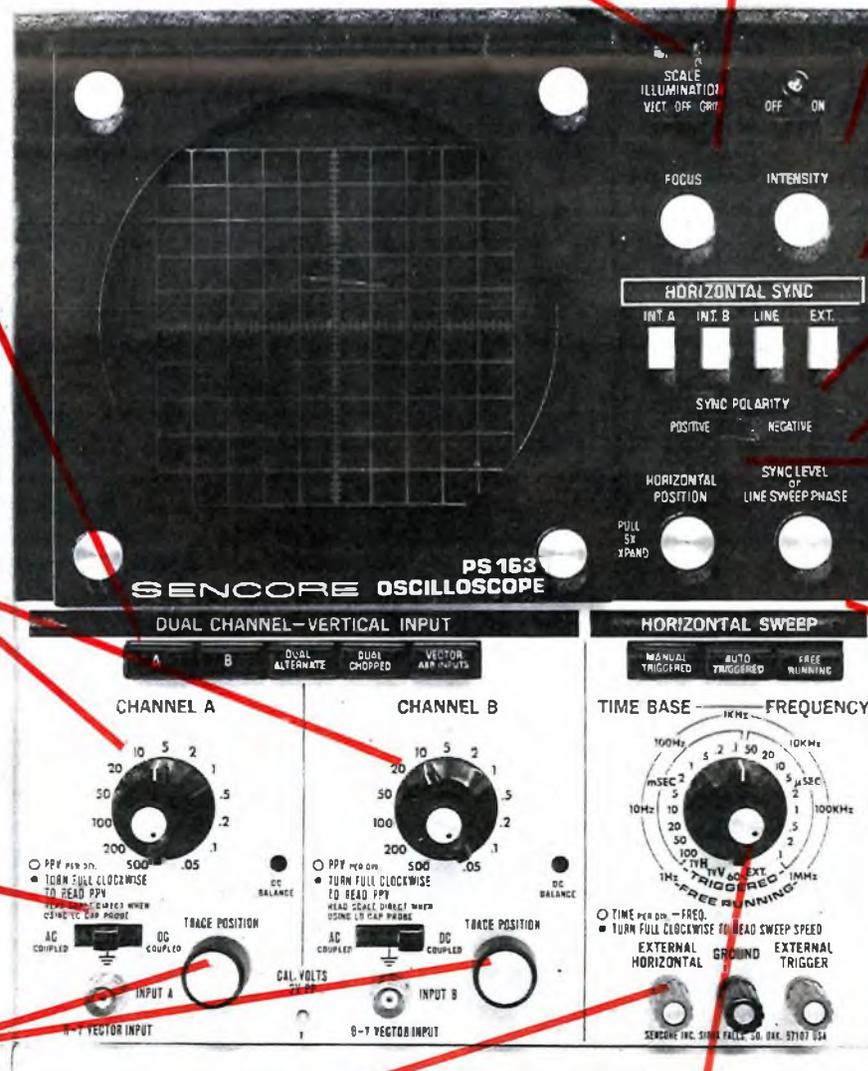
**HORIZONTAL SYNC:** Pushbutton switch selection of sync source. Int. A and Int. B select the respective input signal as the source of sync information. Line position uses a sync signal picked up from the AC line input and EXT. position allows a separate signal to be applied to the External Trigger input jack for synchronization.

**SYNC POLARITY:** Selects polarity of sync pulses taken from sync input signal.

**SYNC LEVEL:** Adjusts the level and trigger point to maintain stable trace when operating in Manual Triggered mode. Control is adjusted until display is synchronized at desired point.

**HORIZONTAL POSITION:** Positions the CRT display horizontally on the CRT for centering or shifting the display for observation of waveforms. 5 times expand of trace horizontally accomplished by pulling out on control.

**HORIZONTAL SWEEP:** Switches select operation of horizontal sweep section of scope. Manual Triggered is triggered sweep operation with manual control over trigger level (Sync Level control). Auto Triggered presets trigger level and provides automatic operation of sweep without knob twisting to adjust sync. Free Running pushbutton converts oscilloscope from triggered to free running or recurrent sweep operation comparable to the sweep used in most service-type oscilloscopes.



**EXTERNAL INPUTS:** Scope grounding jack as well as input jacks for external sweep signal or external trigger (sync) signal.

**TIME BASE FREQUENCY CONTROL:** Switch selection of horizontal sweep speed, accurately calibrated in sweep time in triggered modes of operation. Frequency called out for use in Free Running sweep. Special TVV and TVH positions permit fast troubleshooting in television receivers. The preset sweep positions for television vertical and hori-

zontal rates include a special sync separator to assure rock solid displays of the complex waveforms present in color television. Additional positions for line and external sweep included for sweep alignment simplicity. Vernier control in center of switch permits uncalibrated sweep speed adjustment between fixed positions of switch.

PS163 DUAL TRACE TRIGGERED SWEEP OSCILLOSCOPE

Okay, the 10 KEY WAVEFORMS and what to look for.

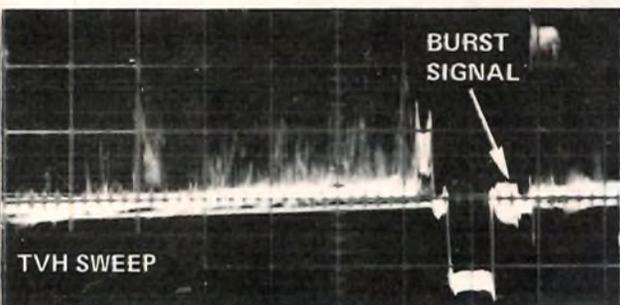
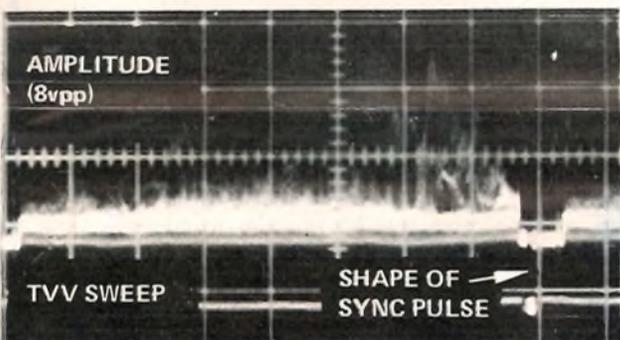
## KEY WAVEFORM ONE

The video detector output is probably the most commonly used test point in the TV set, whether it is black and white or color. The waveform present here will give information about several sections of the receiver at one time. It will show how well the RF/IF, AGC and detector stages are working. The amplitude of the signal, compared to the normal signal level given on the schematic will help determine if the gain of the RF and IF stages is normal.

The amplitude and shape of the sync signal will give an indication of AGC action. Before we show you a couple of bad signals, we should explain what the good signal really tells you.

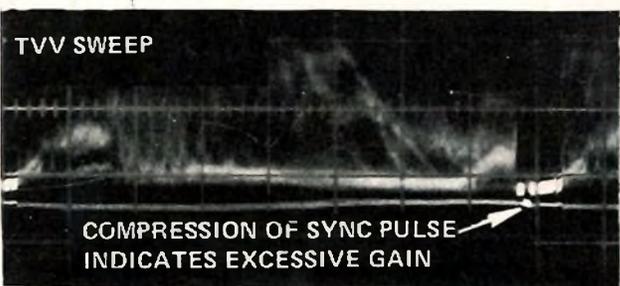
- Check 1 Amplitude-determines the gain of preceding stages.
- Check 2 Shape and Amplitude of sync pulses-Sync pulses should represent about 25% of the total amplitude of the signal. Good check on AGC and RF/IF performance.
- Check 3 Color Burst signal - Must be present or no color! Not too many reasons why it shouldn't unless trap alignment is way off.

The TVV and TVH positions of the PS163 TIME BASE/FREQUENCY control were used to display the signals shown. These are special positions, preset to the horizontal and vertical sweep



rates, and include sync separators for positive syncing on the complex video signals. The TVV and TVH positions are real timesavers when troubleshooting. They eliminate all the knob twisting and sync adjustments needed on other scopes to view the vertical and horizontal sync pulses in succession.

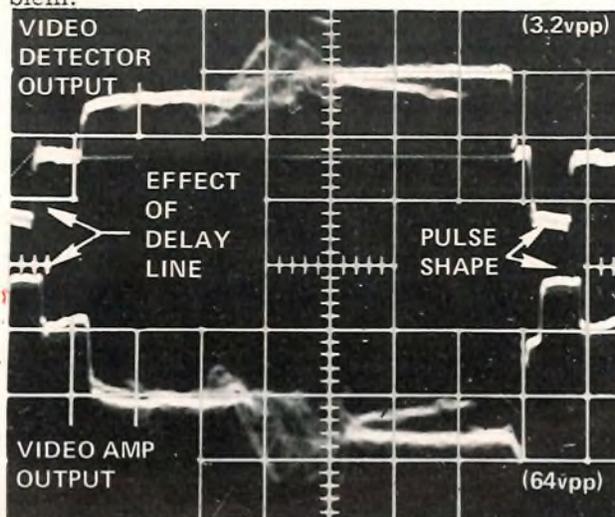
Now lets look at a bad waveform to point out how you can isolate problems.



Notice how the sync pulses are clipped compared to KEY WAVEFORM ONE. This usually indicates excessive gain or AGC trouble. This can also be caused by high grid leakage or I<sub>CBO</sub> leakage in RF or IF sections or another factor influencing bias within those sections. Look for leakage and AGC problems first.

## KEY WAVEFORM TWO

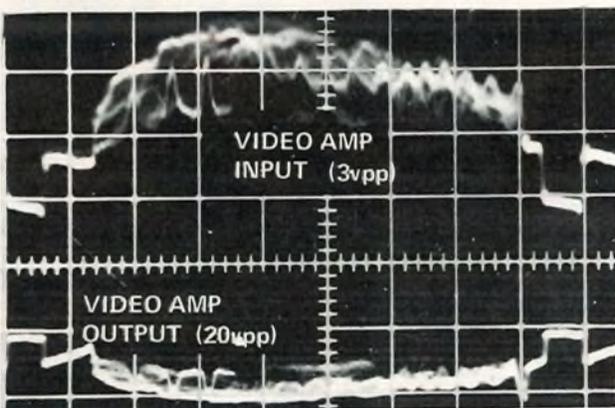
The video output signal allows observation of the quality of video information applied to the CRT. In cases when the black and white video information (Y signal) produces a poor display on the CRT, (smearing, lack of contrast, ringing, grainy picture, etc.) the output signal compared to the video detector signal will aid in isolating the problem.



The waveform shown is representative of the typical waveform to be found at the video output. The amplitude will vary considerably depending on adjustment of contrast control.

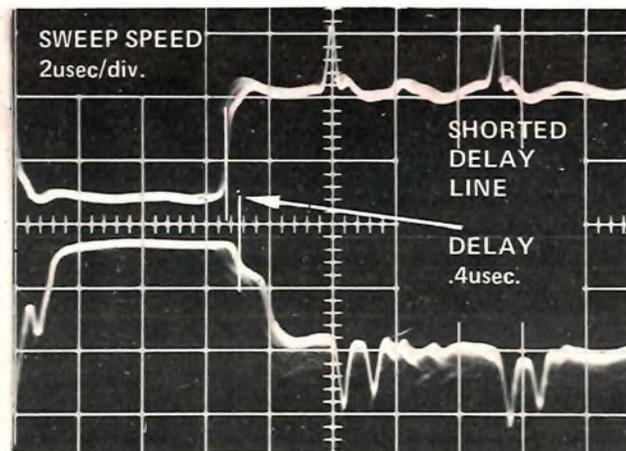
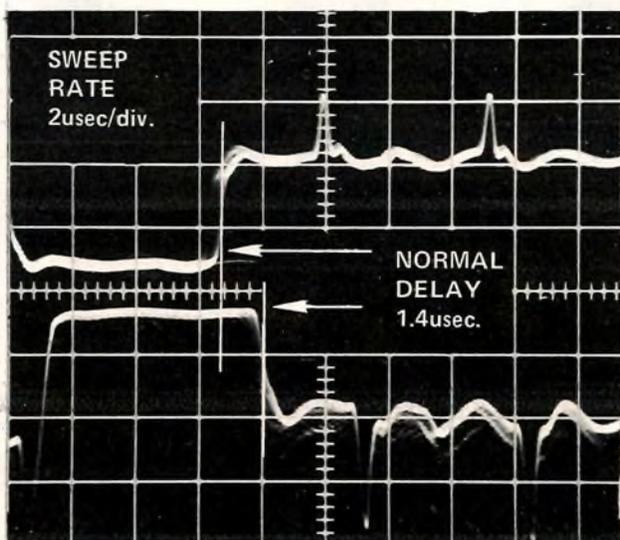
- Check 1 Amplitude - Determines amplification characteristics of video stages.
- Check 2 Shape of sync and blanking pulses - aid in locating section causing signal degradation.
- Check 3 Time comparison to video detector for proper delay line action.

What do incorrect waveforms look like and what do they tell us? The first waveform shows the effects on the output signal amplitude caused by



low gain. The appearance of the picture on the receiver was "washed out" and lacking in contrast. The cause of the problem in this case was an open 100mfd bypass capacitor in the cathode of the video amplifier tube.

The second set of photos show the effects of a shorted delay line on the video detector vs video output waveform. As you know, the video information must be delayed for a few microseconds,



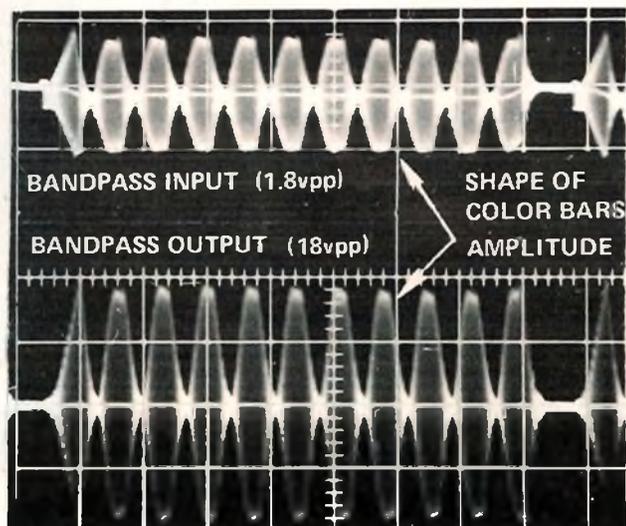
to allow time for signal processing in the chroma circuits. The waveform above shows the effects of a shorted delay line and essentially no signal delay. The result on the screen is much the same as severe ghosting caused by poor reception. The color image will be misplaced to the right of the black and white image.

The 5X expand feature of the PS163 was used to show, in greater detail, the actual amount of signal delay provided by the line and to point out the change which took place when the delay line was shorted out. The PS163 with both triggered sweep and dual trace display, simplifies troubleshooting of this kind of problem. It would be virtually impossible to see the action of the delay line on any other kind of service scope.

## KEY WAVEFORM THREE

In order to have good color reproduction, the bandpass amplifier section of the chroma circuits must be able to provide sufficient signal to the color demodulators. A quick check of the output of the bandpass amplifier, with a low capacity probe as supplied with the PS163 to prevent loading, will give you immediate indication of its performance.

- Check 1 Amplitude
- Check 2 Presence of clean color bars
- Check 3 Shape of color bars (bandpass alignment)



The TVH sweep position was used to display the chroma waveforms shown, with synchronization obtained externally. External trigger input is provided on the PS163 to give solid displays for those video or chroma signals without the normal sync pulses. The external trigger signal at the horizontal rate is easily picked up by placing a lead from the EXTERNAL TRIGGER INPUT jack to some area near the horizontal output tube, or horizontal lead to the deflection yoke. A direct connection to the set is not normally needed as the radiated horizontal signal from these areas is of sufficient strength to give good sync.

The waveform shown below was taken with set symptoms of weak color. The amplitude of the output waveform is only a fraction of the normal signal present at the output; the input signal is normal. This quickly points to a problem in the bandpass amplifier circuit or the color killer stage

# SENCORE

THE ONLY COMPLETE TEST EQUIPMENT LINE THAT IS  
**ALL AMERICAN MADE**

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- HIGH FILTERING ASSURES VIRTUALLY DC OUTPUT. A must when powering solid state and integrated circuit units.
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- FILTERED 6 and 12 VOLT HIGH CURRENT OUTPUTS give you hum-free operation of car radios, tape players and other units requiring high power.

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### AM-FM-Stereo Analyzer

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THE ONLY INSTRUMENT THAT PRODUCES ALL 12 SIGNALS YOU NEED FOR COMPLETE STEREO SERVICING



- AM and FM RF OUTPUT variable over full range of both FM and AM broadcast frequencies for complete RF troubleshooting.
- AM and FM IF OUTPUT, modulated or unmodulated for any alignment or troubleshooting need.
- FM IF SWEEP and MARKER GENERATOR to do the complete job.
- COMPLETE STEREO GENERATOR with MPX output available on both FM RF and IF, plus composite stereo output without carrier for direct injection. High level outputs provided for IHF tests.
- AUDIO GENERATOR producing 400Hz sine and square wave signals for amplifier troubleshooting.
- SEPARATION METERS and SPEAKER SUBSTITUTE — Meters tell at a glance the operation of the MPX decoder. High wattage dummy speaker loads eliminate that annoying howl in the shop.

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### Automatic Transistor Analyzer

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TESTS OVER 20,000 TRANSISTORS - IN CIRCUIT, AUTOMATICALLY, IN SECONDS WITHOUT A REFERENCE BOOK.

- DYNAMIC IN-CIRCUIT AC TESTS for both transistors and FET's. No need to waste time removing components or risking transistor damage from soldering iron heat.
- AUTOMATIC OPERATION — The push of a button sets all test conditions automatically. Ends guesswork and the need for reference books or transistor data sheets.
- FULL PUSHBUTTON OPERATION for the fastest, easiest transistor testing ever.
- EASY TO INTERPRET GOOD - ? - BAD SCALE — Tells you transistor condition at a glance. Calibrated Beta and Gm scales too.
- DC OUT OF CIRCUIT TEST for 100% testing capability. Only the Sencore TF166 gives you both AC and DC tests for fast problem solving.
- LEAKAGE TESTS for transistors (Icbo) and FET's (Igs) with direct read-out in microamps of leakage current.
- ZERO BIAS Idss TEST FOR FET's — A must for matching FET's in cascode circuits and industrial applications.
- SAFE, LOW LEVEL TESTS — Patent pending circuits give sensitive, accurate test without any chance for transistor or circuit damage.

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- 24 VALUES OF RESISTORS from 10 ohms to 5.6 megohms in 1/2 and 1 watt.
- 9 VALUES OF CAPACITORS from 100pf to .5mfd at 500 volts.
- 3 ELECTROLYTICS: 10 & 100mfd at 450 volts, 1000mfd at 50 volts.
- LEAD STORAGE COMPARTMENT to prevent lost or tangled leads.



SMALL AND LIGHTWEIGHT

**RC24 \$38.00**

### "The Substitutor"



**RC167 \$90.00**

SAVE TIME AND YOUR LEGS — PUT A FULL RANGE OF SUBSTITUTION PARTS AT YOUR FINGERTIPS

- 24 VALUES OF RESISTORS from 10 ohms to 5.6 megohms in 1/2 and 1 watt.
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- 7 ELECTROLYTICS from 2 to 200mfd at 450 volts
- 3 LOW VOLTAGE ELECTROLYTICS: 500, 1000 and 2000mfd at 75 volts.
- POWER RESISTORS from 2.5 ohms to 150K at 20 watts.
- UNIVERSAL selenium and silicon rectifier substitutes.
- NEW OVERLOAD INDICATOR to prevent accidental overload of low voltage electrolytics PLUS surge protection.
- SPACE-SAVING GIMBAL MOUNT Set on the bench or hang on the wall.
- EXCLUSIVE PARTS DRAWER to keep those little extras handy and save legs.

FAST REPLACING OLD FASHIONED VTVMs AND VOMs



## FE23 *Little Henry*



FIELD EFFECT  
MULTIMETER  
**\$85.00**



**FE16**  
**\$95.00**

Lab Accuracy  
1.5% DC  
3% AC

ACCURATE  
RUGGED

LESS CIRCUIT LOADING THAN VTVM. 15 megohms on DC, 10 megohms on AC.  
INSTANT STABILITY. Zero warmup time . . . ready with the flip of a switch.  
FULL METER PROTECTION to 100 times AC overload. No more damaged meters.  
SPECIAL SHIELDED INPUT LEADS prevent stray pick-up and erroneous readings.

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14 DC Voltage ranges from 1 volt to 1000 volts full scale, 7 negative and 7 positive.  
7 Zero Center ranges from .5 to 500 volts.  
7 AC Voltage ranges from 1 to 1000 volts full scale.  
5 DC current ranges from 100 microamps to 1 ampere full scale.  
5 Resistance ranges from 1000 ohms to 100 megohms. 10 ohms center scale.

THE TOUGHEST LITTLE METER IN THE WHOLE WIDE WORLD . . . WITH 1.5% FET ACCURACY AND PUSHBUTTON EASE OF OPERATION.

FULLY PROTECTED to 500 times overload

MINIMUM CIRCUIT LOADING with 15 megohm DC input impedance

AUTOMATIC SHUTOFF to prevent battery run-down

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ILLUMINATED meter is fully protected with exclusive sliding cover

SIMPLE PUSHBUTTON OPERATION

1.5% DC ACCURACY - 3% AC

## SENCORE FE METERS

Sencore pioneered the idea of using Field Effect Transistors to provide a high impedance, stable and reliable replacement for the troublesome and easily damaged VOMs and VTVMs. Many changes and improvements have been added since the first Sencore FE Multimeter was introduced. The newest FE meters are shown here. Each of these instruments has the same, high 15 megohm input impedance on DC which provides minimum circuit loading. The stability and accuracy of these instruments makes troubleshooting a pleasure rather than a task.

## TUBE TESTERS



**TC162** **\$115.00**

**MIGHTY MITE - THE WORLD'S MOST POPULAR TUBE TESTER.**

NEW PIN ELIMINATION SWITCHES eliminate normal shorts caused by internal connections.

CHECKS MORE TUBES THAN EVER BEFORE. Pin elimination allows tubes to be tested which could not be checked before.

FULL RATED CATHODE EMISSION TEST.

100 MEGOHM GRID LEAKAGE TEST.

SENSITIVE STETHOSCOPIC SHORTS TEST.



**MU150** **\$270.00**

**WORLD'S ONLY TUBE ANALYZER**

TRUE MUTUAL CONDUCTANCE TEST using a 500 Hertz square wave for true tube test.

TWO TESTERS IN ONE. The MU150 can be used to make the Mighty Mite tests as well as mutual conductance.

FULL RATED CATHODE EMISSION TEST.

100 MEGOHM GRID LEAKAGE TEST.

SENSITIVE STETHOSCOPIC SHORTS TEST.



**CR161** **\$150.00**

**NEW CRT AUTO-TRACKER WITH COMPUTER MEMORY CIRCUITS.**

PATENTED PUSHBUTTON AUTOMATIC TRACKING TEST. Simply push a button to make the previously complicated tracking test.

COMPUTER MEMORY CIRCUITS store CRT information for the tracking test.

CHECKS BLACK AND WHITE TUBES using the same procedure as color.

TESTS TRINITRON TUBES the same as domestic tri-gun tubes. Only one procedure for all tubes, all made possible through computer memory.

FILAMENT VOLTAGE now precisely set on meter.

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## HI-LO FIELD EFFECT MULTIMETERS — A New Concept in FE Meters

NOW . . . MEASURE RESISTANCES IN CIRCUIT IN SOLID STATE DEVICES  
WITH THESE HI-LO FIELD EFFECT MULTIMETERS.



**FE21**  
**\$115.00**

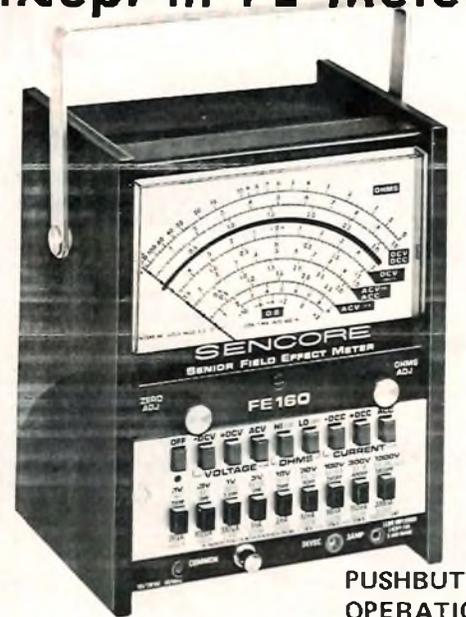
4½ INCH  
METER  
LAB OR  
BENCH



**FE20** **\$150.00**

with 30KV hi voltage probe

A  
SERVICEMAN'S  
DREAM



**FE160**  
**\$195.00**

PUSHBUTTON  
OPERATION  
with 7 inch meter  
112 RANGES  
AT YOUR  
FINGERTIPS

- **LOW POWER OHMS** using .08 volts to make in-circuit resistance measurements accurately. Allows you to use latest Howard Sams service information. Sams specifies it, only Sencore has it.
- **HIGH POWER OHMS** for routine resistance measurements and to check front-to-back ratios of diodes. Meters would not be complete with low power ohms only.
- **ONE-TENTH VOLT FULL SCALE** sensitivity on both AC and DC voltage. A must when servicing in solid state circuit with critical low voltage biases.
- **PROTECTED TO 1000 TIMES OVERLOAD.** A truly burnout proof multimeter. Tested in production with 1,000 volts on .1 volt range. Multimeter resistors protected by .6 amp fuse to save these valuable and expensive components. No more trips to factory when you accidentally measure volts on ohms range.

### SPECIFICATIONS FE20 and FE21

- 9 DC Voltage ranges from .1 to 1000 volts full scale
- 3 High Voltage ranges of 3, 10 and 30KV
- 9 DC Zero Center ranges from .05 to 500 volts
- 9 AC Voltage ranges from .1 to 1000 volts full scale
- 9 AC Peak-to-Peak ranges from .28 to 2800 volts
- 9 DC Current ranges from 100 microamps to 1 amp full scale
- 7 Hi Power ohms ranges from 1000 ohms to 1000 megohms
- 6 Lo Power ohms ranges from 1000 ohms to 100 megohms

### SPECIFICATIONS for FE160

- 10 DC Voltage ranges from .1 to 3000 volts full scale
- 10 DC Zero Center ranges from .05 to 1500 volts
- 9 AC Voltage ranges from .1 to 1000 volts
- 9 AC Peak-Peak ranges from .28 to 2800 volts
- 10 DC current ranges from 30 microamps to 30 amps full scale
- 10 DC current ranges from 30 microamps to 3 amps full scale
- 8 Hi Power ohms ranges from 600 ohms to 6000 megohms
- 7 Lo Power ohms ranges from 600 ohms to 600 megohms

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THE FIRST REALLY  
COMPLETE SERVICE  
SCOPE

- **WIDE BAND 10HZ** 5.2MHz ± 1DB
- **HIGH SENSITIVITY** 17mv rms per inch.
- **HIGH INPUT IMPEDANCE** — 27 megohms shunted by 11 pf low cap
- **SEVEN THOUSAND VOLT** input rating with low cap probe, not 600 volts like other scopes.
- **DIRECT VERTICAL PEAK TO PEAK VOLTAGE READING** with input controls calibrated directly in volts p-p.
- **CONVERTS TO PROFESSIONAL VECTORSCOPE** with the flip of a switch. A truly complete scope with this feature.
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- **POSITIVE SYNC** with variable control locks complex waveforms with triggered ease.
- **EXTERNAL INPUTS** for sync, sweep, Z axis and direct connections to deflection plates.



**PS148** **\$275.00**



## All New Dual-Trace Triggered or Free Running Oscilloscope

DC OR AC  
COUPLED

**PS163** **\$650.00**  
WITH PROBES

**YOUR PRESTIGE BUILDER** — Your customers know you can service everything when you have the PS163. Simple to operate, too . . . just push the button and view the screen.

- **A SERVICE SCOPE:** AC coupled, free running, wide band scope to 8 MHz at 3 DB with direct peak to peak readout enables you to service fast with no interpretations.
- **A SERVICING WAVEFORM ANALYZER** for complex circuits. Dual trace and triggering action enables you to determine right on the nose whether or not two waveforms are appearing at the same time, and their amplitudes, in gated AGC, gated sync separators, burst amplifiers, color killers, etc.
- **A DESIGN SCOPE COSTING ONE FOURTH OF COMPETITORS!** 5 millivolt sensitivity, calibrated sweep speed, dual chopped and alternate displays, and other such specs means performance personified for the lab.
- **A VECTORSCOPE:** Right from the front with sensitivity to spare.

# SWEEP-MARKER GENERATORS

Speed Aligner **SM158** \$275.00 | Deluxe Generator **SM152**



Sencore all solid-state sweep marker generators are constructed to provide the necessary signals for sweep alignment and troubleshooting. The SM158 and SM152 have these common specifications:

- **CRYSTAL CONTROLLED MARKERS** for alignment accuracy.
- **15 MEGAHERTZ SWEEP WIDTH** to cover the entire IF band.
- **SIMPLE HOOKUP** with just four cables, 2 to TV, 2 to scope.
- **ZERO BASE LINE** for reference when adjusting traps and positioning carrier markers.
- **POST INJECTION MARKERS** for distortion free response curves.

If it is speed and simplicity that you want, the all crystal controlled SM158 is your answer and at \$120.00 savings over competition.

- **PUSHBUTTON MARKERS** for the eight most often used IF frequencies: 39.75, 41.25, 41.67, 42.17, 42.67, 44.25, 45.75, and 47.25. Trap and carrier markers listed right on front panel for fast identification.
- **2 EXTRA RF CHANNELS** to assure interference-free response curves on RF - 4 RF channels in all.
- **HORIZONTAL MARKERS** available at the flip of a switch.



**\$450.00**

If it is completeness that you want, the SM152 is the most complete on the market.

- **RF SWEEP FOR ALL BANDS**, VHF, UHF, FM, IF, and Chroma.
- **CALIBRATED RF OUTPUT AND CALIBRATED SWEEP WIDTH.**
- **IF SPOT ALIGN BAND** for pre-alignment adjustments.
- **RF MARKERS** for channels 4, 5, 10 and 13.
- **FM SWEEP** with markers for FM Alignment.

# COLOR GENERATORS

Sencore Color Generators offer these all new outstanding features:

- **SMALLER LINES AND DOTS** for the most precise convergence ever.
- **PERMA-LOCK CIRCUITS** which match or out-perform the digitals.
- **"PAINTED PATTERNS"** so rock solid you'll think they are painted on the screen.
- **STANDARD PATTERNS** including RCA licensed color bars for every convergence need.

## Caddy Bar Jr.

- **"POCKET SIZED"** measuring a mere 2 x 4 x 6. (Size of two 5U4's)
- **PUSHBUTTON OPERATION** for ease of operation.
- **BUILT-IN PREHEATER** for cold days.
- **RETRACTABLE CORD.** No messy cords to untangle.
- **AUTOMATIC SHUTOFF** after 15 minutes if you forget. All electronic using computer memory circuit. No more run down batteries.

WORLD'S SMALLEST... BUT PERFORMS LIKE A GIANT!



**CG22** \$89.00

## Deluxe Color Bar Generator

COLOR KING III - THE BEST GENERATOR YOU CAN BUY.

- **SENCORE EXCLUSIVES.** Single dot and single cross, movable so they can be positioned anywhere on screen to simplify dynamic convergence.
- **SENCORE EXCLUSIVE.** Thermostatic temperature control to warm unit on cold days or to dry out moisture in humid areas.
- **GREATER LINE VOLTAGE** range means stable operation regardless of line potential.
- **HIGH STYLE** in two-toned vinyl clad steel attached case with mirror in cover.



**CG159** \$169.50

# TIME SAVING INSTRUMENTS

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\$250.00

## Field Strength Meter

LOWEST PRICED FIELD STRENGTH METER ON THE MARKET TODAY.

- **HIGHLY SENSITIVE** all the way down to 30 micro-volts.
- **STANDARD REFERENCE** of zero DBJ. 1000 microvolts into 75 ohms for CATV and MATV work.
- **COMPLETE COVERAGE** of all VHF, UHF, and FM bands.
- **ACCURATELY CALIBRATED** in microvolts for direct signal strength reading, 3 DB VHF and FM, 6 DB UHF.
- **COMPLETELY PORTABLE** to go where you need it without extension cords.
- **BOTH 75 AND 300 ohm inputs.**



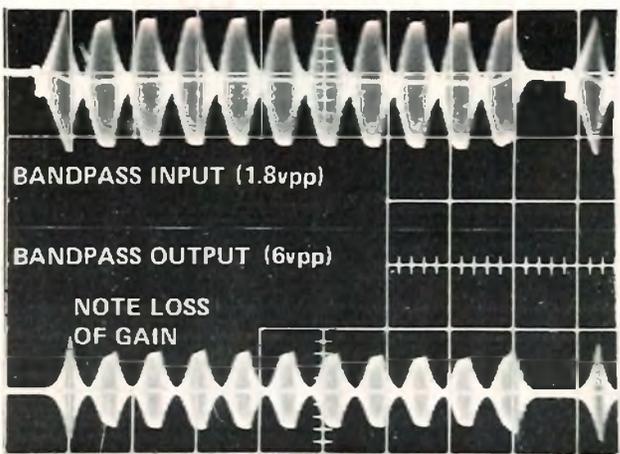
## Power Monitor

THE MOST PRACTICAL SERVICE TOOL EVER DEvised.

- **AC VOLTMETER** from 65 to 135 volts. Calibrated at 115 volts for more accuracy than VOM.
- **AC AMMETER** up to 10 Amps. Check fuse and circuit breaker currents in a flash.
- **AC WATTMETER** up to 1150 watts. A real trouble shooter.
- **DC AMMETER** up to 10 Amps.
- **FUSE RESISTOR CHECKER** with special scales for each resistor.
- **MAKE ALL TESTS** with interrupted line cord or test leads.
- **FULLY PROTECTED** against shock hazard to appliance, instrument and operator.

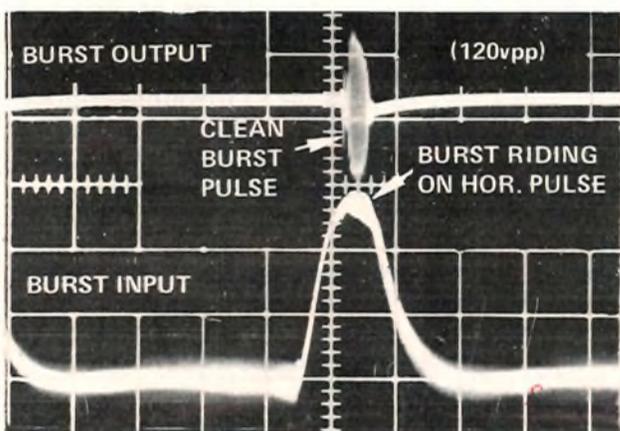
**PM157**  
\$75.00





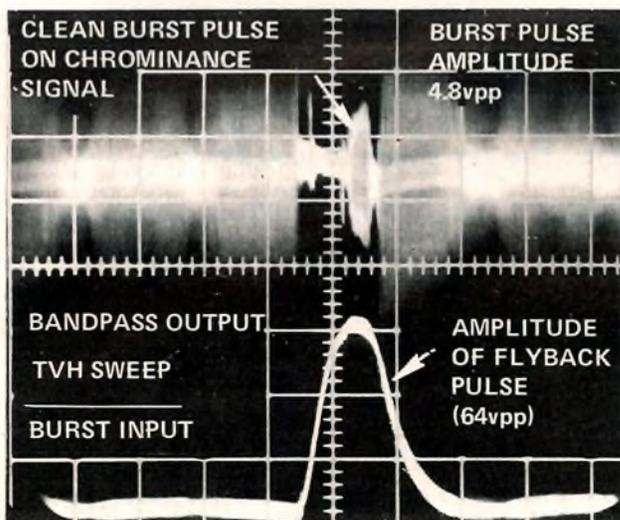
controlling its bias. The color killer can be quickly isolated or eliminated as the cause of the problem by using a BE156 7 in 1 Bias Supply to provide the grid voltage for the bandpass amplifier. The problem in this instance was in the bandpass amplifier; a screen dropping resistor whose value had increased to nearly one megohm virtually eliminated the screen voltage for the tube.

### KEY WAVEFORM FOUR



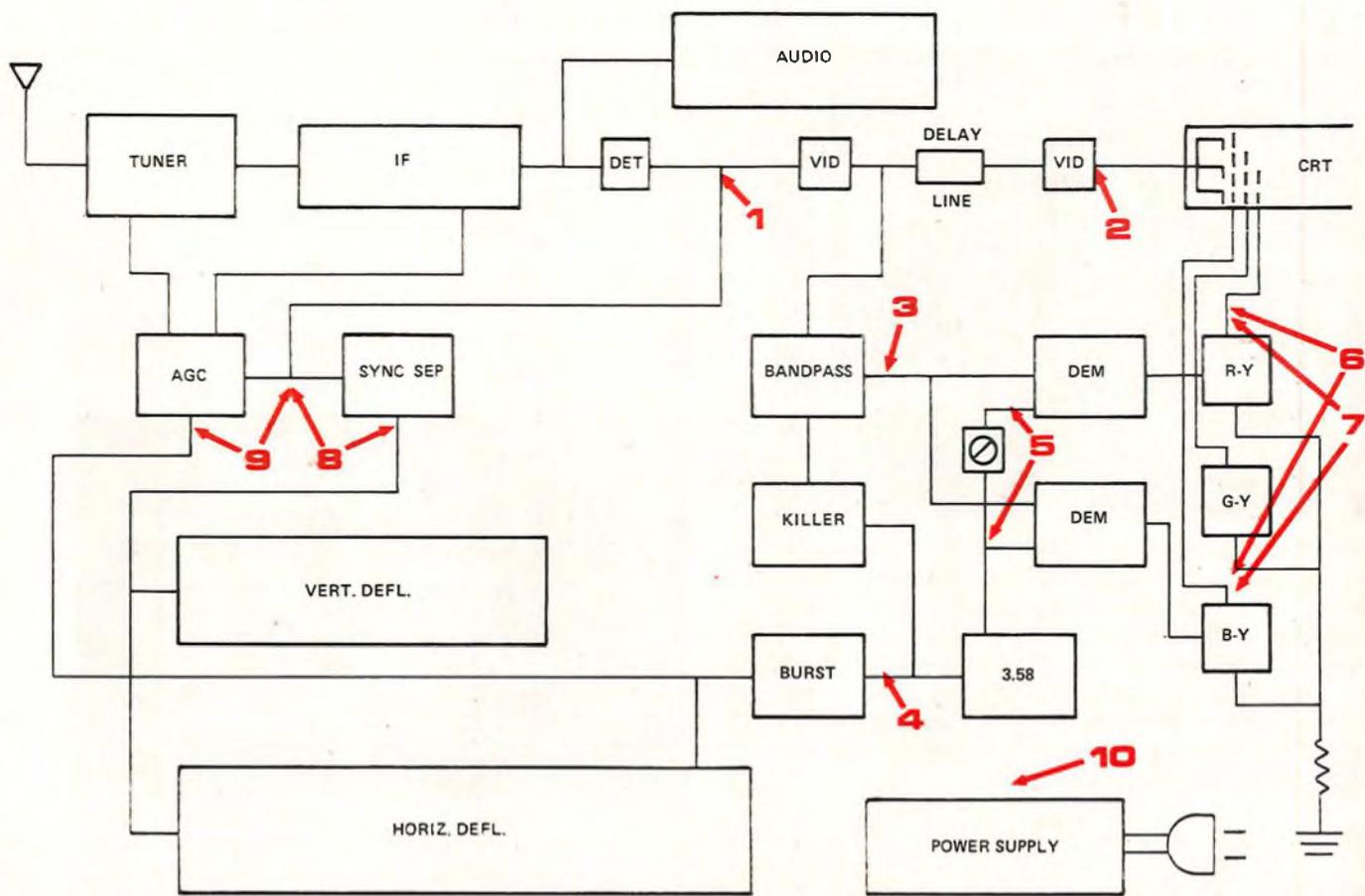
A large portion of the color processing circuits are keyed to the horizontal flyback pulse for timing and gating purposes. The burst gate is one of these stages and is responsible for separating the burst information from the composite chroma signal. To accomplish this, the flyback pulse must be of sufficient amplitude to gate on the burst amplifier stage, and the timing between the flyback pulse and burst must be exact.

- Check 1 Presence and amplitude of chrominance signal
- Check 2 Presence and amplitude of flyback pulse.
- Check 3 Timing of burst and flyback pulses.

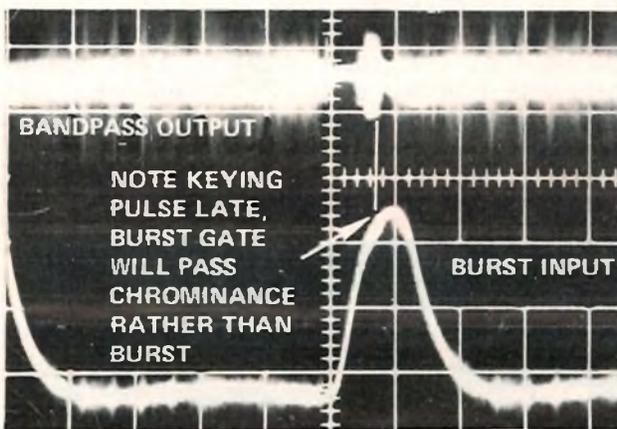


The waveform shown here gives the proper relationship between the chrominance signal (at Chroma Bandpass stage) and the combination of chrominance and flyback pulse present at the input to the burst gate. Note that the peak of flyback pulse occurs at the precise time that the burst pulse portion of the chrominance signal occurs. This provides correct input/output signal relationship.

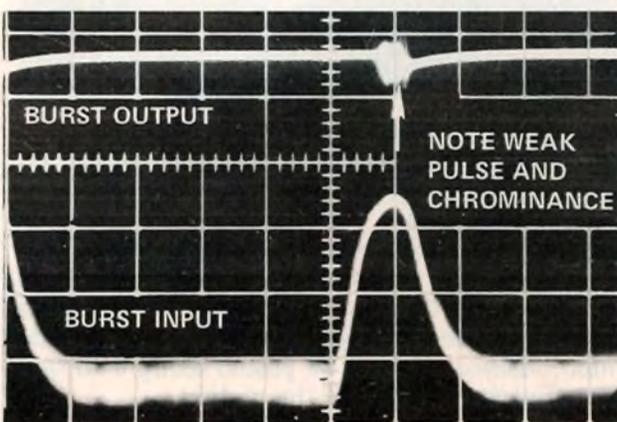
The second photo shows the waveforms when the



SIMPLIFIED BLOCK DIAGRAM OF COLOR RECEIVER SHOWING 10 KEY WAVEFORMS



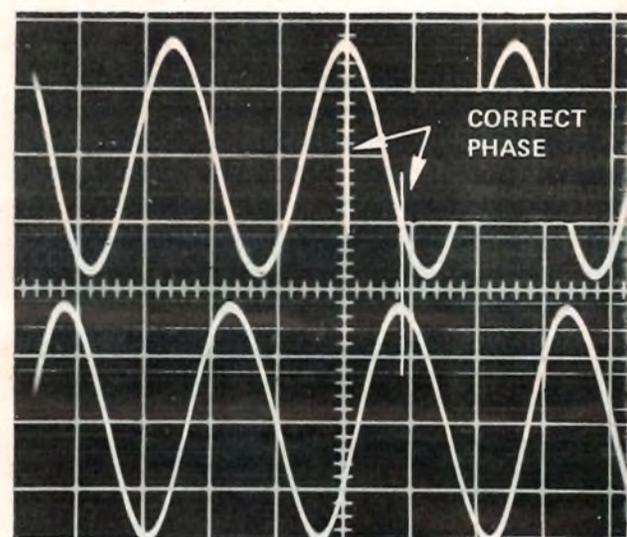
flyback pulse has been delayed a few microseconds and does not correspond in time to the burst pulse. The input/output waveforms for the burst gate show that information is present in the output of the burst gate but is chrominance signal rather than the much larger burst signal.



This condition causes loss of color sync and can be detected very quickly using the Sencore PS163 Dual Trace oscilloscope. A single trace scope, not able to show the time relationship between the chrominance and flyback signals, would show all conditions nearly normal, including the pulse present in the output of the burst stage. It is rather difficult to determine with a single trace scope that the output of the burst stage is chrominance signal in place of the burst signal required for proper color sync.

### KEY WAVEFORM FIVE

The phase angle existing between the two 3.58 MHz signals applied to the demodulator determine the color presented on the screen. The most noticeable area when the phase is not correct is the flesh color displayed. It is nearly impossible to obtain the correct flesh color if 3.58 phase is not correct. The phase angle will vary from 90° on the older sets to as much as 120° on some of

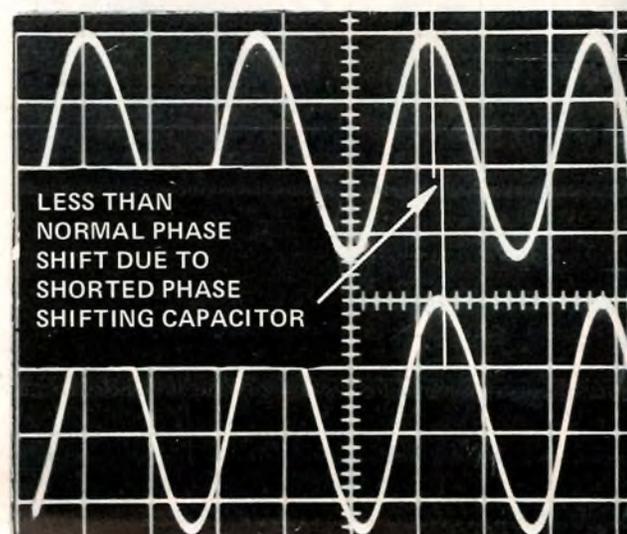


the newer sets with automatic color. The key waveform shows the color phase present in the Magnavox T950 color chassis and is approximately 100°.

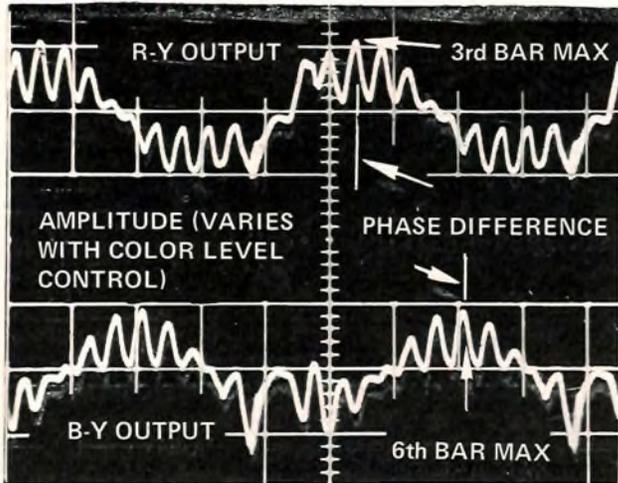
- Check 1 Amplitude of 3.58 signals
- Check 2 Phase of 3.58 signals

The second waveform shows the results of a component failure in the phase shifting network; in this case a shorted phase capacitor. As can easily be seen, the phase is nearly the same between waveforms, prohibiting the demodulators from producing correct color video signals.

Observation of the 3.58MHz signal in this manner requires a scope with high sweep speed, of one megahertz or higher. The PS163 has this sweep capability and allows this signal comparison not possible on other scopes.



## KEY WAVEFORM SIX



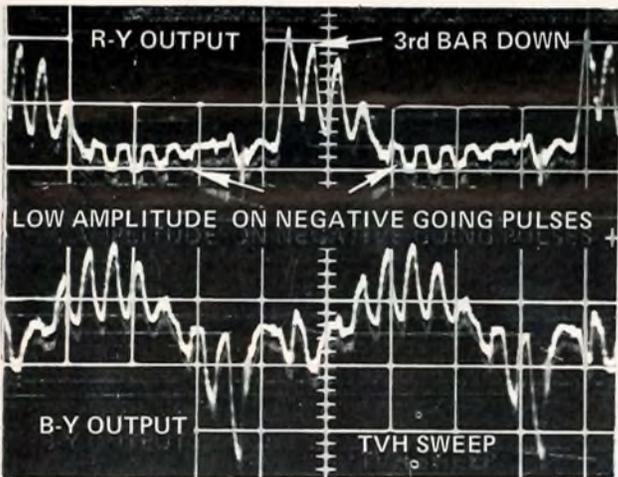
One of the quick-check points that is frequently used is the output signals of the Rand B-Y amplifiers. Generally these signals will give a good indication of the performance of the entire color processing system. The amplitude, which will vary with the setting of the color level control, determines the gain of the chroma amplifiers and/or the different amplifier stages and the performance of the demodulators.

Check 1 Amplitude

Check 2 Phase

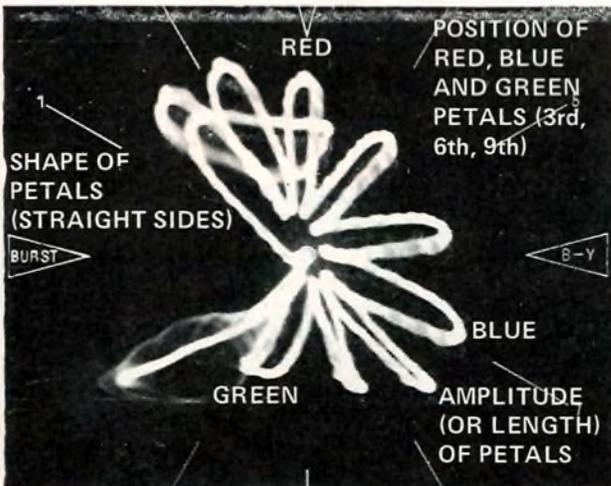
Check 3 Sinusoidal shape of envelope.

In order to demonstrate the interpretation of these signals, the waveform shown here is from a receiver that has marginal performance. The color presentation was poor, although viewable, and the color detail was poor. This is evidenced on



the waveform by the non-symmetrical shape and the rather ragged color bars. The problem ended up being a plate load resistor in the R-Y demodulator, lowering plate voltage and causing the tube to operate in the non-linear portion of curve. Replacing the resistor and aligning the color circuits with the vectorscope corrected the problem and netted the waveform used as KEY WAVEFORM SEVEN.

## KEY WAVEFORM SEVEN



Many technicians may be passing up one of the fastest color troubleshooting methods if they are not making use of the vectorscope for color servicing. The Vector waveform can point out problems in many different sections of the color circuits as well as other points in the receiver. The typical Vector waveform shown as KEY

WAVEFORM SEVEN is from the same Magnavox receiver just mentioned and was taken after repairs were completed. The shape, amplitude and position of the color bar "Petals" are the primary points to observe.

Check 1 Amplitude of petals

Check 2 Shape of petals

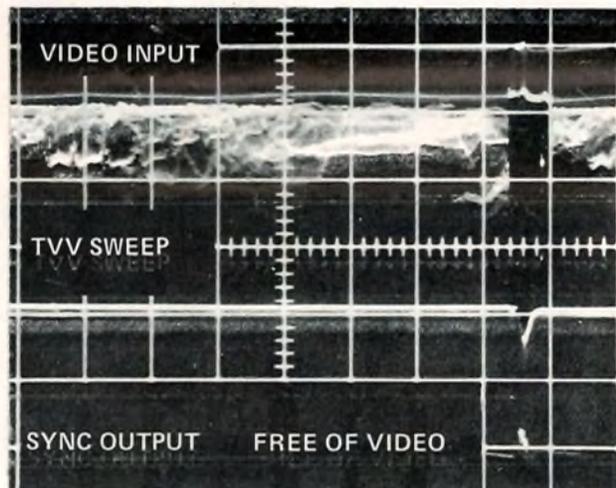
Check 3 Position of petals

An example of the tell-tale tracks of trouble can be seen on this vector pattern taken from the receiver before repairs were made. The pattern



shows a definite loss of greens (petals which should extend downward) and also points out the lack of color detail. The poor shape and edge definition of the petals account for the poor detail. The uneven length of the petals indicate that the intensity of different colors will vary, causing the less-than-ideal color picture. Here, again, the vector function of the PS163 and the push-button selector of vector mode can speed color servicing.

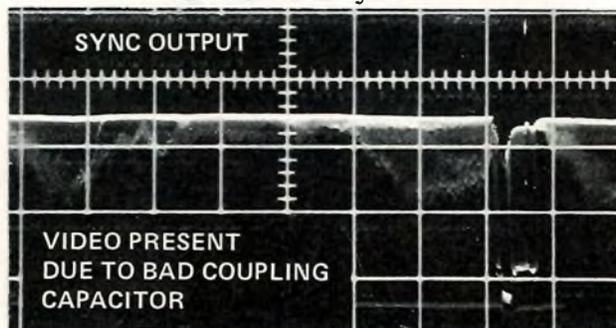
## KEY WAVEFORM EIGHT



By no means exclusive to color receivers, one of the areas known for causing some problems is the Sync Separator Stage. Its sole function is to remove the needed sync information from the video signal. The stage is normally biased well beyond cutoff, conducting only the sync tips. If the tube or transistor develops problems, or some circuit component changes to upset the bias, video information will be passed along with sync upsetting the stability of the picture.

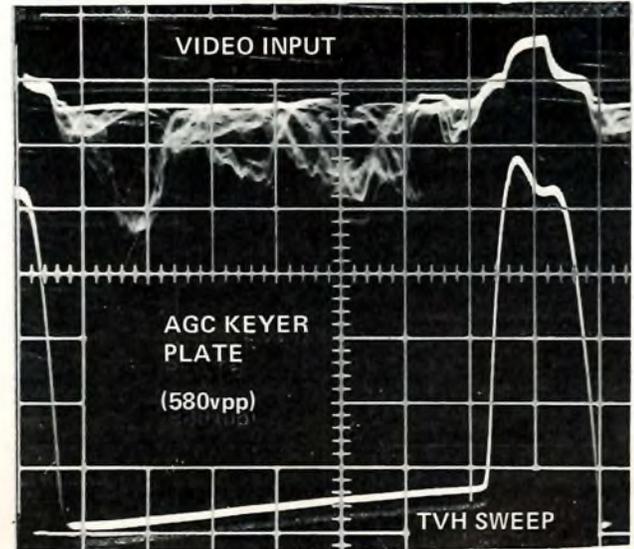
Check 1 Amplitude and freedom from video of vertical sync

Check 2 Amplitude and freedom from video of horizontal sync



The waveform here shows the condition when the bias level is incorrect and video information is present in the output of the sync separator. This particular condition was caused by a leaky coupling capacitor from the video stage to the sync separator.

## KEY WAVEFORM NINE



The single stage that probably causes most grief to technicians is the AGC Keyer. Many problems can be caused by improper action of the keyer. The AGC keyer requires three specific conditions or signals to function properly; DC bias potential holding tube or transistor well beyond cutoff, composite video information, and a horizontal keying pulse to provide operating voltage to collector or plate. Loss of either of the signals, significant reduction of their amplitude or incorrect timing will all result in loss of AGC. The first step to take in troubleshooting apparent AGC problems is to tie down the bias with a bias supply like the Sencore BE156, and then observe the waveforms at the keyer.

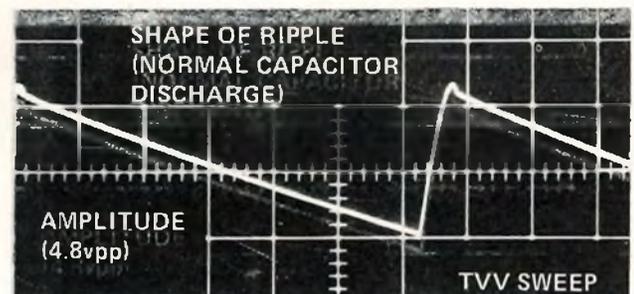
Check 1 Presence and amplitude of video signal.

Check 2 Presence and amplitude of horizontal keying pulse.

Check 3 Timing between keying pulse and horizontal sync pulse of comp. video

The KEY waveform shows these signals of the correct amplitude as well as proper timing.

## KEY WAVEFORM TEN



A section of the receiver that can cause some difficult-to-find and unusual problems is the power supply. This part of the receiver is often omitted from the troubleshooting procedure unless definite signs of high ripple or hum are present. The key points to look for are:

Check 1 Amplitude of 60 or 120Hz ripple

Check 2 Shape of ripple waveform

Check 3 Presence of horizontal frequency ripple, or video information

An example of one of the "bang your head against the wall" type of problems is shown in this waveform. The set symptoms were:

very touchy color sync, poor flesh color, and a predominance of green. Now, one would normally expect to find the problem in the color circuits, but the real cause of the problem was nowhere near the color circuits. It happened to be an open filter on the 21 volt B+ line which supplied power to many of the transistors in the color circuits. The result of this bad filter was a substantially larger ripple content on the B+ line. The ripple affected gain in the color circuits causing low chrominance level, and poor output from the bandpass amplifier. The point we wish to emphasize is that a quick

(Continued on page 15)

SENCORE NEWS

Bob Baum, Senior Engineer, has just received word that a circuit patent has been issued for the Auto Tracking feature of the CR161 CRT Tester. The new patent, number 3,688,184, covers the computer-type memory circuit used in the CR161 to permit pushbutton testing of



color tubes for tracking. The simplified test procedure, test reliability and accuracy of the newly patented system are making the CR161 Auto Tracker the accepted standard of the industry by service technicians, distributors and by set manufacturers.

## CR161 AUTO TRACKER GAINS WIDE ACCEPTANCE

A good example of the acceptance for the CR161 was encountered just recently by one of our engineering technicians, Stan Oestreich, when he was doing some unit testing at the local shops and distributors. Warren Radio, the local RCA distributor uses the Sencore CR161 to test every warranty color tube before returning them to the factory.



Stan Oestreich, left, Sencore engineering technician looks on as Gary Akins of Warren Radio explains how they use the CR161 Auto Tracker to check each warranty picture tube returned.

Gary Akins, one of the Warren Radio personnel, told Stan: "We have found it very profitable to check every warranty tube with the CR161. With the tight warranty return policies of the tube manufacturers today, if the tube checks good after it is returned, we get it back. We in turn, must charge back the dealer to whom warranty credit was issued. Since we began testing every tube, we have found some that did not require replacement to begin with and saved ourselves the freight and embarrassment of returning a good warranty tube. We have not had a single tube returned for electrical defect since we began using the CR161. If every dealer would use the Auto Tracker, they would not replace the tube unnecessarily and would save themselves a great deal of time and money. We highly recommend the Sencore CR161 CRT Auto Tracker to our dealers over any other tester we have seen or used."

## SENCORE AWARDED PATENT ON CRT AUTO TRACKER

### CR161 CRT AUTO TRACKER

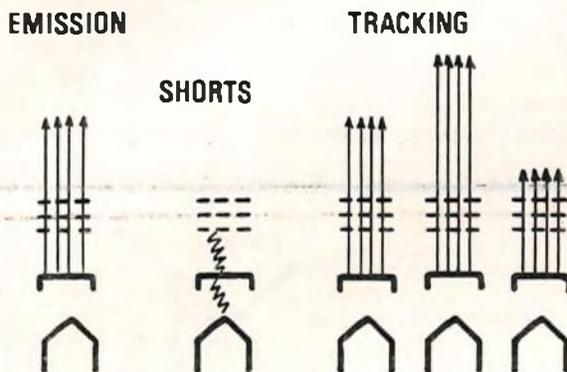


## PUSHBUTTON COLOR CRT TESTING WITH SENCORE'S PATENTED CRT AUTO TRACKER

The Sencore CR161 CRT Auto Tracker provides complete testing and restoration of all black and white and color tubes PLUS pushbutton automatic tracking test for color CRT's. It is the only tester on the market to offer this time-saving, patented tracking test to simplify color CRT testing.

### WHAT IS THIS "TRACKING"?

Even though color television and color CRT's have been in existence for some years, the importance of tracking between the guns of the color CRT is often given less emphasis than deserved. Of course, the color CRT must have sufficient emission capabilities from each gun to illuminate



The three essential tests for a color CRT.

the phosphor dot surface of the tube, and must have no shorts present that will reduce control of the electron beam. Most CRT checkers will test these capabilities adequately. But, the ratio of current between the three guns must also be reasonably well matched in order to maintain a neutral gray-scale through the normal brightness range. If a tube does not "track", the background color will change with changes in brightness. This can be seen most readily by observing the black and white performance of the color set while rotating the brightness control through its range. A tube that does not track will exhibit a shift of background color. During a color program the tube with bad tracking will cause a change in flesh colors, or the color of the grass on the football or baseball field, with changes in overall scene brightness.

The tube with a tracking mismatch greater than the average industry standard of 1.5 to 1 will also

fail to give proper set-up when attempting to set the screen and background controls. Obviously, a tube with this condition will cause a marked deterioration of the performance of the set.

Cathode current ratios as specified by CRT manufacturers.

Ratio of Cathode Currents (Typical)			
Each Gun to Produce White of 9300°K + 27MPCD			
	Min.	Ave.	Max.
Red to Green	1.0	1.3	1.8
Red to Blue	1.0	1.5	2.0

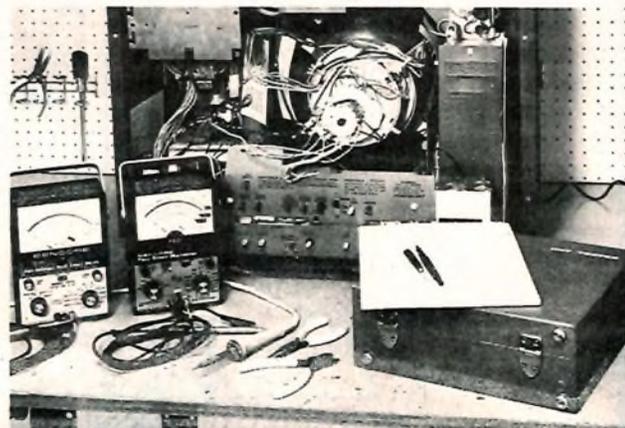
Ratio of Cathode Currents:								
Red to Green			Red to Blue			Blue to Green		
Min.	Ave.	Max.	Min.	Ave.	Max.	Min.	Ave.	Max.
0.65	1.00	1.50	1.00	1.50	1.80	0.50	0.65	1.20

Ratio of cathode currents:			
	Min.	Typ.	Max.
Red/blue	0.75	1.10	1.50
Red/green	0.65	1.00	1.50
Blue/green	0.60	0.91	1.30

### WHY CAN'T I CHECK COLOR TRACKING WITH MY OLD CRT TESTER?

The complexity of the test necessary, before the CR161, was the major reason our engineering department worked long and hard to develop some simple, automatic means of making this test. If you were to check the tracking of a color CRT with many of the other CRT testers, you would have to perform the following steps:

1. Open Red cathode lead, insert microammeter and adjust screen control for cutoff current



This equipment is needed for color CRT tracking test with most CRT testers.

level (usually about 20 microamps) with normal grid (G1) bias applied.

2. Measure and record screen (G2) voltage required for cutoff level of current.

3. Reduce G1 bias to zero, measure and record cathode current level.

4. Repeat above procedure for each gun.

5. Calculate the ratio existing between the cathode current of the highest gun with respect to the lowest gun. This ratio should not exceed 1.5 to 1.

6. Calculate the ratio existing between the highest and lowest G2 voltages at the cutoff level of the tube. This ratio should not exceed 1.86 to 1.

7. If neither the current ratio nor the voltage ratio listed are exceeded, the tracking of the tube should be good in the set and gray scale adjustments can be made without difficulty.

8. If either ratio exceeds the limits listed, the tube will exhibit poor tracking in the receiver, and/or failure to adjust to proper gray scale. The tube should be replaced for proper set performance.

Now compare this long, involved, time consuming process to the ease and simplicity of making the complete CRT test, including tracking, with the computer-type automatic tracking of the CR161.

## HOW DOES THIS "AUTO TRACKING" WORK?

The patented automatic tracking circuitry is shown in this schematic. During the emission test, a voltage is developed across R23 by the cathode current of the gun being tested. This voltage is applied to one of the storage or "memory" capacitors in the automatic tracking circuit. The capacitor is selected by the Gun Selector switch as each of the guns is tested for emission. The capacitors provide a gate bias for the FET's, corresponding to the emission level of the different guns. The level of FET conduction is determined by the potential of the "memory" capacitors. The voltage developed across the source resistors of the FET is applied to a diode comparator circuit. The resistor values and diodes in the source circuit of the FET's are chosen so any difference of 1.5 to 1 or greater in the voltage across the source resistors will cause one set of comparator diodes to conduct. If a color

# TESTS ALL B&W, COLOR AND NEW SINGLE GUN COLOR TUBES WITH ONE SIMPLE PROCEDURE

*Automatic Tracking Test With Computer Type Memory Circuit ... Just Push The Button*

**Step 4. CHECK EMISSION**  
Observe EMISSION on meter. Rotate GUN SELECTOR to check EMISSION on each color gun. TRACKING MEMORY BANK is charged automatically.

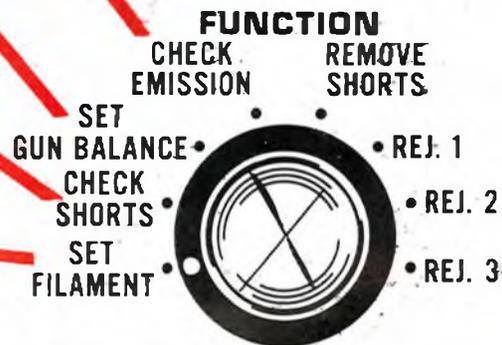
**Step 3. SET GUN BALANCE**  
Adjust GUN BALANCE control to GUN BALANCE line on meter for each gun.

**Step 2. CHECK SHORTS**  
Observe SHORTS lights. Rotate GUN SELECTOR to check all color guns.

**Step 1. SET FILAMENT**  
Connect CRT to socket. Observe meter and adjust FILAMENT VOLTAGE controls for required voltage.

**Step 5. AUTOMATIC TRACKING TEST**  
Depress AUTOMATIC TRACKING pushbutton and observe meter to check color CRT tracking.

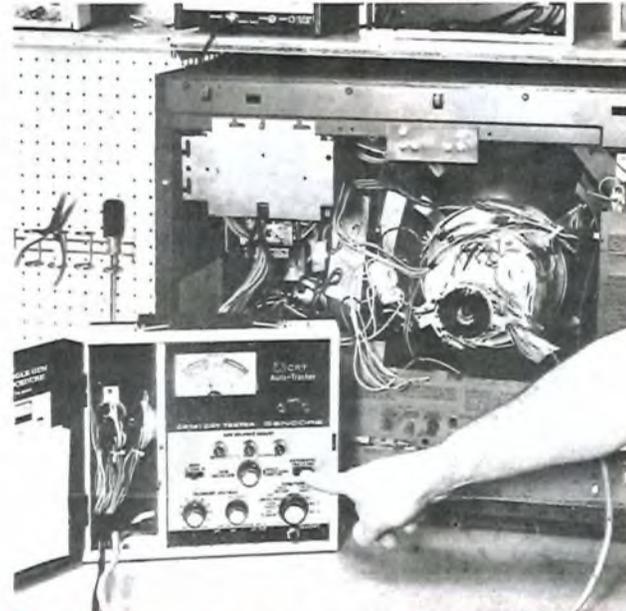
**AUTOMATIC TRACKING**



CRT is within the accepted 1.5 to 1 ratio of cathode currents, the comparator circuit is not a biased one. A ratio of over 1.5 to 1 will cause sufficient voltage change in the source of the FET's to cause diode conduction. The meter is placed in the comparator circuit to monitor the presence of diode conduction when the Automatic Tracking pushbutton is depressed. As might be suspected, any current flow in the comparator represents a tube with a ratio of greater than 1.5 to 1 in cathode currents and the meter will then indicate upscale into the BAD TRACKING portion of the scale.

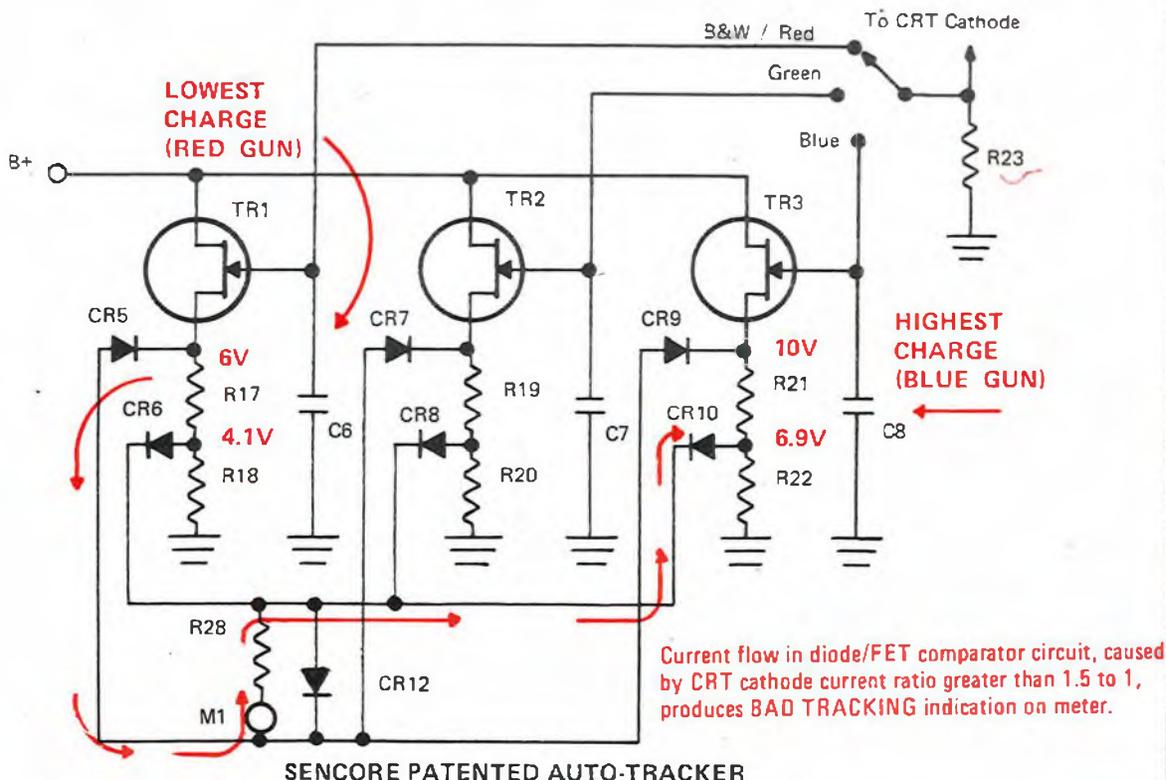
Let us use an example to show the operation of this unique, patented automatic circuit. For our example, we will say the Blue gun has the highest emission level, the Green gun has a somewhat lower level and the Red gun is considerably lower than the other two. The capacitor in the gate of TR3 will have the highest charge. The drain current will be the highest in this FET causing the highest voltage drops across the source resistors. TR1 on the other hand, will have the lowest drain

current due to the lower charge placed on its gate capacitor by the weaker Red gun. Assuming a difference in CRT cathode currents of greater than 1.5 to 1, the voltage at the top of R22 will be high enough compared to the voltage present at the top of R17 to cause the diodes CR5 and CR10 to conduct. When the Automatic Tracking pushbutton is depressed, the level of current flowing in the comparator will be indicated on the meter. This will be an upscale indication

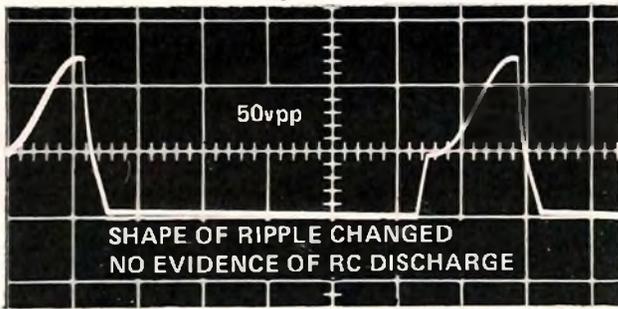


**CR161 Auto Tracker makes the tracking test as easy as pushing a button and reading a meter!**

into the BAD TRACKING area of the meter scale. If the tube has good tracking, in other words a ratio of cathode currents of 1.5 to 1 or less, the comparator circuit is inactive and the meter indication will be zero. The circuit is capable of automatically selecting the highest and lowest guns and making the comparison, and comparing only those guns where the cathode current ratios exceed the 1.5 to 1 ratio. The circuitry employed to accomplish the automatic tracking test is quite simple but it does an outstanding job of simplifying the test of a color CRT. The direct meter readout for emission and tracking tests make interpretation very easy and offers another important advantage. You can show your customer, on the easy to read meter scales, exactly what the condition of the tube is and why they need a new CRT to restore good set performance. The CR161 is a "customer convincer" for you.



**SENCORE PATENTED AUTO-TRACKER**



check of power supply waveforms can often save many hours of chasing a problem in the wrong circuit.

The high sensitivity of the vertical inputs of the PS163 are a real aid in checking the power supply

filtering, especially in solid state sets which must have an extremely low ripple level. The 5 millivolt input sensitivity makes it easy to check presence of ripple or interference at these low AC levels.

Troubleshooting with waveforms is not difficult, but does take some practice and understanding of the waveform seen. The 10 KEY WAVEFORMS included here should aid you in becoming more proficient in the use of the oscilloscope, and waveform troubleshooting. A large majority of the problems in receivers are AC problems; those related to a change or interruption in the signal path. This type of problem is usually very hard to locate unless the effects can be seen. The scope

enables you to observe the AC changes which are taking place and quickly locate and correct the problem. The PS163 Dual Trace Triggered Sweep Oscilloscope is the ultimate in service scopes, offering both high sensitivity and solid sync for servicing convenience. Dual trace, triggered sweep function of the PS163 permits close observation of time related waveforms for rapid diagnosis of phase and timing problems. The preset TV vertical and TV horizontal sweep positions, with built-in sync separator, make waveform analysis in color sets easier than ever before. Add to all these important features pushbutton input selection, pushbutton sweep selection and pushbutton sync selection and you have the finest service scope available today. 



Bob Baum



Norm Pedersen

**BOB AND NORM'S**

# SHOP

- SERVICE TIPS
- SHORT CUTS

### TIME SAVING TIP

The PS163 and a piece of wire takes the mystery out of flybacks.

A simple and very clever method of separating the good from the bad in the often obnoxious horizontal output circuit is credited to Jerome M. Foster, Spring Valley, Minn.

Mr. Foster relates that he uses his Sencore PS163 Triggered Sweep Oscilloscope to simplify the troubleshooting in horizontal circuits using an expanded ringing test. He says, and our tests concur, that this method makes the test virtually 100% reliable.

The conventional flyback ringing test is used to make the test.

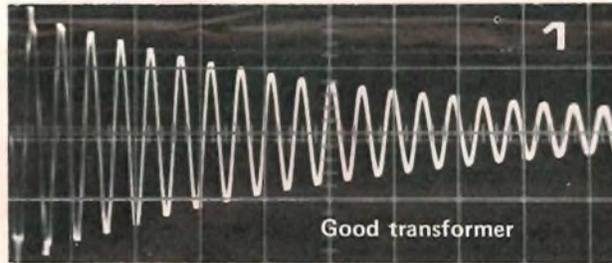
1. Remove power from the set, disconnect the plate cap leads from the horizontal output tube and high voltage rectifier, and pull the high voltage rectifier from its socket.

2. Connect the SWEEP OUTPUT signal from

the rear of the PS163 through a 100pf capacitor to the plate cap lead of the high voltage rectifier.

3. Connect the vertical input of the PS163 to the plate cap lead of the high voltage rectifier and the ground lead to the horizontal output plate cap lead.

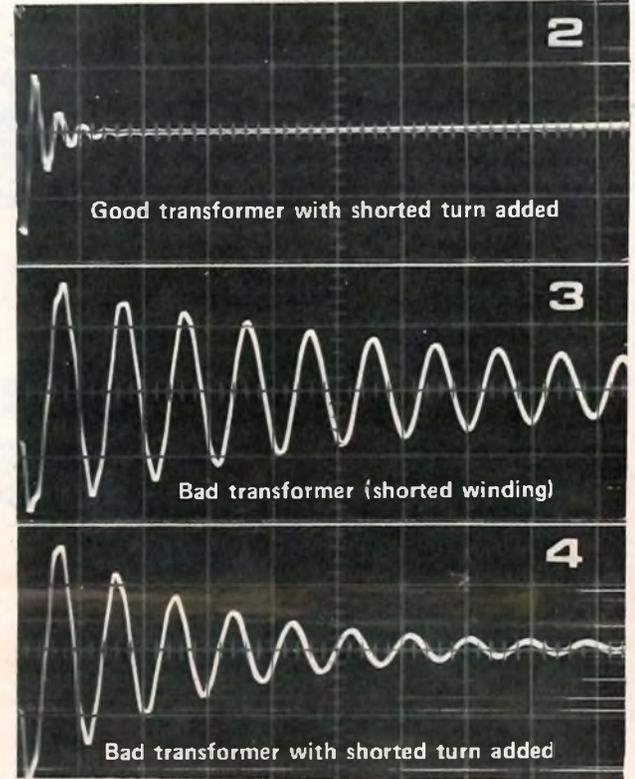
4. Adjust the TIME BASE/FREQUENCY controls of the PS163, using FREE RUNNING sweep, until a ringing pattern appears and extends completely across the screen (Waveform 1).



Good transformer

Now here is where Mr. Foster's procedure and the piece of wire comes in.

5. Wrap a single strand of wire around the core of the transformer to simulate a shorted turn, and observe the effect on the ringing pattern. The pattern will change drastically if the transformer is good (waveform 2) and very little change will take place if the transformer is bad (waveforms 3 and 4).



Good transformer with shorted turn added

Bad transformer (shorted winding)

Bad transformer with shorted turn added

Our thanks and \$5.00 to you, Mr. Foster, and we will also be adding your test procedure to the PS163 manual when we reprint it.

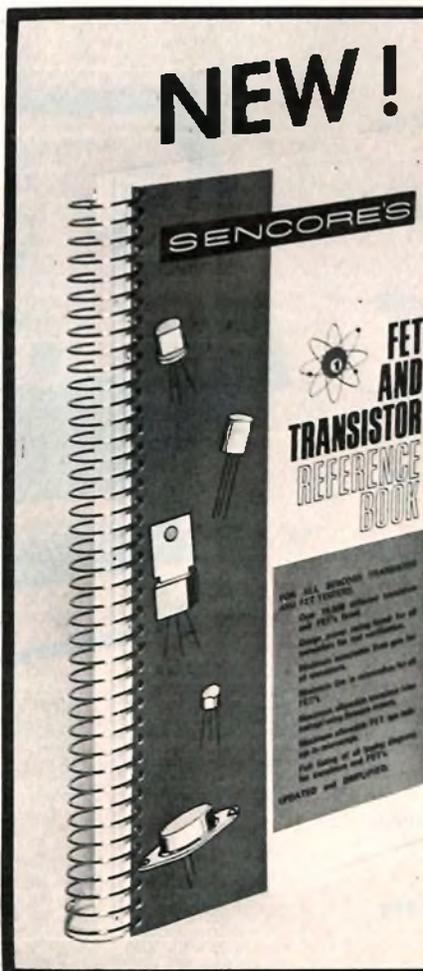
### SENCORE ANNOUNCES NEW CUSTOMER SERVICE OFFICE

Consistent with our long range plan to provide sales, service and technical assistance on a local basis, a new Sencore Customer Service Office has been opened to serve the West coast area. The new office is located at 833 Mahler Road, Burlingame, California 94010, 697-692-5854. The manager in charge of the Customer Service Office is Bill Hefner, a long time Sencore man.

The office will offer complete sales and service departments, tied directly to the factory by TWX for prompt efficient attention to the needs of our West coast customers. A full stock of all literature and parts will be inventoried in the Burlingame office and a cheerful customer service gal is on hand to provide any assistance you might need.

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