INSTRUCTION MANUAL

for

PANORAMIC PANALYZOR

MODEL SB-12b

Panoramic RADIO PRODUCTS, INC.

PANORAMIC RADIO PRODUCTS, INC.
520 South Fulton Avenue, Mount Vernon, N.Y. • Phone: OWens 9-4600

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CHAPTER I
INTRODUCTION

I-1. GENERAL

This Instruction Manual has been prepared to assist in the installation, operation and servicing of the Panoramic Panalyzor, Model SB-12b.

No attempt to operate the equipment should be made until the operator is thoroughly familiar with the information contained in CHAPTER III - OPERATING INSTRUCTIONS.

I-2. APPLICATIONS

The Model SB-12b is designed for research, design or production test applications such as:

- Single sideband studies.
- Hum level analysis.
- RF cross modulation analysis.
- Adjacent channel interference investigations.
- Band occupancy studies.
- Residual carrier and sideband level measurements.
- Spurious oscillation or modulation detection.
- FM deviation measurements.

I-3. EQUIPMENT SUPPLIED

Description	Quantity
Panalyzor, Model SB-12b, Type T-100	1
Power Supply, Model PS-12	1
Transformer, Constant Voltage, T3003A-1	1
Cable, Interconnecting, Power, W1-60	1
Cable, Signal Input, W23-36	2
Spare Fuse, 2 amp, 250 V, Type AGC	3
Tool, Alignment, #E1010	1

I-4. GENERAL DESCRIPTION

The Panalyzor, Model SB-12b, is an automatic scanning superheterodyne receiver which permits analysis and identification of one or many radio-frequency signals at one time. Each signal within the band being scanned is displayed on a cathode-ray tube as one of a series of inverted V's or "pips". The pip amplitude and position along the calibrated horizontal axis are indicative of signal level and frequency, respectively. A CW signal produces a single pip. Modulated signals (AM, FM or pulsed) cause a series of pips which indicate sideband distribution and levels.

The Model SB-12b provides two modes of operation divided into seven ranges.

The variable sweep width mode of operation provides a 0 - 100 KC variable sweep width for search and preliminary analysis and a 0 - 2 KC variable sweep width with automatic frequency controlled sweep for detailed analysis.

The pre-set mode of operation provides pre-set, narrow band, sweep widths of 14 KC, 7 KC, 3.5 KC, 500 cps and 150 cps for slow speed, highly resolved analysis. The 2 KC, 500 cps and 150 cps sweep widths are AFC stabilized.

The Model SB-12b provides visual means of examining the effects of power supply fluctuations, thermal changes, humidity, component variations, shock, vibration and load changes upon frequency. Both magnitude and direction of frequency drift are indicated. Parasitic oscillations which normally may pass unnoticed can quickly be detected and identified. Spurious modulation by subsonics, hum and noise are readily spotted. In single sideband linearity tests, the Model SB-12b permits in-band intermodulation distortion readings to -60 db.

Because of its Panoramic presentation the instrument is invaluable for monitoring a frequency band for the appearance, disappearance and shift of signals. Highly useful graphic displays of such phenomena as Bessel function distributions of f-m signals, energy distribution of pulsed r-f signals with low p.r.f.'s, a-m sidebands, etc., can be obtained.

The SB-12b is unique in that it offers all the advantages of automatically scanning spectrum presentations, yet enables examination of signals so closely adjacent in frequency that their corresponding deflections normally tend to merge together or even completely mask one another even with static wave analyzers. This instrument can, at reduced sweep widths and slow sweep rates, resolve equal amplitude signals down to 10 cps separation. Signals with an amplitude ratio of 60 db separated by 60 cps are clearly separated. (See Resolution and E_2/E_1 Graphs, Figures I-1 and I-2.)

I-5. ELECTRICAL CHARACTERISTICS

a. SWEEP WIDTHS:

	SWEEP WIDTH	MODE
	0-100 KC	Continuously variable
AFC Stabilized	0-2 KC	
	150 cps	Pre-set with automatically optimum I-F Bandwidth (Resolution).
	500 cps	
	3.5 KC	
	7 KC	
	14 KC	

(Other pre-set sweep widths available upon request.)

b. INPUT CENTER FREQUENCY:

500 KC

c. BANDPASS REGION (after input mixer):

450 - 550 KC

d. BANDPASS REGION AMPLITUDE CHARACTERISTIC: (450 - 550 KC)

Uniform within ±5% or ±1/2 db.

e. IMAGE REJECTION:

Better than 100 to 1 at input center frequency.

f. INPUT IMPEDANCE:

50 ohms at each of the two input terminals.

g. INPUT ATTENUATOR:

0 - 50 db attenuation of the input signal in 1 db steps.
Accuracy ±.05 db/db.

h. AMPLITUDE SCALES:

Linear and 2 decade log selectable by front panel switch. A front panel 20 db attenuator may be used to extend calibrated range to 60 db.

i. DIRECT SENSITIVITY:

Maximum rms voltage (at signal input terminal) in center frequency band (450 - 550 KC) required for full scale linear deflection: 200 uv.

j. CONVERSION SENSITIVITY:

Maximum rms signal required at signal input terminal for full scale log deflection when 0.3 volts rms from an external signal generator is injected into the VFO input terminal: 2 mv. (The signal generator frequency should be adjusted to heterodyne the signal down to the input center frequency band of the Panalyzor).

k. INPUT MIXER RANGE:

The SB-12b input aperiodic mixer is suitable for signals up to approximately 1000 mc. Sensitivity and dynamic range are reduced above 40 mc.

l. SCAN RATES:

0.1 cps to 30 cps continuously variable. On pre-set sweep widths of 150 cps, 500 cps, - 0.1 cps scan rate. On pre-set sweep widths of 3.5 KC, 7 KC and 14 KC - 1 cps scan rate.

m. RESOLUTION:

Continuously adjustable with IF BANDWIDTH control except on pre-set sweep widths. Range from approximately 3 KC down to less than 10 cps. (Resolution is defined as the frequency separation between two equal adjacent signals such that the intersection between their respective pip indications is 30% below the apex amplitude.)

See Figure I-1, Resolution Graph. The Model SB-12b is capable of 10 cps resolution or better at slow scan rates and reduced sweep widths.

n. DYNAMIC AMPLITUDE RANGE:

Two Tone Test:

All in-band residual (odd order) intermodulation products better than 60 db below level of two equal reference signals deflected 20 db above full scale log provided that -

1. Reference signals are separated so that their intersection is at least 60 db down.

2. All front panel gain settings are maximum.

3. IF BANDWIDTH control is adjusted for broadest position consistent with visual separation of signals. On pre-set sweep widths of 150 cps, 500 cps, 3.5 KC, 7 KC and 14 KC the 60 db dynamic range is provided automatically.

4. Signal generator amplitude of at least 300 millivolts rms.

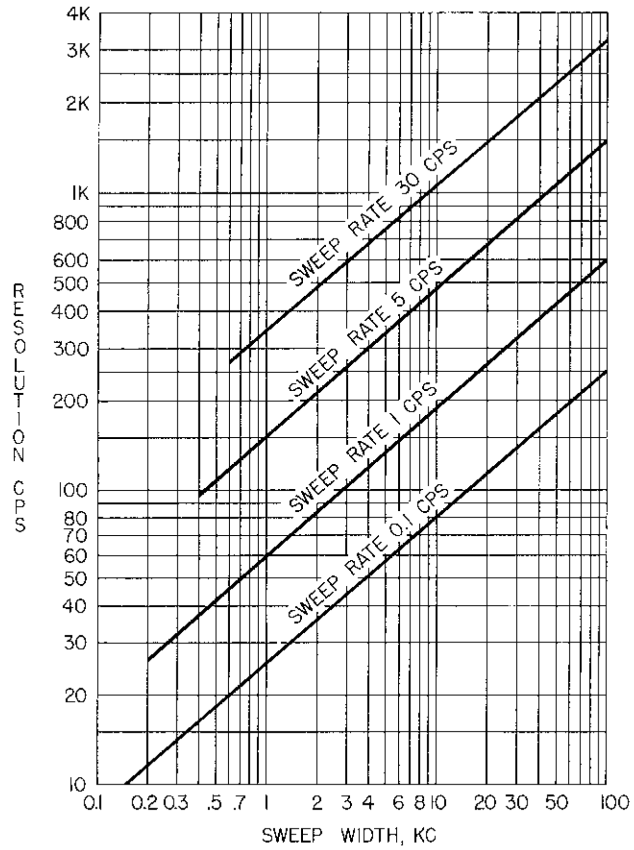
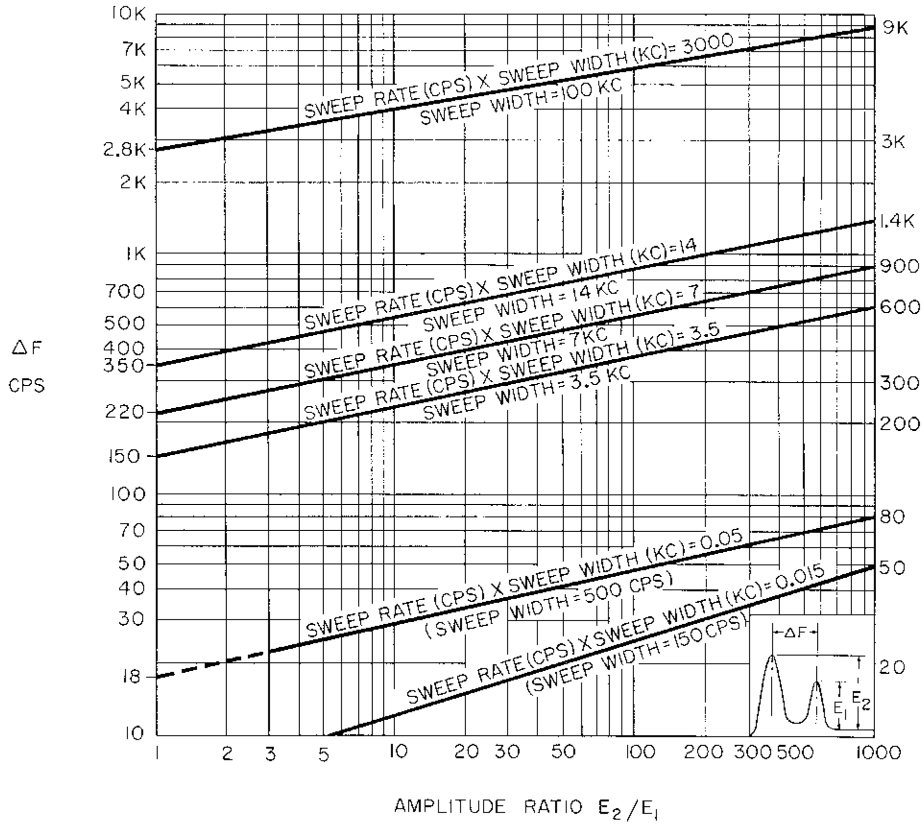


Figure I-1.
Left: Resolution (in cps) vs. Sweep Width (in KC).

Figure I-2.
Below: Minimum Frequency Separation Δf Required to Measure Amplitude Ratios E_2/E_1. Figures in parenthesis represent pre-set sweep widths. The curves represent the electrical resolution of the Model SB-12b. The dashed portion represents electrical resolution beyond optical resolution. To obtain the results shown in this portion of the curve, an expanded scale oscilloscope or Recorder, Model RC-3b, must be used.



o. AUXILIARY OUTPUTS:

Vertical amplitude and horizontal frequency output terminals provided. Connector provided for operation with chart recorder, Model RC-3b.

p. INDICATOR:

5" diameter flat face CRT (5ADP7) with edge lit reticule and scale illumination, and a standard oscilloscope camera mounting bezel.

q. POWER CONSUMPTION:

Approximately 180 watts.

r. POWER SOURCE:

95 - 125 volt 60 cps. Line regulator supplied. Special regulators available for 220 volts or 50 cps operation.

I-6. PHYSICAL CHARACTERISTICS

a. WEIGHTS

Description	Weight
Panalyzor, Model SB-12b, Type T-100	31 lbs.
Power Supply, Model PS-12	28 lbs.
Constant Voltage Transformer T3003A-1	18 lbs.
Analyzer Cabinet	27 lbs.
Power Supply Cabinet	12 lbs.
Cables	3 lbs.

b. DIMENSIONS

Description	Dimensions
Analyzer Cabinet	12-9/16 in. high 22 in. wide 21-3/8 in. deep*
Analyzer Front Panel (Standard Relay Rack)	10-1/2 in. high 19 in. wide
Power Supply Cabinet	8-3/4 in. high 16-1/4 in. wide 14-1/8 in. deep**
Transformer, Constant Voltage, #T3003A-1	8-1/16 in. high 7-1/4 in. wide 4-1/2 in. deep
Cable, Interconnecting, Power, 14 Wire #W3046 with 2 connectors: #MS3106B-28-2P and #MS3106B-28-2P	5 ft. long
Cable, Signal Input, #W3001, RG-8/U, with 1 connector, #UG-21B/U, and one tinned end	3 ft. long

* Includes a 1-1/8 in. knob projection and 3-1/2 in. power plug projection.

** Includes a 1/2 in. pilot light and 3-1/2 in. power plug projection.

I-7. TUBE AND TRANSISTOR COMPLEMENT

a. ANALYZER SECTION

Circuit Reference Symbol	Type	Function
V1	6J6	Input Mixer
V2	12AT7	RF Amplifier
V3	6BE6	2nd Mixer, Local Oscillator
V4	6AH6	Reactance Tube
V5	6BH6	AFC Amplifier
V6	12AL5	Discriminator
V7	6U8	IF Amplifier
V8	6U8	IF Amplifier
V9	6AU6	IF Amplifier
V10	12AU7	Detector: Video Amplifier
V11	12AU7	Amplifier: Cathode Follower
V12	5ADP7	CRT
V13	6AU6	Sweep Tube
V14	12AU7	Blocking Oscillator: Cathode Follower

continued

Circuit Reference Symbol	Type	Function
V15	6BH6	Sweep Discharge Tube
V16	12AU7	Horizontal Deflection Amplifier
V17	5651	Voltage Reference Tube
V18	OA2	Voltage Regulator Tube
V20	6U8	IF Amplifier
Q3	2N404	500 KC Oscillator
Q4	2N404	500 KC Oscillator
Q5	2N404	5 KC Oscillator
Q6	2N404	5 KC Oscillator

b. POWER SUPPLY

Circuit Reference Symbol	Type	Function
V101	5V4GA	Rectifier
V102	6AS7G	Series Regulator Tube
V103	12AX7	Amplifier
V104	5651	Voltage Reference Tube
CR601	International Rectifier V100HF	High Voltage Selenium Rectifier
CR602	International Rectifier V100HF	High Voltage Selenium Rectifier

I-8. FRONT PANEL CONTROLS

a. INPUT ATTENUATOR

This is a group of six toggle switches which provide attenuations of 1 db, 2 db, 2 db, 10 db, 15 db and 20 db in the SIGNAL INPUT circuit. When the switches are in the down position, the indicated attenuation is inserted.

b. GAIN

The amplitude of the indication on the crt screen is adjusted with this control. Maximum gain is obtained at maximum clockwise position. The GAIN control should be operated at the maximum setting consistent with low noise on the crt display to reduce internal distortion in the Model SB-12b input circuits.

c. AMPLITUDE SCALE

Selection of linear or logarithmic amplitude presentations is accomplished with this toggle switch. In the LOG position, signals having a 40 db (100:1) amplitude range may be viewed simultaneously on the screen. When using the LOG amplitude range, the calibration dots at the left edge of the calibrated screen are used. The calibration range is from 0 db to -40 db in 5 db steps. In the LIN position, signals having an amplitude ratio of 20 db (10:1) may be observed at one time. When using the LIN amplitude range, the horizontal lines on the calibrated screen are used. This linear scale is divided into 10 equal divisions. It should be noted that because of the time constant factor, the LOG feature does not function properly with narrow pulses.

d. IF ATTEN(uator)

This toggle switch allows 20 db of attenuation to be inserted in the IF amplifier. When this is done, the input signal may be adjusted for full scale LOG deflection. Placing the IF ATTEN(uator) switch in the 0 db position permits the full 60 db dynamic range of the Model SB-12b to be used. Only the lower 40 db portion is displayed on the crt screen. This switch should always be in the 0 db position when making measurements requiring the full 60 db dynamic range of the instrument.

e. CAL(ibrating OSC(illator) LEVEL

This control varies the output amplitude of the 500 KC crystal oscillator, which is internally connected to the SIGNAL INPUT receptacle. This signal may be used to locate the center frequency of the Panalyzor, and may be modulated by an external audio oscillator or by the built-in 5 KC marker oscillator to provide marker sidebands for setting up any desired sweep width. The 500 KC signal, in conjunction with the INPUT ATTENUATOR, may be used to check the accuracy of the LOG amplitude scale calibrations (which appear as dots at the left side of the calibrated screen).

In its fully counterclockwise position, the CAL(ibrating) OSC(illator) LEVEL control reduces the oscillator output to zero.

f. CENTER FREQ(uency)

This control serves to set or maintain the frequency-modulated local oscillator at its specified mean frequency. In this way, the deflection corresponding to a signal at the input center frequency is centered on the crt screen. A concentric vernier control covers 10% of the range of the main control.

g. AFC

Placing this toggle switch in the ON position turns on the AFC circuit. It reduces the normal 100 KC maximum sweep width to 2 KC. This frequency stabilized narrow scanning rate provides the best resolution of which the instrument is capable. The AFC should only be used with sweep rates of 5 cps or less. It is switched on, independently of this control setting, in the 150 cps and 500 cps positions of the SWEEP WIDTH SELECTOR.

h. ILLUMINATION

This control is rotated in a clockwise direction to turn on the power. Continued clockwise rotation of this control increases the edge illumination of the crt screen.

i. BRILLIANCE

The intensity of the screen presentation is adjusted with this control.

j. FOCUS

The sharpness of the screen presentation is adjusted with this control.

k. SWEEP WIDTH SELECTOR

This control provides a choice of five pre-set widths of 150 cps, 500 cps, 3.5 KC, 7 KC, and 14 KC, and a sixth position marked VAR(iable). In the VAR(iable) position, the sweep width may be set to any value from 0 to 100 KC, the i-f bandwidth may be set for any desired resolution within the capability of the instrument, and the sweep rate may be set to any value from 0.1 cps to 30 cps. The VIDEO FILTER switch is also operative in this position.

In the pre-set positions, the i-f bandwidth is automatically set for optimum resolution. On the three narrowest ranges, the AFC circuit is automatically turned on; on the 3.5 KC, 7 KC and 14 KC ranges it is disabled. On the three narrowest ranges the sweep rate is 0.1 cps, and a low pass video filter with a bandwidth of approximately 40 cps is switched on. The sweep rate on the 3.5 KC, 7 KC and 14 KC ranges is 1 cps, and the video filter bandwidth is approximately 400 cps. The sensitivity of the Panalyzor is constant on all ranges, within ±15%.

l. SWEEP MODE

This lever type switch speeds up the sweep rate from 0.1 cps to 1 cps on the 150 cps and 500 cps pre-set sweep ranges. This facilitates centering the display on the crt screen without the need to wait 10 seconds between sweeps. It also enables the operator to skip undesired portions of the frequency range being scanned. It is not intended to be used on other sweep ranges, where it disables the sweep.

m. 5 KC MARKER

This toggle switch is used to turn on a transistorized 5 KC oscillator which is rich in harmonics. The 5 KC oscillator is connected to, and modulates, the 500 KC calibrating oscillator when the CAL OSC LEVEL control is operated. The sideband pips, at 5 KC intervals, are visable out to ±50 KC from the calibrating oscillator pip at 500 KC. This display facilitates setting up any desired sweep width in the VAR mode of operation.

The following controls are used relatively infrequently or are only needed when setting up the Panalyzor on the VAR(iable) position of the SWEEP WIDTH SELECTOR. They are located behind the door to the left of the crt.

n. HOR(izontal POS(ition

This control is used to adjust the position of the baseline trace along the horizontal axis.

o. VERT(ical) POS(ition)

This control is used to adjust the position of the baseline trace along the vertical axis.

p. SWEEP WIDTH

The scanning width of the instrument is adjusted with this control. When it is turned completely clockwise, the maximum spectrum width for which the instrument is designed; i.e., 100 KC when AFC is off, or 2 KC when AFC is on, can be seen on the screen. As the control is backed off in a counterclockwise direction, the bandwidth viewed becomes narrower. The part that can be seen, however, is expanded across the screen and hence is virtually magnified. The stability required for narrow sweep width and slow sweep rates is provided by turning on the AFC.

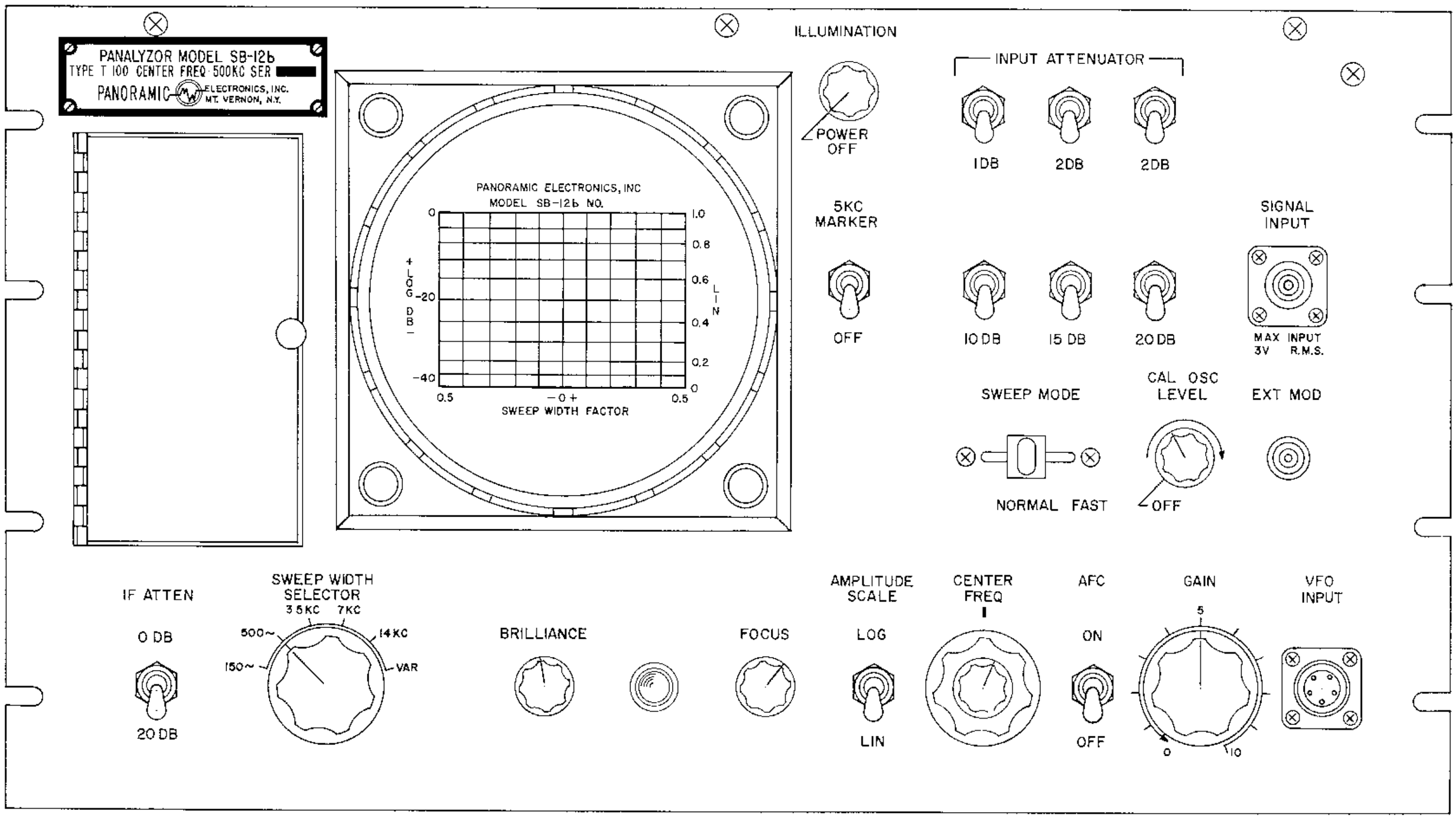


Figure I-3. Front Panel, Model SB-12b.

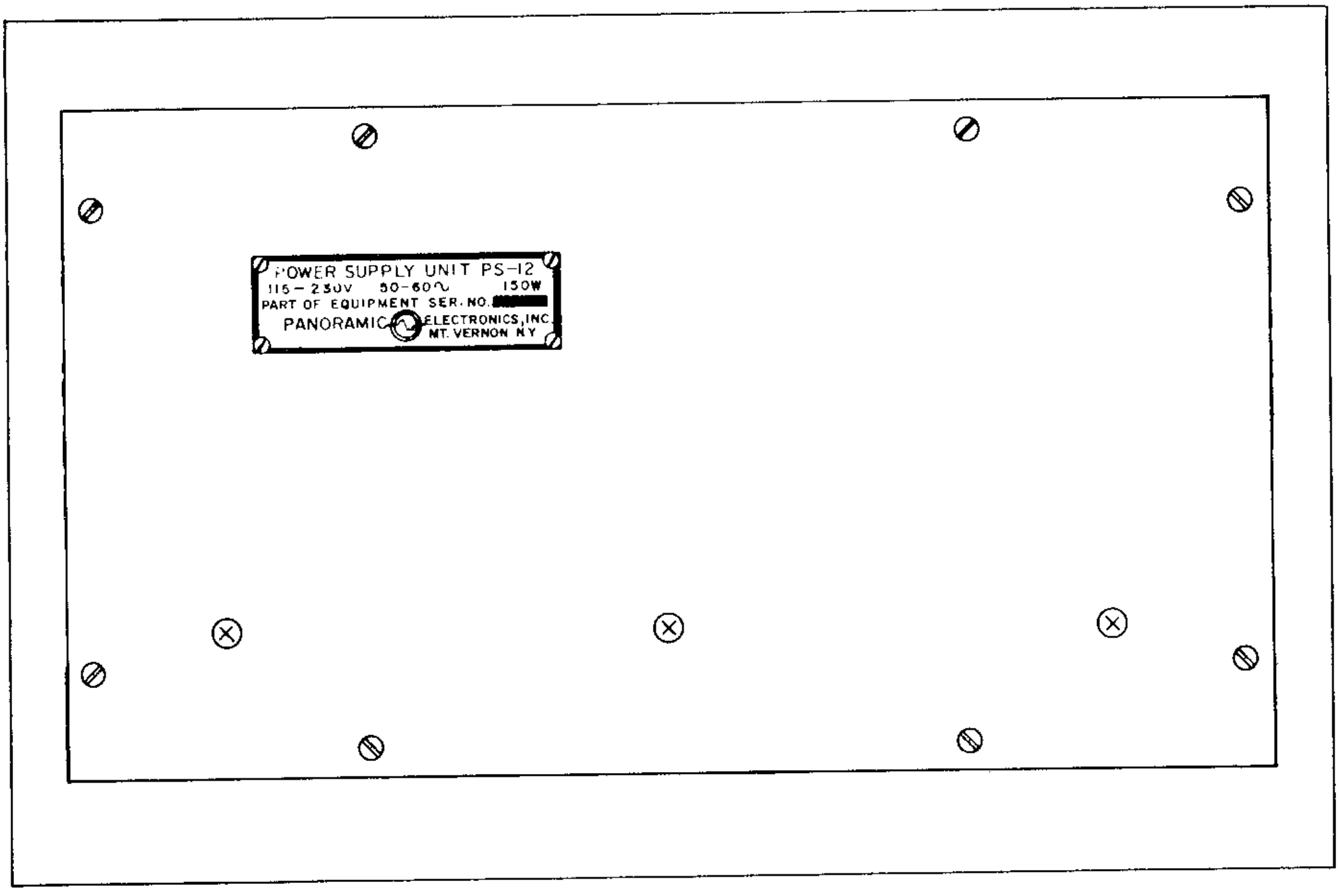


Figure I-4. Front Panel, Model PS-12 in Cabinet.

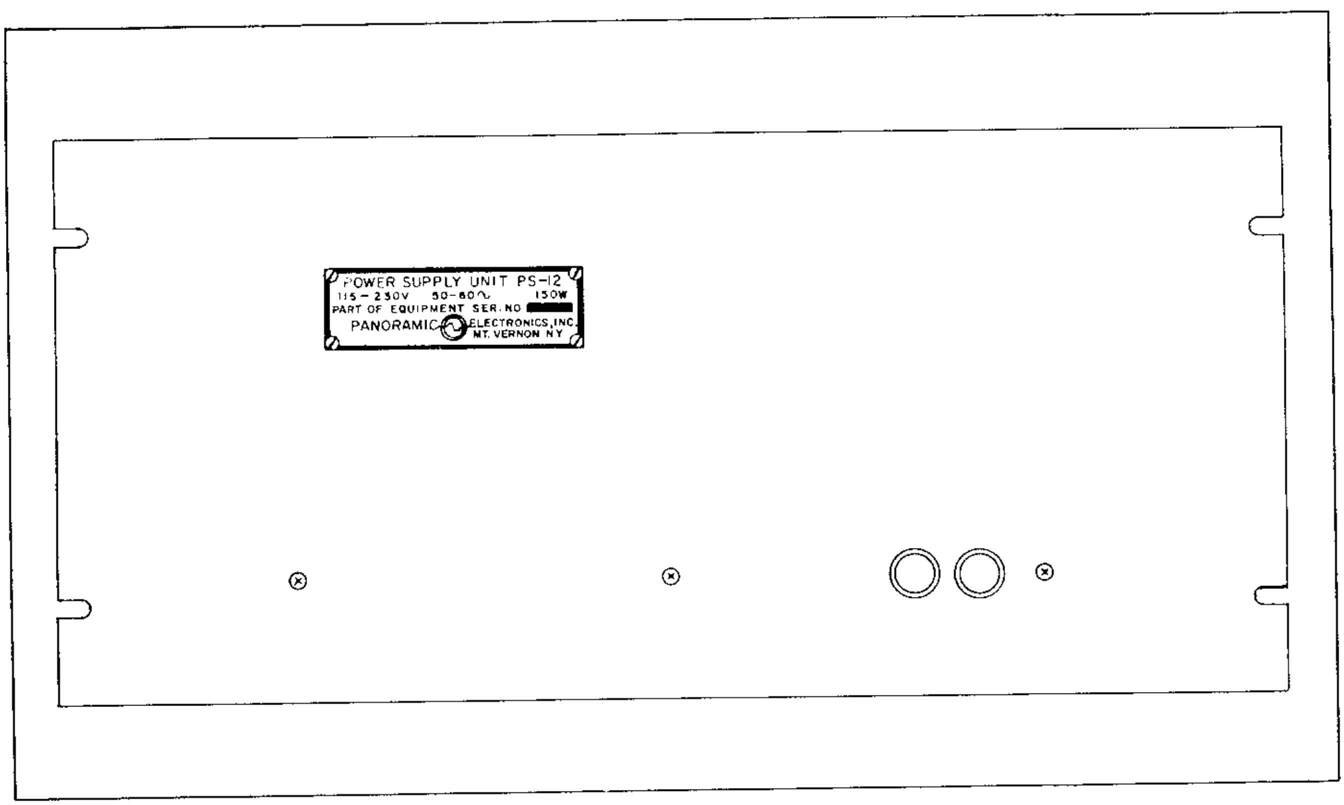


Figure I-5. Front Panel, Model PS-12, Rack Mount Style

The SWEEP WIDTH control, in conjunction with the IF BANDWIDTH control, is useful for separating two or more signal deflections which are so close as to merge into each other.

q. IF BANDWIDTH

Resolution, or the ability to separate individual signals, is dependent upon two factors: the rate of frequency scan and the bandwidth of the i-f section of the instrument. Optimum resolution requires a definite relationship between the two. Resolution sharpens as both the frequency-scanning rate and i-f bandwidth are decreased.

The IF BANDWIDTH control is used to narrow the i-f bandwidth. Counterclockwise rotation of this control narrows the width of the i-f section. It should be noted that as this control is adjusted, there will be some degree of change in the sensitivity of the equipment. The frequency-scanning rate is diminished by increasing the scanning period or conversely by decreasing the spectrum width scanned within a given time. The AFC and SWEEP WIDTH controls provide the latter method. For a given setting of the SWEEP WIDTH control there is a complementary setting of the IF BANDWIDTH control to obtain optimum resolution.

On the pre-set sweep ranges the i-f bandwidth is automatically set for optimum resolution.

r. VIDEO FILTER

This toggle switch provides two degrees of video filtering to suppress such unwanted effects as noise, spurious beating between closely adjacent signals, hum, etc.

In the upper (HI) position, the video bandwidth is moderately reduced. In the lower (LO) position of the VIDEO FILTER switch the video bandwidth is greatly reduced. This position is suitable for use with very slow sweep rates and narrow sweep widths.

On the 150 cps, 500 cps and pre-set sweep ranges, the LO filter is automatically switched on. On the 3.5 KC, 7 KC and 14 KC ranges, the HI filter is automatically switched on.

s. SWEEP RATE

This control provides continuously adjustable scanning rates between 0.1 cps and 30 cps. Counterclockwise rotation of this control reduces the sweep rate.

The control is operative only in the VAR position of the SWEEP WIDTH SELECTOR.

I-9. TERMS AND DEFINITIONS

a. Sweep Width is the band, measured in cycles, kilocycles or megacycles, which can be observed by Panoramic Reception. It corresponds to the range of oscillator sweep in the Panoramic equipment.

b. Frequency Sweep Axis is the line along which the signal deflections are produced and which can be calibrated in frequency according to a given frequency scale.

c. Center Frequency is the frequency of the signal received on that part of the frequency sweep axis corresponding to zero sweep voltage applied to the reactance modulator.

d. Resolution of a given signal is the frequency difference measured along the sweep width scale between the points where its deflection is 30% down from the peak value. This characteristic corresponds to "selectivity" in ordinary receivers. The smaller this frequency difference is, the better the resolution.

e. Sweep Rate is the number of times per second the electron beam sweeps across the cathode-ray tube.

f. Deflection Amplitude is the visual equivalent of signal input voltage. It is the height of a given signal deflection measured from the baseline to the top of the deflection.

g. Screen Scale is the scale adjacent to the baseline which is calibrated in frequency units above and below center frequency for a maximum sweep width setting.

h. VFO is the associated external oscillator or signal generator which is used with the Panalyzor to heterodyne with the test signal to produce the required input frequency of the Panalyzor.

NOTE

The heterodyne product should be the difference between the two frequencies used. If the sum frequency is used, spurious screen indications may result from heterodyne products of the test signals and the external signal generator output (including its harmonics).

CHAPTER II
INSTALLATION

II-1. INITIAL INSPECTION

This instrument has been tested and calibrated before shipment. Only minor preparations are required to put the instrument in operation.

If damage to the case is evident when delivery is made, have the person making the delivery describe the damage and sign the notation on all copies of the delivery receipt.

Most public carriers do not recognize claims for concealed damage if such damage is not reported within fifteen days after delivery. All shipping containers should be opened and the equipment inspected before 15 days elapse.

If damage is found, whether concealed or obvious when delivered, call or write the carrier and ask that an inspection be made by their agent.

Although the carrier is liable for any damage in the shipment, Panoramic Radio Products, Inc. will assist in describing and providing for repair or replacement of damaged items.

The equipment is shipped with all tubes and crystals installed. Check that all such components are properly seated in their sockets.

II-2. INTERCONNECTING PROCEDURE

The Panoramic Panalyzor, Model SB-12b, Type T-100, is normally operated from a 115 volt, 60 cycle, single phase power source. The power transformer connections are factory wired for 115 volt operation. With Constant-Voltage Transformer #T3003A-1, the equipment will operate properly over a line voltage variation of 95-130 volts.

NOTE

THE LINE VOLTAGE REGULATOR SUPPLIED MUST BE USED WITH THE EQUIPMENT TO INSURE PROPER OPERATION. THE REGULATOR IS OF THE SATURABLE REACTOR TYPE AND IS DESIGNED FOR A 60 CYCLE POWER SOURCE. IT SHOULD NOT BE USED ON A 50 CYCLE LINE. 50 CYCLE OPERATION REQUIRES THE USE OF EITHER A SATURABLE REACTOR TYPE REGULATOR SPECIFICALLY DESIGNED FOR THIS FREQUENCY OR A LINE STABILIZER WHICH IS NOT FREQUENCY SENSITIVE. IT SHOULD BE CAPABLE OF A 180 VOLT-AMPERE OUTPUT.

Connect the Panalyzor and Power Supply together with the 14 wire power cable furnished. Connect the cable from the Constant-Voltage Transformer (female connector) to the receptacle on the Power Supply chassis. Connect the AC line cord from the Constant-Voltage Transformer to the a-c power source.

Rotate the ILLUMINATION control clockwise to turn on the equipment. In about a minute the baseline trace should appear on the crt screen.

Adjust the BRILLIANCE control until the trace is just discernible. Allow at least a 30 minute warm-up before proceeding with further adjustments and checks.

Connect the external signal to the SIGNAL INPUT connector, using one of the RF cables supplied. Connect the external signal generator to the VFO INPUT connector with the other RF cable.

NOTE

If the signal generator frequency is not varied during examination of the test signal, the connecting cable need not match the 50 ohm input impedance of the Panalyzor. This also applies when flatness of response is not critical. Otherwise, the generator cable impedance must be 50 ohms and non-terminated, or a suitable pad may be used to prevent reflections and the resultant non-uniform response due to mis-match.

The test signal may be coupled to the free end of the input cable either capacitively or inductively as may be required (a small loop may be attached to the end of the cable). If the test signal has a dc component and the Panalyzor is to be connected directly to the signal source, a suitable blocking capacitor should be used at the free end of the cable.

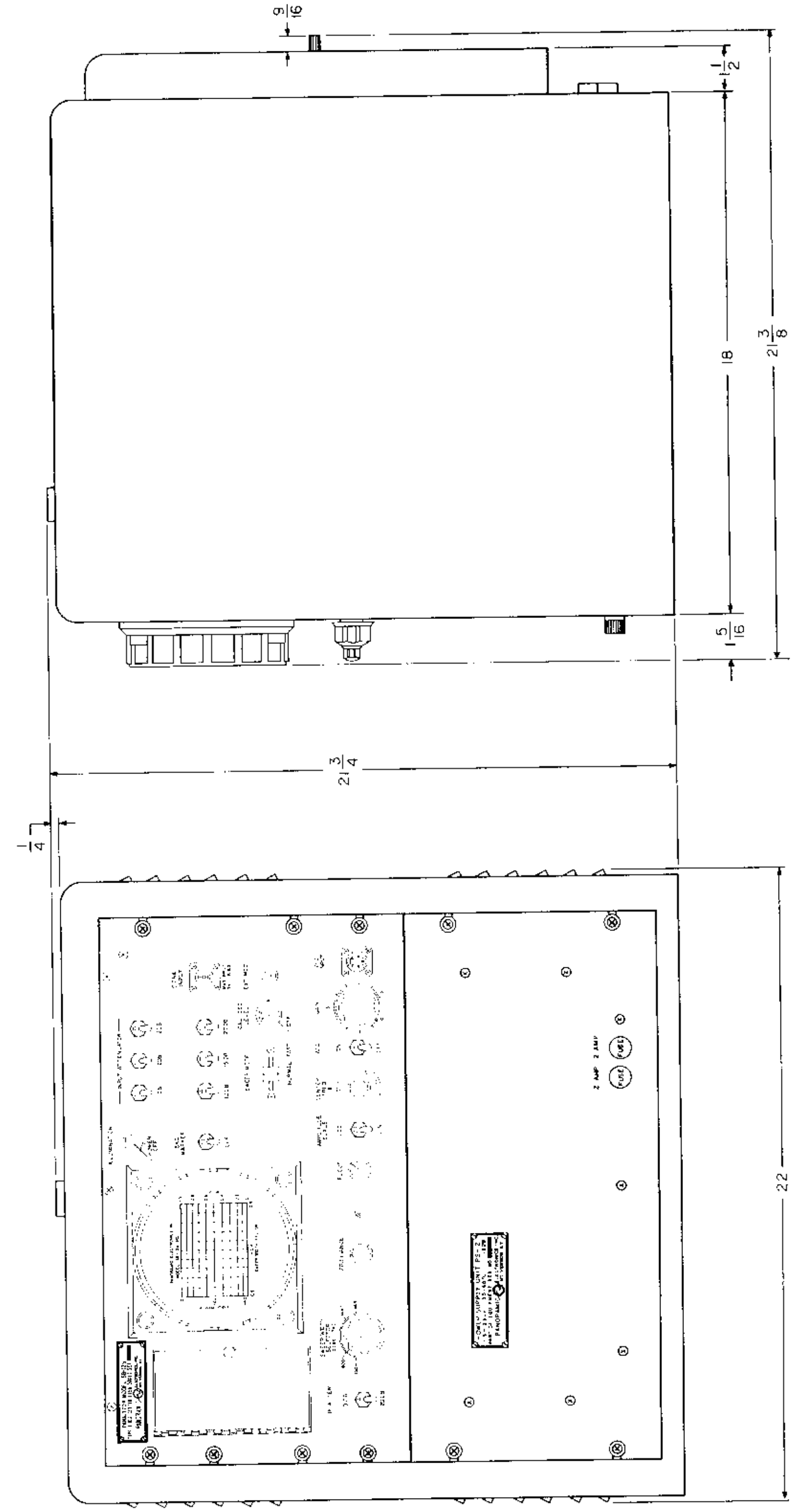


Figure II-1. Outline Dimensional Drawing, Models SB-12b and PS-12 in Common Cabinet.

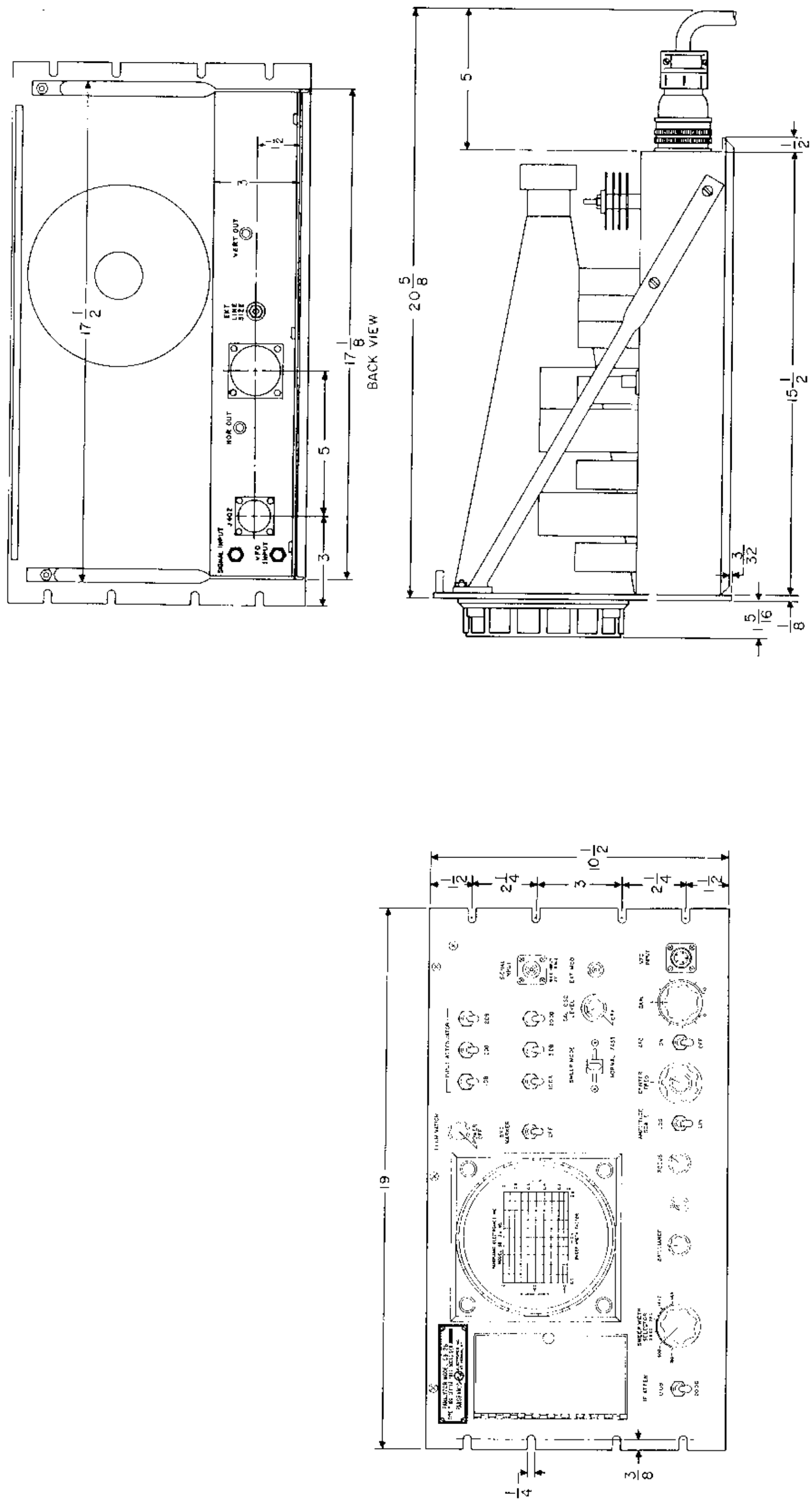


Figure II-2. Outline Dimensional Drawing, Model SB-12b, Rack Mount Style.

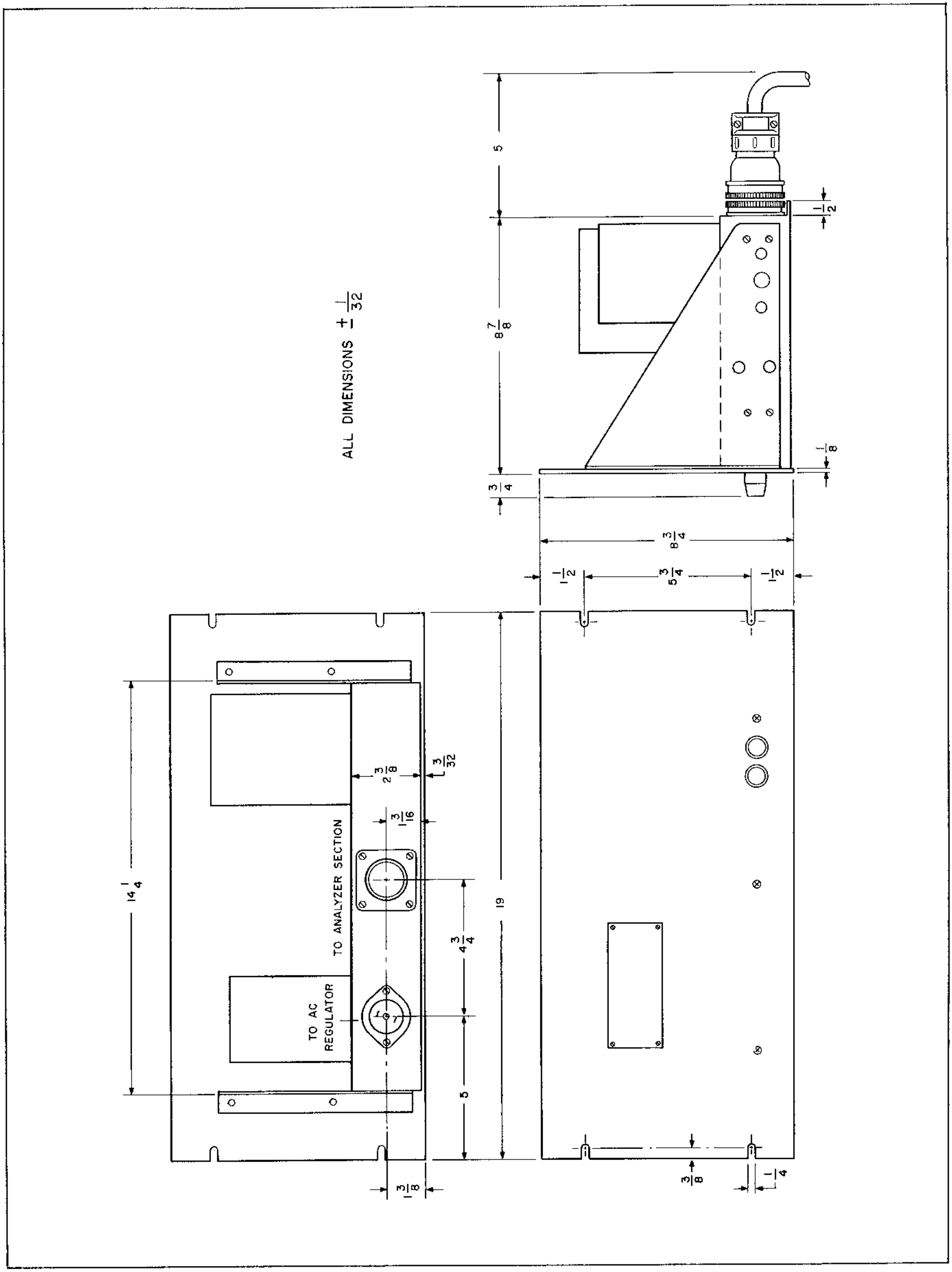


Figure II-3. Outline Dimensional Drawing, Model PS-12, Rack Mount Style.

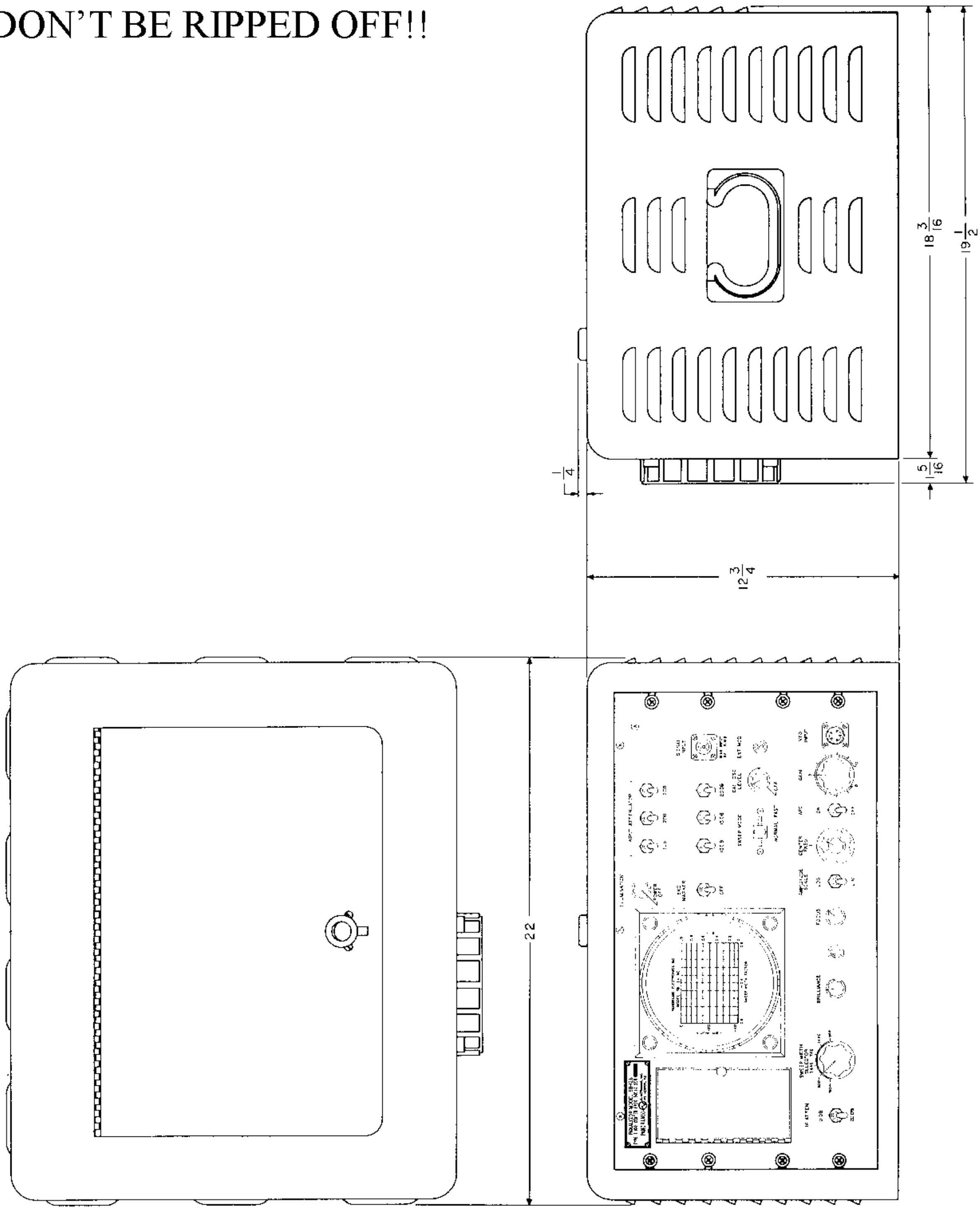


Figure II-4. Outline Dimensional Drawing, Model SB-12b in Cabinet.

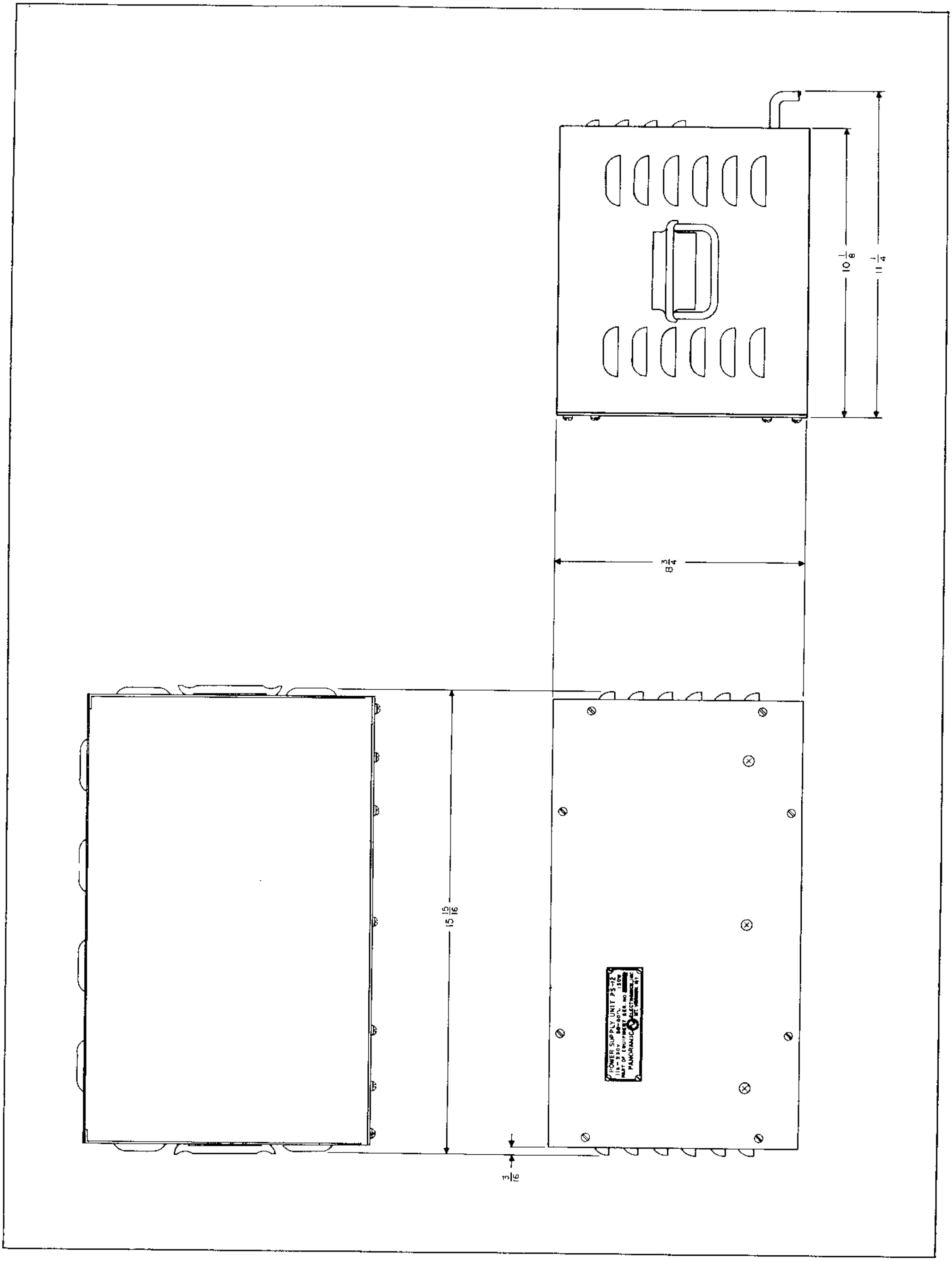


Figure II-5. Outline Dimensional Drawing, Model PS-12 in Cabinet.

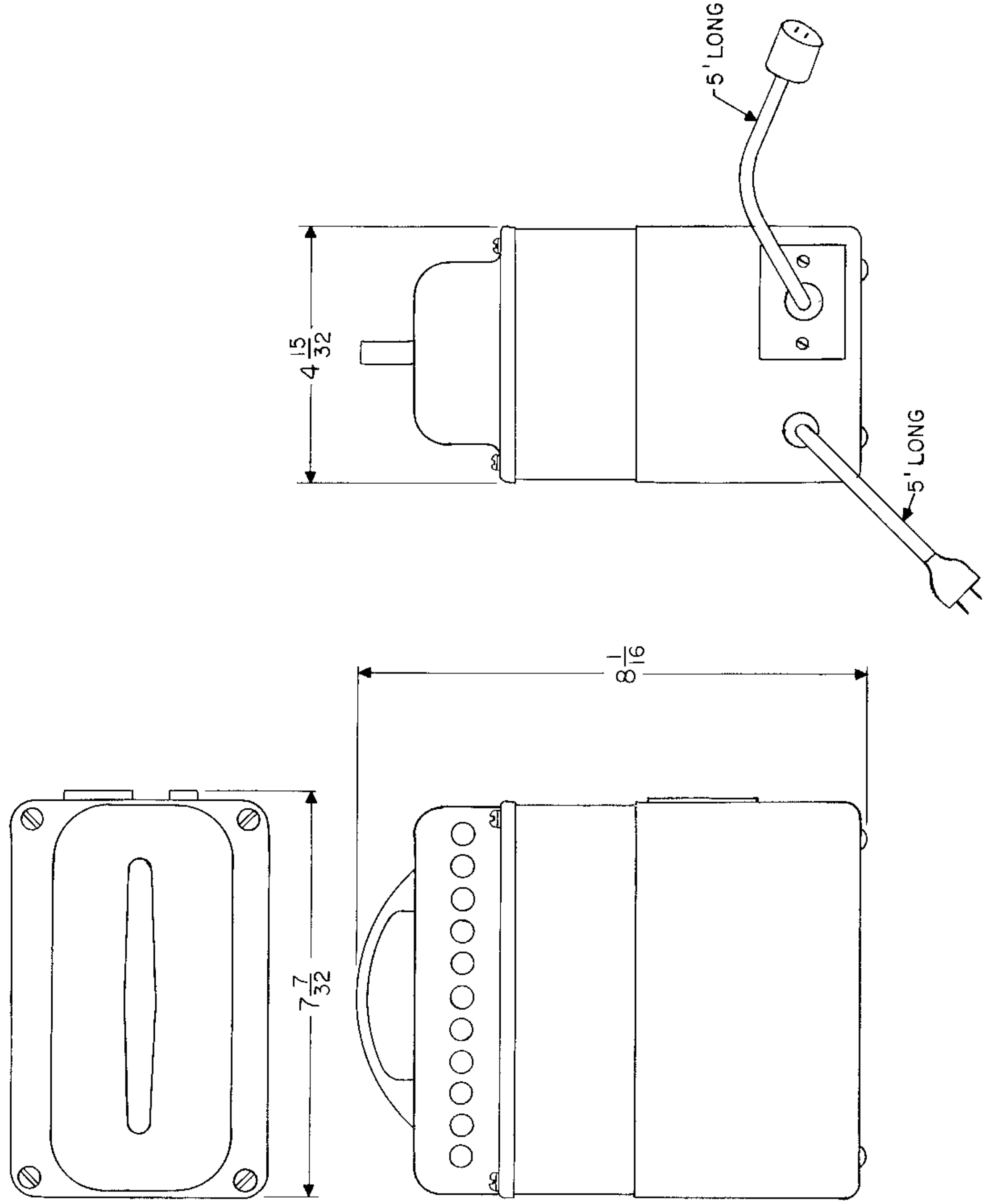


Figure II-6. Outline Dimensional Drawing, Constant-Voltage Transformer, T-3003A-[illegible],

II-3. INSTALLATION ADJUSTMENTS AND CHECKS

a. Set the front panel controls as follows:

INPUT ATTENUATOR	All switches UP
GAIN	Fully counter-clockwise
CAL OSC LEVEL	OFF
CENTER FREQ	center
AFC	OFF
AMPLITUDE SCALE	LIN
FOCUS	For a sharp trace
BRILLIANCE	As desired
SWEEP WIDTH SELECTOR	VAR
5 KC MARKER	OFF
IF ATTEN	0 DB
VIDEO FILTER	OFF
SWEEP RATE	Fully clockwise
IF BANDWIDTH	Fully clockwise
SWEEP WIDTH	Fully clockwise
V POS	So that baseline trace coincides with the frequency scale.
H POS	To approximately center the baseline on the crt screen.

b. Turn the CAL OSC LEVEL control fully clockwise. Advance the GAIN control until a pip is displayed at approximately full screen deflection.

c. Rotate the SWEEP WIDTH control counterclockwise until the pip opens up into a horizontal line. Adjust the CENTER FREQ control for maximum height of the trace. Set the SWEEP WIDTH control fully clockwise. A pip should appear near the center frequency calibration. Adjust the H POS control until the pip coincides with the center frequency calibration.

d. Rotate the SWEEP RATE control through its range. At its clockwise extreme (30 cps) the trace will appear as a line. At its counterclockwise extreme (0.1 cps) a spot should move from right to left on the crt screen with a 10 second period.

e. Turn the SWEEP RATE control fully clockwise. Adjust the SWEEP WIDTH control until the pip base covers approximately one-third of the screen. Turn the IF BANDWIDTH control counterclockwise; the pip width should decrease. At the same time, there may be a change in pip height. It will also be noticed that "ringing" will appear on the trailing edge of the pip. Optimum resolution occurs when the first ringing notch beyond the apex of the pip dips into the baseline.

f. Turn on the AFC by operating the AFC toggle switch. This automatically provides a maximum scanning width of approximately ±1 KC with the necessary center frequency stability. Counterclockwise rotation of the SWEEP WIDTH control reduces the scanning width from ±1 KC to nominally zero. The CENTER FREQ controls may be used to center the pip on the screen. The maximum sweep is checked most conveniently by feeding a 1 KC audio signal to the EXT MOD jack. This will generate sidebands which may be set on the end frequency calibrations of the CRT screen by means of the SWEEP WIDTH control. Use only sufficient audio amplitude to produce visible and usable sidebands, since excessive amplitude may prevent the crystal oscillator from functioning.

It should be noted that there may be an extraneous pip or pips present on the right side of the screen (but outside the calibrations) when the AFC is on. The SWEEP RATE control should be set for a rate of approximately 5 cps or lower and the IF BANDWIDTH control set for approximately optimum resolution.

g. Set the controls as outlined for CENTER FREQ test. Carefully adjust the GAIN control for full scale deflection of the pip. Switch AMPLITUDE SCALE to LOG. The pip should read 20 db (center of screen). The LOG calibrations appear at the left edge of the screen. Dots are engraved at 5 db intervals on the screen.

Set IF ATTEN to 20 db. The pip should now reach the 40 db calibration.

h. Set the GAIN control fully clockwise and adjust the CAL OSC LEVEL control until full screen deflection is obtained. Operate the INPUT ATTENUATOR switches so as to insert attenuations up to 40 db in 5 db steps. At each setting the pip height should coincide with the corresponding screen calibration within ±1 db.

i. Set the INPUT ATTENUATOR to zero (all switches up) and adjust the GAIN control for full scale deflection. Switch the VIDEO FILTER to the HI position. This reduces the video bandwidth to about 400 cps. Any noise on the screen should be filtered, and signal pips will be integrated and shifted slightly. The SWEEP RATE should be reduced to prevent excessive distortion of the pip shape. Switch the VIDEO FILTER to the LO position. The video bandwidth is now about 40 cps and a much greater filtering effect should be observed. This position of the VIDEO FILTER should be used with sweep rates of the order of 1 cps or less.

j. With a full scale, optimally resolved, pip

(LIN amplitude scale) displayed in the center of the screen, set the SWEEP WIDTH SELECTOR to 14 KC. The pip should appear at or near the center of the screen. The amplitude should be essentially unchanged. The sweep width is now ±7 KC, and the sweep rate is 1 cps. The SWEEP WIDTH, SWEEP RATE, IF BANDWIDTH, and VIDEO FILTER controls are not operative on this and the other pre-set sweep width ranges.

k. Set the SWEEP WIDTH SELECTOR to 7 KC. The pip should appear with essentially the same amplitude near the center of the screen. In this position, the sweep width is ±3.5 KC.

l. Set the SWEEP WIDTH SELECTOR to 3.5 KC. The pip should appear with essentially the same amplitude near the center of the screen. In this position the sweep width is ±1.75 KC.

m. Set the SWEEP WIDTH SELECTOR to 500 CPS. The AFC circuit is automatically switched on for this and the 150 cycle sweep width and the sweep rate is 0.1 cps. The amplitude of the pip should be essentially constant on both ranges.

n. To facilitate locating a signal on the ranges employing a 0.1 cps sweep rate, a FAST position has been provided on the sweep mode switch on the front panel. Moving this switch to the right speeds up the sweep rate to 1 cps, and it immediately returns to 0.1 cps when the switch is released. The pip shape is distorted when the FAST sweep is used, but this does not impair its usefulness for locating signals on narrow sweep widths, or for repeated examination of a portion of the sweep width without requiring a 10 second wait between scans.

o. An external audio signal may be connected to the EXT MOD connector to aid in setting up any desired sweep width. This signal amplitude modulates the calibrating oscillator.

For example, a 10 KC audio signal will produce sidebands at ±10 KC relative to the center frequency pip. When the SWEEP WIDTH control is adjusted so that these sidebands appear at the left and right extremities of the calibrated screen, the sweep width is ±10 KC or 20 KC overall. Excessive audio amplitude should be avoided, since it may prevent the crystal oscillator from functioning.

A built-in 5 KC oscillator is provided to modulate the calibrating oscillator, in lieu of an external audio signal. The 5 KC modulation is turned on by setting the 5 KC MARKER switch to the up position. Sidebands are produced at 5 KC intervals, of usable amplitude out to ±50 KC. The frequency accuracy of the 5 KC marker oscillator is ±2%.

p. The H OUTPUT and V OUTPUT connectors on the rear apron of the chassis provide voltages proportional to the horizontal and vertical position of the crt spot. They are intended for operation of a slave oscilloscope or other external indicator.

CHAPTER III
OPERATION

III-1. GENERAL OPERATION

a. Switch on the power by rotating the ILLUMINATION control fully clockwise. The crt scale illumination should go on immediately. Within 30 seconds a dot should appear on the screen and within a few seconds start to sweep across the screen. The scale illumination may be reduced to any desired level by counterclockwise rotation of the ILLUMINATION control.

If no indication appears on the screen, turn the BRILLIANCE control clockwise. The BRILLIANCE control should be set to a minimum point of suitable visibility and the FOCUS control for the finest clear line. A later adjustment of FOCUS and BRILLIANCE may be required, since the appropriate settings are partially dependent upon the signal density. Do not use the BRILLIANCE control to compete with external light falling on the crt screen but rather reduce the external light or shield the screen.

b. When viewing the crt screen, the eye of the observer should be along the axis of the crt at a distance of approximately 15 inches from the face. Since the screen calibrations have been made from this position, any other position will introduce parallax error. See Figure III-1. A convenient method of finding the correct position is to close one eye and obtain a reflection of the other eye at the exact center of the calibrated crt scale.

c. Set the front panel controls as follows:

CENTER FREQ	on vertical marker (See Chapter II, Paragraph 2 e)
SWEEP WIDTH	maximum clockwise
IF BANDWIDTH	maximum clockwise
BRILLIANCE	for desired trace brightness
SWEEP WIDTH SELECTOR	VAR
FOCUS	sharpest trace
AMPLITUDE SCALE	LIN
GAIN	between half and maximum clockwise
SWEEP RATE	maximum clockwise
VIDEO FILTER	OFF
HORIZONTAL POSITION	for centered position of center-frequency pip (See Paragraph II-3.c.)
VERTICAL POSITION	for baseline coincident with bottom screen calibration
AFC	OFF
INPUT ATTENUATOR	all switches up
5 KC MARKER	OFF

d. When the SWEEP WIDTH and IF BANDWIDTH controls are concurrently set close to their maxi-

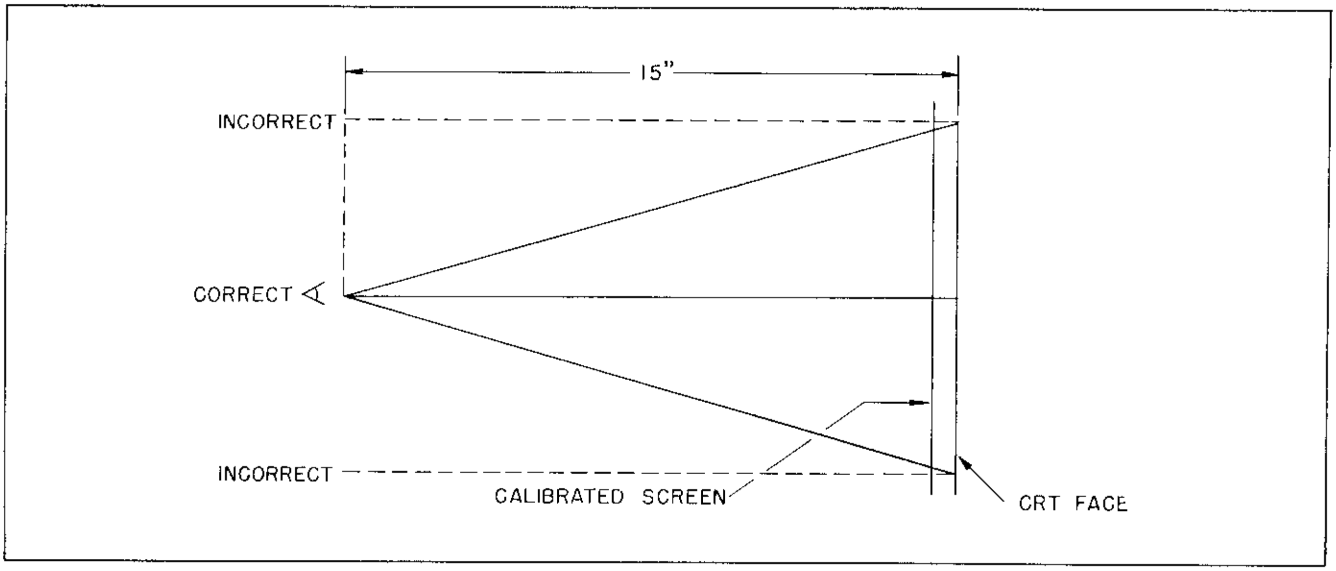


Figure III-1. Correct Viewing of CRT Screen.

mum counterclockwise position the centered signal will appear as an elevated baseline or pip with hum superimposed. This is normal.

Although the frequency of the external heterodyning oscillator or signal generator, which is connected to the VFO INPUT r-f connector, may be either above or below the test-signal frequency by a frequency equal to the input-center frequency of the equipment (500 KC) use the following rules in choosing this frequency. If possible, do not use a frequency within the input-bandpass range of the Panalyzor; i.e, 450 KC to 550 KC.

Therefore, for all test-signal frequencies up to 1,070 KC use a signal-generator frequency 500 KC above the test-signal frequency. For test-signal frequencies between 1,070 KC and 1,770 KC, a signal-generator frequency above the test-signal frequency is preferable but not essential. This will avoid the presence of image frequencies and spurious signals resulting from harmonics of the signal generator. For frequencies above 1,770 KC no advantage will be gained by having the signal-generator frequency above that of the test signal.

NOTE

> The signal generator frequency can be recognized as being below the test signal frequency if the pip moves from left (-) to right (+) as the generator frequency is increased.
>
> When the generator frequency is above the test signal frequency a pip will move from right (+) to left (-) as the generator frequency is increased. When the frequency of the external oscillator is above the test signals, the plus and minus signs on the screen apply; that is, signals on the (+) side are higher in frequency than the center signal while those on the (-) side are lower. If the oscillator frequency is below the test signals, the signs are reversed. Note that when signals whose frequencies are within the bandpass region; i.e., 450 KC to 550 KC are fed directly into the input, the screen signs are reversed.

Slowly search the spectrum with the external oscillator until the signal appears at the center of the screen.

To locate the signal, it may be found convenient to operate the analyzer at maximum gain and the signal generator for high output. Once the signal is located, the GAIN control may be backed off counterclockwise and the generator output lowered to obtain a signal which falls below full scale. The INPUT ATTENUATOR may also be used to reduce signal level.

e. <u>Frequencies of signals appearing on the screen may be quickly determined by adding or subtracting the screen calibration for a given signal to the frequency to which the signal generator is adjusted and then subtracting or adding the input center frequency.</u> See NOTE in Paragraph 1.a. above.

Example: The Panalyzor is set for maximum scanning width. At maximum scanning width each frequency calibration mark for the T-100 is equivalent to a 10-KC separation. A pip appears at +30. The heterodyne oscillator is set to 2,450 KC.

The input center frequency of the Panalyzor is 500 KC. When the generator is raised, the signal moves right to left. Therefore, the screen calibration is added in this example since it is determined by following the procedure indicated in NOTE of Paragraph 2.a. above, that the oscillator was above the test signal. Therefore, the + sign applied.

Signal Freq. = Oscillator Freq. ± Screen Calib. ± Input Center Freq.
Signal Freq. = 2,450 KC + 30 KC -500 KC = 1,980 KC.

f. The relative amplitudes of presented signals are proportional to the relative heights of the corresponding deflections, within the limits specified for flatness of response. The use of a preamplifier may affect this flatness.

To observe signals of comparable amplitude (10:1 or less) the AMPLITUDE SCALE switch should be set to LIN. On the other hand, examination of signals widely divergent in amplitude will require the LOG setting of this control. This will allow simultaneous reading of amplitudes having a 40 db range.

III-2. NARROW BAND ANALYSIS

a. At full sweep width, test signals having a small frequency difference tend to have their corresponding deflections merge into and mask each other. The ability of the equipment to separate individual signals depends upon two factors: the scanning velocity (product of sweep rate and sweep width) and the bandwidth of the intermediate-frequency section of the equipment. For any given scanning velocity, there is a complementary i-f bandwidth for optimum resolution. The scanning velocity is reduced by increasing the sweep period (reducing the sweep rate) and decreasing the spectrum width scanned within a given time (reducing the sweep width). Reducing the scanning velocity improves the resolution

(the ability of the equipment to separate closely-spaced frequency components.)

The IF BANDWIDTH control is used to adjust the intermediate-frequency section bandwidth. Counterclockwise rotation of this control narrows the width of the section. As this control is adjusted, there will be some degree of change in the sensitivity of the equipment. Narrowing the i-f bandwidth improves resolution until a point of optimum resolution is reached. Further narrowing of the i-f bandwidth decreases resolution beyond this point.

To increase the resolution capabilities by reducing sweep width, narrowing the i-f bandwidth, and increasing scanning time, the following procedures are used:

1. Set the IF BANDWIDTH control completely clockwise for widest i-f bandwidth.

2. Adjust the external oscillator frequency so that the desired band of signals is at the center of the screen.

3. Spread the band of signals across the screen by turning the SWEEP WIDTH control counterclockwise. (See b below for use of AFC.) Each frequency calibration mark on the screen represents a frequency separation equal to one-tenth of the reduced sweep width.

4. Turn the IF BANDWIDTH control counterclockwise until individual signals are most clearly resolved. If the signals cannot be resolved, a slower sweep rate will be required. Optimum resolution can be recognized by the nature of the ringing pulses that will appear on the trailing edge of the signal pip as optimum resolution is approached. See Figure III-2.

NOTE

Rotation of the IF BANDWIDTH control may result in increased or decreased pip height. Pip amplitude may be returned to suitable level with the GAIN control. Turning the IF BANDWIDTH control counterclockwise after optimum resolution is reached will decrease the resolving power and result in greatly reduced sensitivity.

If the resolution adjustment results in practically complete separation of signal pips, maximum resolution can be recognized by the presence of "ringing" on one side of the pip. "Ringing" can be seen more easily with the video filter in the OFF position.

5. If the resolution adjustment results in practically complete separation of signal pips, maximum resolution can be recognized by the presence of ringing pulses on the trailing edge of the pips as shown in Figure III-2. Illustrations (a) to (f) of Figure III-2 indicate progressive variations in pip width caused by counterclockwise rotation of the IF BANDWIDTH control. In (a) and (b) i-f width is broad for the particular scanning

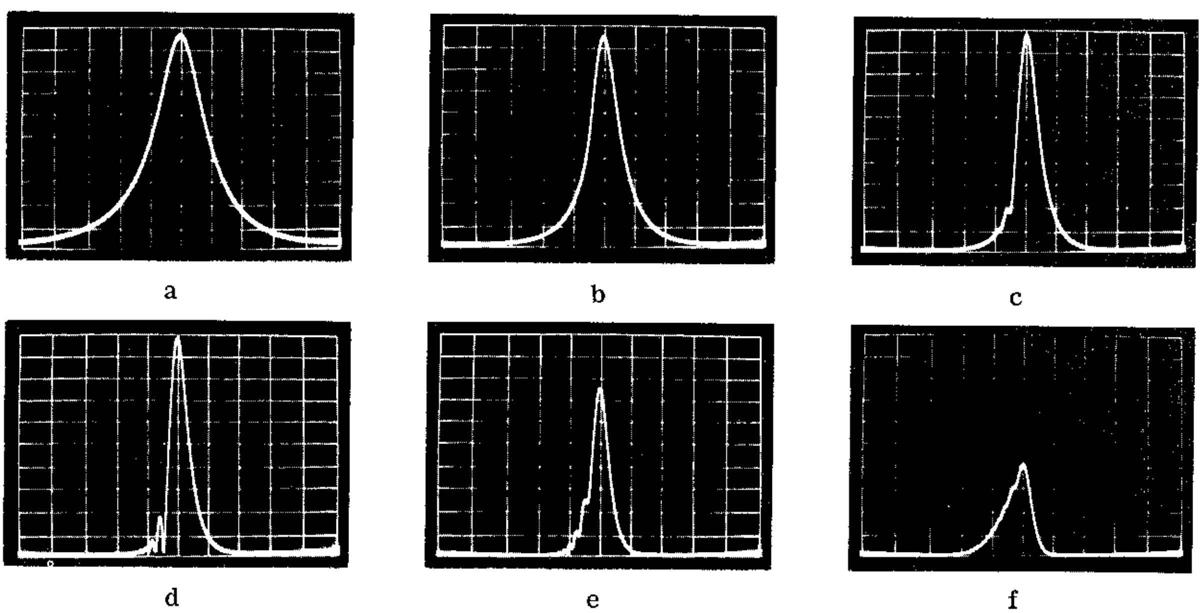


Figure III-2. Ringing as an Indication of Optimum Resolution.

velocity. (c) shows beginning of "ringing". Extent of "ringing" in (d) shows optimum resolution. As the i-f section is made narrower, excessive "ringing" widens pip and amplitude decreases as shown in (e) and (f).

Further counterclockwise rotation of the IF BANDWIDTH control causes a reduction in amplitude and a tendency of remerging of the pips.

6. To better separate the signals, the SWEEP WIDTH and IF BANDWIDTH controls can be further backed off counterclockwise and the SWEEP RATE set to a lower rate. (See b. below for use of AFC.)

If it is mandatory to observe a given bandwidth at one time and the signals contained therein are so closely spaced that they cannot be completely resolved, maximum resolution is recognized by the appearance of the clearest picture. Further counterclockwise rotation of the IF BANDWIDTH control will result in lessened resolution and a "bobbing" presentation.

7. If a signal of small amplitude is close in frequency to a signal of large amplitude, the pip representing the small amplitude signal will be influenced by the skirt of the large amplitude signal (the amplitude-versus-frequency response of the i-f section being bell-shaped). As the signals are separated in frequency, the error becomes less.

If adjacent signals have a large amplitude difference, IF BANDWIDTH control settings to depict the signals as definitely separated pips should be used. Waveforms (a) through (f) of Figure III-3 illustrate the progressive variation in pip separation of two signals as the IF BANDWIDTH control is rotated in a counterclockwise direction.

In (a) the i-f bandwidth is broad and there is no resolution of adjacent signals. In (b) and (c) the smaller adjacent pip begins to emerge as bandwidth is narrowed. In (d) definite separation of the pips is seen, however, due to beating of the two signals, the amplitude indication of the smaller pip is higher than its final value. In (e), the beginning of a ringing pip on the left side of the large pip shows i-f bandwidth approaching an optimum value. The extent of ringing in (f) shows that optimum i-f bandwidth has been reached. Highest accuracy of relative amplitude measurements results when adjacent signals are clearly resolved.

8. If it is mandatory to observe a given band width with the contained signals closely spaced, the best possible resolution is indicated by the clearest picture. A reasonably accurate measurement of relative amplitudes can be made by reading the center of the beats. This is illustrated in Figure III-4. The amplitude ratio in (a) is greater than the ratio (b), resulting in a different presentation.

b. For best separation of signals the 0.1 cps scanning rate can be used. Turning AFC on provides a suitably small scanning width (±1 KC) as well as the necessary frequency stability. The following procedure should be used. AFC

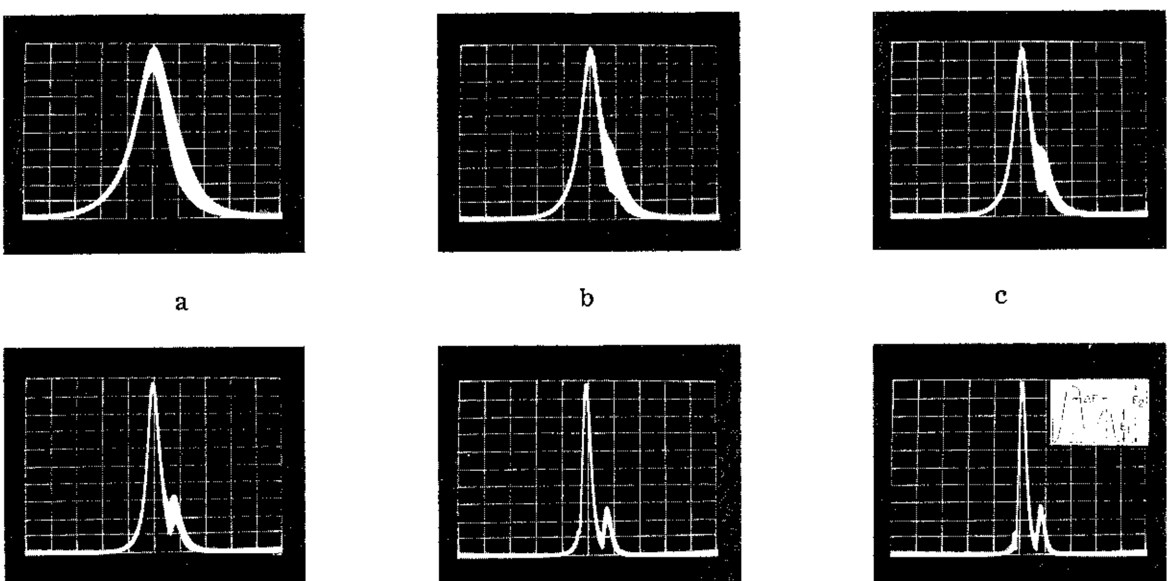


Figure III-3. Resolution of Signals of Unequal Amplitude.

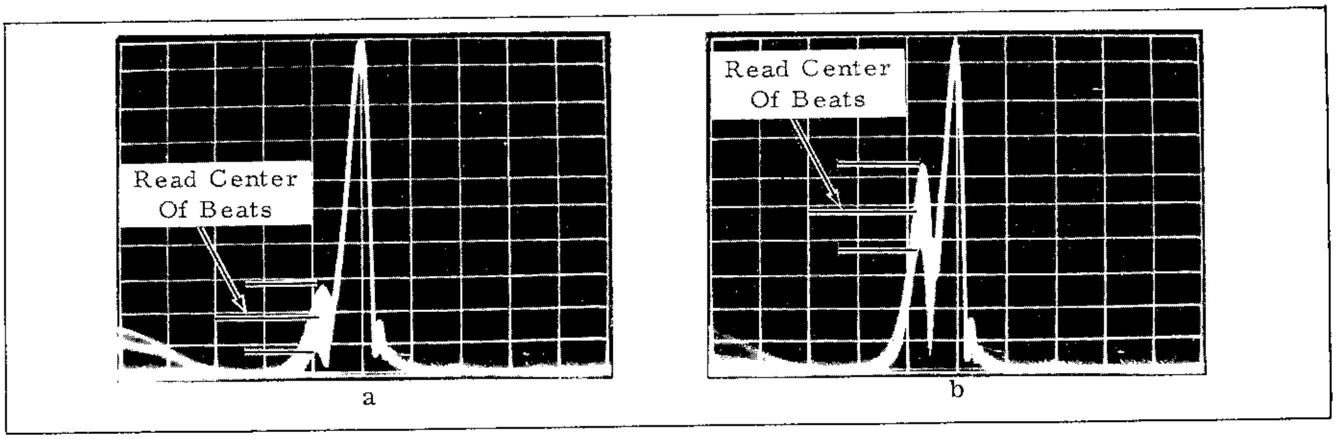


Figure III-4. Measurement of Closely Spaced Unequal Amplitude Signals.

may also be used with faster rates, up to approximately 5 cps.

1. With the IF BANDWIDTH control fully clockwise and SWEEP WIDTH set completely clockwise, tune the signals of interest to the center of the screen with the external oscillator.

2. Turn AFC on. If necessary, adjust the external oscillator for a centered presentation. The CENTER FREQ control may be used as needed to center the presentation.

3. Set the SWEEP RATE control to a suitable rate, less than 5 cps, depending upon the desired degree of frequency separation and the nature of the signals. AFC should not be used at sweep rates greater than 5 cps. Note that with AFC on and SWEEP WIDTH at maximum clockwise, each frequency-calibration mark on the screen represents 200 cps. Further reduction of sweep width can be had by counterclockwise rotation of the SWEEP WIDTH control.

4. Turn the IF BANDWIDTH control counterclockwise until optimum resolution is obtained. See a.4. above.

5. Use the VIDEO FILTER as required to reduce objectionable beating between closely adjacent signals, hum, etc. The HI position provides a moderate amount of filtering. The LO position provides heavy filtering, suitable for use with very low sweep rates. Note that the use of the VIDEO FILTER results in integration of the signal pips as well as slight shifting of the pips.

c. In many cases, it will be most convenient to use the SWEEP WIDTH SELECTOR to set up operating conditions for narrow band analysis. In this mode of operation, the sweep width, sweep rate, i-f bandwidth, and video filtering are automatically set for optimum presentation.

III-3. OPERATING PROCEDURE FOR THIRD-ORDER DISTORTION MEASUREMENTS

In measuring third-order distortion in a single-sideband (SSB) transmitter or exciter, the transmitter is usually modulated by two audio tones of equal amplitude, with a difference frequency of the order of 1 kilocycle. The r-f output consists of two signals separated by the audio difference frequency. The presence of third-order distortion in the transmitter is indicated by the appearance of spurious signals higher and lower in frequency than the two r-f carriers by an amount equal to the difference frequency.

The Panalyzor, Model SB-12b, has very low internal third-order distortion (at least 60 db down from the level of the two test signals). In order to obtain this order of performance, the following procedure should be followed.

a. Set the amplitude of the external signal generator to at least 0.3 volts rms. Greater amplitudes (up to approximately 1 volt) may be used without degradation of performance.

CAUTION

Avoid application of more than 3 volts RMS to either signal or VFO inputs, to prevent burning out the input resistors.

b. Follow the regular operating procedure to display the two r-f signals on the screen. Use a sweep width at least three times the separation between the two signals.

c. Set the AMPLITUDE SCALE switch to LOG. Set the IF ATTEN(uator) to 20 db. Set the GAIN to maximum (fully clockwise) and adjust the INPUT ATTENUATOR to obtain full scale deflection. The GAIN control may be reduced slightly for the final adjustment.

d. Set the IF ATTEN(uator) to 0 db. The Panalyzor display now shows signals from -20 db to -60 db relative to the two input signals. The amplitude of third-order distortion pips may be read from the LOG scale calibration on the screen adding 20 db to account for the fact that the signals are deflected 20 db over full scale.

III-4. OPERATION WITH MODEL RC-3 RECORDER

A connector, J402, located on the rear apron of the analyzer chassis, is provided for operation of the Panalyzor with the accessory chart recorder, Model RC-3b. When the Model RC-3b is not used, the jumper plug, P402, must be installed in J402.

See the Instruction Manual for the Model RC-3b for details of its operation with a Panoramic analyzer. The Model RC-3b Manual refers to a Model LP-1a as the companion analyzer. In all places where the Manual refers to "LP-1a", read "SB-12b". Where reference is made to test frequencies, scan widths and control settings, substitute appropriate values within the operating range of the Model SB-12b.

The Model SB-12b may be operated in the VAR mode or any of the pre-set sweep positions. With the RECORDER OPERATION switch of the Model RC-3b in the STANDBY position, the SWEEP WIDTH control may be used to adjust the sweep width of the Model SB-12b to any desired value within its range in the VAR sweep width position. All normal operating controls are functional in this mode of operation.

It will be found that the IF BANDWIDTH control may be set further counterclockwise (narrower bandwidth) on the 1 minute and longer scans of the Model RC-3b than on the external sweep rates provided by the Model SB-12b. The proper setting must be determined by successive sweeps through a test signal such as the one from the 500 kc calibrating oscillator in the Model SB-12b.

Referring to the instructions on line size in the Model RC-3b Instruction Manual, the line size should be set so that it reaches the right edge of the "0" amplitude calibration at the right of the SB-12b, screen, and midway between the "4" and "0" of the "-40 db" amplitude calibration at the left edge of the screen.

When ordering the Model RC-3b separately from the Model SB-12b, the order should specify that it is to be used with the Model SB-12b, and the serial number of the Model SB-12b must be given.

III-5. INTERPRETATION OF SIGNALS

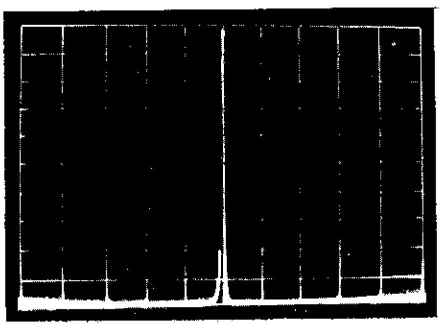
a. A constant carrier signal appears as deflection of fixed, height with the nature of presentation depending upon the sweep width as shown in Figure III-5 (a) and (b).

Deviations of the signal from true c-w will result in displays which will indicate the character of the signals as follows:

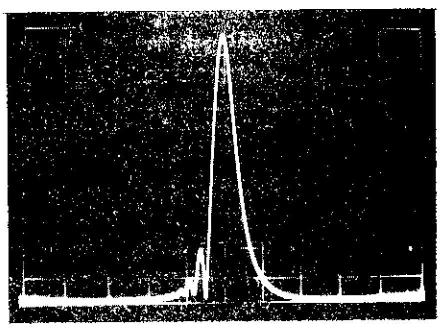
1. Oscillator Drift-deflection moves slowly across the screen.

2. Periodic Drift - deflection moves back and forth across the screen.

3. Squegging - interruption of an oscillator at a-f or r-f rate will result in a spectrum display resembling that of a pulse-modulated signal. Sideband components will be present in addition to the oscillating frequency.

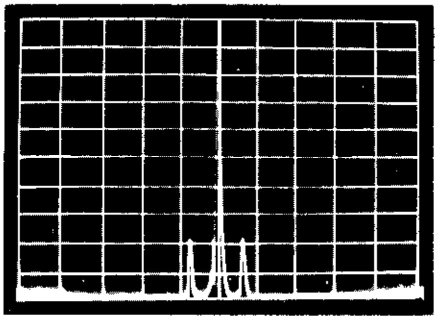


(a) Constant carrier signal at approximately maximum sweep width.

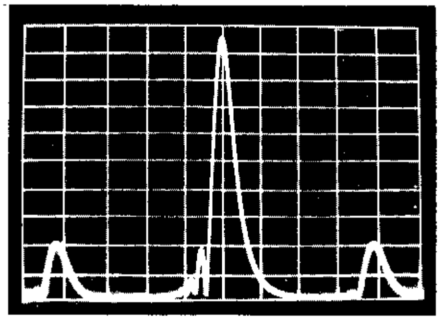


(b) Appearance of constant carrier at reduced sweep width.

Figure III-5. Screen Presentations of Constant Carrier Signal.



(a) A-m signal, showing carrier and two sidebands.



(b) Same a-m signal at reduced sweep width, carrier remains at center of screen.

Figure III-6. Screen Presentations of Amplitude-Modulated Signals.

b. An amplitude-modulated carrier appears as a deflection of variable height. Non-constant tone modulation of low frequency will produce a series of convolutions varying in height, their number being determined by the modulation frequency. The nature of the presentation will depend upon the sweep width (Figure II-5.a. and b.).

As the modulation frequency increases, the convolutions move toward the two sides of the deflections, and the sidebands become visible. When the modulation frequency is increased, it becomes possible to separate the sidebands by reducing the sweep width of the analyzer. The IF BANDWIDTH control will enable further separation. The higher the frequency of modulation, the farther away those sidebands will move from the center deflections, which represent the carrier. The relative heights of the sidebands may vary as the external oscillator is tuned and as the deflection moves from one end of the screen to the other.

c. The appearance of single sideband signals depends upon the type of modulation employed. Tone-modulated single sideband signals appear as a carrier (for a single tone), or a series of carriers (for multi-tones) of slightly different frequency. Voice or music modulated single sideband signals appear as a "smear" of rapidly varying signals which occupy a finite band width. (See paragraph g., "Signal Interference", below.)

d. A carrier, frequency modulated at a low rate appears as a carrier which wobbles sideways.

e. A CW signal appears and disappears in step with the keying of the signal source. During the moments when the signal is off, the frequency sweep axis is closed at the base of the signal. In very rapidly keyed signals the deflection and the baseline are seen simultaneously.

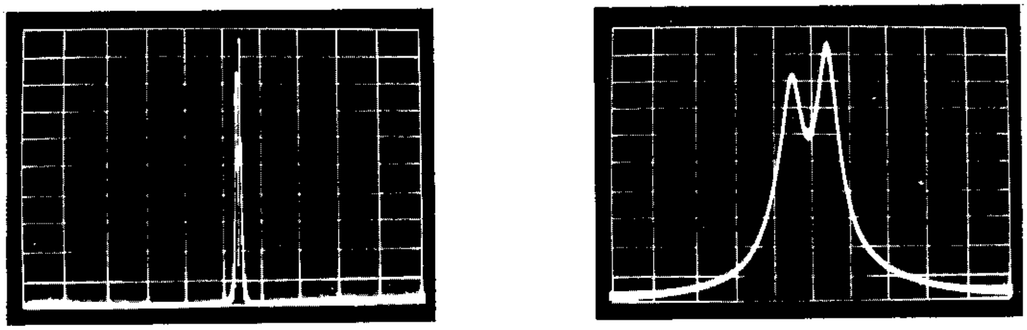
f. An MCW signal appears like a CW signal of periodical varying height. If the modulation rate is high, sidebands will appear as explained above.

g. Signal Interference. Two c-w signals which are so close in frequency as to cause aural interference (beats) may appear on the screen as a single signal varying in height as with modulation. As the frequency separation is increased, the signal appears to be modulated on one side only. Further separation will cause a "break" in the apex of the deflection. By reducing the sweep width of the analyzer, the two signals will gradually separate. Further separation is effected with the IF BANDWIDTH control and by setting the SWEEP RATE to a lower rate (Figure III-7.a. and b).

h. Frequency modulated carriers appear as a series of vertical deflections (Figure III-8.a and b.)

i. Radio interference signals of various types may appear on the screen of the spectrum analyzer. Such signals may have broad or narrow spectral distributions, and may occur at constant or at random repetition rates. Signals which occur at a variable repetition rate (such as those produced by accelerating motors, vibrators, buzzers, etc.) may move in one direction or the other along the frequency sweep baseline; this is caused by the fact that the analyzer is sweeping at a fixed rate, whereas the observed signal occurs at a variable rate. The images stand still on the screen when there is synchronism between the two. Signals produced by such sources as electrical arcing, switching transients, "static", and other short electrical impulses, have broad spectra which may cover the entire frequency sweep range of the analyzer.

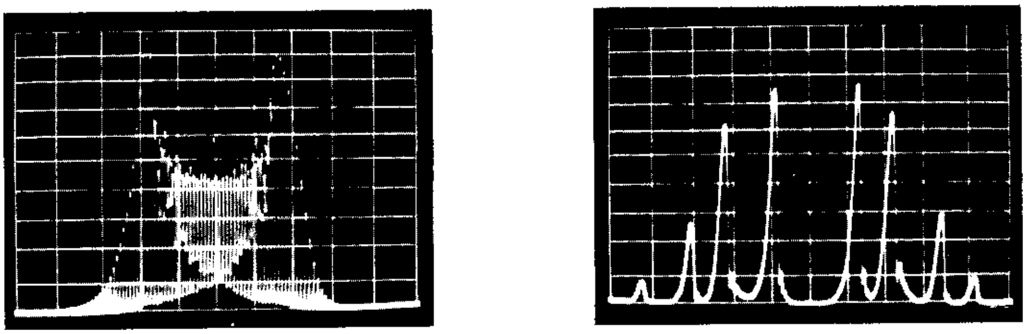
j. Images. Image signals will be distinguishable



(a) Two interfering signals at maximum sweep width.

(b) Same signals at reduced sweep width, resulting in improved separation or resolution.

Figure III-7. Resolution of Interfering Signals.



(a) High level frequency-modulation with a low modulating frequency.

(b) Low level frequency-modulation with a high modulating frequency.

Figure III-8. Screen Presentations of Frequency-Modulated Signals.

from normal signals by the fact that they move in an opposite direction with respect to normal signals on the screen of the Panalyzor when the external oscillator is being tuned.

k. Harmonics, produced in the converter by the beat of very strong signals with harmonics of the oscillator, will be distinguishable from other signals by the fact that they move on the screen more rapidly (with tuning) than the normal signals (twice as fast for second harmonic spurious signals). Generally a reduction in the gain of the Panalyzor and/or reduction in generator output will eliminate this type of spurious signal.

l. Spurious Signals. If the signal strength exceeds a certain value, the deflection caused by any signal may break up into a series of parallel deflections somewhat similar to sidebands. Attenuation of signal input level will remedy this.

III-6. LOCATION OF SIGNALS ON NARROW SWEEP WIDTHS

The following procedure is recommended for acquisition of signals to be displayed on the 150 cps and 500 cps pre-set sweep widths. The CENTER FREQ control should first be set to center the 500 KC CAL OSC signal on the screen, on the 3.5 kc sweep width. Using the VAR sweep width mode, at 100 kc sweep width and 30 sweeps per second, tune in the signal with the external VFO (or CENTER FREQ control if signals are at 500 kc) and center in the screen. Turn AFC to on. A broad pip, resembling a curved, raised base line, will appear. Some re-tuning may be required to center this display. Switch sweep width selector to 500 cps. Use FAST sweep mode and re-tune slightly if needed to place the distorted pip slightly to the left at the center of the screen. At normal (0.1 cps) sweep rate, re-tune VFO to center pip. The pip should now be visible when SWEEP width is set to 150 cps.

CHAPTER IV
THEORY OF OPERATION

IV-1. INTRODUCTION

As shown in Figure IV-1, the Model SB-12b consists of the following seven principal sections.

1. Input section.
2. Sweep generator section.
3. Mixer and sweep oscillator, reactance modulator, and AFC section.
4. 100 KC i-f and video section.
5. Crt with horizontal and vertical plate outputs section.
6. Crystal-controlled calibrating oscillator section.
7. PS-12 section.

The input section is provided with three input circuits and a 450 - to 550- KC output circuit. Since the output of the first mixer has a pass band of 450 to 550 KC, no external oscillator input frequency is required for incoming signals in the 450 - to 550-KC range. An external oscillator input frequency 500-KC higher or lower than the signal input frequency is required for incoming signals outside the 450 - to 550-KC range. With a 0.3-volt rms external oscillator input level, a 2-millivolt or smaller signal input level will produce full-scale log deflection on the crt screen. This sensitivity is maintained throughout the radio communications spectrum to well above 30 MC. The mixer is usable, at reduced sensitivity, up to 1000 MC. Some reduction in dynamic range is normal in the VHF and UHF range. The input attenuator is not effective above 40 mc, and sensitivity "suck-outs" may occur at various frequencies above 40 mc.

The sweep generator section is provided with two sawtooth output circuits. The sawtooth speeds are variable from 0.1 to 30 cps. One sawtooth voltage wave provides the crt with horizontal sweep. The other sawtooth voltage wave is fed to a reactance modulator whose operations are explained in the following paragraph.

On receiving the sawtooth voltage wave, the reactance modulator in combination with network Z101 causes the local sweep oscillator (part of mixer-oscillator tube V3) frequency to vary in proportion to the progressively varying magnitude of the sawtooth voltage. With the AFC feedback circuit OFF, the scanning width is ±50 KC from the 600-center frequency; with the AFC feedback circuit ON, ±1 KC. In the latter case, AFC provides the frequency stability necessary for the narrow bandwidth. The mixer section of V3 receives two signals: one, those in the 450- to 550-KC output circuit of first r-f amplifier V2, and two, the scanning voltage (nominally 550 to 650 KC) of the local sweep oscillator; the scanning voltage progressively translates each voltage component in the 450- to 550-KC signal to a 100-KC difference frequency signal at the output of the mixer's 100-KC center frequency narrow band output filter.

The 100-KC i-f and video section receives the 100-KC voltages from the output of the second mixer. These voltages, whose magnitudes vary from instant to instant depending upon the composition of the 450- to 550-KC i-f amplifier's signal, are amplified in a narrow band four-stage amplifier, are detected, and are fed to the crt vertical plates via a vertical amplifier.

Consequently, the crt displays the component signals in the 100-KC r-f bandwidth under surveillance. If desired, narrower r-f bandwidths may be displayed across the crt screen. The pip amplitude and position along the calibrated horizontal axis are indicative of each component signal level and frequency, respectively. The sawtooth voltage output of the sweep generator progressively shifts the crt electron beam horizontally across the screen in order to enable the crt to display the successively demodulated 100-KC signals emerging from the second mixer. These signals represent magnitudes of the successive frequency components in the r-f bandwidth being scanned.

If desired, the calibrating oscillator will provide the crt screen with a 500-KC marker. When supplied with an audio signal (fed into EXT MOD jack) the modulated 500-KC signal provides frequency markers with known separations. The built-in 5 KC oscillator, controlled from the front panel, performs the same function as an external modulating signal, for situations where 5 KC intervals are satisfactory. The PS-12 is a conventional electronically regulated type supplying +270 volts to the Model SB-12bS.

IV-2. CIRCUIT DESCRIPTION

a. Input Section. The signal and/or calibrating oscillator input is through a 50-ohm step-type attenuator. Up to 49 db of loss can be inserted in the signal path in 1-db steps. The accuracy of the attenuator is ±.05 db/db up to 30 MC. It is usable with reduced accuracy up to several hundred megacycles.

The input attenuator is followed by an aperiodic

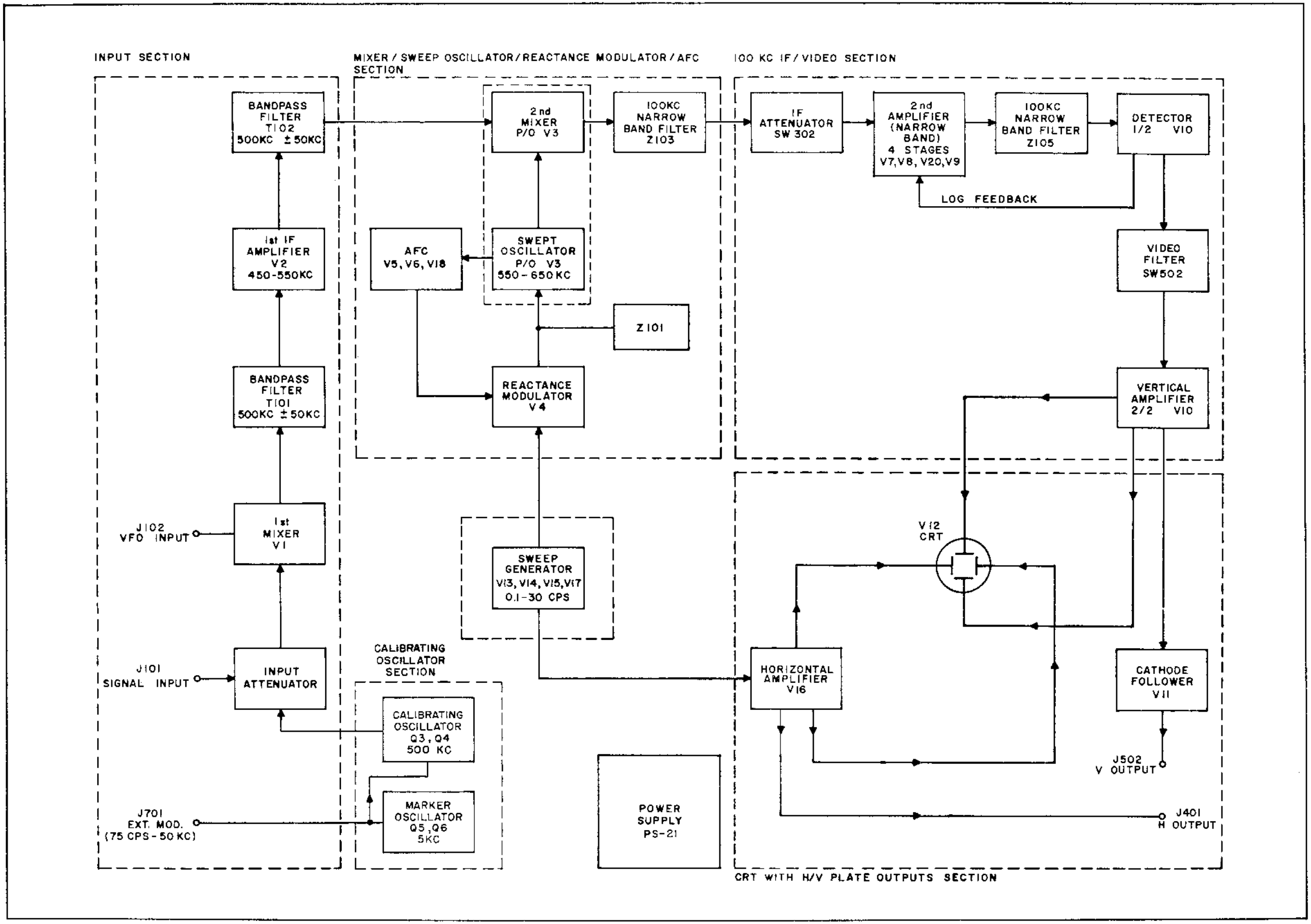


Figure IV-1. Block Diagram, Model SB-12b.

mixer V1 (6J6) which is coupled to neutralized cascode r-f amplifier V2 (12AT7). GAIN control potentiometer R108 in the cathode circuit of V2 allows up to 20 db of attenuation. The output of the r-f amplifier is coupled to second mixer V3 (6BE6). Coupling transformers T101 and T102 in the r-f amplifier are designed to provide a flat bandpass from 450 to 550 KC with a sharp cutoff above 550 KC to reduce image response.

The functions of front panel controls that apply to this section are as follows:

1. INPUT ATTENUATOR S701 through S706. This is a group of six toggle switches which provide attenuations of 1 DB, 1 DB, 2 DB, 10 DB, 15 DB, and 20 DB in the SIGNAL INPUT circuit. When the switches are in the down position, the indicated attenuation is inserted.

2. GAIN R108. The amplitude of the indication on the crt screen is adjusted with this control. Maximum gain is obtained at maximum clockwise position. The GAIN control should be operated at the maximum setting consistent with low noise on the crt display to reduce internal distortion in the Model SB-12b input circuits.

3. SIGNAL INPUT J101. This coaxial jack receives r-f signal to be analyzed. J103 on the rear chassis apron is in parallel with this jack.

4. VFO INPUT J104. VFO is the associated external oscillator or signal generator which is used to heterodyne with the test signal to produce the required frequency to operate the Model SB-12b. J102 on the rear chassis apron is in parallel with this jack.

NOTE

The heterodyne product should be the difference between the two frequencies used. If the sum frequency is used, spurious screen indications may result from heterodyne products of the test signals and the external signal generator output (including its harmonics).

b. Sweep Generator Section. The sawtooth sweep voltage is derived from a feedback integrator circuit consisting of V13 (6AU6) and V14A (1/2 12AU7). Capacitor C401 is charged with a constant current determined by the setting of SWEEP RATE potentiometers R404 and R407. The resulting sawtooth voltage developed across C401 is available at the cathode of V14 (12AU7).

The setting of SWEEP RATE potentiometers R404 and R407 determines the charging current into C401. As C401 charges negatively, the grid of V13 starts to go negative and greatly amplified positive-going voltage appears at its plate. This is passed through cathode follower V14A (1/2 12AU7) for purposes of impedance transformation. The output of the cathode follower causes the output side of C401 to go positive at a much greater rate than the input side goes negative. During any single sweep, the potential of the input side of C401 (and the grid of V13) remains very nearly zero. Thus, the charging current remains constant and a linear voltage sawtooth is generated.

When the sawtooth voltage reaches a predetermined amplitude, blocking tube oscillator V14B (1/2 12AU7) fire and cause discharge tube V15 (6BH6) to conduct heavily. This tube discharges C401 and the charging cycle repeats itself.

The sawtooth is coupled through LINE SIZE potentiometer control R421 to the grid of horizontal deflection amplifier V16 (12AU7) and to reactance tube V4 (6AH6) through SWEEP WIDTH LIMIT potentiometer control R423 and the sweep width divider network. The second half of V16 (12AU7) acts as a direct coupled phase inverter. The plates of V16 are direct coupled to the horizontal deflection plates of the crt. H POS potentiometer control R427 is in the last stage. FOCUS and BRILLIANCE potentiometer controls R520 and R222, respectively, are in the high-voltage bleeder chain.

The functions of front panel controls that apply to this section are as follows:

1. SWEEP RATE R404 and R407. The potentiometer controls provide continuously adjustable scanning rates between 0.1 and 30 cps. Counterclockwise rotation of the controls reduces the sweep rate. The controls are operative only in the VAR position of the SWEEP WIDTH SELECTOR switch.

2. SWEEP MODE SW403. This momentary contact lever switch speeds up the sweep rate from 0.1 to 1 cps on the 150-cps, and 500 cps preset sweep ranges. This facilitates centering the display on the crt screen without the need to wait 10 seconds between sweeps. It also enables the operator to skip undesired portions of the frequency range being scanned.

3. SWEEP WIDTH SELECTOR SW402-4B. This switch control provides a choice of five preset widths of 150 cps, 500 cps, 3.5 KC, 7 KC, and 14 KC, and a sixth position marked VAR. In the VAR position, the sweep width may be set to any value from 0 to 100 KC, the i-f bandwidth may be set for any desired resolution within the capability of the instrument, and the sweep rate may be set to any value from 0.1 to 30 cps. The VIDEO FILTER switch is also operative in this position. In the preset positions, the i-f bandwidth

is automatically set for optimum resolution. On the two narrowest ranges, the AFC circuit is automatically turned on; on the 3.5 KC, 7 KC and 14-KC ranges it is disabled. On the two narrowest ranges, the sweep rate is 0.1 cps, and a low-pass video filter with a bandwidth of approximately 40 cps is switched on. The sweep rate on the 3.5 KC, 7 KC and 14-KC ranges is 1 cps, and the video filter bandwidth is approximately 400 cps. The sensitivity of the Model SB-12b is constant on all ranges within ±15 per cent.

4. SWEEP WIDTH R424 and R218. The scanning width of the instrument is adjusted with this potentiometer control. When it is turned completely clockwise, the maximum spectrum width for which the instrument is designed (that is, 100 KC when AFC is off, or 2 KC when AFC is on) can be seen on the screen. As the control is backed off in a counterclockwise direction, the bandwidth viewed becomes narrower. The part that can be seen, however, is expanded across the screen and, hence, is virtually magnified. The stability required for narrow sweep width and slow sweep rates is provided by turning on the AFC. The SWEEP WIDTH control, in conjunction with the IF BANDWIDTH control, is useful for separating two or more signal deflections which are so close as to merge into each other.

Chassis-mounted controls that apply to this section are as follows: (These are initially set by factory personnel and should be changed only by qualified technical personnel.)

(a). LINE SIZE potentiometer R421.

(b). 30-cycle adjust potentiometer R409.

(c). 0.1-cycle adjust potentiometer R406.

(d). HORIZ OUTPUT jack J401.

(e). SWEEP WIDTH LIMIT potentiometer R423.

c. Mixer and Sweep Oscillator, Reactance Modulator, and AFC Section. The functions of a mixer and local oscillator are combined in V3 (6BE6). The center frequency of the oscillator is 600 KC. Reactance stage V4 (6AH6) sweeps the oscillator between 550 and 650 KC in accordance with a sawtooth voltage applied to its grid. Variable resistor R203, CF PAD, varies the screen voltage on the reactance tube and hence tunes the center frequency of the oscillator.

The oscillator output is amplified by V5 (6BH6) and applied to a frequency discriminator V6 (12AL5). The center frequency of the discriminator is 600 KC. It effectively reduces the normal 100-KC sweep width of the local oscillator to 2 KC and stabilizes it against drift. The AFC circuit also reduces hum modulation of the local oscillator by a factor of 50.

Mixer V3 (receiving 450- to 550-KC i-f amplifier V2 signals, and 550- to 650-KC local sweep oscillator V3 signals), equipped with 100-KC center frequency narrow band output filter Z103, delivers variable 100-KC signals to its following stage; these are the result of the scanning local oscillator's frequency-modulated voltages and the component signal voltages in the r-f band under surveillance. In other words, the 100-KC component signal voltages from V3's 100-KC center frequency narrow band output filter Z103 represent, during the scanning cycle, the magnitude/frequency of the voltage components in the output of the 450- to 550-KC i-f amplifier V2.

The functions of front panel controls that apply to this section are as follows:

1. CENTER FREQ, R206 and R207. Center frequency is the frequency of the signal received on that part of the frequency sweep axis corresponding to zero sweep voltage applied to the reactance modulator.

2. SWEEP WIDTH SELECTOR, S402-2T, -1T, and -3T. This switch control provides a choice of five preset sweep widths of 150 cps, 500 cps, 3.5 KC, 7 KC, and 14 KC, and a sixth position marked VAR. In the VAR position, the sweep width may be set to any value from 0 to 100 KC, the i-f bandwidth may be set for any desired resolution within the capability of the instrument, and the sweep rate may be set to any value from 0.1 to 30 cps. The VIDEO FILTER switch is also operative in this position. In the preset positions, the i-f bandwidth is automatically set for optimum resolution. On the two narrowest ranges, the AFC circuit is automatically turned on; on the 3.5 KC, 7 KC and 14 KC ranges it is disabled. On the two narrowest ranges, the sweep rate is 0.1 cps, and a low-pass video filter with a bandwidth of approximately 40 cps is switched on. The sweep rate on the 3.5KC, 7 KC and 14 KC ranges is 1 cps, and the video filter bandwidth is approximately 400 cps. The sensitivity of the Model SB-12b is constant on all ranges within ±15 per cent.

3. SWEEP WIDTH R424 and R218. The scanning width of the instrument is adjusted with this potentiometer control. When it is turned completely clockwise, the maximum spectrum width for which the instrument is designed (that is, 100 KC when AFC is off, or 2 KC when AFC is on) can be seen on the screen. As the control is backed off in a counterclockwise direction, the bandwidth viewed becomes narrower. The

part that can be seen, however, is expanded across the screen and, hence, is virtually magnified. The stability required for narrow sweep width and slow sweep rates is provided by turning on the AFC. The SWEEP WIDTH control, in conjunction with the IF BANDWIDTH control, is useful for separating two or more signal deflections which are so close as to merge into each other.

4. AFC. This toggle switch places the AFC circuit in operation in its upward position.

Chassis-mounted controls that apply to this section are as follows: (These are initially set by factory personnel and should be changed only by qualified technical personnel.)

(a). CF PAD potentiometer R203.

(b). SWEEP WIDTH LIMIT/AFC potentiometer R216.

(c). AFC TEST jack J201.

d. 100-KC I-f and Video Section. The output of the second mixer is connected through 20-db attenuator S302 to the 100-KC i-f amplifier. This attenuator is used as a convenient means of setting the signal level at 20 db over full-scale log deflection. It is normally operated in the 0-db-position.

First i-f stage V7 (6U8), a neutralized amplifier, has a crystal filter in its cathode circuit. The filter is operated as a series resonant circuit which couples into the grid of the next stage (pentode section of V7). The grid return to ground is a parallel resonant circuit shunted by a resistance. As the shunting resistance is decreased (by operation of SWEEP WIDTH SELECTOR switch S402-1B), the effective series resistance of the crystal filter is decreased and the crystal bandwidth narrows.

Second i-f stage V8 (6U8), a neutralized amplifier, is similar to the first. Two shunting potentiometers, R305 and R309, designated IF BANDWIDTH form part of the i-f selectivity circuits. SWEEP WIDTH SELECTOR switch S402-3B, controls selectivity while switch S402-2B controls gain.

Third i-f stage V20(6U8), a neutralized amplifier, is similar to the first. SWEEP WIDTH SELECTOR switch S402-5B shunts the grid return to ground in this stage.

Fourth i-f stage V9 (6AU6), is a conventional i-f amplifier. A d-c feedback voltage from the following diode detector is applied to the grid of V9 to reduce its gain for strong signals when AMPLITUDE SCALE toggle switch S301 is in LOG position.

The fourth i-f stage is coupled to diode detector pins 6, 7, and 8 of V10 (12AU7). For LOG amplitude scale indications, the rectified pulses, which appear across the diode load, are fed back through the AMPLITUDE SCALE switch to the grid of the last i-f stage. Chassis-mounted LOG ZERO ADJUST R325 and LOG 20 ADJUST R321 controls determine the magnitude of the feedback voltage and the operating point of the i-f stage which controls the logarithmic characteristics.

The output of the detector is direct coupled to the grid of the second half of V10 (12AU7) through a low-pass R-C filter. Two degrees of filtering and an OFF position are provided by the VIDEO FILTER switch S502.

The plate of the video amplifier is direct coupled to one vertical deflection plate of the crt and to the grid of phase inverter V11 (12AU7) whose output drives the other vertical deflection plate. The variable cathode bleeder resistor of the inverter controls the d-c potential on its associated deflection plate and thus governs vertical position. The second section of V11 (12AU7) is a cathode follower which provides an auxiliary vertical output from J502 on the rear apron of the chassis for driving a slave oscilloscope or other external indicator.

The functions of front panel controls that apply to this section are as follows:

1. IF ATTEN S302. This toggle switch allows 20 db of attenuation to be inserted in the i-f amplifier. When this is done, the input signal may be adjusted for full-scale LOG deflection. Placing the IF ATTEN switch in the 0 DB position permits the full 60-db dynamic range of the Model SB-12b to be used. Only the lower 40-db portion is displayed on the crt screen. This switch must always be in the 0 DB position when making measurements.

2. IF BANDWIDTH R305 and R309. Resolution, or the ability to separate individual signals, is dependent upon two factors: the rate of frequency scan and the bandwidth of the i-f section of the instrument. Optimum resolution requires a definite relationship between the two. Resolution sharpens as both the frequency scanning rate and i-f bandwidth are decreased. The IF BANDWIDTH control is used to narrow the i-f bandwidth. Counterclockwise rotation of this control narrows the width of the i-f section. It should be noted that as this control is adjusted, there will be some degree of change in the sensitivity of the equipment. The frequency scanning rate is diminished by increasing the scanning period or, conversely, by decreasing the spectrum width scanned within a given time. The AFC and SWEEP WIDTH controls provide the latter method.

For a given setting of the SWEEP WIDTH control there is a complementary setting of the IF BANDWIDTH control to obtain optimum resolution. On the preset sweep ranges, the i-f bandwidth is automatically set for optimum resolution.

3. SWEEP WIDTH SELECTOR S402-1B, -2B, -3B, -5B, -4T. This control provides a choice of five preset sweep widths of 150 cps, 500 cps, 3.5 KC, 7 KC, and 14 KC, and a sixth position marked VAR. In the VAR position, the sweep width may be set to any value from 0 to 100 KC, the i-f bandwidth may be set for any desired resolution within the capability of the instrument, and the sweep rate may be set to any value from 0.1 to 30 cps. The VIDEO FILTER switch is also operative in this position. In the preset positions, the i-f bandwidth is automatically set for optimum resolution. On the two narrowest ranges, the AFC circuit is automatically turned on; on the 3.5 KC, 7 KC and 14 KC ranges it is disabled. On the two narrowest ranges, the sweep rate is 0.1 cps, and a low-pass video filter with a bandwidth of approximately 40 cps is switched on. The sweep rate on the 3.5 KC, 7 KC and 14 KC ranges is 1 cps, and the video filter bandwidth is approximately 400 cps. The sensitivity of the Model SB-12b is constant on all ranges within ±15 percent.

4. AMPLITUDE SCALE LOG-LIN S301. Selection of linear or logarithmic amplitude presentations is accomplished with this toggle switch. In the LOG position, signals having a 40-db (100:1) amplitude range may be viewed simultaneously on the screen. When using the LOG amplitude range, the calibration lines on the calibrated screen are used. The calibration range is from 0 db to -40 db in 5-db steps. In the LIN position, signals having an amplitude ratio of 20 db (10:1) may be observed at one time. When using the LIN amplitude range, the calibration dots on the right edge of the calibrated screen are used. This linear scale is divided into 10 equal divisions. It should be noted that because of the time constant factor, the LOG feature does not function properly with narrow pulses.

5. VIDEO FILTER HI-LO OFF S502. This toggle switch provides two degrees of video filtering to suppress such unwanted effects as noise, spurious beating between closely adjacent signals, hum, etc. In the upper (HI) position, the video bandwidth is moderately reduced. In the lower (LO) position of the VIDEO FILTER switch, the video bandwidth is greatly reduced. This position is suitable for use with very slow sweep rates and narrow sweep widths. On the 150-cps and 500 cps preset sweep ranges, the LO filter is automatically switched on. On the 3.5 KC, 7 KC and 14 KC ranges, the HI filter is automatically switched on.

Chassis-mounted controls that apply to this section are as follows: (These are initially set by factory personnel and should be changed only by qualified technical personnel.)

(a). BANDWIDTH LIMIT potentiometer R310.

(b). LOG 20 ADJ potentiometer R321.

(c). LOG ZERO ADJ potentiometer R325.

(d). Inductors L101A, L101B, and L101C.

e. Crt with Hor/Vert Plate Outputs Section. Cathode-ray tube V12 (5ADP7) has its horizontal and vertical plates driven as follows: horizontal, V16A and V16B; vertical, V10B and V11A. Cathode follower V11 provides monitoring of the crt vertical plates via VERT OUTPUT jack J502.

The cathode-ray tube screen is calibrated by db (line) calibrations ranging from 0 to -40 db (left-hand scale) and by linear (dot) calibrations ranging from 1.0 to 0. A signal with 0 or reference db deflection will drop to 20 db with 20-db insertion in an attenuator. A signal with 1.0 deflection will drop to 0.1 deflection with a 20-db insertion in an attenuator.

The functions of front panel controls that apply to this section are as follows:

1. FOCUS R520. The sharpness of the screen presentation is adjusted with control R520.

2. BRILLIANCE R522. The intensity of the screen presentation is adjusted with control R522.

3. H POS R427. Control R427 is used to adjust the position of the baseline trace along the horizontal axis.

4. V POS R507. Control R507 is used to adjust the position of the baseline trace along the vertical axis.

5. ILLUMINATION, POWER ON-OFF S501 and R525. Control R525 is rotated in a clockwise direction to turn on the power. Continued clockwise rotation of this control increases the edge illumination of the crt screen.

Controls not mounted on the front panel that apply to this section are as follows: (These are initially set by factory personnel and should be changed only by qualified technical personnel.)

(a). ASTIGMATISM potentiometer R516.

(b). VERT OUTPUT jack J502.

f. CRYSTAL-CONTROLLED CALIBRATING OSCILLATOR SECTION.

Transistor Q3 (2N404) is a 500 KC crystal oscillator. It drives an emitter-follower stage, Q4 (2N404) whose output is coupled through a 1000 ohm isolating resistor (R114) to the SIGNAL INPUT of the Model SB-12b. The output of the calibrating oscillator is varied by the CAL OSC LEVEL control R726 which determines the supply voltage delivered to the two transistors.

An external audio signal may be applied, via EXT MOD connector J701, to the emitter of the oscillator transistor Q3. The external audio signal amplitude modulates the 500 KC signal and provides frequency markers with a known separation.

The 5 KC marker oscillator consists of a bridged-T resistance-capacity oscillator with two transistors, Q5 and Q6 (2N404). The frequency of the oscillator is adjustable over a restricted range. It is factory adjusted to 5000 cps ±2%. The output of the oscillator is at a low impedance, and is capacitively coupled through C813 to the emitter of the 500 KC crystal oscillator transistor.

The functions of front panel controls that apply to this section are as follows:

1. CAL OSC LEVEL R726. This potentiometer control varies the output amplitude of the 500-KC crystal oscillator which is internally connected to the SIGNAL INPUT receptacle. The signal may be used to locate the center frequency of the Model SB-12b and may be modulated by an external audio oscillator to provide marker sidebands for setting up any desired sweep width. The 500-KC signal, in conjunction with the INPUT ATTENUATOR, may be used to check the accuracy of the LOG amplitude scale calibrations. In its fully counterclockwise position, the CAL OSC LEVEL control reduces the oscillator output to zero.

2. EXT MOD J701. Provides the crt screen with markers.

3. 5 KC MARKER S701. This two position switch connects the output of the 5 KC marker oscillator to the 500 KC calibrating oscillator when it is moved to the up position.

A control not mounted on the front panel that applies to this section is as follows: This control is initially set by factory personnel.

FREQ. ADJ. R807. This control is used to adjust the marker oscillator to 5 KC.

g. Power Supply, Model PS-12. The power supply is a conventional electronically regulated type supplying +270 volts to the analyzer.

The high voltage for the crt is obtained from a pair of high voltage selenium rectifiers, CR601, CR602. The bleeder current from the negative crt supply operates a voltage reference tube (V17, 5651) in the analyzer, which supplies -87 volts to the sweep circuits. A voltage regulator (V18 OA2) supplies the r-f amplifier and second mixer with +150 volts.

The heaters of V3, V4, V5, and V6, which are in the oscillator and AFC circuits, are operated from a d-c supply obtained from the a-c heater system via a selenium bridge rectifier, CR-1.

CHAPTER V
SERVICE AND MAINTENANCE

V-1. GENERAL

This equipment has been thoroughly tested and aligned before shipment, and with normal usage should function as described in the previous chapters. However, as in all electronic devices, occasional failure of a tube or component may result in malfunctioning, necessitating maintenance action. This chapter is divided into eight sections to facilitate its use in the adjustment, alignment, maintenance, and repair of the equipment.

Section V-2 describes the procedure for inspecting and replacing components.

Section V-3 is a list of the test equipment recommended for use in servicing the equipment.

Section V-4 is a description of the screw driver-adjust controls found on the chassis of the equipment.

Section V-5 describes the touch-up alignment that may become necessary because of aging or failure of a tube or component in the circuit.

Section V-6 is a description of the complete alignment procedure. It is only under the most unusual circumstances that this procedure will have to be used in its entirety. Most of the alignment problems encountered in the field can be solved by using the applicable adjustment techniques mentioned in Section 4.

Section V-7 provides charts showing the tube layouts and the normal voltage and resistance measurements made on properly functioning instruments.

Section V-8 is a list of the replaceable parts used in the equipment.

If the equipment develops trouble which cannot be corrected by using the procedures outlined in this chapter, it is recommended that the instrument be returned to Panoramic Radio Products, Inc. for servicing. Before returning the instrument fill out and mail the Repair and Maintenance Form bound in the rear of this Manual. Upon receipt of the information thereon, the company's Service Department will supply the necessary servicing data or shipping instructions. After receiving shipping instructions, forward the instrument prepaid to the factory. If requested, an estimate of charges will be made before the repair is begun.

V-2. INSPECTION AND COMPONENT REPLACEMENT

a. INSPECTION.

All components of the equipment should be given a thorough inspection at regular intervals and whenever maintenance requires removal of an instrument from its cabinet. Moisture may cause deterioration of material and produce sub-standard operation. Dust and dirt materially affect both electrical and mechanical operation. Keep the various parts clean. Check accessible connections and tubes regularly to make sure that all contacts are clean and tight and that tubes and crystals are held securely in their sockets.

b. REPLACEMENT.

All tubes and crystals are accessible at the top of the chassis. The pilot lamp is located on the front-panel, and is removed by unscrewing. The fuses are located on the rear chassis apron of the Power Supply, Model PS-12. Spare fuses are mounted on the rear chassis apron of the Model SB-12a.

CAUTION

Never replace a fuse with one of a higher current rating. If a fuse burns out immediately after replacement, do NOT replace it a second time until the cause has been determined and trouble is corrected.

c. VACUUM TUBE REPLACEMENT.

Vacuum tubes should be checked on a reliable tube tester. An indication of "GOOD" on a tube tester does not mean that a tube will necessarily function properly in its circuit, but a "REPLACE", "BAD", or borderline indication does mean that better service will generally result if the tube is replaced. The average commercial tube tester should not be called upon to give more information than this. Many questions regarding the condition of a particular tube in a given circuit can best be answered by substituting a tube known to be free from defects in its place and comparing the performance of the equipment.

V-3. RECOMMENDED TEST EQUIPMENT

The following equipment should be available in order to properly service and align the Model SB-12b.

a. 2 Signal Generator, Hewlett-Packard Model 606A or equivalent (50 kc to 65 MC, 0.1 uv to 3 V).

b. 1 Signal Generator, Hewlett-Packard Model 200CD or equivalent. (5 cps to 600 KC, 0 to 5 V).

c. 1 Vacuum-tube Voltmeter, RCA Model WV-77C or equivalent.

V-4. SCREWDRIVER-ADJUST CONTROLS

These controls are in circuits which seldom require adjustment. They are located on top of the chassis.

a. Line Size: This control is adjusted for correct baseline length of approximately one-quarter inch on either side of the frequency scale limits.

b. Sweepwidth Limit: This control is adjusted to provide correct sweep widths in the VAR, 14 KC, 7 KC and 3.5 KC positions of the SWEEP WIDTH SELECTOR.

1. Set the SWEEP WIDTH SELECTOR to VAR.

2. Set the CAL OSC LEVEL control fully clockwise.

3. Adjust the GAIN and CENTER FREQ controls to give an approximately full scale signal centered on the calibrated screen.

4. Connect a 50 KC signal source to the EXT MOD connector. Adjust the amplitude of the 50 KC signal source to give roughly 1/4 scale sideband pips.

5. Adjust the Sweepwidth Limit control to place the sideband pips approximately 1/8 inch inside the left and right extremes of the frequency scale.

6. Set the SWEEP WIDTH SELECTOR to 14 KC.

7. Shift the signal source to 7 KC and check location of sideband pips relative to the right and left extremes of the frequency scale.

8. Switch SWEEP WIDTH SELECTOR to 7 KC.

9. Shift signal source to 3.5 KC and check location of sideband pips relative to the right and left extremes of the frequency scale.

10. (Same as 8, at 3.5 KC).

11. (Same as 9, at 1.75 KC).

12. In the VAR, 14 KC, 7 KC and 3.5 KC positions of the SWEEP WIDTH SELECTOR the pips should fall within ±1/2 division of the left and right extremes of the frequency scale. If they do not, adjust the Sweepwidth Limit control slightly to move the pips in the required direction. Repeat steps 6 through 9 above until the sideband pips fall within ±1/2 division of the left and right extremes of the frequency scale in the VAR, 14 KC, 7 KC and 3.5 KC positions of the SWEEP WIDTH SELECTOR.

c. Sweepwidth Limit AFC: When the sweep width has been adjusted in accordance with paragraph V-4. above, set the SWEEP WIDTH SELECTOR to 500 cps and modulate the CAL OSC with a 250 cps signal. Adjust the Sweepwidth Limit AFC control, to place the sidebands on the left and right extremes of the frequency scale. This also calibrates the 150 cycle sweep range.

d. Astigmatism: This control is adjusted, together with the FOCUS control, to produce a sharp circular spot over the full width of the crt.

e. 1. IF GAIN: This control is effective in the VAR position of the SWEEP WIDTH SELECTOR. It adjusts the gain of the i-f amplifier for the specified sensitivity.

(a) Set the front panel controls as follows:

IF ATTEN	20 DB
SWEEP WIDTH SELECTOR	VAR
AMPLITUDE SCALE	LIN
CENTER FREQ	Marker
AFC	OFF
GAIN	10 (Maximum)
CAL OSC LEVEL	OFF
INPUT ATTENUATORS	All up
5 KC MARKER	OFF
H POS	Normal Operation
V POS	Normal Operation
SWEEP WIDTH	Maximum (Clockwise)
IF BANDWIDTH	Maximum (Clockwise)
VIDEO FILTER	OFF
SWEEP RATE	Maximum (Clockwise)

(b) Connect a 3.0 MC signal source to the front panel SIGNAL INPUT connector. Set the amplitude of the signal source to 1 millivolt.

(c) Connect a 2.5 MC signal source to the front panel VFO INPUT connector. Set the amplitude of the signal source to 0.3 volts.

(d) Adjust the IF GAIN control for a full scale pip on the screen.

2. 14 KC: This control adjusts the i-f gain in the 14 KC position of the SWEEP WIDTH SELECTOR. It is set for the same overall gain obtained in paragraph e.1.

3. 7 KC, 3.5 KC, 500 cps and 150 cps: These i-f gain controls are adjusted in a manner similar to the adjustment of the 14 KC IF Gain control.

f. Log 20 Adj. and Log Zero Adj.: These controls may require adjustment if the last i-f tube (V9, 6AU6), the detector (V10, 12AU7) or the crt (V12, 5ADP7) is replaced.

1. Set the baseline trace accurately on the calibrated line with the V POS control.

2. Set the INPUT ATTENUATOR to 20 db and AMPLITUDE SCALE to LIN. Adjust the CAL OSC LEVEL control to obtain a full scale deflection on the crt.

3. Set AMPLITUDE SCALE to LOG and the INPUT ATTENUATOR to 0 DB and adjust Log Zero Adjust until the pip reaches the 0 DB screen calibration.

4. Set the INPUT ATTENUATOR to 20 DB and adjust Log 20 Adjust until the pip reaches the dot engraved next to the 20 DB calibration of the screen.

5. Set the INPUT ATTENUATOR to 0 DB and re-adjust Log Zero Adjust if necessary.

6. Since the Log Zero Adjust and Log 20 Adjust controls interact to some extent, it may be necessary to repeat the foregoing procedure several times to obtain proper calibration of the LOG crt scale.

7. Check the intermediate points of the LOG crt calibrations using the INPUT ATTENUATOR. If the error at any point exceeds ±1 DB, it may be possible to re-adjust the log scale calibration controls so that the error remains within these limits over the entire 40 DB range. If this cannot be done, it is suggested that different tubes be tried in the V9 and V10 circuits. If this does not achieve proper calibration the screen must be re-calibrated.

NOTE

This check should be performed with the IF ATTEN switch in the 20 DB position, to reduce noise on the baseline. Set the GAIN control fully clockwise and the CAL OSC LEVEL control set for a full scale (LOG) pip when all INPUT ATTENUATORs are up. The full 40 db calibrated screen may be checked using the INPUT ATTENUATORs above.

g. .1~ Adj and 30~ Adj Sweep Rate Adjustment

1. Set the SWEEP WIDTH SELECTOR to 500 cps. Adjust .1~ Adj control until the period of the horizontal spot motion is 0.1 cps.

2. Set the SWEEP WIDTH SELECTOR to VAR and the SWEEP RATE control fully clockwise. Modulate the calibrating oscillator with a 60 cps signal and turn the SWEEP WIDTH control fully counterclockwise. Adjust CENTER FREQ control until the baseline rises and a sine wave display can be seen on the crt. Adjust the 30~ Adj control until two cycles of the sine wave appear on the screen.

3. Repeat the procedure given in paragraph g.1. above. There is some interaction between the .1~ Adj and 30~ Adj controls, and it may be necessary to repeat the entire procedure several times.

h. CF Pad

Set the CENTER FREQ control to its center position. With the SWEEP WIDTH SELECTOR at VAR, set the SWEEP RATE and IF BANDWIDTH controls fully clockwise and the SWEEP WIDTH control fully counterclockwise. Adjust the CF Pad until the baseline rises to a maximum reading (the CAL OSC LEVEL and GAIN controls should be set for an on-screen deflection near full scale).

Return SWEEP WIDTH to its maximum clockwise position. Adjust H POS to place the pip in coincide with the center frequency scale calibration.

i. Voltage Regulator Adjust

This control (located on the power supply chassis) is adjusted to give +270 volts DC at the pin jack on the rear apron of the Power Supply chassis.

V-5. TUBE REPLACEMENT AND TOUCH-UP ALIGNMENT

The Model SB-12b, has been factory aligned before shipment, and should not require re-alignment under normal conditions. However, it should be noted that the alignment has been made with the original set of tubes in operation; when tubes are replaced, touch-up alignment may become necessary because of non-uniformity in operating characteristics of vacuum tubes. Table V-1 lists the recommended adjustment procedures when the indicated tubes are replaced.

V-6. ALIGNMENT PROCEDURE

The following is a complete factory alignment procedure. It should be used only after touch-up

TABLE V-1. TOUCH-UP ALIGNMENT

TUBE	ADJUSTMENTS
V1	Selected replacement tube. Replacement should provide third order distortion of less than 60 db and direct sensitivity (at 500 KC), at least half as great as conversion sensitivity. IF Gain Controls.
V2	None
V3	CF PAD, Sweepwidth Limit Controls. See paragraphs V-4.b. and h.
V4	Z101, CF PAD, Sweepwidth Limit Control. See paragraphs V-4.b. and h. and V-6.c.
V5	None
V6	None
V7	IF Gain Controls. See paragraph V-4.e.
V8	IF Gain Controls. See paragraph V-4.e.
V9	Log 20, Log Zero Controls. See paragraph V-4.f.
V10	Log 20, Log Zero Controls. See paragraph V-4.f.
V11	None
V12	Line Size, Log Zero, Log 20 and Sweepwidth Limit Controls. See paragraph V-4.a, b and f.
V13	None
V14	None
V15	Selected replacement tube. Replacement should be selected for best linearity.
V16	None
V17	None
V18	None
V20	IF Gain Controls. See paragraph V-4.e.
V101	None
V102	None
V103	None
V104	Voltage Regulator Adjust

alignment techniques have been tried and have failed to yield satisfactory results.

a. GENERAL

1. Transformers T101, T102, Z101, Z102, Z103 and Z105 are tuned by means of movable iron cores. Windings at the top of the coil are tuned with a hollow iron core which may be turned with the pin end of the aligning tool furnished.

The bottom windings may be tuned from either the top or the bottom of the transformer. In either case the screwdriver tip of the aligning tool is used. When the bottom core is approached from the top, the tool is inserted through the hollow top core and finally engaged in a slot in the top of the lower core. Allow the Panoramic equipment and necessary signal generator to "warm-up" for at least one-half hour before alignment is attempted.

2. Set the front panel controls as follows:

IF ATTEN . . . . 0 DB
SWEEP WIDTH SELECTOR. . . . VAR
BRILLIANCE. . . . . Bright Trace
FOCUS . . . . Sharp Trace
AMPLITUDE SCALE . . . . LIN
CENTER FREQ . . . . To marker
GAIN . . . . 10 (Maximum)
AFC . . . . OFF
CAL OSC LEVEL . . . . OFF
INPUT ATTENUATORS . . . . . . All up
5 KC MARKER . . . . OFF
H POS . . . . For normal operation
V POS . . . . For normal operation
SWEEP WIDTH . . . . Maximum (clockwise)
IF BANDWIDTH . . . . Maximum (clockwise)
VIDEO FILTER. . . . . OFF
SWEEP RATE. . . . . Maximum (clockwise)

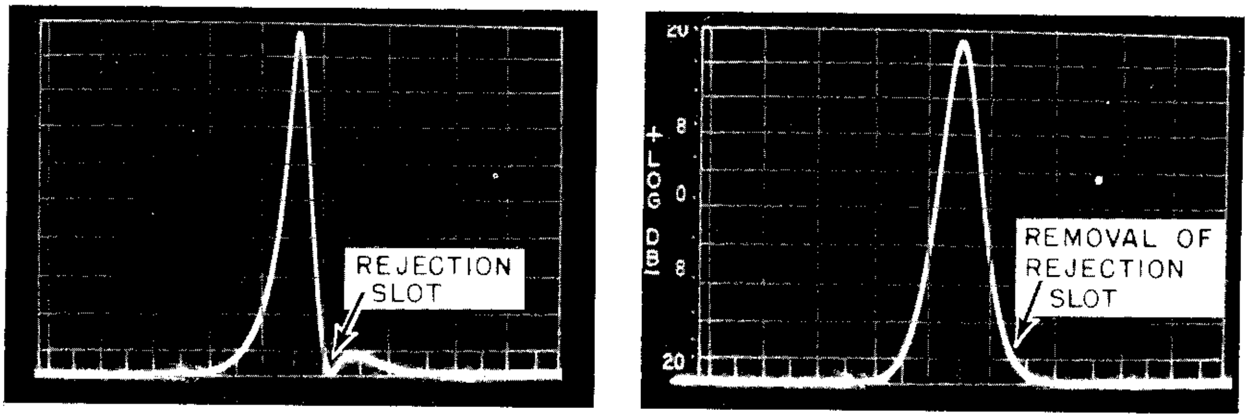
b. I-F AMPLIFIER ALIGNMENT

1. The frequencies involved in i-f alignment are:

TYPE	INPUT CENTER FREQ	IF
SB-12b	500 KC	100 KC

2. Connect a .01 mfd capacitor in series with the output of the signal generator and proceed as follows:

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
1	100 KC (40,000 uv)	Minimum	Pin #1 V9 6AU6	Tune top and bottom cores of Z105 for maximum baseline rise. When either core is tuned for maximum deflection, no further tuning is required because windings are in parallel.
2	Same as above	Same as above	Pin #7 V3 6BE6	Tune top and bottom cores of Z103 for maximum baseline rise possible with each.
3	500 KC (700 uv)	Maximum	Pin #7 V3 6BE6	Adjust the CENTER FREQ. control and, if necessary, the CF PAD control to center the pip on the screen. Gradually reduce the sweep width, at the same time continuously readjusting the CENTER FREQ control to keep the pip on the screen until the base of the pip occupies approximately 25 per cent of the frequency scale.
4	500 KC	Adjust continuously as required to keep the entire pip within screen limits.	Same as above	Mark the position of crystals in their sockets. Holder capacity varies with position; therefore, it will be important, when replacing the crystals, to preserve their orientation with respect to the socket. Remove crystals Y301 and Y302.
5	----	--------	----	A neutralizing capacitor is mounted near each crystal on the underside of the i-f



A. Illustration of Rejection Slot

B. Illustration of Complete Rejection Slot Removal

Figure V-1. Crystal Rejection Slot Removal

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
				strip. These capacitors are to be tuned with the screwdriver end of the aligning tool furnished. Each capacitor tunes the crystal nearest it.
6	----	--------	----	Set the BANDWIDTH LIMIT control to the center of its rotational range. At this point pip should approximate the shape shown in Figure V-1A or V-1B.
7	----	--------	----	Gradually rotate the trimmer screw of the capacitor nearest Y303 in a counter-clockwise direction, and note the change in pip shape. The rejection slot should sharpen and disappear on one side of the pip and approach from the other side.
8	----	--------	----	Reverse the rotation and choose a point where best pip symmetry is obtained and a rejection slot is not present. (Approximately halfway between the two positions at which the slot enters the pip from either side (see Figure V-1B).
9	----	--------	----	Tune coil L101C for a minimum height and a broadest pip. Note that as the core is moved from one end of its range to the other, the pip will broaden and decrease in amplitude until a condition of minimum height and broadest pip is reached. Continued rotation will cause the pip to sharpen and increase in amplitude. (As the pip decreases in amplitude it may be necessary to increase the amplitude of the input signal to maintain a readable deflection on the screen.)
10	----	--------	----	Check for correct rejection slot removal by adjusting sweep width until pip base occupies approximately 25 per cent of the screen baseline. Set the input amplitude for a full-scale deflection. Increase input amplitude by ten times. Set AMPLITUDE SCALE selector to LOG. If the pip is not full-scale, set the LOG SCALE ADJ control for a full-scale pip. Pip should remain approximately symmetrical and no rejection slot should appear. If it does appear, readjust trimmer slightly to remove it and retune as in step 9. Reduce the input amplitude 10 times and set the AMPLITUDE SCALE selector to LIN.
11	----	--------	----	Remove crystal Y303.
12	----	--------	----	Insert crystal Y302 in its socket. Repeat the procedure given in steps 5 through 10 using the capacitor nearest crystal Y302 and coil L101B.

Step	Sig. Gen. Output	Sweep Width Control at	Signal Fed to	Procedure
13	----	--------	----	Remove crystal Y302.
14	----	--------	----	Insert crystal Y301 in its socket. Repeat the procedure given in steps 5 through 10 using the capacitor nearest crystal Y301 and coil L101A.
15	----	--------	----	Replace crystals Y302 and Y303 in the same orientation they have prior to removal. Repeat step 10 with all crystals installed but omit reference to step 9. If trimmer adjustment is required, make small gradual changes in the trimmer settings. If there is no change when adjusting one of the trimmers, restore it to its original setting and adjust one of the other trimmers.
16	----	--------	----	Adjust BANDWIDTH LIMIT control for the broadest (without double peak) symmetrical peak possible without more than a 20 per cent drop in amplitude as the SWEEP WIDTH control is changed from a maximum counterclockwise position to a maximum clockwise position.

c. F-M OSCILLATOR ALIGNMENT

The following adjustments are a series of approximations, which are narrowed down until the desired results are obtained.

1. Set the Sweepwidth Limit control fully clockwise.

2. Adjust the CF PAD for +85 volts, measured between the arm of the CF PAD and ground.

3. Set the front panel CAL OSC LEVEL control fully clockwise.

4. Adjust the GAIN control for a full scale pip.

5. Connect an accurate 50 KC signal source to the front panel EXT MOD connector. Adjust the output amplitude for usable sidebands (approximately 1/4 scale).

6. Adjust the core of Z101 to center the oscillator (center) pip on the screen.

7. Adjust the Sweepwidth Limit control to place the ±50 KC sideband pips directly under the ±50 vertical screen calibrations. If necessary make slight centering re-adjustments with the CF PAD.

8. Check linearity by noting the location of the center pip relative to the vertical CF screen calibration. Linearity is within specifications if, with the ±50 KC pips directly under the ±50 vertical screen calibrations, the center pip is within ± 1/4 of a division of the CF screen calibration.

9. If linearity is not within specifications, rotate the CF PAD slightly in a clockwise direction and re-center the display with Z101. Recheck linearity as in steps 7 and 8.

10. Repeat steps 7, 8 and 9 until the sweep width and linearity are correct.

d. R-F ALIGNMENT

The r-f transformers used in this equipment have sliders. This makes it possible to adjust the spacing between the primary and secondary so as to obtain the proper frequency separation between the peak frequencies. If the frequency separation is correct, then it is only necessary to trim the cores of two r-f transformers until the desired flatness is obtained. If the frequency separation is not correct, the full alignment procedure must be used. The sliders have been waxed down to prevent movement. If it is necessary to change the position of the sliders, the waxing must be removed. Upon completion of the alignment procedure, re-wax the coils to prevent movement.

This alignment requires a "cut and try" procedure. The frequency response of the section is determined by feeding in constant amplitude signals at various frequencies over the r-f band of the equipment.

1. Adjustment of Neutralizing Capacitor C107.

(a) Temporarily clip a 51,000 ohm, 1/2 watt resistor between the junction of R109 and R107 and B+.

(b) Set the GAIN control almost completely counterclockwise (at the first scale division from the counterclockwise end).

(c) Connect a 500 KC signal source to the front panel SIGNAL INPUT connector. Adjust the amplitude of the input signal to give an approximately 1/4 scale pip. If necessary, adjust the GAIN control slightly to give the required pip height.

(d) Adjust C107 for a minimum pip deflection.

(e) Remove the 51,000 ohm resistor.

2. Alignment of Interstage Transformer T102

(a) Make the spacing between the primary and secondary winding approximately 1/4 inch.

(b) Using a .01 mfd coupling capacitor, feed a 500 KC signal to pin #6 of V2. Tune the secondary (bottom core) of T102 for a peak deflection at the center of the screen.

(c) Apply a 515 KC signal to pin #2 of V2. Tune the primary (top core) for a peak deflection.

(d) Shift the signal generator frequency to 485 KC. Tune the secondary (bottom core) of T102 for a peak deflection.

(e) Vary the signal generator frequency between the high and low frequency peaks as read on the screen of the equipment. The peaks should appear at approximately 515 KC and at 485 KC.

If the frequency separation is greater than specified, increase the coil spacing.

If the frequency separation is less than specified, decrease the coil spacing.

(f) Repeat steps (c), (d) and (e) until peak deflections and the proper frequency separation are obtained.

3. Alignment of Input Transformer T101

(a) Make the spacing between the primary and secondary windings approximately 1/16".

(b) Connect the signal generator to pin #5 of V1 and set the frequency to 500 KC. Tune the secondary (bottom core) of T101 for a peak deflection at the center of the screen.

(c) Apply a 550 KC signal to the SIGNAL INPUT connector through the input cable. Tune the primary (top core) of T101 for maximum pip amplitude.

(d) Set the signal generator to 450 KC. Tune the secondary (bottom core) of T101 for maximum pip amplitude.

(e) Vary the signal generator frequency between 450 KC and 550 KC noting the frequency separation between the high and low frequency peaks as read on the screen. The peaks should appear at 450 KC and at 550 KC.

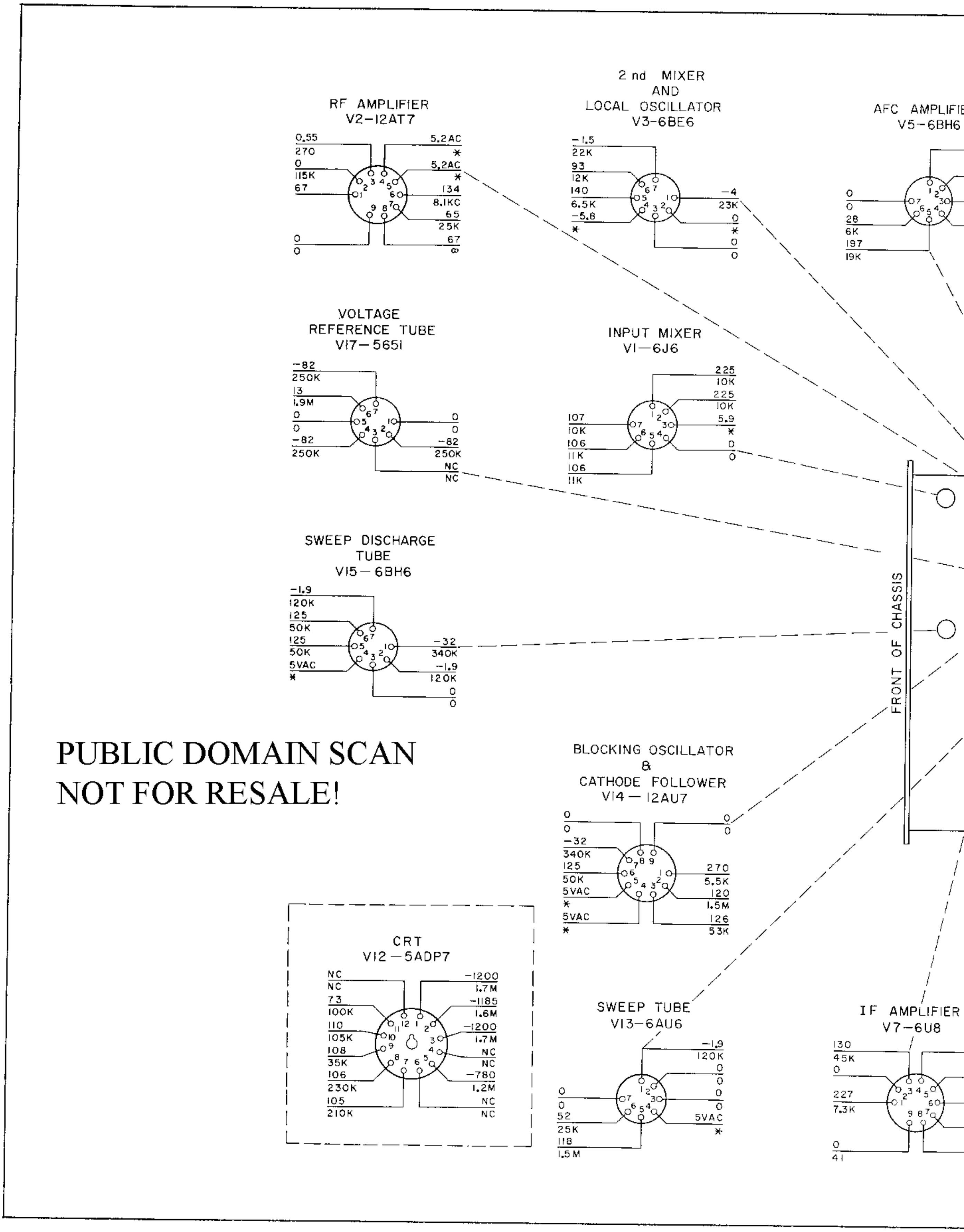
If the frequency separation is greater than specified, increase the coil spacing.

If the frequency separation is less than specified, decrease the coil spacing.

(f) Repeat steps (c), (d) and (e) until peak deflections and the proper frequency separation are obtained.

4. Adjust the cores of r-f transformer T102 for proper flatness as follows:

Step	Sig. Gen. Output	Signal Fed to	Transformer Tuned	Procedure
(1)	450 KC then 550 KC	SIGNAL INPUT Connector	T102	If the 450 KC pip is taller than the 550 KC pip, adjust for equal amplitude by trimming the bottom core clockwise and the top core counterclockwise.


RF AMPLIFIER
V2-12AT7
2 nd MIXER
AND
LOCAL OSCILLATOR
V3-6BE6
AFC AMPLIFIE
V5-6BH6
VOLTAGE
REFERENCE TUBE
V17-5651
INPUT MIXER
V1-6J6
SWEEP DISCHARGE
TUBE
V15-6BH6
FRONT OF CHASSIS
BLOCKING OSCILLATOR
&
CATHODE FOLLOWER
V14-12AU7
CRT
V12-5ADP7
SWEEP TUBE
V13-6AU6
IF AMPLIFIER
V7-6U8

VOLTAGE MEASUREMENTS, TRANSISTOR OSCILLATORS.
CAUTION: RESISTANCE MEASUREMENTS ARE NOT RECOMMENDED DUE TO POSSIBLE DAMAGE TO TRANSISTORS.

RF TEST OSCILLATOR

	Q1		Q2
e	+24.0	e	+24.0
b	+23.5	b	+23.5
c	+7.8	c	+7.8

CALIBRATING OSCILLATOR

	Q3		Q4
e	+4.7	e	+4.3
b	+6.7	b	+4.7
c	+0.05	c	+0.0

5KC MARKER OSCILLATOR

	Q5		Q6
e	+15.8	e	+28.2
b	+15.0	b	+27.8
c	+0.95	c	+15.8

NOTE:
VALUES FOR TRANSISTOR VOLTAGES ARE TYPICAL. VARIATIONS BY A FACTOR OF 2 OR MORE IN EITHER DIRECTION MAY BE FOUND.

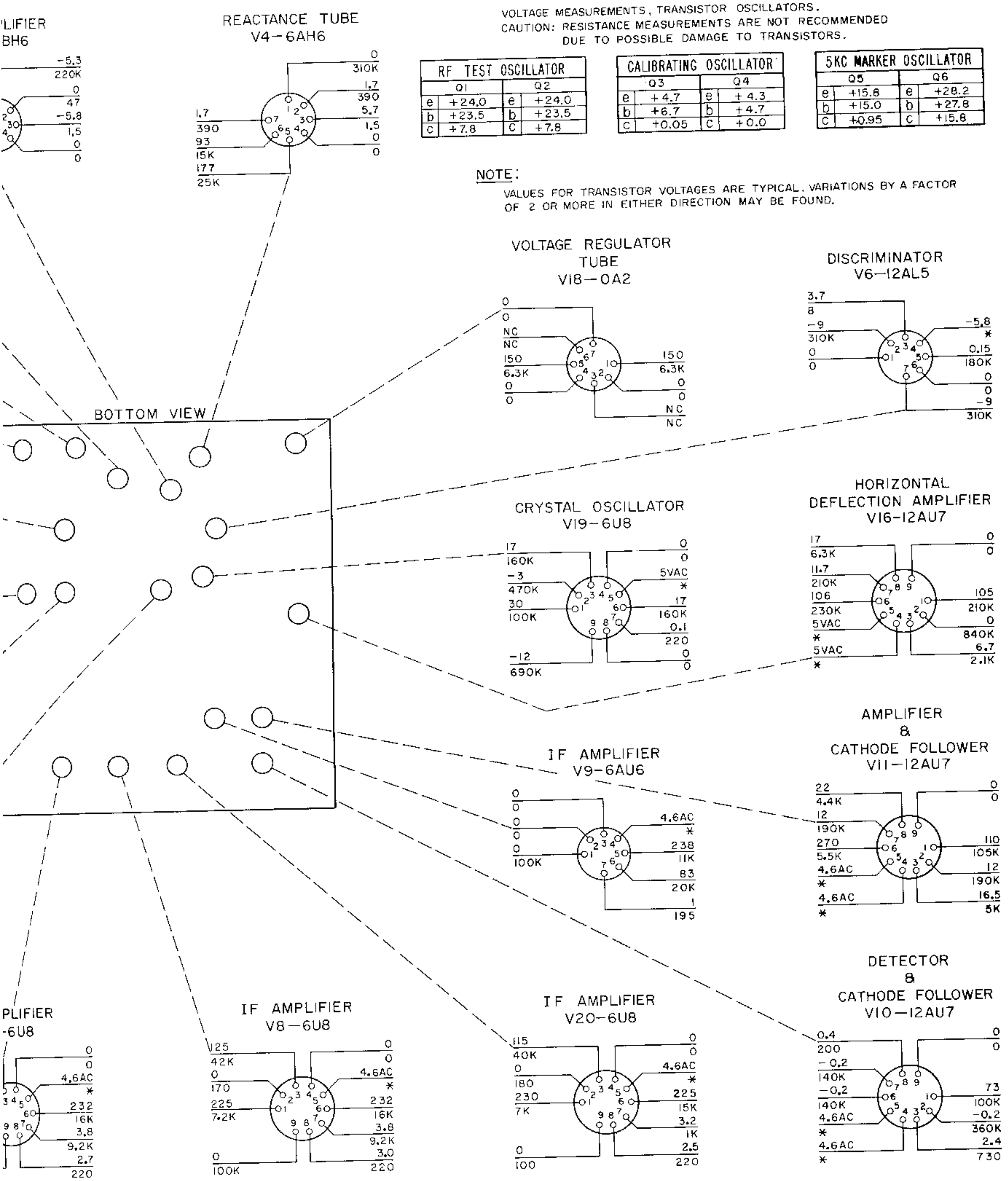


Figure V-2. Voltage and Resistance Chart, Model SB-1

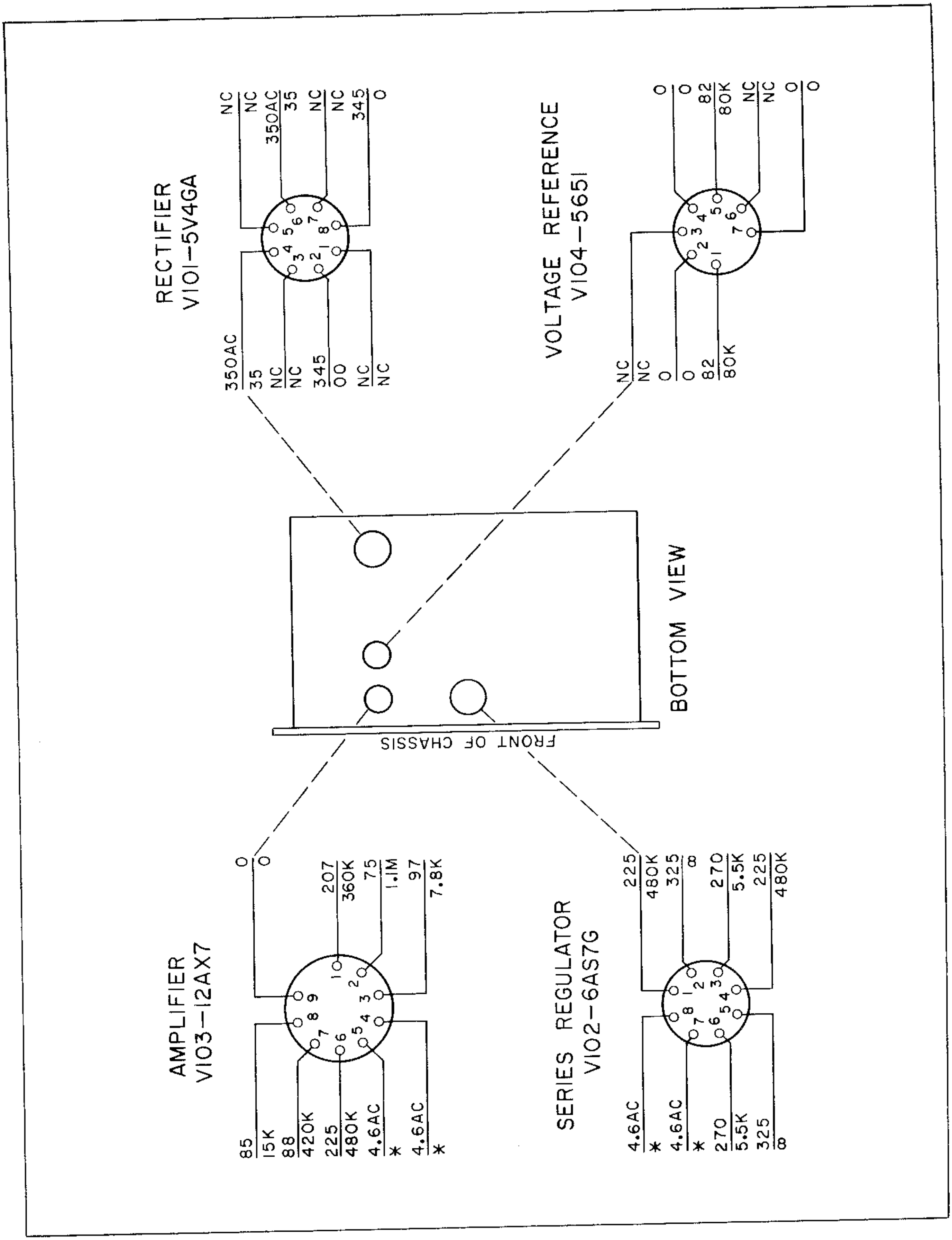


Figure V-3. Voltage and Resistance Chart, Model PS-12.

Step	Sig. Gen. Output	Signal Fed to	Transformer Tuned	Procedure
				On the other hand if the 550 KC pip is the taller of the two, trim the bottom core counterclockwise and the top core clockwise.
(2)	450 KC 500 KC 550 KC	SIGNAL INPUT Connector	T102	If the 450 KC and 550 KC pips are taller than the 500 KC pip, trim the top and bottom cores clockwise. If they are lower, trim both cores counterclockwise.
(3)	------	------	---	Repeat (1) and (2) until response flatness is within ±5%.

e. Discriminator Alignment

1. Before adjusting the discriminator, the CF PAD must be adjusted according to the procedure given in paragraph V-4h.

2. Center the pip on the screen with the SWEEP WIDTH SELECTOR in the 3.5 KC position. Switch it to the 500~ position. The pip should appear near the center of the screen. If it does, switch to the 150~ position and repeat the check. If the pip is off-screen or cannot be centered on one or more of these ranges it will be necessary to adjust the DISC ZERO located on top of Z102, using the insulated tool supplied with the Panalyzor.

(a) Starting on the narrowest sweep range for which a pip can be seen, carefully adjust DISC ZERO to center the pip. This procedure may be expedited by using the FAST sweep, but the final check must be done at a 0.1 cps sweep rate.

(b) Following this adjustment, proceed to the next narrower sweep width and repeat. The final adjustment should be on the 150 ~ sweep width. When this has been adjusted, the pip will be approximately centered on all sweep ranges.

NOTE

The DISC ZERO adjustment is very critical, particularly on the narrowest sweep width. It will usually be necessary to move the adjustment through the correct point several times before the final setting is obtained.

V-7. VOLTAGE AND RESISTANCE MEASUREMENTS

The voltage and resistance measurements shown in Figures V-2 and V-3 should be used as an aid in locating and isolating causes of equipment malfunction.

All measurements were made with an RCA Vacuum Tube Voltmeter, Model WV-77B. The voltage and resistance readings on the charts are taken between the tube socket pin indicated and chassis ground. Resistance measurements were made with the power connecting cable and line cord disconnected and the ILLUMINATION control in the on position.

All measurements were made with the front panel controls in the following positions.

IF ATTEN . . . . 0 DB
SWEEP WIDTH SELECTOR . . . . VAR
BRILLIANCE . . . . Bright Trace
FOCUS . . . . Sharp Trace
AMPLITUDE SCALE . . . . . . LIN
CENTER FREQ . . . . Marker
AFC . . . . OFF
GAIN . . . . 10 (MAX)
CAL OSC LEVEL . . . . OFF
5 KC MARKER . . . . OFF
INPUT ATTENUATORS. . . . . All up
H POS . . . . Normal Operation
V POS . . . . Normal Operation
SWEEP WIDTH . . . . Maximum (clockwise)
IF BANDWIDTH . . . . Maximum (clockwise)
VIDEO FILTER . . . . OFF
SWEEP RATE . . . . Maximum (clockwise)

Notes:
1. Voltage readings above line, resistance readings below line.
2. All voltages are DC unless otherwise specified.
3. All resistances are in ohms.
4. *indicates a very low resistance.
5. NC indicates on connection.

6. Q3 and Q4 measurements made with CAL OSC LEVEL control fully clockwise.
7. Q5 and Q6 measurements made with 5 KC MARKER ON.

V-8. LIST OF REPLACEABLE PARTS

NOTES:

a. In the case where an item appears more than once, the total quantity per section is listed only once in the "number in set" column. It is listed the first time the item appears in each section.

b. A list of the Manufacturers Code Letters used in this list is given on page 101.

c. In some cases values and ratings and source (manufacturer) shown are nominal and variations may be found. Satisfactory replacement may be made with either the listed component or an exact replacement for the part removed from the equipment.

When ordering parts from the factory, always include the following information:

1. Instrument Model Number.
2. Serial Number.
3. Circuit Reference Symbol.
4. Description of Part.

List of Replaceable Parts for Models SB-12b and PS-12.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C101		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0	14	
C102		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z	12	
C103		CAPACITOR: fixed, mylar, .1 uf, 200 V Pan Part CT2125-5	AL 338C104M	3	
C104		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C105		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C106		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C107		CAPACITOR: variable, piston type trimmer, .6 uuf to 6 uuf, 1000 V Pan Part CV2051	AO VC-5	1	
C108		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C109		CAPACITOR: fixed, tubular, .1 uf, 400 V Pan Part CT2011-10	AT 330401	2	

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C201 A,B,C		CAPACITOR: fixed, paper channel type, 3 x .1 uf, +20%, -10%, 600 V Pan Part CP69B5EF104V-5	AL Type 7710-BRN CP69B5EF104V	1	
C202		CAPACITOR: fixed, silvered mica, 51 uuf, ±5% Pan Part CM15C510J	AH CM15C510J	2	
C203		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C204		CAPACITOR: fixed, silvered mica, 5100 uuf, ±5% Pan Part CM35C512J	AH CM35C512J	1	
C205		CAPACITOR: fixed, silvered mica, 270 uuf, ±5% Pan Part CM15C271J	AH CM15C271J	2	
C206		CAPACITOR: fixed, electrolytic, twistlock, 2000 uf, 15 V Pan Part CE31X202E-1	AU Type DFP	1	
C207		CAPACITOR: fixed, paper, metal case, .47 uf, ±10%, 300 V Pan Part CT2060-1	AU 86P47493T15	4	
C301 A,B,C		CAPACITOR: fixed, paper, bathtub, 3 x .1 uf, ±20%, 600 V Pan Part CP54B5FF104M-10	AT CP54B5FF104M	2	
C302		CAPACITOR: fixed, silvered mica, 100 uuf, ±5% Pan Part CM20C101J	AH CM20C101J	3	
C303		CAPACITOR: variable, ceramic trimmer, 3-12 uuf, NPO, 500 V Pan Part CV2111-13	AJ 557-3	3	
C304		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C305		CAPACITOR: fixed, paper, metal case, .47 uf, ±10%, 300 V Pan Part CT2060-1	AU 86P47493T15		
C306		CAPACITOR: variable, ceramic trimmer, 3-12 uuf, NPO, 500 V Pan Part CV2111-13	AJ 557-3		
C307		CAPACITOR: fixed, paper, metal case, .47 uf, ±10%, 300 V Pan Part CT2060-1	AU 86P47493T15		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C308		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C309		CAPACITOR: fixed, silver mica, 100 uuf, ±5% Pan Part CM15C101J	AH CM15C101J	2	
C310		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C311		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM20C471J	AH CM20C471J	1	
C312		CAPACITOR: fixed, silver mica, 270 uuf, ±5% Pan Part CM15C271J	AH CM15C271J		
C313		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C314		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C315		CAPACITOR: variable, ceramic trimmer, 3-12 uuf, NPO, 500 V Pan Part CV2111-13	AJ 557-3		
C316		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C317		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C318		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C319		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C320		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C321		CAPACITOR: fixed, silver mica, 100 uuf, ±5% Pan Part CM20C101J	AH CM20C101J		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C322		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC-2003-2	BA CD16XD-103Z		
C324		CAPACITOR: fixed, silver mica, 100 uuf, ±5% Pan Part CM20C101J	AH CM20C101J		
C325		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C326		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C327		CAPACITOR: fixed, ceramic disc, .05 uf, +80%, -20%, 500 V Pan Part CC2123-13	AJ 827200Z5V0		
C328		CAPACITOR: fixed, paper, metal case, .47 uf, ±10%, 300 V Pan Part CT2060-1	AU 86P47493T15		
C401		CAPACITOR: fixed, paper, metal case, .047 uf, ±10%, 400 V Pan Part CT2077-1	AU 81P47394S1	1	
C402		CAPACITOR: fixed, paper, threaded neck mounting, 4 uf, 600 V Pan Part CP41B1FF405K-10	AT CP41B1FF405K	1	
C403		CAPACITOR: fixed, silver mica, 51 uuf, ±5% Pan Part CM15C510J	AH CM15C510J		
C405		CAPACITOR: fixed, metallized paper, .47 uf, 200 V Pan Part CT2131-3	BI P123ZNP	1	
C407 A,B,C		CAPACITOR: fixed, paper, bath-tub, 3 x .1 uf, ±20%, 600 V Pan Part CP54B5FF104M-10	AT CP54B5FF104M		
C501		CAPACITOR: fixed, silver mica, 100 uuf, ±5% Pan Part CM15C101J	AH CM15-C101J		
C502		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC-2003-2	BA CD16XD-103Z		
C503		CAPACITOR: fixed, mylar .1 uf, 200 V Pan Part CT2125-5	AL 338C104M		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C505		CAPACITOR: fixed, silver mica, 1000 uuf, ±5% Pan Part CM20C102J	AH CM20-C102J	1	
C506		CAPACITOR: fixed, silver mica, 10 uuf, ±5% Pan Part CM20C100J	AH CM20C100J	1	
C510 A,B C,D		CAPACITOR: fixed, electrolytic, twistlock, 4x20 uf, 350 V Pan Part CE34X200P-1	AU Type DFP	1	
C601		CAPACITOR: fixed, electrolytic, twistlock, 20 uf, 500 V Pan Part CE31X200S-1	AU TVL-1943	1	
C602		CAPACITOR: fixed, electrolytic, twistlock, 30 uf, 500 V Pan Part CE31X300S-1	AU Type DFP	1	
C603 A,B		CAPACITOR: fixed, paper, rectangular, 2 x .25 uf, 2000 V Pan Part CP70D6XK254X-10	AT 7125-2x.25	2	
C604		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC2003-2	BA CD16XD-103Z		
C605		CAPACITOR: fixed, plastic molded, .1 uf, 400 V Pan Part CT-2011-10	AT 300401		
C606 A,B		CAPACITOR: fixed, paper, rectangular, 2 x .25 uf, 2000 V Pan Part CP70D6XK254X-10	AT 7125-2 x.25		
C607		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC-2003-2	BA CD16XD-103Z		
C608		CAPACITOR: fixed, ceramic disc, .01 uf, 500 V Pan Part CC-2003-2	BA CD16XD-103Z		
C701		CAPACITOR: fixed, silver mica, 560 uuf, ±5% Pan Part CM15C561J	AH CM15C561J	1	
C702		CAPACITOR: fixed, silver mica, 910 uuf, ±5% Pan Part CM20C911J	AH CM20C911J		
C703		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500-600 V Pan Part CC-2055-1	AU 5GA-S2	2	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
C704		CAPACITOR: fixed, silver mica, 470 uuf, ±5% Pan Part CM15C471J	AH CM15C471J	1	
C706		CAPACITOR: fixed, ceramic disc, .02 uf, ±20%, 500 V Pan Part CC2055-1	AU 5GA-2		
C707		CAPACITOR: fixed, tubular, .1 uf, 400 V Pan Part CT2011-10	AT 330401	2	
C801		CAPACITOR: fixed, mica, 6,800 uuf, ±5% Pan Part CM35-682J	AH CM35-682J	1	
C803		CAPACITOR: fixed, mica, 10,000 uuf, ±5% Pan Part CM35-103J	AH CM35-103J	2	
C805		CAPACITOR: fixed, mica, 10,000 uuf, ±5% Pan Part CM35-103J	AH CM35-103J		
C807		CAPACITOR: fixed, electrolytic, 10 uf, 12 VDC Pan Part CE71X100D-1	AU TE-1128	2	
C809		CAPACITOR: fixed, electrolytic, 10 uf, 12 VDC Pan Part CE71X100D-1	AU TE-1128		
C811		CAPACITOR: fixed, mylar, .1 uf, 200 V Pan Part CT 2125-5	AL 338C104M		
C813		CAPACITOR: fixed, silver mica, 820 uuf, ±5% Pan Part CM20C821J	AH CM20C821J	1	
CR1		RECTIFIER: selenium, full wave, bridge type, 1.5 amp Pan Part CR2021	AS C11S1B1S1G	1	
CR601		RECTIFIER: selenium, half wave, cartridge type, 2000 V 5 ma Pan Part CR-2005	AM V100HF	2	
CR602		RECTIFIER: selenium, half wave, cartridge type, 2000 V 5 ma Pan Part CR-2005	AM V100HF		
F601		FUSE: instantaneous, glass cartridge, 2 amp, 250 V Pan Part F-1003	AD AGC2	2	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
F602		FUSE: instantaneous, glass cartridge, 2 amp, 250 V Pan Part F1003	AD AGC2		
I1		LAMP: miniature, T1-3/4, flanged, base, 6.3 V Pan Part B2106	BD 349	5	
I2		LAMP: miniature, T1-3/4, flanged, base Pan Part B2106	BD 349		
I3		LAMP: miniature, T1-3/4, flanged, base Pan Part B2106	BD 349		
I4		LAMP: miniature, T1-3/4, flanged, base Pan Part B2106	BD 349		
I5		LAMP: miniature, T1-3/4, flanged, base Pan Part B2106	BD 349		
J101		RECEPTACLE: N type, MIL type UG-58/U Pan Part J1061	AB 82-24	2	
J102		RECEPTACLE: N type, MIL type UG-58/U Pan Part J1061	AB 82-24		
J103		RECEPTACLE: bulkhead, BNC type, MIL type UG909A/U Pan Part J2037	AB 31-206	2	
J104		RECEPTACLE: bulkhead, BNC type, MIL type UG909A/U Pan Part J2037	AB 31-206		
J201		JACK: tip, black Pan Part J2001	BG 407	2	
J401		RECEPTACLE: bulkhead, BNC type, MIL type UG1094/U Pan Part J2031	AB 31-221	3	
J402		RECEPTACLE: 10 contact, female, solid shell, box mounting Pan Part J2023	AB MS3102A-18-1S	1	
J501		RECEPTACLE: 14 contact, male solid shell, box mounting Pan Part P2006	AB MS3102A-28-2P	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
J502		RECEPTACLE: bulkhead, BNC type, MIL type UG1094/U Pan Part J2031	AB 31-221		
J601		RECEPTACLE: 14 contact, female, solid shell, box mounting Pan Part J2008	AB MS3102A-28-2S	1	
J602		JACK: tip, black Pan Part J2001	BG 407		
J603		RECEPTACLE: electrical, 3 wire, a-c power, flush mount, male, twistlock, polarized Pan Part J1002	BH 7486	1	
J701		RECEPTACLE: bulkhead, BNC type, MIL type UG-1094/U Pan Part J2031	AB 31-221		
L101A		COIL: crystal, loading, 100 KC Pan Part ZN-8223	AR ZN8223	3	
L101B		COIL: crystal, loading, 100 KC Pan Part ZN-8223	AR ZN8223		
L101C		COIL: crystal, loading, 100 KC Pan Part ZN-8223	AR ZN8223		
L201		CHOKE: insulated, .68 microhenry, ±10% Pan Part L2016	AN Type CLA	1	
L301		CHOKE: RF, 2.5 millihenry Pan Part L2019	AQ 6302	1	
L601		FILTER: reactor, 8 HY, 110 ma Pan Part L2-10789	AR L2-10789	1	
L701		CHOKE: r-f, fixed, 100 uh Pan Part L1112	BF CH-3-3	1	
L702		CHOKE: r-f, fixed, 4.7 uf, ±10% Pan Part L2043	BC 213-11	1	
P402		PLUG: 10 contact, male, straight solid shell Pan Part P2036	AD MS3106A-18-1P	1	
Q3		TRANSISTOR: 2N404 Pan Part Q2N404-2	BE 2N404	4	
Q4		TRANSISTOR: 2N404 Pan Part Q2N404-2	BE 2N404		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
Q5		TRANSISTOR: 2N404 Pan Part Q2N404-2	BE 2N404		
Q6		TRANSISTOR: 2N404 Pan Part Q2N404-2	BE 2N404		
R101		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W Pan Part RC20BX510J	AA EB5105	2	
R102		RESISTOR: fixed, composition, 51 ohms, ±5%, 1/2 W Pan Part RC20BX510J	AA EB5105		
R103		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015	3	
R104		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 2 W Pan Part RC42BX103J	AA HB1035	4	
R105		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025	6	
R106		RESISTOR: fixed, composition, 4,300 ohms, ±5%, 1 W Pan Part RC32BX423J	AA GB4325	1	
R107		RESISTOR: fixed, composition, 270 ohms, ±5%, 1/2 W Pan Part RC20BX271J	AA EB2715	1	
R108		RESISTOR: variable, composition, 3,000 ohms, ±10%, 2 W linear Pan Part RV011	AA JU-3021	1	
R109		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735	5	
R110		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735		
R111		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225	4	
R112		RESISTOR: fixed, composition, 30,000 ohms, ±5%, 1/2 W Pan Part RC20BX303J	AA EB3035	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R113		RESISTOR: fixed, composition, 5,100 ohms, ±5%, 1/2 W Pan Part RC20BX512J	AA EB5125	2	
R114		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R115		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135	4	
R116		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R201		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W Pan Part RC32BX153J	AA GB1535	2	
R202		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R203		RESISTOR: variable, composition, 50,000 ohms, ±10%, 2 W linear Pan Part RV014	AA JU-5031	4	
R204		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R205		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1/2 W Pan Part RC20BX154J	AA EB1545	1	
R206		RESISTOR: composition, variable, 50 ohms, ±10%, linear, concentric with R207 Pan Part RVC602	AR RVC602	1	
R207		RESISTOR: composition, variable, 500 ohms, ±10%, linear, concentric with R206 Pan Part (See: R206)	AR RVC602		
R208		RESISTOR: fixed, composition, 160 ohms, ±5%, 1/2 W Pan Part RC20BX161J	AA EB1615	1	
R210		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245	8	

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R211		RESISTOR: fixed, composition, 39,000 ohms, ±5%, 1/2 W Pan Part RC20BX393J	AA EB3935	1	
R212		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R213		RESISTOR: fixed, composition, 47 ohms, ±5%, 1/2 W Pan Part RC20BX470J	AA EB4705	2	
R214		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1 W Pan Part RC32BX513J	AA GB5135	3	
R215		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1 W Pan Part RC32BX513J	AA GB5135		
R216		RESISTOR: variable, composition, 25,000 ohms, ±10%, 2 W linear Pan Part RV026	AA JU-2531	1	
R217		RESISTOR: fixed, composition, 62,000 ohms, ±5%, 1/2 W Pan Part RC20BX623J	AA EB6235	2	
R219		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1 W Pan Part RC32BX514J	AA GB5145	3	
R220		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1 W Pan Part RC32BX514J	AA GB5145		
R221		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R222		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1/2 W Pan Part RC20BX514J	AA EB5145	2	
R226		RESISTOR: fixed, composition, 5,100 ohms, ±5%, 1/2 W Pan Part RC20BX512J	AA EB5125		
R227		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1/2 W Pan Part RC20BX153J	AA EB1535	2	
R228		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215	4	

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R301		RESISTOR: fixed, composition, 6,200 ohms, ±5%, 1/2 W Pan Part RC20BX622J	AA EB6225	1	
R302		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215		
R303		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W Pan Part RC20BX431J	AA EB4315	3	
R304		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 2W Pan Part RC42BX103J	AA HB1035		
R305 R309		RESISTOR: variable, composition, dual 2 megohms, ±20%, 2 W cw taper (front section) 2 megohms, ±20%, 2 W cw taper (rear section) Pan Part RVT507	AA JJA-2052	1	
R306		RESISTOR: fixed, composition, 2 megohms, ±5%, 1/2 W Pan Part RC20BX205J	AA EB2055	3	
R307		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W Pan Part RC20BX431J	AA EB4315		
R308		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215		
R310		RESISTOR: variable, composition, 5 megohms, ±20%, 2 W linear Pan Part RV003	AA JU-5052	3	
R311		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W Pan Part RC20BX151J	AA EB1515	2	
R312		RESISTOR: variable, composition, 5,000 ohms, ±10%, 2 W linear Pan Part RV012	AA JU-5021	1	
R313		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045	7	
R314		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AA GB7535	5	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R316		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045	6	
R317		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R318		RESISTOR: fixed, composition, 100 ohms, ±5%, 1/2 W Pan Part RC20BX101J	AA EB1015		
R319		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1 W Pan Part RC32BX333J	AA GB3335	1	
R320		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1 W Pan Part RC32BX153J	AA GB1535		
R321		RESISTOR: variable, composition, 50,000 ohms, ±10%, 2 W, linear Pan Part RV014	AA JU-5031		
R322		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735		
R323		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1 W Pan Part RC32BX562J	AA GB5625	1	
R324		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1/2 W Pan Part RC20BX683J	AA EB6835	2	
R325		RESISTOR: variable, composition, 100,000 ohms, ±10%, 2 W linear Pan Part RV025	AA JU-1041	3	
R326		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1 W Pan Part RC32BX102J	AA GB1025	3	
R327		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035	7	
R328		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AA GB7535		
R329		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R330		RESISTOR: fixed, composition, 150 ohms, ±5%, 1/2 W Pan Part RC20BX151J	AA EB1515		
R331		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 2 W Pan Part RC42BX103J	AA HB1035		
R332		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R333		RESISTOR: fixed, composition, 910 ohms, ±5%, 1/2 W Pan Part RC20BX911J	AA EB9115	2	
R334		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 1/2 W Pan Part RC20BX682J	AA EB6825	6	
R335		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035		
R336		RESISTOR: fixed, composition, 910 ohms, ±5%, 1/2 W Pan Part RC20BX911J	AA EB9115		
R337		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 1/2 W Pan Part RC20BX682J	AA EB6825		
R338		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035		
R339		RESISTOR: variable, composition, 5,000 ohms, ±10%, 1/2 W linear Pan Part RVA-M-1005	AA RV6LAYSA502A	5	
R340		RESISTOR: variable, composition, 5,000 ohms, ±10%, 1/2 W, linear Pan Part RVA-M-1005	AA RV6LAYSA502A		
R341		RESISTOR: variable, composition, 5,000 ohms, ±10%, 1/2 W linear Pan Part RVA-M-1005	AA RV6LAYSA502A		
R342		RESISTOR: variable, composition, 5,000 ohms, ±10%, 1/2 W linear Pan Part RVA-M-1005	AA RV6LAYSA502A		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R343		RESISTOR: fixed, composition, 62,000 ohms,* ±5%, 1/2 W Pan Part RC20BX623J	AA EB6235		
R344		RESISTOR: fixed, composition, 8,200 ohms, ±5%, 1/2 W Pan Part RC20BX822J	AA EB8225	1	
R346		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 1/2 W Pan Part RC20BX243J	AA EB2435	2	
R347		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135		
R349		RESISTOR: fixed, composition, 24,000 ohms, ±5%, 1/2 W Pan Part RC20BX243J	AA EB2435		
R350		RESISTOR: variable, composition, 5,000 ohms, ±10%, 1/2 W, linear Pan Part RVA-M-1005	AA RV6LAYSA502A		
R351		RESISTOR: fixed, composition, 22,000 ohms, ±5%, 1/2 W Pan Part RC20BX223J	AA EB2235	2	
R352		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1/2 W Pan Part RC20BX473J	AA EB4735	2	
R353		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1 W Pan Part RC32BX102J	AA GB1025		
R354		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035		
R355		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1 W Pan Part RC32BX102J	AA GB1025		
R356		RESISTOR: fixed, composition, 430 ohms, ±5%, 1/2 W Pan Part RC20BX431J	AA EB4315		
R357		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		

* Selected at final assembly
See Schematic Diagram for actual value.

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R358		RESISTOR: fixed, composition, 220 ohms, ±5%, 1/2 W Pan Part RC20BX221J	AA EB2215		
R359		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035		
R360		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		
R361		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R362		RESISTOR: fixed, composition, 200 ohms, ±5%, 1/2 W Pan Part RC20BX201J	AA EB2015	2	
R363		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R364		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625	2	
R365		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 1/2 W Pan Part RC20BX682J	AA EB6825		
R366		Not Used			
R367		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 2 W Pan Part RC42BX103J	AA HB1035		
R368		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AA GB7535		
R369		RESISTOR: fixed, composition, 390,000 ohms, ±5%, 1/2 W Pan Part RC20BX394J	AA EB3945	1	
R401		RESISTOR: fixed, composition, 120,000 ohms, ±5%, 1 W Pan Part RC32BX124J	AA GB1245	1	
R402		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1/2 W Pan Part RC20BX333J	AA EB3335	3	
R403		RESISTOR: fixed, composition, 1.5 megohms, ±5%, 1/2 W Pan Part RC20BX155J	AA EB1555	1	

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R404 R407		RESISTOR: variable, composition, dual 50,000 ohms, ±10%, 2 W linear (front section) 5 megohms, ±20%, 2 W linear (rear section) Pan Part RVT506	AA JJU-5031/5052	1	
R405		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1/2 W Pan Part RC20BX473J	AA EB4735		
R406		RESISTOR: variable, composition, 100,000 ohms, ±10%, 2 W, linear Pan Part RV025	AA JU-1041		
R408		RESISTOR: fixed, composition, 200,000 ohms, ±5%, 1/2 W Pan Part RC20BX204J	AA EB2045	1	
R409		RESISTOR: variable, composition, 100,000 ohms, ±10%, 2 W, linear Pan Part RV025	AA JU-1041		
R416		RESISTOR: fixed, composition, 750,000 ohms, ±5%, 1/2 W Pan Part RC20BX754J	AA EB7545	1	
R417		RESISTOR: fixed, composition, 56,000 ohms, ±5%, 2 W Pan Part RC42BX563J	AA GB5635	1	
R418		RESISTOR: fixed, composition, 240,000 ohms, ±5%, 1/2 W Pan Part RC20BX244J	AA EB2445	1	
R421		RESISTOR: variable, composition, 5 megohms, ±20%, 2 W, linear Pan Part RV003	AA JU-5052		
R422		RESISTOR: fixed, composition, 5.6 megohms, ±5%, 1/2 W Pan Part RC20BX565J	AA EB5655	1	
R423		RESISTOR: variable, composition, 5 megohms, ±20%, 2 W, linear Pan Part RV003	AA JU-5052		
R424 R218		RESISTOR: variable, composition, dual 1 megohm, ±20%, 2 W linear (front section) 10,000 ohms, ±10%, 2 W linear (rear section) Pan Part RVT505	AA JJU-1052/1031	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R425		RESISTOR: fixed, composition, 10 megohms, ±5%, 1/2 W Pan Part RC20BX106J	AA EB1065	2	
R426		RESISTOR: fixed, composition, 910,000 ohms, ±5%, 1/2 W Pan Part RC20BX914J	AA EB9145	1	
R427		RESISTOR: variable, composition, 50,000 ohms, ±10%, 2 W linear Pan Part RV014	AA JU-5031		
R428		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AA GB7535		
R429		RESISTOR: fixed, composition, 2,200 ohms, ±5%, 1/2 W Pan Part RC20BX222J	AA EB2225		
R430		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		
R431		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 1/2 W Pan Part RC20BX682J	AA EB6825		
R432		RESISTOR: fixed, composition, 1.8 megohms, ±5%, 1/2 W Pan Part RC20BX185J	AA EB1855	1	
R433		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R434		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R435		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R436		RESISTOR: fixed, composition, 2 megohms, ±5%, 1/2 W Pan Part RC20BX205J	AA EB2055		
R437		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R439		RESISTOR: fixed, composition, 1.1 megohm, ±5%, 1/2 W Pan Part RC20BX115J	AA EB1155	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R440		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135		
R441		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1/2 W Pan Part RC20BX513J	AA EB5135		
R442		RESISTOR: fixed, composition, 15,000 ohms, ±5%, 1/2 W Pan Part RC20BX153J	AA EB1535		
R443		RESISTOR: fixed, composition, 12,000 ohms, ±5%, 1/2 W Pan Part RC20BX123J	AA EB1235	1	
R444		RESISTOR: fixed, composition, 22,000 ohms, ±5%, 1/2 W Pan Part RC20BX223J	AA EB2235		
R447		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1/2 W Pan Part RC20BX514J	AA EB5145		
R448		RESISTOR: fixed, composition, 5.1 megohms, ±5%, 1/2 W Pan Part RC20BX515J	AA EB5155	1	
R449		RESISTOR: variable, composition, 2 megohms, ±20%, 2 W linear Pan Part RV017	AA JU-2052	1	
R450		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R451		RESISTOR: fixed, composition, 15 ohms, ±5%, 1/2 W Pan Part RC20BX150J	AA EB1505	1	
R452		RESISTOR: fixed, composition, 10 megohms, ±5%, 1/2 W Pan Part RC20BX106J	AA EB1065	1	
R501		RESISTOR: fixed, composition, 120 ohms, ±5%, 1/2 W Pan Part RC20BX121J	AA EB1215	1	
R502		RESISTOR: fixed, composition, 620 ohms, ±5%, 1/2 W Pan Part RC20BX621J	AA EB6215	1	
R503		RESISTOR: fixed, composition, 150,000 ohms, ±5%, 1 W Pan Part RC32BX154J	AA GB1545	1	
R504		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R505		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R506		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1 W Pan Part RC32BX683J	AA GB6835	1	
R507		RESISTOR: variable, composition, 500,000 ohms, ±10%, 2 W, linear Pan Part RV015	AA JU-5041	1	
R508		RESISTOR: fixed, composition, 1.2 megohms, ±5%, 1/2 W Pan Part RC20BX125J	AA EB1255	1	
R509		RESISTOR: fixed, composition, 220,000 ohms, ±5%, 1/2 W Pan Part RC20BX224J	AA EB2245		
R510		RESISTOR: fixed, composition, 5,600 ohms, ±5%, 1/2 W Pan Part RC20BX562J	AA EB5625	1	
R511		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		
R512		RESISTOR: fixed, composition, 4,700 ohms, ±5%, 1/2 W Pan Part RC20BX472J	AA EB4725	1	
R515		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735		
R516		RESISTOR: variable, composition, 50,000 ohms, ±10%, 2 W, linear Pan Part RV014	AA JU-5031		
R517		RESISTOR: fixed, composition, 47,000 ohms, ±5%, 1 W Pan Part RC32BX473J	AA GB4735		
R518		RESISTOR: fixed, composition, 390,000 ohms, ±5%, 1 W Pan Part RC32BX394J	AA GB3945	1	
R519		RESISTOR: fixed, composition, 510,000 ohms, ±5%, 1 W Pan Part RC32BX514J	AA GB5145		
R520		RESISTOR; variable, composition, 500,000 ohms, ±10%, 2 W, linear Pan Part RVX903	AR RVX903	1	
R521		RESISTOR: fixed, composition, 270,000 ohms, ±5%, 1 W Pan Part RC32BX274J	AA GB2745	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In. Set	Qty. 3 Mo. Opn.
R522		RESISTOR: variable, composition, 100,000 ohms, ±10%, 2 W, linear Pan Part RVX902	AR RVX902	1	
R524		RESISTOR: fixed, wirewound, radial leads, 3,500 ohms, 20 W Pan Part RW20X352R-4	AX 20F3500WL	1	
R525		RESISTOR: variable, wirewound, with switch (SW501), 6 ohms Pan Part RVS700	AF Type GC-252	1	
R527		RESISTOR: fixed, composition, 2 megohms, ±5%, 1/2 W Pan Part RC20BX205J	AA EB2055		
R528		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035		
R601		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1 W Pan Part RC32BX104J	AA GB1045		
R602		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065	4	
R603		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065		
R604		Not Used			
R605		RESISTOR: fixed, composition, 820,000 ohms, ±5%, 1/2 W Pan Part RC20BX824J	AA EB8245	1	
R606		RESISTOR: fixed, composition, 680,000 ohms, ±5%, 1/2 W Pan Part RC20BX684J	AA EB6845	1	
R607		RESISTOR: fixed, composition, 68,000 ohms, ±5%, 1/2 W Pan Part RC20BX683J	AA EB6835		
R608		RESISTOR: fixed, composition, 10,000 ohms, ±5%, 1/2 W Pan Part RC20BX103J	AA EB1035		
R609		RESISTOR: fixed, composition, 51,000 ohms, ±5%, 1 W Pan Part RC32BX513J	AA GB5135		
R610		RESISTOR: variable, composition, 10,000 ohms, ±10%, 2 W, linear Pan Part RV005	AA JU-1031	1	

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R611		RESISTOR: fixed, wire wound, radial leads, 6,000 ohms, 5 W Pan Part RW5X602R-6	AW Type FRL5	1	
R612		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AA GB4745	2	
R613		RESISTOR: fixed, composition, 470,000 ohms, ±5%, 1 W Pan Part RC32BX474J	AA GB4745		
R614		RESISTOR: fixed, wirewound, radial leads, 20,000 ohms, 10 W Pan Part RW10X203R-6	AW Type FRL10	1	
R615		RESISTOR: fixed, composition, 1 megohm, ±5%, 1/2 W Pan Part RC20BX105J	AA EB1055	1	
R616		RESISTOR: fixed, composition, 75,000 ohms, ±5%, 1 W Pan Part RC32BX753J	AA GB7535		
R617		RESISTOR: fixed, composition, 51 ohms, ±5%, 1 W Pan Part RC32BX510J	AA GB5105	1	
R619		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065		
R620		RESISTOR: fixed, composition, 10 megohms, ±5%, 2 W Pan Part RC42BX106J	AA HB1065		
R701		RESISTOR: fixed, composition, 180,000 ohms, ±5%, 1/2 W Pan Part RC20BX184J	AA EB1845	2	
R702		RESISTOR: fixed, composition, 20,000 ohms, ±5%, 1/2 W Pan Part RC20BX203J	AA EB2035	1	
R703		RESISTOR: fixed, composition, 1,000 ohms, ±5%, 1/2 W Pan Part RC20BX102J	AA EB1025		
R704		RESISTOR: fixed, composition, 180,000 ohms, ±5%, 1/2 W Pan Part RC20BX184J	AA EB1845		
R705		RESISTOR: fixed, composition, 3,300 ohms, ±5%, 1/2 W Pan Part RC20BX332J	AA EB3325	1	

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R706		Not used.			
R707		RESISTOR: fixed, composition, 82,000 ohms, ±5%, 2 W Pan Part RC42BX823J	AA HB8235	3	
R708		RESISTOR: fixed, deposited metal film, 253 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ2530F	BJ Type C1/2C	1	
R709		RESISTOR: fixed, deposited metal film, 62.3 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ62P3F	BJ Type C1/2C	2	
R710		RESISTOR: fixed, deposited metal film, 62.3 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ62P3F	BJ Type C1/2C		
R711		RESISTOR: fixed, deposited metal film, 139 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ1390F	BJ Type C1/2C	1	
R712		RESISTOR: fixed, deposited metal film, 72.8 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ72P8F	BJ Type C1/2C	3	
R713		RESISTOR: fixed, deposited metal film, 72.8 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ72P8F	BJ Type C1/2C		
R714		RESISTOR: fixed, deposited metal film, 72.8 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ72P8F	BJ Type C1/2C		
R715		RESISTOR: fixed, deposited metal film, 98 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ980F	BJ Type C1/2C	2	
R716		RESISTOR: fixed, deposited metal film, 98 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ980F	BJ Type C1/2C		
R717		RESISTOR: fixed, deposited metal film, 11.9 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ11P9F	BJ Type C1/2C	4	
R718		RESISTOR: fixed, deposited metal film, 445 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ4450F	BJ Type C1/2C	4	
R719		RESISTOR: fixed, deposited metal film, 445 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ4450F	BJ Type C1/2C		
R720		RESISTOR: fixed, deposited metal film, 11.9 ohms, ±1%, $\frac{1}{2}$ W Pan Part RC20AZ11P9F	BJ Type C1/2C		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R721		RESISTOR: fixed, deposited metal film, 445 ohms, ±1%, ½ W Pan Part RC20AZ4450F	BJ Type C1/2C		
R722		RESISTOR: fixed, deposited metal film, 445 ohms, ±1%, ½ W Pan Part RC20AZ4450F	BJ Type C1/2C		
R723		RESISTOR: fixed, deposited metal film, 11.9 ohms, ±1%, ½ W Pan Part RC20AZ11P9F	BJ Type C1/2C		
R724		RESISTOR: fixed, deposited metal film, 887 ohms, ±1%, ½ W Pan Part RC20AZ8870F	BJ Type C1/2C	2	
R725		RESISTOR: fixed, deposited metal film, 887 ohms, ±1%, ½ W Pan Part RC20AZ8870F	BJ Type C1/2C		
R726		RESISTOR: variable, composition, 100,000 ohms, ±10% 2 W, linear Pan Part RV025	AA JU-1041		
R741		RESISTOR: fixed, composition, 82,000 ohms, ±5%, 2 W Pan Part RC42BX823J	AA HB8235		
R743		RESISTOR: fixed, composition, 82,000 ohms, ±5%, 2 W Pan Part RC42BX823J	AA HB8235		
R750		RESISTOR: fixed, deposited metal film, 11.9 ohms, ±1%, ½ W Pan Part RC20AZ11P9F	BJ Type C1/2C		
R801		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 1/2 W Pan Part RC20BX682J	AA EB6825		
R803		RESISTOR: fixed, composition, 6,800 ohms, ±5%, 1/2 W Pan Part RC20BX682J	AA EB6825		
R805		RESISTOR: fixed, composition, 560 ohms, ±5%, 1/2 W Pan Part RC20BX561J	AA EB5615	1	
R807		RESISTOR: variable, miniature, 250 ohms, ±10%, 1/2 W Pan Part RVM400	AA RV6LAYSA251A	1	
R809		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1/2 W Pan Part RC20BX333J	AA EB3335		
R811		RESISTOR: fixed, composition, 33,000 ohms, ±5%, 1/2 W Pan Part RC20BX333J	AA EB3335		

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
R813		RESISTOR: fixed, composition, 100,000 ohms, ±5%, 1/2 W Pan Part RC20BX104J	AA EB1045		
R815		RESISTOR: fixed, composition, 47 ohms, ±5%, 1/2 W Pan Part RC20BX470J	AA EB4705		
R817		RESISTOR: fixed, composition, 200 ohms, ±5%, 1/2 W Pan Part RC20BX201J	AA EB2015		
S201		SWITCH: toggle, SP-ST, bat handle Pan Part S2022N	AC 81015AW	2	
S301		SWITCH: toggle, DP-DT, bat handle Pan Part S2023	AC 81027-CE	1	
S302		SWITCH: toggle, SP-DT, bat handle Pan Part S2043	AC 81021AV	1	
S402		SWITCH: miniature, rotary, 10/P2-6T, 5 section, shorting contacts Pan Part S2-13124	AR S2-13124	1	
S403		SWITCH: lever, 4 pole, 2 position, spring return Pan Part S3011	AE 1457	1	
S501		See R525		1	
S502		SWITCH: toggle, DP-DT, center OFF, bat handle Pan Part S-2042	BB 8821K5	1	
S701		SWITCH: toggle, DP-DT, bat handle Pan Part S2096	AC 83054	6	
S702		SWITCH: toggle, DP-DT, bat handle Pan Part S2096	AC 83054		
S703		SWITCH: toggle, DP-DT, bat handle Pan Part S2096	AC 83054		
S704		SWITCH: toggle, DP-DT, bat handle Pan Part S2096	AC 83054		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
S705		SWITCH: toggle, DP-DT bat handle Pan Part S2096	AC 83054		
S706		SWITCH: toggle, DP-DT bat handle Pan Part S2096	AC 83054		
S707		SWITCH: toggle, SP-ST bat handle Pan Part S2022N	AC 81015AW		
T101		TRANSFORMER: RF 500 KC, ±50 KC Pan Part ZN8429	AR ZN8429	1	
T102		TRANSFORMER: RF 500 KC, ±50 KC Pan Part ZN8218	AR ZN8218	1	
T401		TRANSFORMER: pulse Pan Part T2-10790A	AR T2-10790A	1	
T601		TRANSFORMER: power, low voltage, Primary: 115/230V 50-60 cycles Secondary: 750VCT, 150 MADC 6.5 V, 4 A; 5 V, 2 A Pan Part T3-9877B	AR T3-9877B	1	
T602		TRANSFORMER: power, high voltage, Primary: 115V/230V, 50-60 cycles Secondary: 6.4 V, 0.6 A, 2.5 V, 1.75 A; 1200 V, 4 MA; 6.3 V, 6 A Pan Part T3-9875D	AR T3-9875D	1	
V1		ELECTRON TUBE: 6J6 Pan Part 6J6	AZ 6J6	1	
V2		ELECTRON TUBE: 12AT7 Pan Part 12AT7	AZ 12AT7	1	
V3		ELECTRON TUBE: 6BE6 Pan Part 6BE6	AZ 6BE6	1	
V4		ELECTRON TUBE: 6AH6 Pan Part 6AH6	AZ 6AH6	1	
V5		ELECTRON TUBE: 6BH6 Pan Part 6BH6	AZ 6BH6	2	
V6		ELECTRON TUBE: 12AL5 Pan Part 12AL5	AZ 12AL5	1	
V7		ELECTRON TUBE: 6U8A Pan Part 6U8A	AZ 6U8A	4	
V8		ELECTRON TUBE: 6U8A Pan Part 6U8A	AZ 6U8A		

List of Replaceable Parts for Models SB-12b and PS-12 (continued)

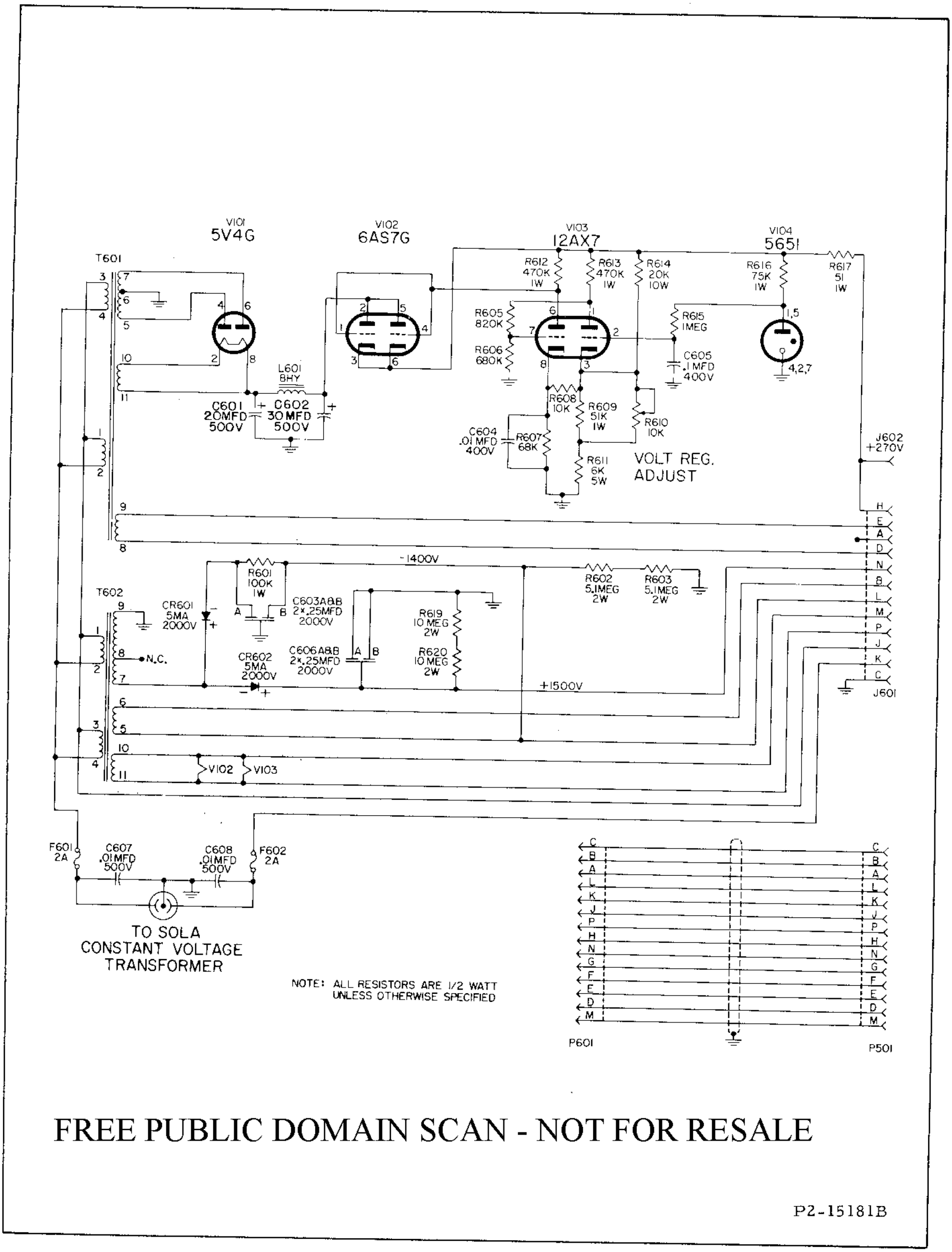
Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
V9		ELECTRON TUBE: 6AU6 Pan Part 6AU6	AZ 6AU6	2	
V10		ELECTRON TUBE: 12AU7 Pan Part 12AU7	AZ 12AU7	4	
V11		ELECTRON TUBE: 12AU7 Pan Part 12AU7	AZ 12AU7		
V12		ELECTRON TUBE: 5ADP7 Pan Part 5ADP7	AZ 5ADP7	1	
V13		ELECTRON TUBE: 6AU6 Pan Part 6AU6	AZ 6AU6		
V14		ELECTRON TUBE: 12AU7 Pan Part 12AU7	AZ 12AU7		
V15		ELECTRON TUBE: 6BH6 Pan Part 6BH6	AZ 6BH6		
V16		ELECTRON TUBE: 12AU7 Pan Part 12AU7	AZ 12AU7		
V17		ELECTRON TUBE: 5651 Pan Part 5651	AZ 5651	2	
V18		ELECTRON TUBE: OA2 Pan Part OA2	AZ OA2	1	
V19		Not Used			
V20		ELECTRON TUBE: 6U8A Pan Part 6U8A	AZ 6U8A		
V101		ELECTRON TUBE: 5V4GA Pan Part 5V4GA	AZ 5V4GA	1	
V102		ELECTRON TUBE: 6AS7G Pan Part 6AS7G	AZ 6AS7G	1	
V103		ELECTRON TUBE: 12AX7 Pan Part 12AX7	AZ 12AX7	1	
V104		ELECTRON TUBE: 5651 Pan Part 5651	AZ 5651		
Y301*		CRYSTAL: 100 KC Pan Part Y3001-2*	AR Y3001-2	2	
Y302*		CRYSTAL: 100 KC Pan Part Y3001-2*	AR Y3001-2		
Y303		CRYSTAL: 100 KC Pan Part Y3001-1	AR Y3001-1	1	

*Supplied as matched pair, Panoramic Part No. 2Y3001MR.

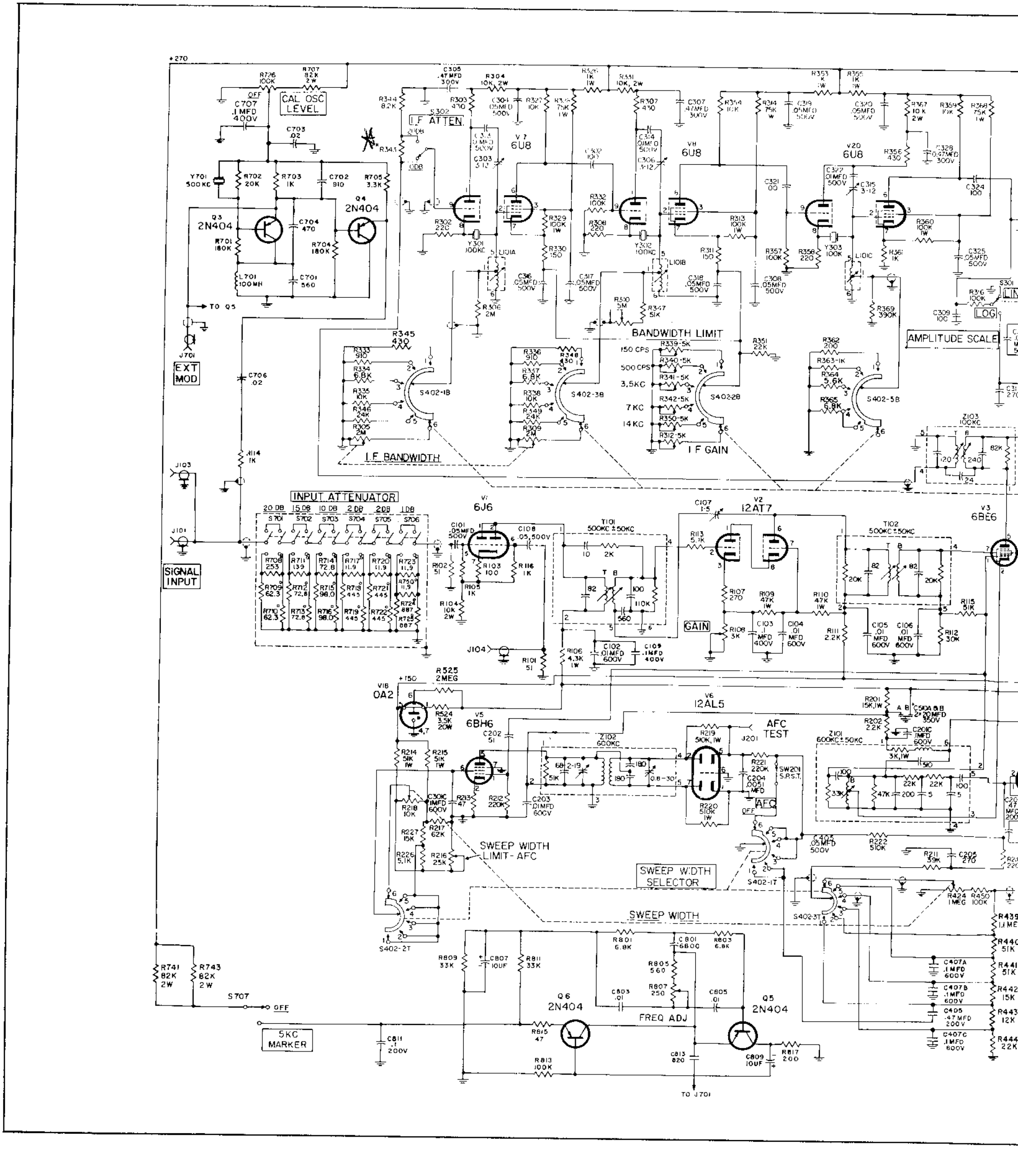
Circuit Ref. Symbol	Stock No.	Description	Mfr. & Mfrs. No.	Qty. In Set	Qty. 3 Mo. Opn.
Y701		CRYSTAL: 500 KC, ±.02% Pan Part Y-3006	AR Y3006	1	
Z101		COIL: oscillator, 600 KC Pan Part ZN-8219	AR ZN8219	1	
Z102		TRANSFORMER: RF, discriminator, 600 KC, ±50 KC Pan Part ZN-8220	AR ZN8220	1	
Z103		TRANSFORMER: RF, 100 KC Pan Part ZN-8372	AR ZN8372	1	
Z105		TRANSFORMER: RF, 100 KC Pan Part ZN-8222	AR ZN8222	1	
		FUSE: instantaneous, glass cartridge, 2 amp, 250 V Pan Part F-1003	AD AGC2	2	
		FUSE: instantaneous, glass cartridge, 2 amp, 250 V Pan Part F-1003	AD AGC2		
		HEX KEY: short arm #8 Allen, 5/64" Pan Part E-1009	AR E-1009	1	
		TOOL: alignment Pan Part E-1010	AR E-1010	1	
		TRANSFORMER: constant-voltage, 180 VA, 60 cps, single phase Pan Part T-3003-1	AR T-3003A-1	1	

MANUFACTURERS CODE FOR LIST OF REPLACEABLE PARTS

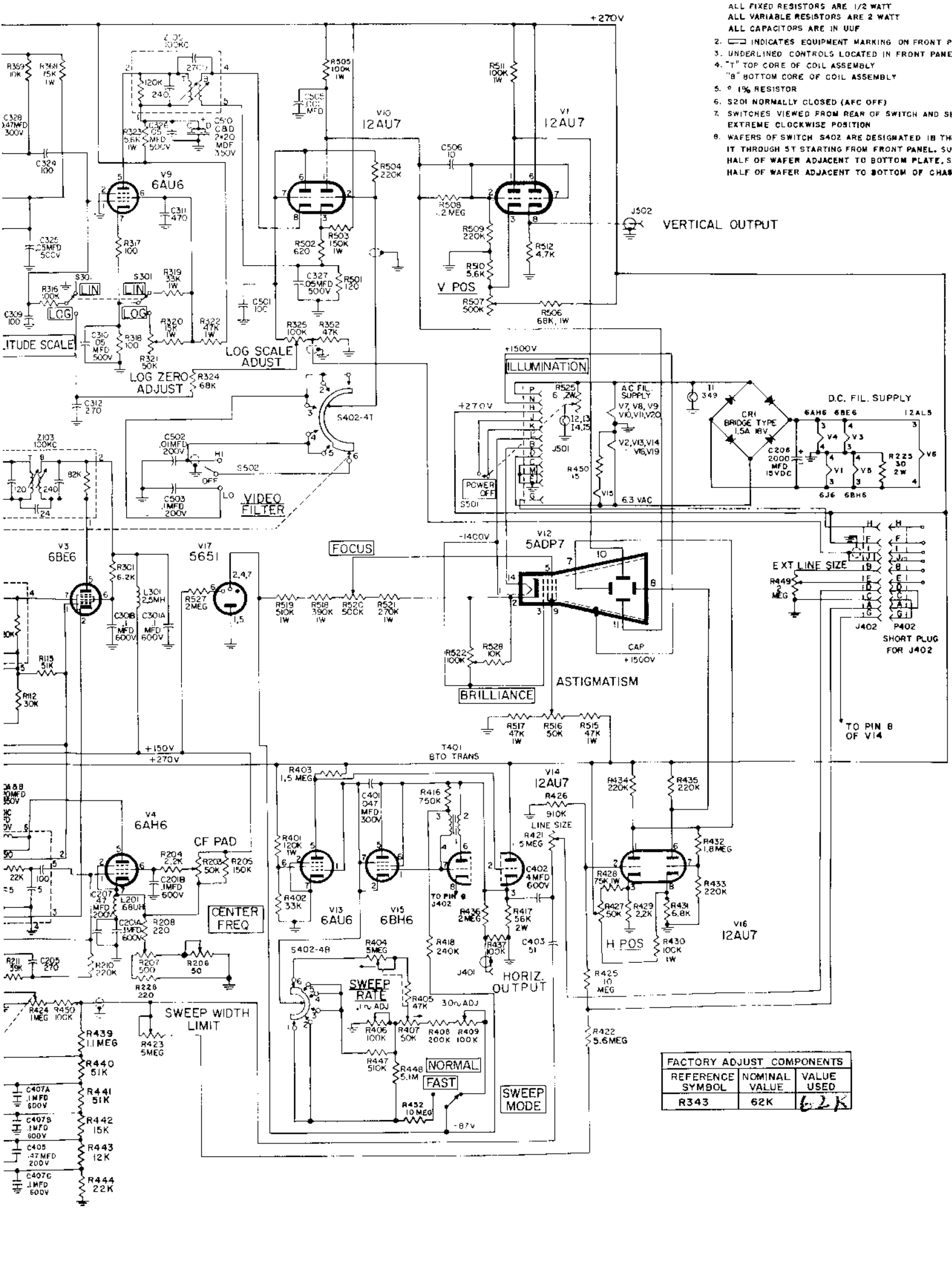
AA	Allen Bradley Company
AB	Amphenol Electronics Corporation
AC	Arrow-Hart & Hegeman Electric Company
AD	Bussman Manufacturing Company
AE	Centralab Division of Globe-Union, Inc.
AF	CTS Corporation
AG	Continental Carbon, Inc.
AH	Electro Motive Manufacturing Company
AJ	Erie Resistor Corporation
AK	General Electric Company
AL	Gudeman Company
AM	International Rectifier Corporation
AN	International Resistance Company
AO	J. F. D. Electronics Corp.
AP	Kulka Electric Manufacturing Company, Inc.
AQ	J. W. Miller Company
AR	Panoramic Electronics, Inc.
AS	Radio Receptor, Inc.
AT	Sangamo Electric Company
AU	Sprague Electric Company
AV	Switchcraft, Inc.
AW	Tru-Ohm Products Division, Model Engineering and Manufacturing, Inc.
AX	Ward-Leonard Electric Company
AY	Wright Electronics, Inc.
AZ	Any E. I. A. Manufacturer
BA	Solar Manufacturing Company
BB	Cutler-Hammer, Inc.
BC	Wilco Corporation
BD	Hudson Lamp Co.
BE	Texas Instruments, Inc.
BF	Teleradio Engineering Corp.
BG	Birnbach Radio Company, Inc.
BH	Harvey Hubbell, Inc.
BI	Aerovox Corp.
BJ	Kidco, Inc.



Schematic Diagram, Power Supply, Model PS-12



+270
CAL OSC LEVEL
I.F ATTEN.
EXT MOD
SIGNAL INPUT
INPUT ATTENUATOR
20 DB
15 DB
10 DB
2 DB
2 DB
1 DB
I.F BANDWIDTH
BANDWIDTH LIMIT
150 CPS
500 CPS
3.5 KC
7 KC
14 KC
I F GAIN
AMPLITUDE SCALE
LOG
GAIN
AFC TEST
AFC
SWEEP WIDTH LIMIT-AFC
SWEEP WIDTH SELECTOR
SWEEP WIDTH
FREQ ADJ
5KC MARKER
TO Q5
TO J701
6U8
6J6
12AT7
6BE6
OA2
6BH6
12AL5
2N404



1. UNLESS OTHERWISE SPECIFIED:
   ALL FIXED RESISTORS ARE 1/2 WATT
   ALL VARIABLE RESISTORS ARE 2 WATT
   ALL CAPACITORS ARE IN UUF
2. ▭ INDICATES EQUIPMENT MARKING ON FRONT PANEL
3. UNDERLINED CONTROLS LOCATED IN FRONT PANEL COMPARTMENT
4. "T" TOP CORE OF COIL ASSEMBLY
   "B" BOTTOM CORE OF COIL ASSEMBLY
5. ° 1% RESISTOR
6. S201 NORMALLY CLOSED (AFC OFF)
7. SWITCHES VIEWED FROM REAR OF SWITCH AND SHOWN IN EXTREME CLOCKWISE POSITION
8. WAFERS OF SWITCH S402 ARE DESIGNATED 1B THROUGH 5B AND 1T THROUGH 5T STARTING FROM FRONT PANEL. SUFFIX "B" INDICATES HALF OF WAFER ADJACENT TO BOTTOM PLATE, SUFFIX "T" INDICATES HALF OF WAFER ADJACENT TO BOTTOM OF CHASSIS.

FACTORY ADJUST COMPONENTS		
REFERENCE SYMBOL	NOMINAL VALUE	VALUE USED
R343	62K	62K

P4-15255

Schematic Diagram, Model SB-12b.