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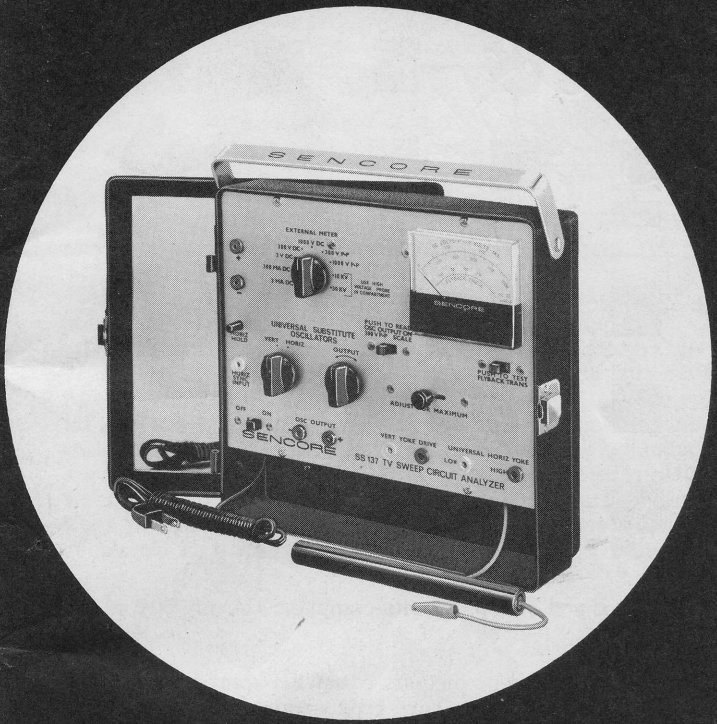
SS 137

SWEEP CIRCUIT ANALYZER



SENCORE

SENCORE SERVICE MANUAL

3200 SENCORE DRIVE, SIOUX FALLS, S. DAKOTA 57107

OPERATING INSTRUCTIONS FOR THE MODEL SS137
SWEEP CIRCUIT ANALYZER

The SS137 SWEEP CIRCUIT ANALYZER is expressly designed to help you trouble shoot TV sweep, sync, and high voltage circuits faster and more profitably. All tests are made dynamically - that is, with the TV set turned on. This is important since many out-of-circuit tests will indicate sweep components are good, only to have them break down in the circuit with operating potentials applied.

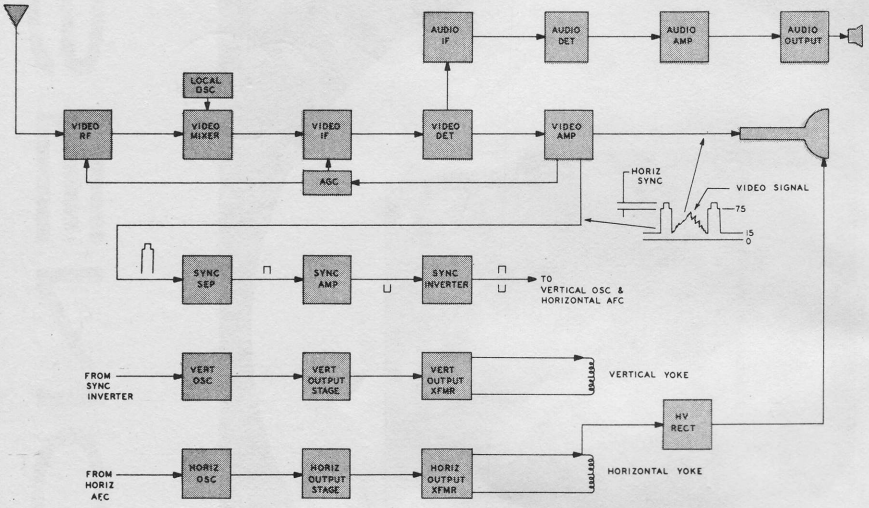


Fig. 1. Block diagram shows sync and sweep circuits comprise roughly 50% of TV.

As seen in Fig. 1, the sweep and sync circuits comprise approximately 50% of a TV receiver. Historically, however, they have represented nearly 80 percent of the "toughdog", time-consuming troubles. One of the main reasons why horizontal sweep troubles are so difficult to trace is that the high voltage is often lost; thus you lose your indicating device, and are figuratively working in the dark. In addition, there is so much interaction in the sweep circuit that it becomes very difficult to pin-point the trouble to a specific section or stage - one trouble often looks like another. For example, insufficient width can be caused by the horizontal oscillator, output tube, flyback or yoke. The SS137 assists you in quickly "tying down" this sort of trouble to the faulty stage, and many times, even to the defective component.

WHAT WILL THE SS137 DO?

To familiarize yourself with what the SS137 does, let's take a look at some of the checks that can be made with it. Both the TV horizontal and vertical sweep circuits contain a driving oscillator, output stage, an output transformer, and a deflection yoke. Both TV oscillators can be checked with the SS137 by directly substituting a known-good, variable-output oscillator.

The horizontal output tube voltages and cathode current can be checked with the SS137 external meter ranges. The external meter ranges can also be used to check high voltage, setting up regulated HV supplies and focus voltage supplies in color TV's, checking fuse currents in the horizontal circuits, etc.

The horizontal deflection yoke can be checked by substituting a known-good yoke contained in the SS137. If high voltage is restored, or a bright vertical line appears on the CRT, you can be certain there is yoke trouble.

Testing the horizontal output transformer is one of the most important checks that can be made with the SS137. This is done under full power to see how well the flyback operates. The meter in the SS137 is calibrated in degrees of deflection to show how much power the transformer is supplying. If enough energy is delivered to reach or surpass the power required to sweep the picture tube in the set being repaired or tested, the transformer is doing its job and can be considered good.

The vertical section of a TV can be checked very easily with the SS137. Three test signals permit you to check the vertical oscillator, output and yoke circuits with a minimum of effort. The variable output of the SS137 vertical oscillator is used to check the TV oscillator and output stage, and a vertical transformer drive signal and a vertical yoke drive signal are used to determine if the transformer or yoke are capable of producing a picture with full height.

The sync circuits are checked by applying either negative or positive sync pulses directly to the horizontal oscillator in the SS137. After the SS137 horizontal oscillator has been substituted for the oscillator in the TV, any pulse from the video amplifier plate on can be applied directly to the SS137 and the horizontal hold on the front panel adjusted to see if the pulse will sync the oscillator. The horizontal hold control in the SS137 lets you sync the picture just as if you were adjusting the oscillator in the TV. If the picture weaves when using the SS137 oscillator it's a sure sign of sync trouble. By moving from stage to stage, you can tell where the video is coming in and causing the weave. Naturally, you'll get a weaving picture when you pick up the sync at the plate of the video output tube, because the sync hasn't yet been separated from the composite video signal.

SPECIFICATIONS

Power Requirements

110/120V 60CPS, 15 watts power used for substitute oscillators and vertical transformer drive signal and vertical yoke drive signal.

Output Signals

Horizontal: waveshape-sawtooth; frequency - variable around 15,750 CPS; amplitude - variable from 0 - 300 volts peak to peak, monitored on meter; sync features - can be synchronized to incoming station signal on any polarity sync pulse.

Vertical: waveshape - sawtooth from substitute oscillator, sine wave for transformer drive signal and for yoke drive signal, frequency - fixed 60CPS; amplitude - variable from 0 - 280 volts peak to peak, monitored on meter.

Dynamic Tests

Horizontal and vertical oscillator substitute
Horizontal deflection yoke substitute
Flyback transformer check, monitored on meter
Vertical transformer drive signal
Vertical yoke drive signal

Meter Ranges

Internal: 0-300 volts peak to peak, for monitoring substitute oscillator signals; 50^{O}, 70^{O}, 90^{O}, 110^{O} and COLOR, for flyback transformer check.

External: 0-3 MA DC, 0-300 MA DC, 0-3 VDC, 0-300 VDC, 0-1000 VDC, 0-10,000 VDC, with external probe, 0-30,000 VDC, with external probe, 0-300 V peak to peak, 0-1,000 V peak to peak.

Physical Specifications

Height - 9 1/2 inches
Width - 10 inches
Depth - 4 "
Weight - 9 lbs.

Vacuum Tube Complement

V1 - 6BN8
V2 - 6CS7

Special Features

Large storage compartment.
Distortion free mirror in detachable cover, for viewing picture while making adjustments.
All Steel case.

CONTROLS ON THE SS137

Before starting to use the SS137, you can save time if you completely familiarize yourself with the unit and its controls.

The SS137 provides a substitute horizontal yoke, four test signals and a multitude of external meter ranges for measuring voltages and currents. Many of these functions are used simultaneously in an average trouble shooting procedure. For example, the yoke coil in the SS137 can be substituted for the TV yoke, the output of the horizontal oscillator in the SS137 can be driving the horizontal output tube in the TV and the TV high voltage can be measured on the SS137 panel meter. In addition, the horizontal output transformer can be checked, without making any changes above, by merely pushing the transformer test button.

Let's see what controls we have to perform these checks.

OFF-ON SWITCH

The OFF-ON switch controls the AC line power to the horizontal and vertical oscillators, the peak to peak meter circuit and the vertical driving signals. It should be placed in the ON position when substitute oscillator signals or vertical drive signals are desired, and when making peak to peak voltage measurements. It does not have to be ON when checking the horizontal yoke or transformer or when making DC voltage and current checks.

UNIVERSAL SUBSTITUTE OSCILLATOR SECTION

The universal substitute oscillator section consists of three controls, one input jack (sync), two output jacks and a test switch permitting oscillator output level to be indicated on the panel meter.

VERT - HORIZ SWITCH

The VERT - HORIZ switch selects the operating frequency of the SS137 oscillator for a 60 cycle sawtooth signal in the VERT position and a 15,750 cycle sawtooth signal in the HORIZ position.

OUTPUT CONTROL

The OUTPUT control changes the amplitude of the signal available at the OSC OUTPUT jacks. It is used for both vertical and horizontal signals selected by the VERT-HORIZ switch.

OSC OUTPUT TEST SWITCH

The OSC OUTPUT test switch, just to the right and slightly above the OUTPUT control, permits the sawtooth output level to be indicated on the panel meter in peak to peak volts so that the OUTPUT control can be set to an exact peak to peak amplitude. The switch can be pushed at any time to read oscillator output level, even if the meter is being used to monitor external voltages or currents.

HORIZ HOLD CONTROL

The HORIZ HOLD control and the HORIZ SYNC INPUT jack are used only when the VERT-HORIZ switch is in the HORIZ position. Plus or minus sync signals from the TV sync stages are fed to the HORIZ SYNC INPUT jack and the HORIZ HOLD control is used just as with a TV to "lock" the SS137 horizontal oscillator to the sync signal. By using sync from the TV in this manner, the TV sync stages can be completely checked out and a defective stage easily located.

HORIZ YOKE SUBSTITUTE

The HORIZ YOKE substitute is an adjustable yoke substitute coil that is connected to the TV flyback transformer in place of the TV yoke on the picture tube, when the TV yoke or flyback transformer is suspected of being bad. It is connected to the flyback transformer through the LOW and HIGH UNIVERSAL HORIZ YOKE jacks; the HIGH jack is connected to the "hot" terminal of the flyback transformer and the LOW jack is connected to the low end of the transformer, or it can be connected to ground.

All of the power from the flyback transformer that would normally go to the TV yoke to develop raster width, of course cannot do so when the substitute yoke in the SS137 is connected, and instead will be developed across the substitute yoke. By measuring the power delivered to the substitute yoke, a dynamic check can be made on the flyback transformer to see if it is delivering sufficient power to develop proper width in the picture tube. This is done on the SS137 when the flyback transformer test switch is pushed. Power is read on the panel meter in terms of picture deflection angle such that if a TV set has a 90 degree tube the meter should indicate at 90 degrees or above with a good flyback transformer.

The HORIZ YOKE substitute coil is adjustable so that it can be set to the same inductance as the TV yoke. This is done dynamically while pushing the FLYBACK TRANS test switch and adjusting the HORIZ YOKE for maximum meter indication.

VERT TRANS DRIVE and VERT YOKE DRIVE JACKS

Vertical transformer drive and vertical yoke drive signals are available from the VERT TRANS DRIVE jack and the VERT YOKE DRIVE jack respectively. These are both 60 cycle AC sine wave signals. The vertical transformer drive signal is approximately 350 volts RMS; EXTREME CAUTION FOR PERSONAL SAFTY SHOULD BE FOLLOWED WHEN USING THIS SIGNAL. The vertical yoke drive signal is a low voltage high current signal. Both signals are designed to produce full raster height when the vertical output transformer and vertical yoke are good.

EXTERNAL METER SWITCH

The EXTERNAL METER switch allows you to check voltages and currents anywhere in the TV set. It operates independently of the rest of the SS137 circuitry. Nine ranges are provided:

0-3 MA DC - used for setting control current of the HV regulator in color TV's.

0-300 MA DC - used for checking cathode current, or sweep fuse current on the horizontal output tube. NOTE; WHEN CHECKING CURRENTS ABOVE CHASSIS GROUND, REMOVE ALL OTHER LEADS BETWEEN THE SS137 AND THE TV SET TO PREVENT DAMAGE TO THE SS137.

0-3V DC - same as the 0-3MA range above. Some color TV's have a built-in resistor and you must set the regulator current for a predetermined voltage.

0-300V DC - used for checking B+ voltage, screen voltage on the horizontal output tube etc.

0-1000V DC - used for checking boost voltage, etc.

0-300V peak to peak and 0-1000V peak to peak - used for checking the driving voltages in the horizontal and vertical oscillators and outputs, AGC and sync circuits.

0-10KV DC - used for setting focus voltage level in color TV's.

0-30KV - used for checking 2nd anode voltages.

The probe places an average load on the 2nd anode voltage source. This means that the picture tube doesn't need to be hooked up to obtain an accurate check of the high voltage. This handy arrangement lets you read high voltage as an indication of a sweep circuit improvement at any time during your test.

USING THE SS137

The SS137 is easy to use. Naturally, the more you use this versatile test instrument, the faster you'll become at tracking down troubles. Therefore, before you start trouble shooting with the SS137, run through all of the following test procedures and see how it works when checking a TV that's operating normally. This way you'll know what to expect from the SS137, and at the same time familiarize yourself with its operation.

When servicing a set, you should, of course, make certain the tubes are good before using the SS137. While it will show up a defective tube, you'll usually find the SENCORE MIGHTY MITE tube tester will find tube troubles faster.

TO USE THE UNIVERSAL HORIZONTAL OSCILLATOR

The horizontal oscillator in the SS137 (tuned to 15,750 cycles at the factory) is used to check the horizontal oscillator in the TV set when it is suspected of being defective. If substituting the known-good oscillator produces a raster, and none was present before, you can be certain the oscillator or AFC circuit in the TV is defective. To pinpoint the trouble, use the substitute oscillator in the SS137 as a signal injector and work back from the control grid of the horizontal output to the point where no raster is present. This isolates the trouble to a specific point in the circuit, and often to the defective component. To substitute the universal horizontal oscillator use the following procedure:

1. Plug the line cord of the SS137 into 115 volts, 60 cycle AC and turn it on with the OFF-ON switch.

2. Set the VERT-HORIZ switch to HORIZ.

3. Insert the black test lead into the jack marked (-) and connect it to the TV circuit ground. USE CAUTION WITH "HOT" CHASSIS TV SETS. Insert a red lead into the red jack marked (+) and connect it directly to the control grid of the horizontal output tube.

4. Start with the OUTPUT control at the counterclockwise position and slowly increase it until a raster appears. If a raster does not appear, check to see whether or not the 2nd anode voltage has been restored. Incidentally, you may want to check peak to peak or DC voltages at any point in the trouble shooting procedure. If you obtain high voltage, the horizontal oscillator in the TV set is at fault. Use the SS137 oscillator as a signal injector and move it across the components one by one until you reach the oscillator plate. If the original condition in the TV set reappears at any point, you have found your trouble spot. In some cases, the coupling capacitor from the horizontal oscillator to the control grid of the output tube may be leaky or in a rare case, the grid resistor may be shorted. To check for this, disconnect all the components from the output tube grid and inject the SS137 signal directly to the grid. The circuits in the SS137 are designed so you can do this without any blocking action taking place.

If the 2nd anode voltage wasn't restored when injecting the signal at the grid of the output tube, see "To Check the Output Circuit".

After you obtain a full raster without drive bars, it is a good idea to see just how hard you are driving the horizontal output tube. Merely push the OSC OUTPUT test switch and read the exact peak to peak output of the SS137 oscillator on the meter. Since the horizontal oscillator in the SS137 can be varied from 0 to 300 volts peak to peak except when heavily loaded, a full raster should be obtained with it set at the value shown on the schematic. If it isn't, there is trouble in the output circuits.

SYNCING THE UNIVERSAL HORIZONTAL OSCILLATOR TO THE STATION SIGNAL

In making the above tests you'll find that the universal horizontal oscillator in the SS137 does not sync in or synchronize with the incoming station signal even though it operates at 15,750 cycles. For normal trouble shooting, this does not matter. However, if you desire, you can lock in the picture by feeding the sync signal from the TV set into the sync jack on the SS137 as follows:

1. Connect the SS137 horizontal oscillator to the control grid of the horizontal output tube, as described above, and set the OUTPUT control to obtain full raster.

2. Connect a lead from the yellow HORIZ SYNC INPUT jack to the plate of the sync separator. You can take the sync from any sync stage or even the video amplifier, but the sync separator plate is best to start with.

3. Tune the TV set to a station signal and rotate the horizontal hold control on the SS137 until the picture locks in. Note that the picture moves to the right or left from normal. This is of no concern as long as the blanking bars remain vertical and in sync on the picture tube. Also the AGC may cause difficulty if it is of the keyed type.

If the sync is absent or weak, the oscillator in the SS137 will react in the same way as the oscillator in the TV set. Then you can concentrate on tracking a sync problem. Video information may be getting into the sync due to poor separation. If so, the SS137 oscillator will cause the picture to weave from side to side and be worse when receiving a dark scene. Thus, by checking the stability of the picture, with the SS137 substituted and fed a sync signal, you can tell the exact condition of the sync pulse without resorting to a scope.

Before starting to trouble shoot an apparent sync problem, it is a good idea to check the AGC system first. Use a negative bias supply, such as the Sencore BE113, to clamp the AGC by connecting the positive lead to ground and the negative lead to the IF AGC line. Slowly increase the negative AGC voltage. If the picture becomes stable, the AGC is at fault and not the sync circuits. When servicing sync troubles in sets with keyed AGC, clamp the AGC line with the bias pack and adjust it to produce a picture with normal to light contrast. This should be done, even if the picture is out of sync, to prevent sync clipping in the video amplifier. With the proper sync level at this point, it is easy to track down a sync defect with the SS137.

Checking TV Sync Circuits with the SS137

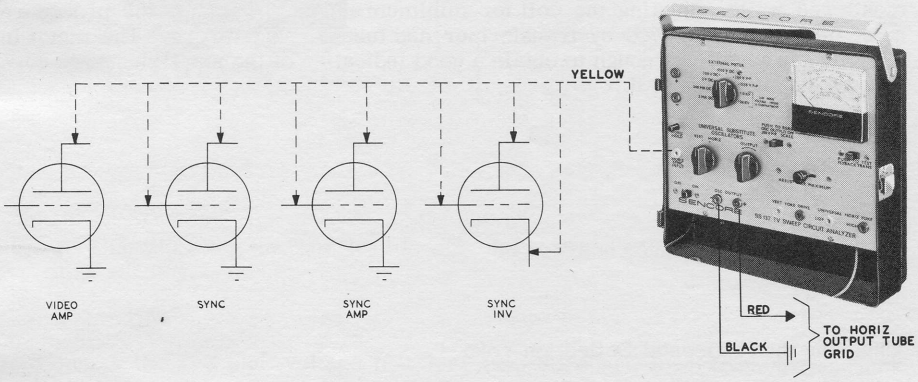
With the SS137 oscillator connected as explained above, you can check the sync path from the video amplifier to the horizontal AFC circuit.

1. Connect the sync input lead of the SS137 to the plate of the video amplifier.

2. Adjust the HORIZ HOLD on the SS137 to obtain a synchronized picture. Naturally, the picture will weave because the sync has not yet been separated from the video.

3. Move the sync input lead from point to point in the sync path (Fig. 2) to find where the picture becomes unstable. (The pulses are automatically limited and differentiated in the SS137 so the oscillator will sync on either a negative or positive sync signal.

Fig. 2. You can pick up the sync signal any place in the circuit to lock the SS137 oscillator.



HOW TO CHECK SYNC PROBLEMS

IF GATED AGC IS USED, IT IS RECOMMEND THAT A BIAS PACK BE USED IN PLACE OF AGC FOR BEST RESULTS.

Checking the Horizontal Output Tube Circuit

If you check the horizontal oscillator in the TV with the SS137 and still do not get a raster or high voltage, the next logical step is to proceed to the horizontal output stage. The output tube screen voltage and cathode current can be checked with the SS137 external meter ranges. Cathode current can be checked by breaking

the cathode connection (see tube chart enclosed with this booklet or a tube manual for pin number) and inserting the SS137 meter test leads across the break. Observe polarity - the negative lead should go to ground; the positive lead should go to the cathode. The EXTERNAL METER switch should be set to 300MA. NOTE: Most of the newer compactron and novar output tubes have more than one cathode pin. All cathode leads must be broken in order to read cathode current. Screen voltage is checked on the 300V DC range.

Compare the cathode current reading with the value shown on the schematic or the tube chart.

If the cathode current is low, the trouble is usually centered in the screen or plate circuit. Check the screen voltage to see if it is normal. If so, change the tube once more to be sure it is good. If in doubt, check it with the Sencore Mighty Mite tube checker.

If the cathode current is high, the trouble is often due to insufficient grid bias. This may be caused by reduced drive. If you haven't checked the oscillator, substitute the SS137 oscillator to see if current will return to normal. If it is still high, check the negative grid bias and/or peak to peak drive at the grid.

In sets equipped with a horizontal linearity coil, the cathode current can be monitored while adjusting the coil for minimum current. This is the procedure most often recommended by transformer and tube manufacturers. The meter in the SS137 is sensitive enough to obtain a good indication of the small change in current as the coil is peaked.

Checking the Horizontal Deflection Yoke

If the trouble has not been found after the horizontal oscillator and output stages have been checked, it is time to check the horizontal deflection yoke. Actually, the yoke can be checked at any time, but a step by step procedure of this type is recommended on "tough dogs".

The universal substitute yoke used in the Sencore SS137 covers a complete range of inductances used in TV sets. If high voltage can be restored by substituting the yoke, the TV yoke is defective.

A bright vertical line will appear on the picture tube, when using the SS137 substitute yoke, if all other parts of the circuit are operating normally. This is because high voltage has been restored but we are delivering the power into the substitute yoke rather than deflecting the beam across the picture tube. If you are checking the set without the picture tube, use the 2nd anode voltage check as an indicator instead of the bright vertical line on the picture tube. To check the horizontal yoke, proceed as follows:

1. Turn off the TV set.

2. Disconnect the lead going to the high side of the yoke (the connection nearest the horizontal output tube plate). It can be disconnected right at the yoke if you desire. On yokes that have three leads, both the high side and center tap must be disconnected. (See Fig. 3)

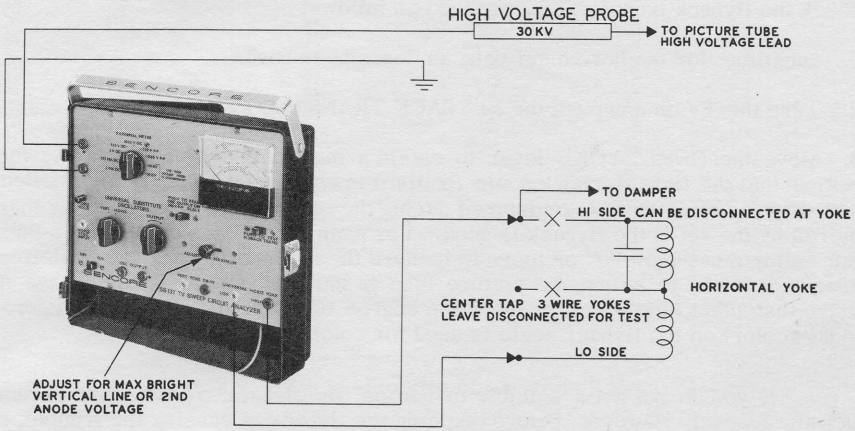


Fig. 3. Disconnecting the "hot" lead feeding the yoke and connecting it to the SS137 substitute winding.

3. Connect the red high-voltage test lead (the thick red lead) from the red jack labeled HIGH to the point where you disconnected the yoke. If the yoke in the set has a center tap, it remains disconnected for these tests. Be sure you don't connect the red test lead to the horizontal yoke rather than to the circuit feeding it - to do so will result in a false test. Remember, you are substituting for the yoke, not applying a signal to it.

4. Connect the blue test lead from the blue test jack marked LOW to the yoke return circuit. If you prefer, instead of connecting it to the low side of the yoke, this lead can be connected to the chassis and the test will work perfectly. This is especially useful for those technicians who want to make all checks above chassis without removing the set from the cabinet.

5. You have now substituted the yoke. Turn the TV on and move the YOKE ADJUST lever up and down. If a bright vertical line appears and/or 2nd anode voltage develops, the yoke in the TV is defective. Keep in mind that the 2nd anode check is the most reliable indication.

6. If high voltage fails to develop, the yoke is not defective. However, do not disconnect the substitute yoke because you will be using the same connections to check the flyback.

Checking the Horizontal Flyback Transformer

The flyback transformer is normally checked after making all of the tests described to this point. This is because the accuracy of this dynamic in-circuit test depends on whether or not the other circuits are functioning properly. To check the flyback transformer, proceed as follows:

1. Substitute for the horizontal yoke as described above.

2. Turn the TV on and push the FLYBACK TRANS test switch.

3. Move the HORIZ YOKE lever to obtain a maximum indication on the meter. Notice that the flyback check scale (bottom) is calibrated in degrees of deflection. The degrees of deflection registered during the test will equal or surpass that required by the set if the flyback is good. For example, if you are testing a 90^{o} set, the meter must show 90^{o} or more to be sure the flyback transformer is delivering adequate power to sweep the picture tube in the set. Color TV sets have more drive than black and white for the same degree of deflection, therefore a separate mark (color) on the flyback scale is used for color sets.

If you do not get a suitable indication, the flyback transformer becomes a definite suspect. However, before deciding the flyback is causing the trouble, make a thorough check of the boost circuit. A shorted or leaky component in the boost circuit can give every indication of a defective flyback. A fast method of checking boost is to disconnect all leads from the boost line except any feeding the horizontal output stage. In sets that have the horizontal oscillator connected to the boost circuit, substitute the horizontal oscillator of the SS137 in place of the oscillator in the TV. If the meter still indicates insufficient deflection, the flyback transformer is definitely bad. If the meter shows plenty of deflection after disconnecting the boost circuits, the trouble is in the boost circuits. You can use the flyback check in the SS137 to isolate boost troubles to the defective stage. If you've just completed the above test, reconnect the boost circuits - the meter should again read low. Then disconnect the lead at each stage being operated from boost voltage. When the meter moves up to normal, you have located the defective stage.

When substituting the SS137 yoke in color TV sets, do not leave the TV on for more than about 15 minutes at a time; the higher power in color TV sets may cause the substitute yoke to overheat.

When servicing horizontal sweep circuits, you should realize there are three basic types of output circuits as shown in Fig. 4. A good understanding of their operation will enable you to locate sweep troubles faster. However, the instructions for servicing with the SS137 remain the same for all three types.

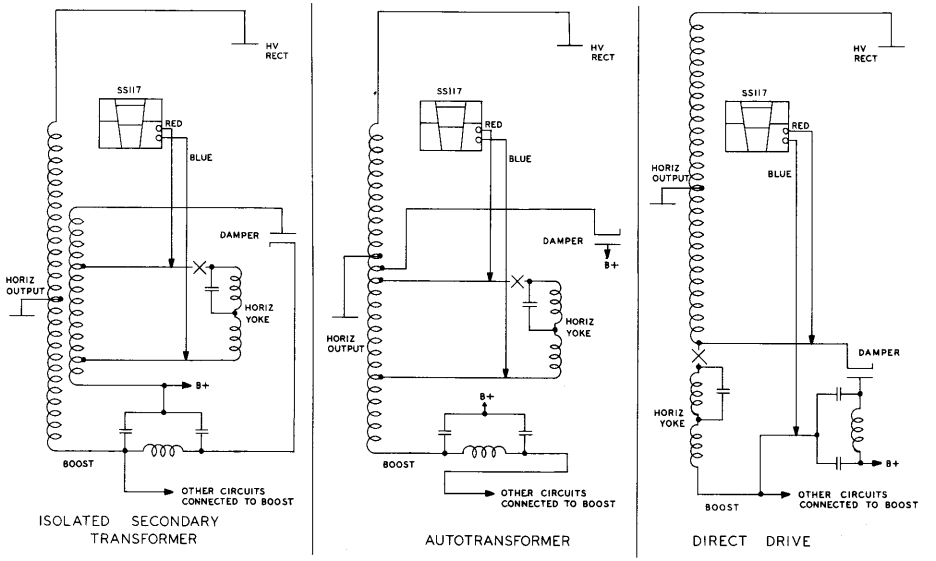


Fig. 4. There are three basic types of horizontal output circuits.

Checking the Vertical Sweep Circuit

The vertical section of a TV receiver is easier to trouble shoot than the horizontal section, because the picture tube can be used as an indicator. The SS137 provides all the signals necessary to make the trouble shooting procedure as simple and as easy as possible.

Checking the TV Vertical Oscillator

The universal oscillator in the SS137, when switched to VERT produces a 60 cycle sawtooth waveform, variable from 0 to 300 volts peak to peak. The vertical oscillator is synchronized to the power line just like a transmitter. Except for an occasional network program, the picture will stay in sync for the vertical tests without external synchronization. The substitution of the vertical oscillator is much the same as the horizontal oscillator. To check the vertical oscillator in a TV set proceed as follows:

1. Plug in the SS137 and turn the unit on. Allow it to warm up.

2. Turn the switch marked VERT HORIZ to VERT.

3. Connect a test lead from the red OSC OUTPUT jack marked (+) to the control grid of the vertical output tube.

4. Connect a black test lead from the black OSC OUTPUT jack marked (-) to the TV circuit ground.

5. Turn the TV set on and allow it to warm up.

6. Advance the OUTPUT control from a full CCW position, slowly clockwise towards maximum signal to see if you can obtain full height. If full height is obtained, and you had no vertical deflection before substituting the vertical oscillator, the TV oscillator is defective.

Checking the Vertical Output Circuit

If when substituting the vertical oscillator you did not get any vertical deflection the trouble has to be in the output tube, the vertical output transformer or the vertical yoke. It can be narrowed down by driving the vertical output transformer with the VERT TRANS DRIVE signal from the SS137. If the vertical sweep is restored when driving the transformer the trouble is in the output tube circuit and the external meter ranges should be used to check out this circuit. If the sweep is not restored the transformer or the vertical yoke is defective. To use the VERT TRANS DRIVE signal proceed as follows:

1. Connect a heavy red lead from the SS137 VERT TRANS DRIVE jack to the "hot" terminal of the vertical transformer and a black lead from the SS137 (-) jack to the TV circuit ground. It is best to disconnect the vertical output tube plate from the "hot" terminal of the transformer to prevent loading of the driving signal. It is not necessary, however. All that will happen is that the height obtained will be less with the plate connected.

2. Turn on the TV receiver and the SS137 and check the vertical deflection on the CRT. If the transformer and yoke are good and the vertical output tube plate lead is disconnected, you will obtain full height on small screens, and about 3/4 height on larger screens and color receivers.

3. If you cannot get the required deflection or no deflection, check the vertical yoke to isolate the problem to the transformer or the yoke.

Checking the Vertical Yoke

After checking the vertical oscillator and output, you may suspect the yoke as causing the trouble. A special yoke drive signal is provided on the SS137 to be applied directly to the vertical deflection yoke in the TV set. Full vertical height should be obtained on smaller black and white sets, and about 3/4 of full raster on large black and white and color sets. If this is obtained, you can figure the vertical yoke as good. To check the vertical yoke proceed as follows:

1. Disconnect the high side of the yoke from the vertical output transformer. (Note: If you wish to apply the test signal without disconnecting the yoke, the test will be accurate, but you will obtain only half the height because of the power absorbed by the vertical output transformer.)

2. Connect a test lead from the red test jack marked VERT YOKE DRIVE directly to the high side of the yoke. This is just the opposite of the horizontal yoke substitute. Now you are driving the yoke with a signal not the circuit that drives the yoke.

3. Connect a test lead from the blue jack marked VERT YOKE DRIVE to the low side of the vertical yoke.

4. Turn on the TV receiver and the SS137 and check the vertical deflection on the picture tube.

If full height or 3/4 height for larger sets and color sets is obtained, the yoke is good. If there is no deflection or very little height, the yoke is defective.

External Voltage and Current Checks

The SS137 provides an external VOM and peak to peak reading VTVM for use in trouble shooting the sweep circuits of the TV set. The current ranges and the DC voltage ranges are used just like a VOM. The peak to peak reading VTVM is operated like a VTVM, and the SS137 must be plugged into 115 VAC before any reading of peak to peak voltages are made.

The ranges provided are 0-3, 0-300 MA DC, 0-3, 0-300, and 0-3000 VDC, 0-300, and 0-1000 V peak to peak AC, and 0-10 KV and 0-30 KV. The 0-3 MA and 0-3 VDC are provided to help set up the high voltage regulator of the color TV sets. The 0-300 and 0-1000 VDC are useful in measuring the boost and screen voltages in the output stage. The 0-300 and 0-1000 volts peak to peak AC can be used to measure the driving voltages in the output stages, oscillator output voltages, AGC and sync circuit voltages. The dual high voltage range covers the high voltage as well as the focus voltage on color sets. To measure the high voltage, the built-in high voltage probe must be used. All other ranges use the external input jacks on the upper left hand corner of the panel.

The special high voltage probe on the SS137 is designed to provide an average load on a black and white CRT. Thus the most accurate check can be made with the 2nd anode lead disconnected from the black and white picture tube. Due to the high voltage regulation of color sets, the lead may be disconnected or left on color CRT.

SS137 CIRCUIT DESCRIPTION

SEE SCHEMATIC SHEET

Horizontal Oscillator

The horizontal oscillator consists of one-half of a 6CM7 (V2) tube operating in a 15,750 cycle blocking oscillator circuit. Feedback between the plate (pin 6) and control grid (pin 7) is by inductive coupling in transformer T2. The operating frequency is determined mainly by R25, R26 and C7 in series with the secondary of T2. The variable control (R26) serves as the HORIZ HOLD. The oscillator output is coupled from the cathode of the oscillator tube section through C12 to the grid of the second section of the 6CM7. R29 is connected across C12 to slightly reduce the bias on the second stage to provide increased output. The waveshaping network C8 and C9 is in the plate circuit of the second stage. A portion of the modified sawtooth is then tapped off by OUTPUT control R31 and coupled through C13 to the OSCILLATOR OUTPUT jack marked plus (+).

The Vertical Oscillator

The vertical oscillator consists of the 6CM7 serving as two triode 60 cycle amplifiers. A sinusoidal signal from the power line is partially shaped in the plate circuit of V2 (pin 6) by C10 and R28. It is then coupled through C11 to the grid of the second stage. Final waveshaping is accomplished by C9, and the primary winding of T2. As in the horizontal circuit, the output is tapped off by R31 and coupled through C13 to the OSCILLATOR OUTPUT jack marked plus (+).

The B Plus Supply

The B plus supply consists of power transformer T1, silicon rectifier D1, and pi filter C1, R4 and C2. In addition, T1 also contains two 6.3 volt windings - one for the tube filaments, and the other for the VERTICAL YOKE DRIVE signal. The limiting resistor R1 prevents damage to T1 in the event the output leads are accidentally shorted together, or connected to a shorted yoke.

The Horizontal Yoke Substitute

The horizontal yoke substitute is a permeability-tuned inductance T3 used as a substitute for the horizontal deflection yoke in the TV set for test purposes only. It has a range from 5 to 40 millihenries to take the place of any horizontal yoke coil including those used in color sets. The return path of the coil is connected to the UNIVERSAL HORIZ YOKE jack marked LOW through a .25 mfd, 1000 volt capacitor C14. This eliminates the possibility of a shock hazard if the low side is connected to chassis ground.

The Horizontal Output Transformer

The horizontal output transformer check uses inductance coil T3 also. The secondary - a small take off coil - picks up some energy from coil T3 and feeds it through the half-wave rectifier D2. Push to test switch S2, then connect the output to the meter and R33 to complete the circuit. R33 is a meter calibration resistor selected at the factory. The meter indicates the quality of the flyback by measuring the power it delivers. Since power output is directly proportional to deflection angle, the meter is calibrated in degrees of deflection. A reading at, or above the deflection angle of the picture tube in the set shows the flyback is satisfactory.

Oscillator Output in Peak to Peak Volts

Oscillator output in peak to peak volts can be read on the meter as well as external peak to peak voltages. The substitute oscillators output is fed through S3 and C3 to a dual-diode section of the 6BN8 where it is rectified. The output equals the sum of the voltages across C3 and C15. A portion of the voltage is tapped off the divider network R5 and R6 and fed to the control grid of the triode section of the 6BN8. This cathode follower DC amplifier is connected to the positive side of the meter M1 through the Meter Zero potentiometer R9, and push to test switch S3. The negative side of the meter goes to ground through S3 and the peak to peak calibrate potentiometer R10 to complete the circuit of the unbalanced VTVM.

The external peak to peak meter ranges, 0 to 300 and 0 to 1000, have identically the same circuit with the incoming signal from the red meter jack going through function switch S5. Switch S3 has to be in a dormant position to read peak to peak voltages externally.

External Voltage and Current Checks

External voltage and current checks are measured by an accurate 100 microamp meter in accordance with the settings of the EXTERNAL METER switch S5. Resistors R15 and R16 form the shunts for the 0 to 3 and 0 to 300 MA current ranges. Resistors R11, R12 and R13 are the multipliers for the 0 to 3, 0 to 300 and 0 to 1000 volts DC ranges. For the AC peak to peak ranges, the 0 to 300 volts AC goes directly to the diode section of the 6BN8, and the 0 to 1000 volts AC must pass through the resistor R18 shunted by C4, which acts as a frequency compensator. The high voltage ranges use the special probe with a built-in 100 megohm resistor. On the 10KV and 30KV ranges, R20 prevents excessive damaging voltages from getting in the unit when the meter switch is switched to some other range. In the 30KV range, R19 shunts the meter so that the same 100 megohm multiplier resistor can be used for both the 10KV and 30KV ranges.

Peak to Peak Voltage Calibration

The peak to peak voltage ranges have been set at the factory and should not require readjustment unless a tube has weakened or been changed. To check the accuracy of the calibration, adjust the power line to EXACTLY 117 VOLTS AC,

apply it to the external voltage jack, and note the reading on the 1000 volt peak to peak scale. It should be 331 volts (117 volts times 2.83 for peak to peak). The 300 volt range will automatically fall into line and does not need to be checked. If it is necessary to recalibrate the instrument, remove from the case. Check the mechanical zero of the meter by switching to 1000 volt DC range. If the meter strays away from zero when switching back to the 1000 volts AC range, with no input to the meter, short the input and reset the meter zero potentiometer to rezero the meter. Then apply the 117 volts AC and set the meter to 328 volts peak to peak. Recheck the meter zero, and work back and forth if necessary. NOTE: If the EXTERNAL METER switch is left in the 300 or 1000 volts peak to peak setting while making other checks, stray pick-up will cause the meter to read above or below zero with no input. Therefore, it is not recommended that you leave this switch on one of these settings when not checking external peak to peak volts. If you should note the meter falls off zero when you start to read peak to peak volts, momentarily switch to one of the other external checks to see that the meter zeros. If the meter will zero on the other settings, the peak to peak measurements will be accurate at any measurements off zero.

PUTTING THE SS137 TO WORK

To show how the SWEEP CIRCUIT ANALYZER can help pinpoint trouble in a hurry, let's look at a typical trouble shooting application. Consider the case of a Zenith Chassis 21K20-3. The complaint had been, "There's no picture".

When the serviceman arrived on the scene his suspicions were soon confirmed that the trouble was, in reality, a case of no raster. Once the back was removed and the "cheater" cord attached, it was easy to see that all of the tubes in the horizontal circuit were lighted. The first thing to do was to determine whether the trouble centered in the high voltage, or CRT circuits. Pulling the high voltage lead from the picture tube and testing for an arc produced a half-hearted spark that indicated there was very little high voltage. This narrowed the trouble to the horizontal sweep circuits.

Substituting tubes failed to make any improvement in the arc, so the chassis was pulled and brought to the shop.

At the shop, the SS137 was brought out. The external meter was used to check the peak to peak drive signal on the grid of the horizontal output. It read 120 volts peak to peak. A check of the schematic showed this to be right on the button. Next the screen voltage was measured. It read 100 volts DC. The schematic called for 130 to VDC, making the screen 30 volts low. The B+ boost was checked and showed a healthy 550 volts, a little higher than called for. This meant there was nothing wrong in the boost lines and apparently the flyback was O. K. The yoke now became the suspect.

As usual, there was a handy tie terminal below chassis, where the high side of the yoke could be disconnected. After removing the yoke lead from the terminal, the heavy red lead supplied with the SS137 was attached from the terminal strip to the UNIVERSAL HORZ YOKE jack marked HIGH. The blue lead was then connected from the LOW jack on the SS137 to the chassis. In order to have a more positive indication of what was going on in the circuit, the high voltage probe of the SS137 was connected to the 2nd anode lead and the range switch set for the 30KV range. When the set was turned on and the YOKE ADJUST lever was properly positioned, the high voltage read a normal 15.5KV. Here was all the proof that was needed to pinpoint the yoke in the set as the culprit.

After a new yoke was installed the picture returned, and the screen voltage on the 6CD6 returned to 130 VDC. The cathode lead was then opened and the SS137 external meter placed in series and set on the 300 MA DC range. The linearity coil was then adjusted to obtain a minimum reading, 115 MA.

TV TROUBLE GUIDE

Here is a quick reference, trouble guide chart to help you get started using the SS137 analyzer. To speed your servicing, you should always check the tubes in the suspected circuits before using the SS137. However, if you choose to use it, the SS137 will show up tube faults, too. Note that the chart lists three general troubles - horizontal, sync and vertical. It is impossible to list all the variations that fall into these three categories. However, once you have used your SS137, you'll find it is easy to trace any trouble that develops in the sweep and sync circuits.

SS137 TROUBLE GUIDE
(for trouble shooting TV troubles)

TV TROUBLE	CIRCUIT	SS137 CHECK
No raster or narrow picture.	Output tube	Check output tube for cathode current, screen voltage, grid voltage and grid drive.
	Oscillator	Substitute the known-good oscillator and vary the output from 2-250 volts P-P while monitoring it on the meter.
	Damper	Check B+ input and boost voltages.
	HV rectifier	Check output of high voltage rectifier under normal load, then remove the HV lead from the CRT and check again.
	Yoke	Substitute universal horizontal yoke. Watch for return of high voltage.
	Flyback	Check flyback transformer under dynamic operation by measuring power delivered to yoke.
Pix not locked horizontally.	Oscillator off frequency; can not be locked in with set control.	Substitute SS137 horizontal oscillator and sync the oscillator from the last stage where a sync pulse is available. A stable picture indicates a defective oscillator circuit in the TV.
	Loss of sync pulses in the sync controls.	Same as above but try to sync the oscillator at preceding stages - working toward the sync separator. The return of a stable picture pinpoints the defective stage.
	Loss of sync Caused by abnormal AGC.	Check the peak to peak amplitude of the keying pulse at the plate of the AGC keyer tube. NOTE: The RF, IF and video stages can also cause loss of sync pulses.
Insufficient or no height.	Oscillator or output tube.	Substitute the known-good oscillator and vary the output form 0-250 volts while monitoring it on the meter.
	Output transformer.	Check output transformer under dynamic operation by driving it with the vertical oscillator signal.
	Yoke.	Check the vertical yoke under dynamic operation by driving it with the vertical yoke drive signal.

SS137 TROUBLE GUIDE
(for trouble shooting SS137 if it should give trouble)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE MEASURE
No horizontal or vertical output (no meter indication.	Defective 6CM7.	Check and replace if necessary.
	Defective oscillator switch.	Clean and adjust switch contacts.
	Defective output potentiometer.	Check and replace, if necessary.

	Defective capacitor C13.	Check and replace, if necessary.
No vertical oscillator output horizontal okay.	Defective oscillator switch.	Clean and adjust switch contacts.
	Defective capacitors C9, C10 or C11.	Check and replace if necessary.
	Defective resistor R23.	Check and replace if necessary.
Horizontal and vertical oscillator working but no meter indication.	Defective oscillator P-P volts switch S3.	Clean and adjust switch contacts.
No internal or external peak to peak output indication.	Defective 6BN8 tube.	Check and replace if necessary.
	Defective resistors R5, R6, R7 & R10 P - P calibrated potentiometer.	Check and replace if necessary.
	Defective capacitor C3.	Check and replace if necessary.
Substitute yoke check inoperative.	Defective capacitor C14.	Check and replace if necessary.
	Substitute yoke coil defective.	If capacitor C14 is okay, replace substitute yoke coil.
No external current check.	Function switch is defective.	Clean and adjust contacts.
Substitute yoke check okay, flyback check inoperative.	Check flyback switch.	Clean contacts.
	Diode D2, D3 defective.	Check and replace with a 1N295 diode if necessary.
	Resistor R34 on secondary of TC open.	Check resistor and continuity of T3. Replace if defective.
0-3 V, 0-300 volt and/or 0-1000 volt external checks inoperative.	Defective multipliers R11, R12, R13 and/or R18.	Check and replace if necessary.
0-10KV or 0-30KV external voltage inoperative.	Open probe resistor R21.	Check and replace if necessary.
	Defective function switch.	Clean and adjust switch contacts.
	Loose connection in probe.	Check connections.
Function switch on P-P volts; meter indicates with no applied signal.	Zero potentiometer misadjusted or defective.	Adjust potentiometer; if no improvement, check potentiometer and replace if necessary.
	Defective 6BN8 tube.	Check tube and replace if necessary.

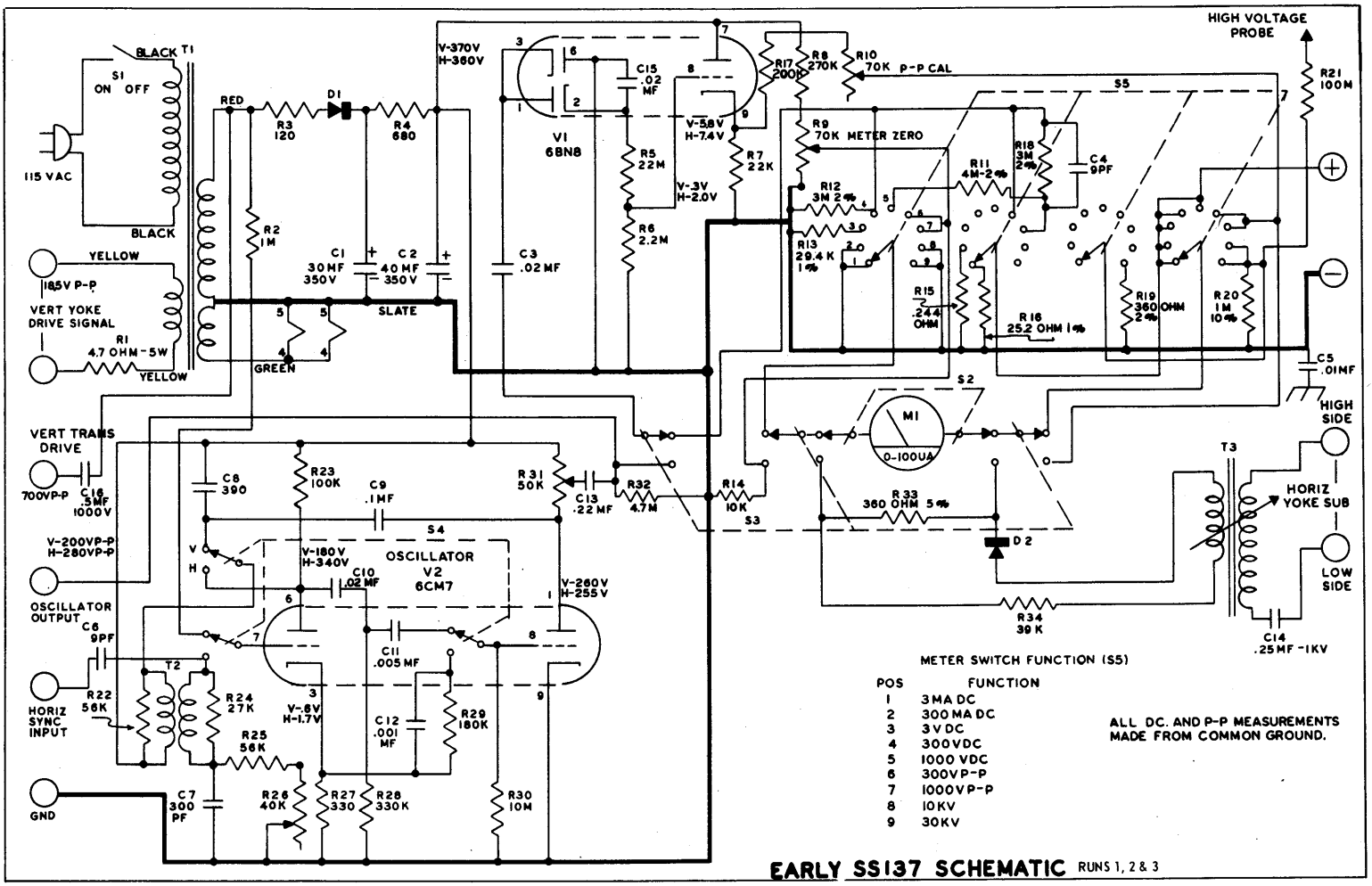
Peak to peak readings and both oscillators inoperative.	No B+.	Check rectifier D1, capacitor C1 and C2, and resistors R3 and R4. Replace any defective item.
Poor sync when using horizontal substitute oscillator.	Defective capacitor C6.	Check and replace if necessary.
Horizontal oscillator cannot be adjusted to 15,750 cycles.	Defective resistor R25 and capacitor C7.	Check values and replace if necessary.
	Defective horizontal hold control.	Check value and replace if necessary.
	Defective 6CM7 tube.	Check tube, if weak, replace it.
No horizontal oscillator output - vertical okay.	Defective oscillator transformer T2.	Check continuity and replace if necessary.
	Defective oscillator switch.	Clean and adjust contacts.
	Defective horizontal hold potentiometer.	Check and replace if necessary.
	Shorted capacitor C7.	Check and replace if necessary.
No vertical yoke drive signal.	Defective resistor R1.	Check and replace if necessary.
	Open transformer winding on T1.	Check continuity of 6volt secondary.

SENCORE, INC.
3200 SENCORE DRIVE, SIOUX FALLS, S. DAKOTA 57107

Form No. 270

SS137 TUBE CHART						
TUBE TYPE	CATHODE PIN	CATHODE CURRENT	CONTROL GRID PIN	CONTROL GRID P/P DRIVE	SCREEN GRID PIN	SCREEN GRID VOLTAGE
(*)AU5	3	100-150	1	100-200	8	110-230
(*)AV5	3	100-150	1	100-200	8	110-230
(*)B-B14	8	100-150	5	90-150	4	130-160
(*)BD5	3	100-150	1	100-200	8	110-230
(*)BG6	3	110-150	5	90-150	8	110-280
(*)BQ6	8	100-150	5	90-150	4	120-170
(*)CB5	3 or 6	140-220	5	120-200	8	140-190
(*)CD6	3	130-200	5	110-190	8	130-180
(*)CL5	3 or 6	150-250	5	120-200	8	140-170
(*)CM5	8	100-150	5	90-150	4	120-160
(*)CU6	8	110-150	5	90-150	4	120-170
(*)DN6	3	130-200	5	110-190	8	140-190
(*)DQ5	3 or 6	165-255	1 or 5	110-190	4 or 8	130-180
(*)DQ6	8	100-180	5	100-200	4	120-160
(*)EX6	3	150-230	5	90-150	8	120-170
(*)FH6	8	120-190	5	110-190	4	110-170
(*)FN5	3 or 6	100-150	5	90-150	8	130-180
(*)FW5	3	120-190	1	110-190	8	110-170
(*)GA7	5	130-200	4	100-200	2 or 3	125-170
(*)G-B3	8	90-100	5	90-110	4	100-120
(*)GB5	3 or 8	140-180	1 or 2	65-85	6 or 7	120-140
(*)GC6	3 or 6	110-185	5	100-200	4 or 8	130-170
(*)GE5	4 or 10	100-180	3 or 11	100-200	2	120-160
(*)GF5	4 or 10	100-180	3 or 11	100-200	2	120-160
(*)GJ5	3	100-125	2 or 6	110-135	7	150-170
(*)GJ6	3	140-170	2	60-100	1 or 7	100-140
(*)GV5	4 or 10	100-180	5 or 9	100-200	3,7 or 11	120-160
(*)GT5	3	130-180	2 or 6	70-160	1 or 7	130-170
(*)GW6	8	100-150	5	90-150	4	120-170
(*)GY5	4 or 10	100-160	5 or 9	75-170	3,7 or 11	100-200
(*)HB5	4 or 10	150-180	3 or 11	60-100	2	120-150
(*)HD5	4 or 10	150-180	3 or 11	100-180	5 or 9	120-180
(*)HE7	8	180-220	9	90-260	11	90-115
(*)HF5	4 or 10	170-210	5 or 9	145-185	3 or 11	120-150
(*)HJ5	2	165-255	3 or 11	110-190	5 or 9	130-180
(*)JB6	3	130-150	6	150-175	1	125-150
(*)JE6	3	180-220	2 or 6	150-250	1 or 7	130-150
(*)JF6	3	120-180	2 or 6	100-150	1 or 7	110-140
(*)JG6	3	90-170	2	65-100	7	90-160
(*)JM6	2	120-155	5	180-200	3	125-180
(*)JN6	2	120-155	11	150-190	3	120-160
(*)JS6	2	160-200	5	180-260	3 or 11	120-160
(*)JT6	3	80-180	2	60-150	1 or 7	120-150
(*)JU6	3	190-230	2 or 5	90-110	1 or 7	100-130
(*)JV6	2	100-180	11	90-110	3	120-160
(*)JY6	8	40-140	5	90-110	4	115-135
(*)JZ6	2	120-180	5	100-180	3	125-170
(*)KA6	10	110-170	5	110-190	3	120-150
(*)KM6	3	165-255	2 or 6	110-190	1 or 7	130-180
18A5	3	100-150	1	100-200	8	110-230
25E5	8	70-155	5	50-100	4	70-150
25EC6	3	130-200	5	110-190	8	130-170
33GT7	8	100-180	9 or 11	100-200	10	120-160
33GY7	8	115-150	9 or 10	90-110	11	100-130
35FM5	3 or 6	150-250	5	120-200	8	140-170
7984	2,6,8 or 9	110-190	10	125-190	7 or 11	125-160
8156	2,6,8 or 9	120-200	10	100-200	7 or 11	125-180
XL500	3 or 8	140-180	1 or 2	65-85	6 or 7	120-140
PL36	8	150-180	5	200-240	4	120-150

(*)INDICATES VOLTAGE MAY BE 6, 12, ETC.

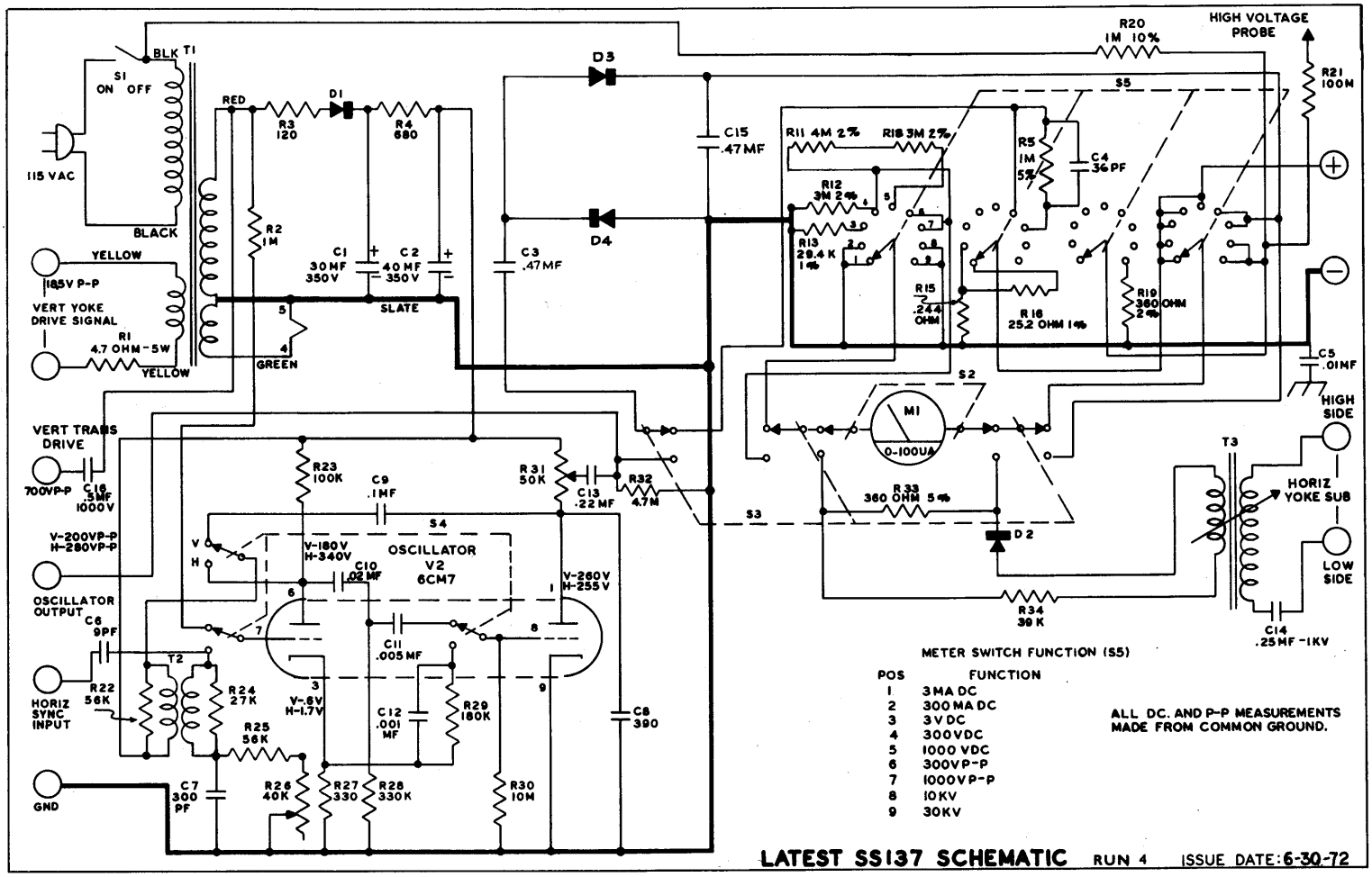


METER SWITCH FUNCTION (S5)

POS	FUNCTION
1	3MA DC
2	300 MA DC
3	3V DC
4	300VDC
5	1000 VDC
6	300VP-P
7	1000VP-P
8	10KV
9	30KV

ALL DC. AND P-P MEASUREMENTS MADE FROM COMMON GROUND.

EARLY SS137 SCHEMATIC RUNS 1, 2 & 3



METER SWITCH FUNCTION (S5)

POS	FUNCTION
1	3MA DC
2	300 MA DC
3	3V DC
4	300VDC
5	1000 VDC
6	300VP-P
7	1000VP-P
8	10KV
9	30KV

ALL DC. AND P-P MEASUREMENTS MADE FROM COMMON GROUND.

LATEST SS137 SCHEMATIC RUN 4 ISSUE DATE: 6-30-72

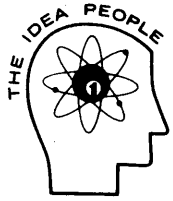
TUBE CHART, SCHEMATIC AND PARTS LIST
for
SS137 SWEEP CIRCUIT ANALYZER

REFERENCE	DESCRIPTION	PART NO.	PRICE
C14	Capacitor, Tub. .25MF/1KV	24G19	1.00
C16	Capacitor, Tub. .5MF/1KV	24G155	1.50
D1, D3, D4	Rectifier, Silicon, 500mA	16S5	.50
D2	Diode, Germanium, 1N34-A	50C3-1	.25
R11	Resistor, Carbon 4.0 Meg., 1/2W, 2%	14C30-4006	.75
R12, R18	Resistor, Carbon 3.0 Meg., 1/2W, 2%	14C30-3006	.75
R13	Resistor, Carbon, 29.4K, 1/2W, 1%	14C29-2944	.75
R16	Resistor, Carbon, 25.2 ohm, 1/2W, 1%	14A41-2551	.75
R19	Resistor, Carbon, 360 ohm, 1/2W, 2%	14C30-3602	.75
R21	Resistor, Carbon, 100 Meg., 30kv, 2%	14A63-1	5.50
*R9, R10	Potentiometer, Dual 70k, 10%	15A4-1	1.25
R26	Potentiometer, 40k, Log Taper	15C3-21	.75
R31	Potentiometer, 50k, Carbon, 30%	15C1-25	1.00
S1	Switch, Slide, SPDT, On-Off	25G4	.50
S2	Switch, Slide, DPDT, Spring Return	25G79	1.00
S3	Switch, Slide 3P2P, Spring Return	25G78	1.50
S4	Switch, Rotary 3P2P	25G85	2.50
S5	Switch, Rotary 4P9P	25A83	3.50
T1	Transformer, Power	28B30	5.25
T2	Transformer, Oscillator	28S16	2.25
T3	Coil, Substitute, Yoke	46A29	5.00
M1	Meter, Panel, 0-100 Microamp	23B20	15.00
*V1	Tube, 6BN8	18G5	2.25
V2	Tube, 6CM7	18G8	2.25
J5, J7	Jack, Phone tip, Black	36G1B	.25
J2, 4, 6, 8, 10	Jack, Phone tip, Red	36G1R	.25
J1, J9	Jack, Phone tip, Blue	36G1BL	.25
J3	Jack, Phone tip, Yellow	36G1Y	.50
	Knob, Yoke Adjust	21S4	.25
	Knob, Black, controls	21G6	.25
	Case	10D246	11.95
	Cover	10D247	4.50
	Panel	10A154	6.00
	Mirror	63A5	1.75

*Not used in latest run. See Schematics.

MINIMUM BILLING $2.00

PRICES SUBJECT TO CHANGE WITHOUT NOTICE



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