THE IDEA PEOPLE

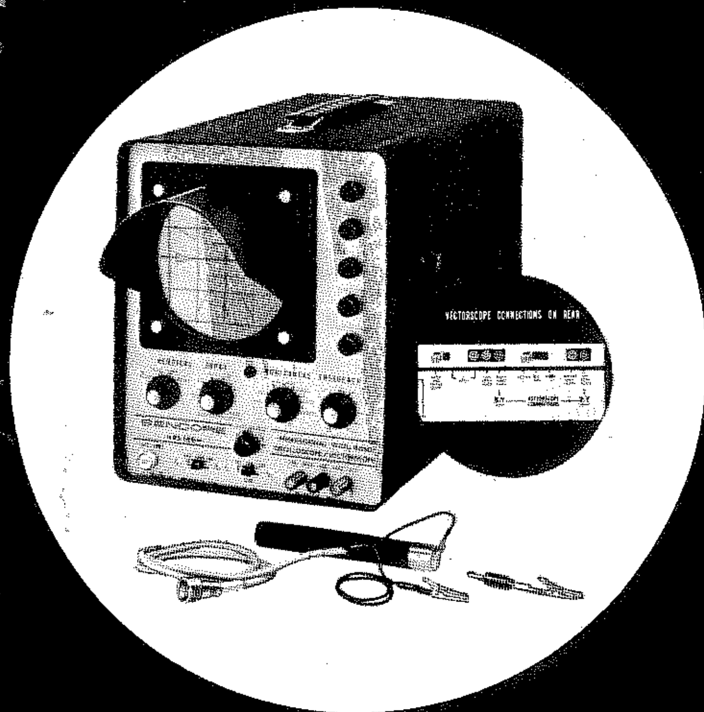
SENCORE, INC

3200 SENCORE DRIVE, SIOUX FALLS, FALLS, SOUTH DAKOTA 57

PS 148

5-INCH WIDE BAND OSCILLOSCOPE AND VECTORSCOPE

SENCORE



SENCORE SERVICE MANUAL

3200 SENCORE DRIVE, SIOUX FALLS, FALLS, SOUTH DAKOTA 57107

OPERATING INSTRUCTIONS FOR THE SENCORE PS148 5 INCH WIDE BAND OSCILLOSCOPE AND VECTORSCOPE

With the boom of solid state and the increasing number of color television receivers and other electronic devices, the wide band scope has become one of the most important tools to the electronic technician. The scope today must be capable of a wide response to cover color burst frequencies, have a high sensitivity for low level signals, be capable of a vector display for color servicing and be easy to use. All of these features and more are found in the Sencore PS148 5 inch scope. The PS148 combines the wide band response with high sensitivity and direct reading of peak to peak voltages as well as a vectorscope, all in one compact, professional-looking piece of equipment. Some of the features found on the PS148, are not found on any other service scope on the market today.

Here are some of those features:

Direct Reading of Peak to Peak Voltages: The vertical amplifier input controls are calibrated directly in peak to peak volts, enabling fast and direct reading of all peak to peak waveform voltages.

Completely Wideband: The vertical amplifier is completely wide band, 5 hertz to 6.5 MHz, from the most sensitive setting of .05 volts peak to peak per inch down to the less sensitive settings of the controls. No confusing band switching or narrow bands to distort the waveforms and result in erroneous analysis.

VECTORSCOPE: Vector patterns are easily displayed through connections on the rear of the PS148 in conjunction with a standard color bar generator for chroma servicing.

Direct and Lo-Cap Probe: Both direct and Lo-Cap probes on the same cable give you maximum versatility. Many of the high impedance circuits, now require the use of a Low capacity probe to prevent upsetting the circuits. With the Sencore probe, you have a direct probe or Lo-Cap at the flick of your wrist.

Direct Measurements of Peak to Peak Voltages in High Voltage Circuits: The Lo-Cap probe, on the PS148, allows you to measure peak to peak voltages of up to 7000 volts peak to peak, directly. Now you can measure the cathode of the damper or the plate of the horizontal output stage, to be sure of proper operation.

Retrace Blanking: Retrace blanking of the horizontal trace is built-in and is effective on all of the horizontal sweep ranges.

Removable Graph Screen: The graph screen can be removed with ease for cleaning, or removed when not needed, such as when photographing waveforms.

Direct Connection to the CRT Deflection Plates: Direct connection to the CRT Deflection Plates (through blocking capacitors) is made available on the rear of the PS148 through easy to use Banana jacks. Intensity modulation (Z axis) signals may also be applied to the CRT cathode at the Z INPUT jack on the rear of the PS148.

Circuit Breaker: Protects the power transformer and other components of the PS148 if trouble ever occurs in the scope.

SPECIFICATIONS

Frequency Response (3 DB limits)

Vertical Amplifier
5 HERTZ to 6.5 MHz
RISE TIME .055 microseconds

Horizontal Amplifier
5 HERTZ to over 400 KHz

Deflection Sensitivity

Vertical Amplifier
Direct Terminal .017 ± 5% volts RMS/inch
Low Capacity Terminal .17 ± 5% volts RMS/inch

Horizontal Amplifier
At Horizontal Input Jack .6 volts RMS/inch

Input Impedance

At vertical input Jack-2.7 megohms shunted by 20 mmf
Through vertical input cable-direct input jack, 2.7 megohms shunted by 107 mmf
Through vertical input cable-low capacity jack, 27 megohms shunted by 11 mmf
At horizontal input jack 3.2 megohms shunted by approximately 18 mmf
At sync input jack 4.7 megohms shunted by approximately 18 mmf

Output Impedance

Vertical amplifier
2700 ohms each plate to ground

Horizontal Amplifier
18,000 ohms each plate to ground

Deflection Sensitivity of CRT thru External Deflection Jacks

Vertical Plates (External-Direct Position)
8.1 ± 10% Volts RMS/inch

Horizontal Plates (External-Direct Position)
15 ± 10% Volts RMS/inch

Horizontal Sweep Generator (Phantastron Type Oscillator Circuit)

Frequency Ranges continuously adjustable with approximately 10% overlap on all ranges

Range 1 - 5 Hertz to 50 Hertz
Range 2 - 50 Hertz to 500 Hertz
Range 3 - 500 Hertz to 5 KHz
Range 4 - 5 KHz to 50 KHz
Range 5 - 50 KHz to 500 KHz

TV Horizontal (7875 Hertz) and Vert. (30 Hertz) are marked on Horizontal Range Control with an "H" and a "V" for fast selection of these ranges.

Synchronization (Selectable and adjustable to over 4 MHz)

Internal
External
Line Frequency
Sync adjustable between plus and minus

Maximum Input Voltages

Thru Direct INPUT JACK or at Cable INPUT JACK - 1000 volts P/P in presence of 1000 volts DC
Thru LO-CAP JACK - 7000 volts P/P in presence of 1000 volts DC
Thru Horizontal Input Jack - 30 volts P/P in presence of 400 volts DC
Thru Sync Input Jack - 30 volts P/P in presence of 600 volts DC

Power Requirements

Input Voltages - 105-125 volts AC: 50 to 60 Hertz
Power Consumption - Approximately 100 watts: 47 watts in Standby Position

Physical Characteristics

Height - 11 inches
Width - 9 inches
Length - 15-1/2 inches
Weight - 22 pounds

Tube Complement

V1 - 6GH8A Vertical Input Cathode Follower and First Vertical Amplifier
V2 - 6DJ8 Balanced Push-Pull Vertical Driver
V3 - 6DJ8 Balanced Push-Pull Vertical Output Amplifier
V4 - 6BN8 Sync Phase Splitter, Sync Pulse Clipper and Blanking Pulse Clipper
V5 - 6GH8A Horizontal Sweep Oscillator and Horizontal Input Cathode Follower
V6 - 6CG7 Balanced Push-Pull Horizontal Output Amplifier
V7 - 6CA4 Low Voltage Full Wave Rectifier
V8 - 1V2 High Voltage Half Wave Rectifier
V9 - 5DEPI Cathode Ray Tube

CONTROLS ON THE PS148

The PS148 is extremely simple to operate, and a few minutes spent now on learning the position and operation of the panel controls would be beneficial. All of the controls are arranged by function to keep hand motions at a minimum. For example, the CRT beam controls (intensity, focus, and the horizontal and vertical positioning controls) are in a group just to the right of the CRT. The main operating controls (vertical course and fine controls, and the horizontal frequency range and vernier controls) are in a row across the center of the panel. The two vertical controls are on the left side of the panel, and the two horizontal controls are on the right side of the panel. The horizontal gain control is just above the horizontal vernier control, and the sync controls, consisting of a sync selector switch and a polarity reversing potentiometer, are at the center bottom of the panel. The scope selector switch and Z input are on the rear of the PS148.

The functions of each of these controls is as follows:

Intensity Control (Controls bias on CRT): Increases intensity (brightness of the trace on the screen of the Cathode Ray Tube. Maximum intensity is applied when the control is fully clockwise. Generally, the further a pattern is spread out horizontally or vertically, the more the intensity will have to be increased. To extend the useful life of the cathode ray tube, always set the intensity control to the lowest brightness level consistent with satisfactory visibility.

Focus Control (Adjusts voltage on focus electrode in CRT): Adjusts the sharpness (clarity) of the trace. This control will normally need re-adjustment only when the intensity level is changed. Automatic focus is used, which reduces the need for frequent re-adjustment.

Vertical Positioning Control (Changes DC voltage between vertical deflection plates): Adjusts the position of the trace vertically. The trace will move up as the control is rotated clockwise and down as the control is rotated counter-clockwise.

Horizontal Positioning Control (Changes DC voltage between horizontal deflection plates): Adjusts the position of the trace horizontally. The trace will move to the right as the control is rotated clockwise and to the left as the control is rotated counter-clockwise.

Horizontal Gain (Controls signal input to horizontal amplifier): Adjusts the width of the horizontal trace. The trace will expand when the control is rotated clockwise and compress when rotated counter-clockwise.

Horizontal Frequency (Range control): (Second large knob from right side of front panel) This control selects the frequency range of the sweep oscillator. There are five internal sweep ranges (See specifications). In addition, this control connects the Horizontal Input Jack for External Horizontal Input operation and connects the horizontal amplifier to the line frequency (50 or 60 Hertz).

Horizontal Frequency (Vernier control): (Large knob at extreme right side of front panel) This control is used in conjunction with the "course" control to obtain the exact horizontal frequency desired to "lock in" a trace.

Vertical Input (Course control): (Large knob at extreme left side of front panel) This control selects the voltage range applied to the vertical amplifier. The full clockwise position is the highest sensitivity (Lowest voltage input) and full counter-clockwise is the lowest sensitivity (highest voltage input).

Vertical Input (Fine Control): (Second large knob from left side of front panel) This control is used in conjunction with the course control to obtain the desired height of the trace. To read peak to peak volts, adjust this control for one inch height (one square) and multiply the number at which the knob is pointing by the multiplier obtained from the vertical course control setting above.

Sync Phase (Small knob at lower center of panel): This control selects the amplitude and polarity of the sync voltage applied to the sweep oscillator. It should be adjusted so the pattern just locks into a stationary position. It also controls the phase of the sinusoidal sweep voltage, when the horizontal frequency (course) is set to "Line".

Sync (Slide Switch - located below Sync/Phase control): This switch selects the source of the synchronizing signal for sweep oscillator control. It has an "Internal" sync position, "External" position which connects the sync input to the sync input jack and a "Line" position which provides synchronization from the Power Line.

Scope Selector (Slide switch located at the rear of the PS148): This three position switch is used to select the mode of operation of the PS148. It selects either "Normal" operation, "External Direct" connection to the deflection plates, or "Vectorscope".

Z INPUT (Slide switch on the rear of the PS148): Selects either normal operation or the Z INPUT jack for intensity modulated signals to the cathode of the CRT.

On-Standby-Off (Slide Switch - located to left of Sync Switch): Applies power to the oscilloscope in the "ON" position. Applies power to Filaments only in "Standby" position. Neon "ON-OFF" indicator should glow in "ON" and "Standby" positions.

OPERATING INSTRUCTIONS

After you have familiarized yourself with the controls and various inputs, the following procedure is recommended for operational simplicity. Place the PS148 in a convenient position and away from any external lighting for easier viewing.

Obtaining a Trace

1. Insert the power cord from the rear of the unit, to a 105 - 125 volt 50-60 Hertz source. The three prong grounded plug is used on the PS148 to comply with the UL code. Plug the PS148 into an outlet with a three prong receptical or use a special adaptor that is available for converting the three prong to the two prong system. Be sure to ground the green pigtail on the adaptor to the conduit or electrical ground.
2. Push the slide switch to the "Standby" position and rotate all Beam Controls to 1/2 rotation.
3. Rotate the Horizontal Frequency Course Control to "Ext", the VERTICAL INPUT control to X100, the Power Slide Switch to "ON" and the Vertical Input and Horizontal Gain controls completely counter-clockwise.
4. Rotate the Intensity control until a dim dot appears on the screen. Adjust the Focus control until the dot is sharp. Keep intensity at a low level, because a bright dot can burn a hole in the coating on the CRT face. This is especially true if the dot is left in one place on the CRT screen for long periods.
5. Rotate the Horizontal and Vertical Positioning controls until the dot is in the exact center of the screen.
6. Rotate both Horizontal Frequency controls to the range which covers the frequency to be checked.
7. Connect the vertical input cable "direct INPUT" jack to the circuit that is to be observed. NOTE: Insert probe tip into "LO-CAP" jack for high voltage or critical circuits.
8. Rotate both Vertical Input controls clockwise: starting with course control first and then the fine control, until one inch height is obtained. Re-adjust the Horizontal Gain control if necessary.
9. Adjust the Horizontal Frequency controls until the trace stabilizes (does not drift across screen). If the trace cannot be stabilized, adjust the Sync control and Horizontal Frequency (vernier control) until it just stabilizes. Do not apply more sync than necessary to synchronize trace.
10. Read peak to peak volts indicated at the Vertical Input controls. Multiply readings by 10 if measurement is through "Lo-Cap" jack of the cable.

OPERATING NOTES

Always keep trace intensity at a minimum level consistant with satisfactory viewing to extend the life of the CRT and reduce the possibility of discoloration or burn on the CRT screen. Slight horizontal non-linearity may be apparent at low frequencies - 5 to 50 hertz. To obtain a more accurate indication, display 6 to 9 cycles of the waveform across the screen and observe the cycles near the center of the screen for the best linearity. All normal observations should be kept below three inches of vertical deflection for the most accurate reproduction of the waveforms.

The horizontal oscillator is free running, but acts somewhat like a triggered sweep in that the pattern never completely goes out of sync; just the timing of the base line changes. This is done to make the PS148 easier to operate than other oscilloscopes.

Scope Applications and Special Uses

The oscilloscope is practically limitless in application. It is a multi-purpose instrument combining features of voltmeters, ammeters, frequency and phase meters, waveform analyzers and many more. Here are a few special applications of the PS148 scope and precautions necessary for correct interpretation and circuit analysis.

Synchroguide Horizontal Oscillator Adjustment: TV receivers employing the RCA type synchroguide circuit require an adjustment on a scope for most stable operation. The ideal waveform is shown in Figure 1. The adjustment is normally made so that the sine wave portion is the same height as the sawtooth portion.

When using the PS148 to make this adjustment, be sure to feed the signal through the Low capacity jack at end of Vertical Input cable. If the adjustment is made through the direct Input jack, the waveform shown can usually be obtained but will change when the scope lead is removed.

Color Servicing: Waveforms present in color servicing are much like those found in black and white TV receivers, except for the circuits that are added over those found in monochrome receivers. Basically, the four new types of waveforms found in color TV receivers are high peak to peak triggering pulses, the color signal before and after removal of the color burst, the detected color signals and the color burst. The color burst is present at the video detector in a color TV receiver as shown in Figure 2.

When viewing the color burst signal from the TV station, it will be apparent that the horizontal gain on the PS148 should be at maximum. If it is difficult to see the nine cycles of color burst signal, it is a good idea to detune the fine tuning on the TV receiver to accentuate the burst. Retuning the fine tuning to normal will reduce the amplitude of the color burst signal, but you will be positive that you are watching the color burst. Also, be sure that a color TV program is on the Air. A more positive check can be made with a color bar generator, such as, the Sencore CG141. Good reference books are available on color and color trouble-shooting with a scope and bar generator.

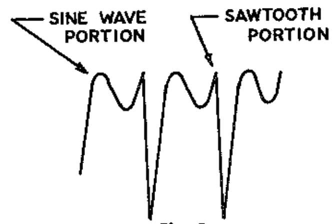


Fig. 1
HORIZONTAL SYNCROGUIDE OSCILLATOR WAVEFORM

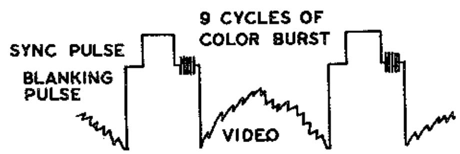


Fig. 2
COLOR BURST SIGNAL

FIG. 3

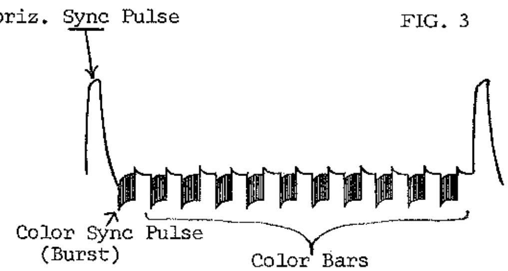


Figure 3. Waveform of the standard color bar pattern as viewed with the PS148. This is the output of the Sencore CA122B, CG141, CG10, and CG12 color generators.

Determining Frequency of an Oscillator: Many times, it is desirable to know whether or not an oscillator, such as the horizontal oscillator in a TV receiver, is operating at the correct frequency. An easy method of determining the frequency of operation is to compare the number of waveforms present to a known frequency. See Figure 4.

Fig. 4

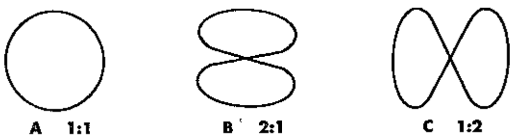
For example, to check the horizontal oscillator frequency in a TV receiver, set the PS148 scope to show two horizontal composite video waveforms at the video amplifier and then, without adjusting any controls except vertical gain, view the horizontal oscillator output waveform. If there are two waveforms present, the horizontal oscillator is on frequency as both waveforms repeat at a rate of 15,750 Hertz per second. Even though the horizontal frequency in color TV receivers is slightly different, both the sync pulses and horizontal oscillator should operate the same frequency. If more than two waveforms are present, the oscillator is operating at a higher frequency than 15,750 Hertz per second. If only one waveform is present, the oscillator is operating at half frequency. Of course, other numbers than two can be made for the comparison. This merely serves as an example.

TV and FM IF ALIGNMENT

The horizontal input jack provided in the lower section of the PS148 is used for alignment work. Place the Horizontal Frequency course control on EXT and feed the sweep output from the sweep generator to the input jack. Adjust the horizontal gain for satisfactory width. The sync/phase control should be adjusted so that the forward trace and the backward trace are superimposed on each other.

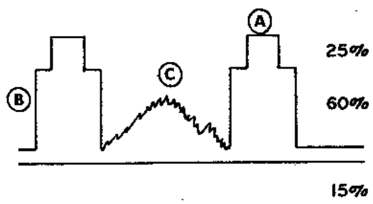
LISSAJOUS FIGURES

Lissajous figures are used to determine an unknown frequency, by applying a known sine wave frequency to the horizontal amplifier and the unknown into the vertical amplifier. The frequency ratio between the horizontal and vertical can then be compared. Some typical Lissajous figures are shown in Figure 5.



LISSAJOU FIGURES

Fig. 5



TYPICAL COMPOSITE SIGNAL

Fig. 6

INTERPRETATION OF WAVESHAPES

Black and White TV: For technicians that work primarily in TV, it is recommended that they obtain a TV in good working condition and observe the waveshapes in the various stages. Then inject various troubles and observe what effect the trouble has on the waveshape. Most TV schematics, designed for TV servicing, will have the correct waveshapes printed on them. Some typical TV waveforms are:

1. Composite Signal (See Figure 6)

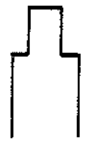
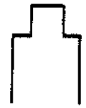
   a. Sync pulse - starts the retrace and is 25% from the blanking pulse to the top of the blacker than black region.

   b. Blanking pulse - blanks out picture before retrace and usually does not require scope trouble-shooting.

   c. Composite video - varies with picture detail.

2. Sync Pulses (See Figure 7)

FIG. 7

NORMAL HORIZONTAL PULSE	CIRCUIT FAULT	HORIZONTAL PULSE DISTORTION	EFFECT ON PICTURE
	NORMAL CIRCUIT		PICTURE NORMAL
	LOSS OF HIGH FREQUENCIES		LOSS OF PICTURE DETAIL
	EXCESSIVE HI FREQUENCY RESPONSE NON-LINEAR PHASE SHIFT		FINE BLK & WHT LINES FOLLOWING A SHARP CHANGE IN PICTURE SHADING
	LOSS OF LOW FREQUENCIES (IN THE RANGE ABOVE 15 OR 20 KC.)		CHANGE IN SHADING OF LARGE PICTURE AREAS; SMEARED PICTURE

AUDIO

An audio amplifier should be checked for the following:

1. Phase Shift 2. Distortion 3. Overload

Phase Shift: To check for phase shift, apply a sine wave from the audio oscillator to the "Horizontal Input" jack on the PS148 and to the input of the amplifier under test. Apply the output of the amplifier to the vertical input of the scope. See Fig. 8. Figure 9 shows the various waveforms which may result.

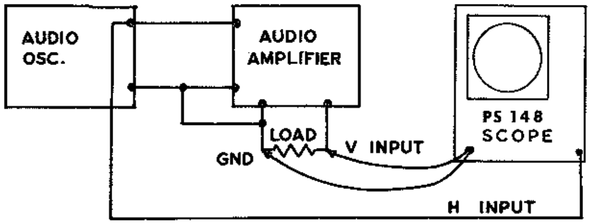


FIG. 8. Connections for Checking Amplitude Distortion and Phase Shift.

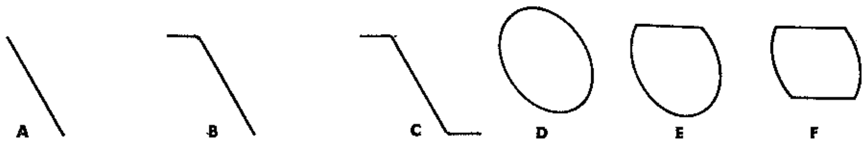


FIG. 9
AMPLITUDE DISTORTION AND PHASE SHIFT WAVEFORMS

A. No overload distortion, no phase shift.
B. Overload distortion, no phase shift.
C. Driving into grid current and past cutoff, no phase shift.
D. Phase shift.
E. Phase shift, overload distortion.
F. Phase shift, driving into grid current and past cutoff.

Distortion: Distortion can be best checked by use of a square wave, because detailed information can be obtained by simple analysis. A square wave, of desired frequency, may be obtained from an audio oscillator and wave clipper or from a square wave generator. Usually square wave tests are made at two frequencies, one at 60 Hertz and one at a higher frequency, usually between 2000 or 3000 Hertz. See Figure 10. Figure 11 shows the various waveforms which may result.

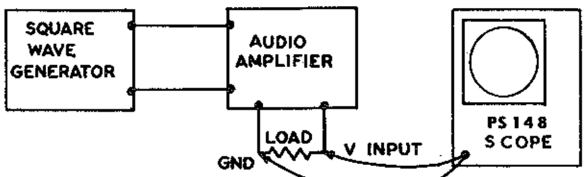


FIG. 10 Connections for Checking Frequency Response.

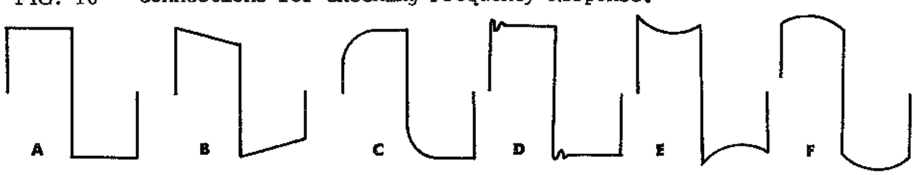


FIG. 11
SQUARE WAVE PATTERNS

A. A typical square wave obtained from a square wave generator.
B. Indicates poor low frequency response.
C. Shows effects of good low frequency response but high frequency cutoff.
D. Indicates excessive high frequency response or even oscillations at high frequencies.
E. Indicates poor transmission of test frequency in relation to other frequencies passed.
F. Shows higher transmission of test frequency than other frequencies passed.

HIGH VOLTAGE CIRCUIT WAVEFORM OBSERVATIONS

When observing high voltage waveforms, such as those in the Vertical or Horizontal output circuits, always use the Lo-Cap jack on the Vertical input cable. Never feed a high voltage pulse through the "direct input" jack. The Vertical Input (course) control should always be in the X100 position. Do not measure pulse voltage higher than 7KV, such as on TV High Voltage Rectifiers. TURN THE TV OFF WHEN MAKING CONNECTIONS TO HIGH VOLTAGE TERMINALS. Place the cap over the "direct" input end of the probe when making high voltage measurements to prevent pickup of spurious signals.

If these precautions are observed, there will be no difficulty in making high pulse voltage observations. Remember to multiply all oscilloscope peak to peak indications by ten when using the "Lo-Cap" input. A typical horizontal and vertical circuit, showing points where waveform observations are generally made, is shown in Figure 12.

VECTORSCOPE SERVICING WITH THE PS148

The PS148 has been designed so that vector patterns can be displayed with ease. Just a flick of a switch converts the PS148 from a regular oscilloscope to a vectorscope. Connections to the deflection plates are made through banana jacks for simplicity. When used with a standard color bar generator (such as the Sencore CG10, CG12, CG141, or CA122) the vectorscope is useful for trouble shooting color receiver problems in the chroma section and is also handy for setting the AFPC (Automatic Frequency Phase Control), for setting the tint range of the receiver, and for "touchup" alignment of the bandpass amplifier.

FINE TUNING ADJUSTMENT OF THE TV RECEIVER

The fine tuning adjustment of the TV receiver from which the vector patterns are to be taken must be set properly. If the fine tuning is off, the vector pattern will have very wide loops. This is caused by the color carrier being placed to one side of the bandpass curve giving erroneous indications of the condition of the chroma section of the receiver. If the generator you are using has a 4.5MHz signal, the fine tuning can be adjusted until the 920KHz beat blends into the backround. A better method is to connect the input of the PS148 scope to the video detector and adjust the fine tuning for minimum 4.5MHz as seen between the 3.56MHz color bursts, but not past the point where the color bursts start to decrease in amplitude.

Connecting the PS148 as a Vectorscope: The vector display is developed from the red and blue color signals. The signals at the picture tube grids are generally observed. However, when trouble shooting it may be desirable to observe the signals at the demodulator plates or at the plates of the R-Y and B-Y amplifiers. Signals at the plates of a high level demodulator will produce a normal pattern, but signals from low level demodulator plates will not. The petals will be smaller in amplitude and the entire pattern will be rotated 180 degrees.

Connect the PS148 to the color receiver as follows:

1. Connect the Red lead to the jack on the rear of the PS148 marked R-Y INPUT. This is the TOP VERT. PLATE of the CRT. The other end of the lead is connected

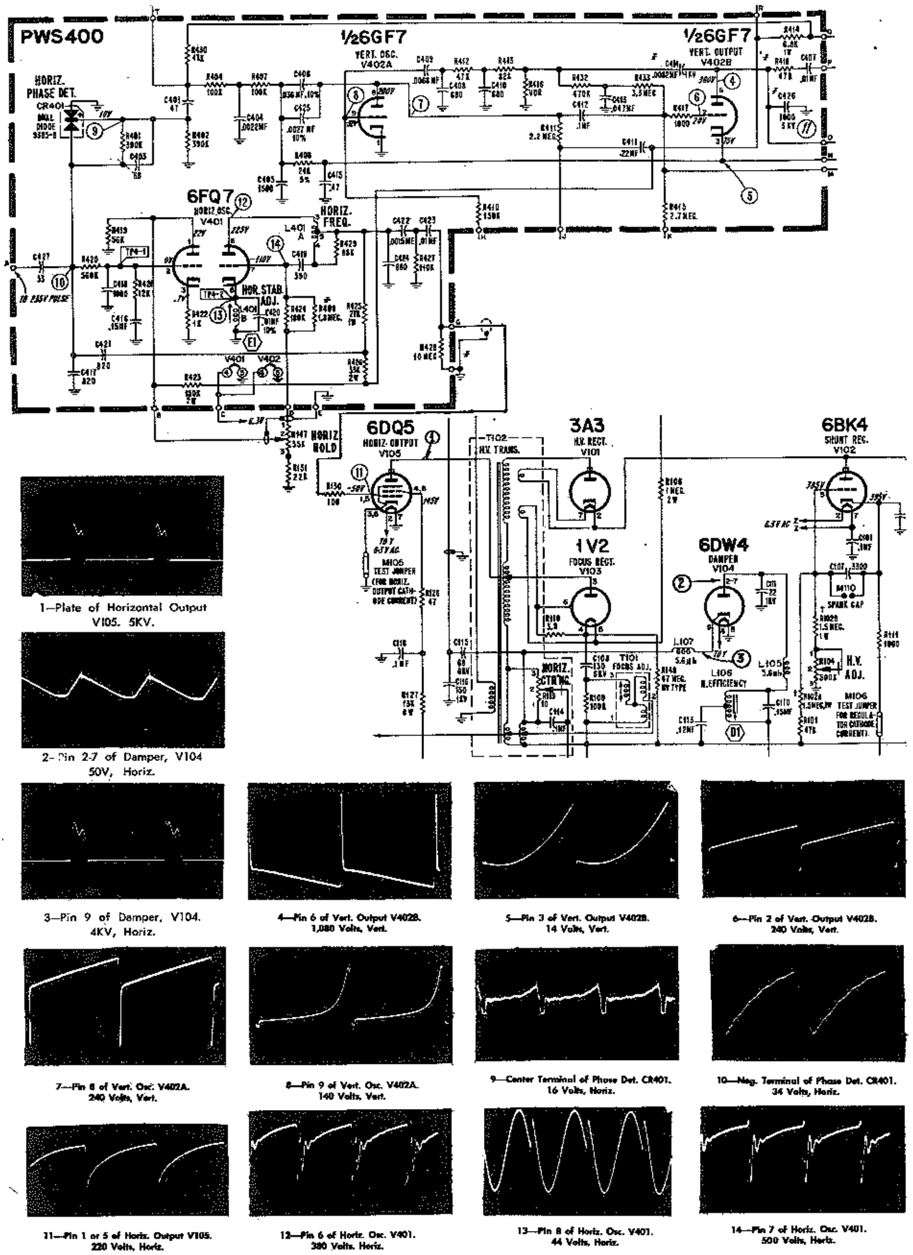
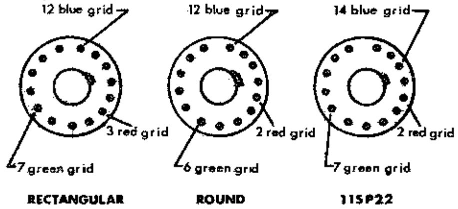


FIG. 12. Typical TV Horizontal and Vertical Waveforms.

to the Red grid of the CRT in the color receiver. Connect the Blue lead from the jack marked B-Y INPUT (right horiz. plate) to the Blue grid of the CRT, and the black lead from the ground jack on the PS148 front panel to the receiver chassis. (If test points are not convienent on the top of the chassis, the red and blue leads supplied have piercing points so connections can be made through the insulation. Simply squeeze the clip on the grid lead to pierce the insulation and make contact. Most sets use solid color wires such as solid red to the red grid, solid blue to the blue grid and solid green to the green grid. If in doubt, figure 13 shows the three bases and the grid pins presently used).

Fig. 13



2. Connect a standard color bar generator such as the Sencore CG10, CG12, CG141, or CA122 to the receiver. Set the color generator to the color bar pattern and tune in the color bars on the receiver. Be sure that the fine tuning is set properly so that the correct display will be seen on the PS148.

3. Slide the three position SCOPE SELECTOR switch on the rear of the PS148 to the VECTOR position. Adjust the receiver color level control until a full pattern is seen on the PS148 screen. Adjust the centering controls on the PS148 so that the bright spot in the center of the pattern is in the center of the screen. Adjust the receiver tint control until the third bar is touching the R-Y mark on the screen. The pattern should look similar to the ones shown in figures 14 to 16 if the receiver is working properly.

NOTE: Each type of demodulation system used in color receivers gives a different vector pattern. To become more familure with these, it is suggested that you observe the vector patterns on several different working color sets. Variations between the same make and model receivers will be noted due to componant tolerances. With the standard color bar generator, the third bar of the vector pattern or R-Y signal should be straight up or on the R-Y mark on the screen. The sixth bar is the B-Y signal and will be to the right and aligns with the B-Y mark on the screen for the standard 90 degree demodulation angle. The G-Y signal is the tenth bar and alignes with the 10 mark on the screen. The burst,which is not present in the pattern for most sets (it occurs during horizontal blanking) is the zero reference for the display, represented by the BURST mark on the screen at the left. The vector pattern will enable you to detect the different colors and determine which colors are weak or missing. Only the red and blue grid signals are used for the vector display and it is possible to get a good vector display even though green may be missing from the picture. If green is missing from the picture, the trouble would have to be after the demodulation. The G-Y amplifier or the CRT circuitry associated with the green gun should be suspected.

<u>90 Degree Demodulation Systems:</u> The standard 90 degree demodulator system has a phase shift of 90 degrees between the R-Y and B-Y signals in the receiver. On the PS148 screen, the R-Y signal will align with the R-Y mark and the B-Y signal will align with the B-Y mark. If the B-Y does not fall within the area of the B-Y mark on the screen, the injection transformer should be adjusted until the B-Y signal is 90 degrees from the R-Y signal and falls within the B-Y mark on the screen. On many of the new color receivers, this is a fixed coil and no adjustment is available. Figure 14 is a 90 degree demodulated signal.

105 Degree Demodulator Systems: On many of the newer color receivers, the angle between the R-Y and the B-Y signals has been increased from 90 degrees to 105 degrees. This has been done to improve flesh tones. If the receiver connected to the PS148 uses a 105 degree angle, the B-Y signal should not touch the B-Y mark on the screen when the R-Y is in its proper position. For a 105 degree angle, the B-Y signal should fall half way between the B-Y mark and 7 mark on the screen. Figures 15 and 16 are 105 degree patterns.

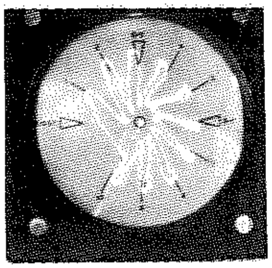


Fig. 14 (Zenith)

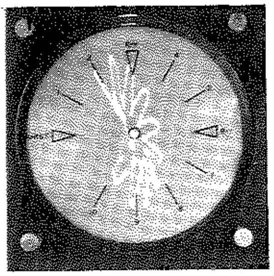


Fig. 15 (Motorola)

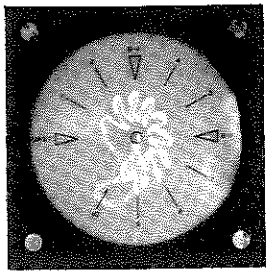


Fig. 16 (G. E. Portacolor)

TINT OR HUE ADJUSTMENTS WITH THE PS148

The range as well as the correct setting of the tint control can be readily checked on the vector pattern on the PS148. After setting the PS148 for the vector display, rotate the Hue or Tint control of the receiver and see if the third bar or R-Y signal can be placed in the R-Y mark on the screen. If it cannot, or the control is at one end, the burst amplifier plate transformer or phase adjustment should be reset in the color receiver. To do this, set the Hue or Tint control to its physical center. This will allow for variations in the transmitted signal and give the customer enough range to get the correct colors. Next, adjust the burst transformer or phase adjustment of the receiver until the third bar on R-Y signal touches the R-Y mark on the screen. Check the range of the Hue or Tint control. You should be able to swing the bar from the R-Y mark at least 30 degrees or one full mark in each direction. Note that the amplitude of the vector pattern may change somewhat as the Hue or Tint control is rotated. A small variation is normal with most receivers.

COLOR SYNC OR AFPC ADJUSTMENTS WITH THE PS148

The color sync or Automatic Frequency Phase Control of the color receiver can be easily adjusted using the PS148 as a vectorscope.

The lock-in ability of the color receiver should first be checked to determine if an adjustment is needed. To do this, connect the PS148 as a vectorscope to the receiver with a standard color bar generator. Slowly decrease the chroma control on the color generator and watch the vector pattern on the screen. If the pattern starts to rotate before the chroma level of the color generator is below the 50% point, the AFPC should be adjusted. Short out the reactance tube or other test point indicated by the set manufacture. The vector patterns should now be rotating on the screen. Adjust the burst transformer or AFPC adjustment for the slowest moving vector pattern on the screen. This will place the oscillator at the proper frequency.

Some manufactures have a different procedure for adjustment of the AFPC. It is best to follow their procedure as listed in the service literature. In all cases, you will be adjusting for the slowest moving vector pattern to put the oscillator on the correct frequency.

BANDPASS AMPLIFIER CHECKOUT AND TOUCHUP ALIGNMENT WITH THE PS148

The bandpass amplifier of a color receiver can be checked out for its proper bandpass alignment with the aid of the PS148 vectorscope. By simply observing the vector pattern, its size, shape of the lines and the brightness at the ends of the petals, the need for alignment can readily be seen and performed.

What does the proper vector pattern look like? Knowing what a proper or ideal vector pattern looks like is very important for checking out the alignment of the bandpass amplifier. The ideal vector pattern would have petals that were pie shaped wedges with straight lines and flat tops with a very small center circle. The pattern you will be looking for on the screen of the PS148 will have the smallest inner circle consistant with the maximum amplitude of the overall pattern, straight sides on the petals with the ends of the petals being brighter than the lines extending from the center of the display.

Bandpass Amplifier Alignment: Two alignment procedures are given in this manual. In most bandpass amplifiers, the response curve of the system can be peaked. If it is peaked at the color carrier, the sideband information is lowered in amplitude and a poor response to color information will be noted. The petals in the vector display will not have straight sides, nor will the ends of the petals be brighter than the rest of the pattern. The Zenith bandpass amplifier system cannot be peaked at the color carrier as most other systems can, so a different procedure is noted for this type of bandpass amplifier.

In either case these procedures should be considered "touch up" procedures only. The only way you can be absolutely sure that the bandpass amplifier is adjusted properly is to observe the response curve using a good sweep generator and the PS148 as a regular oscilloscope.

General Bandpass Alignment: Before the bandpass amplifier is checked or aligned, be sure to set the fine tuning of the receiver. If the fine tuning is off, it will effect the shape of the vector and the alignment of the bandpass system. With the fine tuning adjusted, note the vector pattern on the screen to see if it meets the ideal conditions or if it may be in need of adjustment. If adjustment is necessary, adjust each coil or transformer slightly and note its effect on the vector pattern. You will be adjusting each coil or transformer to obtain the closest to ideal vector pattern that can be obtained. Do not adjust any coil too far until you know what effect it will have on the overall pattern. Adjust the slugs until the circle in the center of the vector pattern is the smallest while the overall size of the pattern remains maximum and the sides of the vector petal are straight. The ends of the petals should be brighter in intensity than the lines extending out from the center of the pattern.

Zenith Bandpass Alignment: The Zenith bandpass amplifier is different than most and it can not be peaked at the color carrier. The alignment procedure listed here is the one recommended by the factory on the present Zenith receivers. On this, as on the standard bandpass alignment, the fine tuning must be properly set to insure the correct alignment.

1. Using the PS148 as a regular scope, connect the vertical input lead to the video detector (test point C1). Set the standard color bar generator to color bars and turn on the 4.5MHz signal. Set the horizontal frequency on the PS148 to 7858 hertz for a two cycle display. Tune the fine tuning until the 4.5MHz in the video pattern is minimized and the color bar bursts just start to reduce in amplitude.

2. Connect the vertical input of the PS148 to the red grid of the receiver CRT. Adjust the 3.58 MHz trap for the smallest amount of 3.58 MHz in the pattern. Do the same to the blue and the green grids, adjusting the 3.58 MHz trap for the smallest amount of 3.58 MHz in the pattern.

3. Connect a bias supply, such as the Sencore BE113, to the ACC test point (Q) and set for 6 volts negative. Connect the PS148 to the receiver as a vectorscope and adjust the 1st amplifier plate coil for the biggest vector display on the PS148 screen. Remove the bias from the ACC test point and adjust the 2nd amplifier coil for straight lines on the vector petals. The lines at this point should be fairly straight, see figure 14. If the lines of the vector petals touch or spread out and are no longer straight, the setting is incorrect. Note, the 2nd amplifier slug should be adjusted to the point where the slug is closest to the chassis. Two points may be found, but the point closest to the chassis is the correct point.

4. Set the Hue control on the receiver fully counter clockwise. Adjust the Burst transformer for the R-Y petal to fall at the second or 2 mark on the screen. Rotate the Hue control. You should be able to make the R-Y petal go from the second position or mark to the R-Y mark to the fourth position or 4 mark on the screen. This is a 30 degree swing in both directions of the Hue control. A variation in the size of the vector pattern from one end of the Hue control rotation to the other will be noted and is normal. A drastic amplitude change at full CW end of control is of no consequence. If the amplitude changes or drops more than 75%, the circuits are not properly aligned and the procedure should be repeated.

3.58 MHz TRAP ADJUSTMENTS WITH THE PS148

The PS148 can be used to align the 3.58 MHz traps in the chroma section of the color receiver with the aid of the standard color bar generator. With the color bar generator set to color bars, use the PS148 as a regular scope and observe the waveform on the red grid of the receiver CRT. The lines of the waveform should be sharp and clean. If they appear fuzzy and thick, it is probably due to the presence of excessive 3.58 MHz signal. Adjust the trap for the red grid for a minimum amount of 3.58 MHz in the red waveform. Do this to each of the grids and adjust the associated **traps** for minimum 3.58 MHz signal.

USING THE PS148 SCOPE VERTICAL OR HORIZONTAL AMPLIFIERS EXTERNALLY

An output may be taken from the jacks at the rear of the PS148 from either the vertical or horizontal amplifiers (see chart). To use the vertical amplifier, feed the signal to be amplified into the "Direct Input" jack of the vertical input cable and take the amplified signal from the first jack at the right end of the terminal board

marked TOP VERT. This jack will produce a signal of the same polarity as that fed into the input cable. If push pull operation is desired, the signal may be taken from both jacks. If the opposite polarity of signal is desired, the signal may be taken from the vertical jack marked BOTTOM VERT. The horizontal amplifiers may be used in the same way. With the Horizontal Frequency control set at EXT, feed the signal into the Horizontal Input jack on the front panel and take the amplified signal from the horizontal jack marked LEFT HORZ. This will provide a signal of the same phase as that applied to the input jack. The vertical and horizontal gain controls should be used to control the amount of gain required.

DEFL. PLATE	SCOPE SELECTOR POSITIONS		
	NORMAL	EXTERNAL DEFLECTION	VECTOR
RIGHT HORIZ.	POSITIVE GOING SAW, AMPLIFIED SIGNAL OPPOSITE POLARITY AS INPUT.	POSITIVE SIGNAL DEFLECTS BEAM TO RIGHT.	INPUT FOR B-Y COLOR SIGNAL.
LEFT HORIZ.	NEGATIVE GOING SAW, AMPLIFIED SIGNAL SAME POLARITY AS INPUT.	POSITIVE SIGNAL DEFLECTS BEAM TO LEFT.	GROUNDED INTERNALLY.
TOP VERT.	AMPLIFIED SIGNAL SAME POLARITY AS INPUT.	POSITIVE SIGNAL DEFLECTS BEAM UPWARD.	INPUT FOR R-Y COLOR SIGNAL.
BOT. VERT.	AMPLIFIED SIGNAL OPPOSITE POLARITY AS INPUT.	POSITIVE SIGNAL DEFLECTS BEAM DOWNWARD.	GROUNDED INTERNALLY.

Scope Selector Chart

COIL AND TRANSFORMER CHECKS WITH THE PS148

A shock exciting technique to determine whether a coil or a transformer is defective is used by some technicians. This check consists of applying a signal to the coil and noting its effect on a scope. Basically, a good coil with a fairly high Q should cause a damped wave effect to show on the scope as shown in figure 18A. A defective coil will have less of a damped wave and appear as in figure 18B.

The PS148 can be used to make these checks very easily. Connect a lead from the horizontal jack marked LEFT HORIZ. on the rear of the PS148 to a small condenser (about 100mmfd). See figure 17. Connect the coil or transformer to be tested to the condenser, and the vertical input of the PS148 to the top of the coil, and the ground lead to the bottom of the coil as shown. The Horizontal Frequency control can be set to almost any position, except EXT, and the frequency varied to obtain the best looking waveform or set to the operating frequency of the coil for a more precise check.

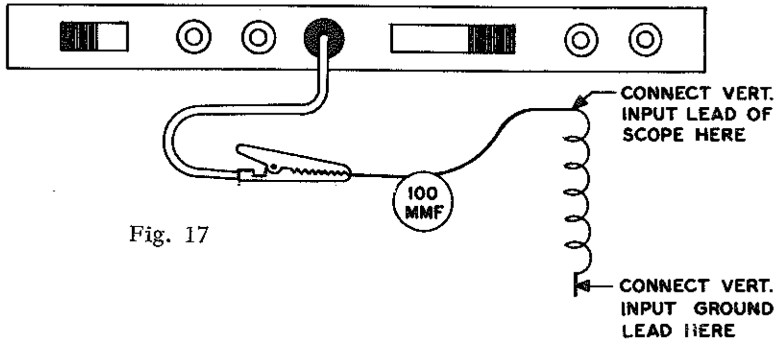


Fig. 17

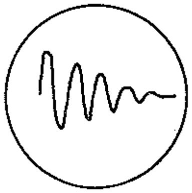


Fig. 18A

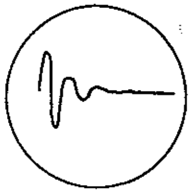


Fig. 18B

To become acquainted with this type of checking, it is a good idea to connect a number of different types of coils and transformers that are known good, and note the results on the scope. A TV horizontal flyback transformer is a good component to begin with. To check the results of a shorted turn, wrap a piece of solder around the transformer and note the reduction in the ringing.

CALIBRATION AND MAINTENANCE

Calibration: The PS148 peak to peak scale should rarely have to be recalibrated, but with aging tubes and components or the replacement of a tube, it is a good idea to check the unit periodically. To check the calibration of the PS148, the following procedure is recommended.

1. Check a known peak to peak voltage with a known accurate VTVM or Field Effect Meter, which has a direct reading peak to peak scale.
2. Check the same peak to peak voltage with the PS148, adjusting the vertical height to 1" of deflection. The readings on the vertical controls should agree with the voltage measured on the meter.

Should your PS148 need recalibration, the following procedure is recommended:

1. Remove the PS148 from the case. (See disassembly instructions.)

2. Apply a known peak to peak voltage to the vertical input. If possible, a 10 volt or 100 volt peak to peak source should be used. For best accuracy, the unit should be calibrated with the vernier control set at 1.0 volt and at frequencies from 400 to 10,000 Hertz.

3. If either the high or low end of a range are used, you will note the fine vertical control will rotate 15% down from either 5 or 0.5. This 15% is a dead spot, such that it still is 5 or 0.5, so no allowances off the end numerals need be made.

4. With the vertical input controls on the front panel adjusted to correspond with the incoming peak to peak voltage, adjust the sensitivity control on the top of the PS148 chassis, labeled CAL CONTROL, until 1" of vertical deflection is obtained on the screen. The Cal Control is located near the last 6DJ8 at the rear of the chassis.

A peak to peak scope calibrator can also be used. For a quick check, the AC line voltage can be applied to the vertical input. It should read about 325 volts peak to peak, if 115 volts AC has been applied. This is obtained by multiplying the RMS value of the line voltage by 2.83. Other voltages can be applied if a variable transformer and accurate AC meter are available.

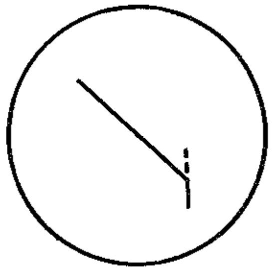
Input Attenuator Adjustment: The vertical input attenuator on the PS148 has compensation networks to insure more accurate reproduction of the input waveform. These should rarely need adjustment, except when a component or the input amplifier tube has been replaced. They can be adjusted, for the correct compensation without an expensive square wave generator, with these simple steps:

1. Remove the PS148 from its case.

2. Connect the vertical input to the center tap of the HORIZ GAIN control, set the vertical input attenuator switch to X10 position and adjust the HORIZ Gain control and VERTICAL input vernier control for a 2" long line set at a 45 degree angle. The Horizontal Frequency Range control should be set to 500 hertz-5KHz.

3. If the trimmer adjustment, on the vertical input switch is incorrect, the line will have a tail on it as shown in figure 19A. Adjust the trimmer, for a straight line, at 45 degrees as shown in figure 19B.

Fig. 19A



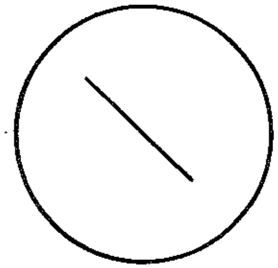


Fig. 19B

4. Turn the vertical input switch to the X1 position and check the line. You will have to adjust the HORIZ GAIN control to bring the line back to 2" long. If the "gimmick" is incorrect, the line will again have the tail. Twist, or untwist the gimmick for the line without the tail.

5. Repeat steps 3 and 4, two or three times for best results.

Circuit Breaker: If an overload occurs in the PS148, the circuit breaker, on the rear of the chassis, will break the primary circuit of the power transformer, to protect the circuits of the scope. To reset the breaker, simply push the red button next to the line cord. If the breaker can not be reset, then there is trouble in the PS148 circuits. Normal trouble-shooting procedures should be used to locate the problem.

Balance Control: The vertical balance control in the push pull 6DJ8 driver stage, allows for compensation of unbalanced tube sections in this stage. If a new tube is put in the PS148, it should be rebalanced to insure the greatest linearity in the waveform, on the screen. To rebalance this stage, follow these simple steps:

1. Remove the PS148 from its case.

2. Connect a VTVM or Field Effect Meter (zero center scale is best) to pins 1 and 6 of the 6DJ8 driver stage. Adjust the ZERO ADJUST for a center scale reading, and set the range switch to the 10 volt range.

3. Turn the PS148 on, and let it warm up for a few minutes.

4. Adjust the VERT BAL control, for a zero reading, on the Meter or so there is no difference of potential between the plates of the tube.

If difficulty is encountered with balancing of the tubes, they should be checked in a sensitive checker, such as, the Mighty Mite for grid leakage. An excess of grid leakage will cause an unbalance in the tubes and may cause the balance control to be on end. Vertical balance is under chassis, mounted on the terminal strip, midway between the 6GH8 and 6DJ8 driver stage.

REMOVING THE PS148 CHASSIS FROM CASE

To remove the PS148 chassis from its case, remove the three screws at the rear of the unit and the two screws on the bottom front. Slide the chassis forward out of the case while guiding the line cord through opening at rear.

REMOVING THE GRAPH SCREEN AND VIEWING HOOD

The PS148 graph screen may be removed easily for cleaning or when photographing waveforms. Simply remove the four bezel thumb nuts on the front holding the bezel to the front panel. Carefully remove the bezel and then the graph screen.

To put the Viewing Hood on or remove it, mearly loosen the top two bezel thumb nuts. Bend the hood in a semi-circle and insert it inside of the bezel so that the tabs go between the bezel and the graph screen. To remove the hood, reverse the procedure.

CIRCUIT DESCRIPTION

Vertical Amplifier: The input signal is fed through the input cable and jack (J1) to a four position frequency compensated attenuator switch (S1). After the signal level is selected in the attenuator switch it is fed through the triode section of a 6GH8A (V1) which operates as a cathode follower. The cathode follower output signal appears across R9 and R10. R9, the Vertical Gain control selects the required amount of signal to be fed to the pentode section of the 6GH8A where it is amplified. Resistors R10 and R11 set up the proper taper for the vertical gain control. Cathode bias is developed across R93 to set the proper operating level for the pentode amplifier. The plate load for the pentode amplifier is R13. Screen potential is fed through R14 and the screen is bypassed by C40C. Shunt peaking coil (L1) keeps gain of V1 flat to well over 5MHz.

The signal is then fed through C10 to the grid of the first triode section of V2. The second triode section of V2 operates as a grounded grid amplifier, the signal applied to it appearing across the common cathode resistor (R15). R16, R18, R17, R89 and R94 set the proper operating bias for V2. The plate circuits of V2 are compensated for good high frequency response by shunt peaking coils L2 and L3. The 180° out of phase signals are then fed to the control grids of V3 through coupling capacitors C12 and C13. Resistors R21 and R23 prevent parasitic oscillations from occuring. R29 is the vertical CAL POT, and controls degeneration between both triode sections, thereby varying their relative gains. The plate circuits of V3

are conventional, using well damped combination series and shunt peaking circuits to obtain a flat response to over 5 Megahertz. Signals are capacitively coupled to the CRT vertical deflection plates.

A synchronizing signal is taken from V3 and fed to a self limiting phase splitter V4, through R30, C42 and the sync switch S2. Sync signals of opposite polarity are available at the output of the phase splitter. One diode section of V4 clips the most positive portion of the sync signal and applies it to the sweep oscillator (V5).

Horizontal Sweep Circuits: The horizontal sweep oscillator (V5) operates as a phantastron circuit generating a very linear sawtooth voltage. A sharp negative spike is taken from the screen of V5. It is then clipped in one section of V4 and applied through C22 to the grid of the cathode ray tube for blanking purposes. The sweep frequency of V5 is determined by R44, R45 and C23, C24, C25, C26 and C27. The sawtooth output of V5 is taken from R51, the "Horizontal Gain" control, fed through an RC network (R42 and C20) and coupling capacitor C31 to the control grid of the horizontal amplifier (V6). This RC network reduces oscillator loading effects at high sawtooth sweep frequencies. The amplified sawtooth waveform is fed through C35 and C50 to one CRT horizontal deflection plate. It is also fed through C32, to a 12 to 1 resistive divider (R56 and R58) to the second triode section of V6. The amplified output is coupled through C34 and C49 to the CRT second horizontal deflection plate. R59 and R60, the plate load resistors for V6, are low in value to improve high frequency amplification in this stage.

Power Supplies and Centering Circuits: The power supplies are of conventional design using a full wave low voltage rectifier (V7) and a half wave high voltage rectifier (V8).

The output of V7 has several RC filter networks to reduce ripple content and provide isolation between various circuits. The output of V8 is a high negative voltage taken from the plate. It is RC filtered and fed to the cathode ray tube circuits.

Balanced horizontal and vertical centering is obtained by use of center-tapped controls R35 and R65. This provides better astigmatic control of the CRT trace. Resistor R81 in conjunction with Switch S4 is used to deflect the spot off of the CRT screen in the "Standby" position.

TROUBLE CHART

SYMPTOM	PROBABLE CAUSE	CORRECTIVE MEASURE
Can obtain dot, but no horizontal or vertical trace.	Scope Selector switch S6 (at rear of PS148) in improper position.	Set Scope Selector Switch to "normal" position.
Trace tilted	CRT positioned incorrectly.	Remove scope from case, loosen screws holding CRT and carefully rotate CRT so that trace is not tilted.
Trace bounces up and down at a slow rate	Open peaking coil L2, L3, L4, or L5 or leaky capacitor L6.	Use ohmmeter to determine which coil is open. Replace capacitor if defective.
Intermittent or erratic vertical output	Short at input jack. Gimmick (C1) touching chassis.	Check for short at input jack or if Gimmick is leaning against chassis.
Poor dot size or shape	MU shield on CRT positioned improperly. Power Transformer tilted incorrectly.	Set Scope Selector Switch to external direct to eliminated pickup from amplifiers. If dot shape does not improve, move MU shield and/or change transformer tilt for best dot.
Unit completely dead	Check "OFF Standby-ON" Switch, Circuit Breaker	Switch all the way to right. Push Circuit Breaker into re-set.
	V7 & V8	Replace if necessary
	R75, R76 & R71 C22, C36 & C37	Replace if necessary Replace if necessary
Insufficient intensity or brightness.	V7, V8 or V9	Replace V7, V8 or V9, if necessary.
Insufficient vertical output.	V1, V2 or V3 R77, C40A, C41C	Replace if necessary Replace if necessary

SYMPTOM	PROBABLE CAUSE	CORRECTIVE MEASURE
Unit will not sync.	V4 C17, C18 and C19 R36, R38, R39, R85 & control R41	Replace if necessary Replace if necessary
Sweep Oscillator Instability.	V4, V5	Replace V4 and/or V5
Insufficient sweep width.	Check setting of R51, V6, R59, R60 and R78	Turn R51 fully clockwise. Replace V6 if necessary Check value and replace if defective.
Trace will not center vertically	Check capacitors C14, C15 for leakage or short	Replace if necessary
Trace will not center horizontally.	C34 and C35	Replace if necessary
Poor Low Frequency	C5, C6	Replace if necessary
Poor High Frequency Response	Adjustment of C1, C2	Adjust C1 and C2 for a perfect square wave, using a square wave generator, operating at 15KHz.
	L1, L2, L3, L4 L5, L6, L7	Check coils for open; replace if defective.