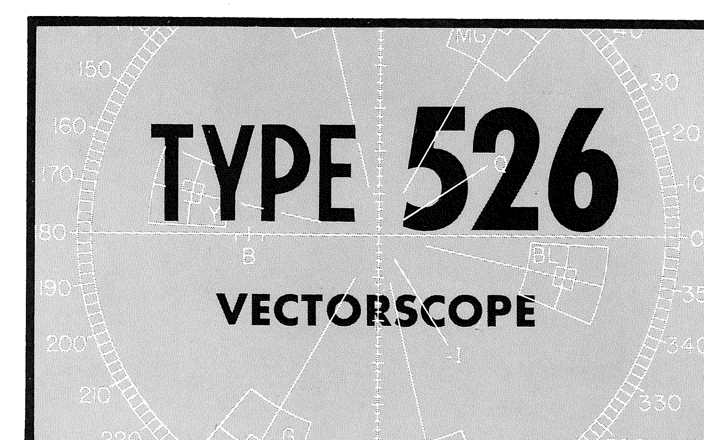
INSTRUCTION MANUAL

Serial Number ____________



Tektronix, Inc.
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070-121

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year. Tektronix transformers, manufactured in our own plant, are warranted for the life of the instrument.

Any questions with respect to the warranty mentioned above should be taken up with your Tektronix Field Engineer.

Tektronix repair and replacement-part service is geared directly to the field, therefore all requests for repairs and replacement parts should be directed to the Tektronix Field Office or Representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type and Serial number with all requests for parts or service.

Specifications and price change privileges reserved.

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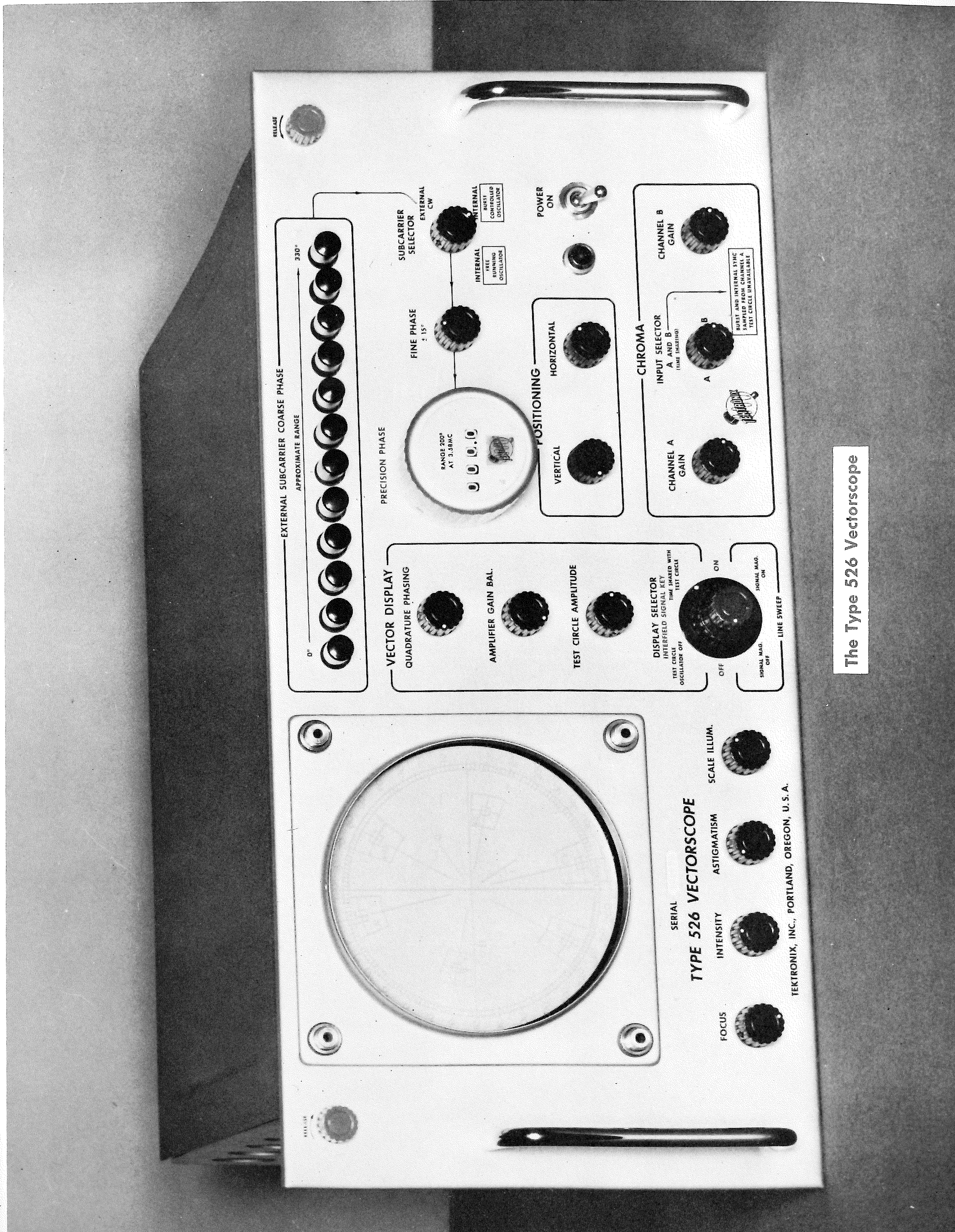
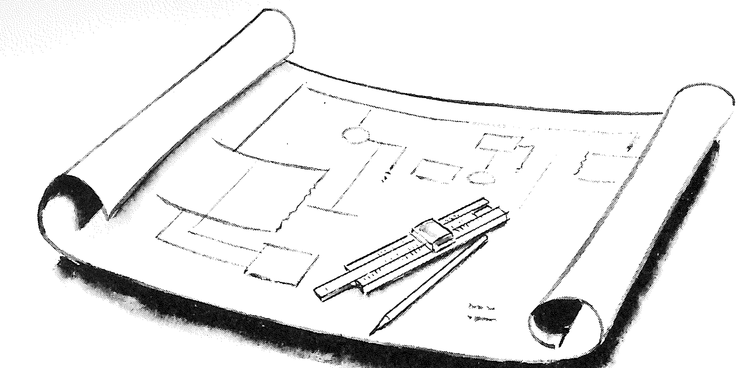


The Type 526 Vectorscope



SECTION 1

GENERAL DESCRIPTION

INTRODUCTION

Each color transmitted in the National Television System Committee system possesses three characteristics; hue, saturation, and luminance. The hue of any color is determined by its wave length (in the visible light spectrum), and is the characteristic by which a color may be identified as red, green, blue, yellow, etc. The word "color" is often considered synonymous with "hue". Saturation of a particular hue may variously be defined as pale, light, pastel, vivid, deep, etc. Luminance is a measure of the light energy contained in a given hue.

The N.T.S.C. has adopted standards for the transmission of chrominance signals. Under these standards the hue transmitted as red shall correspond to a light whose wavelength is approximately 610 millimicrons, green to a wavelength of approximately 540 millimicrons, and blue to a wavelength of approximately 470 millimicrons. Full saturation is specified as the peak amplitude for the chrominance signal during a transmission of white. The amplitude of a fully saturated red hue is specified as 0.63 times the amplitude of the luminance signal during a transmission of white; for green the factor is 0.59; and for blue, 0.45.

The Tektronix Type 526 Vectorscope is designed to measure the hue and saturation of chrominance signals. The Vectorscope phase-demodulates the chrominance signals to display each "color" as a vector on a system of polar coordinates. The hue of each vector is identified by its angular (phase) displacement from the color subcarrier reference vector. The length of each vector (from the origin) corresponds to the saturation of its respective hue.

A standard color-phase vector diagram is shown in Fig. 1-1. Each hue is identified by the angle its vector makes with the color subcarrier axis. For example, the primary color red is represented by a vector which lags the reference vector (the color subcarrier) by an angle of 103.5°. This indicates that the red signal in the N.T.S C. system lags the color subcarrier signal by 103.5°. The complement of red, which is the secondary color cyan, should therefore lag the color subcarrier signal by 283.5°. However, since a standard color-phase vector diagram indicates phase difference, cyan is identified by a negative (leading) angle of 76.5°.

The primary colors green and blue, and the secondary colors magenta and yellow (the complements of green and blue, respectively), are similarly identified by their phase displacement from the reference vector. Notice that complementary colors have identical saturation factors.

A Vectorscope display of a color-bar test signal is shown in Fig. 1-2. The bright dots indicate the ends of the hue vectors. In addition to the color vectors, the Vectorscope also produces a vector which corresponds to the phase angle and amplitude of the color-burst signal. Since burst is generated 180° out of phase with the color subcarrier, this vector lies along the —X axis.

The graticule of the Vectorscope is inscribed with vectors which correspond to the vectors of the three primary and three secondary N.T.S.C. colors, relative to the angle of the color subcarrier and the amplitude of the color-burst signal. For example, the vector marked BL (for blue) is at 348°, in which case it leads the reference or 0° vector by an angle of 12°. According to N.T.S.C. standards, this is the phase difference between the color subcarrier signal and the chrominance signal transmitted as blue. The small inner box on the BL vector indicates the proper degree of saturation for blue. When the "blue dot" falls within this box, it indicates that the signal transmitted as blue has

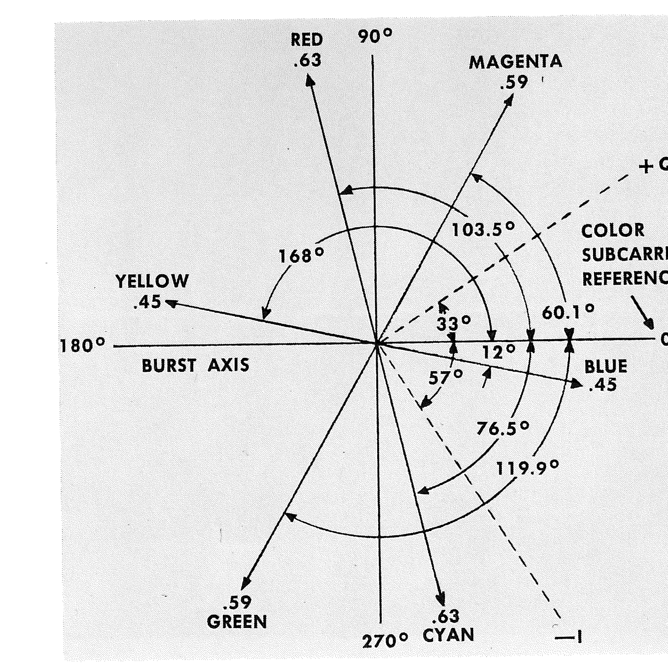


Fig. 1-1. Standard color-phase vector diagram.

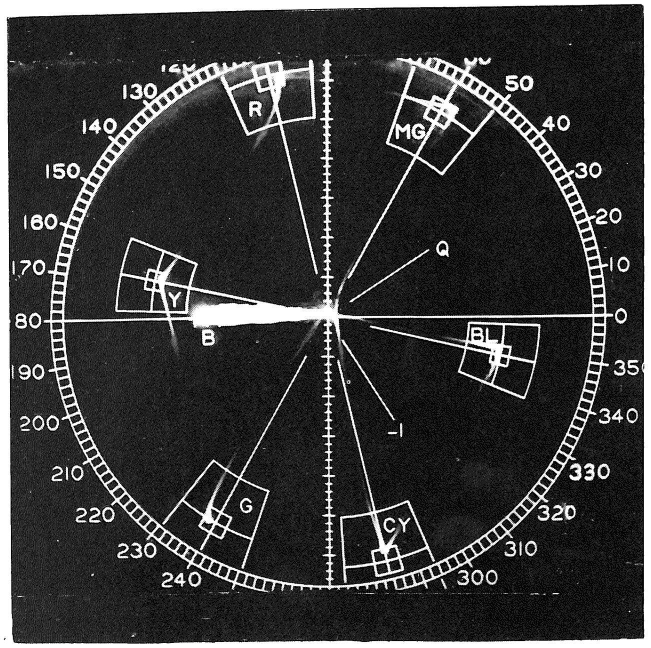


Fig. 1-2. Vector display of 75%-saturated color-bar test signal.

the proper hue and is 75% saturated. In a similar manner all other chrominance signals can be checked quickly and easily with the Vectorscope. In addition to the six colors and burst, vectors corresponding to the Q and —I signals are also inscribed on the graticule.

Comparing Fig. 1-1 and 1-2, it can be seen that all of the information contained in the N.T.S.C. color-phase dia-

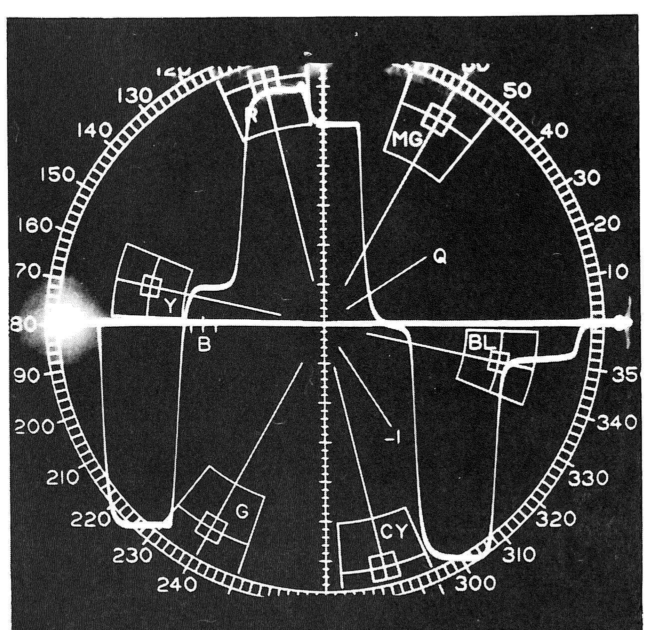


Fig. 1-3. Line-sweep display of 75%-saturated color-bar test signal.

gram is displayed on the Vectorscope. If the display of Fig. 1-2 were produced by a color encoder, for example, you could tell at a glance that the equipment is properly aligned.

A line-sweep display of the same signal is shown in Fig. 1-3. This mode of operation makes possible the very accurate measurement of the phase of any vector.

In addition to presenting chrominance signal information, the Vectorscope can also be used to display vertical interfield test signals without interference from the remainder of the video signal.

SPECIFICATIONS

Displays

Single-channel vector display—option of test circle for checking accuracy of display.

Dual-channel (time-sharing) vector display—test circle unavailable.

Linear sweep display at horizontal line rate; single- or dual-channel presentation. Option of 5X signal magnifier.

Phase Accuracy

Overall phase accuracy ±1.5° by vector presentation, ±1° by null technique with line-sweep presentation.

Phase Resolution

Incremental phase resolution better than 0.1° (75 $\mu\mu$sec) at 3.58 mc.

Saturation Measurements

±2% on graticule, closer when comparing two signals.

Interfield Signal Key

Key unblanks crt for four lines to display test signals occuring during vertical blanking interval.

ISK Delay—Start of key can be varied from few lines after vertical sync to end of blanking pulse.

Burst Gate

Gate provides additional unblanking for identification of burst packet.

Start of gate variable to cover entire back porch of horizontal blanking pulse.

Synchronous Demodulators

Push-pull, dc-coupled to crt to preserve luminance. No dc restoration necessary.

Subcarrier Regenerator

Internal subcarrier regenerator premits operation when external subcarrier is not available—phase and frequency deviation negligible under all operating conditions.

Cathode-Ray Tube

Type—special Tektronix-manufactured T526.

5" flat-face, monoaccelerator; equal vertical and horizontal sensitivity.

Accelerating potential—4 kv.

Phosphor—Type P1 phosphor normally furnished; P2, P7 and P11 phosphors optional. Other phosphors furnished on special order.

Unblanking—ac coupled.

Graticule

Illumination—variable edge lighting.

Engraving—polar coordinates, standard hue and saturation for N.T.S.C. signals indicated.

Power Supplies

Electronically regulated for stable operation.

Line voltage—105 to 125 volts, or 210 to 250 volts, rms.

Line frequency—50 to 60 cycles, single phase.

Power requirements—340 watts.

Signal Connections

Loop-through, compensated for 75-ohm coaxial cable (when power is on).

Ventilation

Forced air. Thermal relay interrupts instrument power in event of overheating.

Construction

Aluminum-alloy chassis and cabinet.

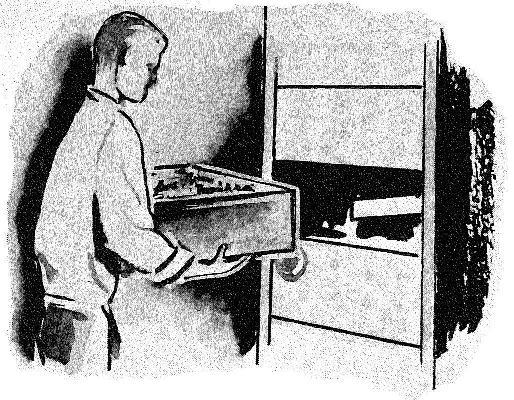
Finish—photo-etched anodized panel, blue wrinkle-finish cabinet.

Dimensions—$8\frac{5}{8}$" high, 19" wide, $18\frac{1}{2}$" rack depth.

Weight—45 pounds.

Accessories

3 75-ohm Terminations, 011-023
1 3-conductor Power Cord, 161-010
2 Instruction Manuals
1 3 to 2-wire adapter, 103-013
1 Guide Tank, Left, 351-010
1 Guide Track, Right, 351-011
1 Green Filter, 378-514



SECTION 2

INSTALLATION INSTRUCTIONS

Cooling

A fan maintains safe operating temperature in the Vectorscope by circulating air over the tubes and other components. The instrument must be placed so that there is free passage of air around the air intake port. A thermal cutout switch, TK601, is provided to remove power from the instrument if the internal temperature should become high enough to cause damage to the components. When the temperature again drops to a safe level, the switch will close automatically; manual reset is not necessary. In spite of the protection afforded by the thermal cutout switch, you should not operate the Vectorscope unless the fan is running.

Power Requirements

Unless tagged otherwise, this instrument is wired for operation at 105 to 125 volts rms, 50 to 60 cycles, single phase ac (117 volts nominal). However, provisions are made for easy conversion to operation at 210 to 250 volts rms, 50 to 60 cycles, single phase ac (234 volts nominal). The power transformer T601 is provided with split input windings which are normally connected in parallel for 117-volt operation, but which can be connected in series for 234-volt operation. Each of these split windings terminates in a nest of four terminal lugs arranged in a square on the top of the transformer, and numbered 1, 2, 3 and 4 in a clockwise rotation.

Terminals 1 and 3 are connected to one winding and terminals 2 and 4 are connected to the second winding. The ac input leads are connected to terminals 1 and 4 for both 117-volt and 234-volt operation, so these connections do not have to be changed when converting from one line voltage to the other.

When wired for 117-volt operation, terminals 1 and 2 are joined by a bare bus wire, and terminals 3 and 4 are similarly joined, as shown in Fig. 2-1. To convert to 234-volt operation remove the bare bus wires between these terminals and substitute a single connecting wire between terminals 2 and 3, as shown in Fig. 2-2.

Fan Connections

The cooling fan is powered by a 117-volt ac motor. If the instrument is converted to operate from a 234-volt line, a change in the fan wiring must be made so that it operates from a 117-volt source.

The leads that connect to the fan motor terminate in a ceramic strip adjacent to the power transformer. For 117-volt line, the leads are soldered to the first and third notches in the ceramic strip, as shown in Fig. 2-1. For operation from a 234-volt line, the lead soldered to the third notch must be lifted free and resoldered to the second notch, as shown in Fig. 2-2.

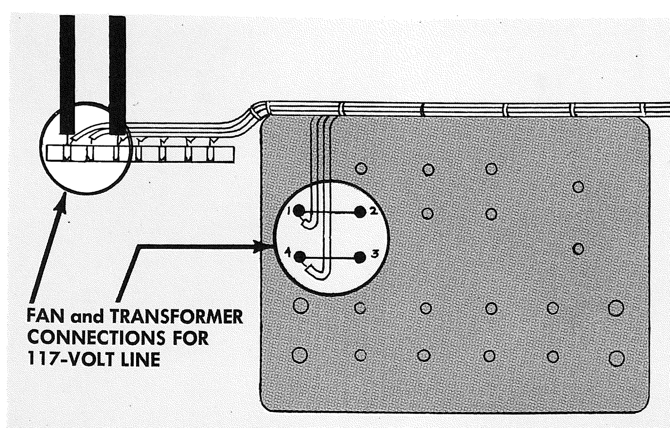


Fig. 2-1. Transformer and fan connections for 105-to-125-volt line operation.

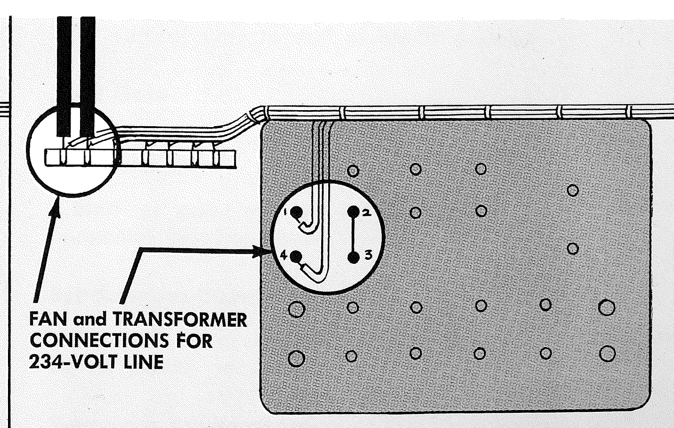


Fig. 2-2. Transformer and fan connections for 210-to-250-volt line operation.

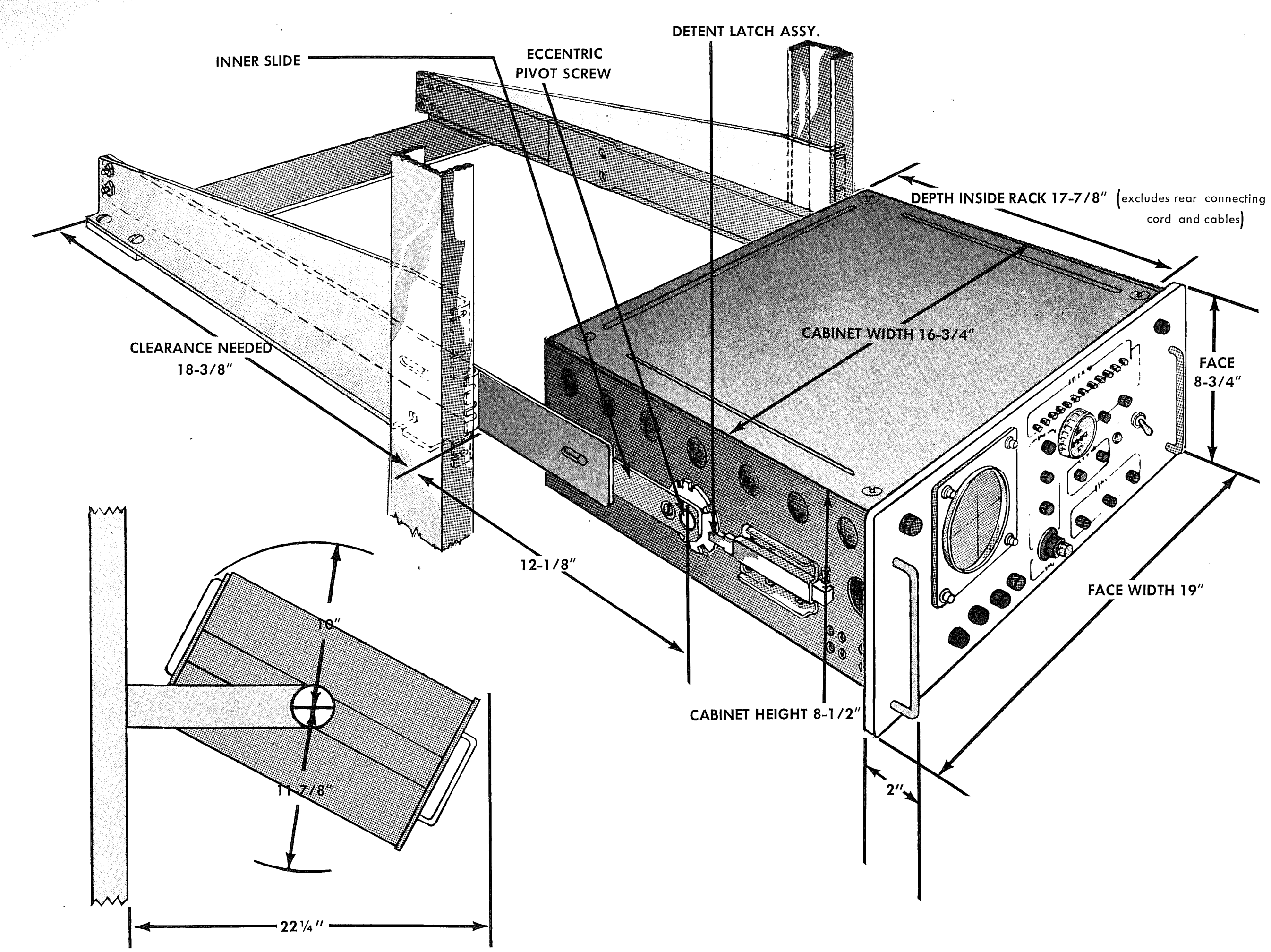


Fig. 2-3. Vectorscope mounting dimensions. These dimensions indicate the space you must allow for mounting the Vectorscope.

Cabinet Rack Mounting

Fig. 2-3 shows the dimensions of the space required for mounting the Vectorscope.

To mount the Vectorscope in a cabinet rack:

1. Mark the point on the cabinet rack where you want to position the top of the front panel. Mark a second position $5\frac{1}{2}$ inches below this point. The center of the top mounting screw should fall on the second mark.

2. Using two 10/32 screws for each bar nut, fasten a 10/32 bar nut to the mounting holes. The top screw will go in the hole found in Step 1, and the bottom screw will go through a mounting hole approximately $1\frac{3}{4}$ inches below the first.

In some cases it may be necessary to enlarge the mounting holes in the cabinet to provide adequate clearance for the mounting screws, or if cabinet holes are threaded, it may be satisfactory to mount rail on the front side.

3. Slip the front lip of the Chassis-Trak between the cabinet and the bar nut as shown in Fig. 2-4(a).

4. Tighten the 8/32 screws so that the Chassis-Trak is held securely to the cabinet.

5. In some types of cabinets, you may need the extension brackets furnished with the Chassis-Traks. Fig. 2-4(a) shows how to assemble the extension brackets furnished with each set of tracks.

6. Slide the Vectorscope into the Chassis-Trak slides. Pull the instrument out and push it back into the cabinet several times. If the slide mechanism seems to work stiffly, loosen the mounting screws and allow the Chassis-Traks to adjust to the weight of the instrument. When the slide mechanism is working smoothly, retighten the mounting screws.

7. If the detent latch assemblies and inner slides are not parallel, loosen pivot nuts and adjust eccentric pivot screws for parallel alignment. Retighten pivot nuts.

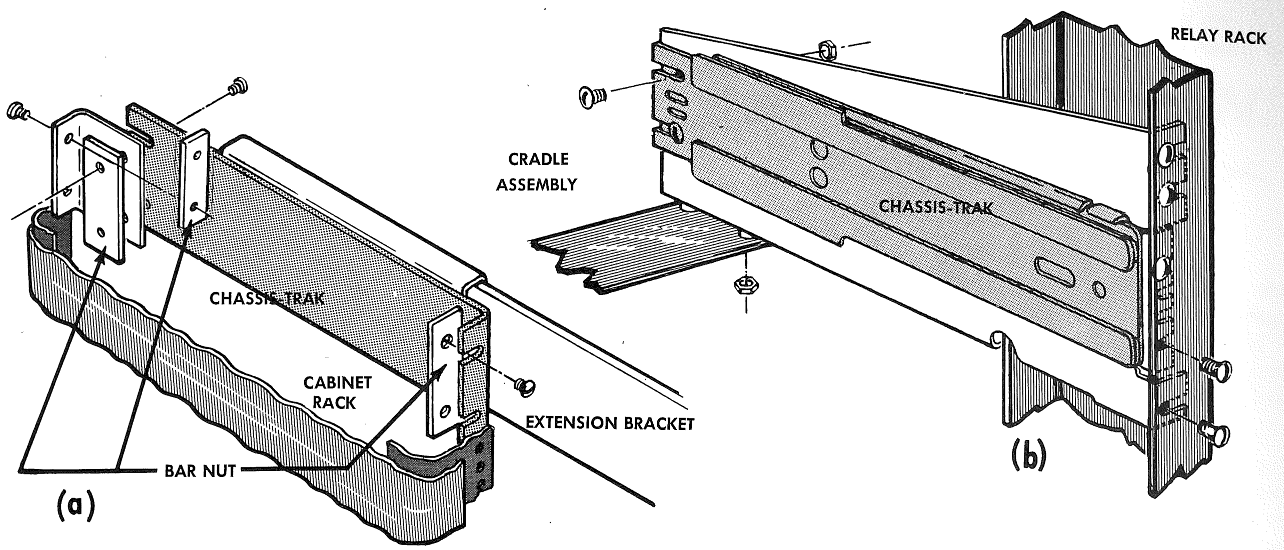


Fig. 2-4. Mounting the Chassis-Trak slides. (a) The Chassis-Trak installed in a cabinet rack. (b) The Chassis-Trak installed in a relay rack.

Relay Rack Mounting

To mount the Vectorscope in a relay rack:

1. Bolt the rear of the Chassis-Trak to the rear of the corresponding cradle section using the 10/32 nuts and bolts provided as shown in Fig. 2-4(b).

2. Mark a point on the relay rack where you want to position the top of the front panel. Mark a second position 2 inches below this point. The center of the top mounting screw should fall at this point.

3. Using Fig. 2-4 as a guide, assemble the cradle and Chassis-Trak on the corresponding rails of the relay rack, allowing 2 inches between the center of the top mounting screw and position you selected for the top of the 526 front panel.

NOTE

Cradel is designed for mounting on front side of cabinet support. If supports are not threaded 10/32, it may be necessary to use nuts on the back side—not furnished.

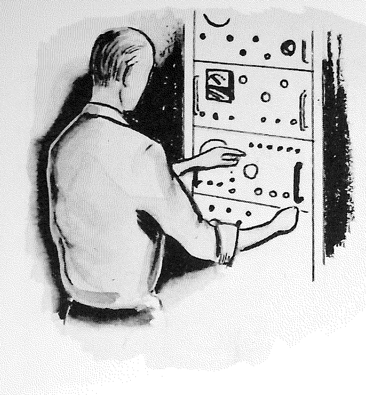
4. Fasten the brace across the rear of the cradle assembly, making sure that it is mounted at the bottom of the cradle sides.

5. Place the Vectorscope in the Chassis-Trak slides as shown in Fig. 2-3. Operate the slide mechanism several times with the instrument installed. If the operation of the slides is not smooth, loosen all the bolts and allow the slide mechanism to adjust to the weight of the instrument. Be sure to retighten all bolts after the mounting has been adjusted.

6. If the detent latch assemblies and inner slides are not parallel, loosen pivot nuts and adjust eccentric pivot screws for parallel alignment. Retighten pivot nuts.

SECTION 3

OPERATING INSTRUCTIONS



SIGNAL CONNECTIONS

All signal connections to the Vectorscope are made through coaxial connectors on the rear panel of the instrument (see Fig. 3-1). Two connectors for each input (except Z AXIS INPUT) provide high-impedance loop-through connections so that the Vectorscope may be connected into any part of a system. All connections are compensated for 75-ohm coaxial cable (when the POWER switch is ON) so that the Vectorscope will not load the system under test.

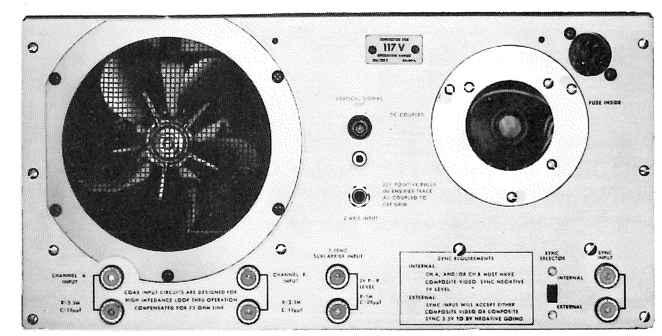


Fig. 3-1. Rear panel of the Type 526 Vectorscope.

When the Vectorscope is connected to the output of a system (loop-through connections not required), a 75-ohm terminating resistor should be connected to the unused input terminal to properly terminate the system.

Chrominance Signal Inputs

The signal (or signals) from the system under test is applied to the CHANNEL A INPUT and/or CHANNEL B INPUT connector. This may be either a composite color signal, with negative sync pulses, or a chrominance signal only, without sync pulses. If a chrominance signal only is applied, and synchronization of the sweep and unblanking is desired, separate sync pulses must be applied as described in the following paragraph.

Sync Input

The SYNC INPUT connector accepts external signals for synchronizing the Vectorscope sweep and unblanking circuitry. This input is connected to the synchronizing circuits when the SYNC SELECTOR switch (rear panel) is in EXTERNAL. Sync-negative composite video, about 1 volt peak-to-peak, or negative-going composite sync, approximately 3.5 to 8 volts, can be used.

Horizontal drive pulses may also be used to synchronize the Vectorscope; however, with this type of synchronization it is not possible to view vertical interfield test signals. Also, if you wish to use the internal Subcarrier Regenerator when you are using horizontal drive pulses, it will be necessary to readjust the Burst Gate Delay (See Calibration section) to obtain synchronized operation. Then, it will be necessary to readjust it again if you return to operation with horizontal sync pulses. This is because the leading edge of a horizontal drive pulse occurs some time before the leading edge of the corresponding horizontal sync pulse.

It is important to note that the sweep circuits in the Vectorscope will not operate if synchronizing pulses are not present. However, it is possible to present, without synchronizing pulses, a vector display of a chrominance signal only, using an external subcarrier signal. In this case, the burst packet would not be brightened on the crt.

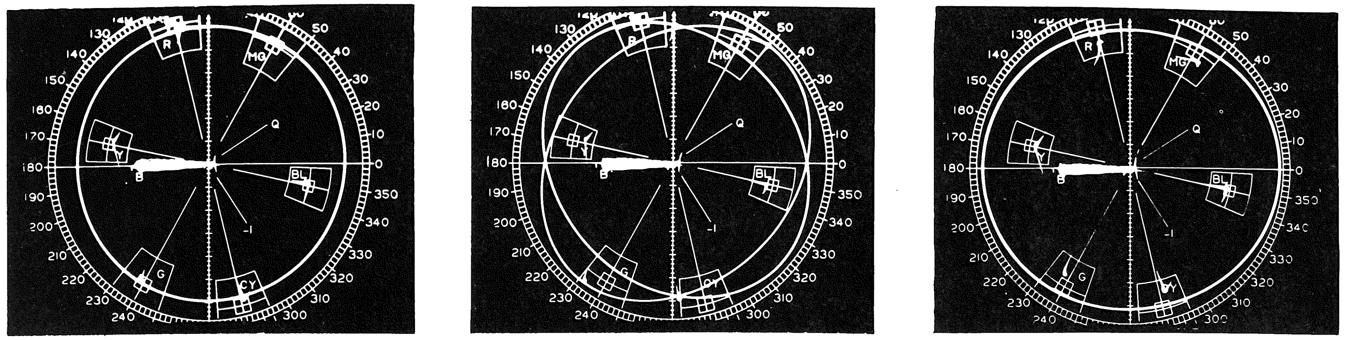
External Subcarrier Input

The 3.58 MC SUBCARRIER INPUT accepts an external 3.579545-mc subcarrier necessary for demodulating the input chrominance signal. The external subcarrier signal must have a peak-to-peak amplitude of about 1.5 volts. This signal is connected to the subcarrier processing circuits of the Vectorscope when the SUBCARRIER SELECTOR switch is in the EXTERNAL CW position.

If a subcarrier is not conveniently available, it can be generated within the Vectorscope. Placing the SUBCARRIER SELECTOR switch to INTERNAL BURST CONTROLLED OSCILLATOR applies the color-burst portion of the applied chrominance signal to the internal Subcarrier Regenerator. The Subcarrier Regenerator then generates a 3.579545-mc signal of the proper phase relationship to burst to be used throughout the Vectorscope in place of the external subcarrier.

Trace Intensification Input

The Z AXIS INPUT jack (for a PL-55 plug) accepts external trace-brightening pulses. The internal blanking circuitry is disconnected when an external brightening pulse is being applied. A 20-volt positive-going pulse is required for trace brightening.



(a) (b) (c)

Fig. 3-2. Test Circle Adjustments. (a) Test circle properly adjusted. (b) Result of improper setting of the QUADRATURE PHASING control. (c) Result of improper setting of the AMPLIFIER BAL. control.

Vertical Signal Output

The demodulated vertical signal is dc-coupled to the VERTICAL SIGNAL OUT binding post. This signal, which may be used to feed remote indicators, is at dc ground level; output impedance is about 5000 ohms.

OBTAINING A DISPLAY

The Vectorscope should be turned on and allowed to warm up for about 30 minutes before you interpret any display.

To obtain a vector display on the Vectorscope, proceed as follows:

1. Set the DISPLAY SELECTOR switch to VECTOR DISPLAY —TIME SHARED WITH TEST CIRCLE.

2. Set the INPUT SELECTOR switch to A or B, depending upon the channel on which you wish to observe the signal. (If you wish to observe signals on both channels, set the INPUT SELECTOR switch to either A or B at this point. This will permit you to verify the proper phasing of the subcarrier before you observe the signals.)

3. Set the FOCUS, INTENSITY, and ASTIGMATISM controls for the sharpest display of desired brightness.

4. Set the POSITIONING controls so that the center dot of the display is at the center of the graticule.

5. Set the TEST CIRCLE AMPLITUDE control and the gain control of the channel not selected by the INPUT SELECTOR switch so that the test ellipses are displayed.

6. Set the QUADRATURE PHASING control so that the two test ellipses merge into a single circle.

7. Set the AMPLIFIER GAIN BAL. control so that as nearly perfect a circle as possible is obtained. This can be done most easily by setting the size of the test circle to approximately the same size as the inscribed circle on the graticule.

NOTE

You should observe the test circle often during operation of the Vectorscope to verify the phase and amplitude relationships of the horizontal and vertical deflection systems. It should appear as a single, perfectly round circle. This can be maintained by periodic adjustment of the QUADRATURE PHASING and AMPLIFIER GAIN BAL. controls. See Fig. 3-2. (The size of the test circle is not critical.)

8. If you are using an external subcarrier (SUBCARRIER SELECTOR switch at EXTERNAL CW), depress the EXTERNAL SUBCARRIER COARSE PHASE pushbuttons one at a time until the burst vector lies as close as possible to the —X axis (180°).

9. Adjust the FINE PHASE control until the burst vector lies exactly along the —X axis. (Fig. 3-3 shows the result of improper adjustment of the FINE PHASE control.)

10. Adjust the gain control of the input channel selected by the INPUT SELECTOR switch until the end of the burst vector lies at the point labeled B on the —X axis.

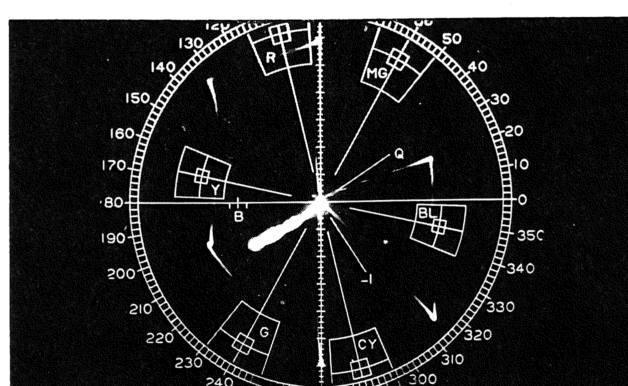


Fig. 3-3. Result of improper setting of the FINE PHASE control. Note that the entire display (burst and color vectors) is rotated from its proper position.

11. If you wish to observe the signal on the other channel, set the INPUT SELECTOR switch to the other channel position. (The test circle will probably change in size or disappear. This is normal and you do not need to adjust for it. However, if you do wish to adjust its size, do so with the TEST CIRCLE AMPLITUDE control, not the input channel gain control.)

12. Adjust the gain control of the input channel selected (in step 11) by the INPUT SELECTOR switch until the end of the burst vector lies at the point labeled B on the —X axis. (If the burst vector does not lie along the —X axis, C26 needs adjusting; see "Input Amplifier Alignment" in the Calibration section.)

13. To display both signals at the same time, set the INPUT SELECTOR switch to A AND B. (The test circle is disabled and will not be displayed when the INPUT SELECTOR switch is in this position.)

To obtain a line-sweep display simply obtain a vector display as described in the foregoing procedure, and then set the DISPLAY SELECTOR switch to one of the LINE SWEEP positions. (In the LINE SWEEP — SIGNAL MAG. ON position, the vertical deflection is magnified five times.) The test circle will not be displayed with a line-sweep presentation. The setting of the QUADRATURE PHASING control is not critical during line-sweep presentation since it does not affect the signal in the Vertical Channel.

APPLICATIONS

Chrominance-Vector Phase Measurements

Approximate phase measurement of a vector can be made simply by increasing the appropriate input channel gain until the end of the vector lies between the etched circles on the face of the graticule and reading the phase angle directly.

A more accurate method of determining the angle of a particular vector is as follows:

1. With the PRECISION PHASE control set at 000.0, obtain a vector display of the signal.

2. S/N 300-up. The PRECISION PHASE control is a single-speed dial. Caution must be used in turning the control as too rapid turning will cause the control to skip. Rotate the PRECISION PHASE control clockwise until the vector to be measured lies along the +X or —X axis (0 or 180°).

S/N 101-299. The PRECISION PHASE control is a two-speed control with a ratio of about 3 to 1. Push the control in to rotate the vectors fast; pull the control out to rotate them slowly.

3. Set the DISPLAY SELECTOR switch to LINE SWEEP — SIGNAL MAG. OFF. The vector to be measured will now appear as a horizontal portion of the trace very close to or exactly on the horizontal centerline of the graticule.

4. Set the DISPLAY SELECTOR switch to LINE SWEEP — SIGNAL MAG. ON, and adjust the PRECISION PHASE control so that the vector to be measured lies exactly on the horizontal centerline.

5. Note the reading on the PRECISION PHASE dial. If the measured vector originally fell in the first or second quadrant, it lags the subcarrier by the reading on the dial. If it originally fell in the third or fourth quadrant, it leads the subcarrier by 180° minus the reading on the dial.

Detecting Stray Chroma

Dc coupling through the Horizontal and Vertical Channels makes it possible to detect and deduce, from a display, the source of any stray chroma signals which may be present in the video. Normally, a white or black (or gray) signal will appear as a spot in the center of the Vectorscope screen when the Vectorscope is set for vector presentation. If this no-color signal is displaced from the center of the screen, this indicates that stray chroma is present; the angle at which it is displaced indicates the source of the stray chroma and thereby indicates the balance adjustment in the TV system necessary to cancel it out.

Detecting Differential-Phase and Differential-Amplitude Distortion

Figs. 3-4 through 3-8 show how the Vectorscope can be used in conjunction with a Bell Kelly Set test signal (or other test signal, such as a linearity stairstep, on which a 3.579545-mc signal and horizontal sync have been superimposed) to detect and measure differential-phase and differential-amplitude distortion through an amplifier or signal processing system. With the SUBCARRIER SELECTOR switch in the INTERNAL — BURST CONTROLLED OSCILLATOR position, differential-phase distortion is shown by the curvature of the phase-demodulated signal in the line-sweep mode of operation (see Fig. 3-6). The amount of differential-phase distortion at any point on the signal can be measured by moving that point up or down to the reference line with the PRECISION PHASE control and noting the reading on the dial.

With the SUBCARRIER SELECTOR switch in the INTERNAL — FREE RUNNING OSCILLATOR position, differential-amplitude distortion is shown by the varying amplitude of the demodulation envelope in the line-sweep mode of operation (see Fig. 3-8). The amount of differential-amplitude distortion at any point on the signal can be measured by comparing its amplitude with a reference.

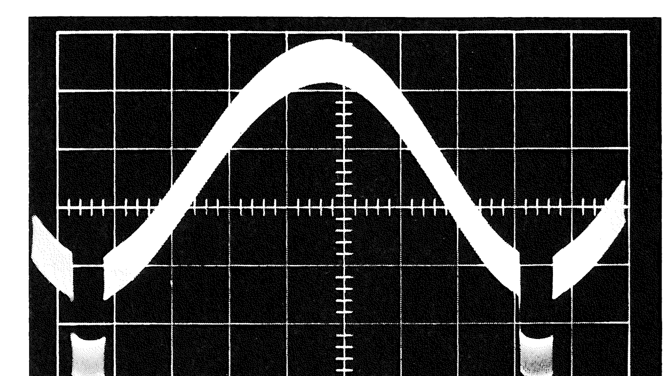


Fig. 3-4. Oscilloscope display of Bell Kelly Set test signal used to measure both differential-phase distortion and differential-amplitude distortion.

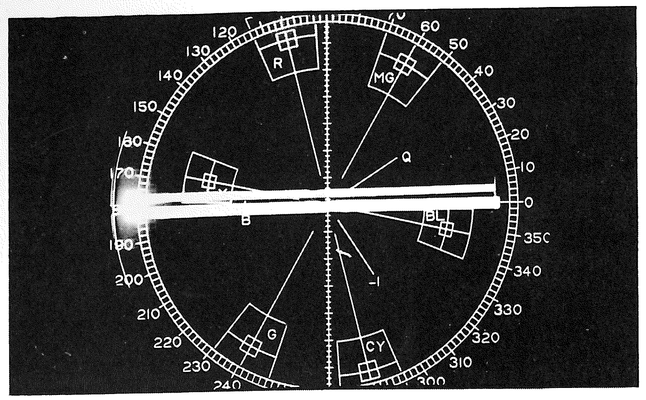


Fig. 3-5. Line sweep display of signal shown in Fig. 3-4 fed directly into Vectorscope. Lower line is reference; upper line is phase-demodulated 3.58-mc information contained in signal. Lack of differential-phase distortion is evidenced by straight line.

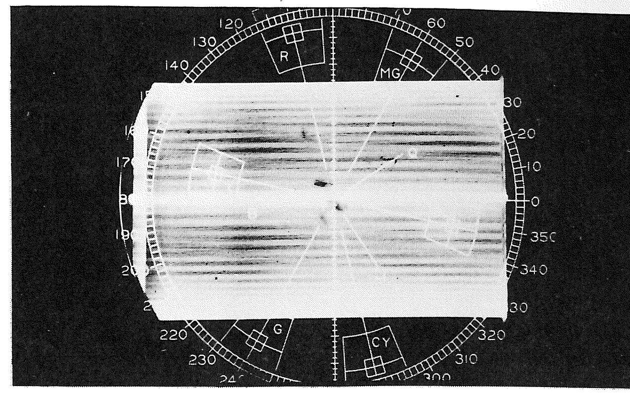


Fig. 3-7. Line-sweep display of Bell Kelly Set signal with SUBCARRIER SELECTOR switch set at INTERNAL—FREE RUNNING OSCILLATOR. Lack of differential-amplitude distortion is evidenced by lack of variation in amplitude of envelope.

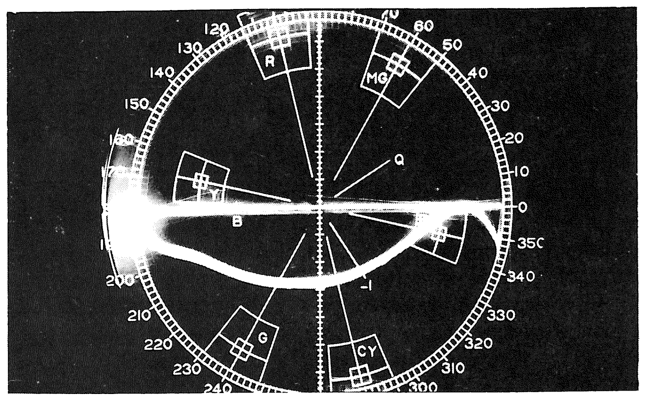


Fig. 3-6. Same conditions as Fig. 3-5 except Bell Kelly Set signal has passed through an amplifier and Vectorscope gain has been turned down. Differential-phase distortion is shown by irregularities in phase-demodulated signal.

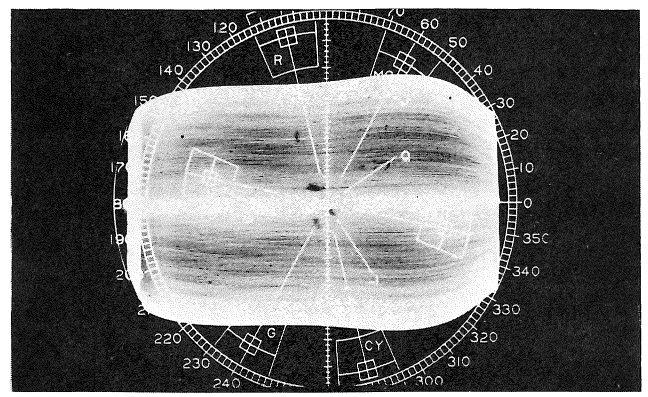
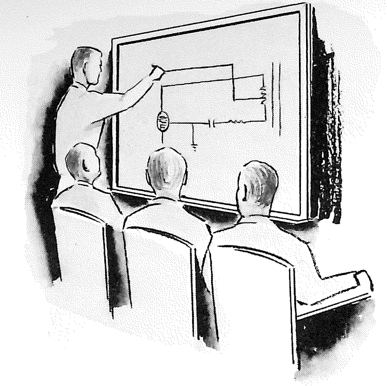


Fig. 3-8. Same conditions as Fig. 3-7 except that signal has passed through an amplifier and Vectorscope gain has been turned down. Differential amplitude distortion contributed by the amplifier is measured at about 30% using maximum amplitude as reference.



SECTION 4

CIRCUIT DESCRIPTION

Introduction

This section of the manual describes the operation of the various circuits of the Vectorscope. The first part of the section presents an overall functional description of the circuits based upon the simplified block diagram shown in Fig. 4-1. This is followed by a more detailed discussion of each particular circuit. You will need to refer to the block and schematic diagrams at the rear of this manual to follow the discussion of the individual circuits.

Block Diagram

The chrominance signal, or signals, to be observed are applied through either or both Input Amplifier channels to the control grids of the Vertical and Horizontal Demodulators. The two input channels, A and B, operate on a time-shared basis, switching at about a 500-cps rate. The Subcarrier Processing circuits develop the proper phase relationships in the chrominance subcarrier for application to the suppressor grids of the Vertical and Horizontal Demodulators. The chrominance subcarrier may be either obtained externally or generated internally by the Subcarrier Regenerator.

The Vertical and Horizontal Demodulators develop voltages proportional to the phase differences between the chrominance signal in the Input Amplifier and the chrominance subcarrier in the Subcarrier Processing circuits. For vector presentation, these phase-difference voltages are applied through the Vertical and Horizontal Amplifiers to the crt deflection plates.

For certain applications of the Vectorscope, a sweep presentation rather than a vector presentation is desired. In this case, the input to the Horizontal Amplifier is disconnected from the Horizontal Demodulator and connected to the output of the Sweep Generator. The Sweep Generator generates a sweep each time it receives a sync pulse.

In addition to their blanking and unblanking functions, the blanking and unblanking circuits also produce a burst-gate pulse. This pulse allows the color-burst signal on the incoming chrominance signal to be applied to the Subcarrier Regenerator, when the Subcarrier Regenerator is being used. The color-burst signal maintains the proper phase and frequency relationship between the oscillator in the Subcarrier Regenerator and the incoming chrominance information.

Input Amplifier

The chrominance signals are applied through either or both input cathode followers, V13 and V23, to the control grids of the amplifier tubes, V14 and V24. C11 and C31 act as blocking capacitors to prevent the synchronizing pulses and most of the luminance information (Y signal) from reaching the amplifier tubes.

V14 and V24 are alternately switched off and on by the action of the A-B Switching Multivibrator, V55. This is an astable multivibrator with a frequency of about 500 cps. During one half of each cycle of the multivibrator, the suppressor grid of V14 is at ground potential and the suppressor grid of V24 is at about —36 volts. This allows V14 to conduct and amplify the signal at its grid. The output is then coupled through T16 to the control grids of the Vertical and Horizontal Demodulators. The —36 volts on the suppressor grid of V24 cuts that tube off and no signal passes through it. During the other half cycle, the situation is reversed; V24 conducts and V14 is cut off.

L19 and C19 filter out the fourth harmonic of 3.58 mc which is produced by interaction of the control grids and suppressor grids of the four demodulator tubes.

The gain control of each channel varies the dc level of the control grid and cathode of the amplifier tube between 0 and about +20 volts. Since the suppressor grid is clamped at 0 volts during the time of conduction, moving the cathode positively decreases the plate current and, therefore, the gain of the tube.

V44 applies the negative horizontal synchronizing pulses from the incoming signal to the Synchronizing Circuits. It also applies the color-burst signal to the Subcarrier Regenerator to synchronize the operation of the Subcarrier Regenerator oscillator. Note that when the INPUT SELECTOR switch is in the A AND B position, the synchronizing pulses and burst are taken from the A-channel information (section 2R of the INPUT SELECTOR switch). C26 compensates for differences in wiring and tube capacitances to cancel out phase differences between the two channels when they are used together.

The Test Circle Oscillator, Q40, generates a 3.59-mc sine wave which, when mixed with the chrominance subcarrier in the Vertical and Horizontal Demodulators, produces a difference-frequency sine wave of about 10 kc. When the DISPLAY SELECTOR switch is in the VECTOR DISPLAY — TIME SHARED WITH TEST CIRCLE position and the INPUT SELECTOR switch is in the A or the B position, the output of the Test Circle Oscillator is applied to the suppressor grids of the demodulators for half of each cycle of the

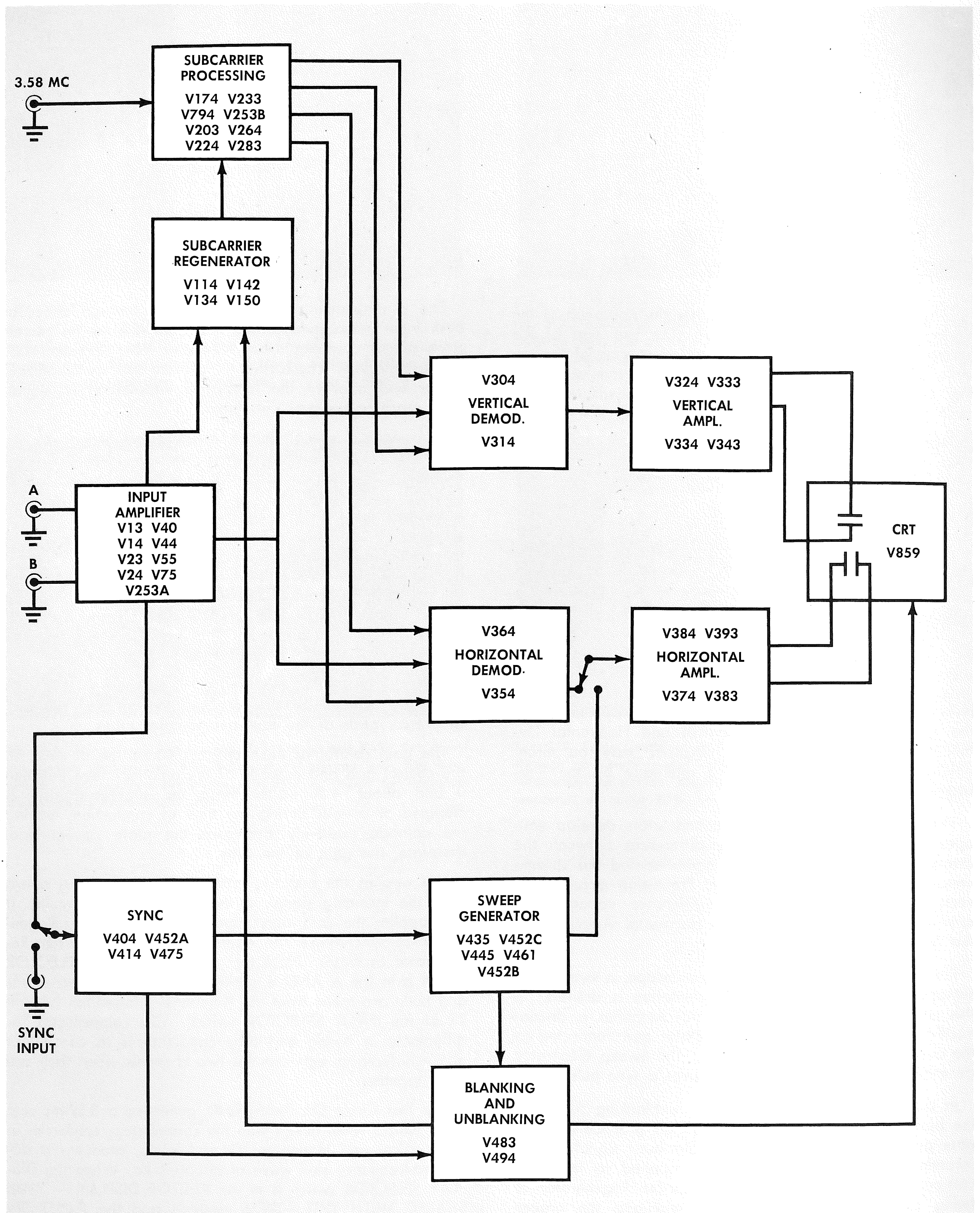


Fig. 4-1. Simplified block diagram of the Type 526 Vectorscope.

A-B Switching Multivibrator. When the INPUT SELECTOR switch is in the A position, the test circle signal is applied through the B channel; when the INPUT SELECTOR switch is in the B position, the test circle signal is applied through the A channel.

The 180° Switching Multivibrator, V75, is a monostable multivibrator which is triggered by the positive-going output from one side or the other of the A-B Switching Multivibrator. It remains in its unstable state for about 500 microseconds, or about one fourth of one cycle of the A-B Switching Multivibrator. Then it returns to its stable state until the beginning of the next cycle of the A-B Switching Multivibrator.

In its stable state, the plate of V75A is at about +160 volts and the plate of V75B is at about +90 volts. In its unstable state, the plate of V75B is at about +160 volts and the plate of V75A is at about +90 volts. This action, relative to the outputs of the A-B Switching Multivibrator, is shown in Fig. 4-2.

The outputs of the 180° Switching Multivibrator are applied to the 180° Switcher Tube, V264, in the Subcarrier Processing circuit, which inverts the phase of the subcarrier during half of the time that the test circle signal is being applied to the demodulators. The purpose of this action is to verify the 90° phase relationship between the Vertical Demodulator and the Horizontal Demodulator. It is discussed further under the descriptions of the Subcarrier Processing Circuits and the Horizontal and Vertical Channels.

Subcarrier Processing Circuits

The Subcarrier Processing circuits phase-shift and phase-split the chrominance subcarrier and apply it to the suppressor grids of the Vertical and Horizontal Demodulators for use in demodulating the chrominance information in the Input Amplifier. The subcarrier signal applied to the Vertical Demodulator tubes must bear a 90° and 270° phase relationship to the original subcarrier on which the chrominance information rides, and the subcarrier signal applied to the Horizontal Demodulator tubes must bear a 0° and 180° phase relationship to the original subcarrier.

The EXTERNAL SUBCARRIER COARSE PHASE circuit compensates roughly for phase shift due to signal delay in the cables and circuits through which the external chrominance subcarrier is applied to the Vectorscope. When the internal

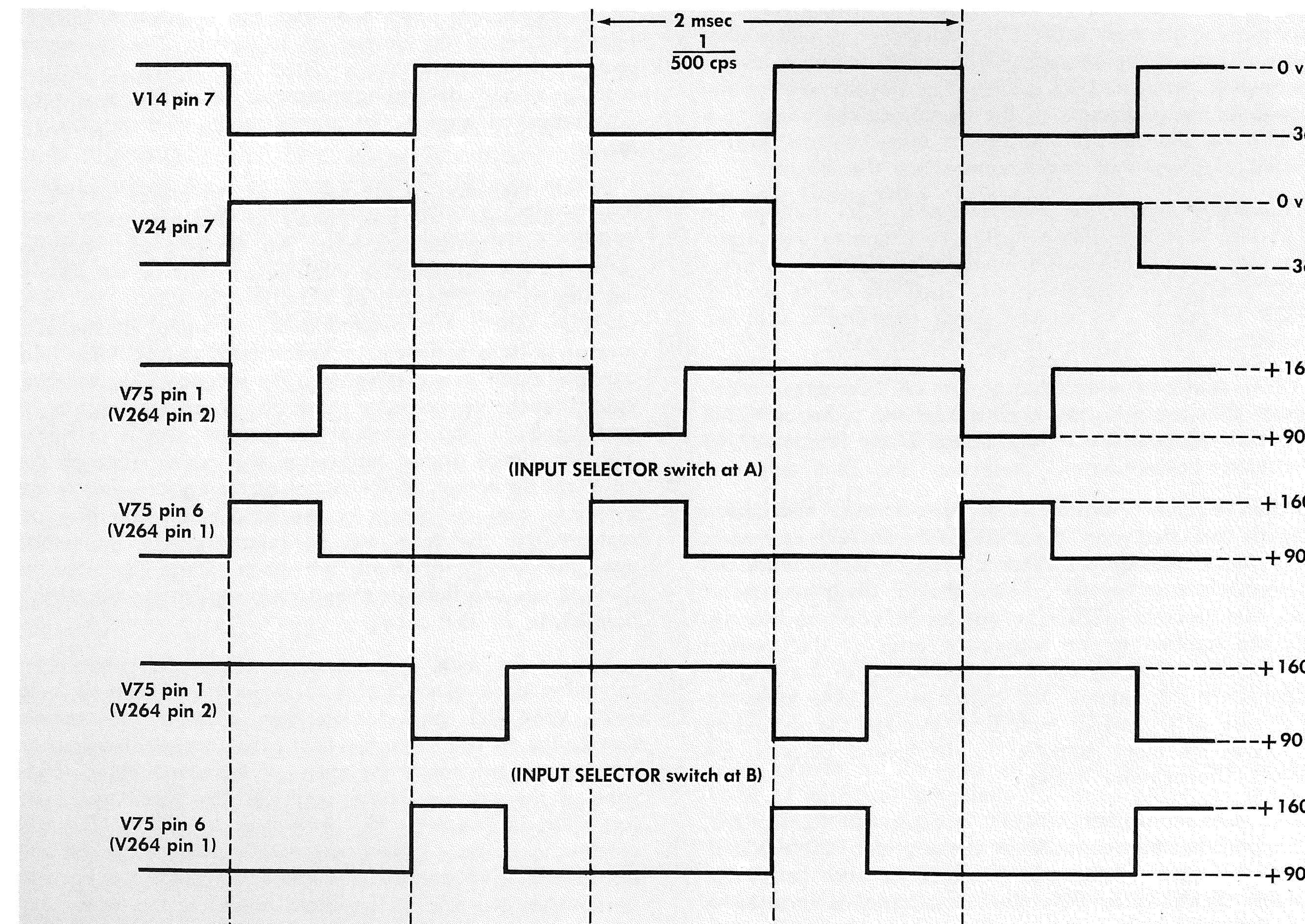


Fig. 4-2. Outputs of A-B Switching Multivibrator and 180° Switching Multivibrator.

Subcarrier Regenerator is used, its output is locked very nearly in the proper phase relationship with the original subcarrier by the color-burst signal from the chrominance signal in the Input Amplifier. The FINE PHASE control provides fine phase adjustment for either signal.

The PRECISION PHASE control provides a means of "rotating" the display of the Vectorscope by introducing a precise amount of chrominance subcarrier delay. This permits accurate phase measurement, by direct readout, of any vector component of the display. Accurate tracking for this control is provided by the tracking correction network which operates as follows:

L197 is actually wound so that, without the tracking correction network, it would provide slightly more than the amount of phase shift indicated by the PRECISION PHASE dial. The built-in error is proportional to the setting of the control throughout its range. Therefore, a correction factor which is proportional to the setting of the PRECISION PHASE control is introduced by the tracking correction network. When L205 is properly adjusted, the C205-L205 network appears as a pure resistance to the chrominance subcarrier at a given setting of the PRECISION PHASE control (normally at 000.0). The dc drop between the left end and the wiper arm of L197 sets the capacitance of the voltage-sensitive capacitor C205C. Thus, any change in the setting of the control changes the dc voltage across C205C and detunes the C205-L205 network. The resulting inductive or capacitive reactance, with R205, introduces a phase shift in the signal at the grid of V203B which compensates for the built-in error in L197. R205 can be set so that the change in the reactance of the circuit, as the wiper arm of L197 is moved, will constantly introduce the proper amount of phase-shift compensation into the circuit.

Adjustment of the FINE PHASE control, R221, detunes the C224-C225-L224 tank circuit slightly by changing the capacitance of the voltage-sensitive capacitor C224. This introduces a slight phase shift in the subcarrier at the grid of V233A to produce the proper phase relationship with the chrominance information at the demodulators.

V224A and associated circuitry form an AGC circuit which detects changes in signal amplitude at the plate of V224B and feeds proportional voltages back to the grid of V224B to counteract them.

When all the Subcarrier Processing circuits have been properly adjusted and the PRECISION PHASE control is set at 000.0, the signal at the cathode of V233B leads the applied subcarrier by 90°. The signal at the other end of L245, then, leads by 270° (or lags by 90°). These two signals are applied to the suppressor grids of the Vertical Demodulator tubes for use in demodulation of the applied chrominance information. The center tap of L245 forms the other side of the signal path back through the secondary of T16 in the Input Amplifier to the control grids of the Vertical Demodulator Tubes.

The 90° phase shift network made up of R251, R252, C251, and the stray capacitance in the grid circuit of V253B causes the signal at the grid of V253B to lead that at the cathode of V233B by 90°. Then this signal is inverted in V264 (only the right plate (pin 9) conducts during the time the chrominance signal is being applied to the control grids of the demodulators) and applied through V283 to the top of L295. Therefore, the signal at the top of L295 is in phase with the original subcarrier and the signal at the bottom of L295 is 180° out of phase with the original subcarrier. These two signals are then applied to the suppressor grids of the Horizontal Demodulator tubes, for use in demodulation of the applied chrominance information.

As mentioned previously, only the right plate of V264 conducts during the time that the chrominance signal is applied to the demodulators. This is because of the more positive voltage on the right deflector (pin 2). However, during half the time that the test circle signal is being applied, the 180° switching Multivibrator is in its unstable state. Thus, a more positive voltage is applied to the left deflector (pin 1) of V264 and the left plate (pin 8) conducts. This has the effect of inverting the phase of the subcarrier at the Horizontal Demodulators during half the time that the test circle signal is being applied. The effect of this phase inversion is discussed under the description of the Horizontal and Vertical Channels following.

Horizontal and Vertical Channels

The chrominance information at the control grids of the demodulators lags or leads the original subcarrier by some angle, depending upon hue, and has a given amplitude, depending upon the degree of saturation. The Horizontal and Vertical Demodulators detect this phase angle and amplitude, and develop appropriate horizontal and vertical deflection signals for amplification and display on the crt.

In the discussion of the Subcarrier Processing Circuits, it was established that the signals at the suppressor grids of the four demodulator tubes lag the original subcarrier on which the chrominance information rides by the following angles: at V364, 0°; at V314, 90°; at V354, 180°, and at V304, 270°. The amplitude of the signal at the suppressor grids is sufficient to switch each demodulator tube between cutoff and conduction. The subcarrier signal, then, causes each demodulator tube to phase-demodulate its grid signal. If the signal at the control grid is in phase with the signal at the suppressor, the current through the tube will be heavy. If the signal at the control grid is not in phase with the signal at the suppressor grid, the current through the tube will be relatively less, depending upon the amount of phase difference. These demodulated grid signals are then amplified and applied to the deflection plates of the circuit.

Thus, if the relative phase angle of the chrominance information at a given instant is closer to 0° than it is to 180°, V364 will conduct more than V354 and the deflection on the crt will be to the right. The amount of deflection will be proportional to the cosine of the phase angle. Likewise, if the relative phase angle of the chrominance information is closer to 90° than it is to 270°, V314 will conduct more than V304 and the deflection on the crt will be upward. The amount of vertical deflection will be proportional to the sine of the phase angle. In this way, each bit of chrominance information is displayed on the Vectorscope as a deflection of given amplitude and given phase angle.

During the time that the 3.59-mc test circle signal is being applied to the control grids of the demodulators, it mixes with the chrominance subcarrier being applied to the suppressor grids. The useful output is an approximate 10-kc sine wave in each of the demodulators These sine waves bear the same phase relationship to each other as do the subcarrier signals in the two demodulators. That is, when the subcarrier signals are exactly 90° apart, the beat-frequency sine waves are also 90° apart.

When two sine waves of the same frequency, but not of the same phase, are applied to the vertical and horizontal deflection plates of a crt, an ellipse is displayed. When the two signals are of equal amplitude and exactly 90° apart in phase, the ellipse becomes a circle. Thus, the pattern displayed on the crt, either circular or elliptical, provides a means of checking the horizontal and vertical channels for phase relationship and gain balance.

As mentioned previously, during the time that the test circle signal is being received by the demodulators, the subcarrier signal applied to the Horizontal Demodulators is switched 180° in phase by the action of the 180° Switching Multivibrator and the 180° Switcher tube in the Subcarrier Processing circuit. Thus, two 10-kc sine waves, 180° apart in phase, are produced in the horizontal circuit; one leads the sine wave in the Vertical Channel by 90°, the other lags the sine wave in the Vertical Channel by 90°.

From this, it can be seen that two ellipses, having opposite eccentricities, are produced on the crt. The two ellipses will merge into a single circle only when the subcarrier signals applied to the Vertical and Horizontal Demodulator circuits are exactly 90° apart in phase. The QUADRATURE PHASING control, R276, in the Subcarrier Processing Circuit detunes the plate tank circuit of V264 as necessary to produce an exact 90° phase difference between the signal in L245 and the signal in L295. Note that adjustment of the QUADRATURE PHASING control will alter the subcarrier phase relationship whether the test circles are being displayed or not. The test circles are merely provided as a convenient way of setting the control properly.

The test circles also provide a convenient means of setting the gains of the Vertical and Horizontal Amplifiers equal to each other. If the gains of the two amplifiers are not equal, the circle produced by the 90° phase relationship will be flattened either horizontally or vertically, depending upon which amplifier has the greater gain. The AMPLIFIER GAIN BAL. control adjusts the gain of the Vertical Output Amplifier so that the gains of the two amplifiers are equal, as indicated by a perfect circle on the crt.

For sweep operation, the Horizontal Output Amplifiers are disconnected from the Horizontal Differential Amplifiers, and a sawtooth waveform from the Sweep Generator is applied. Demodulation takes place in the Vertical Channel as before. When the DISPLAY SELECTOR switch is in the LINE SWEEP — SIGNAL MAG. ON position, the degeneration in the cathode circuit of the Vertical Output Amplifiers is shorted out, and the gain of the amplifier is increased by a factor of five.

Cathode followers in both the horizontal and vertical channels isolate the Differential Amplifiers from the Output Amplifiers.

Note that both the Horizontal and Vertical Channels are dc coupled from the demodulator tube inputs to the crt deflection plates. The significance of this feature is described under "Detecting Stray Chroma" in Section 3.

Synchronizing Circuits

The synchronizing pulses (negative-going) are obtained either from an external source through rear-panel loop-through connections, or internally from the Input Channel through the Burst and Internal Sync Pickoff Stage. The sync pulses are amplified by V404, and then separated from the rest of the signal and amplified again by V414A. Thus, the signal at the plate of V414A is a series of negative synchronizing pulses approximately 100 volts in amplitude.

Each pulse at the plate of V414A cuts off V414B and produces a sharp rise in voltage at its plate. This rise is differentiated in the grid circuit of the Sweep Gating Multivibrator to produce a sharp positive pulse which resets the Sweep Generator. V414B is turned back on again between sync pulses by a portion of the Sweep Generator output sawtooth waveform coupled to its grid through R413.

The amplified horizontal sync pulses at the plate of V414A are narrow enough and far enough apart to have no effect on the grid of V475A. But the wider, more closely spaced vertical sync pulses build up sufficient voltage in the integrating circuit to cut V475A off. This action is discussed further under Trace Blanking and Unblanking.

Sweep Generator

The Sweep Generator operates all of the time that synchronizing pulses are being received, regardless of whether the sweep is actually being displayed on the screen or not. The synchronizing pulses do not start the sweep; instead, they stop it and cause the Sweep Generator to reset. Then, a few microseconds after each reset (the actual amount of time depends upon the setting of the BURST GATE adjustment), the Sweep Generator reactivates itself and generates another sweep.

Basically, the sweep waveform is developed by the charging up of the Sweep-Timing Capacitor, C460, through the Sweep-Timing Resistor, R460, and the Runup Cathode Follower, V461B. The waveform applied to the Horizontal Amplifier is taken from the upper side of C460.

During sweep time, V435A is cut off and V445B is conducting. The low voltage (about —6 volts) at the plate of V445B holds the Disconnect Diodes, V452B and V452C, cut off so that C460 can charge. The synchronizing pulse arrives at the grid of V435A as a sharp positive spike of sufficient amplitude to force V435A to conduct. The drop at the plate of V435A is coupled through V435B and C446 to the grid of V445B and causes V445B to cut off. The common cathode connection drops in voltage because of the decreased current through R438. This allows V435A to continue to conduct after the positive spike at its grid has passed. The rise in voltage at the plate of V445B turns on V452C. C460 then discharges through

V452C, R447, and R469. When the upper side of C460 drops to about −4 volts, V452B conducts, clamping it there. Thus, the sweep is turned off.

Between sweeps, the diodes keep the grid of V461A clamped at about −2 volts and the cathode of V461B clamped at about −4 volts.

The amount of time the sweep remains turned off depends upon the discharge rate of C446. As C446 discharges, the grid of V445B moves in a positive direction. After from about 4 to 13 microseconds (depending upon the value of R441 set by the BURST GATE adjustment), the grid of V445B becomes positive enough to allow V445B to conduct. The drop at the plate of V445B turns off the diodes and the grid of V461A starts to move toward −150 volts at a rate determined by the time constant of C460 and R460. However, as the grid of V461A moves negatively, the plate of V461A moves positively. This positive change, coupled through V461B back to the upper side of C460, tends to prevent the lower plate from moving negatively. The result is that the lower side of C460 moves about 1 volt negatively, before the next synchronizing pulse, while the upper side moves about 150 volts positively. This 150-volt sawtooth, then, is applied to the Horizontal Amplifier as a sweep waveform when the Vectorscope is used in the line-sweep mode of operation.

A portion of the sawtooth waveform at the upper side of C460 is also coupled back to the Synchronizing Circuit where it is used to turn on V414B between horizontal pulses. The waveform at the cathode of V435B is applied to the blanking and unblanking circuits to provide blanking of the trace between sweeps and brightening of the trace during burst time.

Blanking and Unblanking Circuits

Four different crt intensity-modulation signals are generated in the Vectorscope during the different modes of operation. These are the sweep-retrace blanking signal, the burst-brightening signal, the test-circle switching-transient blanking signal, and the vertical interfield test unblanking signal. Development of these signals is discussed in the following paragraphs.

Sweep-Retrace Blanking Signal. At the end of each sweep, the potential at the cathode of V435B drops from about +120 volts to about +30 volts. During the line-sweep mode of operation, this drop is applied through V483B, C852, and C853 to the crt grid to turn off the trace between sweeps. The rise in voltage at the cathode of V435B turns the trace back on again at the beginning of the next sweep. (See waveform 5 on the block diagram at the rear of the manual)

Burst-Brightening Signal. The positive-going and negative-going portions of the sweep-retrace blanking signal are differentiated by Delay Line DL437 and the cathode resistances to form two-microsecond-wide positive and negative pulses at the grid of V494A. Since V494A is normally cut off, the negative pulses have no effect. The positive pulses, which correspond timewise to the beginning of the sweep, force V494A into conduction and produce negative pulses at its plate. These negative pulses are applied through V494B to the crt cathode to brighten the first two microseconds of the sweep. The BURST GATE adjustment in the Sweep-Gating Multivibrator sets the beginning of the sweep to correspond to the start of burst; therefore, brightening the first two microseconds of the sweep effectively brightens the burst pulse as displayed on the crt. Since the Sweep Generator operates all of the time, these burst-brightening pulses are also generated during the vector mode of operation. The pulses at the plate of V494A are also applied to the burst-gating circuit to permit the application of the color-burst signal from the Input Amplifier to the Subcarrier Regenerator. (See waveforms 8 and 9 on the block diagram at the rear of this manual.)

Test Circle Switching Transient Blanking. When the DISPLAY SELECTOR switch is in the VECTOR DISPLAY — TIME SHARED WITH TEST CIRCLE position, the assymetrical square wave outputs at the two plates of the 180° Switching Multivibrator are applied to the Switching Transient Blanking Diodes through C483 and C484. The negative-going portions of the square waves are differentiated to produce narrow negative spikes which are coupled through the switch and V483B to the crt grid to prevent the test-circle switching transients from appearing on the crt screen.

Vertical Interfield Test Signal Unblanking. The ISK circuitry, V475, V452A, and V483A, causes the Vectorscope to be unblanked only during a selected 250-microsecond period toward the end of the vertical blanking interval of the applied signal. This allows the observation of a vertical interfield test signal (if one is present) without interference from the video signal. The ISK circuitry will not operate if vertical synchronizing pulses are not present.

When the INTERFIELD SIGNAL KEY switch is turned to ON, V483A conducts heavily and drops the voltage at its plate to about +15 volts. During the vertical blanking interval, the vertical sync pulse is integrated in the grid circuit of V475A and causes V475A to cut off. This causes the monostable ISK Multivibrator to switch from its stable state to its unstable state. The amount of time that the multivibrator will remain in the unstable state is determined by the time constant of C475, R476, and R477. The signal at the plate of V475A, then, is a positive gate, the duration of which is adjustable from about 700 to 1300 microseconds by means of the ISK DELAY adjustment, R477. The trailing edge of the gate is differentiated by C481 and R480 to produce a negative pulse which cuts off V483A for about 250 microseconds. (See waveform 13 on the block diagram at the rear of this manual) The resulting positive pulse at the plate of V483A is coupled through V483B to unblank the crt. The time constant in the grid circuit of the crt is long enough to keep the crt beam cut off between vertical blanking intervals so only the vertical interfield test signal appears on the screen.

It should be noted that if the DISPLAY SELECTOR switch is in the VECTOR DISPLAY — TIME SHARED WITH TEST CIRCLE or in either of the LINE SWEEP positions, the blanking signals from the Switching Transient Blanking Diodes or from the cathode of V435B will also be present at the grid of V483B during the time that V483A is cut off. Waveform 15 on the block diagram at the rear of the manual shows the signal at the cathode of V483B when the INTERFIELD SIGNAL KEY is in the ON position and the DISPLAY SELECTOR switch is in either of the LINE SWEEP positions.

Subcarrier Regenerator

The Subcarrier Regenerator puts out a continuous 3.579545-mc sine wave which can be used in place of an external subcarrier if none is available. When the SUBCARRIER SELECTOR switch is in the INTERNAL — BURST CONTROLLED OSCILLATOR position, the output of the Subcarrier Regenerator is locked into the proper phase and frequency relationship with the chrominance signal by the color-burst signal. This color-burst signal is gated through the Burst Amplifier, V134, to the Phase Detector by the action of the burst-gating pulse, as inverted and amplified by the Burst Gate Inverter, V114.

The Phase Detector, V142, maintains a 90° phase relationship between the output of the Burst-Controlled Oscillator in the Subcarrier Regenerator and the color-burst signal in the secondary of T132. That is, the output of the oscillator lags the signal at the bottom of T132 by 90° and leads the signal at the top of T132 by 90°. With this relationship between the two signals, the plate of V142A is positive with respect to its cathode for half of each cycle, and the plate of V142B is positive with respect to its cathode for half of each cycle. Therefore, each half of V142 conducts during half of each cycle, as shown in Fig. 4-3.

During the time that V142A is conducting, current flows from ground through the secondary of T152, through V142A, C136, and the top half of the secondary of T132 to C141. Thus, a charge is developed across C136 such that the right side of C136 is negative with respect to ground. During the time that V142B is conducting, current flows from C138 through V142B and the secondary of T152 to ground, from C141 through the lower half of the secondary of T132 to the other side of C138. Thus, a charge is developed across C138 such that the right side is positive with respect to ground. In this way, a dc potential is developed across R136, R137, and R138, negative at the top and positive at the bottom, with respect to ground. During calibration of the Vectorscope, the DC BAL. adjustment is set so that its wiper arm lies at the dc ground level between the two ends of the divider.

If the frequency of the Burst-Controlled Oscillator decreases between bursts, its output at the next burst pulse will lag the bottom of T132 by more than 90° and will lead the top of T132 by less than 90°. It can be seen from Fig. 4-3 that this will cause V142B to conduct more and V142A to conduct less (on the figure, the oscillator sine wave will be shifted slightly to the right), producing a positive voltage at the DC BAL. wiper arm. This voltage, applied to the two voltage sensitive capacitors in the oscillator tank circuit, will increase the frequency of the oscillator. The potential on the other side of the voltage-sensitive capacitors is fixed at about −7 volts.

If the frequency of the Burst-Controlled Oscillator increases between burst pulses, the opposite set of conditions will exist. V142A will conduct more than V142B, and the resulting negative voltage at the DC BAL. wiper arm will decrease the frequency of the oscillator.

With this dc correction network, the maximum phase shift of the oscillator between burst pulses is less than 0.1°.

Setting the SUBCARRIER SELECTOR switch to INTERNAL — FREE RUNNING OSCILLATOR places a fixed potential of about −5.4 volts at the junction of the two voltage-sensitive capacitors. This lowers the frequency of the oscillator by about 200 cps. At this frequency, the voltages developed in the Phase Detector cannot correct for phase and frequency shift and the Subcarrier Regenerator free runs.

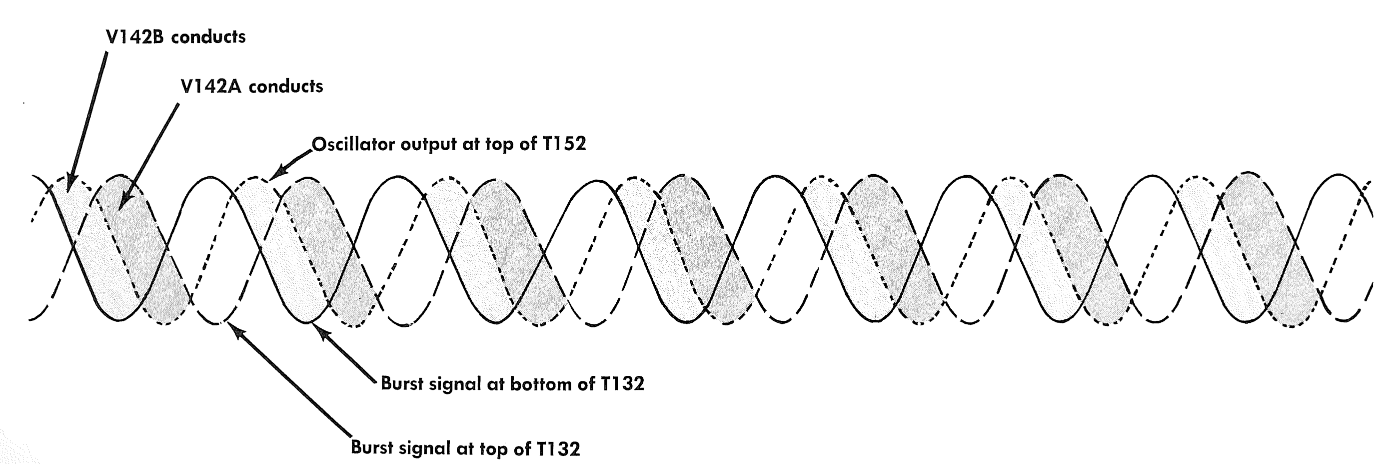


Fig. 4-3. Phase relationships between signals applied to the Phase Detector.

LOW VOLTAGE POWER SUPPLY

Plate and filament power for the tubes in the Vectorscope is furnished by a single power transformer, T601. The primary has two equal windings which are connected in parallel for 117-volt operation or in series for 234-volt operation.

The three main full-wave power supplies furnish regulated voltages of —150, +120, and +350 volts. The +350-volt supply also has an unregulated output of about +500 volts for the high-voltage power supply. It is unnecessary to regulate this supply as the high-voltage supply has its own regulating circuit.

Reference voltage for the —150-volt supply is established by a gas-filled diode, VR tube V609. This tube establishes a fixed potential of about —85 volts at one grid of the Difference Amplifier, V634 and V627B. The grid potential for the other half of the Difference Amplifier is obtained from a voltage divider consisting of R615, R616, and R617. The setting of the —150 ADJ. potentiometer, R616, determines the percentage of the total output voltage that appears at the grid of V627B, and thus determines the total voltage across the divider. When this adjustment is properly set, the output voltage of the —150-volt supply will lie between —148 and —152 volts.

Should the output voltage start to change, either because of a change in loading or a change in source voltage, the potential at the grid of V627B will change proportionately. This change, as amplified by the Difference Amplifier, changes the bias of V627A to allow more or less current, as required, to flow through the load and bring the output voltage back toward its original level.

The —150-volt output serves as a reference for both the +120-volt and the +350-volt supplies. In the +120-volt supply, the voltage divider R650-R651 establishes a voltage of essentially zero at the grid of the Comparator, V664. (The actual voltage at this grid will be equal to the bias voltage required by the tube.) If the output voltage should start to change, the resulting change in voltage at the grid of V664 will be amplified and inverted, and will appear at the grid of the Series Regulator tubes, V667 and V677. The cathodes of the V667 and V677 will follow the grids, and thus the output voltage will be returned to its established level.

The +350-volt supply functions in the same manner as the +120-volt supply.

In each of the supplies, a small sample of the ripple present at the plate of the Series Regulator tubes is coupled back to the screen of the Comparator tube to cancel out any ripple in the regulated supply. C617, C650 and C710 improve the response of the regulator circuits to sudden changes in output voltage.

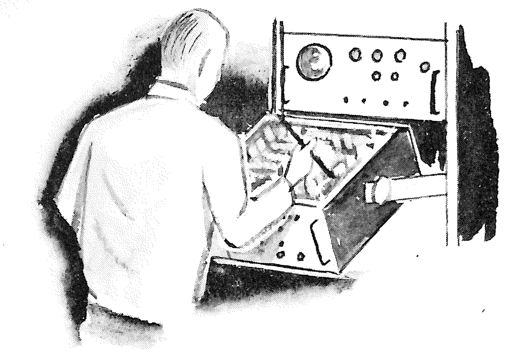
HIGH-VOLTAGE POWER SUPPLY

A 50-kc Hartley oscillator, V800, furnishes energy for the single high-voltage rectifier tube, V852. Current through V852 develops about —3800 volts at the lower end of the high-voltage divider. B847 and B848 provide a constant drop across R848 regardless of the amount of cathode current drawn by the crt.

Regulation of the high-voltage power supply is provided by feeding back a sample of the output voltage to the screen of the oscillator tube, V800. This voltage, taken from the junction of R841 and R842, controls the amplitude of the oscillations of V800. The amplitude of the oscillations, in turn, controls the magnitude of the voltage developed by V852. Specifically, if the output of the high-voltage power supply should drop because of a change in loading or a change in the +500-volt unregulated supply, the sample voltage will be more positive than before. This positive change in voltage is amplified and applied to the screen of V800 where it increases the amplitude of the oscillations. This raises the output of the supply back toward its original level. Conversely, if the output of the high-voltage power supply increases, the voltage at the screen of V800 will be less positive, and the amplitude of the oscillations will decrease.

The CRT BEAM ROTATOR is included on only a few early-production instruments on which the crt cannot be rotated mechanically. It provides a means of electronically aligning the line-sweep trace with the horizontal centerline of the graticule. R866 and R868 control the polarity and magnitude of the potential across L868, which is wrapped around the crt. The magnetic field thus set up interacts with the magnetic field generated by the moving electrons in the beam, and thereby controls the position of the beam as it moves across the crt.

The means for aligning the trace with the graticule on later versions of the Vectorscope is described in Section 5 under "Crt Replacement."



SECTION 5

MAINTENANCE

PREVENTIVE MAINTENANCE

Cleaning

The most important aspects of maintaining the Type 526 Vectorscope in proper operating condition are keeping it cool and keeping it clean. The instrument must be placed where there is no obstruction to free air flow through the fan at the rear. Dust inside the instrument can reduce cooling efficiency as well as create current leakage paths and changes in component reactance. For this reason, we recommend periodic cleaning of the instrument with a vacuum cleaner. The frequency of cleaning will depend upon the environment of the instrument. The fan grill can be removed and washed in soap and water.

The fan motor has oil-sealed bearings and does not require lubrication.

Soldering Precautions

In the production of Tektronix instruments a solder containing about 3% silver is used to establish a bond to the ceramic terminal strips. Although occasional use of ordinary tin-lead solder will not destroy this bond, we recommend the use of silver-bearing solder for parts replacement. This type of solder is locally available in most areas; or, if you prefer, you may purchase it from Tektronix in one-pound rolls (order by part number 251-514).

It is also important to use as little heat as possible when soldering on the ceramic terminal strips. A wedge-shaped soldering iron tip is best for this purpose.

Crt Replacement

Disconnect the Vectorscope from its power source when you remove the crt, as the power connector is very close to the crt clamp. Refer to Fig. 5-1 during the following discussion.

To remove the crt, proceed as follows:

1. Disconnect the wires from the five crt neck pins.

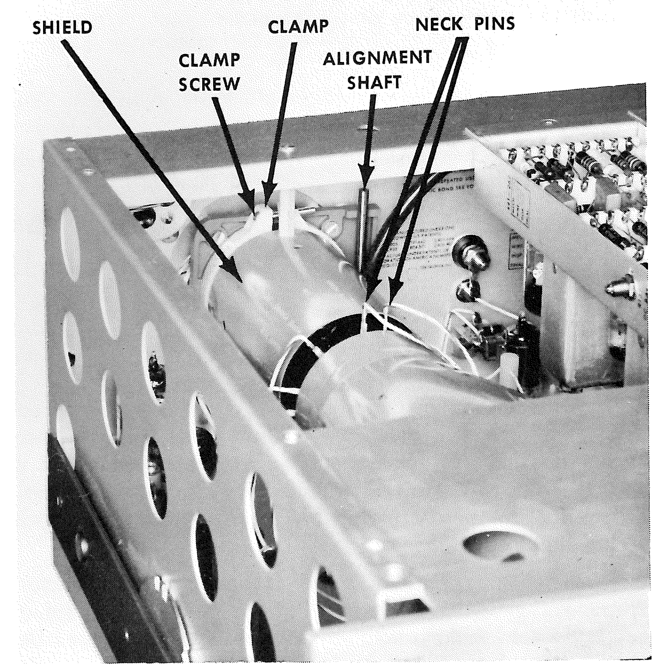


Fig. 5-1. Crt installation.

2. Remove the graticule cover and graticule from the face of the instrument.

3. Loosen the crt clamp screw at the base of the crt and, from the rear of the instrument, push the crt forward until the base is clear of the clamp.

4. Retighten the crt clamp screw. The clamp should now be holding the crt socket.

5. Unseat the crt from its socket by pushing forward on its base.

6. Pull the crt out through the face of the Vectorscope. Be careful not to bend or break the neck pins on the tube shield as you remove the crt.

WARNING

The crt can cause serious damage and injury if broken. Handle it carefully.

To replace the crt, proceed as follows:

1. Carefully insert the crt into the opening in the face of the Vectorscope. Be careful not to bend or break the neck pins on the tube shield.

2. Make sure that the crt socket is held tightly in the crt clamp.

3. View the crt from the rear of the instrument to align the key, and press the crt into its socket.

4. After the crt is seated in its socket, loosen the crt clamp screw and push on the face of the crt until the socket is clear of the clamp.

5. Replace the graticule and graticule cover.

6. Push on the base of the crt until its face is flush against the rear surface of the graticule.

7. Tighten the crt clamp screw.

8. Reconnect the wires to the crt neck pins, observing the color-coding on the shield.

9. Reconnect the instrument to the power source and obtain a line sweep with no signal applied.

10. With a screwdriver, rotate the crt alignment shaft until the trace is aligned with the horizontal centerline of the graticule.

TROUBLESHOOTING

The troubleshooting information presented in this section of the manual is divided by trouble symptoms presented to the operator; for each symptom you are referred to a step in Table 5-1. This table provides a step-by-step procedure for isolating virtually any trouble which may occur within the Vectorscope.

Whenever an apparent trouble appears in the Vectorscope, you should first check all control settings and signal connections to make sure that they are as they should be. Most difficulties with the instrument will be due to improper control settings or signal connections. **Make sure all connectors are properly terminated.**

Tube failure is the most prevalent cause of circuit failure. For this reason, one of the first things the table instructs you to do, after isolation of a trouble to a stage, is to replace the tube or tubes in the stage. Do not depend upon tube testers to adequately indicate the suitability of a tube for a given circuit; the only criterion of suitability is whether the tube operates properly in that circuit.

Before replacing any tube, it is a good idea to perform a visual check of the circuit to see if any components through which the tube draws current have been damaged. If they have, they should be replaced before the new tube is inserted. If possible, the reason for the excessive current should be found and removed. A visual inspection can also reveal other sources of trouble, such as broken connections, broken terminal strips, broken switch wafers, etc.

If replacement of a tube does not eliminate the trouble, put the original tube back into the same socket. Otherwise, recalibration of the circuit may be required.

In a number of the steps of Table 5-1, you are instructed to locate a trouble by waveform tracing through a circuit or by voltage and resistance measurements within a given stage. Typical voltages and waveforms present at many points throughout the instrument are given on the schematic diagrams. Peak-to-peak amplitudes of the subcarrier signal through the Subcarrier Processing circuits are also given. Resistance measurements in a circuit will usually be point-to-point checks, for which the proper values can be approximated from the schematic diagrams.

All wiring in the Vectorscope is color-coded to facilitate circuit tracing. The regulated power-supply busses follow the standard color code. The —150-volt bus is coded brown-green-brown on a black wire, the +120-volt bus is coded brown-red-brown on a white wire, and the +350-volt bus is coded orange-green-brown on a white wire. The 6.3-volt heater leads are coded blue-orange on a white wire. The widest stripe identifies the first color in the code.

Switch wafers are coded on the schematic diagrams to indicate the position of the wafers on the switches. The number portion of the code refers to the wafer number on the switch assembly. Wafers are numbered from the front of the switch to the rear. The letters F and R indicate front and rear of the wafer, respectively.

No Spot or Trace

If no spot or trace is displayed on the crt regardless of the positions of the controls, first check the power supplies by performing steps 1 through 4 of Table 5-1. If the desired result is obtained in all four steps, the trouble is probably due to an imbalance in the vertical or horizontal deflection system or to a faulty crt circuit. In this case, set the DISPLAY SELECTOR switch to LINE SWEEP — SIGNAL MAG. OFF and go to step 26.

Vector Display Normal but No Horizontal Sweep

If the vector display is normal but no display can be obtained when the DISPLAY SELECTOR switch is placed in one of the LINE SWEEP positions (there may be a bright spot off the right side of the screen), set the DISPLAY SELECTOR switch to VECTOR DISPLAY — TEST CIRCLE OFF and turn the intensity down slowly. If the burst vector is brightened more than the other vectors, the Sweep-Gating Multivibrator is operating, so the trouble is in the remainder of the Sweep Generator or in the dividers connected to the Horizontal Amplifier in the LINE SWEEP positions of the DISPLAY SELECTOR switch. In this case, start at step 32. If the burst vector is not brightened more than the other vectors, the Sweep-Gating Multivibrator is not working, and the trouble can be either in the Synchronizing Circuits or the Sweep Generator. In this case, start at step 34.

Line-Sweep Presentation Normal, but Vector Display Compressed Horizontally

If you are able to obtain a normal line-sweep display, but the vector display is compressed horizontally (there may be no horizontal deflection at all), the trouble is probably in the last two stages of the Subcarrier Processing circuits or in the first two stages of the horizontal deflection system. In this case, start at step 36.

Vertically Compressed Displays

If both the vector and line-sweep displays are compressed vertically (vertical deflection may be totally absent), but horizontal deflection is normal for both displays, the trouble probably lies in the Vertical Demodulator and Amplifier circuits. In this case, start at step 38.

No Vector or Line-Sweep Presentation, Both Channels

If you are unable to obtain either a proper vector display or line-sweep display regardless of the input channel used, but you can display a spot, the trouble is probably in the Subcarrier Processing circuits or in the Subcarrier Regenerator. This trouble may be characterized by less-than-normal deflection or no deflection at all. In a vector display, the lack of deflection will be evident both vertically and horizontally; in a line-sweep display, the horizontal deflection will be correct but the vertical deflection will be diminished or totally absent.

If this trouble is present only when an external subcarrier is being used, start at step 39. If it is present only when the internal subcarrier is being used, start at step 41. If it is present with both external and internal subcarriers, check the power supplies by performing steps 1 through 4. If all of the power supply outputs are normal, go to step 42.

No Vector or Line-Sweep Display, One Channel Only

If vertical deflection on line-sweep and horizontal and vertical deflection on vector display are normal for one input channel but less than normal for the other, the trouble is either in the faulty input channel or in the A-B Switching Multivibrator. Start at step 43.

No Lock-In On Internal Subcarrier

If the display does not lock in with the internal subcarrier, but it does with the external subcarrier, check the Burst-Gate Delay Adjustment and the Subcarrier Regenerator Alignment as described in Section 6. If this does not remedy the trouble, start at step 47.

Excessive Jitter in the Display

If excessive jitter is present in the display when you are using an external subcarrier, the trouble is probably in the equipment being monitored. Excessive jitter when you are using the internally regenerated subcarrier is probably caused by excessive ripple in the power supply. In this case, perform steps 1 through 3 of Table 5-1, paying particular attention to the amount of 120-cps ripple on the output voltages. There will be some 50-kc and 3.58-mc ripple in the power supplies as well as some 1-kc spikes; these can be ignored. If the 120-cps ripple is within the maximum specified, adjust the Subcarrier Regenerator alignment according to the procedure described in Section 6. If this does not remedy the trouble, start at step 47.

Missing Test Circle

If only one test circle (or ellipse) is present as the QUADRATURE PHASING control is rotated, start at step 49. If there is no test circle at all present, but both input amplifier channels are operating normally, perform step 52.

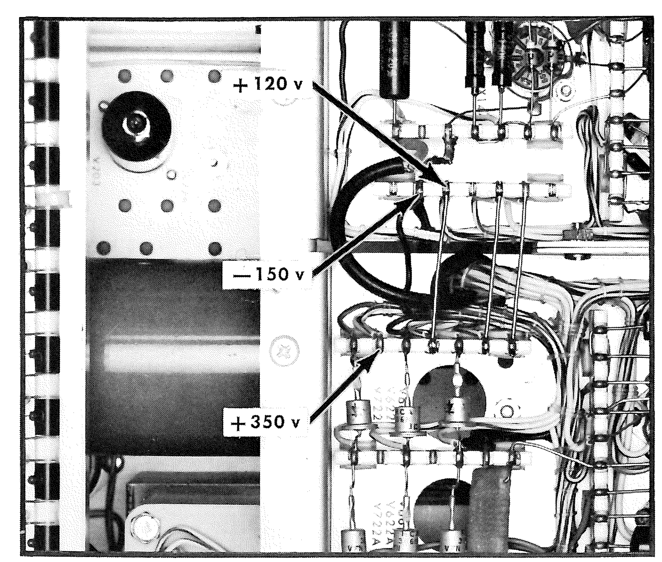


Fig. 5-2. Low-Voltage Power Supply check points.

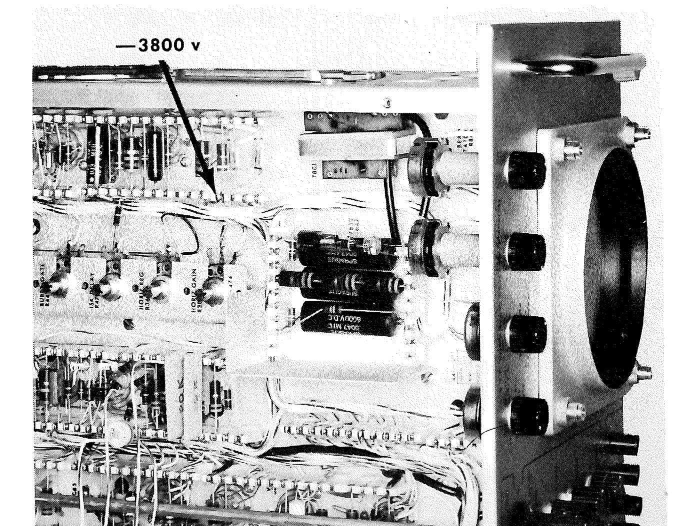


Fig. 5-3. High-Voltage Power Supply check points.

TABLE 5-1
TROUBLESHOOTING PROCEDURE

STEP	DESIRED RESULT	IF DESIRED RESULT IS OBTAINED	IF DESIRED RESULT IS NOT OBTAINED
1. Check —150 volts. (See Fig. 5-2.)	—148 to —152 volts; maximum 120-cps ripple, 20 millivolts peak-to-peak.*	Go to step 2.	Go to step 5.
2. Check +120 volts. (See Fig. 5-2.)	+116.5 to +123.5 volts; maximum 120-cps ripple, 5 millivolts peak-to-peak.*	Go to step 3.	Go to step 8.
3. Check +350 volts. (See Fig. 5-2.)	+339.5 to +360.5 volts; maximum 120-cps ripple, 20 millivolts peak-to-peak.*	Go to step 4.	Go to step 10.
4. Check —3800 volts. (See Fig. 5-3.)	—3420 to —4180 volts.	Power supplies are operating properly.	Go to step 13.
5. Check source voltage.	105 to 125 volts ac or 210 to 250 volts ac	Go to step 6.	Correct source voltage.
6. Replace V609, V627, V634.	Proper operation.	Trouble has been eliminated.	Replace original tubes and go to step 7.
7. Measure voltage drop across R640.	0.28 volt ± 10%	Go to step 54.	If less than desired result, check rectifier diodes, then go to step 54. If more, go to step 12.
8. Replace V664, V667, V677.	Proper operation.	Trouble has been eliminated.	Replace original tubes and go to step 9.
9. Measure voltage drop across R670.	0.16 volt ±10%	Go to step 54.	If less than desired result, check rectifier diodes, then go to step 54. If more, go to step 12.
10. Replace V724, V727, V737.	Proper operation.	Trouble has been eliminated.	Replace original tubes and go to step 11.
11. Measure voltage drop across R730.	1.0 volt ±15%	Go to step 54.	If less than desired result, check rectifier diodes, then go to step 54. If more, go to step 12.
12. Determine cause of overload by circuit tracing and resistance measurements.	See Low-Voltage Power Supply schematic diagram.		Replace faulty component.
13. Check for glow in B847 and B848.	Glow in B847 and B848.	Go to step 14.	Go to step 15.
14. Measure resistances in high-voltage divider.	See High-Voltage Power Supply schematic diagram.	Go to step 54.	Replace faulty component.
15. Check for heater glow in V852.	Heater glow in V852.	Go to step 16.	Replace faulty component.
16. Measure resistances in high-voltage divider.	See High-Voltage Power Supply schematic diagram.	Go to step 17.	Replace faulty component.

*Swing-out chassis must be securely bolted down while measuring ripple. Ripple on +350-volt supply may go as high as 35 millivolts at low line voltage (105 volts) but should be less than 20 millivolts at nominal line (117 volts)

STEP	DESIRED RESULT	IF DESIRED RESULT IS OBTAINED	IF DESIRED RESULT IS NOT OBTAINED
17. Replace V852.	Proper operation.	Trouble has been eliminated.	Go to step 18.
18. Measure grid voltage of V800.	Approx. —100 volts.	Go to step 19.	Go to step 21.
19. Measure resistance from heater of V852 to ground.	160 Ω	Go to step 20.	Replace faulty component.
20. Replace V852.	Proper operation.	Trouble has been eliminated.	Go to step 54.
21. Measure plate voltage of V800.	Approx. +490 volts.	Go to step 22.	Replace faulty component.
22. Measure resistance of T801 secondary.	160 Ω	Go to step 23.	Replace faulty component. (probably T801).
23. Measure resistance of T801 primary.	40 Ω	Go to step 24.	Replace faulty component. (probably T801).
24. Measure resistance across C806.	More than 120 K.	Go to step 25.	Replace faulty component. (probably C806 or R806).
25. Replace V800 and V814.	Proper operation.	Trouble has been eliminated.	Go to step 54.
26. Short vertical deflection plates together at crt neck pins; adjust HORIZONTAL POSITIONING control.	Appearance of spot or horizontal trace.	Go to step 27.	Go to step 28.
27. Short between pairs of points shown in Fig. 5-4, starting at right and working toward left.	A spot should appear each time the shorting strap is connected.	Stage following is good.	Stage following is bad; go to step 53.
28. Short horizontal deflection plates together at crt neck pins; adjust VERTICAL POSITIONING control.	Appearance of spot or vertical trace.	Go to step 29.	Go to step 30.
29. Short between pairs of points shown in Fig. 5-5, starting at right and working toward left.	A spot should appear each time the shorting strap is connected.	Stage following is good.	Stage following is bad; go to step 53.
30. Short out both pairs of deflection plates at crt neck pins; adjust both POSITIONING controls.	Appearance of spot.	Leave horizontal plates shorted and go to step 27. After clearing up trouble in vertical channel go to step 29.	Go to step 31.
31. Remove crt and check voltages at crt socket.	See High-Voltage Power Supply schematic diagram.	Replace crt. (See Fig. 5-1)	Replace faulty component.
32. Obtain vector display; turn intensity down slowly.	Burst vector should remain brighter than other vectors.	Go to step 33.	Go to step 34.
33. Replace V452 and V461.	Proper operation.	Trouble has been eliminated.	Go to step 54.

STEP	DESIRED RESULT	IF DESIRED RESULT IS OBTAINED	IF DESIRED RESULT IS NOT OBTAINED
34. Replace V404, V414, V435, V445 (and V44, if using internal sync).	Proper operation.	Trouble has been eliminated.	Go to step 35.
35. Locate trouble by waveform tracing through Sync and Sweep Generator circuits.	See Sync and Unblanking and Sweep Generator schematic diagrams; also Block Diagram.		Replace faulty component.
36. Replace V253, V264, V283, V354, V364, V374, V384.	Proper operation.	Trouble has been eliminated.	Go to step 37.
37. Locate defective stage by waveform tracing from cathode of V233B to plates of V374 and V384.	See Subcarrier Processing and Horizontal Demodulator and Amplifier schematic diagrams.		Go to step 53.
38. Locate defective stage by waveform tracing through Vertical Demodulator and Amplifier circuits.	See Vertical Demodulator and Amplifier schematic diagrams.		Go to step 53.
39. Replace V174.	Proper operation.	Trouble has been eliminated.	Go to step 40.
40. Locate trouble by waveform tracing from 3.58 MC SUBCARRIER INPUT connector to C191.	See Subcarrier Processing schematic diagram.		Replace faulty component.
41. Replace V142 and V150.	Proper operation.	Trouble has been eliminated.	Go to step 54.
42. Locate defective stage by waveform tracing through Subcarrier Processing circuit.	See Subcarrier Processing schematic diagram.		Go to step 53.
43. Apply signal to good channel, set INPUT SELECTOR switch to corresponding position and obtain a line-sweep display.	Proper display with horizontal base line present across center of crt.	Go to step 44.	Go to step 46.
44. Change both tubes in faulty channel and apply signal through that channel (set INPUT SELECTOR switch accordingly).	Proper display.	Trouble has been eliminated.	Go to step 45.
45. Locate faulty stage by waveform tracing through faulty input channel.	See Input Amplifier schematic diagram.		Go to step 54.
46. Replace V55.	Proper operation.	Trouble has been eliminated.	Go to step 54.
47. Replace V114, V134, V142.	Proper operation.	Trouble has been eliminated.	Go to step 48.

STEP	DESIRED RESULT	IF DESIRED RESULT IS OBTAINED	IF DESIRED RESULT IS NOT OBTAINED
48. Locate faulty stage by waveform tracing from plate of V494A through Subcarrier Regenerator.	See Sync and Unblanking and Subcarrier Regenerator schematic diagrams.		Go to step 53.
49. Replace V75 and V264.	Proper operation.	Trouble has been eliminated.	Go to step 50.
50. Check output waveform of V75.	See Input Amplifier schematic diagram.	Go to step 51.	Go to step 53.
51. Check 180° Switcher Tube (V264) circuit by voltage and resistance measurements.	See Subcarrier Processing schematic diagram.		Replace faulty component.
52. Check Test Circle Oscillator (Q40) circuit by voltage and resistance measurements.	See Input Amplifier schematic diagram.		Replace faulty component.
53. Replace the tube or tubes in the suspected stage.	Proper operation.	Trouble has been eliminated.	Go to step 54.
54. Check the stage by voltage and resistance measurements.	See schematic diagram.		Replace faulty component.

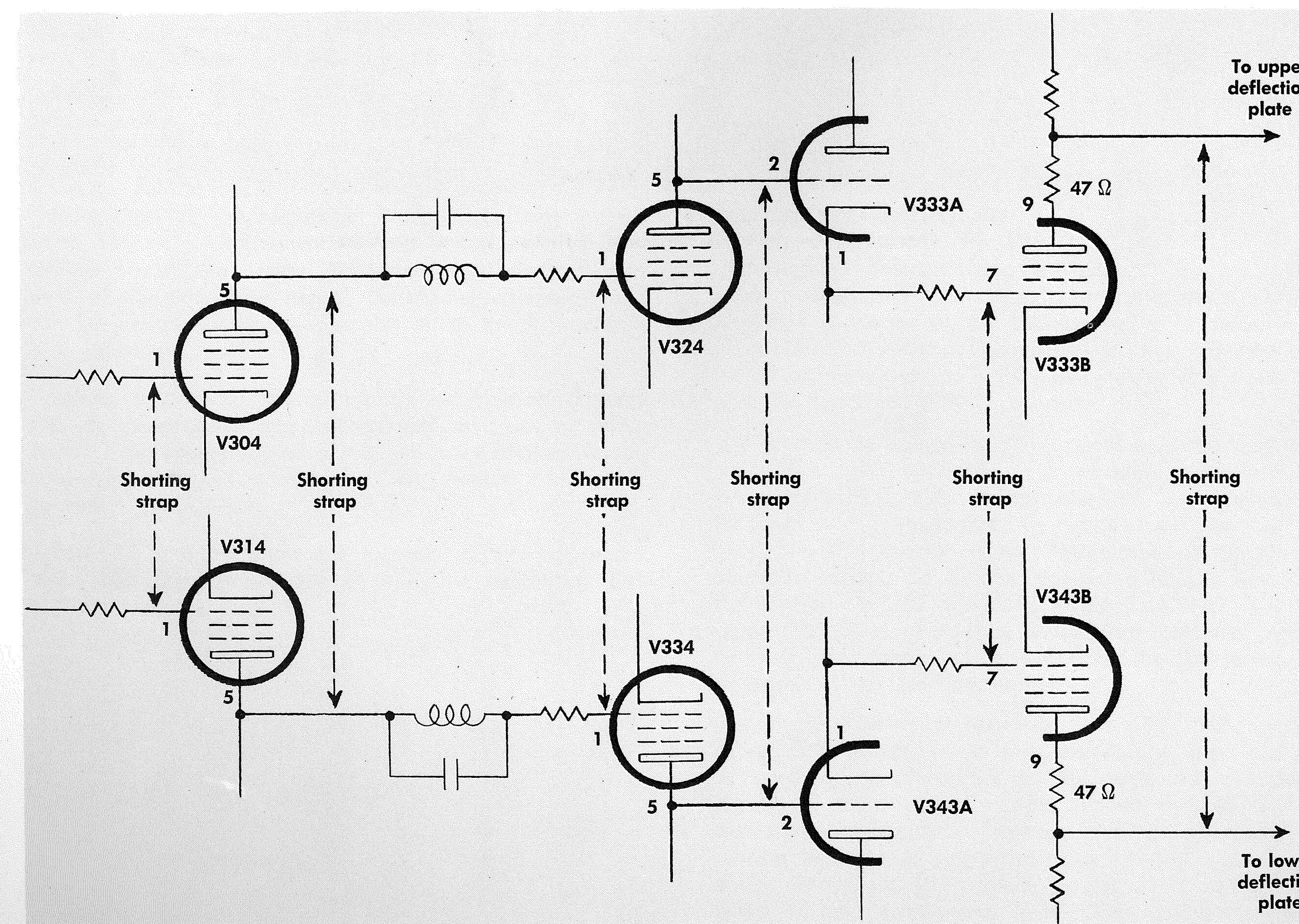


Fig. 5-4. Checkpoints for isolating vertical deflection system imbalance.

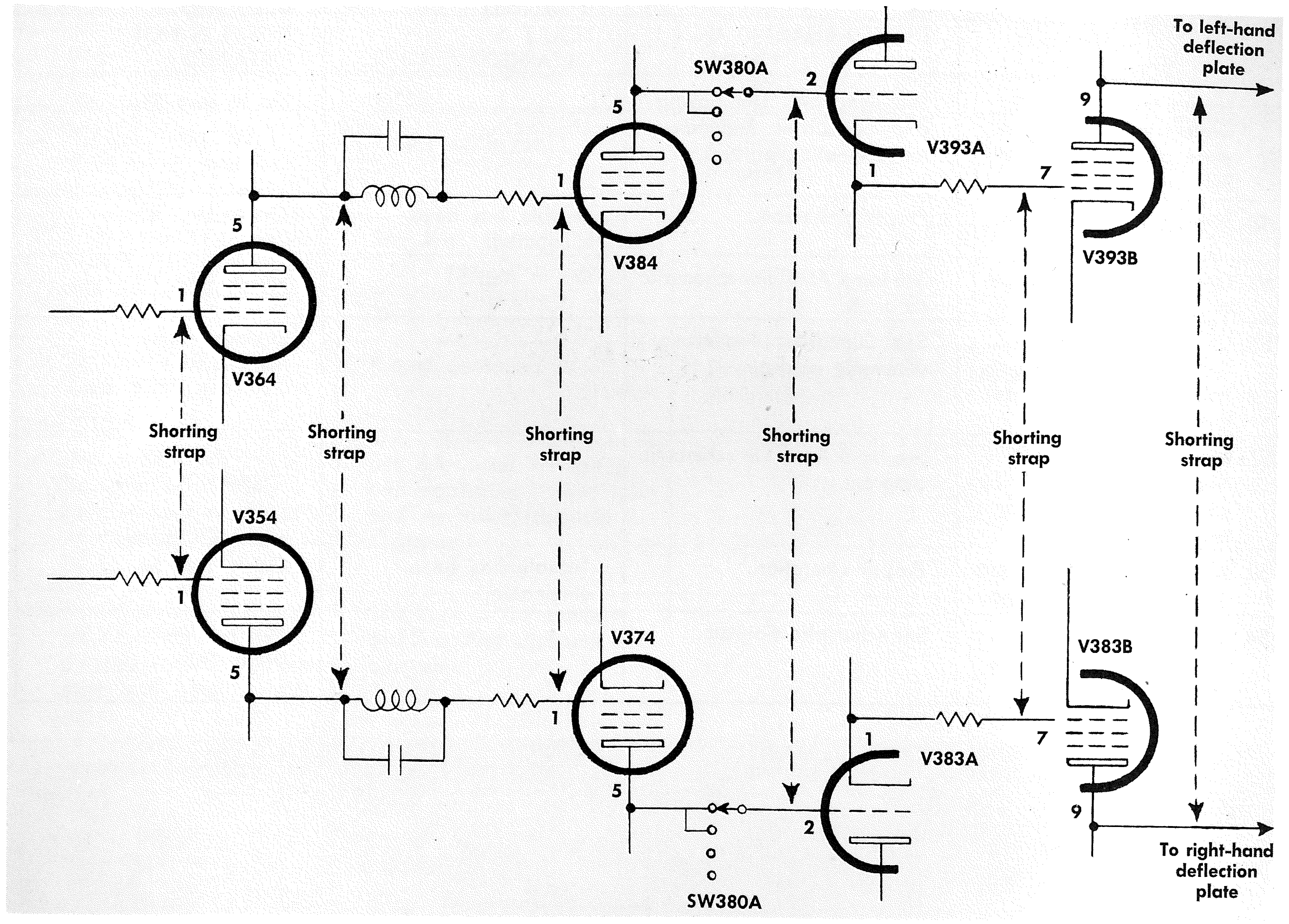
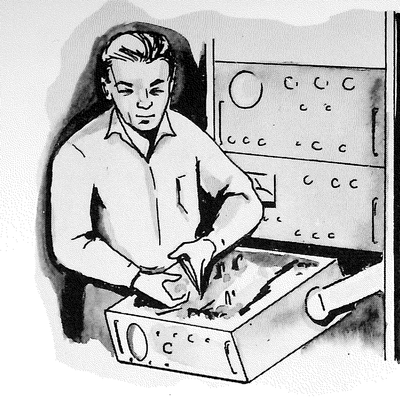


Fig. 5-5. Checkpoints for isolating horizontal deflection system imbalance.



SECTION 6

CALIBRATION

Introduction

This section of the manual contains complete calibration instructions for all circuits in the Vectorscope. If a recalibration of the entire instrument is desired, the steps of the procedure should be performed in the order presented. However, it is permissible to perform any part of the calibration separately as long as you perform all of the steps given under a particular subheading. If the instrument fails to calibrate in any of the steps, refer to the maintenance instructions in Section 5.

Before performing any part of the calibration procedure, you should read the Operating Instructions section so that you will have the proper connections to the instrument and the proper initial control settings. Other control settings will be called out in the steps of the procedure. Any control not mentioned in a given step is assumed to be in the position it was in at the end of the previous step. The settings of those controls not mentioned at all are not critical.

Note that the Crt Alignment, Burst Gate Delay Adjustment, Geometry Adjustment, Sweep Adjustment, and Interfield Signal Key Delay Adjustment (first method) portions of the procedure require no special equipment and can be performed by the operator while the Vectorscope is in operation.

During calibration, check carefully for physical damage such as loose connections, broken terminal strips or switch wafers, improperly seated tubes, worn or broken insulation, heat-damaged components, etc., which could lead to circuit troubles later.

Figs. 6-1 and 6-2 show the location of internal adjustments and checkpoints referred to in the calibration procedures.

Equipment Required

The following equipment is required for a complete calibration of the Type 526 Vectorscope.

1. Dc Voltmeter, 0 to 350 volts, accuracy within 1%; 20,000 ohms per volt or better.

2. Test oscilloscope, with 10X and 1X attenuator probes, sensitivity of at least 0.05 volt per centimeter at the oscilloscope input. Must have dual-trace capability for ISK Delay adjustment. (Tektronix Type 530-, 540-, or 550-Series with Type CA plug-in module recommended.)

3. Signal generator capable of supplying sine waves continuously variable from 3 mc to 4 mc in frequency and approximately 5 volts peak-to-peak in amplitude. (Tektronix Type 190 Constant-Amplitude Signal Generator recommended.)

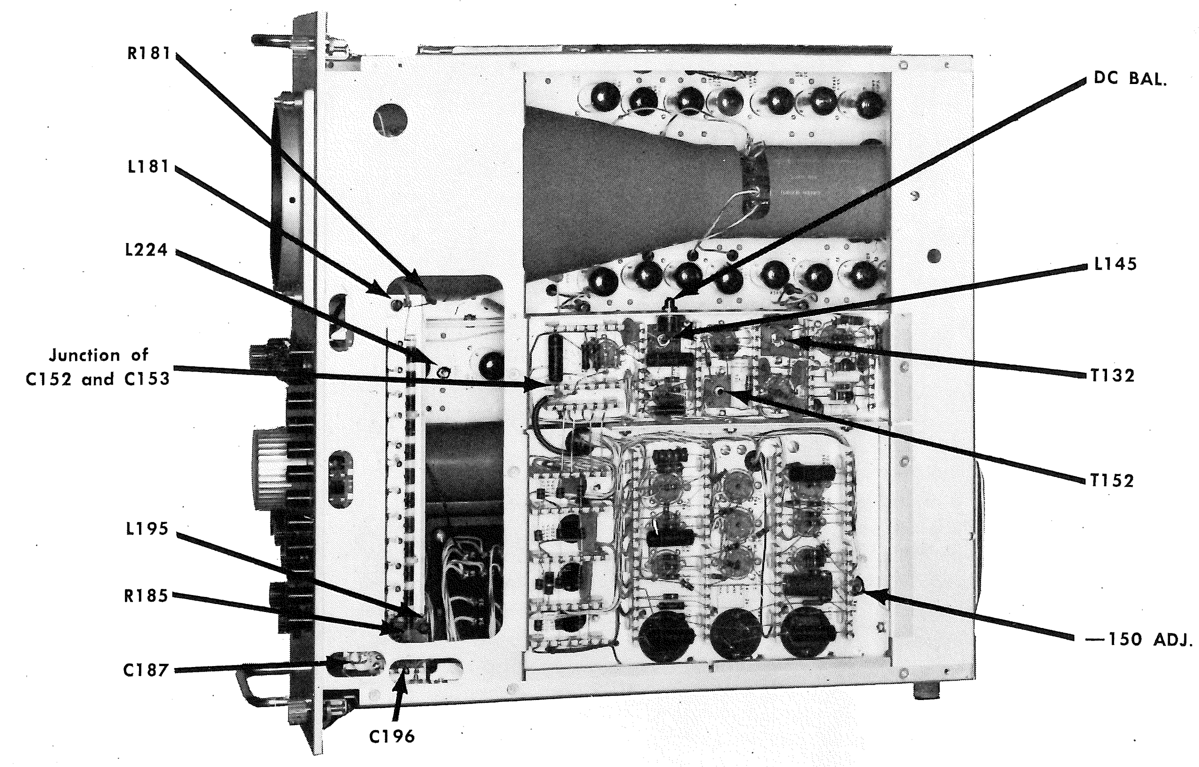
4. Non-metallic tuning tools.

Preliminary Instructions

Throughout the following procedures you must have either a composite color signal applied to the CHANNEL A INPUT connector of the Vectorscope, or a chrominance subcarrier (3.579545 mc) connected to the CHANNEL A INPUT connector and a horizontal synchronizing signal applied to the SYNC INPUT connector.

If there is no composite color signal or external chrominance subcarrier available, it is possible to perform the entire calibration, with the exception of the alignment of the Subcarrier Regenerator, by using the output of the Subcarrier Regenerator in the Vectorscope as the chrominance subcarrier. To do this, connect a jumper wire from the junction of C152 and C153 to the CHANNEL A INPUT connector. This, of course, should not be attempted if there is any reason to suspect that the Subcarrier Regenerator is not working properly.

If you are using a Tektronix Type 530-, 540-, or 550-Series Oscilloscope as a test oscilloscope, you can use its sweep-gating waveform as the horizontal synchronizing signal for the Vectorscope. To do this, set the oscilloscope controls for a 5-microsecond-per-centimeter free-running sweep, and apply the output of the +GATE connector through a 10:1 divider to the SYNC INPUT connector of the Vectorscope. Be sure that you have at least 10k of resistance between the +GATE connector of the test oscilloscope and ground.



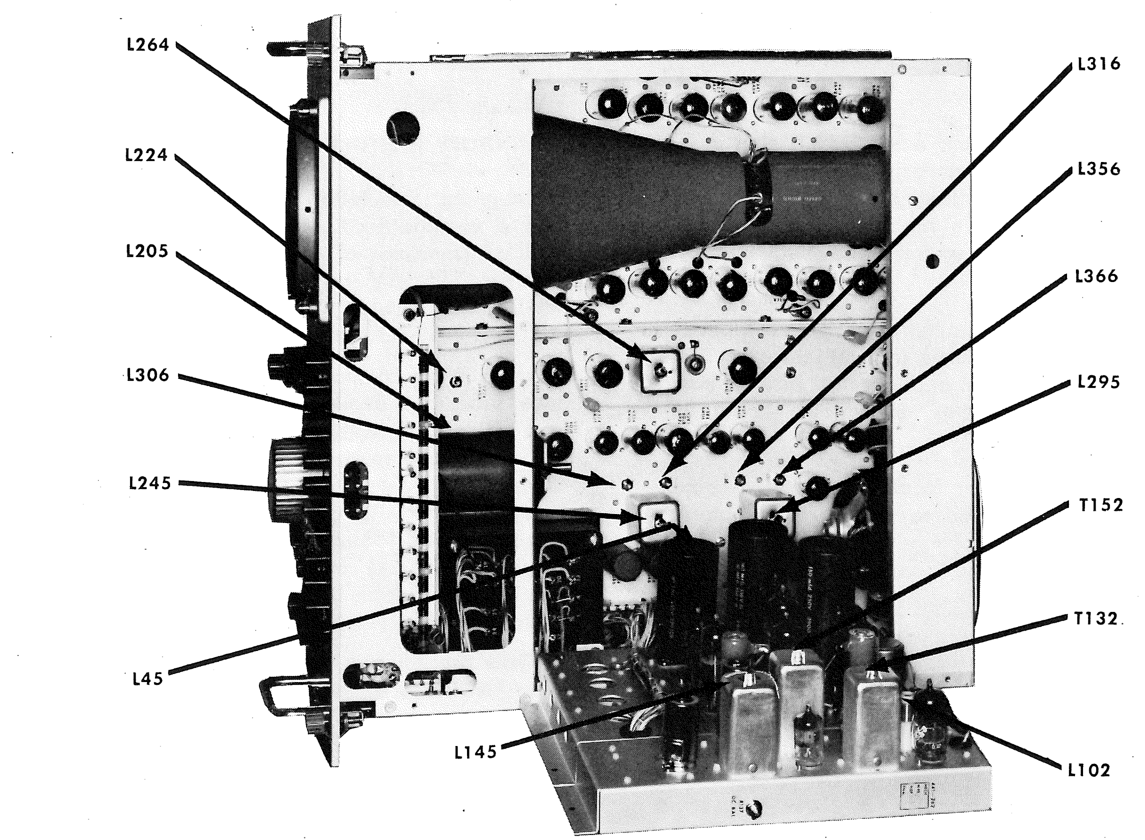


Fig. 6-1. Top of Vectorscope, showing location of internal adjustments. (Upper photo shows swing-out chassis closed; lower photo shows swing-out chassis open.)

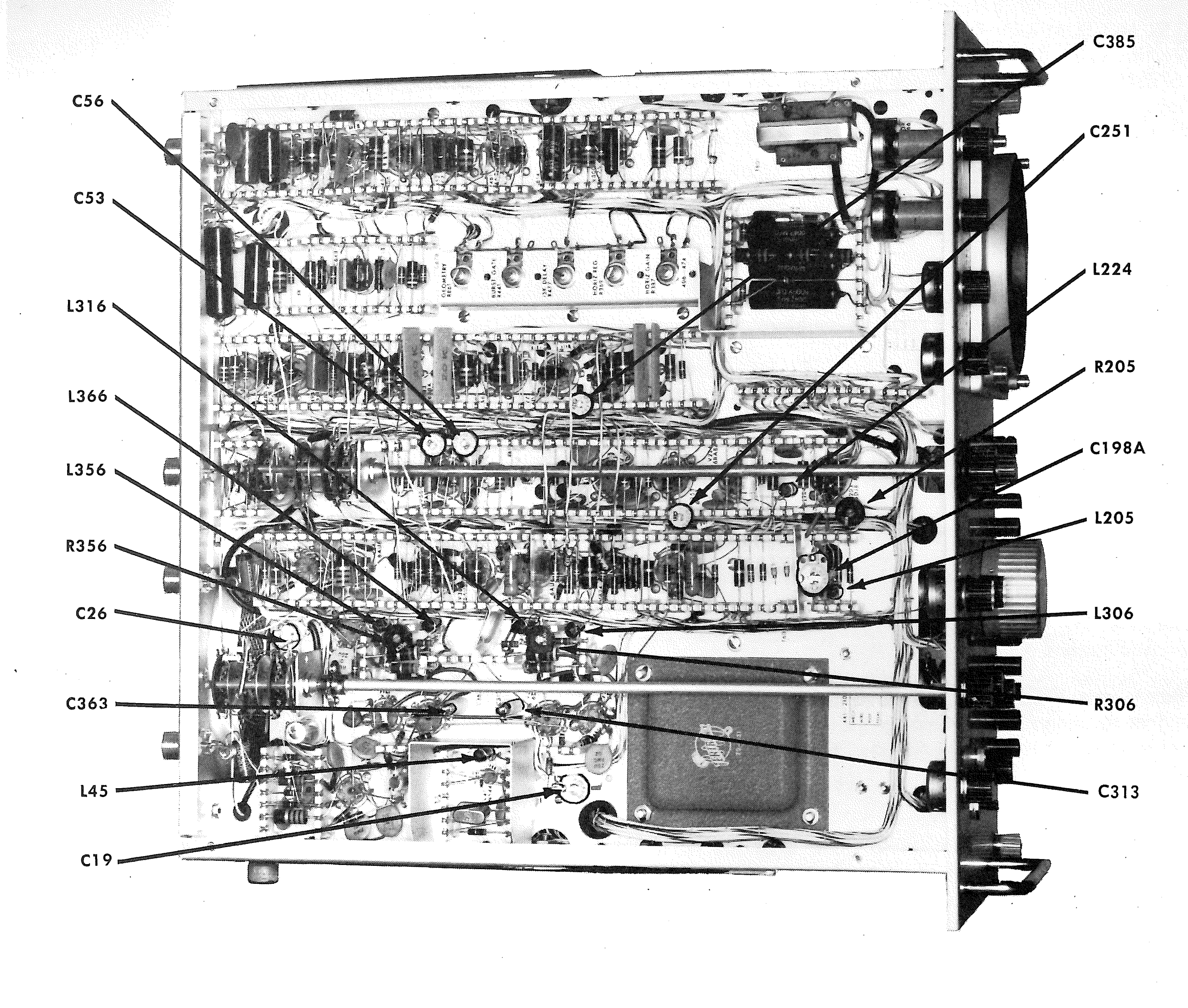


Fig. 6-2. Bottom of Vectorscope, showing location of internal adjustments.

Properly terminate all connectors (except SYNC INPUT if using +GATE output of test oscilloscope as horizontal synchronizing signal).

Turn the Vectorscope on and allow it to warm up for about 30 minutes before making any adjustments. Set the INPUT SELECTOR switch to A and the INTERFIELD SIGNAL KEY to OFF. If you are using a composite color signal, set the SYNC SELECTOR switch on the rear of the instrument to INTERNAL; if you are using a chrominance subcarrier and a separate synchronizing signal, set the SYNC SELECTOR switch to EXTERNAL.

Unless specifically instructed otherwise, always use the 10X attenuator probe (10-megohm input resistance) when displaying a signal on the test oscilloscope.

Power Supply Adjustment

1. Set the DISPLAY SELECTOR switch to LINE SWEEP — SIGNAL MAG. OFF and check the voltages at the three check points shown in Fig. 5-2.

2. Set the —150 ADJ. adjustment so that the output of the —150-volt supply lies between —148 and —152 volts, the output of the +120-volt supply lies between +116.5 and +123.5 volts, and the output of the +350-volt supply lies between +339.5 and +360.5 volts.

Crt Alignment

1. Check to see if the crt fits snugly against the rear surface of the graticule. If it does not, loosen the crt clamp (see Fig. 5-1), and move the crt forward by pushing on the tube socket. Then retighten the crt clamp.

2. Obtain a line-sweep display. Adjust the crt alignment shaft to align the horizontal trace with the horizontal centerline of the graticule.

Subcarrier Processing Circuit Alignment

1. Set the SUBCARRIER SELECTOR switch to EXTERNAL CW and apply a 3.579545-mc chrominance subcarrier to

the 3.58 MC SUBCARRIER INPUT connector at the rear of the Vectorscope. (If you do not have an external source of 3.579545 mc available, connect a jumper wire from the junction of C152 and C153 to the 3.58 MC SUBCARRIER INPUT connector.)

2. Set the DISPLAY SELECTOR switch to VECTOR DISPLAY — TEST CIRCLE OSCILLATOR OFF and the CHANNEL A GAIN control to display a burst vector of convenient size.

3. Disengage all of the EXTERNAL SUBCARRIER COARSE PHASE pushbuttons (by depressing one pushbutton slightly).

4. Unsolder one end of R181. Tune L181 for maximum signal at the top of R185 as observed on the test oscilloscope.

5. Tune C187 for maximum signal at pin 5 of V194.

6. Unsolder C196 from ground. Tune L195 for minimum signal at the junction of C196 and L195.

7. Reconnect R181 and C196.

8. Depress one of the EXTERNAL SUBCARRIER COARSE PHASE pushbuttons.

9. Rotate the PRECISION PHASE control past 000.0 to the end of its range. (This removes the PRECISION PHASE coil, L197, from the circuit.) Adjust C198A for maximum signal at pin 3 of V203.

10. Set the FINE PHASE control to midrange and the PRECISION PHASE control to 100.0. Tune L224 for maximum signal at pin 3 of V233. Adjustment of the FINE PHASE control should now cause the burst vector on the Vectorscope screen to swing through at least 30° of phase shift. (If there is more than one maximum point in the adjustment of L224, choose the one which results in the greatest swing of the burst vector as the FINE PHASE control is adjusted.)

11. Touch the insulated portion of the test oscilloscope probe to the wire connected to pin 8 of V233, and tune L245 for a maximum indication on the test oscilloscope. (If you connect the probe directly to the circuit at this point, the capacitance of the probe will detune the circuit, and it will not be possible to obtain an accurate setting of L245.)

CAUTION

The swing out chassis should be grounded to the main chassis of the oscilloscope to prevent a shock hazard.

12. Touch the insulated portion of the test oscilloscope probe to the wire connected to pin 3 of V283, and tune L295 for a maximum indication on the test oscilloscope.

13. Set the DISPLAY SELECTOR switch to VECTOR DISPLAY — TIME SHARED WITH TEST CIRCLE and the QUADRATURE PHASING control to midrange. Trigger the test oscilloscope externally from pin 2 of V264 and set the sweep rate to 100 microseconds per centimeter.

14. Touch the test oscilloscope probe to pin 3 of V283 and position the trace so that a phase transition is centered on the screen.

15. Turn the test oscilloscope sweep magnifier on. Tune L264 for a complete null at the phase transition point.

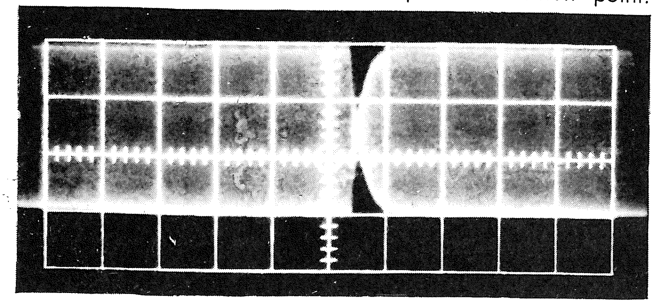


Fig. 6-3. Subcarrier phase-transition point, as seen on test oscilloscope.

Fig. 6-3 shows what the test oscilloscope display should look like at the conclusion of this adjustment.

Burst Gate Delay Adjustment

1. Leave the external subcarrier connected as in the preceding step and the SUBCARRIER SELECTOR switch in EXTERNAL CW.

2. Set the DISPLAY SELECTOR switch to LINE SWEEP — SIGNAL MAG. OFF and adjust the FINE PHASE control so that the burst signal is displayed as a vertical deflection on the trace.

3. Reduce the intensity of the display so that only the small brightened portion at the start of the sweep is visible.

4. Set the BURST GATE (R441) adjustment so that the top of the burst signal is most nearly level.

Subcarrier Regenerator Alignment

Since you will be adjusting the frequency of the Subcarrier Regenerator in this part of the procedure, you may not use its output as a reference signal. Therefore, you must apply an external 3.579545-mc signal as described in the Preliminary Instructions at the beginning of this section. If you have connected jumper wires to apply the output of the Subcarrier Regenerator to the CHANNEL A INPUT connector of the SUBCARRIER INPUT connector, you must disconnect them.

1. Set the SUBCARRIER SELECTOR switch to INTERNAL — BURST CONTROLLED OSCILLATOR.

2. Center the display with the POSITIONING controls and adjust the CHANNEL A GAIN control to display the burst vector. (The vector may or may not be "locked in," depending upon the degree of misadjustment of the Subcarrier Regenerator circuits.)

3. Short the wiper arm of the DC BAL. potentiometer (R137) to ground. Adjust L145 to obtain near lock-in of the burst vector. Remove the short.

4. Short pin 2 of V134 to ground. Tune T152 for maximum negative dc volts at pin 7 of V142. (Use a VTVM or the test oscilloscope on DC to check dc voltages.)

5. Remove the short from pin 2 of V134.

6. Short pin 7 of V150 to ground. Tune T132 and L102 for maximum negative dc volts at pin 7 of V142.

7. Adjust the DC BAL. potentiometer for zero volts at its wiper arm.

8. Remove the short from pin 7 of V150.

9. Short the wiper arm of the DC BAL. potentiometer to ground. Retune L145 to obtain near lock-in of the burst vector. Remove the short; the vector should now lock in.

10. If the vector does not lock in in step 9, adjust the BURST GATE adjustment until it does.

11. Adjust the FINE PHASE control to see if the burst vector will lie along the —X axis. If it will not, set the FINE PHASE control to midrange and adjust T132 until it does. (There will be no deterioration of performance if all other adjustments are properly set.)

Test Circle Adjustment

NOTE

If you are performing this part of the calibration merely to improve the appearance and overlay of the test circles, you may perform only step 1 and steps 3 through 10. If you are performing it as a part of a complete calibration, you should perform all the steps.

1. Set the DISPLAY SELECTOR switch to VECTOR DISPLAY — TIME SHARED WITH TEST CIRCLE and the TEST CIRCLE AMPLITUDE control to midrange.

2. Tune L45 for maximum signal amplitude at the junction of the TEST CIRCLE AMPLITUDE potentiometer (R45) and L45, as observed on the test oscilloscope.

3. Adjust the CHANNEL B GAIN control to display the test circles.

4. Tune L306 and L316 for minimum vertical "hash" on the test circles.

5. Adjust R306 for a null in the hash, and again adjust L306 and L316 for minimum hash. When tuning, keep the two slugs approximately even in the coils.

6. Tune L356 and L366 for minimum horizontal hash on the test circles.

7. Adjust R356 for a null in the hash, and again adjust L356 and L366 for minimum hash. When tuning, keep the two slugs approximately even in the coils.

8. Adjust C251 for best overlay and circularity of the test circles.

9. Turn the TEST CIRCLE AMPLITUDE control and the CHANNEL A GAIN and CHANNEL B GAIN controls fully counterclockwise. The test circles will be observed as two dots.

10. Adjust C313 and C363 to superimpose the two dots. When increased to normal size, the two test circles should overlay with the proper setting of the QUADRATURE PHASING control.

11. Apply a 3.58-mc sine wave from the signal generator to the CHANNEL B INPUT connector.

12. Set the Vectorscope INPUT SELECTOR switch to A AND B. A circle should be present on the screen of the Vectorscope.

13. Adjust C385 for the best circularity as the signal generator frequency is varied back and forth between 3 mc and 4 mc.

14. Remove the output of the signal generator from the CHANNEL B INPUT connector.

Input Amplifier Alignment

1. Connect a jumper wire, terminated into 75 ohms on each end, from the CHANNEL A INPUT connector to the CHANNEL B INPUT connector. (Use as short a jumper wire as possible.) Two burst vectors, slightly displaced in phase, should be present on the Vectorscope screen.

2. Adjust C26 to cause the two burst vectors to overlay.

3. Remove the jumper wire and terminations.

4. Connect the 1X attenuator probe to pin 5 of V14 and V24 and adjust C19 for minimum fourth harmonic of 3.58 mc as displayed on the test oscilloscope.

Geometry Adjustment

1. Set the DISPLAY SELECTOR switch to VECTOR DISPLAY — TIME SHARED WITH TEST CIRCLE and the INPUT SELECTOR to A.

2. Set the QUADRATURE PHASING control so that the two test circles overlay, and adjust the GEOMETRY potentiometer (R861) for best circularity.

It should now be possible, by adjusting the TEST CIRCLE AMPLITUDE, AMPLIFIER GAIN BAL., and CHANNEL B GAIN controls, to make the test circle lie entirely between the two etched circles on the graticule.

Sweep Adjustment

1. Set the DISPLAY SELECTOR switch to LINE SWEEP — SIGNAL MAG. OFF.

2. Adjust the VERTICAL POSITIONING control so that the trace is aligned with the horizontal centerline of the graticule. (If the trace is tipped relative to the horizontal centerline, adjust the crt alignment shaft, Fig. 5-1.)

3. Adjust the HORIZ. GAIN potentiometer (R387) and the HORIZONTAL POSITIONING control so that the sweep starts and ends on the inner circle of the two etched circles on the graticule.

4. Set the DISPLAY SELECTOR to VECTOR DISPLAY — TEST CIRCLE OSCILLATOR OFF and the CHANNEL A GAIN control fully counterclockwise.

5. Adjust the HORIZ. REG. potentiometer (R369) to center the dot.

Precision Phase Tracking Compensation

1. Obtain a vector display on the Vectorscope and set the PRECISION PHASE control to 000.0.

2. Adjust the FINE PHASE control so as to align the burst vector with the —X axis.

3. Set L205 so that rotating R205 back and forth does not cause the burst vector to move.

4. Set the PRECISION PHASE control to 180.00.

5. Set R205 so that the burst vector lies along the +X axis. The reading on the PRECISION PHASE dial should now correspond exactly to 180° minus the angle of the burst vector as the PRECISION PHASE control is rotated.

Interfield Signal Key Delay Adjustment

Either of two methods may be used for correctly setting the ISK DELAY adjustment. The first method is the simpler of the two. However, it is slightly less accurate than the second and can be performed only when an interfield test signal is present. The second method requires the use of a dual-trace test oscilloscope and can be performed without an interfield test signal being present.

The first method for setting the ISK DELAY adjustment is as follows:

1. Obtain a line-sweep display of a composite color signal containing a vertical interfield test signal.

2. Reduce the intensity until only the burst packet is visible.

3. Set the INTERFIELD SIGNAL KEY switch to ON, and adjust C53 and C56 for maximum flicker rate (minimum flicker) in the display.

4. Adjust the ISK DELAY potentiometer (R477) for brightest display of the test signal.

The second method for setting the ISK DELAY adjustment is as follows:

1. Obtain a line-sweep presentation of any television program signal (black-and-white or color).

2. Reduce the intensity until only the burst packet is visible.

3. Set the INTERFIELD SIGNAL KEY switch on ON.

4. Externally trigger the dual-trace test oscilloscope from pin 2 of V475.

5. Connect one probe from the test oscilloscope to pin 8 of V483 and observe the ISK unblanking waveform.

6. Connect the other probe from the test oscilloscope to pin 7 of V414 and observe the composite sync.

7. Set the vertical blanking group to the center of the test oscilloscope screen and turn the test oscilloscope sweep magnifier on.

8. Set the ISK DELAY potentiometer (R477) so that the unblanking waveform observed in step 5 coincides with lines 16 through 21 of the vertical group in the composite sync observed in step 6.

9. Adjust C53 and C56 for maximum flicker rate (minimum flicker) in the Vectorscope display.

SECTION 7

PARTS LIST AND DIAGRAMS

PARTS ORDERING INFORMATION

Replacement parts are available from or through your local Tektronix Field Office.

Changes to Tektronix instruments are sometimes made to accommodate improved components as they become available, and to give you the benefit of the latest circuit improvements developed in our engineering department. It is therefore important, when ordering parts, to include the following information in your order: Part number including any suffix, instrument type, serial number, and modification number if applicable.

If a part you have ordered has been replaced with a new or improved part, your local Tektronix Field Office will contact you concerning any change in part number.

ABBREVIATIONS AND SYMBOLS

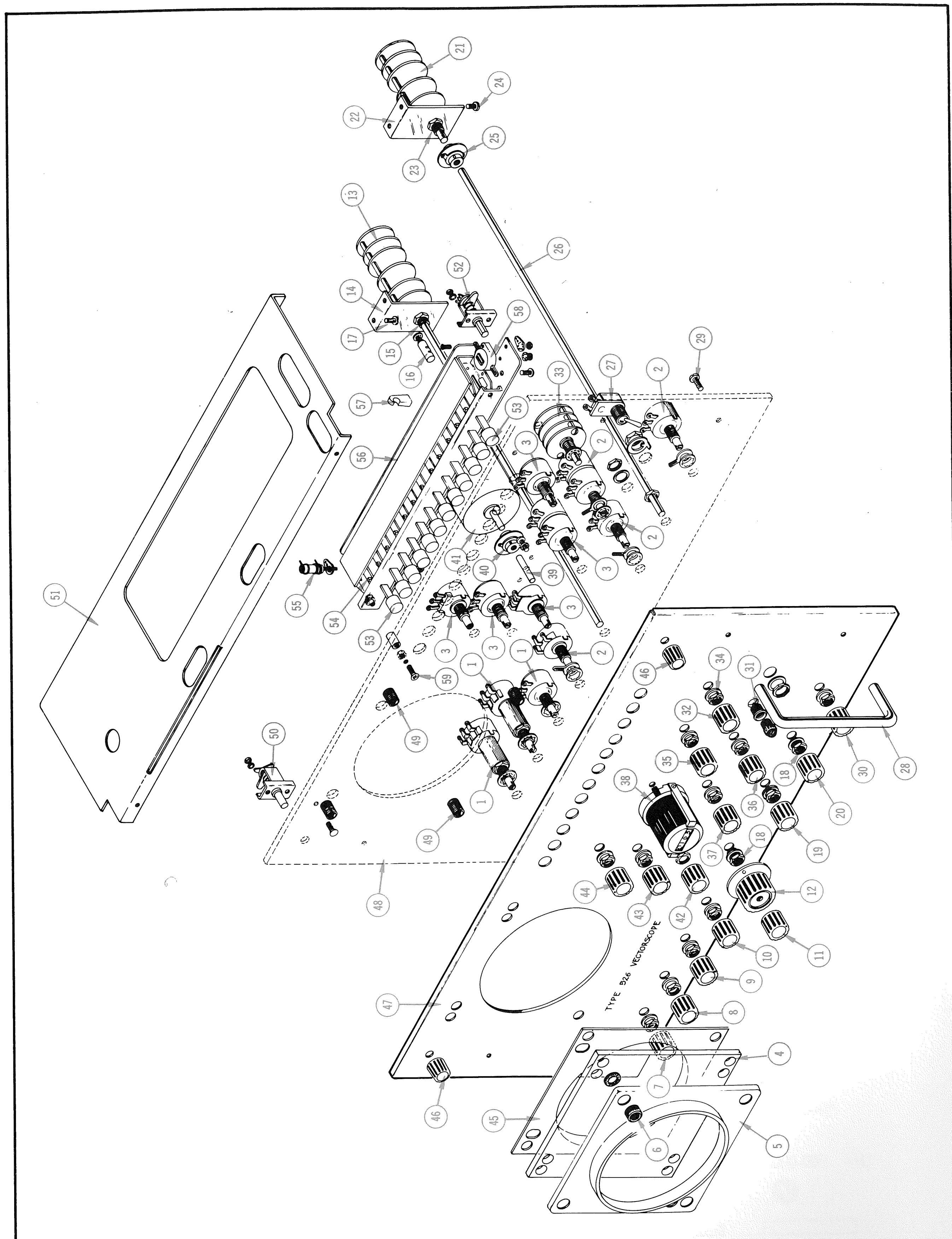
a or amp	amperes
BHS	binding head steel
C	carbon
cer	ceramic
cm	centimeter
comp	composition
cps	cycles per second
crt	cathode-ray tube
CSK	counter sunk
dia	diameter
div	division
EMC	electrolytic, metal cased
EMT	electroyltic, metal tubular
ext	external
f	farad
F & I	focus and intensity
FHS	flat head steel
Fil HS	fillister head steel
g or G	giga, or 10^9
Ge	germanium
GMV	guaranteed minimum value
h	henry
hex	hexagonal
HHS	hex head steel
HSS	hex socket steel
HV	high voltage
ID	inside diameter
incd	incandescent
int	internal
k or K	kilohms or kilo (10^3)
kc	kilocycle
m	milli, or 10^{-3}
mc	megacycle

mm	millimeter
meg or M	megohms or mega (10^6)
met.	metal
μ	micro, or 10^{-6}
n	nano, or 10^{-9}
Ω	ohm
OD	outside diameter
OHS	oval head steel
p	pico, or 10^{-12}
PHS	pan head steel
piv	peak inverse voltage
plstc	plastic
PMC	paper, metal cased
poly	polystyrene
Prec	precision
PT	paper tubular
PTM	paper or plastic, tubular, molded
RHS	round head steel
rms	root mean square
sec	second
Si	silicon
S/N	serial number
t or T	tera, or 10^{12}
TD	toroid
THS	truss head steel
tub.	tubular
v or V	volt
Var	variable
w	watt
w/	with
w/o	without
WW	wire-wound

SPECIAL NOTES AND SYMBOLS

X000	Part first added at this serial number.
000X	Part removed after this serial number.
*000-000	Asterisk preceding Tektronix Part Number indicates manufactured by or for Tektronix, or reworked or checked components.
Use 000-000	Part number indicated is direct replacement.
	Internal screwdriver adjustment.
	Front-panel adjustment or connector.

FRONT



FRONT

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	- - - -			3	POT
	- - - -			-	mounting hardware for each: (not included w/pot)
	210-013			1	LOCKWASHER, internal, 3/8 x 11/16 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
2	- - - -			4	POT
	- - - -			-	mounting hardware for each: (not included w/pot)
	210-207			1	LUG, solder, 3/8 inch
	210-012			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
3	- - - -			5	POT
	- - - -			-	mounting hardware for each: (not included w/pot)
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
4	331-048	101	379	1	GRATICULE
	331-104	380		1	GRATICULE
5	200-025	101	379	1	COVER, graticule (see ref #6)
	200-382	380		1	COVER, graticule (see ref #6)
	- - - -			-	cover includes:
	354-116			1	RING, ornamental
6	- - -			-	mounting hardware: (not included w/cover)
	210-816			4	WASHER, rubber
	210-424			4	NUT, knurled, graticule
7	366-033			1	KNOB, small black — FOCUS
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
8	366-033			1	KNOB, small black — INTENSITY
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
9	366-033			1	KNOB, small black — ASTIGMATISM
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
10	366-033			1	KNOB, small black — SCALE ILLUM.
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
11	366-031			1	KNOB, small red — INTERFIELD SIGNAL KEY
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
12	366-040			1	KNOB, large black — DISPLAY SELECTOR
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS

FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
13	262-0229-00	101	1579	1	SWITCH, wired—DISPLAY SELECTOR (see ref #17)
	262-0229-01	1580		1	SWITCH, wired—DISPLAY SELECTOR (see ref #17)
	- - - - - - -			-	switch includes
	260-0279-00			1	SWITCH, unwired—DISPLAY SELECTOR
14	406-0495-00			1	BRACKET, display switch
15	- - - - - - -			-	mounting hardware: (not included w/bracket)
	210-0012-00			1	LOCKWASHER, internal, $\frac{3}{8}$ x $\frac{1}{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $\frac{9}{16}$ inch OD
	210-0413-00			1	NUT, hex., $\frac{3}{8}$-32 x $\frac{1}{2}$ inch
16	129-0029-00			1	POST, connecting, ceramic
	- - - - - - -			-	mounting hardware: (not included w/post)
	210-0850-00			1	WASHER, #2
	210-0002-00			1	LOCKWASHER, external, #2
	210-0405-00			1	NUT, hex., 2-56 x $\frac{3}{16}$ inch
17	- - - - - - -			-	mounting hardware: (not included w/switch)
	211-0507-00			2	SCREW, 6-32 x $\frac{5}{16}$ inch BHS
	210-0457-00			2	NUT, keps, 6-32 x $\frac{5}{16}$ inch
18	358-0029-00			2	BUSHING, hex., $\frac{3}{8}$-32 x $\frac{13}{32}$ inch
	- - - - - - -			-	mounting hardware for each: (not included w/bushing)
	210-0840-00			1	WASHER, .390 ID x $\frac{9}{16}$ inch OD
	210-0413-00			1	NUT, hex., $\frac{3}{8}$-32 x $\frac{1}{2}$ inch
19	366-0033-00			1	KNOB, small black—CHANNEL A GAIN
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $\frac{3}{16}$ inch HSS
20	366-0033-00			1	KNOB, small black—INPUT SELECTOR
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, 6-32 x $\frac{3}{16}$ inch HSS
21	262-0230-00			1	SWITCH, wired—INPUT SELECTOR (see ref #24)
	- - - - - - -			-	switch includes:
	260-0280-00			1	SWITCH, unwired—INPUT SELECTOR
22	406-0384-00			1	BRACKET, input switch
23	- - - - - - -			-	mounting hardware: (not included w/bracket)
	210-0207-00			1	LUG, solder, $\frac{3}{8}$ inch
	210-0012-00			1	LOCKWASHER, internal, $\frac{3}{8}$ x $\frac{1}{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $\frac{9}{16}$ inch OD
	210-0413-00			1	NUT, hex., $\frac{3}{8}$-32 x $\frac{1}{2}$ inch
24	- - - - - - -			-	mounting hardware: (not included w/switch)
	211-0507-00			2	SCREW, 6-32 x $\frac{5}{16}$ inch BHS
	210-0457-00			2	NUT, keps, 6-32 x $\frac{5}{16}$ inch
25	376-0003-00			1	COUPLING, fiber
	- - - - - - -			-	mounting hardware: (not included w/coupling)
	213-0020-00			4	SCREW, set, 6-32 x $\frac{1}{8}$ inch HSS
26	384-0188-00			1	ROD, extension

FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
27	260-0134-00			1	SWITCH, toggle—POWER ON
				-	switch includes:
	210-0414-00			1	NUT, hex, $\frac{15}{32}$-32 x $\frac{9}{16}$ inch
	- - - - - - -			-	mounting hardware: (not included w/switch)
	354-0055-00			1	RING, locking, switch
	210-0902-00			1	WASHER, .470 ID x $\frac{21}{32}$ inch OD
	210-0473-00			1	NUT, switch $\frac{15}{32}$-32 x $\frac{5}{64}$ inch, 12 sided
28	367-0008-00			2	HANDLE, drawer
	- - - - - - -			-	mounting hardware for each: (not included w/handle
29	212-0507-00			2	SCREW, 10-32 x $\frac{3}{8}$ inch BHS
30	366-0033-00			1	KNOB, small black—CHANNEL B GAIN
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $\frac{3}{16}$ inch HSS
31	136-0031-00			1	SOCKET, light, red, assembly
32	366-0033-00			1	KNOB, small black—SUBCARRIER SELECTOR
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $\frac{3}{16}$ inch HSS
33	262-0231-00			1	SWITCH, wired—SUBCARRIER SELECTOR (see ref #34)
	- - - - - - -			-	switch includes:
	260-0281-00			1	SWITCH, unwired—SUBCARRIER SELECTOR
34	- - - - - - -			-	mounting hardware: (not included w/switch)
	210-0012-00			1	LOCKWASHER, internal, $\frac{3}{8}$ x $\frac{1}{2}$ inch
	210-0840-00			1	WASHER, .390 ID x $\frac{9}{16}$ inch OD
	210-0413-00			1	NUT, hex, $\frac{3}{8}$-32 x $\frac{1}{2}$ inch
35	366-0033-00			1	KNOB, small black—FINE PHASE
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $\frac{3}{16}$ inch HSS
36	366-0033-00			1	KNOB, small black—HORIZONTAL POSITIONING
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $\frac{3}{16}$ inch HSS
37	366-0033-00			1	KNOB, small black—VERTICAL POSITIONING
	- - - - - - -			-	knob includes:
	213-0004-00			1	SCREW, set, 6-32 x $\frac{3}{16}$ inch HSS
38	331-0050-00	101	299	1	DIAL, counter, assembly
	- - - - - - -			-	mounting hardware: (not included w/dial)
	211-0011-00			3	SCREW, 4-40 x $\frac{5}{16}$ inch BHS
	210-0003-00			3	LOCKWASHER, external, #4
	331-0098-00	300		1	DIAL, counter, assembly
	- - - - - - -			-	mounting hardware: (not included w/dial)
	211-0011-00			2	SCREW, 4-40 x $\frac{5}{16}$ inch BHS
	210-0003-00			2	LOCKWASHER, external, #4
39	384-0224-00	X155	299	1	ROD, extension
	384-0267-00	300		1	ROD, extension
40	376-0003-00	X155		1	COUPLING, fiber
	- - - - - - -			-	mounting hardware: (not included w/coupling)
	213-0020-00			4	SCREW, set, 6-32 x $\frac{1}{8}$ inch HSS

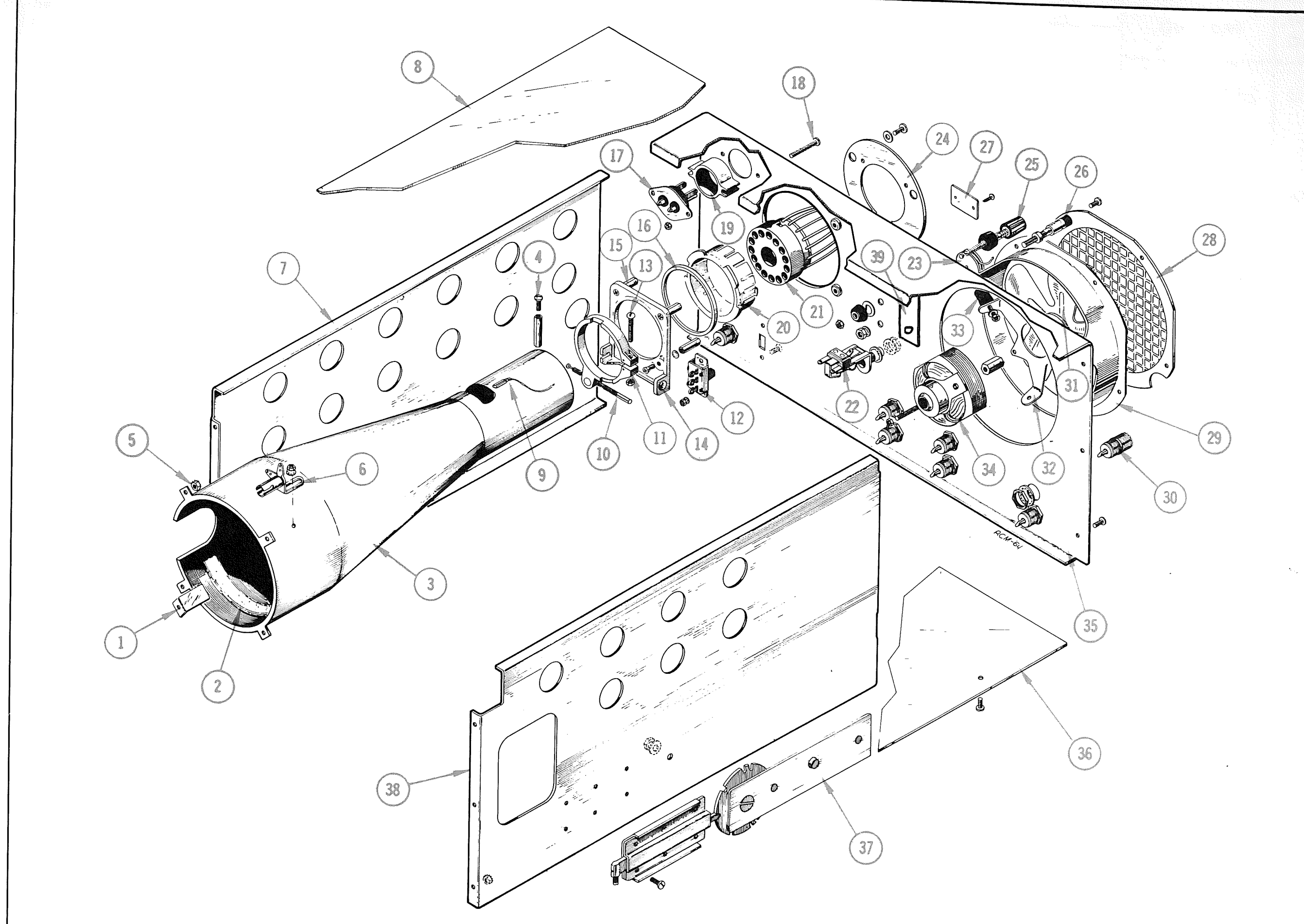
FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
41	- - - -			1	DELAY LINE, variable (shown for orientation purposes)
42	366-033			1	KNOB, small black — TEST CIRCLE AMPLITUDE
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
43	366-033			1	KNOB, small black — AMPLIFIER GAIN BAL.
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
44	366-033			1	KNOB, small black — QUADRATURE PHASING
	- - - -			-	knob includes:
	213-004			1	SCREW, set, 6-32 x 3/16 inch HSS
45	337-187			1	SHIELD, graticule light
46	366-061			2	KNOB, small gray
	- - - -			-	each knob includes:
	213-020			1	SCREW, set, 6-32 x 1/8 inch HSS
47	333-461	101	299	1	PANEL, front
	333-738	300		1	PANEL, front
48	386-826	101	299	1	PLATE, sub-panel
	387-736	300		1	PLATE, sub-panel
49	355-043			4	STUD, graticule, replacement
	- - - -			-	each stud includes:
	212-507			1	SCREW, 10-32 x 3/8 inch BHS
	210-010			1	LOCKWASHER, internal, #10
50	214-053	101	513	1	FASTENER, pawl left, w/stop
	214-425	514		1	FASTENER, pawl left, w/stop
	- - - -			-	mounting hardware: (not included w/fastener)
	211-038			2	SCREW, 4-40 x 5/16 inch FHS phillips
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
51	406-501			1	BRACKET, reinforcing
	- - - -			-	mounting hardware: (not included w/bracket)
	211-538			4	SCREW, 6-32 x 5/16 inch FHS phillips
52	214-052	101	513	1	FASTENER, pawl right, w/stop
	214-424	514		1	FASTENER, pawl right, w/stop
	- - - -			-	mounting hardware: (not included w/fastener)
	211-038			2	SCREW, 4-40 x 5/16 inch FHS phillips
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
53	200-114			12	CAP, pushbutton

FRONT *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
54	262-0228-00			1	SWITCH, wired, EXTERNAL SUBCARRIER COARSE PHASE (see ref #59)
	- - - - - -			-	switch includes:
	260-0278-00			1	SWITCH, unwired, pushbutton
55	- - - - - -			1	COIL
	- - - - - -			-	mounting hardware: (not included w/coil alone)
	210-0205-00			2	LUG, solder, SE #8
	210-0409-00			1	NUT, hex, 8-32 x 5/16 inch
56	337-0294-00			1	SHIELD, switch
	- - - - - -			-	mounting hardware: (not included w/shield alone)
	213-0044-00			2	SCREW, thread forming 5-32 x 3/16 inch PHS phillips
57	352-0019-00			2	HOLDER, nylon
	- - - - - -			-	mounting hardware for each: (not included w/holder alone)
	213-0088-00			1	SCREW, thread forming, 4-40 x 1/4 inch PHS phillips
58	- - - - - -			1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor alone)
	211-0013-00			2	SCREW, 4-40 x 3/8 inch RHS
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0201-00			1	LUG, solder, SE #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
59	- - - - - -			-	mounting hardware: (not included w/switch)
	211-0522-00			2	SCREW, 6-32 x 5/8 inch FHS phillips
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
	166-0029-00			2	TUBE, spacer
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch

REAR



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
1	406-0239-00			1	BRACKET, crt spring
2	124-0068-00			1	STRIP, felt
3	337-0367-00			1	SHIELD, crt
	- - - - - -			-	mounting hardware: (not included w/shield)
4	211-0507-00			2	SCREW, 6-32 x 5/16 inch BHS
	385-0006-00			1	ROD, hex
5	211-0538-00			4	SCREW, 6-32 x 5/16 inch FHS phillips
	210-0457-00			4	NUT, keps, 6-32 x 5/16 inch
6	136-0001-00			2	SOCKET, graticule lamp
	- - - - - -			-	mounting hardware for each: (not included w/socket)
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
	210-0803-00			1	WASHER, 6L x 3/8 inch
	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
7	386-0832-00			1	PLATE, left side
	- - - - - -			-	mounting hardware: (not included w/plate)
	212-0040-00			3	SCREW, 8-32 x 3/8 inch FHS phillips
	210-0458-00			3	NUT, keps, 8-32 x 11/32 inch
	211-0538-00			3	SCREW, 6-32 x 5/16 inch FHS phillips
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
	210-0457-00			3	NUT, keps, 6-32 x 5/16 inch

REAR *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
8	386-0918-00	101	339	1	PLATE, dust cover, top
	387-0073-00	340		1	PLATE, dust cover, top
	- - - - - -			-	mounting hardware: (not included w/plate)
	211-0542-00			4	SCREW, 6-32 x 5/16 inch THS phillips
9	175-0586-00			1	WIRE, crt lead, .960 foot, striped brown, w/connector
	175-0588-00			1	WIRE, crt lead, .833 foot, striped orange, w/connector
	175-0592-00			1	WIRE, crt lead, .960 foot, striped green, w/connector
	175-0594-00			1	WIRE, crt lead, 1 foot, striped blue, w/connector
	175-0595-00			1	WIRE, crt lead, .960 foot, striped red, w/connector
10	355-0058-00			1	STUD, crt rotator
11	354-0103-00			1	RING, crt rotator
	- - - - - -			-	ring includes:
	210-0502-00			1	NUT, crt rotator
12	260-0212-00			1	SWITCH, slide—INTERNAL/EXTERNAL
	- - - - - -			-	mounting hardware: (not included w/switch)
	211-0101-00			2	SCREW, 4-40 x 1/4 inch, 100° CSK, FHS
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
13	211-0560-00			1	SCREW, 6-32 x 1 inch RHS
	210-0407-00			1	NUT, hex, 6-32 x 5/16 inch
14	432-0022-00			1	BASE, crt rotator
	- - - - - -			-	mounting hardware: (not included w/base)
	211-0559-00			3	SCREW, 6-32 x 3/8 inch FHS phillips
	210-0005-00	101	889	3	LOCKWASHER, external, #6
	210-0006-00	890		3	LOCKWASHER, external, #6
15	385-0146-00			3	ROD, hex
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
16	354-0100-00	101	909X	1	RING, spacer, crt rotator
17	131-0102-00	101	1889	1	CONNECTOR, motor base (see ref #18)
	131-0102-01	1890		1	CONNECTOR, motor base (see ref #18)
	- - - - - -			-	connector includes:
	129-0041-00	101	1889	1	POST, ground
	129-0041-01	1890		1	POST, ground
	200-0185-00	101	1889	1	COVER, motor base
	200-0185-01	1890		1	COVER, motor base
	210-0003-00	101	1889X	2	LOCKWASHER, external, #4
	210-0551-00	101	1889X	2	NUT, hex, 4-40 x 1/4 inch
	211-0132-00	X1890		1	SCREW, sems, 4-40 x 1/2 inch, PHS
	211-0015-00	101	1889	1	SCREW, 4-40 x 1/2 inch RHS
	213-0088-00	1890		1	SCREW, thread forming, 4-40 x 1/4 inch, PHS
	214-0078-00			2	PIN, connecting
	377-0041-00	101	1889	1	INSERT, black plastic
	377-0051-00	1890		1	INSERT, black plastic
	386-0933-00			1	PLATE, motor base
18	- - - - - -			-	mounting hardware: (not included w/connector)
	211-0545-00			2	SCREW, 6-32 x 1 1/4 inches THS phillips
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
19	361-0012-00			1	SPACER, motor base

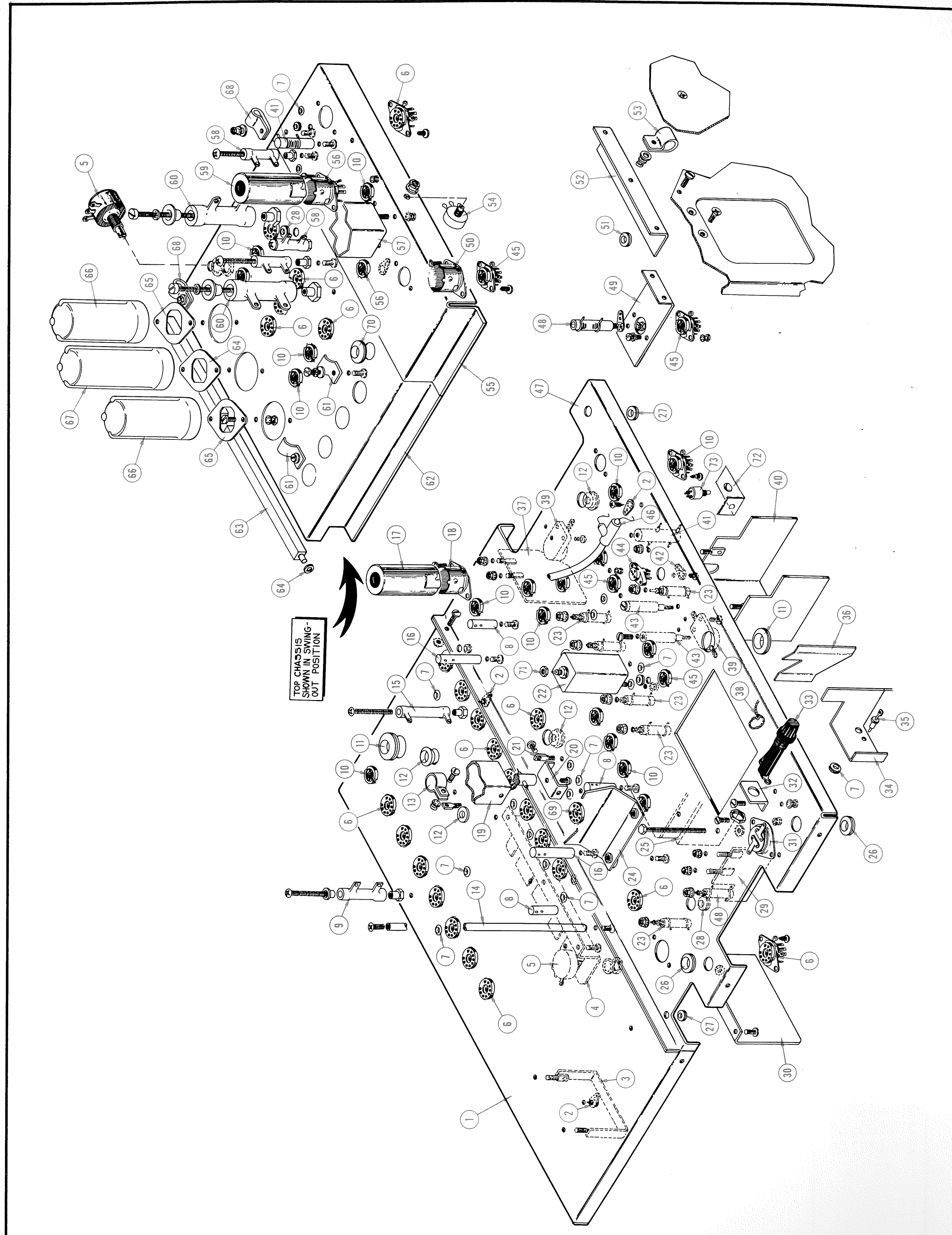
REAR *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
20	354-0078-00	101	279	1	RING, crt rotator
	354-0178-00	280		1	RING, crt rotator
21	136-0043-00	101	259	1	SOCKET, CRT
	131-0059-00	101	259	7	CONNECTOR, CRT pin
	354-0049-00	101	259	1	RING, fiber, securing
	213-0035-00	101	259	2	SCREW, thread cutting, 4-40 x 1/4 inch, PHS
	136-0116-00	260		1	ASSEMBLY, CRT socket
	- - - - - -			-	assembly includes:
	131-0178-00			7	CONNECTOR, cable end, crt socket
	136-0117-00			1	SOCKET, crt
	387-0393-00			1	PLATE, back, crt socket
	213-0086-00			2	SCREW, thread cutting, 2-32 x 7/16 inch PHS
22	131-0024-00			1	CONNECTOR, jack, phone meter
	- - - - - -			-	mounting hardware: (not included w/connector)
	210-0012-00			1	LOCKWASHER, internal, 3/8 x 1/2 inch
	210-0840-00			1	WASHER, .390 ID x 9/16 inch OD
	210-0413-00			1	NUT, hex, 3/8-32 x 1/2 inch
23	214-0210-00			1	SPOOL, solder, assembly
	- - - - - -			-	spool assembly includes:
	214-0209-00			1	SPOOL, solder
	- - - - - -			-	mounting hardware: (not included w/spool)
	361-0007-00			1	SPACER, nylon, .063 inch
24	337-0366-00			1	SHIELD, crt rear plate
	- - - - - -			-	mounting hardware: (not included w/shield)
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
	210-0949-00	X240		3	WASHER, 9/64 ID x 1/2 inch OD
25	129-0036-00			1	POST, binding
	- - - - - -			-	mounting hardware: (not included w/post)
	358-0036-00			1	BUSHING, binding post
	210-0445-00	101	438	2	NUT, hex, 10-32 x 3/8 inch
	220-0410-00	439		1	NUT, keps, 10-32 x 3/8 inch
	210-0010-00	101	438X	1	LOCKWASHER, internal, #10
	210-0206-00	101	438X	1	LUG, solder, SE #10
26	129-0051-00			1	POST, binding, assembly
	- - - - - -			-	post includes:
	355-0507-00			1	STEM, adapter
	200-0182-00			1	CAP
	- - - - - -			-	mounting hardware: (not included w/post)
	210-0011-00			1	LOCKWASHER, internal, 1/4 inch
	210-0455-00			1	NUT, hex, 1/4-28 x 3/8 inch
27	334-0649-00			1	TAG, voltage rating
	- - - - - -			-	mounting hardware: (not included w/tag)
	213-0088-00			2	SCREW, thread forming, 4-40 x 1/4 inch PHS phillips

REAR *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
28	378-0758-00	101	239X	1	SCREEN, ventilating
	354-0083-00	101	239	1	RING, fan
	354-0084-00	240	909	1	ASSEMBLY, fan ring cover
	354-0084-01	910		1	ASSEMBLY, fan ring cover
	- - - - - -			-	mounting hardware: (not included w/assembly)
	211-0542-00			5	SCREW, 6-32 x 5/16 inch THS phillips
29	354-0059-00			1	RING, fan
30	131-0081-00			8	CONNECTOR, coaxial, 1 contact, UHF
31	369-0001-00	101	909	1	FAN, 5 1/2 inch blade
	369-0015-00	910		1	FAN, 5 1/2 inch blade
32	426-0075-00			1	MOUNT, fan motor
33	348-0008-00			3	SHOCKMOUNT
	- - - - - -			-	mounting hardware for each: (not included w/shockmount)
	210-0008-00			2	LOCKWASHER, internal, #8
	210-0409-00			2	NUT, hex, 8-32 x 5/16 inch
34	147-0021-00	101	909	1	MOTOR, AC, 110 V, 2770 RPM, 35 watt
	147-0022-00	910		1	MOTOR, AC
	- - - - - -			-	mounting hardware: (not included w/motor)
	212-0004-00			2	SCREW, 8-32 x 5/16 inch BHS
	166-0098-00			2	TUBE, spacing
	212-0020-00			2	SCREW, 8-32 x 1 inch BHS
35	386-0830-00			1	PLATE, rear frame
36	387-0123-00	101	339	1	PLATE, dust cover, bottom
	387-0136-00	340		1	PLATE, dust cover, bottom
	- - - - - -			-	mounting hardware: (not included w/plate)
	211-0542-00			4	SCREW, 6-32 x 5/16 inch THS phillips
37	351-0007-00	101	154	1	SLIDE, chassis track, 1 pair left & right
	351-0039-00	155	610	1	SLIDE, chassis track, 1 pair left & right
	351-0082-00	611		1	SLIDE, chassis track, 1 pair left & right
	- - - - - -			-	mounting hardware: (not included w/slide)
	212-0023-00	X611		12	SCREW, 8-32 x 3/8 inch BHS
	210-0458-00	X611		12	NUT, keps, 8-32 x 11/32 inch
38	386-0831-00			1	PLATE, right side
	- - - - - -			-	mounting hardware: (not included w/plate)
	212-0040-00			3	SCREW, 8-32 x 3/8 inch FHS phillips
	210-0458-00			3	NUT, keps, 8-32 x 11/32 inch
	211-0538-00			3	SCREW, 6-32 x 5/16 inch FHS phillips
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
	210-0457-00			3	NUT, keps, 6-32 x 5/16 inch
39	- - - - - -	X910		1	CAPACITOR
	- - - - - -			-	mounting hardware: (not included w/capacitor)
	211-0542-00			2	SCREW, 6-32 x 5/16 inch THS
	210-0803-00			2	WASHER, 6L x 3/8 inch
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch

CHASSIS



CHASSIS

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	Q T Y.	DESCRIPTION
1	441-211			1	CHASSIS, sweep
	- - - -			-	mounting hardware: (not included w/chassis)
	211-538			5	SCREW, 6-32 x 5/16 inch FHS phillips
	210-457			5	NUT, keps, 6-32 x 5/16 inch
	212-040			2	SCREW, 8-32 x 3/8 inch FHS phillips
	210-458			2	NUT, keps, 8-32 x 11/32 inch
	212-001			2	SCREW, 8-32 x 1/4 inch BHS
2	210-201			6	LUG, solder, SE #4
	- - - -			-	mounting hardware for each: (not included w/lug)
	213-044			1	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
3	346-001			1	STRAP, mounting, high voltage transformer
	- - - -			-	mounting hardware: (not included w/strap)
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 3/16 inch
4	406-474			1	BRACKET, pot
	- - - -			-	mounting hardware: (not included w/bracket)
	211-507			3	SCREW, 6-32 x 5/16 inch BHS
	210-006			3	LOCKWASHER, internal, #6
	210-407			3	NUT, hex, 6-32 x 1/4 inch
5	- - - -			6	POT
	- - - -			-	mounting hardware for each: (not included w/pot)
	210-840			1	WASHER, .390 ID x 9/16 inch OD
	210-413			1	NUT, hex, 3/8-32 x 1/2 inch
6	136-015			28	SOCKET, STM9G
	- - - -			-	mounting hardware for each: (not included w/socket)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
7	348-002			26	GROMMET, 1/4 inch
8	385-074	101	239	3	ROD, nylon, 1 inch
	385-135	240		3	ROD, delrin, 15/16 inch
	- - - -			-	mounting hardware for each: (not included w/rod)
	211-507	101	239	1	SCREW, 6-32 x 5/16 inch BHS
	213-054	240		1	SCREW, thread cutting, 6-32 x 5/16 inch PHS phillips
9	- - - -			1	RESISTOR, 10 watt
	- - - -			-	mounting hardware: (not included w/resistor)
	211-553			1	SCREW, 6-32 x 1 1/2 inches RHS phillips
	210-601			1	EYELET
	210-478			1	NUT, hex, resistor mounting
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
10	136-008			16	SOCKET, STM7G
	- - - -			-	mounting hardware for each: (not included w/socket)
	213-044			2	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
11	348-006			2	GROMMET, 3/4 inch
12	354-068			4	RING, securing

CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
13	343-036			1	CLAMP, 1/2 x 3/4 inch diameter
	- - - -			-	mounting hardware: (not included w/clamp)
	210-006			2	LOCKWASHER, internal, #6
	210-407			2	NUT, hex, 6-32 x 5/16 inch
	211-504			1	SCREW, 6-32 x 1/4 inch
	214-012			1	BOLT, spade, 6-32 x 3/8 inch
14	384-571	X155		1	ROD, support post
	- - - -			-	mounting hardware: (not included w/rod)
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
	211-559			1	SCREW, 6-32 x 3/8 inch FHS phillips
15	- - - -			2	RESISTOR, 8 watt
	- - - -			-	mounting hardware for each: (not included w/resistor)
	211-545			1	SCREW, 6-32 x 1 1/4 inches THS phillips
	210-478			1	NUT, hex, resistor mounting
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
16	385-042	101	239	3	ROD, nylon, 1 1/2 inches
	385-138	240		3	ROD, delrin, 1 9/16 inches
	- - - -			-	mounting hardware for each: (not included w/rod)
	211-507	101	239	1	SCREW, 6-32 x 5/16 inch BHS
	213-054	240		1	SCREW, thread cutting, 6-32 x 5/16 inch PHS phillips
17	337-293			4	SHIELD, tube
18	337-004			4	SHIELD, socket
19	- - - -			1	COIL, variable
	- - - -			-	coil includes:
	202-126	X512		1	CAN, shield
20	407-023	X512		1	BRACKET, coil mounting
21	214-059	X512		2	BOLT, spade, 6-32 x 5/16 inch
	211-565	X512		2	SCREW, 6-32 x 1/4 inch THS phillips
	213-054	X512		1	SCREW, thread cutting, 6-32 x 5/16 inch PHS phillips
	- - - -			-	mounting hardware: (not included w/coil)
	210-457			2	NUT, keps, 6-32 x 5/16 inch
22	- - - -			2	COIL, variable
	- - - -			-	mounting hardware for each: (not included w/coil)
	210-457			2	NUT, keps, 6-32 x 5/16 inch
23	- - - -			6	COIL, variable
	- - - -			-	mounting hardware for each: (not included w/coil)
	210-008			2	LOCKWASHER, internal, #8
	210-409			1	NUT, hex, 8-32 x 5/16 inch
	210-442	X592		1	NUT, hex, 3-48 x 3/16 inch
24	406-504	101	154	1	BRACKET, aluminum
	406-643	155	299	1	BRACKET, pot mounting
	406-887	300		1	BRACKET, pot mounting
	- - - -			-	mounting hardware: (not included w/bracket)
	211-507			2	SCREW, 6-32 x 5/16 inch BHS
	210-803			2	WASHER, 6L x 3/8 inch

CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
25	- - - - - -			1	TRANSFORMER
	- - - - - -			-	transformer includes:
	212-0545-00			4	SCREW, 10-32 x 4 inches HHS
	210-0812-00			4	WASHER, fiber, #
	220-0410-00			4	NUT, keps, 10-32 x 3/8 inch
26	348-0005-00			2	GROMMET, 1/2 inch
27	348-0003-00			2	GROMMET, 5/16 inch
28	348-0004-00			2	GROMMET, 3/8 inch
29	337-0323-00			1	SHIELD, subcarrier
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
30	337-0298-00			1	SHIELD, high voltage power
	- - - - - -			-	mounting hardware: (not included w/shield)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch BHS
31	260-0070-00	101	909	1	SWITCH, thermal cutout
	260-0208-00	910		1	SWITCH, thermal cutout
	- - - - - -			-	mounting hardware: (not included w/switch)
	211-0504-00			2	SCREW, 6-32 x 1/4 inch BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
32	406-0473-00			1	BRACKET, fuse
	- - - - - -			-	mounting hardware: (not included w/bracket)
	211-0507-00			2	SCREW, 6-32 x 5/16 inch BHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
33	352-0002-00			1	HOLDER, fuse, assembly
	- - - - - -			-	holder assembly includes:
	352-0010-00			1	HOLDER, fuse
	200-0582-00			1	CAP, fuse
	210-0873-00			1	WASHER, rubber, 1/2 ID x 11/16 inch OD
	- - - - - -			1	NUT, fuse holder
34	337-0316-00			1	SHIELD, vertical amplifier
35	131-0025-00			2	CONNECTOR, terminal feed-through
36	337-0327-00			1	SHIELD, demodulator
37	337-0315-00			1	SHIELD, subcarrier input
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch
38	346-0023-00	101	278X	2	STRAP, cable tie
39	- - - - - -			2	CAPACITOR
	- - - - - -			-	mounting hardware for each: (not included w/capacitor)
	211-0013-00			2	SCREW, 4-40 x 3/8 inch RHS
	210-0004-00			2	LOCKWASHER, internal, #4
	210-0406-00			2	NUT, hex, 4-40 x 3/16 inch
40	337-0297-00			1	SHIELD, test circle
	- - - - - -			-	mounting hardware: (not included w/shield)
	210-0457-00			2	NUT, keps, 6-32 x 5/16 inch

CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
41	- - - -			2	COIL
	- - - -			-	mounting hardware for each: (not included w/coil)
	213-054			1	SCREW, thread cutting, 6-32 x 5/16 inch PHS phillips
42	210-202			1	LUG, solder, SE #6
	- - - -			-	mounting hardware: (not included w/lug)
	211-008			1	SCREW, 4-40 x 1/4 inch BHS
	210-004			1	LOCKWASHER, internal, #4
	210-406			1	NUT, hex, 4-40 x 3/16 inch
43	384-542			2	ROD, capacitor mounting
	- - - -			-	mounting hardware for each: (not included w/rod)
	211-507			1	SCREW, 6-32 x 5/16 inch BHS
44	136-050			1	SOCKET, transistor, 4 pin
	- - - -			-	mounting hardware: (not included w/socket)
	213-055			2	SCREW, thread forming, 2-32 x 3/16 inch PHS phillips
45	136-008			6	SOCKET, STM7G
	- - - -			-	mounting hardware for each: (not included w/socket)
	211-033			2	SCREW, 4-40 x 5/16 inch PHS w/lockwasher
	210-004			2	LOCKWASHER, internal, #4
	210-406			2	NUT, hex, 4-40 x 1/4 inch
46	- - - -			1	DELAY LINE, fixed (shown for orientation purposes)
47	441-210			1	CHASSIS, indicator
	- - - -			-	mounting hardware: (not included w/chassis)
	211-507			5	SCREW, 6-32 x 5/16 inch BHS
	211-538			5	SCREW, 6-32 x 5/16 inch FHS phillips
	210-457			10	NUT, keps, 6-32 x 5/16 inch
	212-004			2	SCREW, 8-32 x 5/16 inch BHS
	212-040			2	SCREW, 8-32 x 3/8 inch FHS phillips
	210-458			4	NUT, keps, 8-32 x 11/32 inch
48	- - - -			2	COIL, variable
	- - - -			-	mounting hardware for each: (not included w/coil)
	210-008			1	LOCKWASHER, internal, #8
	210-205			1	LUG, solder, SE #8
	210-409			1	NUT, hex, 8-32 x 5/16 inch
49	406-472			1	BRACKET, tube socket
	- - - -			-	mounting hardware: (not included w/bracket)
	211-538			2	SCREW, 6-32 x 5/16 inch FHS phillips
50	337-004	101	587X	1	SHIELD, socket
51	348-003	X240		1	GROMMET, 5/16 inch
52	406-642	X155		1	BRACKET, transformer mounting
	- - - -			-	mounting hardware: (not included w/bracket)
	212-001			3	SCREW, 8-32 x 1/4 inch BHS

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CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
53	343-0003-00			1	CLAMP, cable, 1/4 inch
	- - - - - -			-	mounting hardware: (not included w/clamp)
	211-0559-00			1	SCREW, 6-32 x 3/8 inch FHS phillips
	210-0803-00			1	WASHER, 6L x 3/8 inch
	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
54	- - - - - -			1	POT
	- - - - - -			-	mounting hardware: (not included w/pot)
	210-0011-00			1	LOCKWASHER, internal, 1/4 inch
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch
55	441-0262-00	101	1322	1	CHASSIS, subcarrier generator
	441-0262-01	1323		1	CHASSIS, subcarrier generator
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0507-00			3	SCREW, 6-32 x 5/16 inch BHS
	210-0457-00			3	NUT, keps, 6-32 x 5/16 inch
56	136-0009-00			1	SOCKET, STM7 shielded
	- - - - - -			-	mounting hardware: (not included w/socket)
	211-0033-00			2	SCREW, 4-40 x 5/16 inch PHS w/lockwasher
	210-0004-00			1	LOCKWASHER, internal, #4
	210-0201-00			1	LUG, solder, SE #4
	210-0406-00			1	NUT, hex, 4-40 x 3/16 inch
57	- - - - - -			3	COIL
	- - - - - -			-	mounting hardware for each: (not included w/coil)
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
58	- - - - - -			3	RESISTOR, 5 watt
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	211-0544-00			1	SCREW, 6-32 x 3/4 inch THS phillips
	210-0478-00			1	NUT, hex, resistor mounting
	211-0507-00			1	SCREW, 6-32 x 5/16 inch BHS
59	337-0007-00			1	SHIELD, tube
60	- - - - - -			2	RESISTOR, 25 watt
	- - - - - -			-	mounting hardware for each: (not included w/resistor)
	212-0037-00			1	SCREW, 8-32 x 1 3/4 inches Fil HS
	210-0008-00			1	LOCKWASHER, internal, #8
	210-0809-00			1	WASHER, resistor, centering
	210-0462-00			1	NUT, hex, resistor, mounting
	212-0004-00			1	SCREW, 8-32 x 5/16 inch BHS
61	343-0042-00			2	CLAMP, cable, 5/16 inch (half)
	- - - - - -			-	mounting hardware for each: (not included w/clamp)
	211-0510-00			1	SCREW, 6-32 x 3/8 inch BHS
	210-0803-00			1	WASHER, 6L x 3/8 inch
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch

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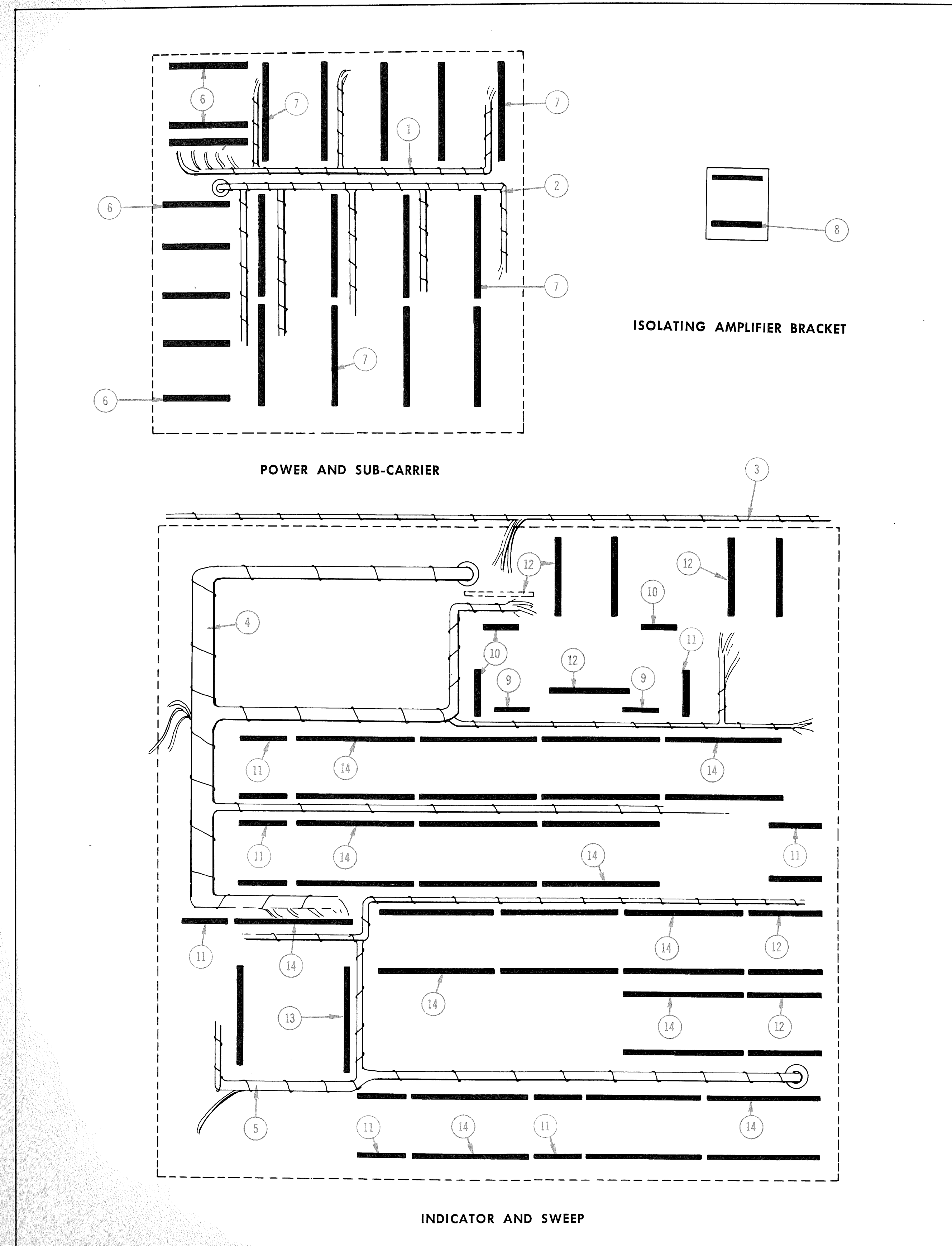
CHASSIS *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	DISC.	QTY.	DESCRIPTION
62	441-0261-00			1	CHASSIS, power
	- - - - - -			-	mounting hardware: (not included w/chassis)
	211-0510-00			4	SCREW, 6-32 x 3/8 inch BHS
63	381-0136-00			2	BAR, chassis hinge
64	210-0812-00			2	WASHER, fiber, #10
65	386-0254-00			3	PLATE, fiber, large capacitor
	- - - - - -			-	mounting hardware for each: (not included w/plate)
	211-0543-00			2	SCREW, 6-32 x 5/16 inch RHS
	210-0006-00			2	LOCKWASHER, internal, #6
	210-0407-00			2	NUT, hex, 6-32 x 1/4 inch
66	200-0293-00			2	COVER, capacitor, 2 9/16 inches
67	200-0258-00			1	COVER, capacitor, 3 1/32 inches
68	343-0002-00			2	CLAMP, cable, 3/16 inch
	- - - - - -			-	mounting hardware for each: (not included w/clamp)
	211-0510-00			1	SCREW, 6-32 x 3/8 inch BHS
	210-0803-00			1	WASHER, 6L x 3/8 inch
	210-0006-00			1	LOCKWASHER, internal, #6
	210-0407-00			1	NUT, hex, 6-32 x 1/4 inch
69	136-0024-00			1	SOCKET, STM9G, w/center pin
	- - - - - -			-	mounting hardware: (not included w/socket)
	213-0044-00			2	SCREW, thread cutting, 5-32 x 3/16 inch PHS phillips
70	348-0012-00			1	GROMMET, 5/8 inch
71	210-0442-00	X592		6	NUT, hex, 3-38 x 3/16 inch
72	407-0042-00	X748		2	BRACKET, pot
	- - - - - -			-	mounting hardware for each: (not included w/bracket)
	211-0504-00			1	SCREW, 6-32 x 1/4 inch BHS
	210-0457-00			1	NUT, keps, 6-32 x 5/16 inch
73	- - - - - -	X748		2	POT
	- - - - - -			-	mounting hardware for each: (not included w/pot)
	210-0046-00			1	LOCKWASHER, internal, .400 OD x .261 ID
	210-0940-00			1	WASHER, 3/8 OD x 1/4 inch ID
	210-0583-00			1	NUT, hex, 1/4-32 x 5/16 inch

CABLE HARNESS & CERAMIC STRIP DETAIL



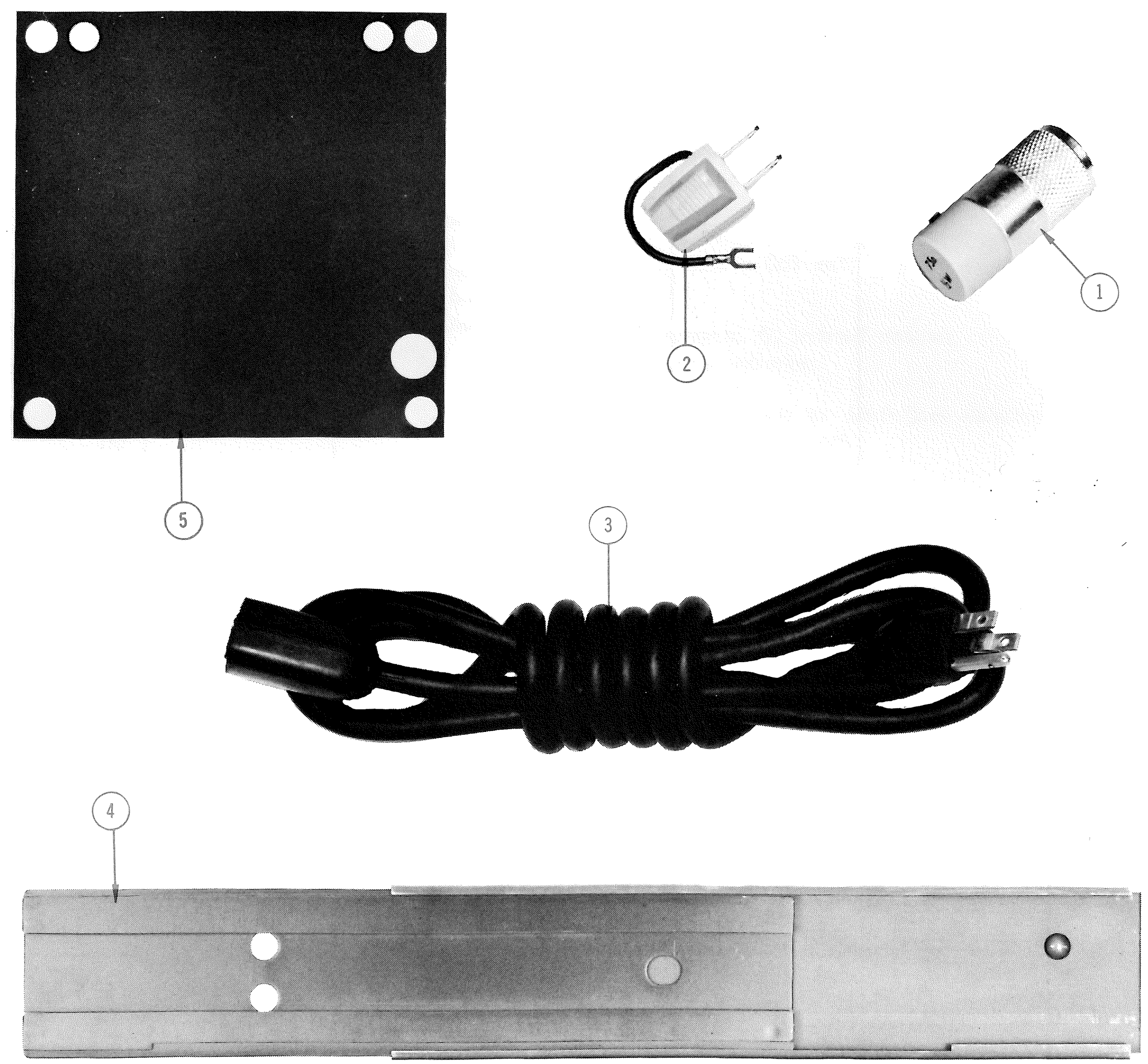
CABLE HARNESS AND CERAMIC STRIP DETAIL

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
1	179-0353-00			1	CABLE HARNESS, subcarrier regenerator
2	179-0336-00			1	CABLE HARNESS, power
3	179-0337-00			1	CABLE HARNESS, 110 watt
4	179-0334-00			1	CABLE HARNESS, indicator
5	179-0335-00			1	CABLE HARNESS, sweep
6	124-0089-00			8	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, nylon, .063 inch
7	124-0090-00			13	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, nylon, .063 inch
8	124-0088-00			2	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0007-00			2	SPACER, nylon, .063 inch
9	124-0086-00			2	STRIP, ceramic, 3/4 inch x 2 notches
	- - - - - -			-	each strip includes:
	355-0046-00			1	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			1	SPACER, nylon, .313 inch
10	124-0087-00			3	STRIP, ceramic, 3/4 inch x 3 notches
	- - - - - -			-	each strip includes:
	355-0046-00			1	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			1	SPACER, nylon, .313 inch
11	124-0088-00			12	STRIP, ceramic, 3/4 inch x 4 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch
12	124-0089-00			10	STRIP, ceramic, 3/4 inch x 7 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch

CABLE HARNESS AND CERAMIC STRIP DETAIL *(Cont'd)*

REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	QTY.	DESCRIPTION
13	124-0090-00			2	STRIP, ceramic, 3/4 inch x 9 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch
14	124-0091-00			29	STRIP, ceramic, 3/4 inch x 11 notches
	- - - - - -			-	each strip includes:
	355-0046-00			2	STUD, nylon
	- - - - - -			-	mounting hardware for each: (not included w/strip)
	361-0009-00			2	SPACER, nylon, .313 inch

STANDARD ACCESSORIES



REF. NO.	PART NO.	SERIAL/MODEL NO. EFF.	SERIAL/MODEL NO. DISC.	Q T Y.	DESCRIPTION
1	011-0023-00			3	TERMINATION, 75 Ω
2	103-0013-00			1	ADAPTER, power cord
3	161-0010-00	101	1009	1	CORD, power
	161-0024-00	1010	2349	1	CORD, power, right angle
	161-0024-01	2350		1	CORD, power, right angle
4	351-0017-00	101	393	1	GUIDE, chassis track, 1 pair left & right
	351-0010-00	394	610	1	GUIDE, cabinet, left
	351-0011-00	394	610	1	GUIDE, cabinet, right
	351-0084-00	611		1	SLIDE, stationary & intermediate sections (1 pair)
5	378-0514-00	X279	939	1	FILTER, green
	378-0567-00	940		1	FILTER, smoke gray
	070-0121-00			2	MANUAL, instruction (not shown)

PARTS LIST

Lamps

			Tektronix Part Number
B465		Neon, Type NE-23	Use 150-027
B466		Neon, Type NE-23	Use 150-027
B601		Incandescent, #47	150-001
B602		Incandescent, #47	150-001
B603		Pilot Light	136-031
B800	X724-up	Neon, Type NE-2 V	150-0030-00
B847		Neon, Type NE-23	Use 150-027
B848		Neon, Type NE-23	Use 150-027

Capacitors

C2	.01 μf	PTM	Fixed	400 v		285-510
C3	.02 μf	Cer.	Fixed	600 v		283-006
C6	.005 μf	Cer.	Fixed	500 v		283-001
C10	.02 μf	Cer.	Fixed	500 v		283-006
C11	82 μμf	Cer.	Fixed	500 v	±8.2 μμf	281-528
C12	.02 μf	Cer.	Fixed	600 v		283-006
C13	.01 μf	Cer.	Fixed	500 v		283-002
C15	.02 μf	Cer.	Fixed	600 v		283-006
C18	.02 μf	Cer.	Fixed	600 v		283-006
C19	4.5-25 μμf	Cer.	Var.			281-010
C20	20 μf	EMT	Fixed	150 v		290-110
C22	.01 μf	PTM	Fixed	400 v		285-510
C23	.02 μf	Cer.	Fixed	600 v		283-006
C26	4.5-25 μμf	Cer.	Var.			281-010
C30	.02 μf	Cer.	Fixed	600 v		283-006
C31	82 μμf	Cer.	Fixed	500 v	±8.2 μμf	281-528
C32	.02 μf	Cer.	Fixed	600 v		283-006
C33	.01 μf	Cer.	Fixed	500 v		283-002
C41	.02 μf	Cer.	Fixed	600 v		283-006
C43	15 μμf	Cer.	Fixed	500 v	10%	Use 281-0509-00
C44	1000 μμf	Cer.	Fixed	500 v	±100 μμf	281-536
C45	100 μμf	Cer.	Fixed	350 v	±20 μμf	281-523
C46	.02 μf	Cer.	Fixed	600 v		283-006
C49	.001 μf	Cer.	Fixed	500 v		283-000
C53	8-50 μμf	Cer.	Var.			281-022
C54	750 μμf	Mica	Fixed	500 v	5%	283-524
C55	750 μμf	Mica	Fixed	500 v	5%	283-524
C56	8-50 μμf	Cer.	Var.			281-022
C61	100 μμf	Cer.	Fixed	350 v	±20 μμf	281-523
C65	6.25 μf	EMT	Fixed	300 v		290-000
C67	100 μμf	Cer.	Fixed	350 v	±20 μμf	281-523
C70	470 μμf	Cer.	Fixed		±94 μμf	281-525
C80	360 μμf	Mica	Fixed	500 v	5%	283-519
C106	5.6 μμf	Cer.	Fixed	500 v	10%	281-544
C120	.1 μf	PTM	Fixed	200 v		285-572
C121	.1 μf	PTM	Fixed	200 v		285-572
C131	.02 μf	Cer.	Fixed	600 v		283-006

							Tektronix Part Number
C134		.01 μf	Cer.	Fixed	500 v		283-002
C135		.01 μf	Cer.	Fixed	500 v		283-002
C136*		.002 μf	Mica	Fixed	500 v		295-062
C138*		.002 μf	Mica	Fixed	500 v		295-062
C140		.47 μf	PTM	Fixed	100 v		Use 285-623
C141		.01 μf	PTM	Fixed	400 v		285-510
C142	101-1409X	56 μμf	Silicon	Var.	V56E		281-042
C143	101-1409X	56 μμf	Silicon	Var.	V56E		281-042
C147		.02 μf	Cer.	Fixed	600 v		283-006
C150		3.3 μμf	Cer.	Fixed		±.25 μμf	281-534
C151		.01 μf	Cer.	Fixed	500 v		283-002
C153		.01 μf	PTM	Fixed	400 v		285-510
C154		270 μμf	Mica	Fixed			283-551
C156		.01 μf	Cer.	Fixed	500 v		283-002
C164		.001 μf	Cer.	Fixed	500 v		283-000
C168	101-149X	.1 μf	PTM	Fixed	50 v		285-559
C171		1000 μf	Cer.	Fixed	500 v	±100 μμf	281-536
C176		.02 μf	Cer.	Fixed	600 v		283-006
C185A		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185B		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185C		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185D		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185E		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185F		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185G		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185H		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185J		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185K		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185L		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C185M		27 μμf	Cer.	Fixed	500 v	±1.35 μμf	281-515
C186		39 μμf	Cer.	Fixed	500 v	±3.9 μμf	281-517
C187		4.5-25 μμf	Cer.	Var.			281-010
C191		.01 μf	Cer.	Fixed	500 v		283-002
C194		.02 μf	Cer.	Fixed	600 v		283-006
C195		27 μμf	Cer.	Fixed	500 v	±2.7 μμf	281-512
C196		.01 μf	Cer.	Fixed	500 v		283-002
C197		.01 μf	Cer.	Fixed	500 v		283-002
C198A		4.5-25 μμf	Cer.	Var.			281-010
C198B		39 μμf	Cer.	Fixed	500 v	±3.9 μμf	281-517
C199		.01 μf	Cer.	Fixed	500 v		283-002
C201		.01 μf	Cer.	Fixed	500 v		283-002
C203		.01 μf	Cer.	Fixed	500 v		283-002
C205A		.001 μf	Cer.	Fixed	500 v		283-000
C205B		.001 μf	Cer.	Fixed	500 v		283-000
C205C	101-1409X	56 μμf	Silicon	Var.	V56E		281-042
C205D		.01 μf	Cer.	Fixed	500 v		283-002
C210		.01 μf	Cer.	Fixed	500 v		283-002
C213		.1 μf	PTM	Fixed	200 v		285-572
C214		.001 μf	Cer.	Fixed	500 v		283-000
C224	101-1409X	56 μμf	Silicon	Var.	V56E		281-042

*C136, C138 checked within 1% of each other. Furnished as a unit.

							Tektronix Part Number
C225	101-1409X	56 μμf	Silicon	Var.	V56E		281-042
C227		.02 μf	Cer.	Fixed	600 v		283-006
C231		470 μμf	Cer.	Fixed		±94 μμf	281-525
C238	101-511X	.02 μf	Cer.	Fixed	600 v		283-006
C240		.001 μf	Cer.	Fixed	500 v		283-000
C241		.02 μf	Cer.	Fixed	600 v		283-006
C244		51 μμf Nominal	Cer.	Fixed	500 v		See L245
C246		.02 μf	Cer.	Fixed	600 v		283-006
C251		3-12 μμf	Cer.	Var.			281-036
C260		470 μμf	Cer.	Fixed		±94 μμf	281-525
C263		.02 μf	Cer.	Fixed	600 v		283-006
C264	101-2469	56 μμf	Cer.	Fixed	500 v		See L264
C264	2470-up	53 μμf	Cer.	Fixed	300 v	5%	283-0602-00
C265		4.7 μμf	Cer.	Fixed	200 v	±.5 μμf	See L264
C267		.02 μf	Cer.	Fixed	600 v		283-006
C268		.02 μf	Cer.	Fixed	600 v		283-006
C270	101-2253	5.6 μμf	Cer.	Fixed	500 v	±10%	281-544
C270	2254-up	10 μμf	Cer.	Fixed	500 v	±10%	281-0504-00
C272	101-1409X	56 μμf	Silicon	Var.	V56E		281-042
C281		470 μμf	Cer.	Fixed		±94 μμf	281-525
C287	X512-up	.02 μf	Cer	Fixed	600 v		283-006
C288	101-511X	.02 μf	Cer.	Fixed	600 v		283-006
C290		470 μμf	Cer.	Fixed		±94 μμf	281-525
C291		.02 μf	Cer.	Fixed	600 v		283-006
C294		51 μμf Nominal	Cer.	Fixed	500 v		See L295
C296		.02 μf	Cer.	Fixed	600 v		283-006
C303		1.5 μμf	Cer.	Fixed	500 v	±0.25 μμf	281-529
C304		47 μμf	Cer.	Fixed	500 v	±4.7 μμf	281-519
C305		.02 μf	Cer.	Fixed	600 v		283-006
C306		18 μμf	Cer.	Fixed	500 v		281-558
C308		.005 μf	Cer.	Fixed	500 v		283-001
C313		.7-3 μμf	Tub.	Var.			281-027
C314		47 μμf	Cer.	Fixed	500 v	±4.7 μμf	281-519
C316		18 μμf	Cer.	Fixed	500 v		281-558
C318		.005 μf	Cer.	Fixed	500 v		283-001
C322		56 μμf	Cer.	Fixed		±5.6 μμf	281-521
C325		56 μμf	Cer.	Fixed		±5.6 μμf	281-521
C329	101-1579X	1.5-7 μμf	Cer.	Var.			281-034
C353		1.5 μμf	Cer.	Fixed	500 v	±0.25 μμf	281-529
C354		47 μμf	Cer.	Fixed	500 v	±4.7 μμf	281-519
C355		.02 μf	Cer.	Fixed	600 v		283-006
C356		18 μμf	Cer.	Fixed	500 v		281-558
C358		.005 μf	Cer.	Fixed	500 v		283-001
C359		.01 μf	Cer.	Fixed	500 v		283-002
C363		.7-3 μμf	Tub.	Var.			281-027
C364		47 μμf	Cer.	Fixed	500 v	±4.7 μμf	281-519
C366		18 μμf	Cer.	Fixed	500 v		281-558
C368		.005 μf	Cer.	Fixed	500 v		283-001
C372		56 μμf	Cer.	Fixed		±5.6 μμf	281-521
C375		56 μμf	Cer.	Fixed		±5.6 μμf	281-521
C385	X1580-up	1.5-7 μμf	Cer.	Var.			281-0034-00
C391		.01 μf	Cer.	Fixed	500 v		283-002
C400		12 μμf	Cer.	Fixed	500 v	10%	281-506
C402		.1 μf	Cer.	Fixed	500 v		283-008

Capacitors *(continued)*

							Tektronix Part Number
C407	101-747X	50 μf	EMT	Fixed	25 v		290-100
C410	101-747	.047 μf	PTM	Fixed	400 v		285-519
C410	748-up	.01 μf	PTM	Fixed	400 V		285-0510-00
C411	101-747	220 μμf	Mica	Fixed	500 v	10%	283-536
C411	748-up	270 pf	Cer.	Fixed	500 V	10%	281-0543-00
C414	X748-up	.001 μf	Cer.	Fixed	500 V		283-0000-00
C421		.005 μf	Cer.	Fixed	500 v		283-001
C423		.001 μf	Cer.	Fixed	500 v		283-000
C425		220 μμf	Mica	Fixed	500 v	10%	283-536
C431		22 μμf	Cer.	Fixed	500 v	±4.4 μμf	281-510
C434		10 μμf	Cer.	Fixed	500 v	±1 μμf	281-504
C443		.02 μf	Cer.	Fixed	600 v		283-006
C445		.02 μf	Cer.	Fixed	600 v		283-006
C446		100 μμf	Cer.	Fixed	500 v	±10 μμf	281-530
C450		330 μμf	Mica	Fixed	500 v	10%	283-518
C460		47 μμf	Mica	Fixed		5%	283-501
C465		.001 μf	Cer.	Fixed	500 v		283-000
C475		.002 μf	Mica	Fixed	500 v	5%	283-529
C481		500 μμf	Mica	Fixed	500 v	5%	283-523
C483		150 μμf	Cer.	Fixed	500 v	±30 μμf	281-524
C484		150 μμf	Cer.	Fixed	500 v	±30 μμf	281-524
C491		4.7 μμf	Cer.	Fixed	500 v	±1 μμf	281-501
C601	X910-up	2 μf	PMC	Fixed	236 v		285-0588-00
C610		.047 μf	PTM	Fixed	400 v		285-519
C617		.047 μf	PTM	Fixed	400 v		285-519
C640A,B		160 x 10 μf	EMC	Fixed	350 v		Use 290-0059-00
C648		6.25 μf	EMT	Fixed	300 v		290-000
C650		.047 μf	PTM	Fixed	400 v		285-519
C670		150 μf	EMC	Fixed	250 v		Use 290-0019-00
C675		6.25 μf	EMT	Fixed	300 v		290-025
C678		6.25 μf	EMT	Fixed	300 v		290-000
C710		.047 μf	PTM	Fixed	400 v		285-519
C730		60 μf	EMC	Fixed	450 v		Use 290-0108-00
C738		8 μf	EMT	Fixed	450 v		290-094
C771		.005 μf	Cer.	Fixed	500 v		283-001
C802		.02 μf	Cer.	Fixed	1400 v		Use 283-022
C803		.001 μf	Cer.	Fixed	500 v		283-000
C806		.001 μf	PTM	Fixed	600 v		285-501
C841		.033 μf	PTM	Fixed	400 v	20%	285-568
C842		.0047 μf	Cer.	Fixed	6000 v	20%	Use 283-101
C850		.0047 μf	Cer.	Fixed	6000 v	20%	Use 283-101
C852		.1 μf	PTM	Fixed	400 v	20%	285-526
C853		.0047 μf	Cer.	Fixed	6000 v	20%	Use 283-101
C854		.0047 μf	Cer.	Fixed	6000 v	20%	Use 283-101

Fuses

F601	5 amp, Fast-Blo 117 v, 60 cycle	159-014
	5 amp, Slo-Blo 117 v, 50 cycle	159-006
	2 amp, Fast-Blo 234 v, 60 cycle	159-021
	2 amp, Slo-Blo 234 v, 50 cycle	159-023

Coils

					Tektronix Part Number
L2		56 mμh	Fixed		Use *108-194
L19		8.8 μh	Fixed		*108-057
L22		56 mμh	Fixed		Use *108-194
L45		27-60 μh	Var.	core not replaceable	*114-034
L102		22-46 μh	Var.	core 276-511	*114-116
L145		42-86 μh	Var.		114-124††
L154		12 μh	Fixed		*108-005
L171		56 mμh	Fixed		*108-194
L181		10-27 μh	Var.	core not replaceable	*114-128
L185		Delay Line			*108-180
L187		29 μh	Fixed		*108-016
L195		27-60 μh	Var.	core not replaceable	*114-034
L197	101-154	Replacement Kit			Use *050-036
L197	155-up	20T, 0.155 mμsec	Var.		*119-012
L198		29 μh	Fixed		*108-016
L205		10-27 μh	Var.	core not replaceable	*114-128
L224		27-60 μh	Var.	core not replaceable	*114-034
L245†		15-27 μh	Var.		Use 114-137††
L264†	101-511	Replacement Kit			Use *050-210
	512-2469	20-40 μh	Var.	core 276-511 (2)	*114-163
L264†	2470-up	20-40 μh	Var.	core 276-0511-00 (2)	*114-0163-01
L295†		15-27 μh	Var.		Use 114-137††
L306		42-90 μh	Var.	core not replaceable	*114-117
L316		42-90 μh	Var.	core not replaceable	*114-117
L356		42-90 μh	Var.	core not replaceable	*114-117
L366		42-90 μh	Var.	core not replaceable	*114-117
L400		56 mμh	Fixed		Use *108-194
DL437		2500 Ω	Fixed		*119-002

†With internally contained capacitor, or capacitors.
††Core not available separately.

Resistors

R2		3.3 meg	½ w	Fixed	Comp.	10%	302-335
R3		8.2 k	½ w	Fixed	Comp.	10%	302-822
R4		47 Ω	½ w	Fixed	Comp.	10%	302-470
R5		6.8 k	1 w	Fixed	Comp.	10%	304-682
R6		1 k	½ w	Fixed	Comp.	10%	302-102
R7		270 k	½ w	Fixed	Comp.	10%	302-274
R8		50 k		Var.	Comp.		311-023
R9		100 k	½ w	Fixed	Comp.	10%	302-104
R10		820 Ω	½ w	Fixed	Comp.	10%	302-821
R11		47 Ω	½ w	Fixed	Comp.	10%	302-470
R12		33 k	2 w	Fixed	Comp.	10%	306-333
R13		100 Ω	½ w	Fixed	Comp.	10%	302-101
R15		100 Ω	½ w	Fixed	Comp.	10%	302-101
R16		3.9 k	½ w	Fixed	Comp.	10%	302-392
R17		820 Ω	½ w	Fixed	Comp.	10%	302-821
R18		1 k	½ w	Fixed	Comp.	10%	302-102
R19	X748-up	4.7 meg	¼ w	Fixed	Comp.	10%	316-0475-00
R20		10 k	½ w	Fixed	Comp.	10%	302-103
R22		3.3 meg	½ w	Fixed	Comp.	10%	302-335
R23		8.2 k	½ w	Fixed	Comp.	10%	302-822
R24		47 Ω	½ w	Fixed	Comp.	10%	302-470

Resistors *(continued)*

							Tektronix Part Number
R25		6.8 k	1 w	Fixed	Comp.	10%	304-682
R27		270 k	½ w	Fixed	Comp.	10%	302-274
R28		50 k		Var.	Comp.		311-023
R29		100 k	½ w	Fixed	Comp.	10%	302-104
R30		820 Ω	½ w	Fixed	Comp.	10%	302-821
R31		47 Ω	½ w	Fixed	Comp.	10%	302-470
R32		33 k	2 w	Fixed	Comp.	10%	306-333
R33		100 Ω	½ w	Fixed	Comp.	10%	302-101
R34	X748-up	4.7 meg	¼ w	Fixed	Comp.	10%	316-0475-00
R40		470 k	½ w	Fixed	Comp.	10%	302-474
R41		820 Ω	½ w	Fixed	Comp.	10%	302-821
R42		150 k	½ w	Fixed	Comp.	10%	302-154
R45		2 k		Var.	Comp.		Use 311-221
R46		10 k	½ w	Fixed	Comp.	10%	302-103
R47		47 Ω	½ w	Fixed	Comp.	10%	302-470
R49		6.8 k	1 w	Fixed	Comp.	10%	304-682
R51		22 k	½ w	Fixed	Comp.	10%	302-223
R52		39 k	1 w	Fixed	Comp.	5%	303-393
R54		3.3 meg	½ w	Fixed	Comp.	10%	302-335
R55		3.3 meg	½ w	Fixed	Comp.	10%	302-335
R57		39 k	1 w	Fixed	Comp.	5%	303-393
R58		22 k	½ w	Fixed	Comp.	10%	302-223
R61		8.2 k	½ w	Fixed	Comp.	10%	302-822
R62		47 k	1 w	Fixed	Comp.	10%	304-473
R64		18 k	½ w	Fixed	Comp.	10%	302-183
R65		56 k	½ w	Fixed	Comp.	10%	302-563
R67		8.2 k	½ w	Fixed	Comp.	10%	302-822
R68		47 k	1 w	Fixed	Comp.	10%	304-473
R70		75 k	½ w	Fixed	Comp.	5%	301-753
R71		1.5 meg.	½ w	Fixed	Prec.	1%	309-017
R72		1 k	½ w	Fixed	Comp.	10%	302-102
R73		82 k	2 w	Fixed	Comp.	5%	305-823
R74		12 k	½ w	Fixed	Comp.	5%	301-123
R80	101-2130	5.6 meg	½ w	Fixed	Comp.	10%	302-565
R80	2131-up	5.6 meg	½ w	Fixed	Comp.	5%	301-0565-00
R81		1 k	½ w	Fixed	Comp.	10%	302-102
R84		27 k	2 w	Fixed	Comp.	10%	306-273
R86		82 k	2 w	Fixed	Comp.	5%	305-823
R87		12 k	½ w	Fixed	Comp.	5%	301-123
R102		3.3 k	½ w	Fixed	Comp.	10%	302-332
R106		900 k	½ w	Fixed	Prec.	1%	309-111
R107		1 meg	½ w	Fixed	Prec.	1%	309-014
R108		1 meg	½ w	Fixed	Prec.	1%	309-014
R113		33 k	½ w	Fixed	Comp.	10%	302-333
R114		100 Ω	½ w	Fixed	Comp.	10%	302-101
R117		22 k	1 w	Fixed	Comp.	10%	304-223
R120		39 k	1 w	Fixed	Comp.	10%	304-393
R121		47 k	1 w	Fixed	Comp.	10%	304-473
R130		47 Ω	½ w	Fixed	Comp.	10%	302-470
R131		330 Ω	½ w	Fixed	Comp.	10%	302-331
R132		15 k	½ w	Fixed	Comp.	10%	302-153
R134		10 k	5 w	Fixed	WW	5%	308-008

Resistors *(Continued)*

							Tektronix Part Number
R135		330 Ω	½ w	Fixed	Comp.	10%	302-331
R136		1 meg	½ w	Fixed	Prec.	1%	309-014
R137		500 k	0.2 w	Var.		20%	311-068
R138		1 meg	½ w	Fixed	Prec.	1%	309-014
R140		10 k	½ w	Fixed	Comp.	10%	302-103
R142		220 k	½ w	Fixed	Comp.	5%	301-224
R145		120 k	½ w	Fixed	Comp.	10%	302-124
R147		7.3 k	½ w	Fixed	Prec.	1%	309-120
R148		150 k	½ w	Fixed	Prec.	1%	309-049
R151		4.7 k	½ w	Fixed	Comp.	10%	302-472
R156		56 k	½ w	Fixed	Comp.	10%	302-563
R160		100 k	½ w	Fixed	Comp.	10%	302-104
R162		47 k	½ w	Fixed	Comp.	10%	302-473
R164		5.6 k	½ w	Fixed	Comp.	10%	302-562
R165		150 k	½ w	Fixed	Comp.	5%	301-154
R168	101-149X	12 Ω	½ w	Fixed	Comp.	10%	302-120
R170		3 meg	½ w	Fixed	Prec.	1%	309-026
R171		1.5 meg	½ w	Fixed	Prec.	1%	309-017
R172		47 Ω	½ w	Fixed	Comp.	10%	302-470
R175		100 Ω	½ w	Fixed	Comp.	10%	302-101
R176		8.2 k	1 w	Fixed	Comp.	10%	304-822
R181		866 Ω	½ w	Fixed	Prec.	1%	309-273
R185		866 Ω	½ w	Fixed	Prec.	1%	309-273
R190		1.2meg	½ w	Fixed	Comp.	5%	301-125
R191		300 k	½ w	Fixed	Comp.	5%	301-304
R192		47 Ω	½ w	Fixed	Comp.	10%	302-470
R193		100 Ω	½ w	Fixed	Comp.	10%	302-101
R194		4.7 k	1 w	Fixed	Comp.	10%	304-472
R197		390 Ω		Selected			Use 301-0391-00
R199		10 k	½ w	Fixed	Comp.	10%	302-103
R200		100 k	½ w	Fixed	Prec.	1%	309-045
R201		50 k	½ w	Fixed	Prec.	1%	309-090
R202		47 Ω	½ w	Fixed	Comp.	10%	302-470
R203		100 Ω	½ w	Fixed	Comp.	10%	302-101
R204		6.8 k	1 w	Fixed	Comp.	10%	304-682
R205		2.5 k	0.1 w	Var.	Comp.		311-010
R206		47 Ω	½ w	Fixed	Comp.	10%	302-470
R207		6.8 k	1 w	Fixed	Comp.	10%	304-682
R208		82 k	½ w	Fixed	Comp.	10%	302-823
R209		15 meg	½ w	Fixed	Comp.	10%	302-156
R211		2.7 meg	½ w	Fixed	Comp.	10%	302-275
R212		1 meg	½ w	Fixed	Comp.	10%	302-105
R213		150 k	½ w	Fixed	Comp.	10%	302-154
R216		100 Ω	½ w	Fixed	Comp.	10%	302-101
R221		20 k		Var.	Comp.		311-018
R222		330 k	½ w	Fixed	Comp.	10%	302-334
R223		330 k	½ w	Fixed	Comp.	10%	Use 302-0334-00
R225		1.8 meg	½ w	Fixed	Comp.	10%	302-185
R227		1 k	1 w	Fixed	Comp.	10%	304-102
R231		1 meg	½ w	Fixed	Comp.	10%	302-105
R232		100 Ω	½ w	Fixed	Comp.	10%	302-101

Resistors *(continued)*

							Tektronix Part Number
R235		15 k	5 w	Fixed	WW	5%	308-108
R238		1 k	1 w	Fixed	Comp.	10%	304-102
R240		1 meg	½ w	Fixed	Comp.	10%	302-105
R241		10 k	½ w	Fixed	Comp.	10%	302-103
R242		100 Ω	½ w	Fixed	Comp.	10%	302-101
R246		4.7 k	2 w	Fixed	Comp.	10%	306-472
R251		91 k	½ w	Fixed	Comp.	5%	301-913
R252		18 k	½ w	Fixed	Comp.	10%	302-183
R256		6.8 k	1 w	Fixed	Comp.	10%	304-682
R261		100 k	½ w	Fixed	Comp.	10%	302-104
R262		47 Ω	½ w	Fixed	Comp.	10%	302-470
R263		1 k	½ w	Fixed	Comp.	10%	302-102
R264	X2254-up	47 k	½ w	Fixed	Comp.	5%	301-0473-00
R267		390 Ω	½ w	Fixed	Comp.	10%	302-391
R268		100 Ω	½ w	Fixed	Comp.	10%	302-101
R274		1 meg	½ w	Fixed	Comp.	10%	302-105
R276		500 k		Var.	Comp		311-034
R277		4.7 meg	½ w	Fixed	Comp.	10%	302-475
R281		1 meg	½ w	Fixed	Comp.	10%	302-105
R282		100 Ω	½ w	Fixed	Comp.	10%	302-101
R285		15 k	5 w	Fixed	WW	5%	308-108
R288		1 k	1 w	Fixed	Comp.	10%	304-102
R290		100 k	½ w	Fixed	Prec.	1%	309-045
R291		50 k	½ w	Fixed	Prec.	1%	309-090
R292		1 meg	½ w	Fixed	Comp.	10%	302-105
R293		100 Ω	½ w	Fixed	Comp.	10%	302-101
R296		4.7 k	2 w	Fixed	Comp.	10%	306-472
R302	X748-up	250 Ω		Var			311-0461-00
R303		47 Ω	½ w	Fixed	Comp.	10%	302-470
R304		1.5 k	½ w	Fixed	Comp.	5%	301-152
R305		6.8 k	1 w	Fixed	Comp.	10%	304-682
R306		50 k		Var.	Comp.		311-078
R307		3.3 k	½ w	Fixed	Comp.	10%	302-332
R308		560 k	½ w	Fixed	Comp.	10%	302-564
R309		2 x 500 k		Var.	Comp.	20%	311-152
R310		100 Ω	½ w	Fixed	Comp.	10%	302-101
R313		47 Ω	½ w	Fixed	Comp.	10%	302-470
R314		1.5 k	½ w	Fixed	Comp.	5%	301-152
R317		3.3 k	½ w	Fixed	Comp.	10%	302-332
R318		560 k	½ w	Fixed	Comp.	10%	302-564
R319		120 k	½ w	Fixed	Comp.	10%	302-124
R320		100 Ω	½ w	Fixed	Comp.	10%	302-101
R321		12 k		Selected			303-123
R322		5.6 k	½ w	Fixed	Comp.	5%	301-562
R323		6.2 k	½ w	Fixed	Comp.	5%	301-622
R324		22 k	2 w	Fixed	Comp.	5%	305-223
R325		5.6 k	½ w	Fixed	Comp.	5%	301-562
R326		6.2 k	½ w	Fixed	Comp.	5%	301-622
R332		100 Ω	½ w	Fixed	Comp.	10%	302-101
R333		33 k	2 w	Fixed	Comp.	10%	306-333
R334		100 Ω	½ w	Fixed	Comp.	10%	302-101
R335		47 Ω	½ w	Fixed	Comp.	10%	302-470
R336		20 k	8 w	Fixed	Prec.	1%	*310-510
R337	101-154	0-1 k		Var.	Comp.		Use 311-008
R337	155-up	2 k	2 w	Var.	Comp.		311-008

Resistors *(continued)*

							Tektronix Part Number
R338		3.6 k	1 w	Fixed	Comp.	5%	303-362
R339		10 k	8 w	Fixed	WW	5%	308-126
R342		100 Ω	½ w	Fixed	Comp.	10%	302-101
R343		27 k	2 w	Fixed	Comp.	10%	306-273
R344		100 Ω	½ w	Fixed	Comp.	10%	302-101
R345		5.6 k	½ w	Fixed	Comp.	10%	302-562
R346		20 k	8 w	Fixed	Prec.	1%	*310-510
R347		1 k	½ w	Fixed	Comp.	10%	302-102
R348		3.6 k	1 w	Fixed	Comp.	5%	303-362
R349		47 Ω	½ w	Fixed	Comp.	10%	302-470
R352	X748-up	250 Ω		Var			311-0461-00
R353		47 Ω	½ w	Fixed	Comp.	10%	302-470
R354		1.5 k	½ w	Fixed	Comp.	5%	301-152
R355		6.8 k	1 w	Fixed	Comp.	10%	304-682
R356		50 k	0.1 w	Var.	Comp.		311-078
R357		3.3 k	½ w	Fixed	Comp.	10%	302-332
R358		330 k	½ w	Fixed	Comp.	10%	302-334
R359A,B		2 x 500 k		Var.	Comp.	20%	311-152
R360		100 Ω	½ w	Fixed	Comp.	10%	302-101
R363		47 Ω	½ w	Fixed	Comp.	10%	302-470
R364		1.5 k	½ w	Fixed	Comp.	5%	301-152
R366		120 k	½ w	Fixed	Comp.	10%	302-124
R367		3.3 k	½ w	Fixed	Comp.	10%	302-332
R368		330 k	½ w	Fixed	Comp.	10%	302-334
R369		500 k		Var.	Comp.		311-034
R370		100 Ω	½ w	Fixed	Comp.	10%	302-101
R371		12 k		Selected			303-123
R372		5.6 k	½ w	Fixed	Comp.	5%	301-562
R373		6.2 k	½ w	Fixed	Comp.	5%	301-622
R374		22 k	2 w	Fixed	Comp.	5%	305-223
R375		5.6 k	½ w	Fixed	Comp.	5%	301-562
R376		6.2 k	½ w	Fixed	Comp.	5%	301-622
R377		150 k	½ w	Fixed	Comp.	5%	301-154
R378		60 k	½ w	Fixed	Prec.	1%	309-041
R379		25 k	½ w	Fixed	Prec.	1%	309-193
R380		120 k	½ w	Fixed	Comp.	5%	301-124
R381	101-209	390 k	½ w	Fixed	Comp.	5%	use 302-564
R381	210-up	560 k	½ w	Fixed	Comp.	10%	302-564
R382		100 Ω	½ w	Fixed	Comp.	10%	302-101
R383		33 k	2 w	Fixed	Comp.	10%	306-333
R384		100 Ω	½ w	Fixed	Comp.	10%	302-101
R386		20 k	8 w	Fixed	Prec.	1%	*310-510
R387	101-224	0-1 k		Var.	Comp.		use 311-008
R387	225-up	2 k	2 w	Var.	Comp.		311-008
R388		3.6 k	1 w	Fixed	Comp.	5%	303-362
R389		10 k	8 w	Fixed	WW	5%	308-126
R390		60 k	½ w	Fixed	Prec.	1%	309-041
R391		25 k	½ w	Fixed	Prec.	1%	309-193
R392		100 Ω	½ w	Fixed	Comp.	10%	302-101
R393		33 k	2 w	Fixed	Comp.	10%	306-333
R394		100 Ω	½ w	Fixed	Comp.	10%	302-101
R396		20 k	8 w	Fixed	Prec.	1%	*310-510
R397		1 k	½ w	Fixed	Comp.	10%	302-102
R398		3.6 k	1 w	Fixed	Comp.	5%	303-362
R402		470 k	½ w	Fixed	Comp.	10%	302-474

							Tektronix Part Number
R403		47 Ω	½ w	Fixed	Comp.	10%	302-470
R404		39 k	1 w	Fixed	Comp.	10%	304-393
R405		68 k	2 w	Fixed	Comp.	10%	306-683
R407		150 Ω	½ w	Fixed	Comp.	10%	302-151
R410	101-747	2.2 meg	½ w	Fixed	Comp.	10%	302-225
R410	748-up	10 meg	½ w	Fixed	Comp.	10%	302-0106-00
R411	101-747	220 k	½ w	Fixed	Comp.	10%	302-224
R411	748-up	1 meg	½ w	Fixed	Comp.	10%	302-0105-00
R412		10 k	1 w	Fixed	Comp.	10%	304-103
R413		100 k	½ w	Fixed	Comp.	10%	302-104
R414		4.7 k	1 w	Fixed	Comp.	10%	304-472
R415		56 Ω	½ w	Fixed	Comp.	10%	302-560
R416		22 k	2 w	Fixed	Comp.	10%	306-223
R417		18 k	1 w	Fixed	Comp.	10%	304-183
R420		8.2 meg	½ w	Fixed	Comp.	5%	301-825
R421		820 k	½ w	Fixed	Comp.	5%	301-824
R423		180 k	½ w	Fixed	Comp.	10%	302-184
R425		220 k	½ w	Fixed	Comp.	10%	302-224
R427		100 Ω	½ w	Fixed	Comp.	10%	302-101
R430		4.7 k	½ w	Fixed	Comp.	10%	302-472
R431		100 Ω	½ w	Fixed	Comp.	10%	302-101
R433		10 k	3 w	Fixed	Prec.	1%	*310-559
R434		100 Ω	½ w	Fixed	Comp.	10%	302-101
R436		18 k	2 w	Fixed	Comp.	10%	306-183
R437		3.3 k	½ w	Fixed	Comp.	5%	301-332
R438		11 k	2 w	Fixed	Comp.	5%	305-113
R441		250 k		Var.	Comp.		311-032
R442		82 k	½ w	Fixed	Comp.	5%	301-823
R443		18 k	½ w	Fixed	Comp.	5%	301-183
R444		1.8 k	½ w	Fixed	Comp.	5%	301-182
R445		39 k	1 w	Fixed	Comp.	5%	303-393
R446		100 Ω	½ w	Fixed	Comp.	10%	302-101
R447		1 k	½ w	Fixed	Comp.	10%	302-102
R448		56 k	½ w	Fixed	Comp.	10%	302-563
R450		680 Ω	½ w	Fixed	Comp.	10%	302-681
R460		1.2 meg	½ w	Fixed	Prec.	1%	309-149
R464		56 k	2 w	Fixed	Comp.	10%	306-563
R465		1.8 meg	½ w	Fixed	Comp.	10%	302-185
R466		220 k	½ w	Fixed	Comp.	10%	302-224
R467		47 Ω	½ w	Fixed	Comp.	10%	302-470
R469		25 k	10 w	Fixed	WW	5%	308-154
R472		36 k	½ w	Fixed	Comp.	5%	301-363
R473		180 k	½ w	Fixed	Comp.	5%	301-184
R475		1 k	½ w	Fixed	Comp.	10%	302-102
R476		1 meg	½ w	Fixed	Comp.	10%	302-105
R477		2 meg		Var.	Comp.		311-042
R478		82 k	1 w	Fixed	Comp.	5%	303-823
R480		1.8 meg	½ w	Fixed	Comp.	5%	301-185
R481		470 k	½ w	Fixed	Comp.	10%	302-474
R482		10 k	½ w	Fixed	Comp.	10%	302-103
R483		3.3 meg	½ w	Fixed	Comp.	10%	302-335
R485		33 k	1 w	Fixed	Comp.	10%	304-333
R486		1 k	½ w	Fixed	Comp.	10%	302-102

						Tektronix Part Number
R488	68 k	1 w	Fixed	Comp.	10%	304-683
R491	500 k	½ w	Fixed	Prec.	1%	309-003
R492	1.75 meg	½ w	Fixed	Prec.	1%	309-019
R493	100 Ω	½ w	Fixed	Comp.	10%	302-101
R494	1 meg	½ w	Fixed	Prec.	1%	309-014
R495	33 k	½ w	Fixed	Comp.	10%	302-333
R496	100 Ω	½ w	Fixed	Comp.	10%	302-101
R499	22 k	½ w	Fixed	Comp.	10%	302-223
R601	30 Ω	3 w	Fixed	WW	5%	308-142
R602	50 Ω		Var.	WW		311-055
R603	12 Ω	1 w	Fixed	Comp.	10%	304-120
R608	33 k	1 w	Fixed	Comp.	10%	304-333
R610	1 meg	½ w	Fixed	Comp.	10%	302-105
R611	1 k	½ w	Fixed	Comp.	10%	302-102
R615	68 k	½ w	Fixed	Prec.	1%	309-042
R616	10 k	2 w	Var.	Comp.	10%	311-076
R617	50 k	½ w	Fixed	Prec.	1%	309-090
R618	1 meg	½ w	Fixed	Comp.	10%	302-105
R621	1 k	½ w	Fixed	Comp.	10%	302-102
R625	18 k	1 w	Fixed	Comp.	10%	304-183
R633	1.5 meg	½ w	Fixed	Comp.	10%	302-155
R634	1 k	½ w	Fixed	Comp.	10%	302-102
R637	1 meg	½ w	Fixed	Comp.	10%	302-105
R638	10 k	½ w	Fixed	Comp.	10%	302-103
R639	100 k	½ w	Fixed	Comp.	10%	302-104
R640	1 Ω	4 w	Fixed	Prec.	½%	310-535
R650	390 k	½ w	Fixed	Prec.	1%	309-056
R651	500 k	½ w	Fixed	Prec.	1%	309-003
R652	1 meg	½ w	Fixed	Comp.	10%	302-105
R653	1 k	½ w	Fixed	Comp.	10%	302-102
R663	2.2 meg	½ w	Fixed	Comp.	10%	302-225
R667	4.7 meg	½ w	Fixed	Comp.	10%	302-475
R668	82 k	½ w	Fixed	Comp.	10%	302-823
R669	56 k	½ w	Fixed	Comp.	10%	302-563
R670	1 Ω	4 w	Fixed	Prec.	½%	310-535
R673	1 k	½ w	Fixed	Comp.	10%	302-102
R674	1 k	½ w	Fixed	Comp.	10%	302-102
R675	3.5 k	5 w	Fixed	WW	5%	308-080
R676	3.5 k	5 w	Fixed	WW	5%	308-080
R677	1.5 k	25 w	Fixed	WW	5%	308-040
R710	237 k	1 w	Fixed	Prec.	1%	Use 310-124
R711	100 k	½ w	Fixed	Prec.	1%	Use 323-385
R712	1 meg	½ w	Fixed	Comp.	10%	302-105
R713	1 k	½ w	Fixed	Comp.	10%	302-102
R723	470 k	½ w	Fixed	Comp.	10%	302-474
R728	330 k	1 w	Fixed	Comp.	10%	Use 304-334
R729	47 k	½ w	Fixed	Comp.	10%	302-473
R730	10 Ω	1 w	Fixed	Comp.	10%	304-100
R733	1 k	½ w	Fixed	Comp.	10%	302-102
R734	1 k	½ w	Fixed	Comp.	10%	302-102

Resistors *(continued)*

							Tektronix Part Number
R737		3 k	25 w	Fixed	WW	5%	Use 308-042
R771		100 k	½ w	Fixed	Comp.	10%	302-104
R772		100 k	½ w	Fixed	Comp.	10%	302-104
R802		680 Ω	2 w	Fixed	Comp.	10%	306-681
R803	101-723	68 k	2 w	Fixed	Comp.	10%	306-683
R803	724-up	470 k	½ w	Fixed	Comp.	10%	302-0474-00
R804	X724-up	1 k	¼ w	Fixed	Comp.	10%	316-0102-00
R805	X724-up	100 k	½ w	Fixed	Comp.	10%	302-0104-00
R806		100 k	½ w	Fixed	Comp.	10%	302-104
R807	101-723	3.9 k	½ w	Fixed	Comp.	10%	Use 302-392
R807	724-up	4.7 k	½ w	Fixed	Comp.	10%	302-0472-00
R814		470 k	½ w	Fixed	Comp.	10%	302-474
R817		100 Ω	½ w	Fixed	Comp.	10%	302-101
R841		3.6 meg	1 w	Fixed	Comp.	5%	303-365
R842		6.8 meg	2 w	Fixed	Comp.	5%	305-685
R843		6.8 meg	2 w	Fixed	Comp.	5%	305-685
R844		6.8 meg	2 w	Fixed	Comp.	5%	305-685
R845		2 meg		Var.	Comp.		311-043
R846		3.9 meg	1 w	Fixed	Comp.	5%	303-395
R848		2 meg		Var.	Comp.		311-043
R850		10 k	½ w	Fixed	Comp.	10%	302-103
R852		1 meg	½ w	Fixed	Comp.	10%	302-105
R853		1 meg	¼ w	Fixed	Comp.	10%	316-105
R854		22 k	½ w	Fixed	Comp.	10%	302-223
R855		100 k	½ w	Fixed	Comp.	10%	302-104
R861		100 k		Var.	Comp.		311-026
R864		100 k		Var.	Comp.		311-026

Switches

			Unwired | Wired
SW10		Input Selector, Rotary, 3 Section, 3 Position	260-280 262-230
SW185		External Sub-carrier Course Phase Rotary, 6 Section, 24 Position	260-278 262-228
SW190		Sub-carrier Selector, Rotary, 2 Section, 3 Position	260-281 262-231
SW380	101-1579	Display Selector, Rotary, 3 Section, 4 Position, Front, 1 Section, 2 Position, Rear	260-279 262-229
SW380	1580-up	Display Selector, Rotary, 3 Section, 4 Position, Front, 1 Section, 2 Position, Rear	260-0279 *262-0229-01
SW400		Sync Selector, Slide, Double Pole, Double Throw	260-212
SW601		Power On, Toggle, Single Pole, Single Throw	260-134
TK601		Thermal Cutout, Opens at 133 degrees	Use 260-0208-00
SW852		Z Axis Input, Single Pole, Single Throw (On EXTERNAL UNBLANKING connector)	131-024

Transformers

T16	Video Output Coupling	120-134
T132	Detector Stage Coupling	120-136
T152	Regenerator Output	120-135
T601	Low-Voltage Power Supply	120-131
T801	HV Oscillator	120-130

Tubes

			Tektronix Part Number
V13	101-1379	6AU6	154-022
V13	1380-up	8425	154-0022-07
V14	101-559	Replacement Kit	Use *050-206
V14	560-up	6HZ6	154-447
V23	101-1379	6AU6	154-022
V23	1380-up	8425	154-0022-07
V24	101-559	Replacement Kit	Use *050-206
V24	560-up	6HZ6	154-447
V44	101-1379	6AU6	154-022
V44	1380-up	8425	154-0022-07
V55		12AU7A	154-041
V75		6DJ8	154-187
V114		6DJ8	154-187
V134	101-1322	6688	154-215
V134	1323-up	6EJ7	154-0421-00
V142		6AL5	154-016
V150	101-1379	6AU6	154-022
V150	1380-up	8425	154-0022-07
V174	101-1379	6AU6	154-022
V174	1380-up	8425	154-0022-07
V194	101-1379	6AU6	154-022
V194	1380-up	8425	154-0022-07
V203		6DJ8	154-187
V224		6BA8A	154-163
V233		6DJ8	154-187
V253		6DJ8	154-187
V264		6AR8	154-200
V283		6DJ8	154-187
V304	101-559	Replacement Kit	Use *050-206
	560-up	6HZ6	154-447
V314	101-559	Replacement Kit	Use *050-206
V314	560-up	6HZ6	154-447
V324	101-1379	6AU6	154-022
V324	1380-up	8425	154-0022-07
V333		6BA8A	154-163
V334	101-1379	6AU6	154-022
V334	1380-up	8425	154-0022-07
V343		6BA8A	154-163
V354	101-559	Replacement Kit	Use *050-206
V354	560-up	6HZ6	154-447
V364	101-559	Replacement Kit	Use *050-206
V364	560-up	6HZ6	154-447
V374	101-1379	6AU6	154-022
V374	1380-up	8425	154-0022-07
V383		6BA8A	154-163
V384	101-1379	6AU6	154-022
V384	1380-up	8425	154-0022-07
V393		6BA8A	154-163
V404	101-1379	6AU6	154-022
V404	1380-up	8425	154-0022-07
V414		6BA8A	154-163
V435		6DJ8	154-187
V445		6BA8A	154-163
V452		6BJ7	Use 154-0453-00
V461		6AN8	154-078
V475		12AU7	154-041
V483		6DJ8	154-187
V494		6DJ8	154-187
V609		5651	154-052

Tubes *(Cont'd)*

			Tektronix Part Number
V627		6DE7	154-188
V634		6AU6	154-022
V664		6AU6	154-022
V667		6CW5	154-202
V677		6CW5	154-202
V724		6AU6	154-022
V727		12B4	154-044
V737		12B4	154-044
V800	101-723	6CZ5	154-167
V800	724-up	6GV8	154-0468-00
V814		12AU7	154-041
V852		5642	154-051
V859		CRT, T5260-31 Standard Phosphor	Use *154-0289-01

Crystals

X44		3.59 mc.	158-011
X144	101-587	Replacement Kit	Use *050-209
	588-up	3.579 mc.	158-017

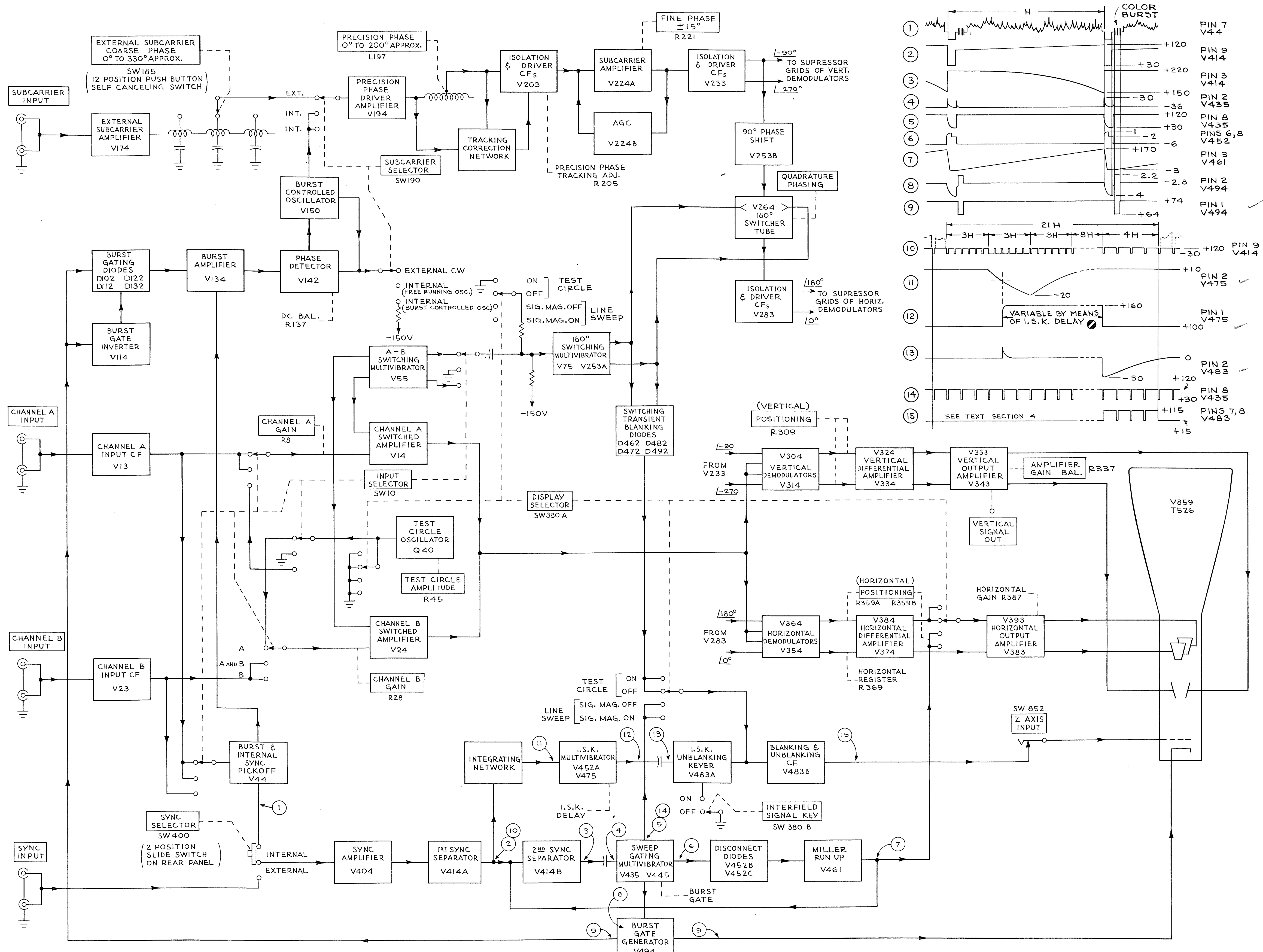
Diodes*

D52	101-1569	Germanium	152-008
D52	1570-up	Silicon, Tek Spec	*152-0061-00
D62	101-1569	Germanium	152-008
D62	1570-up	Silicon, Tek Spec	*152-0061-00
D72	101-1569	Germanium	152-008
D72	1570-up	Silicon, Tek Spec	*152-0061-00
D82	101-1569	Germanium	152-008
D82	1570-up	Silicon, Tek Spec	*152-0061-00
D102	101-1569	Germanium	152-008
D102	1570-up	Silicon Diode, Replaceable by 1N3605	*152-0185-00
D112	101-1569	Germanium	152-008
D112	1570-up	Silicon Diode, Replaceable by 1N3605	*152-0185-00
D122	101-1569	Germanium	152-008
D122	1570-up	Silicon Diode, Replaceable by 1N3605	*152-0185-00
D132	101-1569	Germanium	152-008
D132	1570-up	Silicon Diode, Replaceable by 1N3605	*152-0185-00
D134	X1570-up	Silicon Diode, Replaceable by 1N3605	*152-0185-00
D142	X1410-up	Silicon, Vari-cap, 56 pf	152-0270-00
D143	X1410-up	Silicon, Vari-cap, 56 pf	152-0270-00
D205	X1410-up	Silicon, Vari-cap, 56 pf	152-0270-00
D224	X1410-up	Silicon, Vari-cap, 56 pf	152-0270-00
D225	X1410-up	Silicon, Vari-cap, 56 pf	152-0270-00
D272	X1410-up	Silicon, Vari-cap, 56 pf	152-0270-00
D462		Silicon Diode, Checked	Use *153-007
D466	101-1479	Silicon Diode, Replaceable by 1N2862	Use *152-047
D466	1480-up	Silicon 1N3194	152-0066-00
D472		Silicon Diode, Checked	Use *153-007
D482		Silicon Diode, Checked	Use *153-007
D492		Silicon Diode, Checked	Use *153-007
D622 A,B,C,D	101-1479	Silicon Diode, Replaceable by 1N2862	Use *152-047
D622 A,B,C,D	1480-up	Silicon 1N3194	152-0066-00
D662 A,B,C,D	101-1479	Silicon Diode, Replaceable by 1N2862	Use *152-047
D662 A,B,C,D	1480-up	Silicon 1N3194	152-0066-00
D722 A,B,C,D	101-1479	Silicon Diode, Replaceable by 1N2862	Use *152-047
D722 A,B,C,D	1480-up	Silicon 1N3194	152-0066-00

Transistors

Q40	101-214	Replacement Kit	Use *050-038
	215-up	2N1631 Transistor	151-047

* Even though the diodes may be different in physical size, they are direct electrical replacements for the diodes in your instrument.

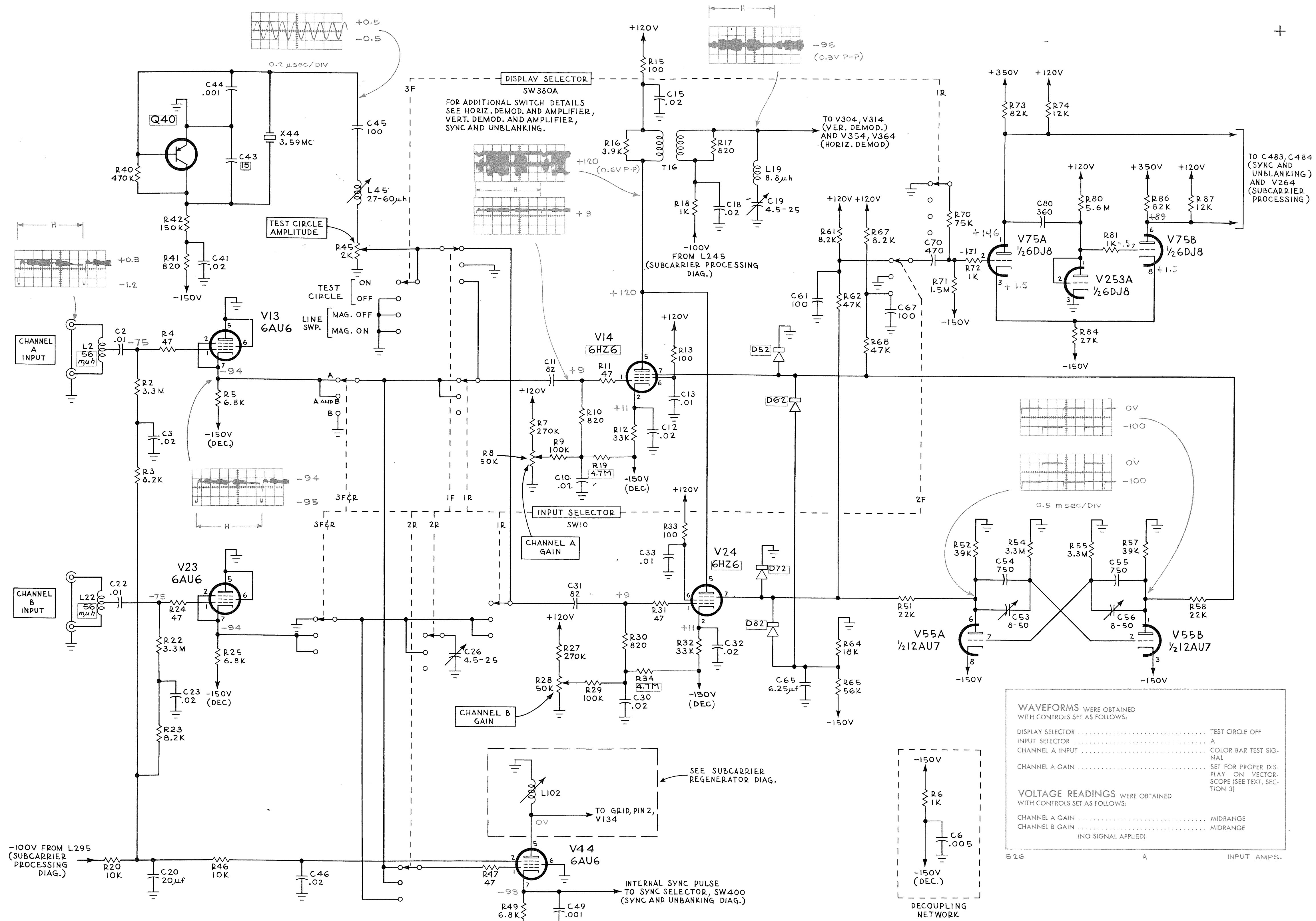


TYPE 526 VECTORSCOPE

C2

BLOCK DIAGRAM

GAB 8-5-62



WAVEFORMS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

DISPLAY SELECTOR	TEST CIRCLE OFF
INPUT SELECTOR	A
CHANNEL A INPUT	COLOR-BAR TEST SIGNAL
CHANNEL A GAIN	SET FOR PROPER DISPLAY ON VECTORSCOPE (SEE TEXT, SECTION 3)

VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

CHANNEL A GAIN	MIDRANGE
CHANNEL B GAIN	MIDRANGE

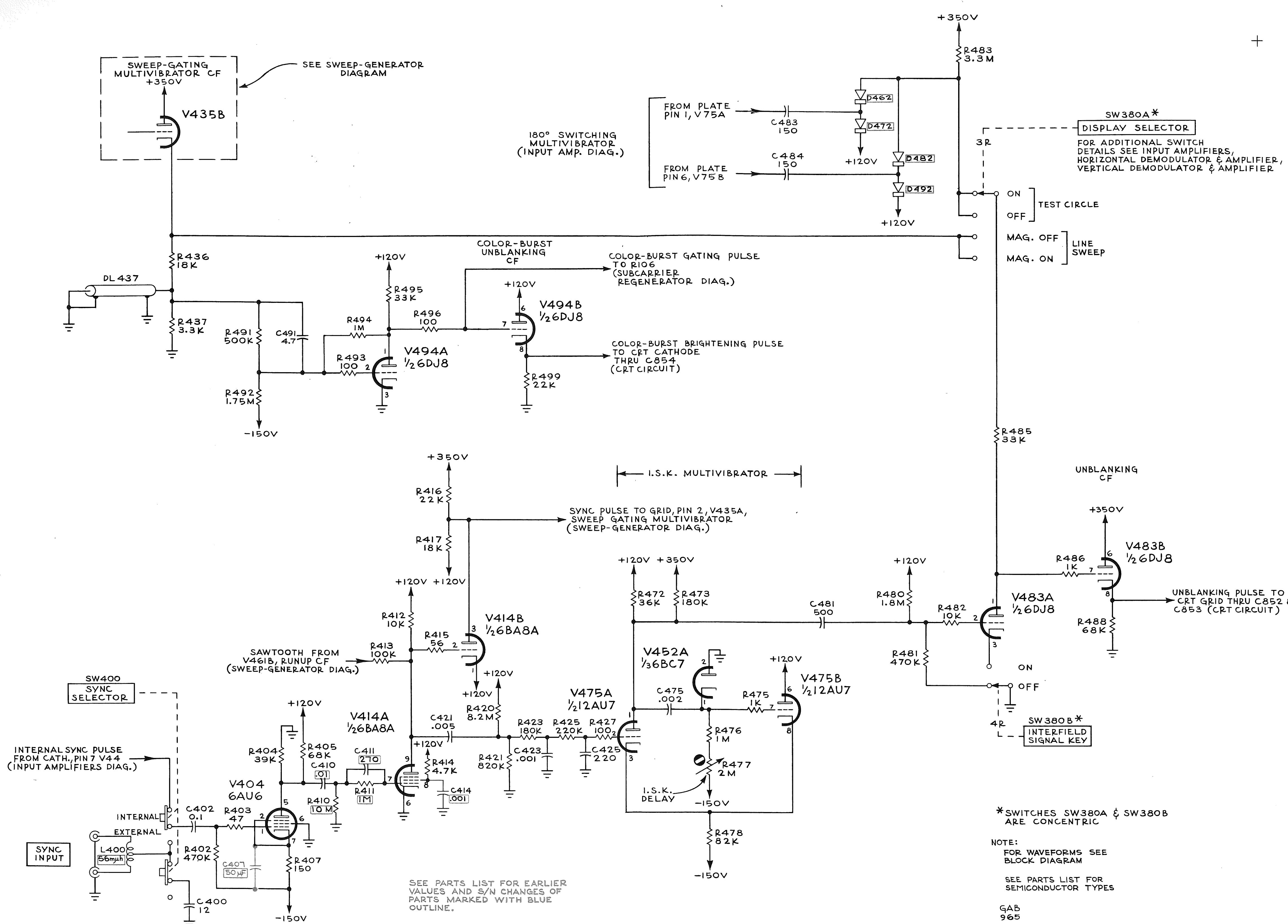
(NO SIGNAL APPLIED)

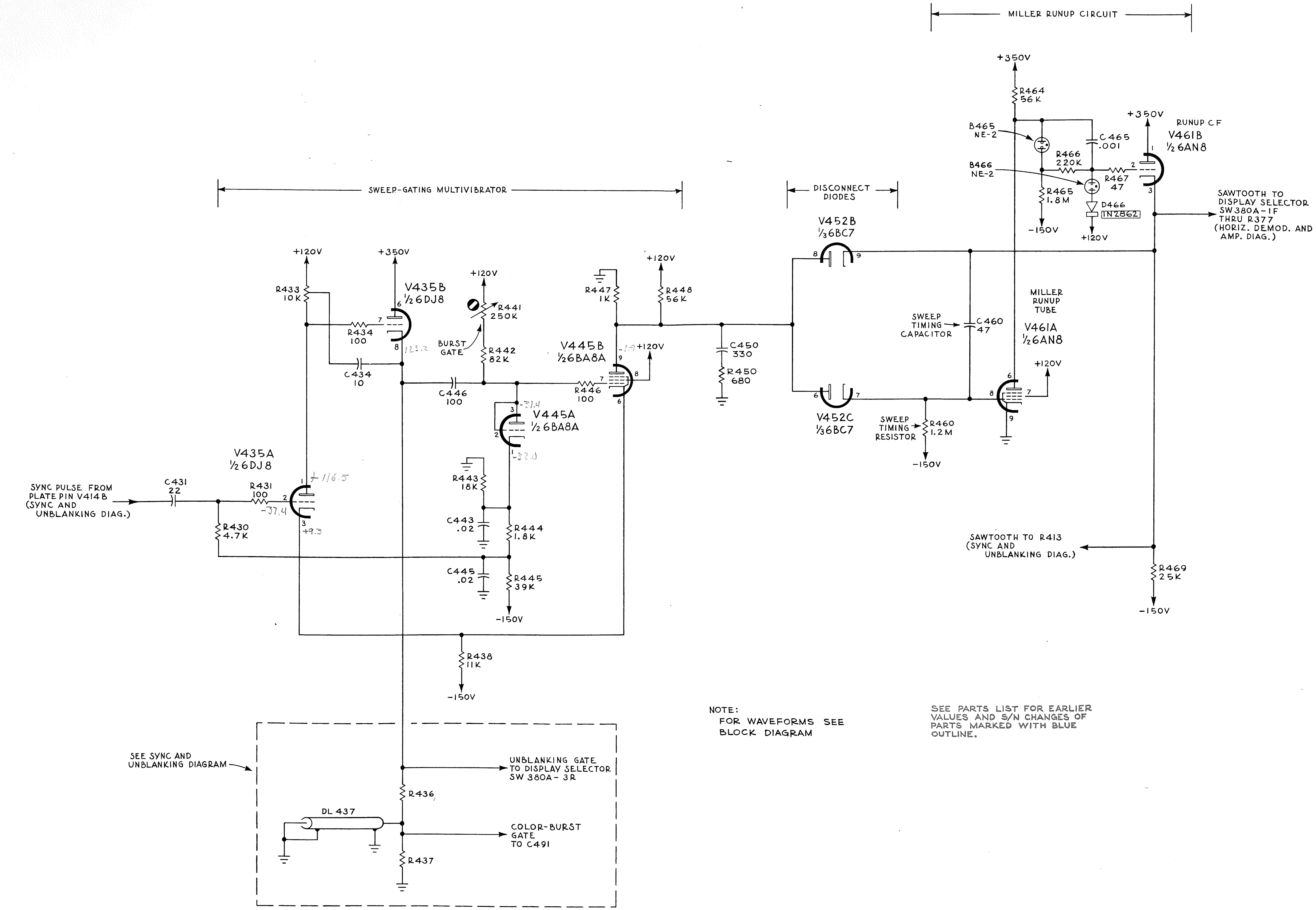
526 A INPUT AMPS.

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE.

SEE PARTS LIST FOR SEMICONDUCTOR TYPES

966
GAB

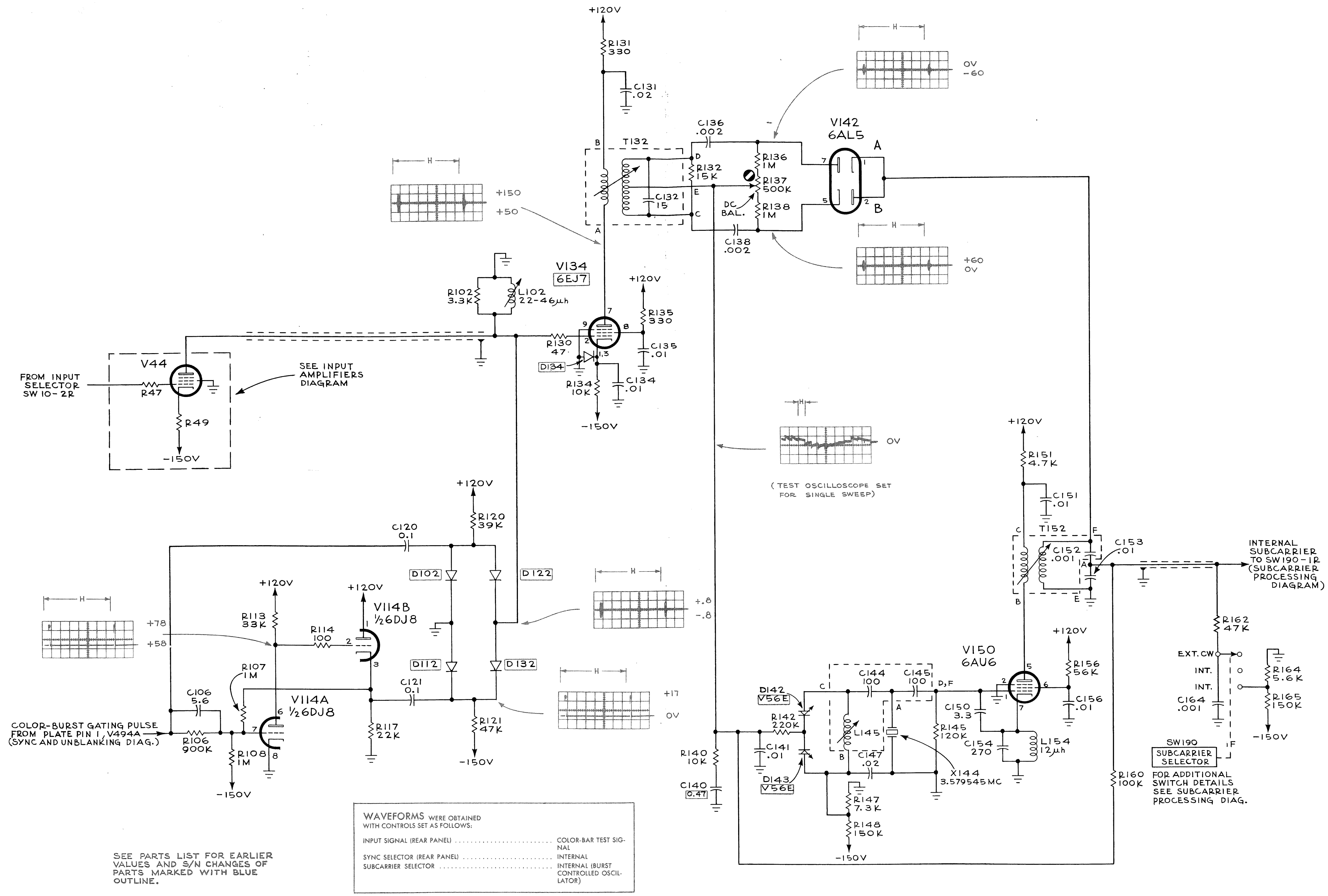

SWEEP-GATING MULTIVIBRATOR CF
+350V
V435B
SEE SWEEP-GENERATOR DIAGRAM
180° SWITCHING MULTIVIBRATOR (INPUT AMP. DIAG.)
FROM PLATE PIN 1, V75A
FROM PLATE PIN 6, V75B
C483 150
C484 150
D462
D472
D482
D492
+120V
+350V
R483 3.3M
SW380A*
DISPLAY SELECTOR
3R
FOR ADDITIONAL SWITCH DETAILS SEE INPUT AMPLIFIERS, HORIZONTAL DEMODULATOR & AMPLIFIER, VERTICAL DEMODULATOR & AMPLIFIER
ON
OFF
TEST CIRCLE
MAG. OFF
MAG. ON
LINE SWEEP
R436 18K
DL 437
R437 3.3K
R491 500K
C491 4.7
R492 1.75M
-150V
R494 1M
R493 100
V494A ½6DJ8
R495 33K
R496 100
COLOR-BURST UNBLANKING CF
V494B ½6DJ8
R499 22K
COLOR-BURST GATING PULSE TO R106 (SUBCARRIER REGENERATOR DIAG.)
COLOR-BURST BRIGHTENING PULSE TO CRT CATHODE THRU C854 (CRT CIRCUIT)
R485 33K
UNBLANKING CF
R416 22K
R417 18K
SYNC PULSE TO GRID, PIN 2, V435A, SWEEP GATING MULTIVIBRATOR (SWEEP-GENERATOR DIAG.)
I.S.K. MULTIVIBRATOR
R412 10K
R415 56
V414B ½6BA8A
R413 100K
SAWTOOTH FROM V461B, RUNUP CF (SWEEP-GENERATOR DIAG.)
R420 8.2M
C421 .005
R421 820K
V414A ½6BA8A
R414 4.7K
C414 .001
C411 270
R411 1M
R410 10M
C410 .01
R405 68K
R404 39K
V404 6AU6
R403 47
C402 0.1
R402 470K
C407 50µF
R407 150
C400 12
SW400 SYNC SELECTOR
INTERNAL SYNC PULSE FROM CATH., PIN 7 V44 (INPUT AMPLIFIERS DIAG.)
INTERNAL
EXTERNAL
L400 56mµh
SYNC INPUT
R423 180K
C423 .001
R425 220K
R427 100
C425 220
V475A ½12AU7
R472 36K
R473 180K
V452A ⅓6BC7
C475 .002
R476 1M
R477 2M
I.S.K. DELAY
R478 82K
R475 1K
V475B ½12AU7
C481 500
R480 1.8M
R481 470K
R482 10K
V483A ½6DJ8
R486 1K
V483B ½6DJ8
R488 68K
UNBLANKING PULSE TO CRT GRID THRU C852 & C853 (CRT CIRCUIT)
SW380B*
INTERFIELD SIGNAL KEY
4R
SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE.
*SWITCHES SW380A & SW380B ARE CONCENTRIC
NOTE:
FOR WAVEFORMS SEE BLOCK DIAGRAM
SEE PARTS LIST FOR SEMICONDUCTOR TYPES
GAB 965



NOTE:
FOR WAVEFORMS SEE BLOCK DIAGRAM

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE.

GAB
364

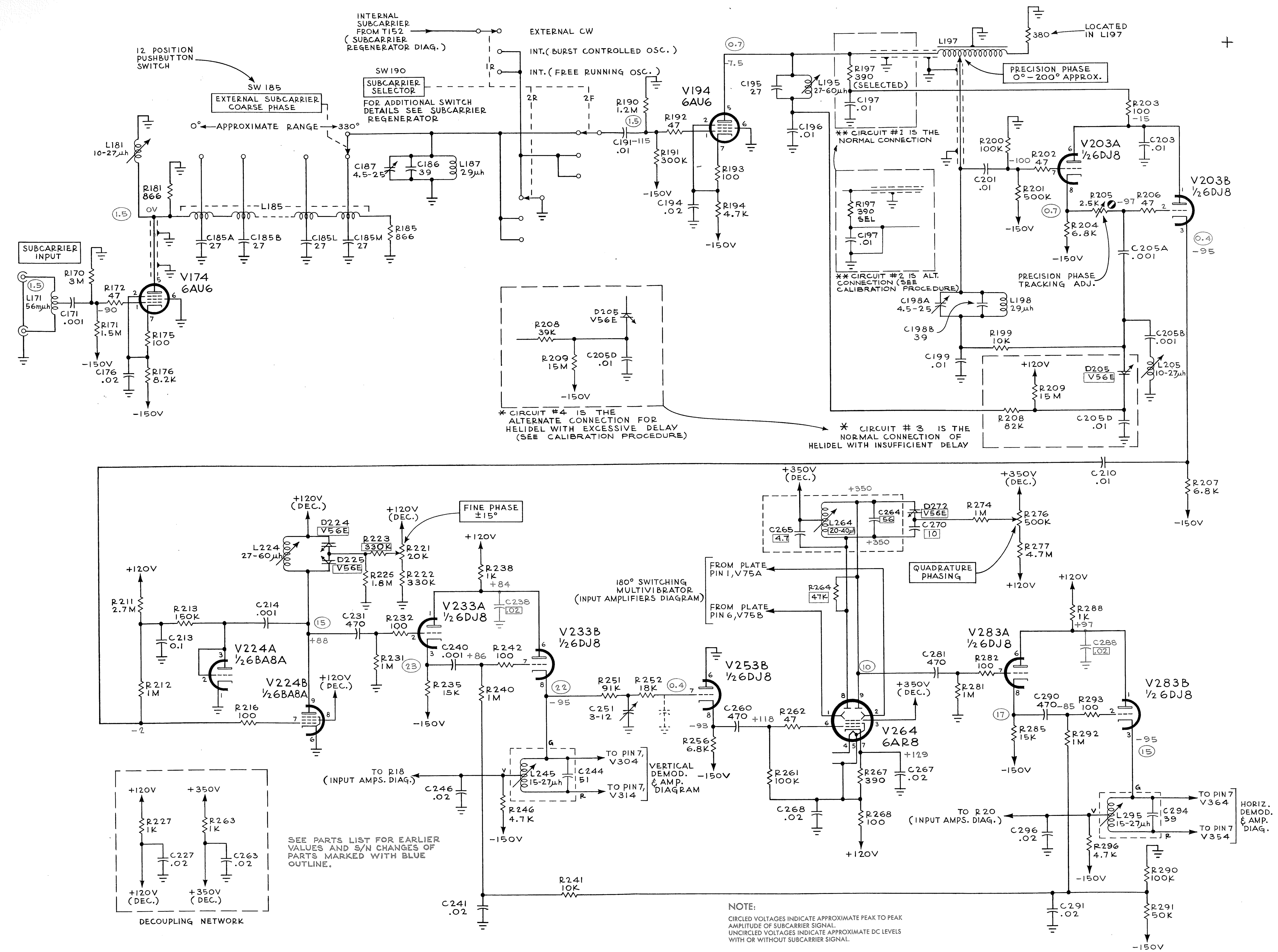


GAB
966

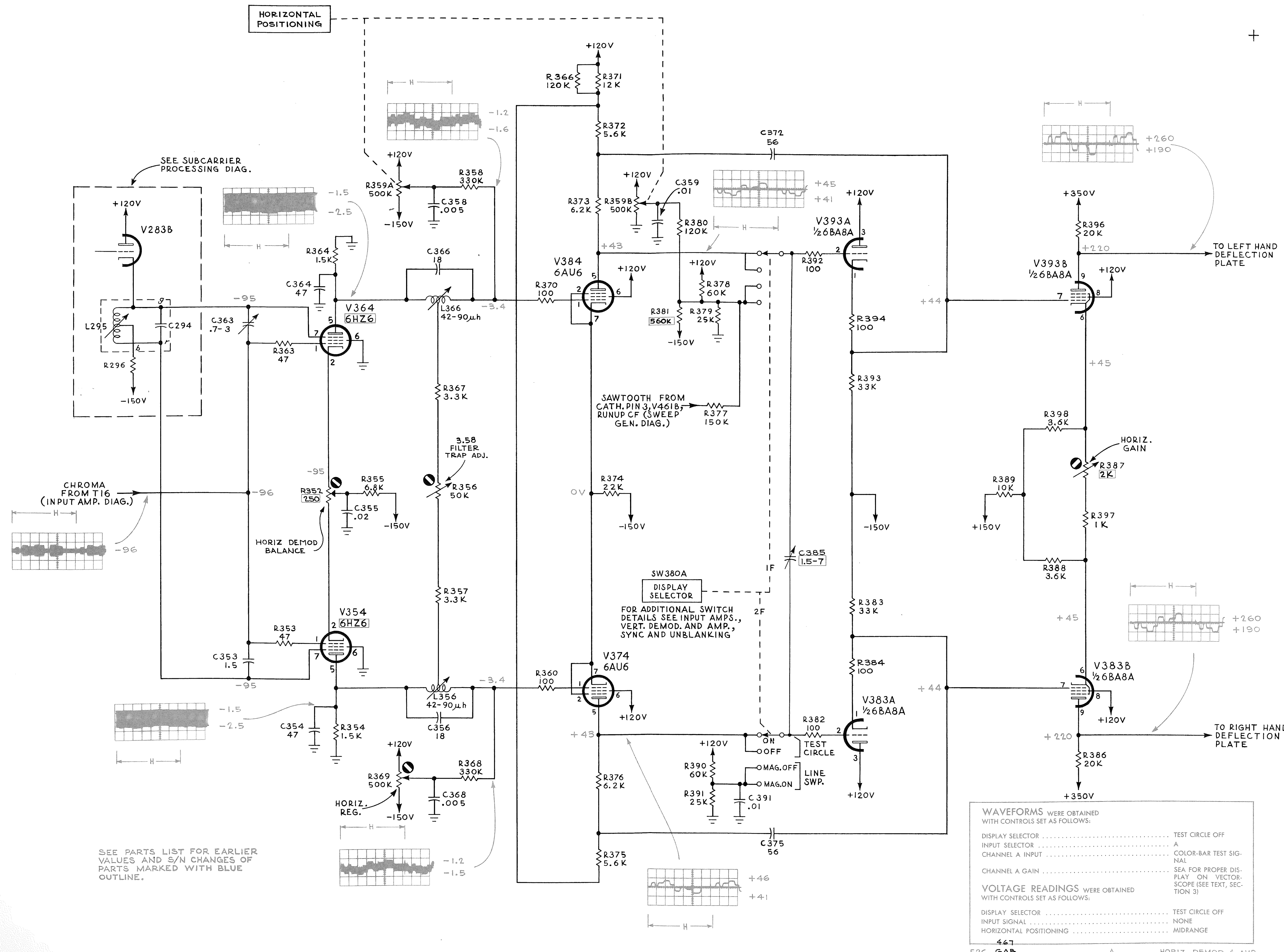
TYPE 526 VECTORSCOPE

F

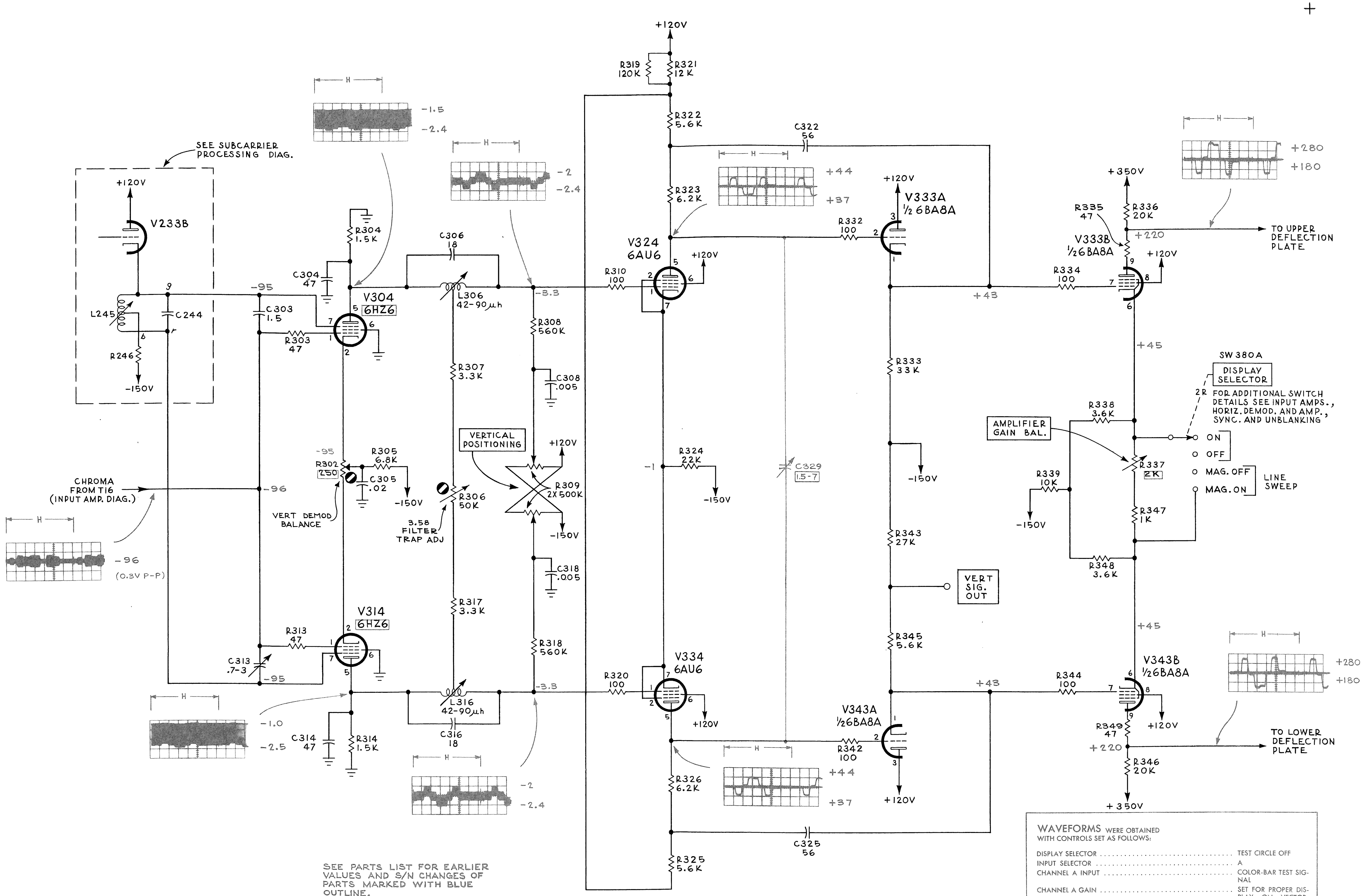
SUBCARRIER REGENERATOR



SUBCARRIER PROCESSING



TYPE 526 VECTORSCOPE F1 HORIZONTAL DEMODULATOR AND AMPLIFIER



WAVEFORMS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

DISPLAY SELECTOR	TEST CIRCLE OFF
INPUT SELECTOR	A
CHANNEL A INPUT	COLOR-BAR TEST SIGNAL
CHANNEL A GAIN	SET FOR PROPER DISPLAY ON VECTORSCOPE (SEE TEXT, SECTION 3)

VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

INPUT SIGNAL	NONE
VERTICAL POSITIONING	MIDRANGE

526 A VERT. DEMOD. & AMP.

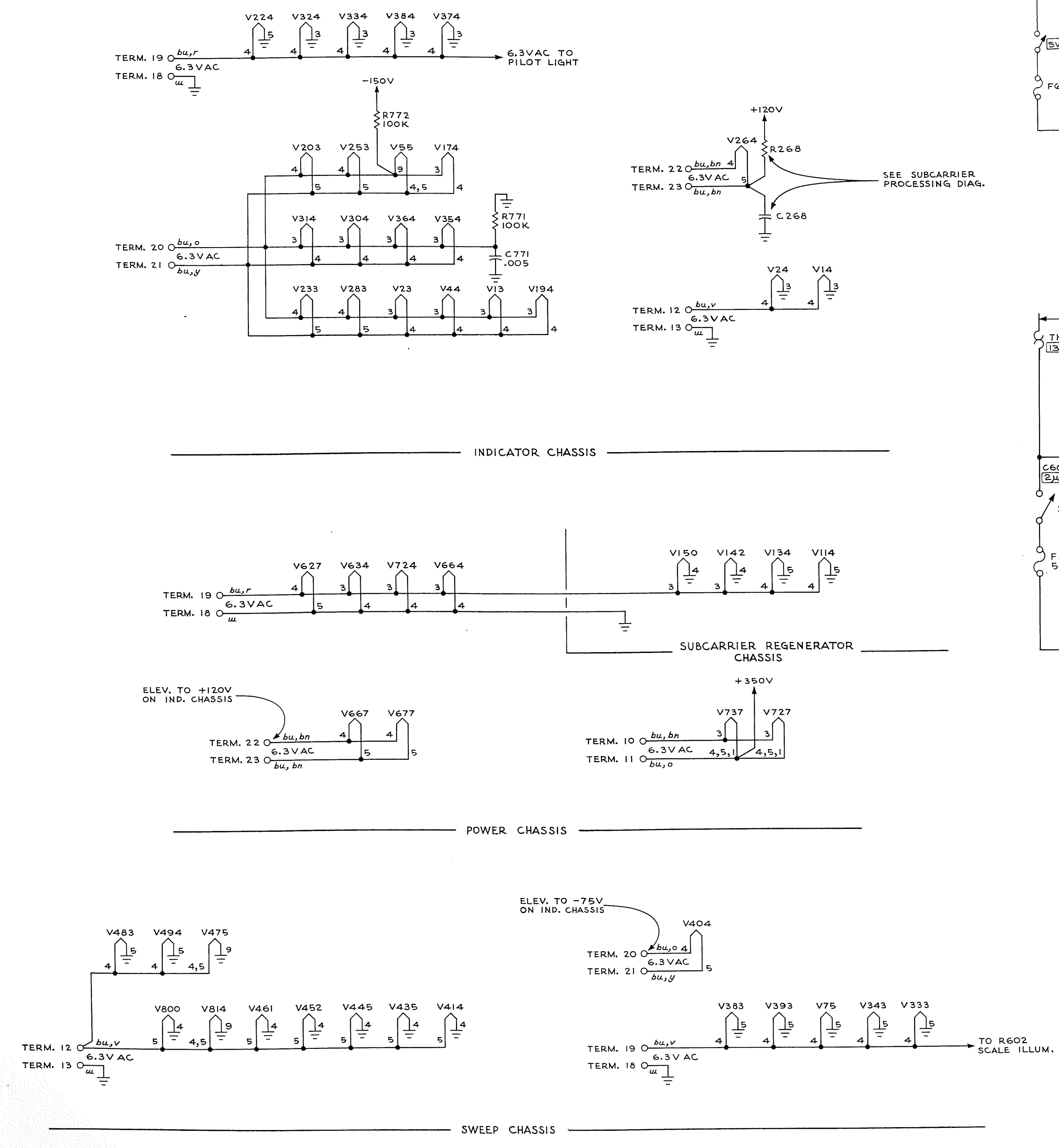
TYPE 526 VECTORSCOPE

F1

VERTICAL DEMODULATOR AND AMPLIFIER

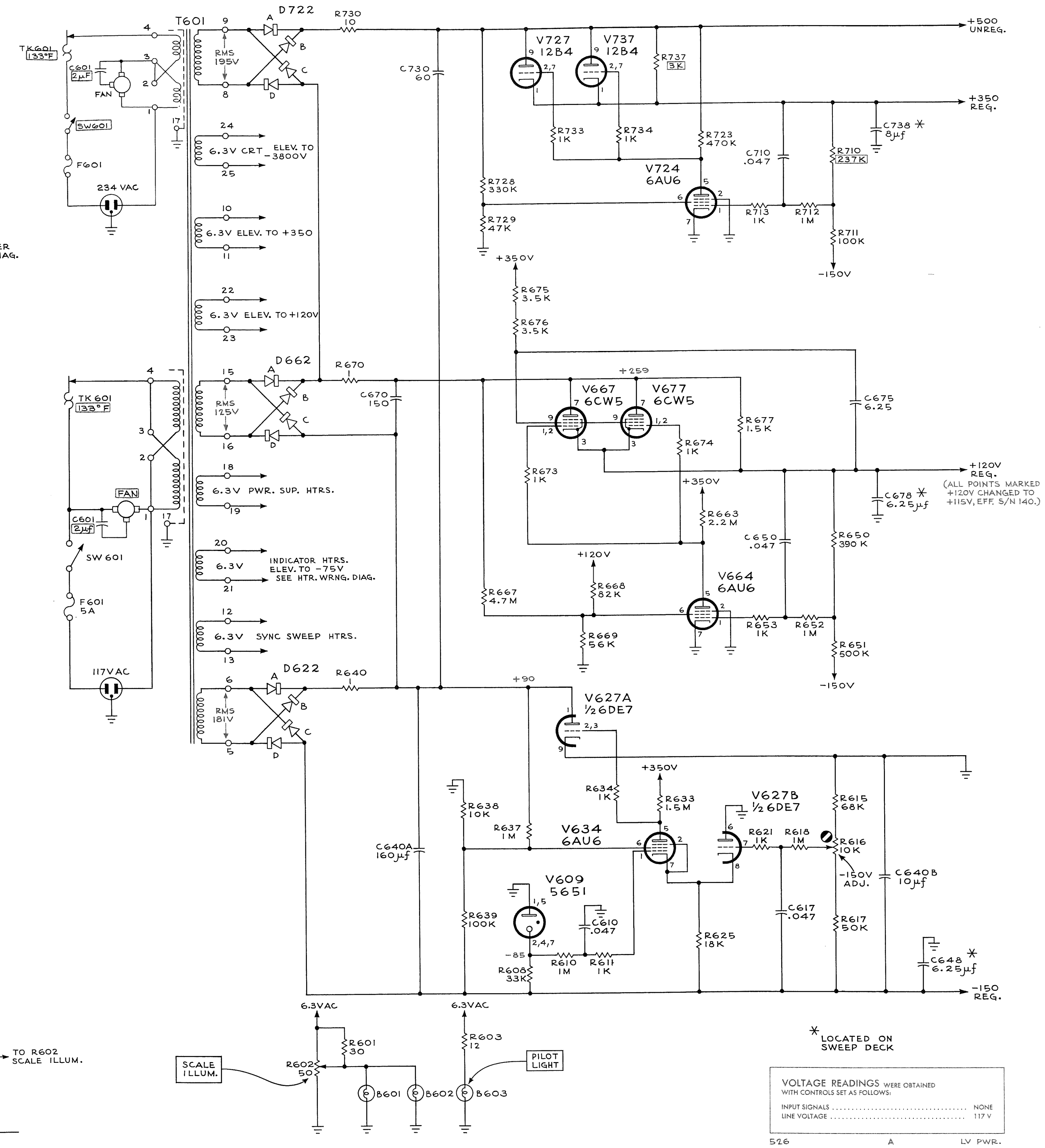
GAB 467

VERT. DEMODULATOR AND AMP.



TYPE 526 VECTORSCOPE

HEATER WIRING DIAGRAM



*LOCATED ON SWEEP DECK

VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:

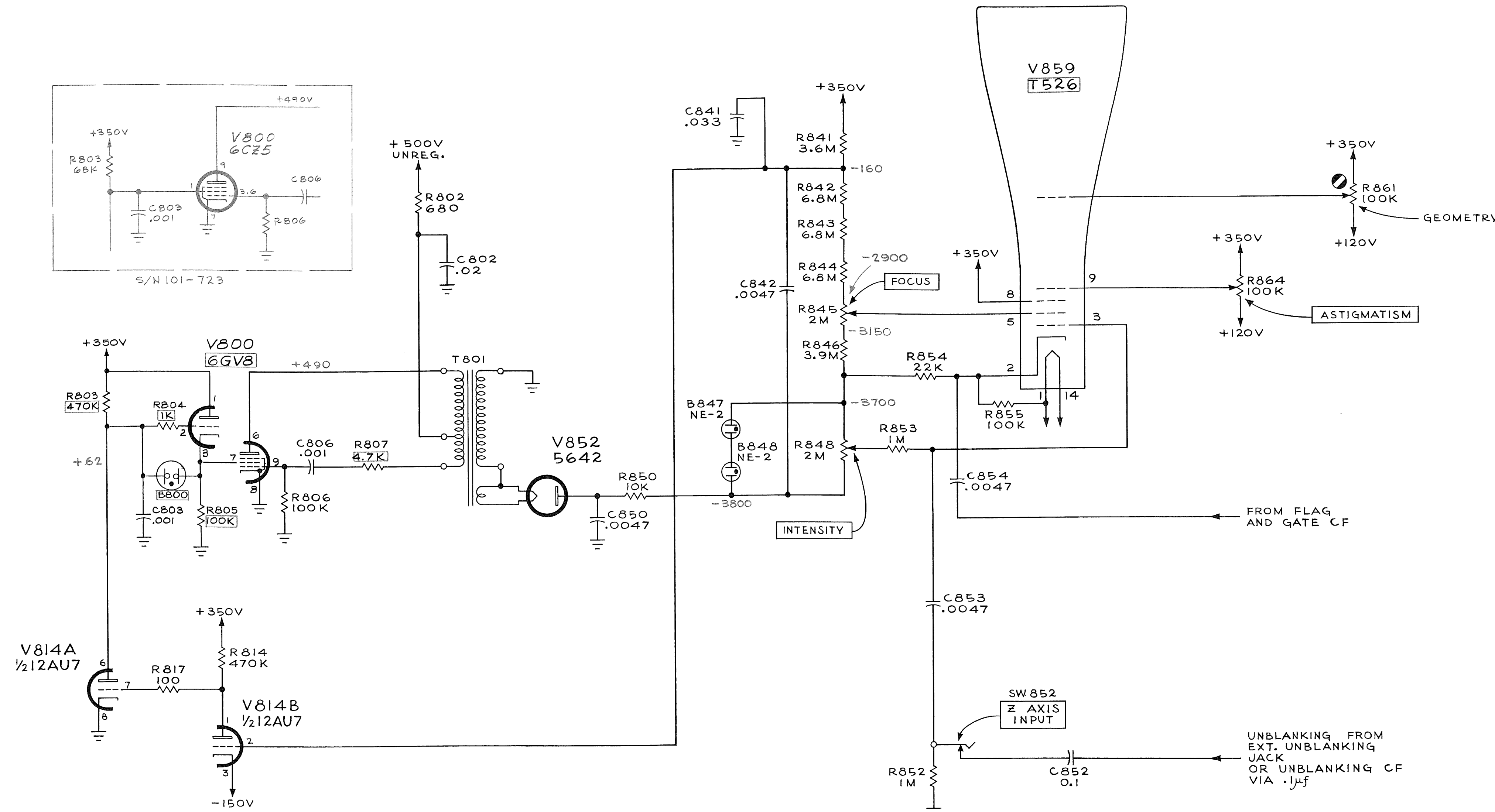
INPUT SIGNALS	NONE
LINE VOLTAGE	117 V

526 A LV PWR.

SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE.

GAB 467

LV POWER SUPPLY



SEE PARTS LIST FOR EARLIER VALUES AND S/N CHANGES OF PARTS MARKED WITH BLUE OUTLINE.

VOLTAGE READINGS WERE OBTAINED WITH CONTROLS SET AS FOLLOWS:
INTENSITY .... CCW

526 A HV & CRT

GAB
467

TYPE 526 VECTORSCOPE

D1

HV POWER SUPPLY & CRT

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages. If it does not, your manual is correct as printed.

TEXT CORRECTION

CALIBRATION

Page 6-6

Replace Precision Phase Tracking Compensation procedure with the following:

Precision Phase Tracking Compensation

1. Obtain a vector display on the Vectorscope and set the PRECISION PHASE control to 000.0.

2. Adjust the FINE PHASE control so as to align the burst vector with the -X axis.

3. Set L205 so that rotating R205 back and forth does not cause the burst vector to move.

4. Set the PRECISION PHASE control to 180.00.

5. Set R205 so that the burst vector lies along the +X axis.

If the burst vector cannot be made to lie along the +X axis, it will be necessary to make circuit wiring changes. Use the following procedure to determine what circuit wiring changes to make.

a. If the circuit wiring in the instrument being calibrated does not agree with the dotted areas on the Subcarrier Processing diagram marked circuits #1 and 2 rewire the instrument so it will agree.

b. Set R205 so that the burst vector lies as close as possible to the +X axis, proceed to step 6, if it does not go to part c.

c. Note the angle of the burst vector from the +X axis line and wire the two dotted areas on the Subcarrier Processing diagram according to the information given in Table 6-1 and on the Subcarrier Processing diagram.

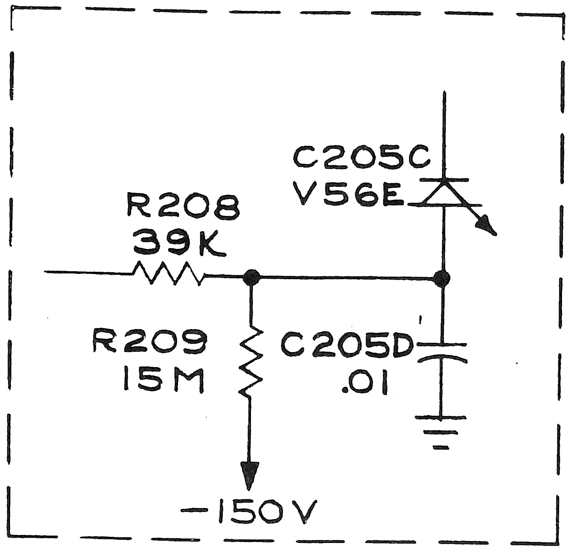
Table 6-1

If Burst Vector Lies Between---	---Wire Dotted Areas As Per Circuits
357° and 0°	#1 and #4
354° or less	#3 and #2
354° and 357°	#3 and #4

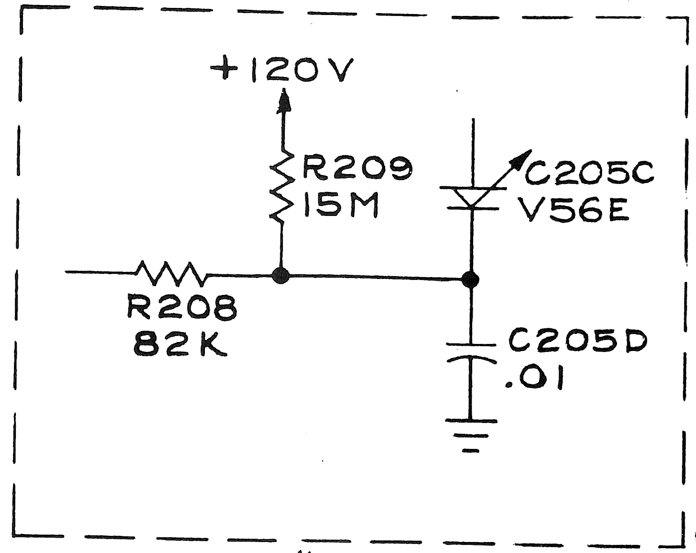
d. Set R205 so that the burst vector lies along the +X axis.

6. With the burst vector lying along the +X axis, the reading on the PRECISION PHASE dial should correspond exactly to 180° minus the angle of the burst vector as the PRECISION PHASE control is rotated.

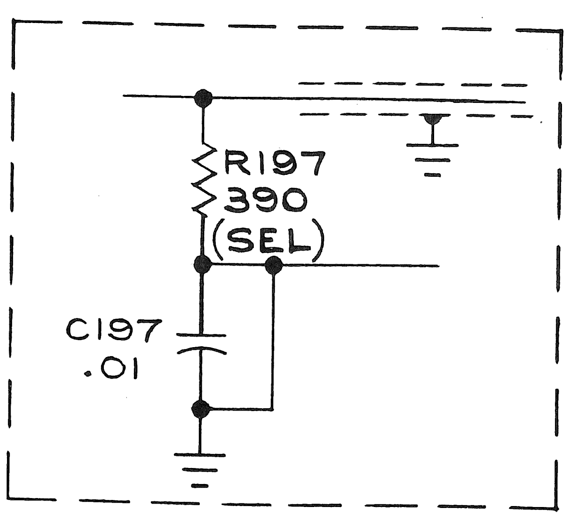
SCHEMATIC CORRECTION



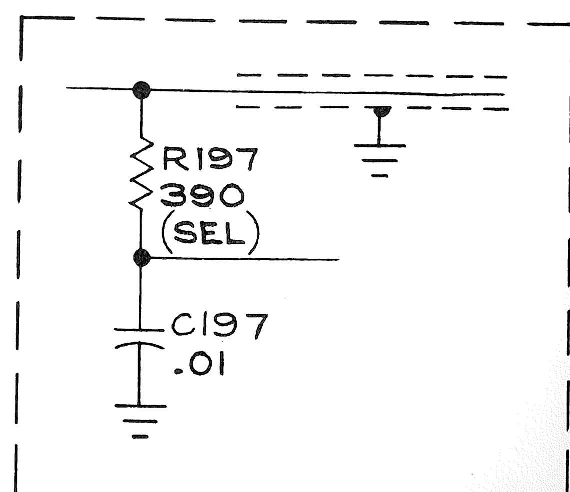
*CIRCUIT #3 ALTERNATE CONNECTION (SEE CALIBRATION PROCEDURE)



*CIRCUIT #1 IS THE NORMAL CONNECTION



* *CIRCUIT #4 ALTERNATE CONNECTION (SEE CALIBRATION PROCEDURE)



* *CIRCUIT #2 IS THE NORMAL CONNECTION

PART SUBCARRIER PROCESSING C1/466

TEXT CORRECTION

CALIBRATION PROCEDURE - Page 6-5

Test Circuit Adjustment

(Precede NOTE with the following:)

a. Set the VERTICAL POSITIONING, HORIZONTAL POSITIONING and HORIZ. REG. controls to midrange.

b. Connect one lead of a 20,000 ohm/volt dc voltmeter to the junction of L306-R308 and the other voltmeter lead to the junction of L316-R318.

c. Adjust VERT DEMOD BAL control (R302) for a zero volt reading on the voltmeter.

d. Remove the voltmeter connections.

e. Connect one lead of the voltmeter to the junction of L366-R358 and the other voltmeter lead to the junction of L356-R368.

f. Adjust HORIZ DEMOD BAL control (R352) for a zero volt reading.

g. Remove the voltmeter connections.

(Add the following after step 13.)

a. Set the VERTICAL and HORIZONTAL POSITIONING controls to midrange.

b. Adjust the VERT DEMOD BAL control (R302) so the doe in the center of the circle lies on the center horizontal graticule line.

c. Adjust the HORIZ DEMOD BAL control (R352) so the doe in the center of the circle lies on the center vertical graticule line.

TEXT CORRECTION

Section 6 Calibration

Page 6-4, Subcarrier Processing Circuit Alignment

ADD the following procedure to the end of Step 15:

Set the test oscilloscope for a vertical deflection factor of 5 V/cm (includes 10X attenuation factor of probe). Connect the 10X probe from the test oscilloscope to pin 8 of V233. Note the signal amplitude. Connect the 10X probe to pin 8 of V283 and adjust C251 for the same amplitude that was noted at pin 8 of V233. Disconnect the probe.

Page 6-5, Test Circle Adjustment

DELETE Step 8 from the procedure.

PARTS LIST CORRECTION

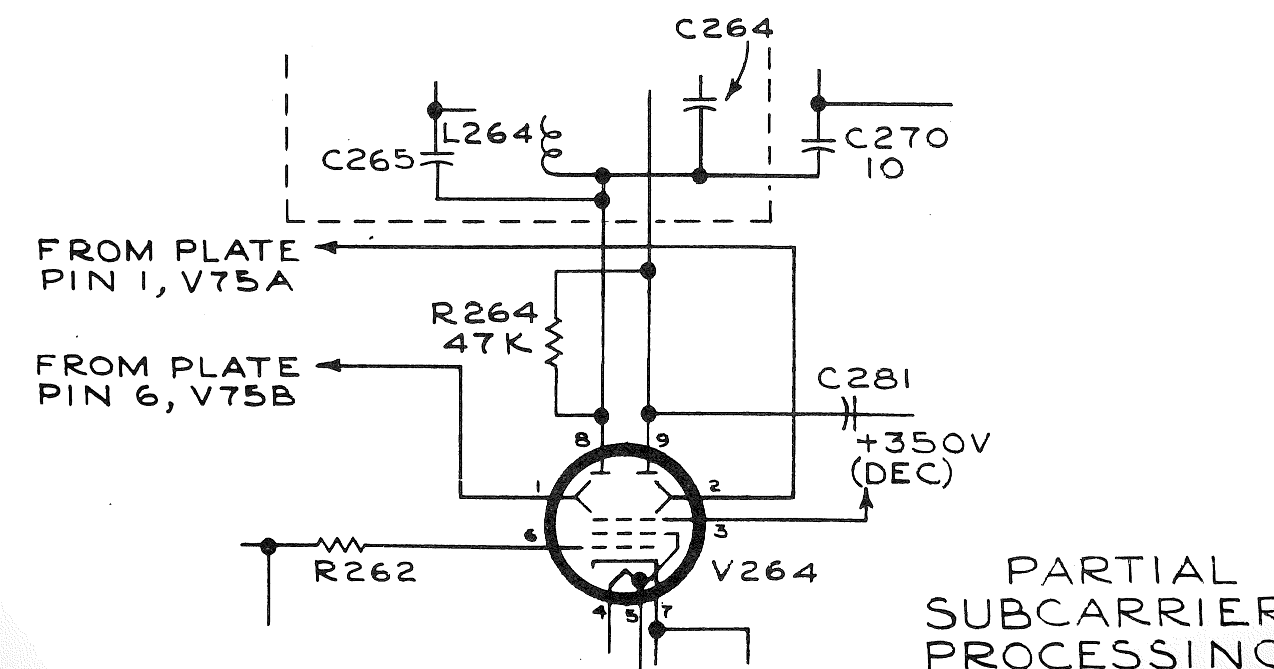
CHANGE TO:

C270	281-0504-00	10 pF	Cer	

ADD:

R264	301-0473-00	47 k	1/2 W	5 %

SCHEMATIC CORRECTION



M12,239/367

TYPE 526 TENT SN 2470

PARTS LIST & SCHEMATIC CORRECTION

CHANGE TO:

L264	114-0163-01	20-40 µH		Var
C264		53 pF	Mica	

M12,280/567

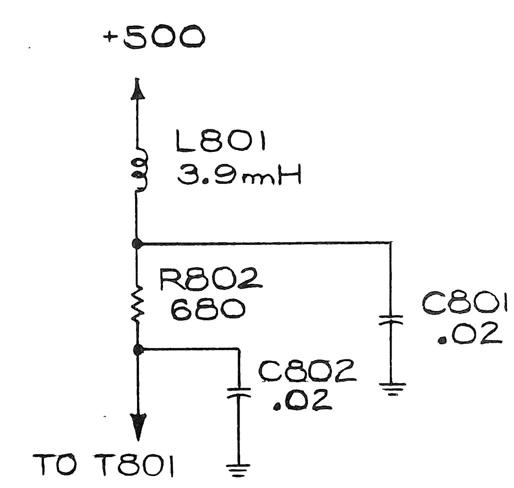
TYPE 526 TENT SN 2550

PARTS LIST CORRECTION

ADD:

C801	283-0022-00	.02 µF		Cer	1400 V	
L801	108-0224-00	3.9 mH	Fixed			5 %

SCHEMATIC CORRECTION



PARTIAL
HV POWER SUPPLY

M12,456/667

M12,456/667

TYPE 526 TENT SN 2740

PARTS LIST CORRECTION

CHANGE TO:

R845	311-0043-02
R848	311-0043-02

M11,639/1067