T.O. 31S1-5SSUD-2

TECHNICAL MANUAL

SERVICE, CIRCUIT DIAGRAMS,
AND ILLUSTRATED PARTS BREAKDOWN

PANORAMIC INDICATOR
IP-804/GR

ASTRO COMMUNICATION LABORATORY, INC.

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CHAPTER 1
GENERAL INFORMATION

1-1. DESCRIPTION AND PURPOSE

1-2. Panoramic Indicator IP-804/GR was specially designed to operate as a companion to the Dual Range UHF Receiver, Type R-1368/GR. The panoramic indicator provides a visual spectrum display of radio frequency (rf) signal activity in a band of frequencies centered on the frequency to which the receiver is tuned. Connection between the receiver and the panoramic indicator is made through a 50-ohm impedance coaxial cable connected to the input jack located on the chassis rear apron. The incoming rf signal from the receiver is centered around 21.4 megacycles (mc) for conversion and processing in the panoramic indicator. The panoramic indicator uses modular construction techniques and is completely transistorized with the exception of the three-inch cathode ray tube (crt). The sweep width is variable from zero (dc) to three mcs with an overall sensitivity such that a one microvolt (uv) continuous wave (cw) signal input to the receiver will produce a one inch vertical display on the panoramic indicator crt. The incoming signal from the receiver, centered at 21.4 mc, is converted to the first intermediate frequency (i-f) of 4.3 mc by mixing with a sweep oscillator centered at 25.7 mc, and then further converted to the final i-f of 455 kilocycles (kc) by heterodyning action of the first i-f and a crystal controlled oscillator operating at 4.755 mc. Since the final i-f bandwidth is approximately five kc, the panoramic indicator has a resolution of better than 20 kc; two signals, 20 kc apart can be clearly distinguished on the crt display. An added feature, for optional use, is the built-in 21.4 mc crystal marker and sideband markers. The 21.4 mc center frequency marker enables the operator to position the incoming signals in the center of the crt display while the sideband markers are used to calibrate the sweep width or determine incoming signal frequencies.

1-3. The panoramic indicator has completely transistorized circuitry which minimizes heat dissipation problems by virtue of reduced power consumption. This also enables light weight construction and structural design simplicity. Power supplies for all transistor circuitry and the high voltage supply for the crt are regulated to minimize the effects of primary power fluctuation and ensure highly stable operation.

1-4. The panoramic indicator is designed for a rack mounting installation, and as a result, all controls and indicators are located on the front panel, while input connections are located on the chassis rear apron. Both top and bottom chassis dust covers are included to minimize personnel safety hazards and to eliminate dust and dirt accumulation inside the chassis. Both top and bottom dust covers are of the slide on type secured by two 1/4 turn fasteners located on the chassis rear apron.

1-5. INFORMATION AND REFERENCE TABLES.

1-6. Tables 1-1 through 1-4 contain information that will be helpful to you in becoming familiar with all of the features and characteristics of the panoramic indicator.

Table 1-1. Leading Particulars

PRIMARY AC POWER:	
Type	108-132 volts, three wires, single phase, 48-62 cycle, 10 watts
Source	Commercial power lines
DC POWER:	
Type	-1200 volts regulated, 200 ma, filtered +150 volts regulated, 30 ma, filtered +12 volts regulated, 200 ma, filtered -12 volts regulated, 200 ma, filtered
Source	Self-contained power supplied (circuit board modules PS-105, PS-106)
AC POWER	
Type	6.3 volts ac
TRANSPORTABILITY	Can be shipped by any mode of transportation desired in factory cartons
PHYSICAL CHARACTERISTICS:	
Weight	15 pounds
Height	3.5 inches
Width	19 inches
Length	16.5 inches measured from front panel to rear apron handles
Warm-up Time	Approximately one minute required to warm-up the crt.
Cabling Requirements	Standard two or three prong power cords permanently attached. One coaxial cable, 50 ohm impedance, type RG-55/U, 24 inches long with two BNC male connectors
VIBRATION AND SHOCK	Normal shipping and handling
MECHANICAL STORAGE:	
Knockdown Condition	All circuit boards stored in their normal operating position
Operating Condition	Normally mounted on standard 19-inch rack according to MIL-STD-189

Table 1-2. Capabilities and Limitations

INPUT CHARACTERISTICS:	
Center Frequency	21.4 mc
Bandwidth	3 mc measured at the three db points
Impedance	50 ohms nominal
PANORAMIC INDICATOR CHARACTERISTICS:	
Sweep Width	Continuously variable by front panel control from zero to 3 mc
Resolution	The panoramic indicator is capable of resolving two cw signals of equal amplitude separated by 20 kc located anywhere within the passband.
Sweep Rate	20 cycles per second (cps) nominal
I-F Frequencies:	
First i-f	4.3 mc
Second i-f	455 kc
Frequency Response	Flat within three decibels (db) over the 3 mc input bandwidth
Deflection Linearity	Linear deflection in proportion with the signal amplitude. At least ±5% as the signal amplitude is varied over a ten to one range up to a maximum of 10 millivolts (mv) at the antenna terminals of companion receiver, R-1368/GR with automic gain control (agc) off. Horizontal deflection as a function of signal frequency is linear to at least ±2%.
Sensitivity	Measured in conjunction with companion receiver, R-1368/GR. The overall gain is such that a one uv cw signal input to the receiver produces at least one inch vertical deflection on the crt. With the receiver antenna input terminated in its characteristic impedance, the panoramic indicator gain is sufficient to produce 1/4-inch of grass on the crt.

Table 1-2. Capabilities and Limitations (Cont)

Crystal Markers	
Center Frequency Marker	21.4 mc ±0.01%
Sideband Marker	Crystal controlled sideband marker oscillator is provided less crystal*.
Display Stability	Stable to within ±2%. The display center does not shift vertically or horizontally when the sweep width or gain control is adjusted. The base line is not disturbed when signal levels sufficient to overload the panoramic indicator are applied. The display stability is not affected beyond limits by changes in power source characteristics, specified in Table 1-1.
Spurious Rejection	Spurious signals, including those created by frequency conversions or mixing, are rejected a minimum of 50 db.
AMBIENT OPERATING TEMPERATURE RANGE:	
Temperature	0°C(32°F) to 55°C (130°F)
Humidity	Up to 90% relative humidity at 36°C (96°F)
Altitude	Up to 15,000 feet
AMBIENT STORAGE TEMPERATURE RANGE:	
Temperature	-50°C (-58°F) to 65°C (150°F)
Humidity	Up to 90% relative humidity at 36°C (96°F)
Altitude	Up to 45,000 feet

*Some panoramic indicators may be shipped with the sideband crystal installed

Table 1-3. Equipment Supplied

OFFICIAL NOMENCLATURE	COMMON NAME	QTY	DESCRIPTION AND PURPOSE
Component Board Assembly, Module A1	*Signal Board SB-101	1	The entire panoramic indicator circuitries, except the power supplies and the crt, are contained on the signal board, SB-101. The entire board consists of one cascode 21.4 mc amplifier, the cascode first mixer, a cascode 4.3 mc amplifier, the second mixer, the 4.755 mc crystal oscillator, a 455 kc amplifier, the push-pull detectors, the sweep oscillator, the linearity network, the horizontal deflection amplifier, the sawtooth generator, and two marker generators.
Component Board Assembly, Module A2	±12 VDC power supply *PS-105	1	The plug in circuit board consists of two identical, but separate power supply circuits. One is used for -12 vdc supply and the other is used for +12 vdc supply. Each circuit contains a full-wave bridge rectifier with regulator circuit and the filter capacitors mounted on the main chassis.
Component Board Assembly, Module A3	CRT power supply *PS-106	1	This plug in board consists of two separate power supply circuits, one is for the -1200 vdc crt accelerating grid power supply, the other is for the +150 vdc supply. Each power supply circuit contains its own rectifier and regulator circuits.
Cable, Coaxial RG-55/U	Signal Input Cable	1	The 24 inch 50-ohm impedance coaxial cable with male BNC connectors used to interconnect receiver R-1368/GR to input of the panoramic indicator.
Receiver, R-1368/GR	UHF Receiver	1	UHF receiver, frequency range, 250 to 1000 mc in two bands. Operational in am, fm, cw or pulse modes.

*Astro Communication Laboratory (ACL) Part Numbers

CHAPTER 3
OPERATION

3-1. INTRODUCTION.

3-2. This chapter will present you with all the information required to operate the Panoramic Indicator, IP-804/GR. This chapter is divided into three Sections for your convenience. Section I includes names, reference designation, and the function of each operating control and indicator. Section II contains complete operating instructions including turn-on procedure, operational adjustments and turn-off procedure. Section III, emergency operation, is not applicable to this equipment.

SECTION I
CONTROLS AND INDICATORS

3-3. IDENTIFICATION OF CONTROLS AND INDICATORS.

3-4. Figure 3-1 illustrates all operating controls and indicators and Table 3-1 lists all the operator's controls by name, reference designation and indicates the function they serve in the operation and adjustment of the panoramic indicator.

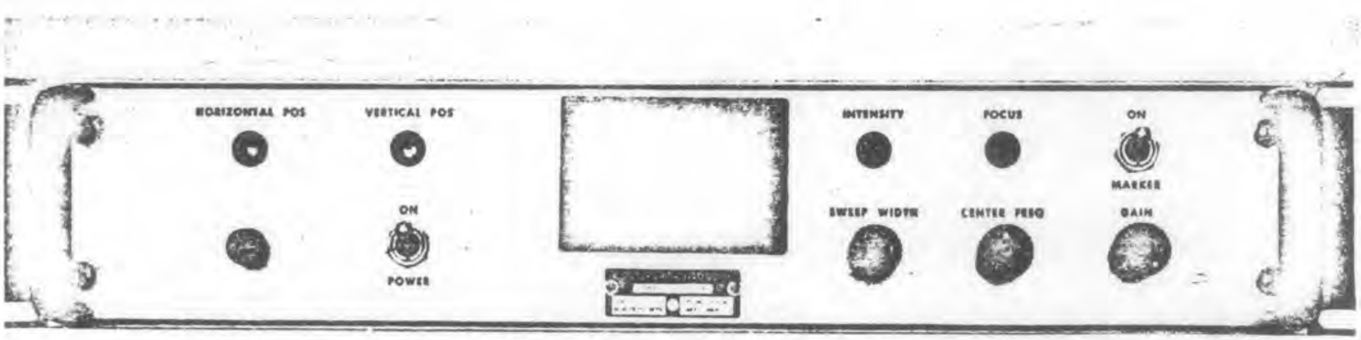


Figure 3-1. Front Panel Controls and Indicators

Table 3-1. Controls and Indicators

NAME	REF DES	FUNCTION
POWER ON switch	S1	Applies input power to chassis.
Power on pilot lamp (red)	DS1	Indicates primary power is applied to chassis.
MARKER ON switch	S2	Applies power to marker generator(s) for center frequency and side band frequency (optional) marker display on crt.
GAIN control	R1	Provides for amplitude adjustment of signals displayed on crt.
CENTER FREQ control	R2	Used in conjunction with MARKER ON switch to position center of the sweep on the center of the crt using the center frequency marker (21.4 mc.).
SWEEP WIDTH control	R4	Determines frequency spectrum displayed on crt.
HORIZONTAL POS control	R17	Positions the horizontal sweep trace on the crt.
VERTICAL POS control	R16	Positions the sweep trace vertically on the crt.
INTENSITY control	R9	Adjusts the sweep trace intensity on the crt.
FOCUS control	R11	Adjusts the sweep trace image for a sharp crt presentation.
CRT display	V1	Permits visual display of monitored signals.

3-5. INTERLOCKS.

3-6. The Panoramic Indicator, IP-804/GR does not contain interlock protection since the chassis is completely enclosed and does not present a hazard unless the top and/or bottom chassis dust covers are removed.

3-7. FUSING.

3-8. The panoramic indicator is fused in the primary power supply. The fuse holder, along with a spare, is located on the chassis rear apron. The transistor circuitry is also fused in the +12 volt and the -12 volt supplies. Fuses for these supplies are located on module board A2 (PS-105) which is mounted to the main chassis and accessible by removing the chassis bottom dust cover.

SECTION II
OPERATING INSTRUCTIONS

3-9. OPERATING PROCEDURE.

3-10. Proceed with the following steps for the turn-on and initial operating procedures for the panoramic indicator.

a. Place the POWER ON switch in the ON position. The primary power lamp will light indicating chassis power application. After approximately 15 seconds, enough time for the filament to heat, a trace will appear on the crt screen.

b. Adjust the GAIN control for desired signal height on the crt; clockwise rotation increases gain.

c. Adjust the SWEEP WIDTH control for the desired frequency spectrum you wish to monitor. A maximum clockwise setting enables you to view the entire 3 mc passband.

d. If you wish to center the incoming signal on the crt screen, place the MARKER ON switch in the ON position. A large pip, or marker will appear on the crt trace indicating the relative position of the 21.4 mc center frequency on the crt.

e. Turn the CENTER FREQ control until the marker pip is superimposed on the vertical line located on the center of the crt screen.

3-11. Sideband markers can be displayed on the panoramic indicator in order to calibrate the sweep width and/or to assist you in determining the frequency of signals being monitored. Although the panoramic indicator has the built in circuitry for sideband markers, a crystal for this circuit is not included with the equipment. If you wish to operate the panoramic indicator with sideband markers proceed as follows:

a. Place the POWER ON switch in the down (off) position.

b. Remove the chassis from the equipment rack and loosen the two 1/4-turn screw fasteners securing the chassis top dust cover to the chassis.

c. Grasp the 1/4 turn screw fasteners and pull the dust cover off of the chassis.

d. Locate the sideband crystal holder on module (SB-101) A1, refer to Figure 3-2.

e. Select a parallel mode crystal made for 32 pf (micromicrofarad) shunt capacity of any frequency between 100 kc and 1.5 mc (CR-63A/U).

f. Insert the crystal in crystal holder XY3 and replace chassis dust cover.

g. Install the panoramic indicator in the equipment rack and place the POWER ON switch in the ON position.

h. Place the MARKER ON switch in the ON position.

NOTE

The number of sideband markers visible on the crt is dependent upon the SWEEP WIDTH setting and the operating frequency of your sideband marker crystal.

i. When operating with sideband markers, note that the markers appear lower in amplitude than the center frequency marker.

3-12. Under normal operating conditions front panel controls marked HORIZONTAL POS, VERTICAL POS, INTENSITY, and FOCUS will not require adjustment. However, in the event one or more of the front panel inset slotted controls (red) require adjustment, use the non-magnetic adjustment tool furnished for your convenience. This tool is spring clipped to the main chassis beneath the top dust cover. In the event that you wish to make these adjustments, proceed with the following steps as required.

a. The HORIZONTAL POS control should be adjusted so that the horizontal trace extends across the entire face of the crt. Using the adjustment tool provided, turn the slotted inset clockwise or counter-clockwise as required to properly position the crt trace.

b. Using the tool provided, adjust the VERTICAL POS control as required to superimpose the horizontal trace (base line) over the lowest horizontal line on the Plexiglass screen of the crt.

c. Adjust the INTENSITY control, for the desired image brightness, using the non-magnetic adjustment tool.

CAUTION

Avoid setting the INTENSITY control any higher than necessary for proper image display. If the intensity is set too high permanent damage to the crt face may result.

d. Adjust FOCUS control as required, using the non-magnetic adjustment tool provided for your use. Focus should be set for maximum trace clarity on the crt.

3-13. TURN-OFF PROCEDURE.

3-14. The turn-off procedure is accomplished by simply placing the POWER ON switch in the down (off) position.

CHAPTER 4
PRINCIPALS OF OPERATION

4-1. INTRODUCTION. Proper operation and maintenance requires a thorough knowledge of the principles of operation of the panoramic indicator. The information presented in this chapter will assist you in understanding the principals of operation for the panoramic indicator IP-804/GR. The chapter excludes basic theory, which can be obtained by reference to T.O. 31-1-141. The chapter is divided into three sections; Section I defines the functions of the equipment by describing the signal path, from input to display, using a functional block diagram; Section II explains, in signal sequence, the functional operation of each module within the panoramic indicator. Simplified schematics for each circuit are also included for your convenience. For modules which are multi-operational i.e. modules which perform more than one operation, simplified schematics explain each operation. Section III, Functional Operation of Mechanical Assemblies, is not applicable to this equipment. For complete schematic diagrams of the panoramic indicator, refer to Chapter 6 of the manual.

SECTION I
FUNCTIONAL SYSTEM OPERATION

4-2. GENERAL DESCRIPTION.

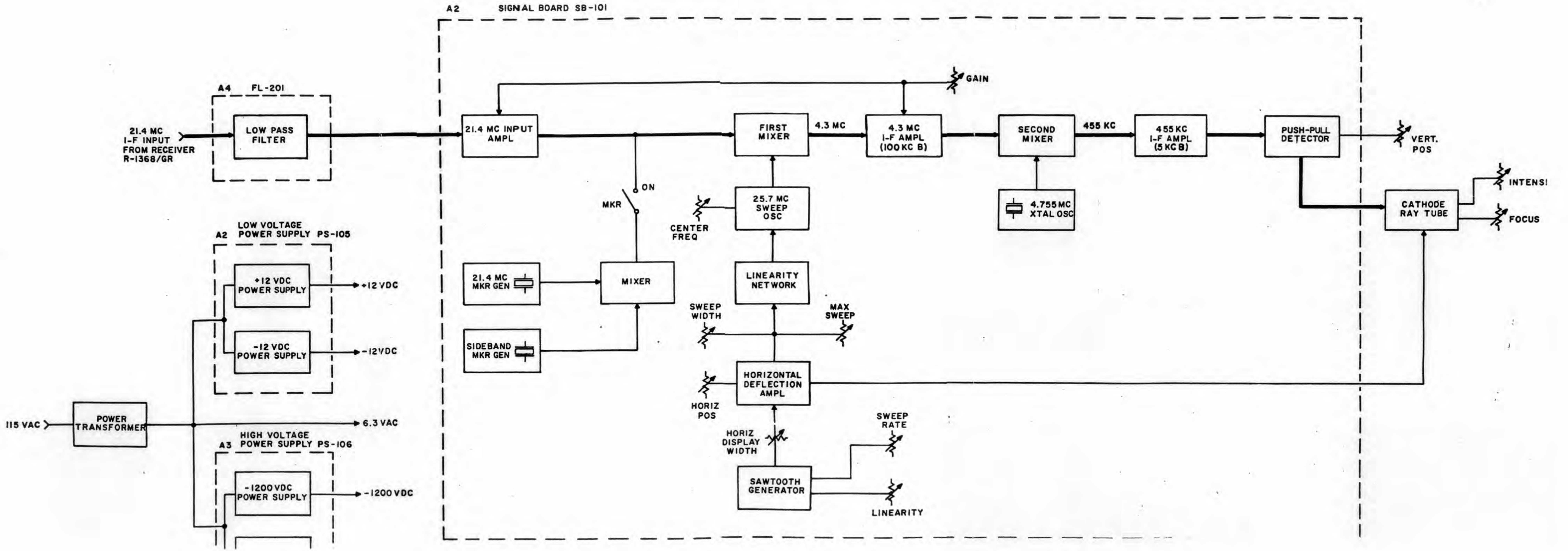
4-3. To supplement the information in this section, you should refer to chapter 1, which outlines the general description and purpose of the panoramic indicator as well as listing its capabilities and limitations.

4-4. The panoramic indicator presents a visual display of the presence and relative amplitude of signals and their sidebands on a crt. To provide the means to this end, the i-f from the companion receiver, R-1368/GR is used to provide the input signal. The crt display then, is of the spectrum surrounding the input frequency, (21.4 mc) from the receiver.

4-5. The panoramic indicator performs double conversion of the input signal with i-f conversions to 4.3 mc and 455 kc. Heterodyning methods provide both conversions with the resultant i-f being the difference frequency. An auto-transformer steps up the i-f signal for demodulation by a push-pull detector and this output is then applied to the vertical deflection plates of the crt. The signal applied to the horizontal deflection plates is supplied from a sawtooth generator and horizontal deflection amplifier circuits. Synchronization of the horizontal trace with a sweep oscillator provides a vertical deflection during each sawtooth cycle and at the same horizontal position. Two marker generators permit centering and calibration of the sweep oscillator as well as establishing the relationship of displayed signals to the center frequency (21.4 mc).

4-6. SIGNAL FLOW.

4-7. Figure 4-1 shows a complete functional block diagram of the panoramic


A2 SIGNAL BOARD SB-101
A4 FL-201
21.4 MC I-F INPUT FROM RECEIVER R-1368/GR
LOW PASS FILTER
21.4 MC INPUT AMPL
GAIN
FIRST MIXER
4.3 MC
4.3 MC I-F AMPL (100 KC B)
SECOND MIXER
455 KC
455 KC I-F AMPL (5 KC B)
PUSH-PULL DETECTOR
VERT. POS
4.755 MC XTAL OSC
CATHODE RAY TUBE
INTENS
FOCUS
ON
MKR
25.7 MC SWEEP OSC
CENTER FREQ
A2 LOW VOLTAGE POWER SUPPLY PS-105
+12 VDC POWER SUPPLY
+12 VDC
-12 VDC POWER SUPPLY
-12 VDC
21.4 MC MKR GEN
MIXER
SIDEBAND MKR GEN
LINEARITY NETWORK
SWEEP WIDTH
MAX SWEEP
HORIZONTAL DEFLECTION AMPL
HORIZ POS
115 VAC
POWER TRANSFORMER
6.3 VAC
A3 HIGH VOLTAGE POWER SUPPLY PS-106
-1200 VDC POWER SUPPLY
-1200 VDC
HORIZ DISPLAY WIDTH
SWEEP RATE
SAWTOOTH GENERATOR
LINEARITY

indicator. The block diagram and the text which follows, will assist you in understanding the principles of operation.

4-8. As described previously the panoramic indicator operates in conjunction with a UHF receiver, type R-1368/GR. This receiver provides an i-f output signal, centered at 21.4 mc for the panoramic indicator. In operation, the input signal from the companion receiver is applied through a 50 ohm coaxial cable to a filter network FL-201, module A4. After passing through the low-pass filter, the input signal is amplified and applied to the first mixer. The input amplifier gain is controlled by the front panel GAIN control. In the first mixer, the input 21.4 mc signal heterodynes with a 25.7 mc sweep oscillator signal resulting in a conversion to 4.3 megacycles.

4-9. From the first mixer, the signal is applied to the 4.3 mc i-f amplifier. The gain of this amplifier, like the input amplifier, is also varied by the front panel GAIN control. The output of the amplifier contains a double tuned circuit which is aligned for a 4.3 mc center frequency with a three db bandwidth of 100 kc. Its output is applied to the second mixer.

4-10. Conversion of the 4.3 mc i-f to a frequency of 455 kc is performed by the heterodyning action in the second mixer. Here, the 4.3 mc input signal is beat with a 4.755 mc crystal controlled oscillator to obtain the desired 455 kc i-f. An overall circuit bandwidth of 5 kc is obtained by employing a tuned circuit in both the emitter and collector circuit of the second mixer. The emitter resonant circuit consists of a ceramic filter with a 5 kc bandwidth. The output of the mixer is amplified by a 455 kc i-f amplifier and fed to a push-pull detector.

4-11. The push-pull detector provides demodulated signals of both polarities for application to the vertical deflection plates of the crt. A VERTICAL POS potentiometer permits positioning of the signal trace on the crt.

4-12. The signal applied to the crt horizontal deflection plates is supplied from the sawtooth generator and horizontal deflection amplifier circuits. The sawtooth generator develops 20 cps sawtooth waveform whose repetition rate is variable by adjusting the SWEEP RATE control. The linearit of the sawtooth waveform is adjusted by the LINEARITY potentiometer.

4-13. The sawtooth generator also provides an input to the sweep oscillator. This input assures that the vertical deflection is synchronized with the horizontal sweep.

4-14. The MARKER ON switch energizes a 21.4 mc center frequency marker and the sideband marker crystal generators whose outputs are applied to the first mixer The sideband markers will not be displayed however, unless a crystal has been inserted into the socket provided.

SECTION II
FUNCTIONAL OPERATION OF ELECTRONIC CIRCUITS

4-15. LOW PASS FILTER, FL-201, MODULE A4.

4-16. The low pass filter is a five section "M" derived ladder type filter with a transmission band extending from zero frequency to 22.9 mc (cut-off) and an attenuation band extending from the cut-off frequency to infinite frequency. A complete schematic diagram of the low pass filter is shown in Figure 6-1 of this manual. As shown on the schematic the filter is comprised of three identical pi, or intermediate sections connected in cascade and two identical terminating half pi-sections. Each pi-section contains a series inductor shunted on each side by an inductor and a variable capacitor. All sections of the filter are matched on an image impedance basis. The filter skirt selectivity in conjunction with the input amplifier tuned circuits provides a minimum of 50 db spurious signal rejection. Figure 4-2 shows the first terminating section and the first pi-section of the filter. Input transformer T1 is a step up transformer with a 2.5 to 1.0 ratio providing input coupling to the filter. Series inductor L1 is shunted by the secondary winding of T1 and variable capacitor C1. As shown in the diagram, series inductor L3 is shunted on each side by L2, C2 and L4 and C3 respectively. Since the terminal half sections have the same load resistance as the intermediate sections, their image impedance will match the intermediate sections at one pair of terminals.

4-17. SIGNAL BOARD, SB-101, MODULE A1.

4-18. INTRODUCTION.

4-19. Signal board (SB-101) module A1 is the heart of the panoramic indicator system. It is a multi-functional module in that it includes all signal processing sweep circuits, with the exception of the filter and power supplies. Since it is multi-functional, each operational function will be presented individually in separate paragraphs. Refer to Chapter 6, Circuit Diagrams, for a complete signal board schematic. A breakdown of the signal board circuits include:

a. 21.4 mc amplifier

b. First mixer

c. Sweep oscillator

d. Linearity network

e. 4.3 mc amplifier

f. Crystal oscillator and second mixer

g. 455 kc i-f amplifier

h. Push-pull detector

i. Sawtooth generator

j. Horizontal deflection amplifier

k. Marker generators

4-20. 21.4 MC INPUT AMPLIFIER

4-21. A simplified schematic diagram of the 21.4 mc amplifier is shown in Figure 4-3. The input amplifier is a cascode connected circuit using npn transistors to produce high gain, low noise and good over-all stability characteristics. The input impedance is nominally 50 ohms with impedance match to the input, base of Q1,

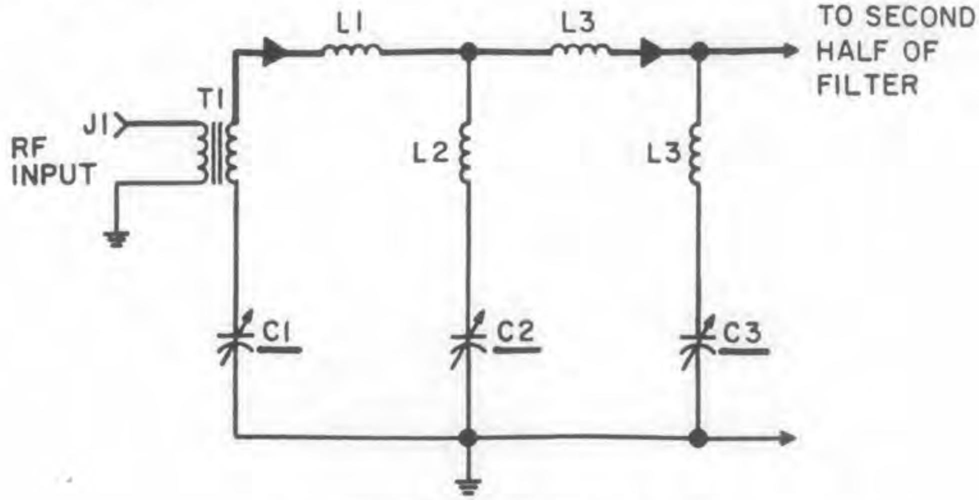


Figure 4-2. Low Pass Filter

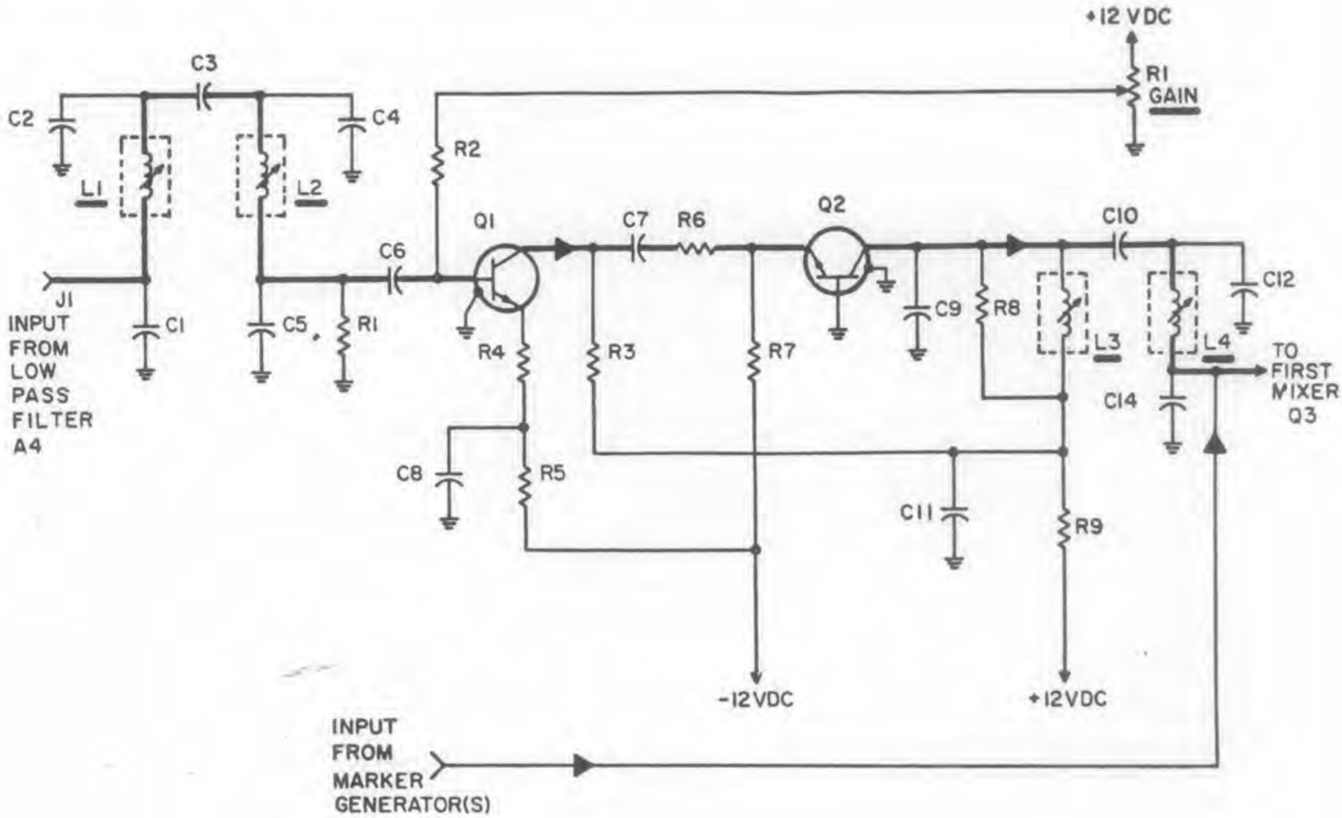


Figure 4-3. 21.4 MC Input Amplifier

provided by appropriate tapping of the double tuned input circuit. Inductor L1 and resonating capacitors C1 and C2 form the primary of the double tuned circuit where C3 couples the signal to the secondary circuit consisting of L2 and resonating capacitors C4 and C5. C4, C5, and R1 also provide an impedance match between the output of the tuned circuit and the input to Q1. Both L1 and L2 have powdered iron tuning cores used to align the circuit for a 3 mc peak-to-peak bandwidth. The base connection of Q1 operates at a positive potential, its base bias is determined by the current through R2 which is varied by GAIN control R1. C6 couples the output of the double tuned circuit to the base of Q1. The collector of Q1 is coupled to the emitter of Q2 by C7 and R6. R6 provides series damping action to eliminate any parasitic high frequency oscillation of cascode circuit Q1 and Q2. The collector circuit of Q2 contains a double tuned circuit identical in operation to that of the input double tuned circuit. However, parallel resistor R8 provides the necessary loading for the required bandwidth of the tuned circuit. C12 and C14 comprise two arms of a pi network which match the impedance of the tuned circuits to the low input impedance of the first mixer.

4-22. FIRST MIXER.

4-23. The first mixer, Figure 4-4, contains two npn transistors Q3 and Q4 connected in cascode. The collector of Q3 is dc coupled to the emitter of Q4. Resistors R10 and R11 in the base circuit and R12 in the emitter circuit of Q3 develop the bias voltages. The 21.4 mc signal output from the input amplifier, and the 25.7 mc signal from the sweep oscillator are applied to the base of Q3. Heterodyning of the two input signals occurs in the emitter-base junction of Q3. The resultant difference frequency of 4.3 mc is amplified by Q4. The collector output of Q4 is developed across a double tuned circuit designed to pass the 4.3 mc signal and reject all others. Primary circuit components include inductor L5 and resonating capacitor C16. Inductor L6, and resonating capacitors C19 and C20 comprise the secondary circuit. Coupling between the tuned circuits is provided by C18. Secondary circuit components C19 and C20 also provide impedance matching for the 4.3 mc amplifier, Q5. Variable inductors L5 and L6 permit a 4.3 mc center frequency alignment for a 3 db bandwidth of 100 kc. TP2 permits connection of test equipment for this alignment.

4-24. 4.3 MC AMPLIFIER.

4-25. Transistors Q5 and Q6, two npn transistors, connected in cascode, comprise the 4.3 mc amplifier stage. Like the

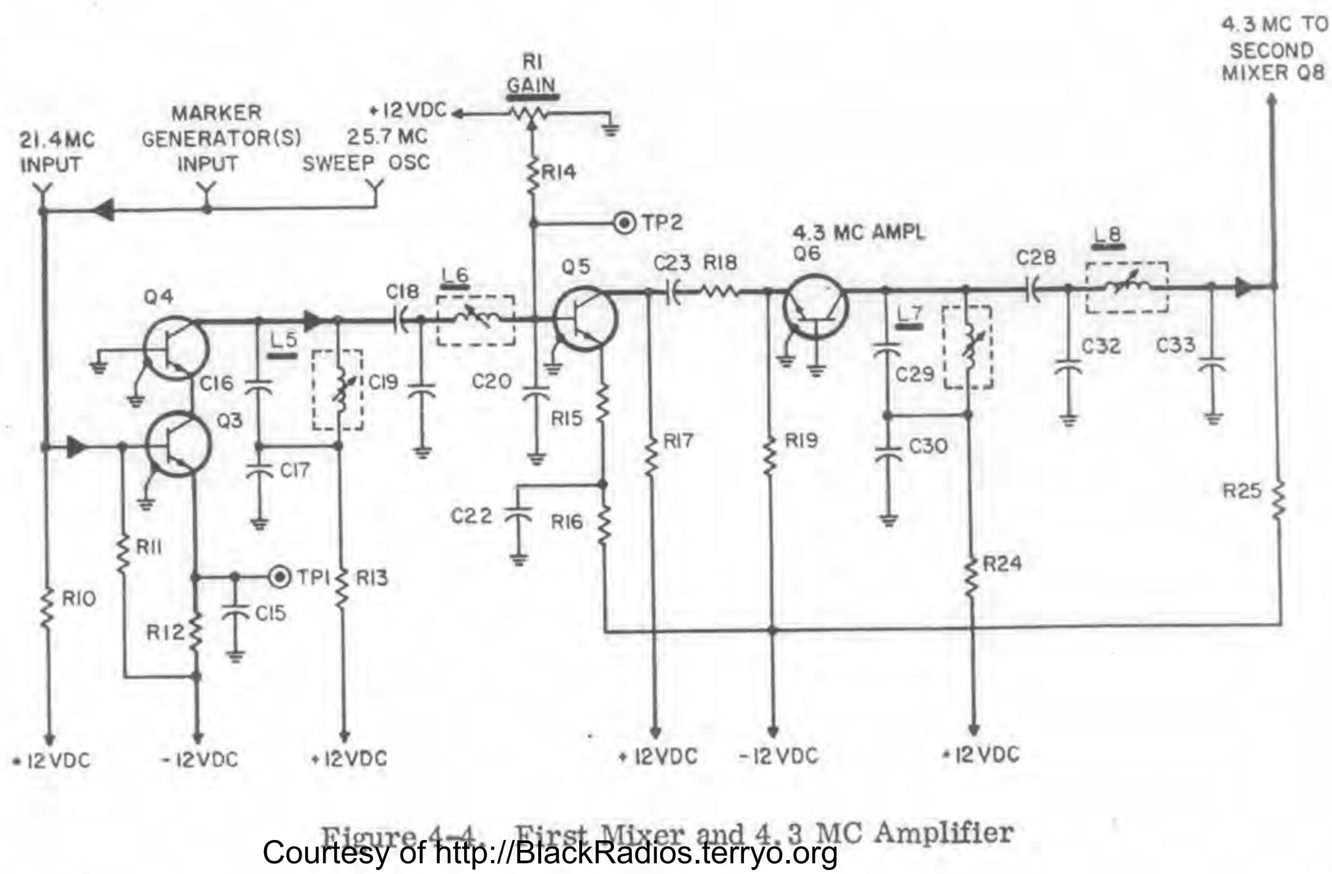


Figure 4-4. First Mixer and 4.3 MC Amplifier

input amplifier stage, Q5 is forward gain controlled. Base bias is determined by the voltage across R14 which is varied by GAIN control R1. The output of Q5 is coupled by C23 to the emitter of grounded base amplifier Q6. The output of Q6 is developed across a double tuned network and applied to second mixer Q8. This double tuned network is similar to that between the first mixer and the 4.3 mc i-f amplifier.

4-26. SWEEP OSCILLATOR.

4-27. Figure 4-5 illustrates Sweep oscillator Q12, an npn transistor connected in a Colpitts circuit configuration with regenerative feedback obtained from the emitter-base tank circuit. Base bias is provided by the resistive divider consisting of R53 and R52. The tuned circuit consists of capacitors C59 and C60 in parallel with L12; C58 is a blocking capacitor. Variable inductor L12 permits alignment of the 25.7 mc oscillator center frequency.

4-28. The 25.7 mc output from oscillator Q12 is swept across a range of 3 mc by varicap CR12. CR12 is connected in series with the oscillator tank circuit and controls the oscillator frequency by varying the tank circuit series capacitance. Control voltages which vary the capacitance of CR12 are derived from two sources. One voltage is tapped from the arm of CENTER FREQ control R2 through terminal 10 on module A1. Potentiometer R2 is part of a voltage divider circuit across Zener diode CR11. By varying CENTER FREQ control R2, the

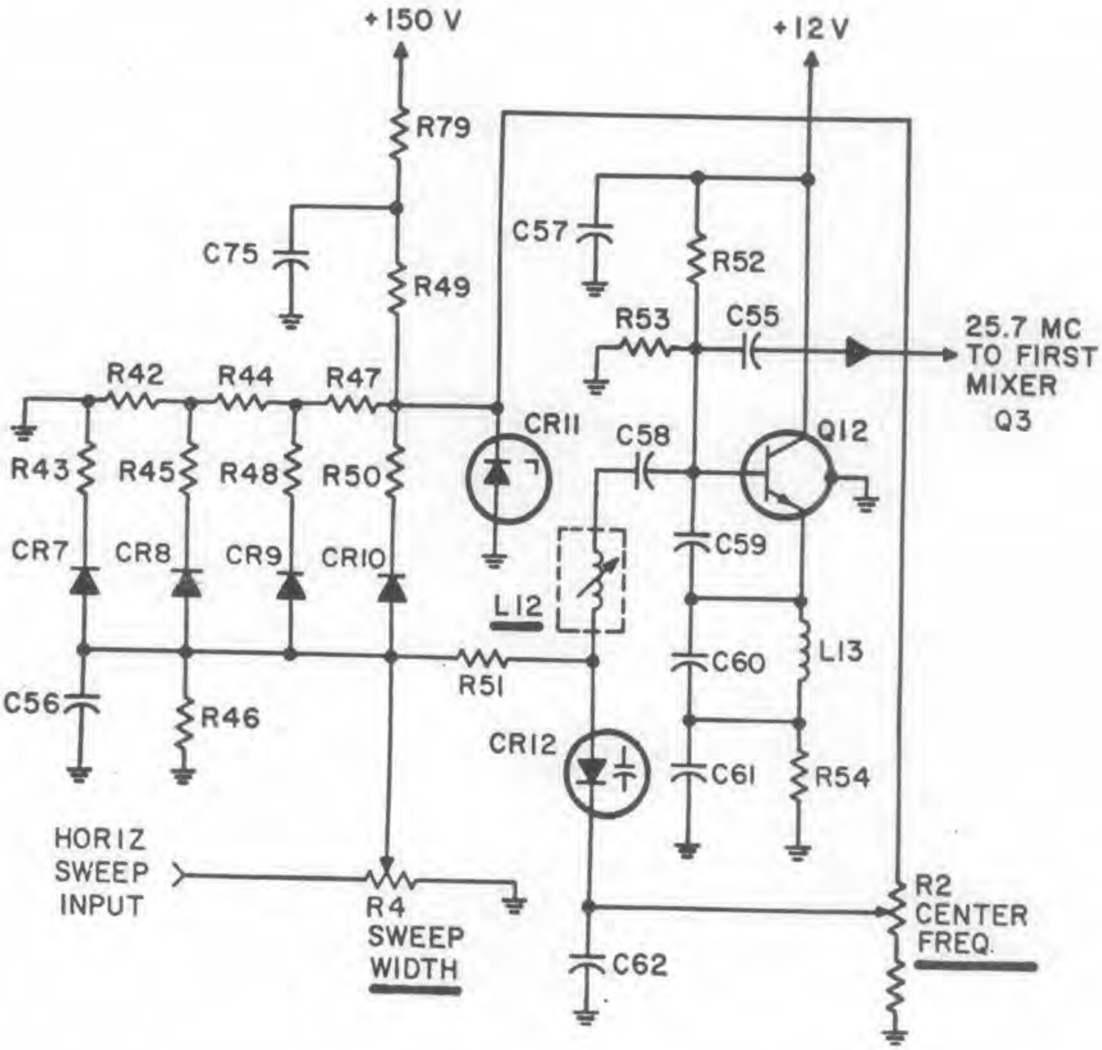


Figure 4-5. Sweep Oscillator and Linearity Network

fixed bias applied to the varicap may be adjusted to vary the sweep oscillator approximately ±250 kc from its center frequency. The other voltage applied to the varicap is a sawtooth waveform. This is developed in the horizontal sweep circuitry. When this voltage is applied to the varicap, it varies the sweep oscillator frequency in synchronization with the horizontal sweep of the cathode-ray beam. The amplitude of the sawtooth applied to the varicap, and hence the sweep width of local oscillator Q12 is controlled by MAX SWEEP control R75 and SWEEP WIDTH control, R4. R75 is adjusted so that when the SWEEP WIDTH control is at maximum, the local oscillator sweeps plus and minus 1.5 mc around the 25.7 mc center frequency.

4-29. LINEARITY NETWORK.

4-30. Diodes CR7 through CR10 and load resistors R42, R43, R44, R45, R47, and R48 comprise the linearity network. This network compensates for the non-linear capacitance versus voltage characteristics of varicap CR12 to provide a linear frequency versus time characteristics at the output of the sweep oscillator. The action of the diodes is essentially that of four voltage controlled electronic switches, each switch with an associated load. As the input sawtooth voltage is applied to the network, each switch opens at a different time in the sawtooth cycle. Its associated load is added to the input. As each load is added, the waveform is reshaped, and a linear relationship of frequency as a function of time is achieved.

4-31. CRYSTAL OSCILLATOR AND SECOND MIXER.

4-32. Crystal oscillator Q7 and second mixer Q8, figure 4-6, convert the 4.3 mc i-f to a final i-f frequency of 455 kc. Oscillator Q7 operates at a frequency of 4.755 mc which is controlled by base circuit crystal Y1. Resistors R21 and R22 provide the proper bias for the circuit. Capacitor C27 couples the 4.755 mc local oscillator signal to the base of the second mixer Q8. Here, the 4.755 mc is mixed with the 4.3 mc i-f signal developed across C33, resulting in an i-f frequency of 455 kc. Mixing action is accomplished in the emitter-base junction of Q8. The emitter of Q8 is series resonated at 455 kc by ceramic filter Y4. Q8 is highly degenerative at frequencies other than 455 kc. The collector output is developed across a 455 kc resonant circuit consisting of L9, C36, and C39. Resonant circuit components C36 and C39 form a voltage divider network to step the voltage down to match the low input impedance of 455 kc amplifier Q9. The output of the mixer is applied to the 455 kc i-f amplifier.

4-33. 455 KC AMPLIFIER.

4-34. Figure 4-7 is a simplified schematic diagram of the 455 kc i-f amplifier and the push-pull detector. The output of Q9 is stepped up by T1 and then resistance-capacitance coupled to the push-pull detector.

4-35. PUSH-PULL DETECTOR.

4-36. The input to the push-pull detector is a 455 kc, i-f signal from amplifier Q9. The detector rectifies the input signal, and provides an output voltage which varies according to the input signal envelope. This voltage is applied directly to the vertical deflection plates of the crt. This circuit includes two series diode detectors, CR1 and CR2, with their outputs filtered through two identical resistance-capacitance networks. The diodes are connected into their respective circuits in opposite directions to provide the positive and negative polarities necessary for push-pull deflection. Since the functional operation for each detector circuit is identical, only one will be described. In the circuit illustrated, diode CR1 is the rectifying device, resistor R78 is the load, and capacitor C47 is the filter. Diode CR1 conducts on only one-half of the input cycle and therefore rectifies the input i-f signal. The time constant of resistor R78 and capacitor C47 is long compared to the time of one cycle of the 455 kc i-f signal, but sufficiently short to follow envelope excursion. CR4 is a voltage clamping diode that prevents the vertical deflection plate from dropping below 75 volts since the anode of CR4 is connected to the junction of R33 and R34. The i-f is then filtered out and the detector output is the modulation envelope.

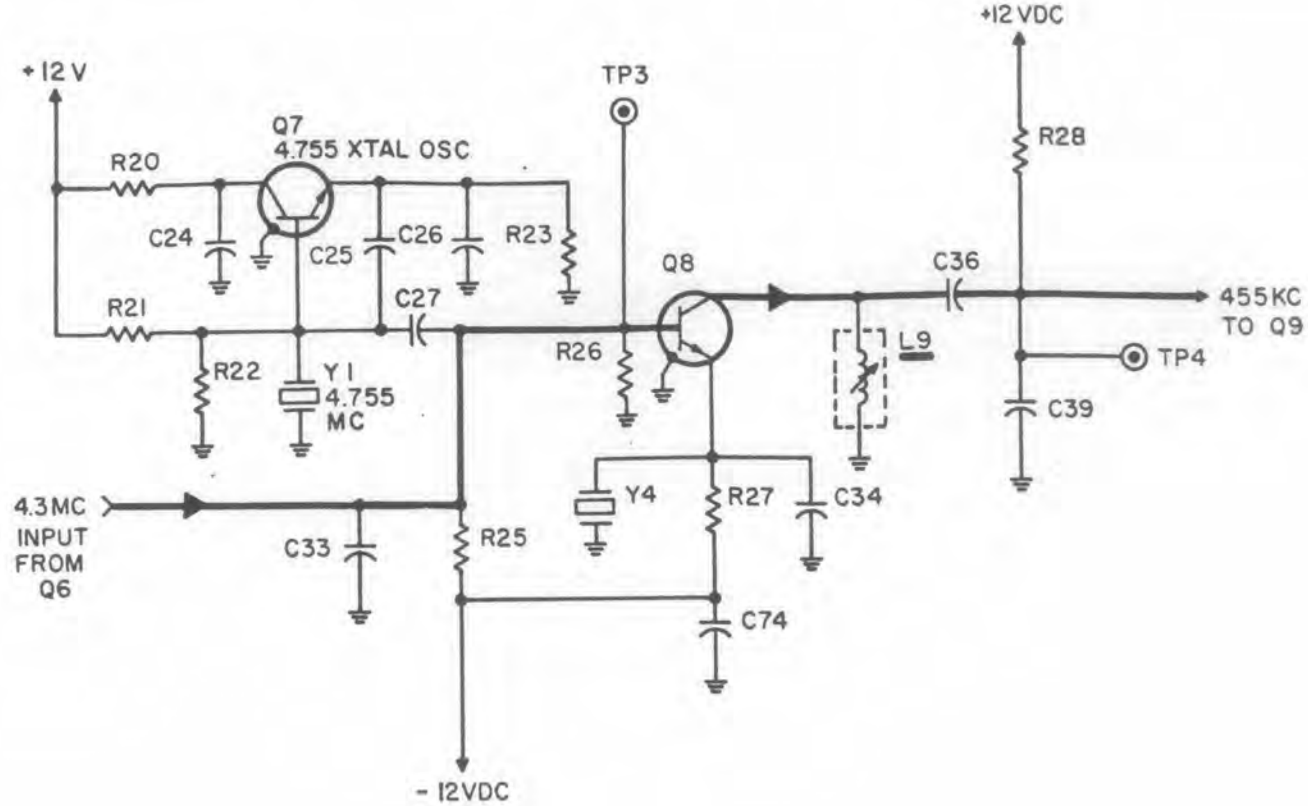


Figure 4-6. Crystal Oscillator and Second Mixer

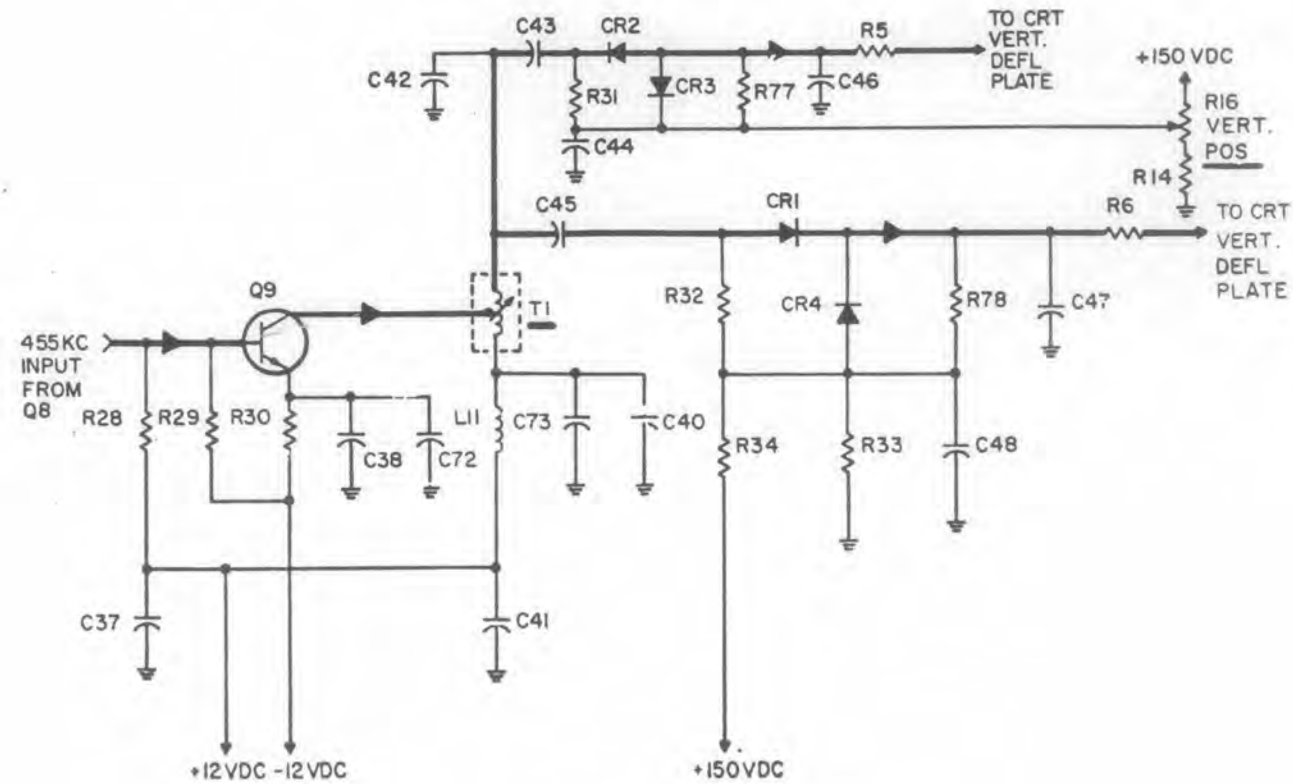


Figure 4-7. 455 KC Amplifier and Push-Pull Detector

4-37. SAWTOOTH GENERATOR.

4-38. Transistor Q13 and Q15 and unijunction transistor Q14 develop the sawtooth voltage waveform which is applied to the sweep oscillator and to the horizontal deflection plates of the crt, see Figure 4-8. Transistor Q13 is a common emitter d-c amplifier. Its collector output is simultaneously applied to the emitter of unijunction transistor Q14, the base of emitter follower Q15, and a capacitance network containing C63, C64, C65, and C66. As Q13 conducts, capacitors, C63, C64, C65 and C66 charge very slowly. The charge rate of the capacitors, and therefore the rate of conduction of Q13, is determined by the value of resistor R46, SWEEP RATE control. As the capacitors charge, the positive dc voltage across them rises. When the voltage across the capacitors is sufficient to cause Q14 to fire, Q14 conducts through its emitter circuit discharging the capacitors very rapidly. This sequence of slow charging and rapid discharging of the capacitors produces a sawtooth waveform in the output. The rate of charging and discharging the capacitors is set for 20 cps by SWEEP RATE resistor R56. The sawtooth output of Q13 is applied to the base of emitter follower Q15. Q15 reproduces the sawtooth waveform and also provides circuit isolation to Q16. A portion of the emitter circuit is fed back to capacitors C64 and C66 through LINEARITY control R58. This forms a bootstrap circuit permitting greater linearity in the sawtooth waveshape. Additional linearity is provided by the negative feed back loop from Q14 to the base of Q13.

4-39. HORIZONTAL DEFLECTION AMPLIFIER.

4-40. The horizontal deflection amplifier as shown in Figure 4-9 is used to amplify the output of the sawtooth generator for application to the crt. A portion of the sawtooth is also applied to the sweep oscillator through potentiometers R75, MAX SWEEP, and R4, SWEEP WIDTH to synchronize the local oscillator with the horizontal sweep on the crt screen. The output from the sawtooth generator is fed through HORIZONTAL DISPLAY WIDTH control, R62 directly to the base of phase splitter Q16 resulting in a 180° phase shift between emitter and collector. The collector and emitter outputs of Q16 are resistance-capacitance coupled to push-pull amplifiers Q17, and Q18 respectively. Therefore the resulting outputs to the horizontal deflection plates in the crt are equal in amplitude but opposite in phase.

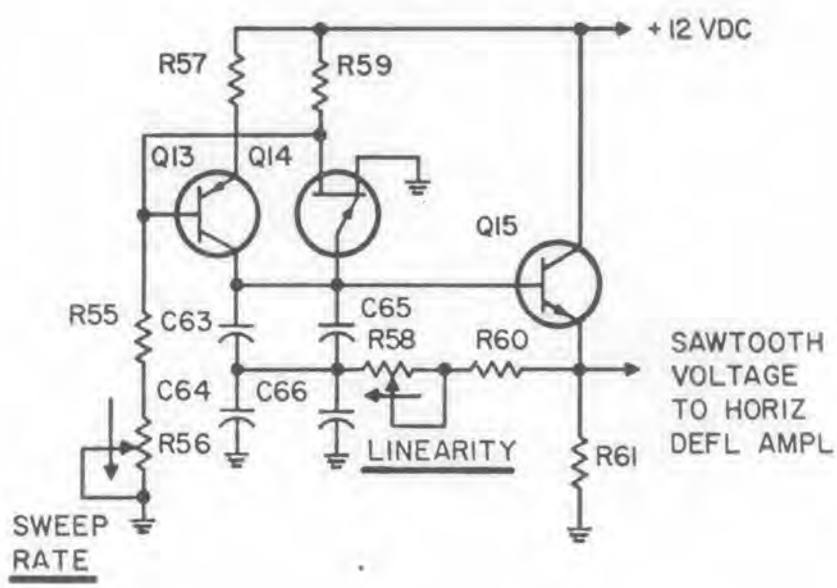


Figure 4-8. Sawtooth Generator

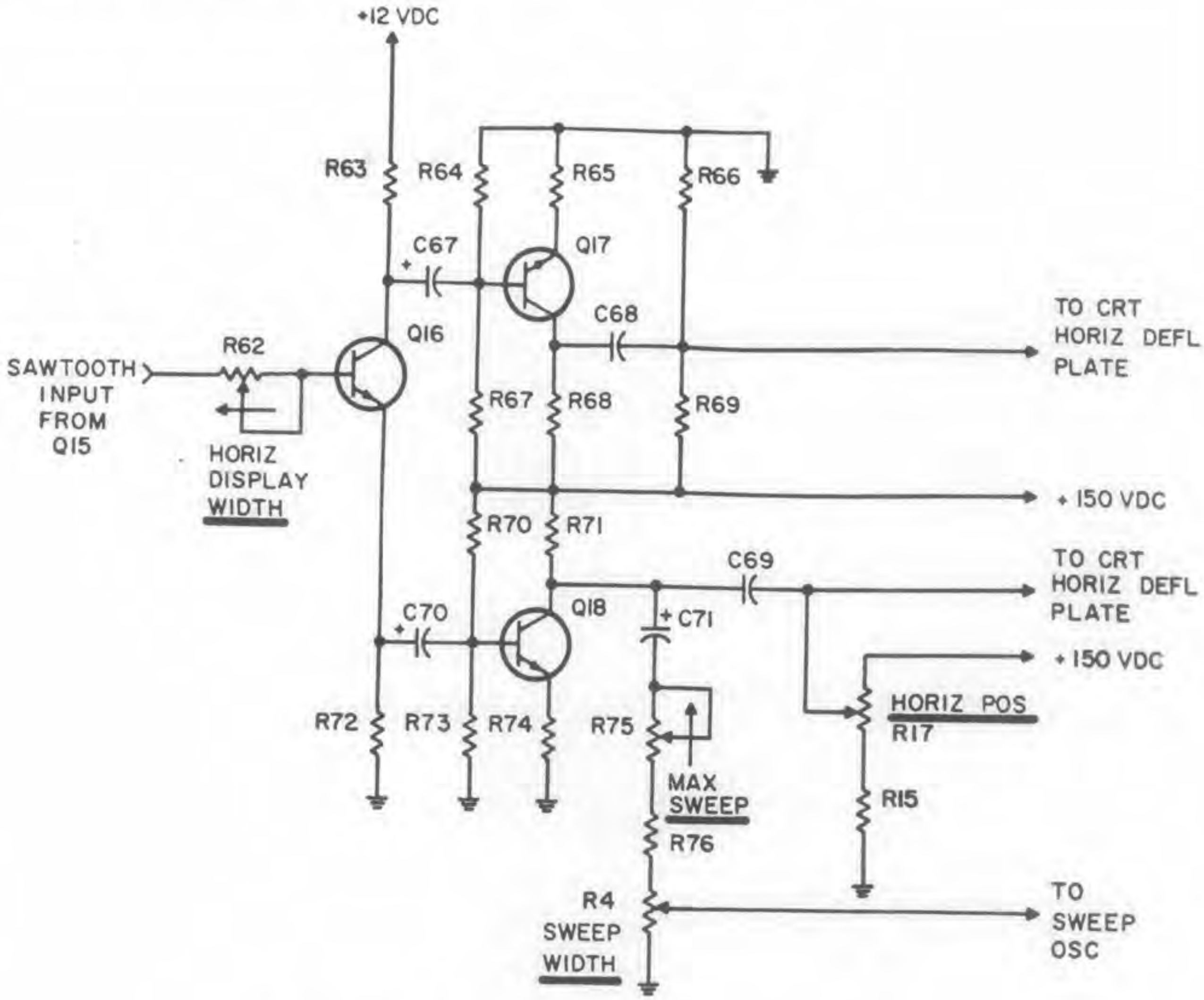


Figure 4-9. Horizontal Deflection Amplifier

4.41 MARKER GENERATORS.

4-42. Refer to Figure 4-10 for a simplified schematic diagram of the marker generators. Two marker generator circuits are incorporated to provide center frequency and sideband frequency markers at the option of the operator through MARKER ON switch, S2. Both marker generators use the Colpitts design configuration with transistor Q10 providing the center frequency marker and Q11 the sideband markers. A 21.4 mc crystal, Y2, generates the center frequency marker through a direct coupling to the base of transistor Q10. If sideband markers are desired you may have to install crystal Y3 to actuate the sideband marker generator Q11. Potentiometer R41 permits a limited amplitude adjustment of the sideband markers. Diodes CR5 and CR6 mix the center frequency and sideband markers to provide a modulated signal to the input of the first mixer, Q3.

4-43. <u>CRT AND MAIN CHASSIS CIRCUITRY</u>.

4-44. Refer to the schematic diagram of the crt circuitry located in Chapter 6 of this manual. The crt has a rectangular face measuring 2-3/4 by 1-1/4 inches overlaid with a green Plexiglass screen. The screen is inscribed with a horizontal base line, a vertical center marker and three equally separated vertical markers on each side of the screen center. These markers are for

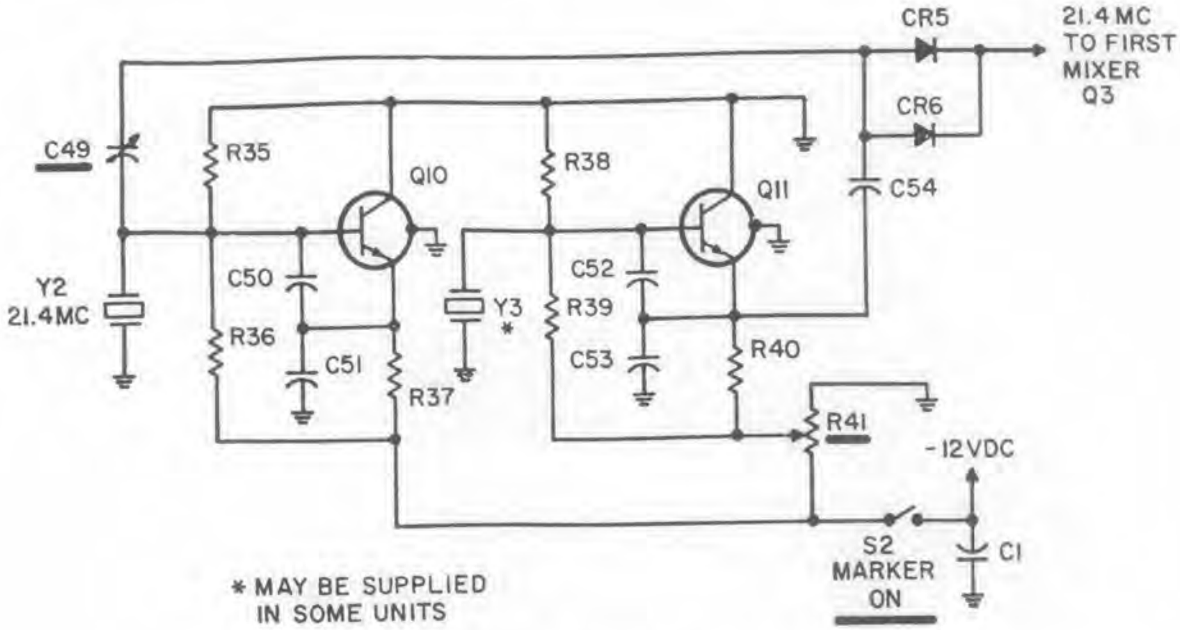


Figure 4-10. Marker Generators

relative reference purposes only and are not calibrated to read in specific units.

4-45. The crt uses -1200 volts dc accelerating potential which is developed in high voltage power supply, PS-106, module A3 via transformer T2, which is located on the main chassis. The secondary winding of transformer T2, taps 9 and 10 provide 6.3 volts to the filament in the crt. From high voltage power supply PS-106, terminal 12, the -1200 volt source is connected across a voltage divider composed of INTENSITY control R9, resistor R10, FOCUS control R11, and resistors R12 and R13. INTENSITY control R9 determines the voltage applied to the crt control grid while FOCUS control R11 selects the voltage applied to the crt first anode. Fixed astigmatism is derived by connection of the second anode to the junction of resistors R7 and R8. The vertical deflection plates receive a signal from the push-pull detector located in signal board, SB-101, module A1. The horizontal deflection plates receive a signal from the horizontal deflection amplifier also located in signal board SB-101. Vertical and horizontal trace adjustment is provided to the crt deflection plates via VERTICAL POS, potentiometers R16, and HORIZONTAL POS control R17 from the high voltage power supply PS-106 module A3.

4-46. 12 VOLT POWER SUPPLIES, PS-105, MODULE A2.

4-47. INTRODUCTION.

4-48. Power supply board PS-105 contains two identical circuits, one to furnish +12 volts, and the other to supply -12 volts to signal board SB-101. Refer to Chapter 6 for a complete schematic diagram. The polarity difference between the two circuits is determined by the location of chassis ground connection. In the +12 volt supply, terminals 3B, 4B, and 5B are connected to chassis ground. While in the -12 volt supply, terminals 10A, 11A, and 12A are chassis grounded. Each power supply is series regulated by associated series regulator transistor and filter capacitor mounted on the main chassis.

4-49. +12 VDC REGULATED POWER SUPPLY.

4-50. Input power is applied from the secondary winding of transformer T1, terminals 10 and 12 to full-wave bridge rectifier CR3 on the PS-1054 boards. A +18 volt unregulated output is derived from CR3 and direct coupled to amplifier Q3 through line fuse F2. Regulation to +12 volts is obtained in the circuitry consisting of control amplifier Q4, driver Q3, and the chassis mounted series regulator transistor Q2. Resistors R11, R12, R13, and R14 form a resistance divider network to act as a sensing circuit for series regulator transistor Q2. Potentiometer R12 is adjustable to provide the regulated +12 volts output supply.

4-51. With a load or line condition change, any increase, or decrease in voltage is transmitted to the base of transistor Q3 by the sensing network. As the potential between the base and emitter of Q3 rises, the current through transistor Q4 increases, resulting in a voltage drop at the collector of Q4 and base of Q3. This action results in a current decrease at Q3 and at the same time causing series regulator transistor Q2 (main chassis) to be driven towards cut-off. As a result, the voltage drop across the regulator increases, and the supply output voltage returns to +12 volts.

4-52. -12 VDC REGULATED POWER SUPPLY.

4-53. The -12 volt power supply operates in the same manner as the +12 volt supply with exception of polarity reversal and component nomenclature.

4-54. HIGH VOLTAGE POWER SUPPLIES, PS-106, MODULE A3.

4-55. High voltage power supply PS-106 provides both +150 volts and -1200 volts to operate the crt. Refer to Chapter 6 of this manual for a complete schematic diagram of these circuits. This supply draws a-c voltage from the secondary windings of transformer T2 which is located on the main chassis. Taps 7 and 8 supply input power to full-wave bridge rectifier CR3, the output of which is passed through a conventional capacitive input filter before being coupled to the +150 volt Zener diode CR4 which operates as a voltage regulator. Taps 5 and 6 of transformer T2 provide the input power for the -1200 volt supply which is developed in a full-wave voltage doubler circuit and regulated by diode VR1.

CHAPTER 5
MAINTENANCE

5-1. INTRODUCTION. This chapter describes in detail all maintenance and alignment procedures necessary for you to maintain the panoramic indicator in optimum working condition. Instructions given in this chapter are intended to supplement the preventive maintenance workcard procedures in T.O. 31S1-5SSUD-6WC-1, and are based on the assumption that qualified personnel will perform the procedures outlined. Under normal circumstances, this chapter contains organizational field maintenance data which is intended to supplement preventive maintenance data found on workcards, and special maintenance procedures. However because of the mechanical and electronic design characteristics as well as the purpose and use of the panoramic indicator, all maintenance procedures are covered at the organizational/field maintenance level, Section I.

SECTION I
ORGANIZATION/FIELD MAINTENANCE

5-2. SCOPE.

5-3. This section provides instructions for maintenance and repair procedures for the panoramic indicator. As explained previously all maintenance requirements for the panoramic indicator are to be performed at this level. This section includes detailed procedures required to perform repair and alignment of the panoramic indicator. Equipment performance standards, waveshapes, and voltages at key points in the panoramic indicator are given along with a list of test equipment required to maintain this equipment, Table 5-1.

5-4. MAINTENANCE PRACTICES.

5-5. The panoramic indicator has been specially designed to minimize operational down time by the use of modular construction techniques. When a fault occurs, an experienced technician can quickly determine whether repairs can be made immediately, or a spare module inserted until maintenance time is available. Spare module boards must be in good working order and properly aligned for rapid installation into the system when required. Repair and alignments of all spare modules must be accomplished as soon as possible to insure good operating condition. All performance tests, standards, and alignment procedures should be performed with the modules installed in their appropriate location in the panoramic indicator, refer to Figures 5-1 and 5-2 for location of all module boards. In order to expedite performance tests and alignment procedures for the panoramic indicator, it is necessary for you to fabricate a high impedance detector as specified in Figure 5-3.

5-6. PERFORMANCE TEST STANDARDS.

5-7. Complete panoramic indicator performance test standards are given in Table 5-2. This information will assist you in evaluating the performance of the equipment by monitoring circuit output at key points in signal board, SB-101, module A1.

Table 5-1. Test Equipment for Organizational/Field Maintenance But Not Supplied

NOTE

The test equipment characteristics presented in this table are minimum requirements. These characteristics do not necessarily reflect the full capabilities of test equipment listed.

STOCK NO.	EQUIPMENT	MODEL NO.	MFR	REQD CHARACTERISTICS
6625-964-2629	Multimeter	WV-98C*	RCA	Voltage range: 0-1,5000 ac and dc Ohmmeter range: 0-1,000 Megohms. Accuracy: ±3%
6625-539-8601	Sweep Generator	SM-2000*	Telonic	Impedance: 50 ohms Frequency range: 20 cps to 3,000 mc determined by plug-in head. Attenuation: 0 to 60 db Signal to noise ratio: 10 to 1 minimum Operational modes: sweep, cw, 1 kc modulated.
6625 NC	Sweep Generator Plug-in	SH-1	Telonic	Sweep range: 500 kc to 460 mc Sweep width: 200 kc to 200 mc Flatness: ±1 db
	High Impedance Detector			Locally Fabricated (Fig. 5-3.)
6625-819-0473	Signal Generator	606A	Hewlett-Packard	Frequency range: 50 kc to 65 mc.
6625-079-3676	Oscilloscope	561A*	Tektronix	Frequency range: dc to 450 kc. Vertical sensitivity: 1 mv per cm to 20 volts per cm Sweep range: 1 mc per cm to 5 seconds per cm
6625-	Oscilloscope Dual Trace Amplifier Plug-in	3A1	Tektronix	Passband: dc to 10 mc per channel Sensitivity: 10 mv to 10 volts per cm
6625-	Oscilloscope Time Base Unit Plug-in	2B67	Tektronix	Rise time: 35 uv seconds Sweep: 1 microsecond to 5 seconds per cm
6625-	Sideband Marker Crystal	CR-63A/U		500 kc crystal**

*or equivalent

**Check the panoramic indicator A1 module for the sideband marker crystal Y3. Some units may be shipped with Y3 installed.

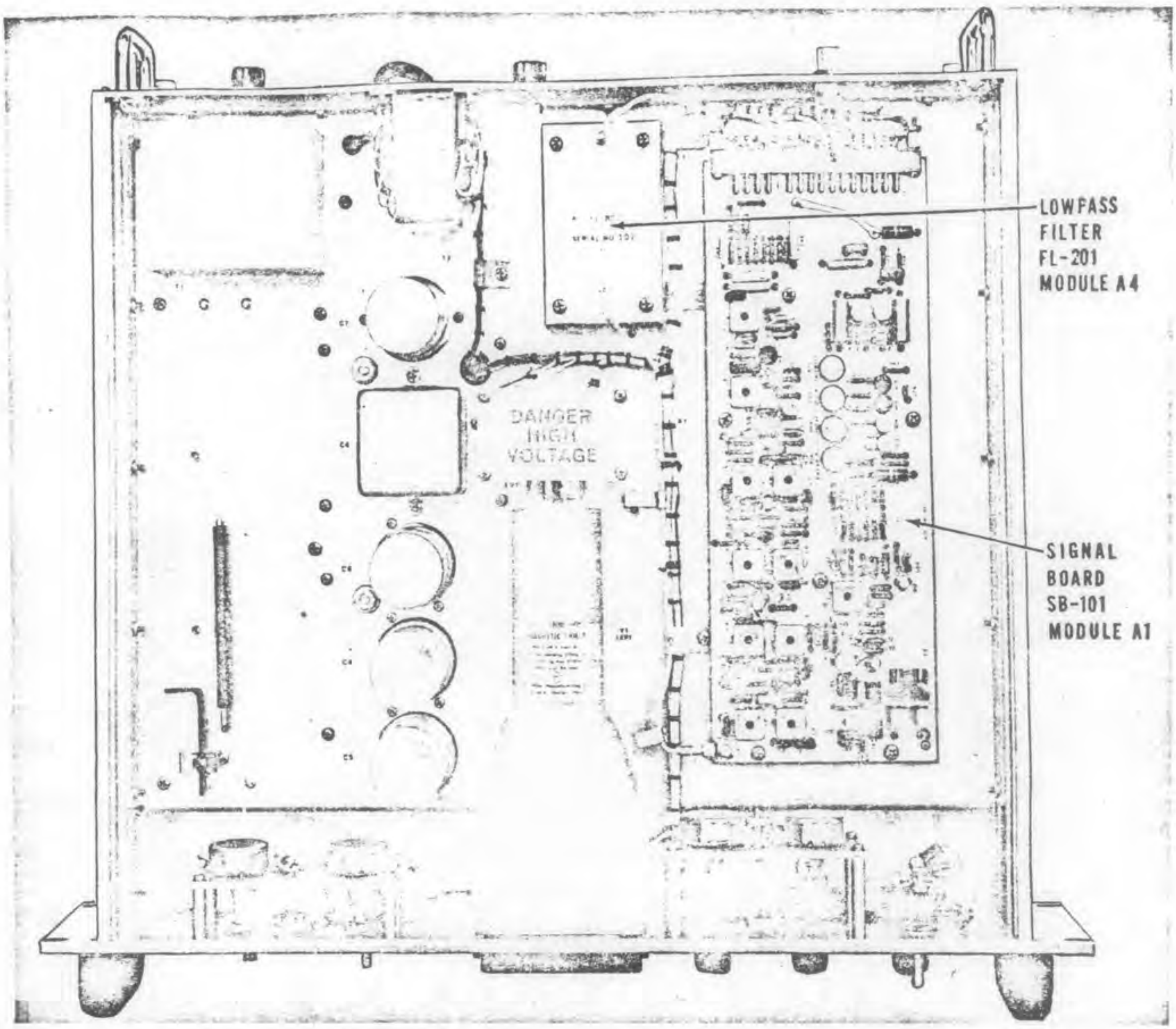


Figure 5-1. Chassis Top View

5-8. ALIGNMENT.

5-9. Because proper alignments and adjustment of the panoramic indicator is dependent upon complete understanding of the equipment, it is assumed that you are familiar with the principles of operation, preliminary checks, starting procedures and operator's adjustments contained in other chapters of this manual. The alignment procedures contained herein will enable you to perform complete alignment of the panoramic indicator. Table 5-3 contains a list of the dc voltages supplied to key components and the source of each voltage. The alignment procedures necessarily assume familiarity with the operation of the test equipment required to perform these alignments and that power supply voltages are normal.

5-10. 12 VOLT POWER SUPPLIES, PS-105, MODULE A2 ADJUSTMENT.

a. Remove the panoramic indicator from the equipment rack and remove the chassis bottom dust cover by loosening the two 1/4-turn fasteners on the chassis rear apron. Pull bottom dust cover away from the chassis rear apron.

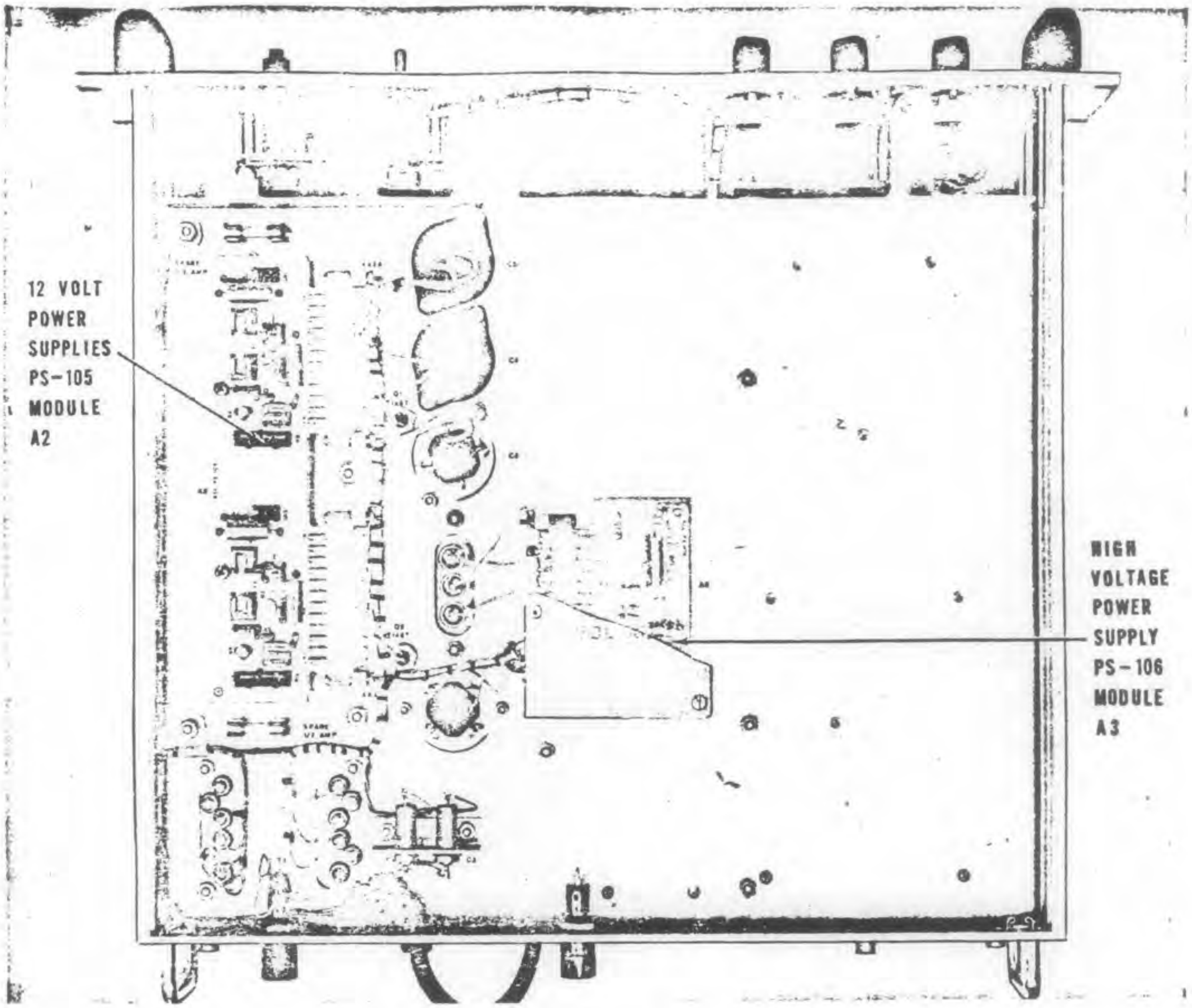


Figure 5-2. Chassis Bottom View

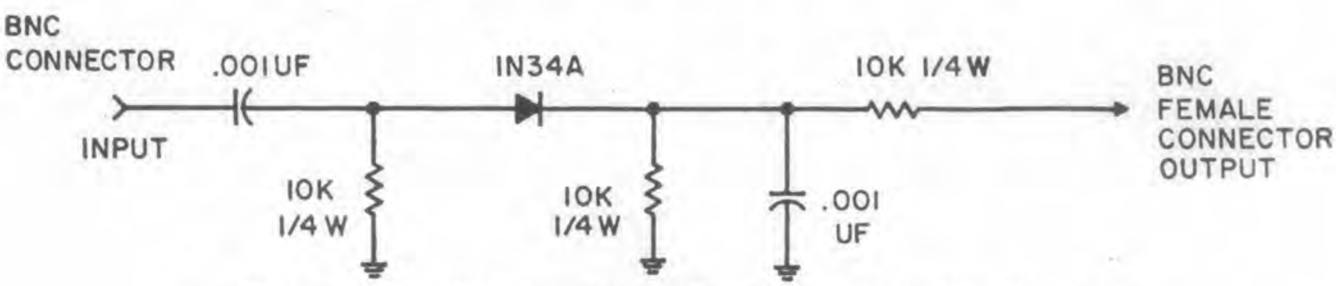


Figure 5-3. High Impedance Detector Schematic Diagram

CAUTION

Avoid contacting large capacitor terminal and high voltage power supply board; PS-106, module A3.

b. Connect power plug to a 115 volt ac outlet and place the POWER ON switch in ON position. Connect the vtvm to module A2, (PS-105) connector XA2A terminal 3, 4, or 5 (see Figure 5-9).

Table 5-2. Panoramic Indicator Performance Tests.

PRELIMINARY INSTRUCTIONS: Perform these tests with dust covers removed and the POWER switch in the ON position. Turn the MARKER switch to the down (off) position. Turn the GAIN control fully clockwise connect the 606A signal generator and oscilloscope to the panoramic indicator as shown in Figure 5-4. Make interconnections using RG-55/U coaxial cables.

STEP	TEST EQUIP. OPR	TEST POINT	OPR OF RCVR	PERFORMANCE STD
1	Connect 606A signal generator to W2J1 on the panoramic indicator chassis rear apron. Set the 606A for 21.4 mc 50% 1000 cps output at -30 dbm (7 mv). Connect 561A oscilloscope through 0.01 uf capacitor to TP1. Bypass R53 (5.1K) resistor on A1 to ground through a 0.01 uf capacitor.	A1, TP1	Normal Operation	1 kc sine wave. Minimum amplitude of 35 mv. (see Figure 5-5)
2	Same as step 1 but adjusting the 606A frequency from 21 mc to 22 mc.	A1, TP1	Normal Operation.	Same as step 1 with amplitude remaining relatively constant.
3	Same as step 1 except switch the 606A signal generator to cw operation connect oscilloscope through high impedance detector to TP2 on A1 module. Apply external synchronization to oscilloscope from XA1 pin 11.	A1, TP2	Adjust SWEEP WIDTH and CENTER FREQ controls to approximately mid-range position.	Linear pulse of 60 mv minimum (Figure 5-6)
4	Same as step 3 except increase signal generator output to -60 dbm (225 mv) and connect 561A oscilloscope to A1, TP3	A1, TP3	Same as step 3.	Linear response of mv minimum (Figure 5-7)
5	Same as step 3 except set signal generator for -80 dbm (225 uv) and apply oscilloscope to TP4.	A1, TP4	Same as step 3.	Linear response of 100 mv minimum (Figure 5-8)

c. Adjust potentiometer R5, for a vtvm reading of +12 volts dc.

d. Connect the vtvm to connector XA2B, terminal 12 and adjust potentiometer R12 for a reading of +12 volts dc.

5-11. LOW PASS FILTER, FL-201 MODULE A4 ALIGNMENT.

a. Remove the chassis top dust cover and remove the coaxial connector from J1 and J2 on the module A4.

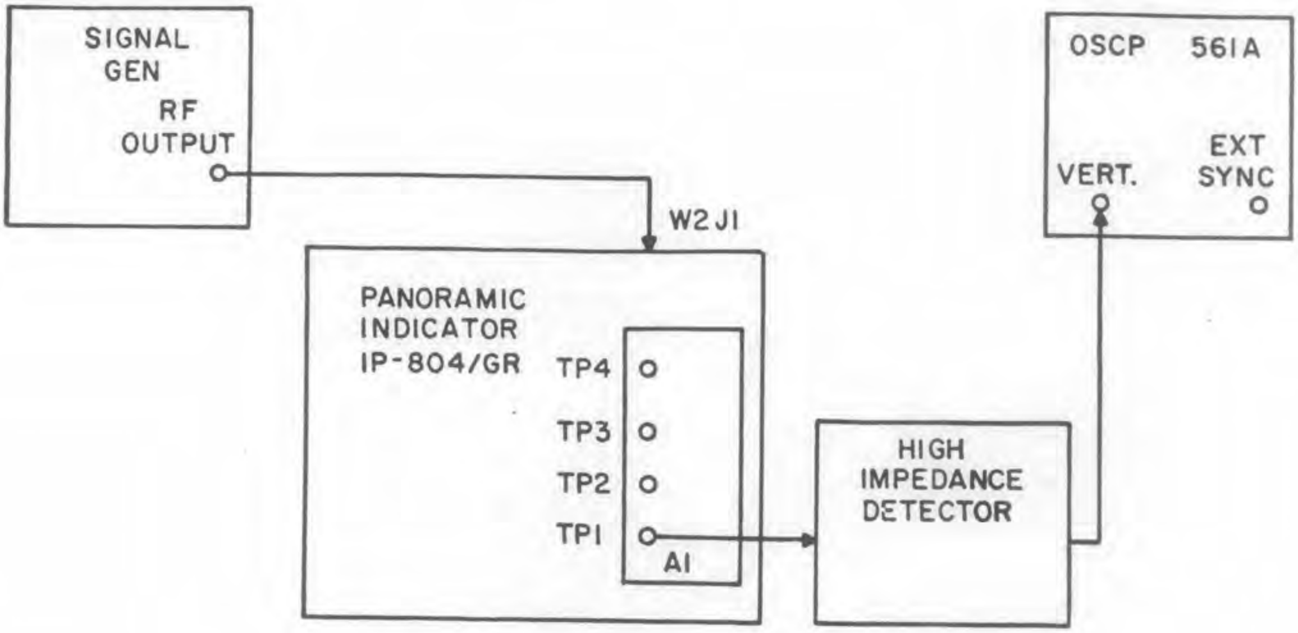


Figure 5-4. Performance Test Setup

Figure 5-5. 1 KC Response at TP1

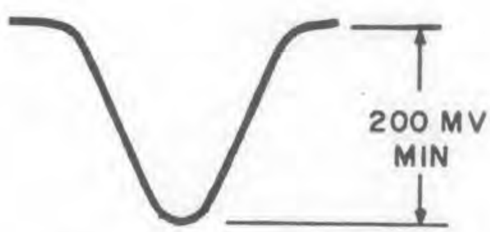


Figure 5-7. Response at TP3

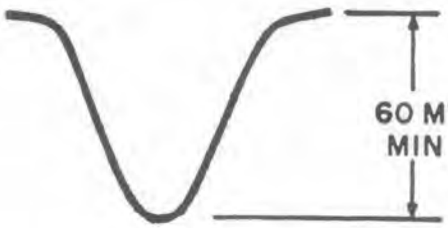


Figure 5-6. Response at TP2

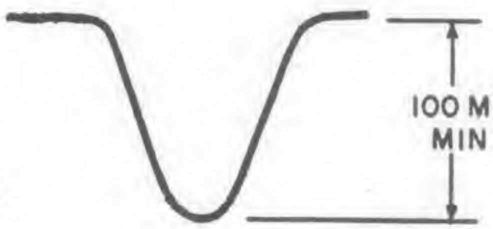


Figure 5-8. Response at TP4

Table 5-3. DC Voltage Supplies

UNIT	VOLTAGE SUPPLIED	FUSE	SOURCE OF SUPPLY
Signal Board, SB-101, Module A1	+12 vdc Regulated, ±10%	F2, 1/2 amp.	+12 vdc Power supply, PS-105, Module A2B
	-12 vdc Regulated, ±10%	F1, 1/2 amp.	-12 vdc Power supply, PS-105, Module A2A
	+150 vdc Regulated, ±10%		Power supply, PS-106, Module A-3
Panoramic Indicator Main Chassis	+12 vdc Regulated, ±10%	F2, 1/2 amp.	+12 vdc Power supply, PS-105, Module A2B
	-12 vdc Regulated, ±10%	F1, 1/2 amp.	-12 vdc Power supply, PS-105, Module A2A
	+150 vdc Regulated ±10%		Power supply, PS-106, Module A-3
	-1200 vdc Regulated, ±10%		Power supply, PS-106, Module A3

b. Stand the panoramic indicator on its side. Locate and remove the four screws that attach the module through the bottom of the main chassis.

c. Connect test equipment as illustrated in Figure 5-10.

d. Adjust the oscilloscope vertical sensitivity to two mv per cm and the marker generator for 21.4 mc.

e. Adjust capacitors C1 through C6, on module A4 (refer to Figure 5-11) for optimum flatness below 22.9 mc, and maximum skirt slope above 22.9 mc. The 22.9 mc 1 db point will be on the upper skirt as illustrated in figure 5-12.

f. Replace module A4 in main chassis and secure with the four screws. Replace coaxial connectors on J1 and J2.

NOTE

When installing module A4 connector J1 must be closest to the chassis rear apron.

5-12. SIGNAL BOARD SB-101 MODULE A1, ALIGNMENT.

5-13. INPUT AMPLIFIER ALIGNMENT.

a. Remove panoramic indicator chassis top dust cover.

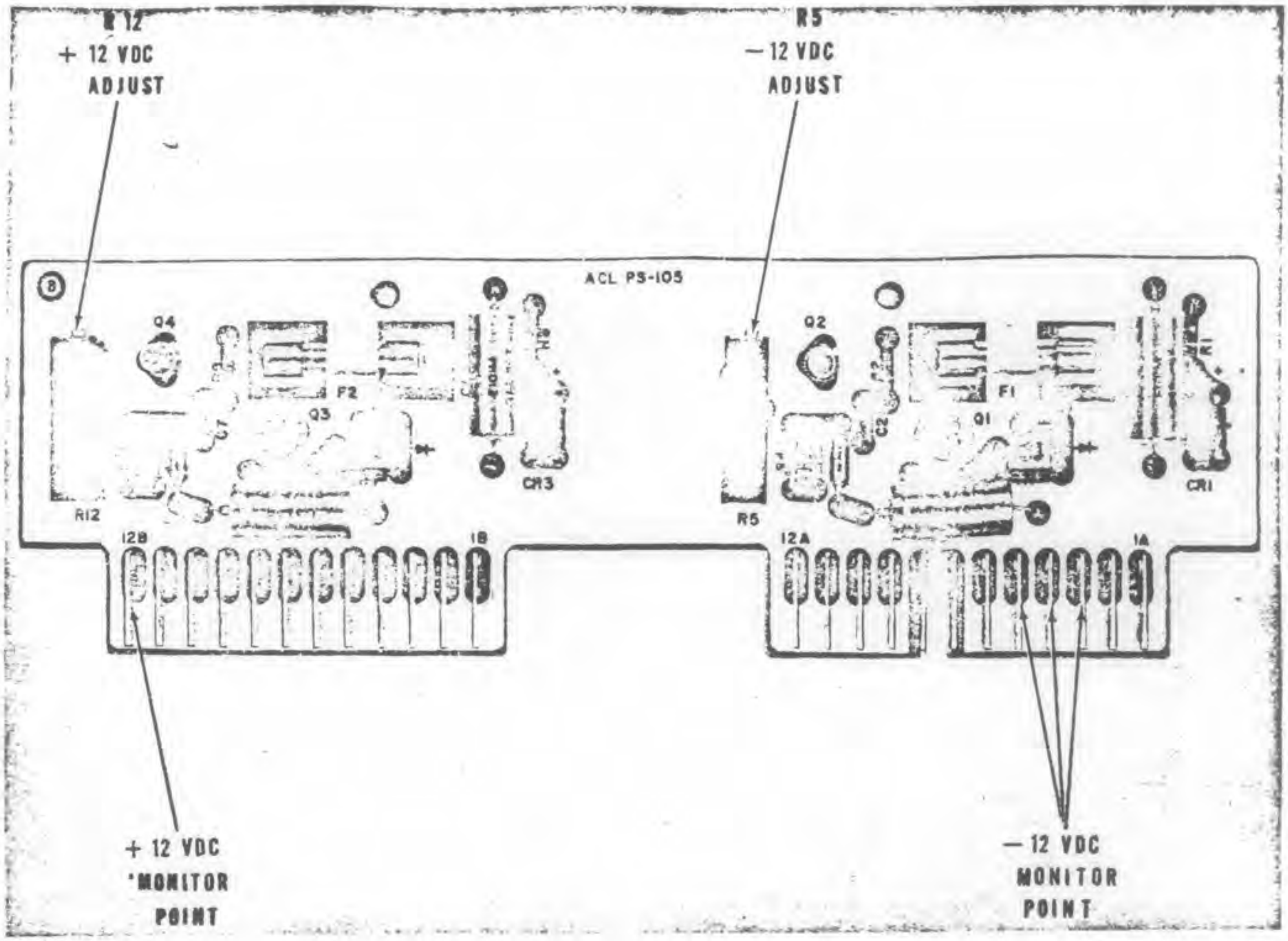


Figure 5-9. 12 Volt Power Supply, PS-105

b. Connect test equipment as illustrated on Figure 5-13. The rf input to the panoramic indicator should be injected into the 21.4 MC INPUT connector A1J1 located on the signal board. The detector can be connected to the cathode side of diode CR5 or CR6 in order to monitor the output of the input amplifier, see Figure 5-14.

c. Place the POWER ON switch in the ON position and adjust the oscilloscope vertical sensitivity for 2 mv per cm and the horizontal sensitivity to achieve a full-scale deflection of the horizontal trace.

d. Adjust the GAIN control for maximum gain and place the MARKER ON switch in the MARKER (off) position.

e. Adjust the output level of the signal generator and the marker gain control on the sweep generator as required to achieve a small marker pattern on the oscilloscope. Adjust the frequency of the sweep generator to 21.4 mc as indicated by the presence of the marker in the center of the oscilloscope trace.

f. Adjust L12 for stabilized oscilloscope display.

g. Adjust L1, L2, L3 and L4, (Figure 5-14) for a slightly overcoupled response centered around the 21.4 mc marker. Reduce the output level of the sweep generator as required to maintain peak-to-peak response on the oscilloscope at approximately 6 mv or less. The response should have a peak-to-peak bandwidth of approximately 3 mc. A minimum bandwidth of 3 mc is required at the 1 db points.

h. Remove the test equipment.

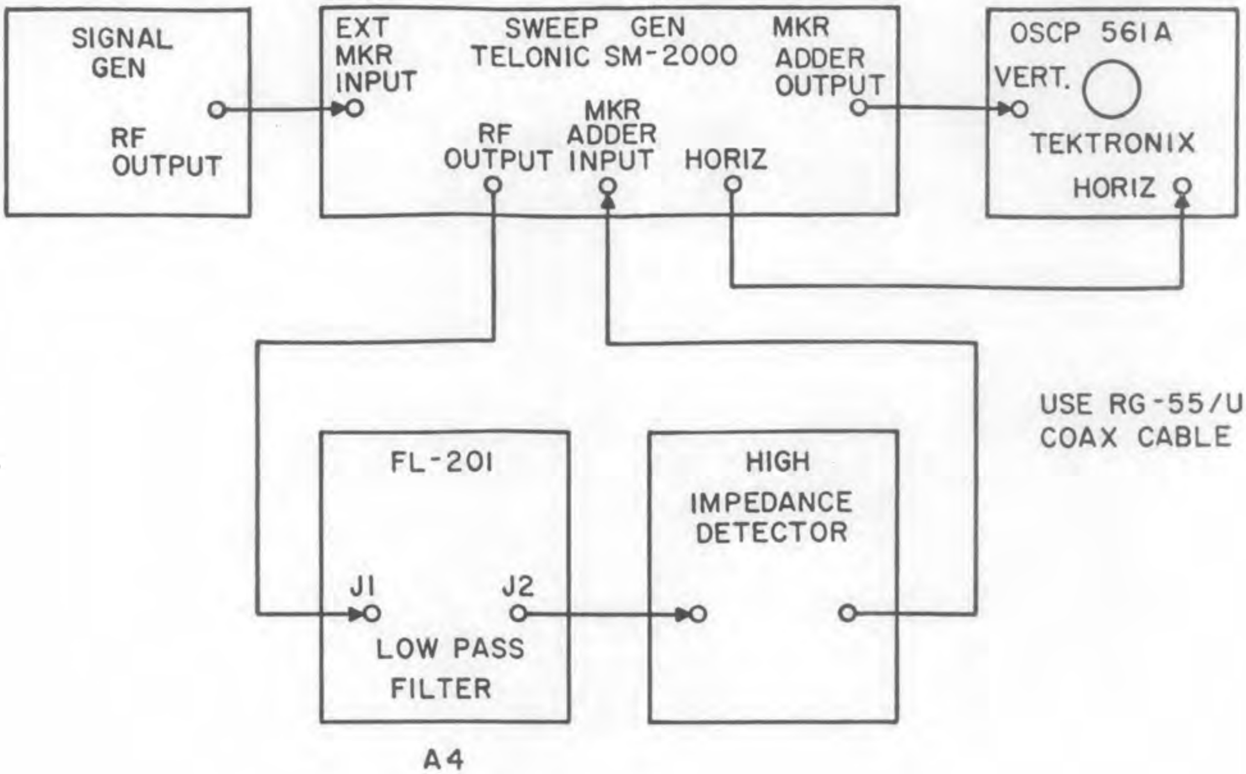


Figure 5-10. Low Pass Filter Test Equipment Setup

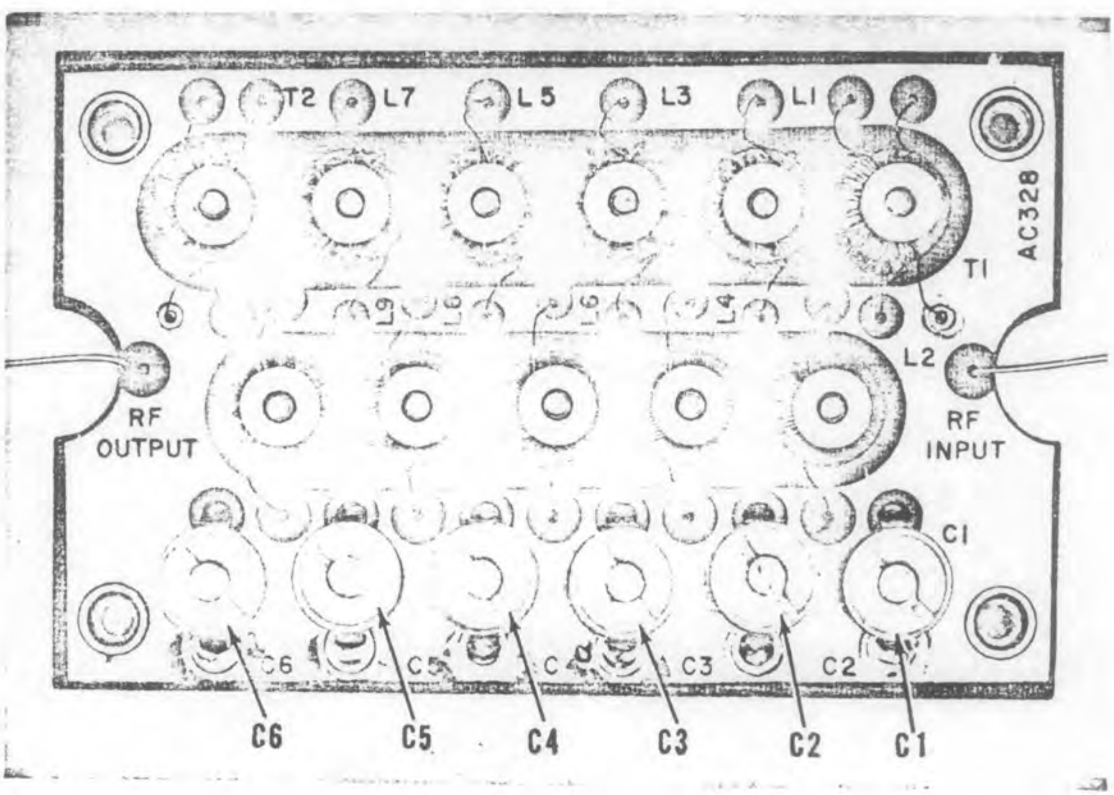


Figure 5-11. Low Pass Filter Module A4

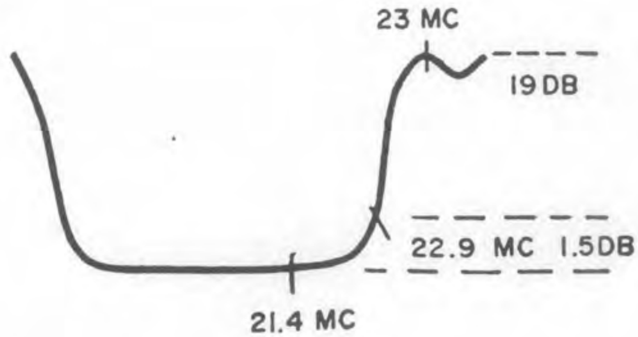


Figure 5-12. Low-Pass Filter Response

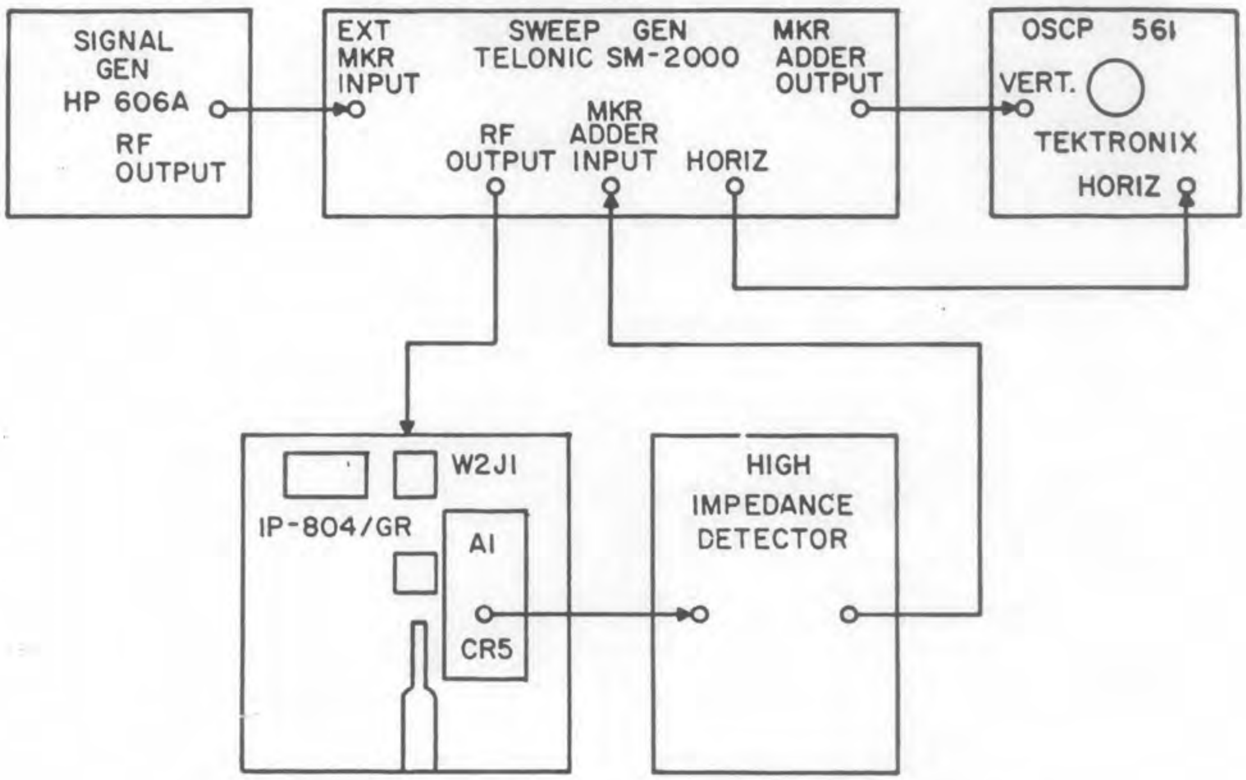


Figure 5-13. Signal Board Module A1 Test Equipment Setup

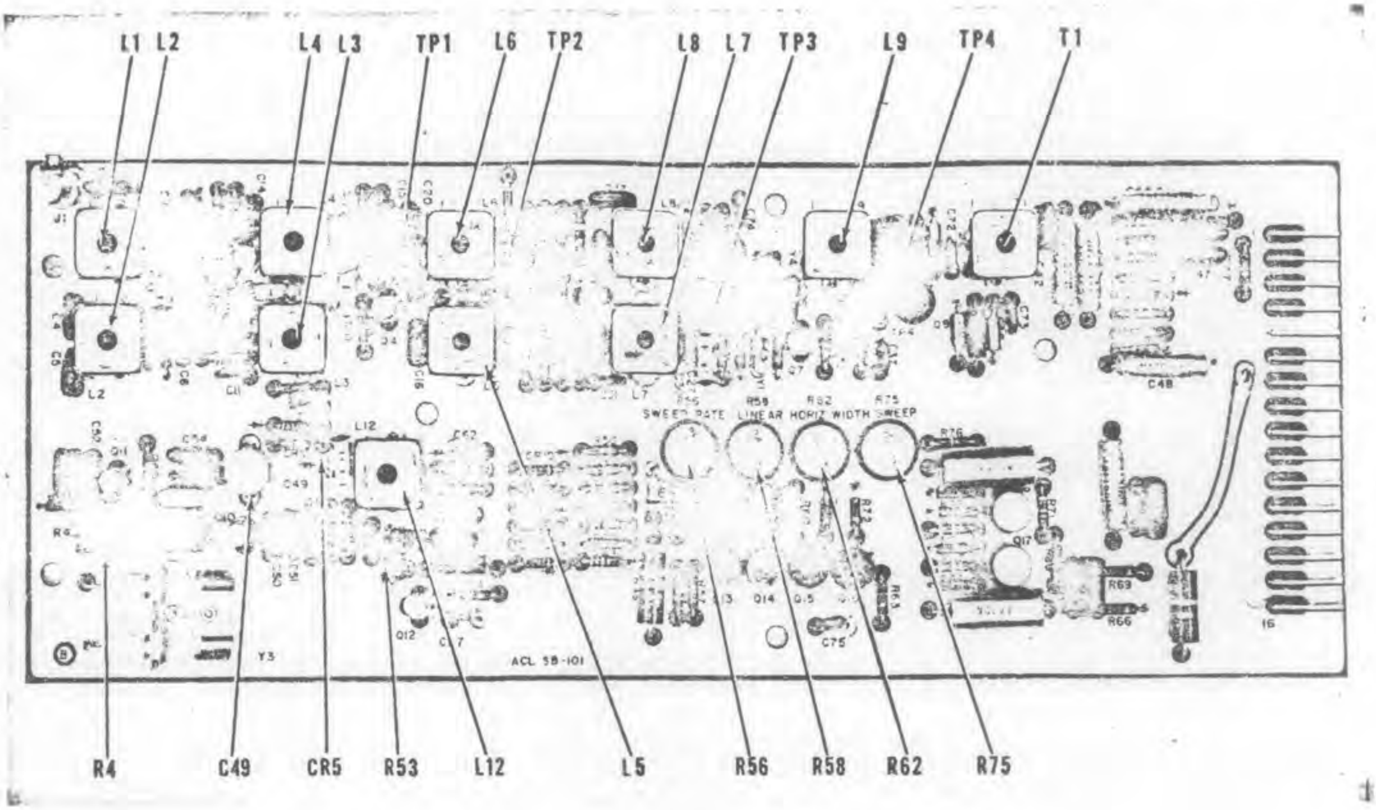


Figure 5-14. Signal Board Module A1

5-14. 4.3 MC AND 455 KC I-F ALIGNMENT.

a. Set the signal generator to 455 kc and connect the generator output through a 0.01 μf capacitor to TP4, located adjacent to Q9 on the A1 module, see figure 5-14.

b. Place the POWER ON switch in the ON position and the MARKER on switch in the down (off) position.

c. Adjust front panel controls as required to achieve a deflection on the panoramic indicator crt.

d. Adjust the signal generator output for approximately half scale deflection on the crt.

e. Using the adjustment tool provided, adjust transformer T1 for a maximum deflection on the crt.

f. Remove the 455 kc signal generator from TP4 and conne

adjacent to transistor Q8. Vary signal generator output frequency about 455 kc for maximum deflection on crt to assure that the 455 kc output is within the bandwidth of Y4.

g. Reduce the signal generator output as required to achieve a one half scale deflection on the crt.

h. Adjust inductor L9 for a maximum deflection on the crt. Repeat T1 (step e) for a maximum deflection on crt.

i. Remove the signal generator from TP3 and reset to 4.3 mc.

j. Inject the 4.3 mc signal at TP2, physically located adjacent to L6.

k. Adjust the signal generator output for a half scale deflection on the crt and tune inductors L7 and L8 for maximum crt deflection.

l. Inject a 4.3 mc signal at the junction ... CR6 through a 0.01 uf capacitor.

m. Adjust the signal generator output for a half scale deflection on the crt and tune inductors L5 and L6 for maximum crt deflection.

5-15. SWEEP CIRCUITRY ALIGNMENT.

a. Connect the signal generator set at 21.4 mc to the cathode of CR5 and CR6, figure 5-14.

b. Turn the CENTER FREQ control to its mid-range position. Set the SWEEP WIDTH control about one quarter range from maximum counter-clockwise. Adjust inductor L12 to center the 21.4 mc marker on the crt screen.

c. Connect the oscilloscope between terminal 14 on module A1 and chassis ground. Adjust SWEEP RATE potentiometer R56 for a rate of 20 cps. 20 cps equals 50 msec. Adjust oscilloscope for a horizontal sensitivity of 10 msec. When sawtooth is 50 msec wide (minimum to maximum amplitude) the sweep rate is 20 cps. Vertical sensitivity should be approximately 10 volts per cm.

d. Place the POWER ON switch in the down (off) position and remove the signal generator and oscilloscope.

e. Install a CR-63A/U, 500 kc crystal, Y3 in the socket provided on signal board, SB-101 module A1.

f. Place the POWER ON switch in the ON position and the MARKER ON switch in the ON position.

g. Turn SWEEP WIDTH to maximum clockwise position.

h. A center frequency marker, 21.4 mc, and three sideband pips on each side of the display trace should be visible on the crt.

i. If the marker oscillator is not functioning properly, adjust potentiometer R41 for proper oscillator output and sideband marker pip height.

j. Adjust HORIZ WIDTH control R62, MAX SWEEP potentiometer R55, HORIZONTAL POS adjustment R17, and inductor L12 for the best linearity of the crt display.

k. When the panoramic indicator is properly aligned, all sideband pips should be superimposed over the scribed marks on the crt screen. Repeat steps "i" and "j" until no further improvement can be obtained.

5-16. FINAL ALIGNMENT CHECK

a. Connect a 21.4 mc signal generator input to J1.

b. Turn GAIN control fully clockwise.

c. Place the POWER ON switch in the ON position and adjust the signal generator output to achieve full scale deflection on the crt.

d. Turn SWEEP WIDTH control R4, counter-clockwise as required to reduce the sweep width sufficiently to display only (the expanded) 21.4 mc marker on the crt screen in order to view and measure the display pulse.

e. The marker pip should be symmetrical and show no evidence of bumps or irregularities. If such irregularities are noted, touch up the tuning of only the 455 kc and 4.3 mc inductors L5 through L9 and T1 per paragraph 5-14. Perform this adjustment while viewing the expanded signal on the crt screen. Adjust for both maximum gain and the narrowest pulse width.

f. Adjust the signal generator for not more than 10 uv output.

g. Ensure that the crt displays a full scale deflection.

h. Place the POWER ON switch in the off position and remove the signal generator.

5-17. MODULE SERVICING.

5-18. MODULE REPLACEMENT.

5-19. To gain access to modules within the panoramic indicator, remove the top and/or bottom chassis dust cover(s) from the main chassis by turning the quick release 1/4-turn screw fasteners located on the chassis rear apron. To replace individual modules proceed with the instructions in the applicable paragraph(s) which follow(s).

5-20. SIGNAL BOARD, SB-101, MODULE A1 REMOVAL.

a. Remove coaxial connectors from J1 located on the signal board.

b. Locate and remove the six captive screws which secure the signal board to the main chassis.

c. Gently slide or pull signal board, SB-101, module A1 away from connector XA1 (towards the front panel).

d. To install another signal board, reverse the procedures in steps a, b, and c.

5-21. LOW PASS FILTER, FL-201, MODULE A4 REMOVAL.

a. Loosen and uncouple coaxial connectors from J1 and J2 on module A4.

b. Turn the main chassis upside-down and locate the four captive screws which secure the low pass filter module to the main chassis. Remove the four screws being careful not to let the module drop out of the chassis.

c. To reinstall module A4, reverse steps a and b of this paragraph.

5-22. 12 VOLT POWER SUPPLIES, PS-105, MODULE A2 REMOVAL.

a. Locate and remove the two screws which secure the A2 module to the main chassis.

b. Pull the module board away from connectors XA2A and XA2B.

c. To replace module A2 reverse steps a and b of this paragraph.

5-23. HIGH VOLTAGE POWER SUPPLIES, PS-106, MODULE A3 REMOVAL.

a. Locate the high voltage power supply and remove the three screws which attach the protective cover over the module board, Figure 5-15.

b. Remove the cover and two standoffs.

c. Pull the module board away from connector XA3.

d. To install module A3, reverse steps a, b, and c of this paragraph.

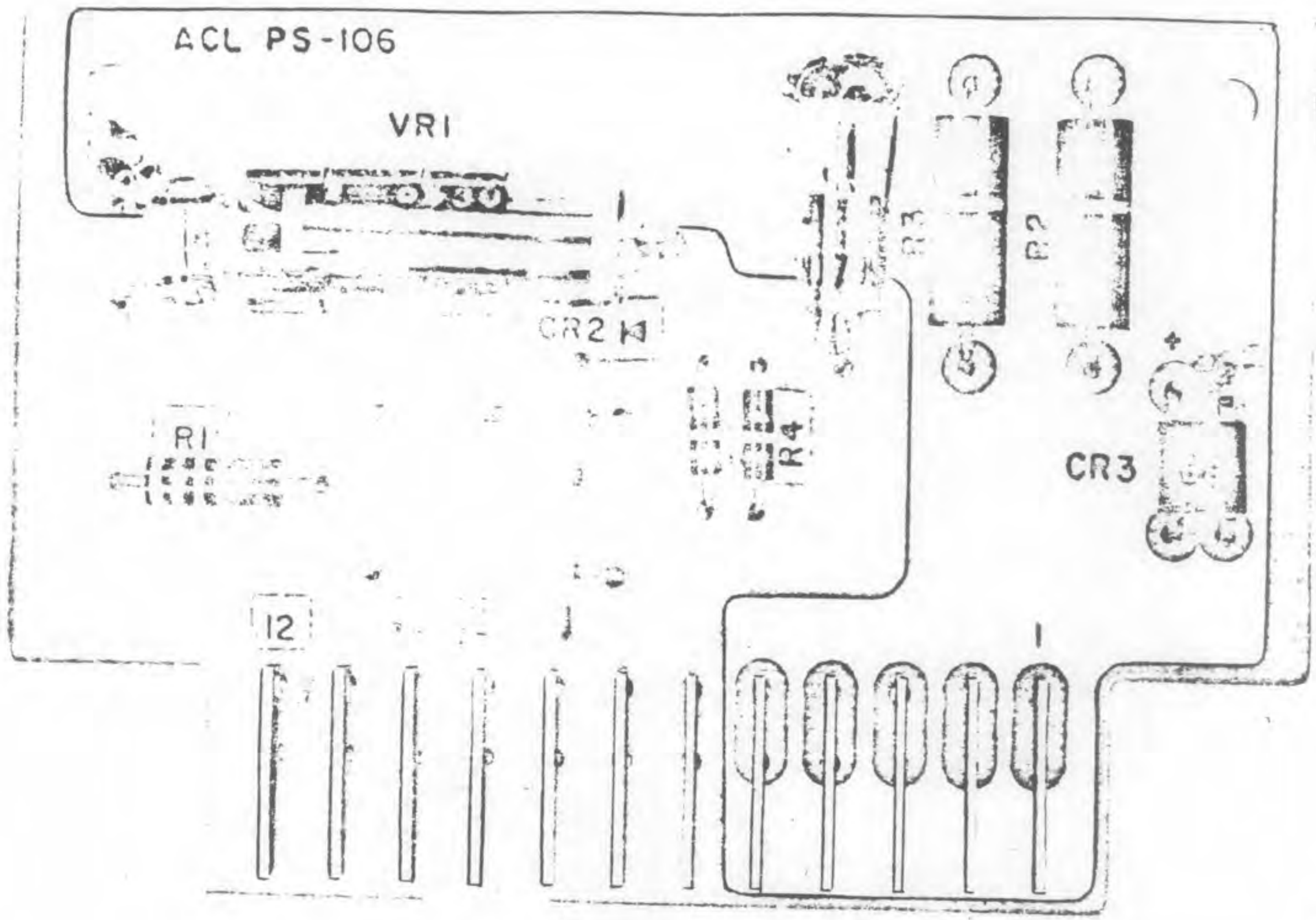
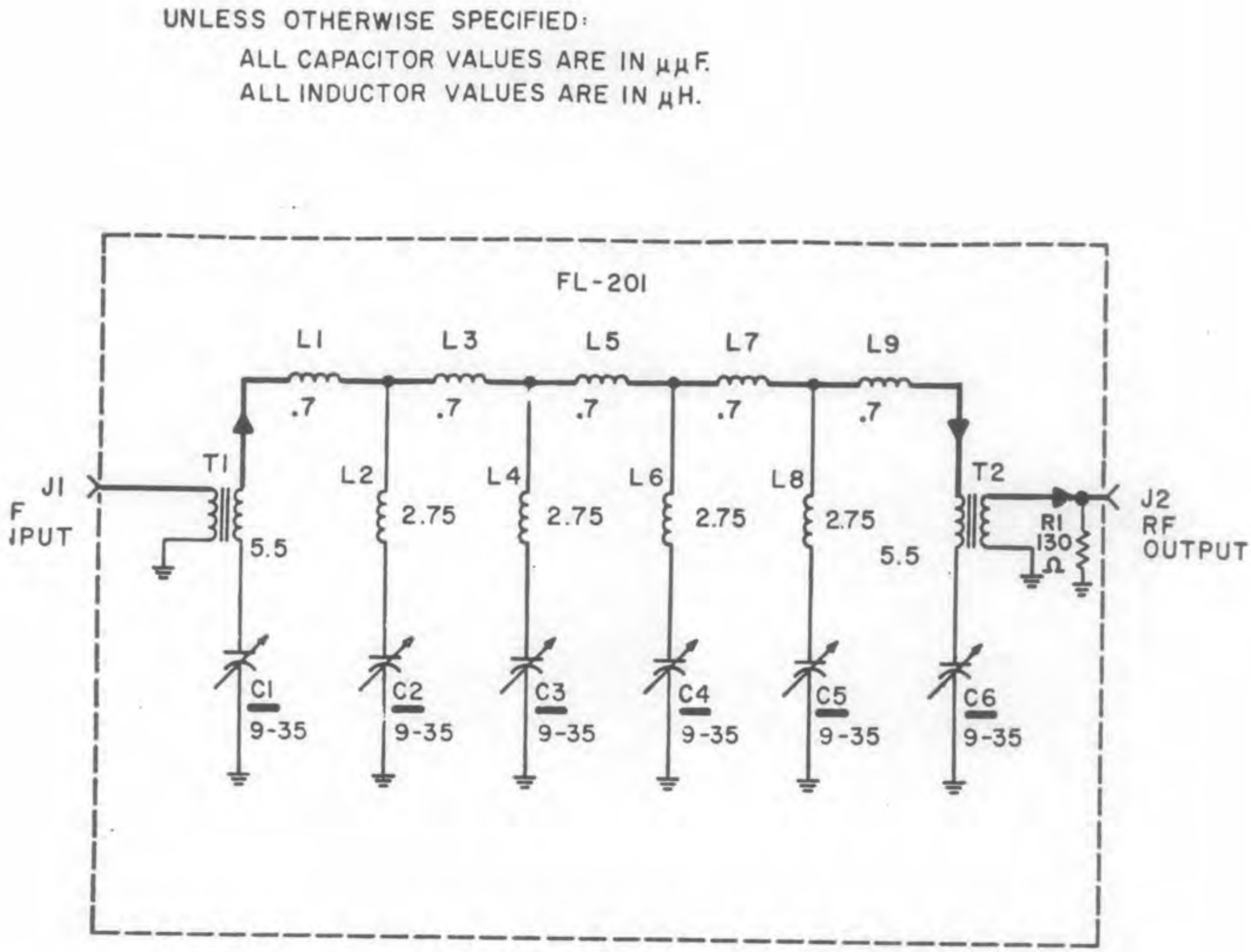


Figure 5-15. High Voltage Power Supply, Module A3

SECTION II

SPECIAL MAINTENANCE

5-24. NOT APPLICABLE.



igure 6-1. Low Pass Filter, FL-201, Module A4, Schematic Diagram

UNLESS OTHERWISE SPECIFIED
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.
ALL CAPACITOR VALUES ARE IN $\mu\mu$F

PIN DESIGNATION

REF	E		B		C	
DES	V	R	V	R	V	R
Q1	− 1.1	4.7	− 0.3	4.7	+ 6.3.	2.2
Q2	− 0.7	6.8	GRD	0	+12.0	1.2
Q3	− 1.3	4.6	− 0.6	6.2	− 0.7	∞
Q4	−0.7	∞	GRD	0	+ 6.5	2.2
Q5	− 1.1	4.5	− 0.4	4.5	+ 6.3	2.2
Q6	− 0.7	6.5	GRD	0	+ 9.4	2.2
Q7	+ 8.4	5.6	+ 5.3	6.8	+10.8	2.2
Q8	− 8.1	5.0	− 7.5	4.0	0	12Ω
Q9	− 0.85	3.8	− 0.11	3.6	+12.0	1.2
Q10	0(−7.3)*	210	0(−6.6)*	39	GRD	0
Q11	0(−3.2)*	370	0(−2.5)*	4.6	GRD	0
Q12	+ 5.6	950Ω	+ 6.0	2.7	+12.0	1.1
Q13	+11.7	1.9	+11.3	1.1	+ 4.0	1.7
Q14	+ 4.0	1.7	B1 GRD	0	B2 +11.3	1.1
Q15	+ 4.0	5.0	+ 4.0	1.7	+12.0	1.1
Q16	+ 2.3	1.0	+ 3.5	4.5	+10.0	2.2
Q17	+ 2.3	1.2	3.0	5.8	+49.0	75
Q18	+ 2.4	1.2	+ 2.9	5.8	+58.0	68

NOTES.

1. ALL VOLTAGE AND RESISTANCE MEASUREMENTS WERE TAKEN WITH WV-98C MULTIMETER TO CHASSIS GROUND. ALL MEASUREMENTS TAKEN WITH PANORAMIC INDICATOR MODULES INSTALLED FOR NORMAL OPERATION. SLIGHT VARIATIONS IN VOLTAGES AND RESISTANCES MAY BE ENCOUNTERED IN THE FIELD.
2. ALL RESISTANCES ARE IN K OHMS UNLESS OTHERWISE STATED.
3. WHEN MAKING MEASUREMENTS, PRESET THE PANORAMIC INDICATOR AS FOLLOWS.
   - A. HORIZONTAL AND VERTICAL POSITION–NORMAL OPERATION
   - B. INTENSITY AND FOCUS–NORMAL OPERATION
   - C. SWEEP WIDTH AND CENTER FREQ–MID RANGE
   - D. GAIN–MAXIMUM CLOCKWISE
   - E. MARKER–OFF EXCEPT AS NOTED BY *
   - F. NO SIGNAL INPUT

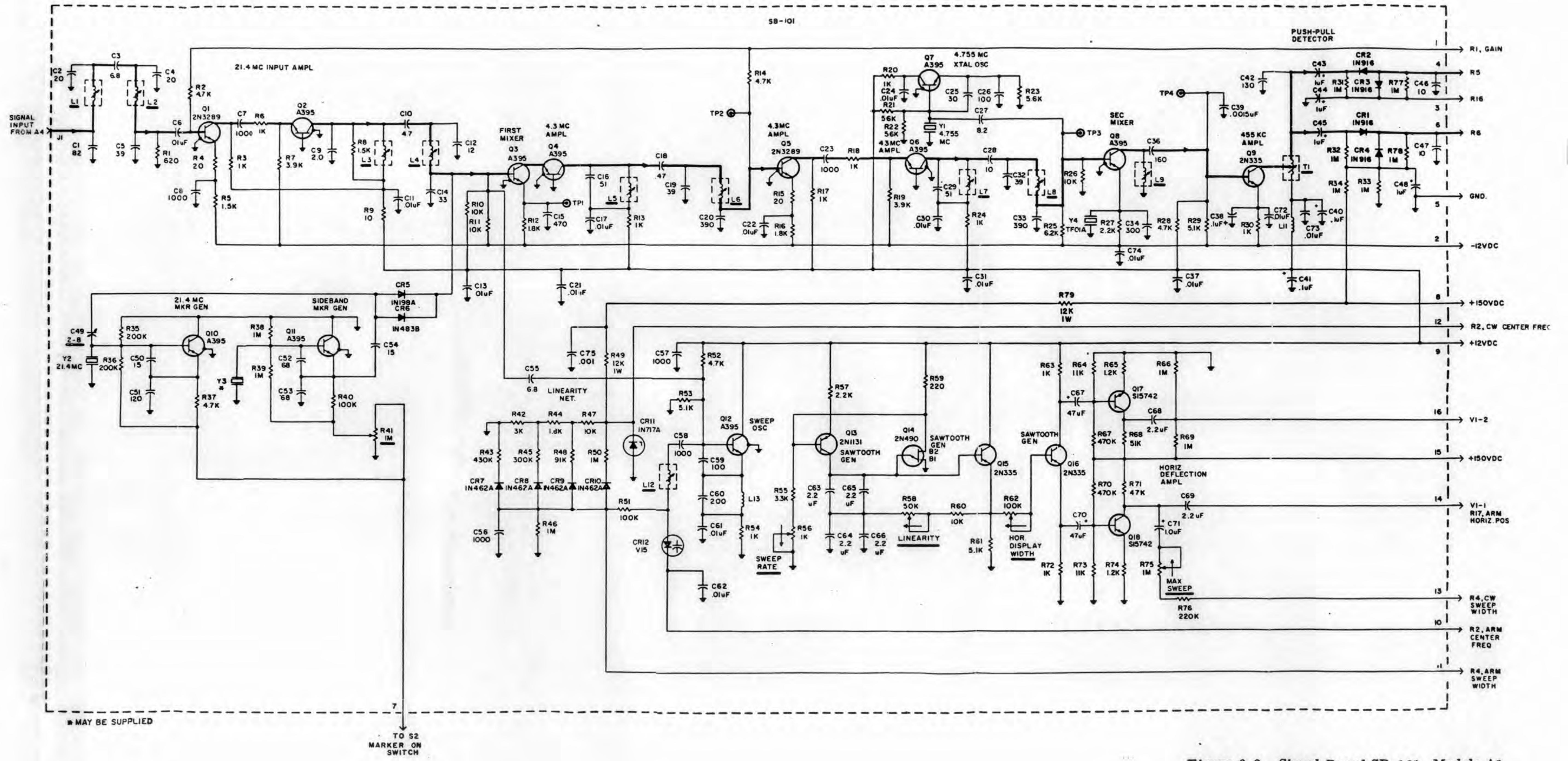


Figure 6-2. Signal Board SB-101, Module A1, Schematic Diagram

REF DES	PIN DESIGNATION E V	E R	B V	B R	C V	C R
Q1	+ 0.7	84 Ω	+1.25	400 Ω	+15.0	400 Ω
Q2	− 5.3	1.4	−4.6	1.35	+ 1.25	2.2
Q3	+12.0	7	+12.6	16	+27.0	5.6
Q4	+ 6.5	2.25	+7.2	1.82	+12.6	16

NOTES.

1. ALL VOLTAGE AND RESISTANCE MEASUREMENTS WERE TAKEN WITH WV–98C MULTIMETER TO CHASSIS GROUND. ALL MEASUREMENTS TAKEN WITH PANORAMIC INDICATOR MODULES INSTALLED FOR NORMAL OPERATION. SLIGHT VARIATIONS IN VOLTAGES AND RESISTANCES MAY BE ENCOUNTERED IN THE FIELD.
2. ALL RESISTANCES ARE IN K OHMS UNLESS OTHERWISE STATED.
3. WHEN MAKING MEASUREMENTS, PRESET THE PANORAMIC INDICATOR AS FOLLOWS.
   - A. HORIZONTAL AND VERTICAL POSITION–NORMAL OPERATION
   - B. INTENSITY AND FOCUS–NORMAL OPERATION
   - C. SWEEP WIDTH AND CENTER FREQ–MID RANGE
   - D. GAIN–MAXIMUM CLOCKWISE
   - E. MARKER–OFF
   - F. NO SIGNAL INPUT

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4 W, 5%.
ALL CAPACITOR VALUES ARE IN μμF.

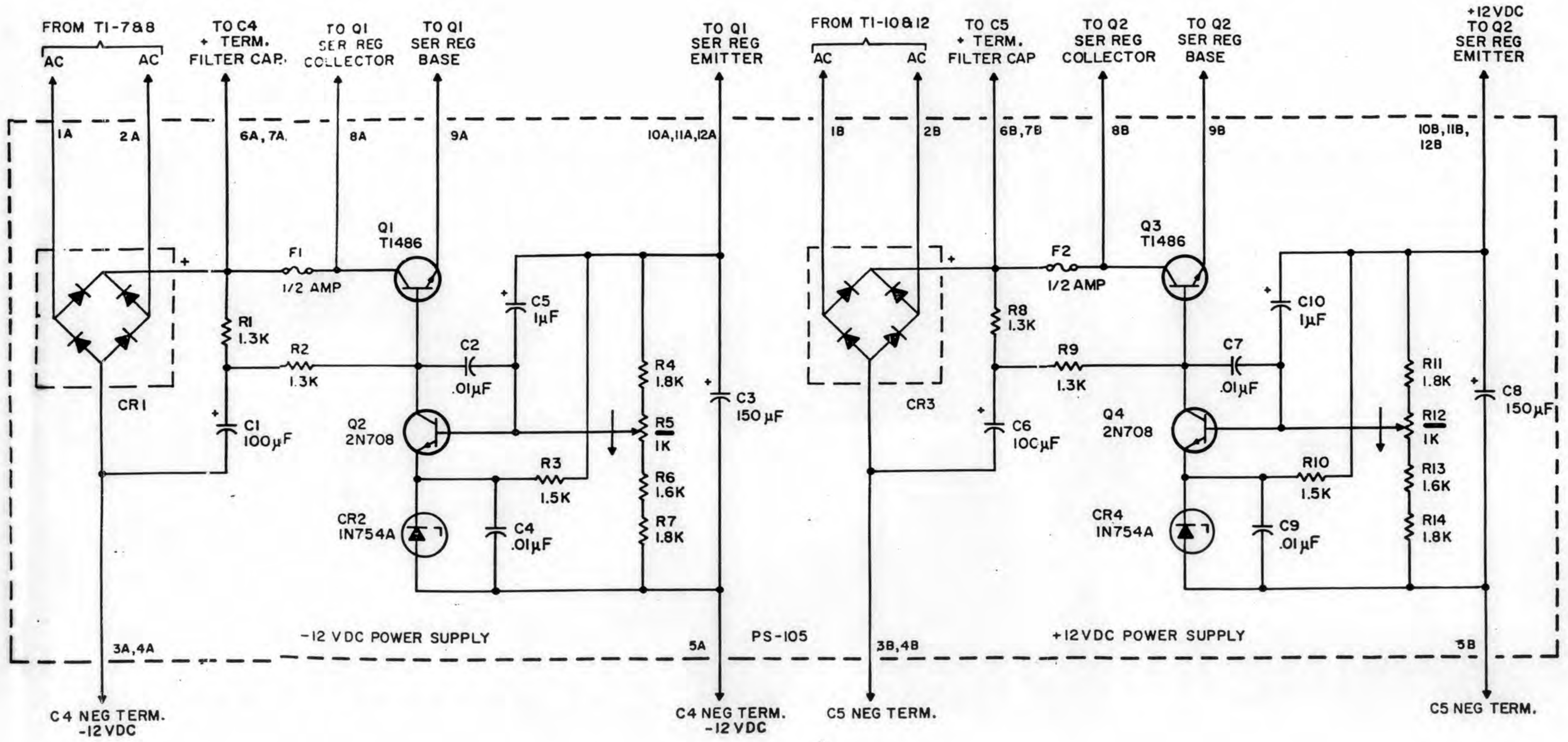


Figure 6-3. 12 Volt Power Supplies PS-105, Module A2, Schematic Diagram

UNLESS OTHERWISE SPECIFIED:
ALL RESISTOR VALUES ARE IN OHMS, 1/4W, 5%.

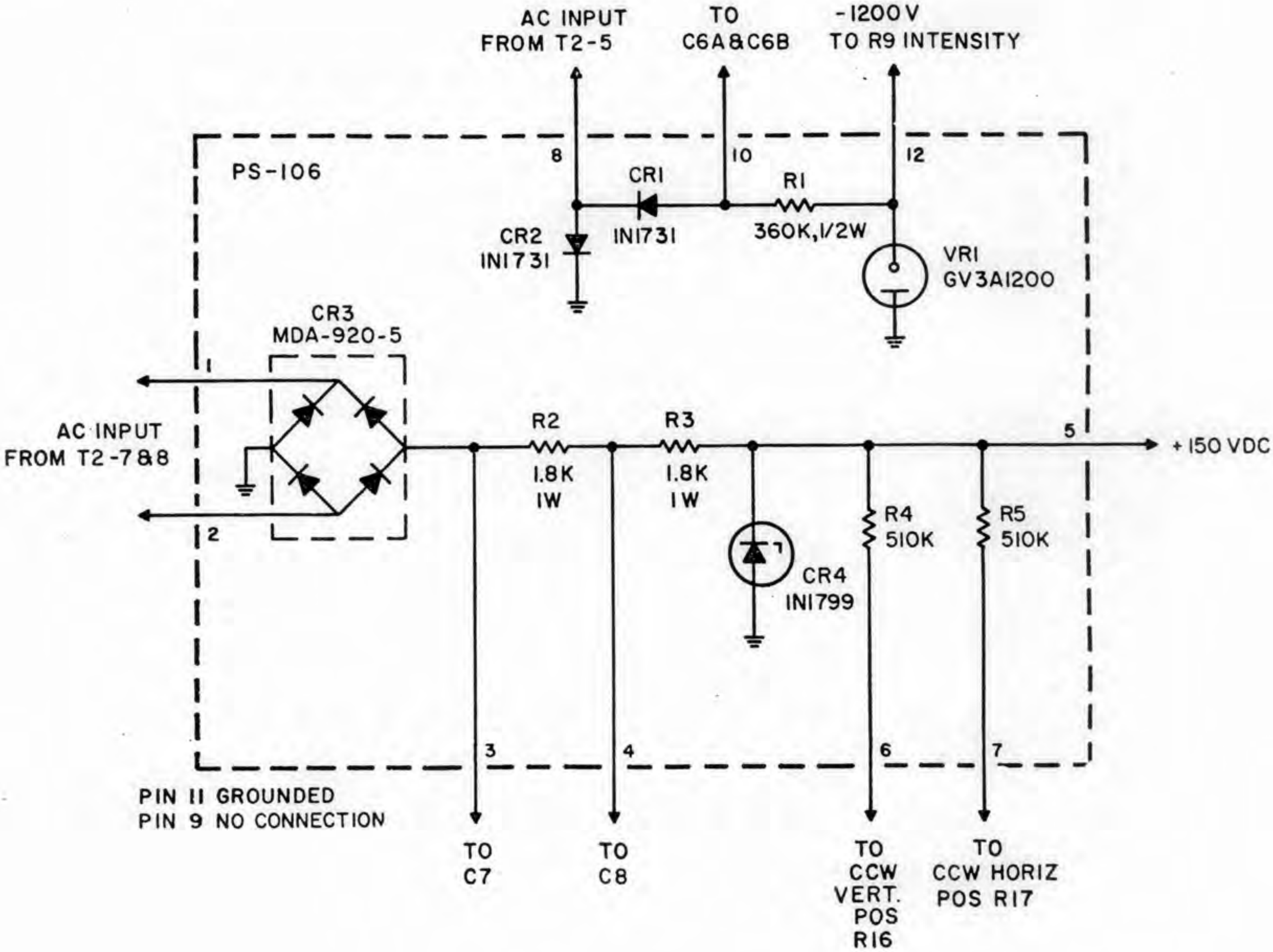


Figure 6-4. High Voltage Power Supplies PS-106, Module A3, Schematic Diagram

REF DES	PIN DESIGNATION E V	E R	B V	B R	C V	C R
Q1	GRD	0	+ 0.7	5.3	+15.0	16
Q2	+12.0	1	+12.6	6.8	+27.0	16

NOTES.

1. ALL VOLTAGE AND RESISTANCE MEASUREMENTS WERE TAKEN WITH WV-98C MULTIMETER TO CHASSIS GROUND. ALL MEASUREMENTS TAKEN WITH PANORAMIC INDICATOR MODULES INSTALLED FOR NORMAL OPERATION. SLIGHT VARIATIONS IN VOLTAGES AND RESISTANCES MAY BE ENCOUNTERED IN THE FIELD.
2. ALL RESISTANCES ARE IN K OHMS UNLESS OTHERWISE STATED.
3. WHEN MAKING MEASUREMENTS, PRESET THE PANORAMIC INDICATOR AS FOLLOWS.
   - A. HORIZONTAL AND VERTICAL POSITION—NORMAL OPERATION
   - B. INTENSITY AND FOCUS—NORMAL OPERATION
   - C. SWEEP WIDTH AND CENTER FREQ—MID RANGE
   - D. GAIN—MAXIMUM CLOCKWISE
   - E. MARKER—OFF
   - F. NO SIGNAL INPUT

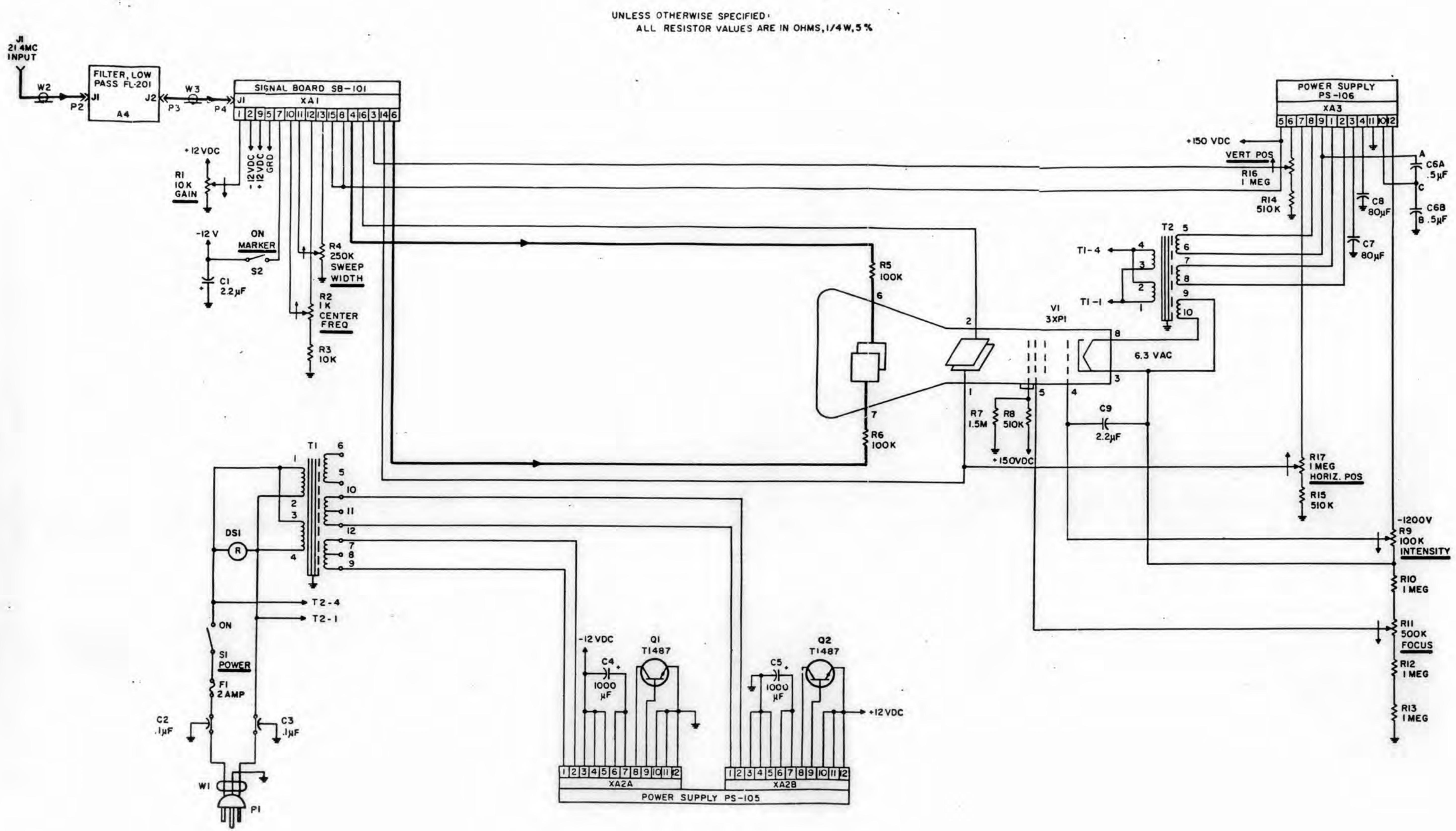


Figure 6-5. Panoramic Indicator Overall Schematic Diagram