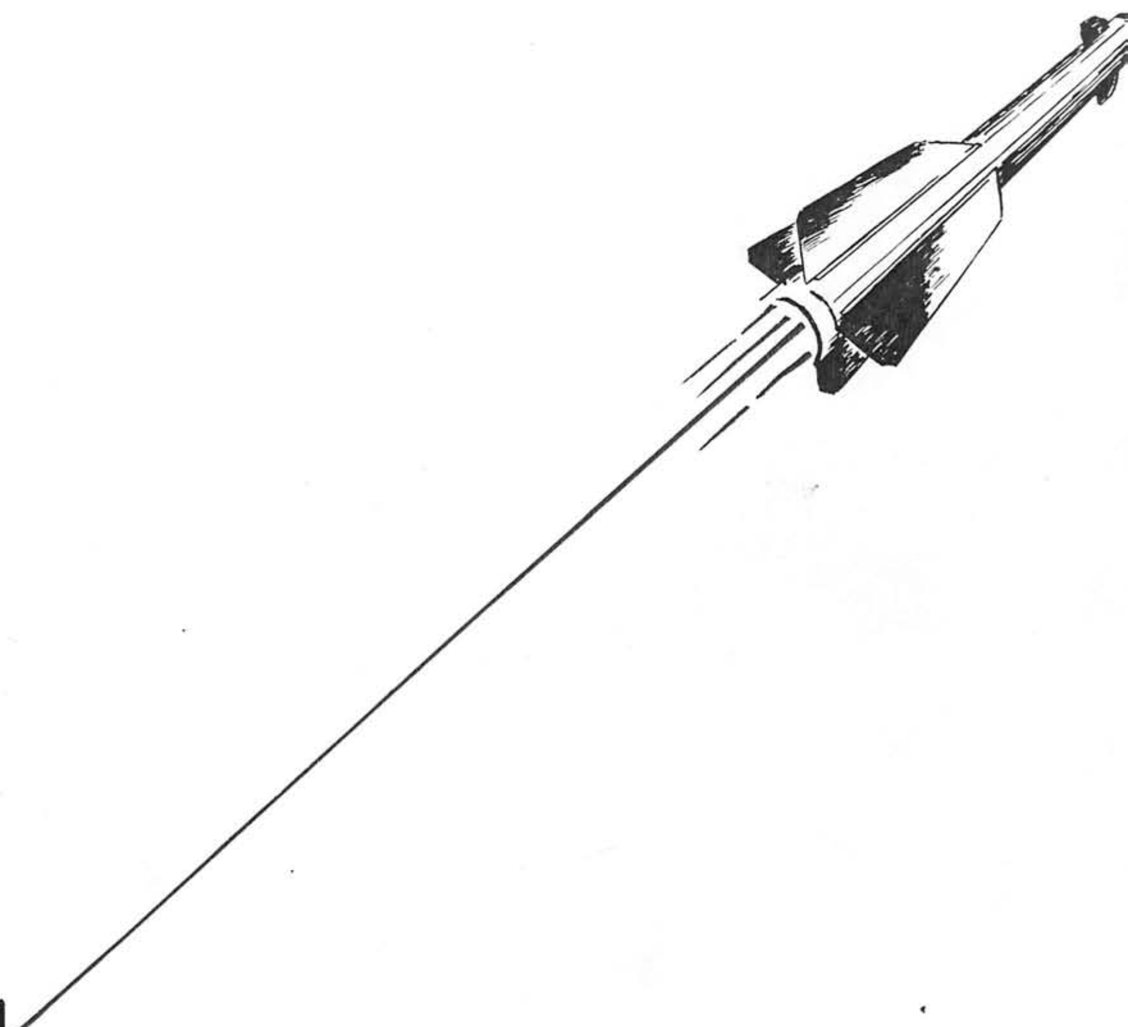
INSTRUCTION BOOK FOR SPECTRUM DISPLAY UNITS



NEMS CLARKE CO.
919 JESUP BLAIR DRIVE • SILVER SPRING, MARYLAND
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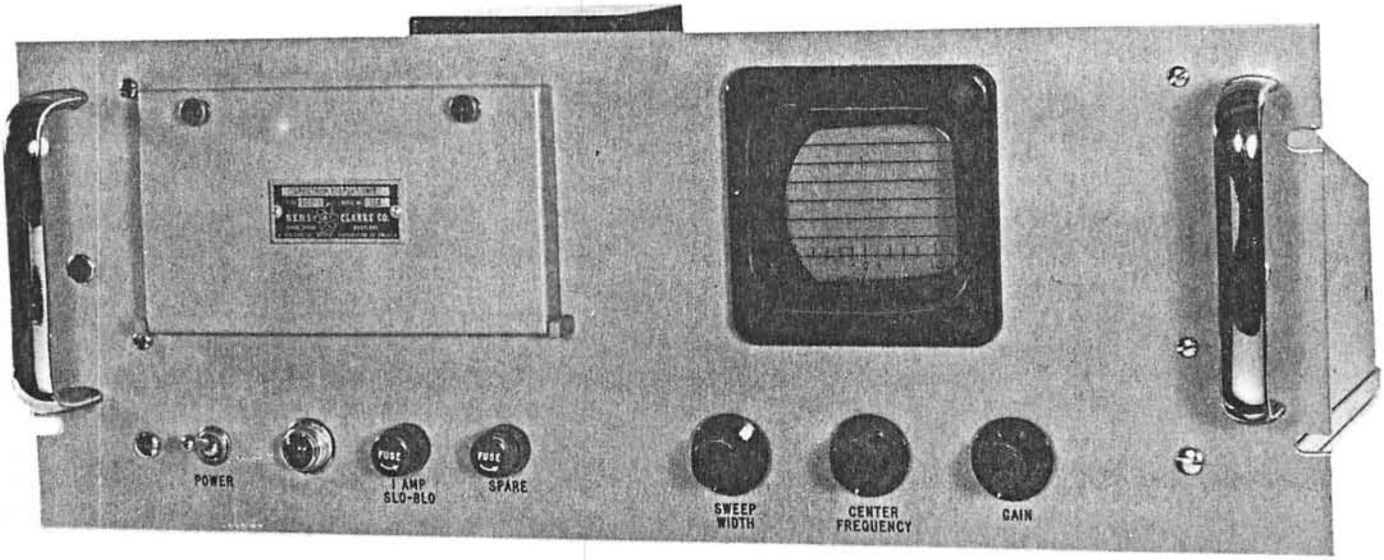


Figure 1. Spectrum Display Unit, Front View

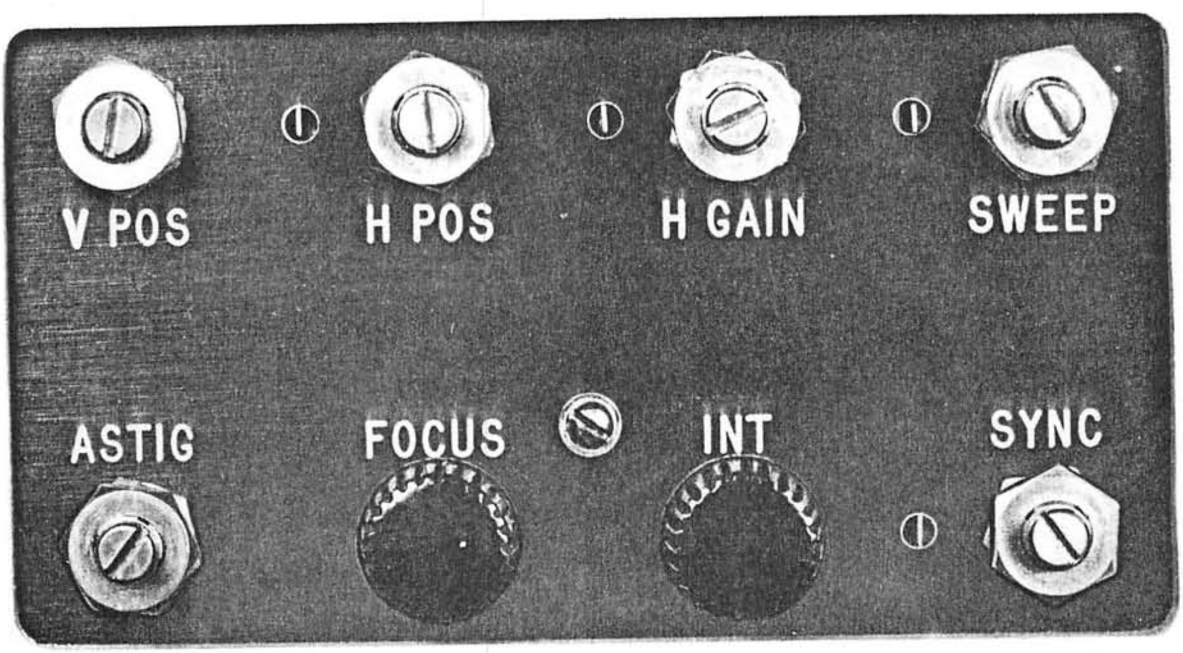


Figure 2. Cathode-Ray Tube Adjustment Control Sub-Panel

SECTION 1

INTRODUCTION AND DESCRIPTION

1-1. THE SPECTRUM DISPLAY UNIT, Figure 1, is an instrument designed specifically for use with Telemetering Receivers to determine the frequency, relative amplitude and type of modulation of a signal being received. The bandwidth of the Spectrum Display Unit is 2 MC or 3 MC displayed visually on a calibrated cathode ray tube screen. The cathode ray tube used is capable of showing all signals within a range of 1 MC or 1.5 MC on either side of the tuned frequency. The bandwidth is adjustable by means of a SWEEP WIDTH control. Maximum bandwidth is normally used when searching for signals around the desired frequency; a narrow bandwidth is used when evaluating missile signals.

The input signal for the SDU comes from an auxiliary IF output on the receiver. The usable bandwidth at the SDU output of the receiver is considerably less than the desired sweep width of the SDU, so, a broadband amplifier has been built into the SDU to compensate for the narrow bandwidth. Each receiver type requires a different compensation to produce a relatively flat amplitude response over the frequency range corresponding to maximum sweep width. Table 2 shows the proper SDU Type for the various Models of Telemetry and Special Purpose Receivers.

Mounted on the front panel, in addition to the cathode ray tube screen, are the following operating controls: a toggle POWER SWITCH, SWEEP WIDTH control knob, CENTER FREQUENCY control knob and GAIN control knob. There are also a pilot-light, an operating fuse, and a spare fuse. Under the hinged cover, at the upper left hand corner of the panel, is a sub-panel (Figure 2) containing six screw-driver controls and two manual control knobs for adjusting the cathode-ray tube image. Screw-driver controls are: vertical position (V-POS), horizontal position (H-POS), horizontal gain (H-GAIN) SWEEP, astigmatism (ASTIG), and synchronization (SYNC). Manual controls are: FOCUS and intensity (INT). The power and coaxial inputs are located on the rear apron of the chassis. For the electrical characteristics of the Spectrum Display Unit, see Table 1.

All models of the SDU are identical in physical appearance, the difference being in the performance characteristics and components of the first IF amplifiers. Overall dimensions are: 19 inches wide by 15 inches deep by 7 inches high. The net weight is 25 lbs.; shipping weight, approximately 50 lbs. The equipment is supplied with a rigid perforated cover when it is to be used on a table or shelf, but it is designed for mounting in a standard 19 inch relay rack. Provisions are made for the installation of Grant hardware, consisting of bracket and slide assemblies which permit the unit to be withdrawn from the rack and tilted at either 45 or 90 degrees to facilitate servicing. Signal input and power input connectors are located on the rear apron of the chassis. A type BNC coaxial connector is used for signal input. A "twist-lock" receptacle with a grounding terminal is used for the power input.

The mechanical and electrical design of the unit is such that the various models are identical with the exception of the first IF assembly, the cathode-ray tube scale, and the adjustment of certain controls which set the reactance tube sweepwidth and linearity. Sub-chassis construction has been used extensively in the Spectrum Display Units to facilitate replacement of the interchangeable IF amplifier chassis, and as an aid in servicing the units. One sub-chassis consists of the first and second IF Amplifiers, 21.4 MC or 30.0 MC; a second sub-chassis contains the local oscillator, reactance tube, and mixer; a third chassis consists of the 4.3 MC IF Amplifier strip. The remainder of the circuitry is located on the main chassis with components mounted on terminal boards whenever practicable.

TABLE 1. ELECTRICAL AND PERFORMANCE CHARACTERISTICS—SPECTRUM DISPLAY UNITS

Specifications	*Type 200*	*Type 300*
Maximum Sweep Width	2 MC	3 MC
Input Center Frequency	21.4 MC or 30.0 MC	21.4 MC or 30.0 MC
Second IF Amplifier Frequency	4.3 MC	4.3 MC
Sensitivity for full deflection:	5 microvolts to receiver	5 microvolts to receiver
Resolution*	Approximately 20 KC	Approximately 20 KC
Power Input	117 volts, 50–60 CPS	117 volts, 50–60 CPS

*Two equal-amplitude signals 20 KC apart will appear as two separate pips with the point of intersection being at least 6 db down.

Note: A suffix number is added to the "type number" to denote the type of receiver with which the SDU is to operate; i.e., SDU-200-3 indicates an SDU to be used with a receiver having an IF operating frequency of 30 MC.

TABLE 2. LIST OF SPECIAL PURPOSE RECEIVERS AND SPECTRUM DISPLAY UNIT REQUIRED

Receiver Model Number	*SDU Type Number and Suffix*			
	Type 200		*Type 300*	
Input Center Frequency:	21.4 MC	30.0 MC	21.4 MC	30.0 MC
1301, 1301-A 1302, 1302-A	200-2 200-2			
1400, 1400-A 1401, 1401-A, 1401-B		200-3 200-3		
1401-R		1401-SDU		
1402 1403 1410, 1410-A 1411, 1411-A 1412 1420, 1421 1430, 1431, 1432, 1433		200-3 200-3 200-3 200-3 200-3 200-3 200-3		
1500, 1501-A, 1502, 1502-A 1503, 1503-A 1509, 1510, 1511, 1512	200-2 200-2 200-2			
1670-E, 1670-F	200-1		300-1	
1670-G, 1670-J	200-2			
1671, 1672	200-1		300-1	
1673, 1674	200-2			
1700-A Series	200-2		300-5	
2100			300-4	
2301	200-2			
2401	200-2			
2701	200-1			

SECTION 2

THEORY OF OPERATION

2-1. GENERAL. From the block diagram, Figure 3, it can be seen that the Spectrum Display Unit is a complete superheterodyne receiver in itself. The first section, which can be considered a radio-frequency amplifier, receives a 21.4 or 30.0 MC signal from the first converter in the telemetry receiver. Since the bandwidth from the receiver, at the SDU output, is considerably narrower than the sweep width desired, a broad-band amplifier with frequency response compensation has been built into the Spectrum Display Unit to spread the band. Each type of receiver requires a different compensation setting to produce a relatively flat amplitude response over the range corresponding to the maximum sweep width of the instrument. The Spectrum Display Unit has a first amplifier with bandpass characteristics inverse to the bandpass characteristics of the receiver, that is, it amplifies when the receiver attenuates and vice-versa. Consequently, when the two units are used together, the over-all bandpass characteristics become uniform.

The input of the bandpass amplifier is connected to the plate circuit of the first detector of the receiver. A reasonably constant overall response of two megacycles is obtained at the connector output. Signals from the radio-frequency bandpass amplifier are mixed with the signal from the FM Oscillator. The frequency of the oscillator varies in step with a saw-tooth voltage applied to the grid of a reactance tube included in the tuning circuit of the oscillator. The oscillator is frequency modulated over a range extending equally above and below a mean frequency at a fixed rapid rate, the mean frequency being the difference between the intermediate frequencies of the receiver and the Spectrum Display Unit. Signals from the output connector pass through a sharply tuned I.F. Amplifier, are rectified, and subsequently amplified by a video type amplifier. Then they are fed to the vertical deflecting plates of the cathode ray tube. Thus the movement of the beam in the tube is synchronized with the tuning of the oscillator. The signals appear in rapid succession and no more than one signal appears on the screen at any one instant. However, due to persistance of the screen image, all the signals seem to appear at the same time. This must be fully understood by the operator to assure correct interpretation of the visual display.

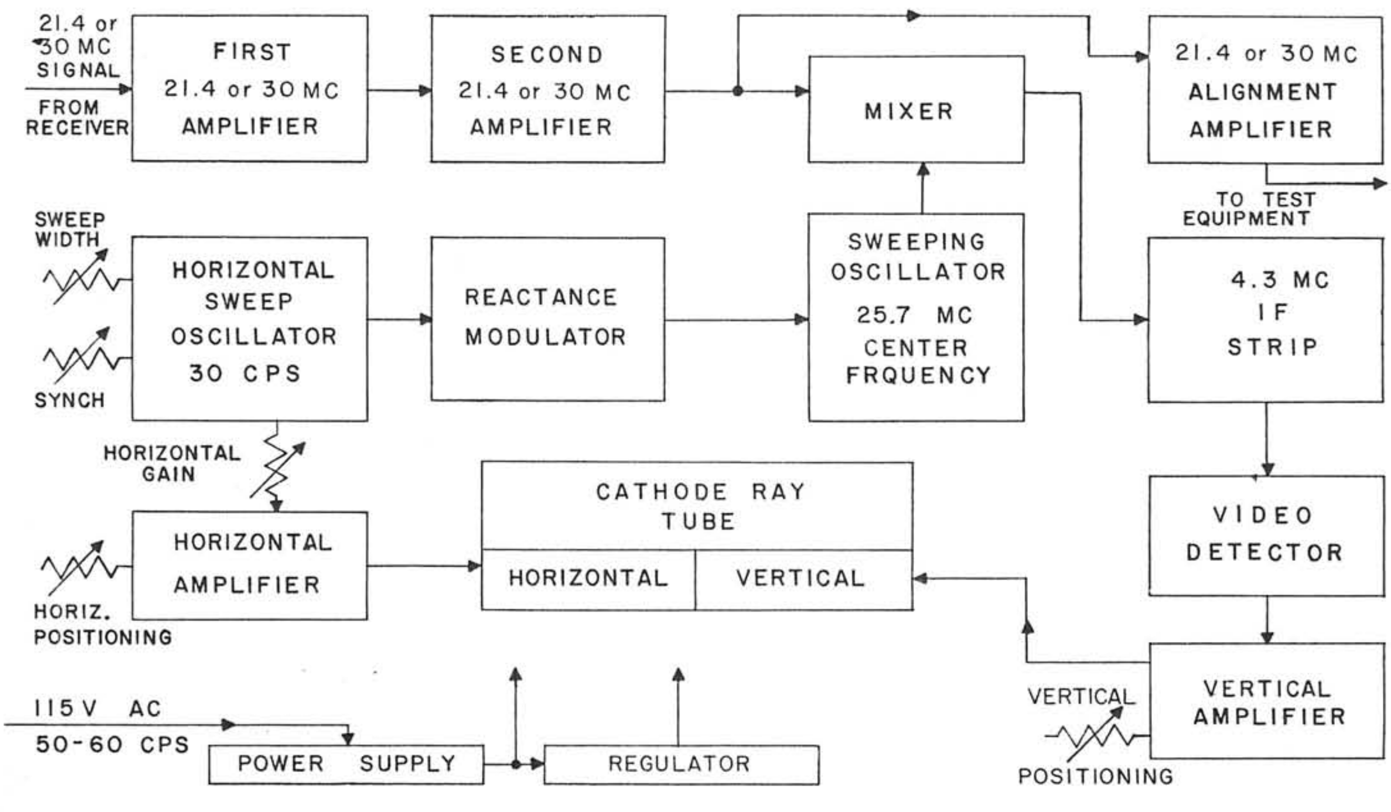


Figure 3.—Block Diagram, Spectrum Display Units

2-2. INPUT SECTION. The input to the Spectrum Display Unit is taken from the first converter in the Receiver. The 21.4 or 30.0 megacycle signal is amplified in the first I.F. section of the SDU which consists of three stages: the first stage, tube V-201, is single-tuned by a tuned tank, and capacitively coupled to the second stage, tube V-202. The second stage is double-tuned by the capacitively coupled transformers T-201A and T-201B. Transformer T-201B is directly coupled to the third tube, V-203. The signal to the second I.F. section is taken from the input of the third amplifier through connector J-203. The output of the third tube, V-203, is rectified and used for alignment purposes. Gain of the first I.F. section is controlled by resistor R-109 which adjusts the cathode bias on tube V-201.

2-3. LOCAL OSCILLATOR AND REACTANCE TUBE. The local oscillator, V-302, generates a frequency of 25.7 megacycles. A capacitor, C-311, connected to coil Z-301 in the tuned grid circuit of the local oscillator is used for manual adjustment of the SDU center frequency.

The Sweep Width control resistor, R-112, regulates the amplitude of the saw-tooth wave. When the voltage is reduced to zero the reactor no longer sweeps, and the oscillator operates at its mean frequency. The oscillator output is inductively coupled by the transformer T-301 to tube V-303. The secondary coil of the transformer connects to the first grid of the pentagrid mixer V-303 where it combines with the 30 megacycle signal from the first I.F. amplifier. The difference in frequency of 4.3 megacycles appears at J-302, the output of the mixer section.

2-4. SWEEP VOLTAGE GENERATOR AND AMPLIFIER. The sweep voltage generator consists of dual triode, V-104, and its associated components. Half of V-104 is used for a blocking oscillator and the other half as a cathode follower. The frequency of the sweep generator is controlled by the blocking oscillator circuit. T-102 is the blocking oscillator transformer. Capacitor, C-106, and resistors, R-110 and R-111, control the oscillator timing. Resistor R-111, the SYNC control, is used to synchronize the blocking oscillator frequency with that of the power line. The saw-tooth sweep voltage waveform is generated by capacitor C-108 and resistor R-118, while capacitor C-108 charges during the time in which the blocking oscillator section of V-104 is non-conducting. The plate current pulse of the blocking oscillator tube acts to discharge capacitor C-108 completing the saw-tooth wave shape

The saw-tooth voltage across capacitor C-108 is applied to the grid of the cathode follower section of tube V-104. The cathode output voltage is applied to the C.R.T. horizontal deflecting plates through tube V-105 to provide the base line. The output is also applied to the reactance tube V-301 for the purpose of sweeping the oscillator frequency.

In the cathode follower circuit of tube V-104, resistor R-116 is the horizontal gain control, adjustment of which determines the physical length of the base line. Resistors R-112 and R-114 are the SWEEP WIDTH and SWEEP controls respectively; R-112 is for fine adjustment of sweep voltage, while R-114 is used for coarse adjustment. Sweep Width and Sweep refer to the frequency range covered by the SDU. Dual triode tube, V-105, is used as a cathode-coupled push-pull horizontal sweep amplifier. Its output is directly coupled to the C.R.T. horizontal deflecting plate. Horizontal positioning is performed by adjustment of resistor, R-124, which controls the bias on half of tube V-105.

2-5. 4.3 MC I.F. AMPLIFIER SECTION. The second I.F. section consists of three stages of I.F. amplification. All interstage transformers are tuned to 4.3 megacycles and are adjusted for critical coupling. The gain is controlled by resistor R-109 which also controls the gain of the first I.F. section.

2-6. DETECTOR AND VERTICAL DEFLECTION AMPLIFIER. One half of tube V-404 is used as the detector. The other half is not used and is grounded. Direct coupling is used between the diode detector and tube V-107, a video amplifier similar to the horizontal sweep amplifier. The vertical deflection plates of the cathode ray tube are directly coupled to the video amplifier. Vertical positioning is accomplished by adjustment of resistor R-136 which controls the bias on half of tube V-107.

2-7. CATHODE-RAY TUBE. The cathode-ray tube, V-106 consists of a number of elements operating at high potentials. When the potentials are applied in the proper ratio, they cause the electrons emitted from the cathode to be accelerated to a high velocity and focused into a beam. The beam strikes the fluorescent coating on the "screen" of the tube and glows as a "dot". There are two sets of plates in the cathode-ray tube, one set for horizontal deflection of the "dot" and the other set for vertical deflection. Varying voltages applied to the plates cause the "dot"to be deflected to varying positions on the screen. The deflection is so rapid that the dots on the screen appear as a continuous pattern. Performance of the cathode-ray tube is regulated by manual (screwdriver) adjustment of the following resistors:

R-130 controls the brightness (intensity) of the image on the screen and is labeled "INT".

R-133 is used to control the sharpness of the trace, and is labeled "FOCUS".

R-129, labeled "ASTIG" (astigmatism) further sharpens the trace.

R-136, "V-POS" controls the vertical position of the trace.

R-124, "H-POS" controls the horizontal position of the trace.

SECTION 3

OPERATION

3-1. INSTALLATION. Although the Spectrum Display Unit is designed for mounting in a standard 19 inch relay equipment rack, it may be used on a table or shelf. The unit is supplied with a rigid protective cover for use when it is installed outside of an equipment rack.

(a) Select a well ventilated location to provide adequate heat dissipation.

(b) Plug in the power cord supplied to J-101 and a 115-V, 60-C, ac. outlet.

(c) Connect the unit to the SDU output of the receiver to be checked.

3-2. OPERATION OF THE SPECTRUM DISPLAY UNIT.

(a) Turn on the SDU and the receiver to be used for Spectrum Display checking.

(b) Turn on the SDU and wait for the base line to appear.

(c) Turn the GAIN control up about half way.

(d) Tune the receiver slowly until one or more signals move across the screen of the cathode-ray tube.

(e) Tune in any station on the receiver. The signal should appear exactly in the center of the scale directly over the ZERO (0) point of the screen calibration. For best results, it is advisable to adjust the mean frequency of the SDU oscillator to give a signal which remains in the center of the screen regardless of the position of the SWEEP WIDTH control. This adjustment is accomplished by turning the SWEEP WIDTH control fully clockwise, then centering the deflection peak by rotating the CENTER FREQUENCY knob to left or right. Gradually turn the SWEEP WIDTH control counter-clockwise meanwhile maintaining the peak centered with the CENTER FREQUENCY control until the base of the pip curve occupies the entire screen width. Now, turn the SWEEP WIDTH control fully clockwise. The peak of the curve should remain at the zero point on the screen; if not, adjust the HORIZONTAL POSITION control until the curve is centered. Once set, the CENTER FREQUENCY control should rarely need to be readjusted, however, incorrect adjustment of the CENTER FREQUENCY will result in misalignment of the SDU with the receivers.

3-3. INTERPRETATION OF SIGNALS. With a little experience, the operator will be able to recognize visually the character of the various types of signals without the need of listening to them. However, the receiver must be adjusted properly if good results are to be obtained.

(a) A Constant carrier appears as a deflection of fixed height.

(b) An amplitude-modulated carrier appears as a deflection of variable height. Voice or music modulaion causes the carrier to vary irregularly.

A constant tone modulation of low frequency will produce a series of convolutions varying in height, their number being determined by the modulation frequency. As the modulation frequency increases, the convolutions move toward the two sides of the deflection as the sidebands tend to become visible. When the modulation frequency is increased, it becomes possible to separate the two side-bands by reducing the sweep width. The higher the frequency of modulation, the further away these sidebands will move from the center deflection representing the carrier. Note that, due to the imperfect equalization of the receiver, the two side-bands may appear unequal in height, even though they are of equal strength. Their relative heights may vary as the receiver is tuned and as the deflection moves from one end of the screen to the other.

(c) Single side-band modulation appears as two carriers of slightly different frequency. (See (h) below on signal interference).

(d) A frequency-modulated carrier appears as a carrier which is "wobbling" sideways.

(e) A speech or music modulation FM signal appears as a multiplicity of deflections spreading over a variable band-width.

(f) A CW signal appears and disappears in step with the keying of the transmitter. During the moments when the signal is off, the frequency sweep axis closes at the base of the signal. A radio operator used to reading CW signals on phones can, with little practice, read such signals directly off the screen. In very rapidly keyed signals the deflection and the base line are seen simultaneously.

(g) An MCW signal appears like a CW signal of periodically varying height. If the modulation rate is high, side-bands will appear as explained above.

(h) Signal Interference: Two signals which are so close in frequency as to cause aural interference (beats) may appear on the screen as a single deflection varying in height as with a modulated signal. As the frequency separation is increased, the deflection appears as if modulated on one side only. Further increase of frequency will cause a "break" in the apex of the deflection. By reducing sweep width of the SDU, the respective deflections will separate gradually.

(i) Transient disturbances, generally received as noises in the receiver, are of two types; periodic and random. Periodic transients, such as produced by automobile ignition systems, motors, vibrators, buzzers, etc., appear as signals moving along the frequency sweep base line in one direction or another.

Thus, an automobile which is accelerating, will produce a set of deflections which may move first in one direction, slow down, stop, and then move in an opposite direction. This is caused by the fact that the SDU is sweeping at a fixed rate (20 to 40 times per second), whereas the random type disturbances occur at a variable rate. The image stands still on the screen only when the two signals are synchronized. If the transient disturbance is synchronized with the 60 cycle line, the "noise" appears as a fixed signal which, however, does not move on the screen when the receiver is tuned, but only varies in height. Such deflections may appear like amplitude modulated signals or like steady carriers. (See (m) below, on diathermy apparatus). Random transients, such as "static", appear as irregular deflections and flashes along the whole frequency sweep axis.

(j) Tube noise, due to too great an amplification of the receiver, or of the SDU, or both, appears as varying irregularities along the frequency sweep axis. Proper adjustment of the gain controls should reduce or eliminate this disturbance.

(k) Images. If the receiver allows "images" to pass, they will be distinguishable from normal signals by the fact that they move in the opposite direction with respect to normal signals on the screen when the receiver is being tuned. Such images are most likely to appear in the higher frequency ranges.

(l) Harmonics produced in the receiver 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 than the normal signals while tuning (twice as fast for second harmonic spurious signals). Generally, a reduction in the gain of the receiver will eliminate harmonics.

(m) Diathermy apparatus using an unfiltered power supply will produce a periodic disturbance causing deflections to appear on certain portions of the screen. This is because such equipment emits a pulsating signal synchronous with that of the power line. On the other hand, the SDU is sweeping the spectrum synchronously with the line, but at a lower frequency, and only when a certain phase relationship exists, is it possible for the SDU to receive those periodic pulses.

(n) Spurious Signals. If the signal strength exceeds a certain value, the deflection caused by any signal breaks up into a series of parallel deflections somewhat similar to side-bands. A reduction in the gain of the SDU will eliminate this type of distortion.

TABLE 3. SEMI-CONDUCTOR AND TUBE COMPLEMENT, SPECTRUM DISPLAY UNIT

Circuit Symbol	*Tube Type*	*Function*
CR-101, 102	026-30H-QC	Rectifier: Selenium half-wave 315 V DC, 5 ma output. Voltage doubling rectifier.
CR-201	CK-705/IN66	Rectifier: Germanium, 60V continuous reverse working voltage, 5 ma at +1 volt forward current.
V-101	5Y3GT	Rectifier
V-102	OA2	Voltage Regulator for 2nd IF Amplifier, Oscillator, reactance modulator, and frequency converter.
V-103	OA2	Voltage Regulator for 1st IF Amplifier, Sweep voltage generator.
V-104	12AU7	Sweep Voltage Generator
V-105	12AT7	Horizontal Deflection Amplifier
V-106	3RPIA	Cathode Ray Indicator
V-107	12AT7	Vertical Deflection Amplifier
V-201	6BA6	1st IF Amplifier
V-202	6AU6	1st IF Amplifier
V-203	6AU6	1st IF Amplifier (Alignment Amplifier)
V-301	6AH6	Reactance Modulator
V-302	6AU6	Local Oscillator
V-303	6BE6	Mixer
V-401	6BA6	2nd IF Amplifier (1st stage)
V-402	6BA6	2nd IF Amplifier (2nd stage)
V-403	6AU6	2nd IF Amplifier (3rd stage)
V-404	6AL5	Video Detector

SECTION 4

MAINTENANCE

WARNING

This equipment employs voltages which are dangerous and may be fatal if contacted by operating personnel. Extreme caution should be exercised while working with this equipment.

4-1. TROUBLE SHOOTING, GENERAL. When the SDU does not operate properly, a complete visual inspection should be made. The signal and power input cables should be properly connected. The tubes should be inspected to insure that they are properly seated in their sockets. All tubes should show the red glow of the tube heater. Lack of this indication of an operating tube heater, should be followed by

TABLE 4. TUBE VOLTAGE CHART, SPECTRUM DISPLAY UNITS

Note: 115V AC INPUT. All measurements taken with RCA WV-97A VTVM to chassis ground.
Gain control set at maximum: no input.
Sweep width set at maximum.

Tube	*Type*	*Pin Number*								
		1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
V-101	5Y3GT		340		315AC		315AC		340	
V-102	OA2	150				150		0		
V-103	OA2	150				150		0		
V-104	12AU7	150	44	49	6.0AC	6.0AC	44	−21	0	0
V-105	12AT7	165	45	50	6.0AC	6.0AC	160	46	50	0
V-106	3RPIA	(See below)								
V-107	12AT7	200	49	53	6.0AC	6.0AC	150	50	53	0
21.4 MC (Type A) IF Chassis										
V-201	6BA6	0	Gnd	6.0AC	Gnd	130	76	1.3		
V-202	6AU6	0	Gnd	6.0AC	Gnd	133	90	1.4		
V-203	6AU6	0	Gnd	6.0AC	Gnd	135	97	1.5		
30.0 MC (Type B) IF Chassis										
V-201	6BA6	0	0	6.1AC	0	140	86	1.35		
V-202	6AU6	0	0	6.1AC	0	144	102	1.4		
V-203	6AU6	0	0	6.1AC	0	145	100	1.53		
V-301	6AH6	0	0	6.0AC	0	190	148	2		
V-302	6AU6	−3.5	0	6.0AC	0	195	146	0		
V-303	6BE6	−9.1	1.1	6.0AC	0	140	104	0		
V-401	6BA6	0	0	6.0AC	0	190	80	1.3		
V-402	6BA6	0	0	6.0AC	0	190	82	1.2		
V-403	6AU6	0	0	6.0AC	0	140	99	1.5		
V-404	6AL5	50	0	4.65AC	0	0	0	50		

WARNING—Beware of Dangerous Voltages in the Cathode-Ray Tube Socket.

V-106	3RPIA	(Remove cover from socket to measure).								
Pin No.	*1*	*2*	*3*	*4*	*6*	*7*	*8*	*9*	*10*	*12*
Voltage	*	−760	−730	−500	160	165	172	200	150	*

* Voltage between pins 1 and 12 is 6.1V AC (Pins 5 and 11 not used).

replacement of the tube. If none of the tube filaments are operating and the pilot lamp does not light, the wire connecting the fuse F-101 is likely to be broken. It often happens that vibration during transportation of the equipment will break the fuse wire in one of the end caps, and a superficial visual inspection would not indicate the defective condition of the fuse connection.

4-2. INOPERATIVE SDU. If there is no indication on the face of the cathode-ray tube, the equipment is considered to be inoperative. This may be caused by maladjusted controls, lack of necessary operating voltages, or defective cathode-ray tube. Advancing the intensity (INT) control, R-130, will cause the trace to appear, if this control has been retarded enough to cause extinction of the tube trace.

The controls marked "V-POS" (R-136) and "H-POS" (R-124) may be adjusted to determine if the trace has been moved completely off the face of the tube by mal-adjustment of these controls. The V-101 rectifier tube should be replaced by a new one to determine if a defective rectifier tube is depriving the unit of operating voltage. If these manipulations do not produce a spot or trace on the tube, the operating voltage of the tube should be checked in accordance with Table 4.

4-3. IMPROPERLY OPERATING SDU. Since defective vacuum tubes are the most prevalent cause of improper equipment operation, systematic tube substitution often results in quick repair of such equipment. A horizontal trace with no vertical "pips" calls for adjustment of the "GAIN" control R-109 to the maximum clockwise position. If this produces "grass" on the trace, it is likely that no input signal is being received. Failure of any of the tubes, V-101, V-102, V-103, V-104, V-107, V-201, V-202, V-302, V-303, V-401, V-402, V-403, or V-404 would prevent a vertical deflection. Replacement of tubes here will determine whether this is the cause of the trouble. A vertical line trace indicates no horizontal sweep. Tubes V-104 or V-105 should be replaced to determine if they are the source of the trouble.

A horizontal trace which shifts vertical position when a signal is tuned in would indicate that tube V-107 or its associated circuitry is at fault. If this procedure does not locate the source of trouble, then the tube-pin-voltages should be checked against the tube voltage table, Table 4. Any appreciable deviation from the listed values should indicate the circuitry at fault. A check of associated circuit components by the schematic diagram, Figures 11 to 11B should indicate the defective component. Any further servicing will necessitate reference to the maintenance section of this manual.

4-4. REPLACEMENT OF CATHODE-RAY TUBE IN SDU.

A. Removal of Cathode-Ray Tube

(a) Pull off CRT socket from tube base.

(b) Remove the 4 screws that hold bezel on front panel. Lift off the bezel and the calibrated green filter screen from the front panel.

(c) Pull rubber boot off the face of the CRT.

(d) Loosen the base clamp of CRT. Remove tube through the front panel. The magnetic shield remains attached to the panel.

B. Installation of CRT:

(a) Insert the tube through front panel, into the magnetic shield.

(b) Put rubber boot over face end of CRT, positioned so that rectangular boot opening will be aligned with the bezel and filter screen.

(c) Connect the socket to the base of the tube.

(d) Install bezel and green filter screen on the panel and tighten the 4 mounting screws. Align the boot opening with the filter screen by pulling CRT away from bezel and rotating base of tube.

(e) With the SDU turned on and adjusted for a well defined base line, check the alignment of the CRT with that of the filter screen. Rotate the CRT, if needed, by turning its socket until the base line is parallel with the horizontal lines on the filter screen. Press forward lightly on the CRT face while rotating in order to prevent simultaneous rotation of the boot.

(f) After aligning the base line with the filter screen, press forward lightly on the tube base and tighten the base mounting clamp.

4-5. ALIGNMENT PROCEDURE

Before alignment of the SDU is attempted, the instrument should be allowed to "warm up" for at least one-half hour.

A. SWEEP GENERATOR AND CATHODE-RAY TUBE ALIGNMENT

Equipment required:

One oscilloscope, DuMont 304-A or equivalent.

PROCEDURE:

(1). Connect the vertical amplifier of the oscilloscope between pin 3 of Tube V-104 and ground.

Connect the horizontal amplifier to pin 5 of V-104 tube.

(2). Set the SYNC control fully clockwise. Turn it slowly counter-clockwise and note where the scope pattern locks in, displaying two cycles of a sine wave positioned vertically. Continue turning the control counter-clockwise until the pattern drops out of sync. Set SYNC control approximately midway between these two positions.

(3). Disconnect the oscilloscope before proceeding with the next step.

B. 4.3 MC I.F. AMPLIFIER ALIGNMENT. This unit has a center frequency of 4.3 megacycles.

Equipment required:
One VTVM (Vacuum Tube Voltmeter)
One Signal Generator, Measurements Corp. #65-B.

PROCEDURE:

(1). Connect a short clip lead across capacitor C-434 to short out the D-C voltage that is normally in series with the detector output.

(2). Connect the VTVM from grid pin 2 of tube V-107 to ground.

(3). Set the SDU GAIN control to maximum, clockwise.

(4). Remove tube V-302 from socket and leave out until needed for oscillator alignment.

(5). Connect the Signal Generator to J-301 and set its frequency to 4.3 mc, adjust its output as required to produce an indication on the VTVM, not to exceed 5 volts.

(6). Install bottom covers on both IF strips. Adjust transformers T-302-A and B. T-401-A and B, T-402-A and B, and T-403-A and B for maximum output and reducing generator output to maintain 5 volts or less on the VTVM until no further improvement can be achieved.

(7). Remove clip lead from the C-434 Capacitor.

C. REACTANCE TUBE AND LOCAL OSCILLATOR ALIGNMENT.

Equipment required:
One Signal Generator, Hewlett-Packard #608-A.
One Signal Generator, Measurements Corp. #65-B
One D-C V.T.V.M. (Vacuum Tube Voltmeter)
One Oscilloscope, DuMont #304-A

PROCEDURE:

(1). Adjust variable resistor R-101 to 100 ohms.

(2). Connect the 608-A signal generator to connector J-301 and set the generator for 21.4 mc for Type A IF or 30.0 mc for Type B IF, and 1 mv. output.

(3). Set GAIN control knob fully clockwise.
Set SWEEP control set-screw fully clockwise.
Set HORIZONTAL GAIN control set-screw counter-clockwise.
Set SWEEP WIDTH control knob fully clockwise.
Replace tube V-302.

(4) Adjust coil Z-301, CENTER FREQUENCY CONTROL, and coil L-301 to obtain vertical pips on the cathode-ray tube.

(5). Set CENTER FREQUENCY control knob pointer straight up. Adjust scope controls so that the cathode-ray tube trace is coincident with the calibrated base line, with the ends of the trace as near the end calibration marks as possible.

(6). Adjust coil Z-301 to center of the pip at the "0" mark on the scale.

(7). Adjust coil L-301 for maximum pip movement toward the left side of the screen.

(8). Repeat steps (6) and (7) while reducing the SWEEP WIDTH control, counter-clockwise, until the response covers the entire tube trace.
Reduce GAIN control as necessary.
Repeat the process until no further improvement can be produced.

(9). Remove the cover from the oscillator unit, Figure 8. Connect the VTVM to tiepoint junction of capacitor C-303 and resistor R-301. Connect vertical amplifier of the scope to capacitor C-328.

(10). Reduce SWEEP WIDTH as necessary to prevent a bias voltage from being indicated on the VTVM. Adjust transformer T-301 for maximum response, centered about 25.7 mc with a 3 db bandwidth of approximately 3.6 mc. Marker generator output is to be held near base of the transformer T-301. The correct response wave shows approximately 5% dip.

(11). Repeat steps (8) and (10).

(12). Replace the bottom cover on the oscillator unit. Touch up the adjustments of transformer T-301 for symmetrical response; coil Z-301 for centering of trace with SWEEP reduced; and coil L-301 for maximum movement of pip toward left of trace.

(13). Modulate the 608-A signal generator by the 65-B signal generator. Use 1 mc modulation for Type 200 SDU, and 1.5 mc for Type 300 SDU.

(14). Set SWEEP WIDTH control to maximum.
Set SWEEP control so modulation pip nearest end of trace is approximately ⅛ inch from end of trace.

(15). Adjust HORIZONTAL POSITION (H-POS) control to set center marker at "0". Set HORIZONTAL GAIN (H-GAIN) to position positive (right side) modulation marker under last screen calibration mark on right.

D. FIRST I.F. AMPLIFIER, GENERAL. It is desirable to have an amplitude response that is as nearly constant as possible over the frequency range displayed by the SDU at maximum sweep. The purpose of the first I.F. amplifier is to compensate the amplitude response at the SDU output of a receiver to achieve constancy of amplitude over the frequency range at maximum sweep.

Type "A" IF chassis has a center frequency of 21.4 MC.

Type "B" IF chassis has a center Frequency of 30.0 MC.

Equipment required:

Sweep Generator, RCA WR59C
Signal Generator, Hewlett-Packard 608-A
Oscilloscope, DuMont 304-A, or equivalent Pad, 6 db, 50/50 ohms.
Marker Generator, Measurements Corp, 65-B; or equivalent Receiver (any unit from the Telemetry Rack)
Coaxial Cable, RG-62/U, 4 ft. long with a UG-260/U connector on one end and an amphenol 75-MCIF connector on the other end.
Coaxial Cable, RG-55/U 3 ft. long, with a UG-88/U connector on each end.

(GENERAL INSTRUCTIONS:—The oscilloscope should be connected across capacitor C-223 in type "A" IF chassis, or C-203 in type "B" chassis, and the direct coupled amplifier used. A low capacity shielded cable such as RG-62/U coaxial cable should be used for connection to the oscilloscope. Cable capacity plus oscilloscope input capacity should be held to a maximum of 100 $\mu\mu$f. There is some local oscillator, 25.7 mc, signal present at the signal grid of the mixer due to coupling through the tube. This signal is amplified by tube V-203 and produces a DC output from the detector. However, since there is a base-line for the visual response, no confusion should result. The marker generator signal should be coupled in as required to produce a suitable marker pip. Check that the marker signal does not upset the response shape, by disconnecting and reconnecting the marker generator and observing that the response shape does not change. In general, the marker signal can be introduced through a small capacitor connected to the sweep generator lead.)

PROCEDURE:

(1). Set the SWEEP WIDTH control knob fully counterclockwise.

(2). Set the GAIN control fully clockwise.

(3). Connect the Sweep Generator between pin 1 of tube V-203 and ground on the tube-socket mounting strap nut.

(4). Set the Sweep Generator output to maximum.

(5) a. On units having a type "A", 21.4 MC IF chassis, adjust transformer T-203 for maximum response at the center frequency, then adjust the transformer for equal response at plus or minus 1 mc for Type 200, or 1.5 mc for Type 300 units. The response curve should be round-nosed with a 5% to 10% greater response at center frequency than at plus or minus 1 mc or 1.5 mc on corresponding units.

b. On units having a type "B", 30.0 MC IF chassis, adjust transformer T-202 for maximum response at the center frequency, then adjust the transformer for equal response at plus or minus 1 mc for Type 200, or 1.5 mc for Type 300 units. The response curve should be round-nosed with 5% to 10% greater response at center frequency than at plus and minus 1 mc or 1.5 mc on corresponding units.

(6). Connect the sweep generator between pin 1 of tube V-202 and ground on the tube-socket mounting strap nut. Set generator output to maximum.

(7). Adjust transformers T-202A and T-202B, on type "A", or, T-201A and T-201B on type "B" chassis for a response in which the peaks have equal amplitudes and are symmetrical about the center frequency. This circuit is greatly overcoupled, which will make the response appear to be two separate peaks about 3 mc apart.

(8). Connect the Sweep Generator between the grid pin 1 of tube V-201 and ground on the tube-socket mounting strap nut. Set the output as required to maintain a volt peak deflection.

(9) a. On type "A" units, adjust T-201A and T-201B for maximum amplitude while maintaining equal amplitude outside peaks.

b. On type "B" units, adjust Z-202 for maximum response at center frequency without regard to overall response curve shape.

(10). Connect the SDU to the receiver and connect the Sweep Generator to the receiver input. Set the Sweep Generator output as required to produce a 1 volt peak deflection. Adjust coil L-201 for maximum response *at center frequency* without regard to the overall response shape.

(11) a. On type "A" units, make slight readjustments to T-201A, T-201B, T-202A, and T-202B for flattest overall response while maintaining approximately maximum amplitude.

b. On type "B" units, make slight re-adjustments to T-201A and T-201B for flattest overall response while maintaining approximately maximum amplitude.

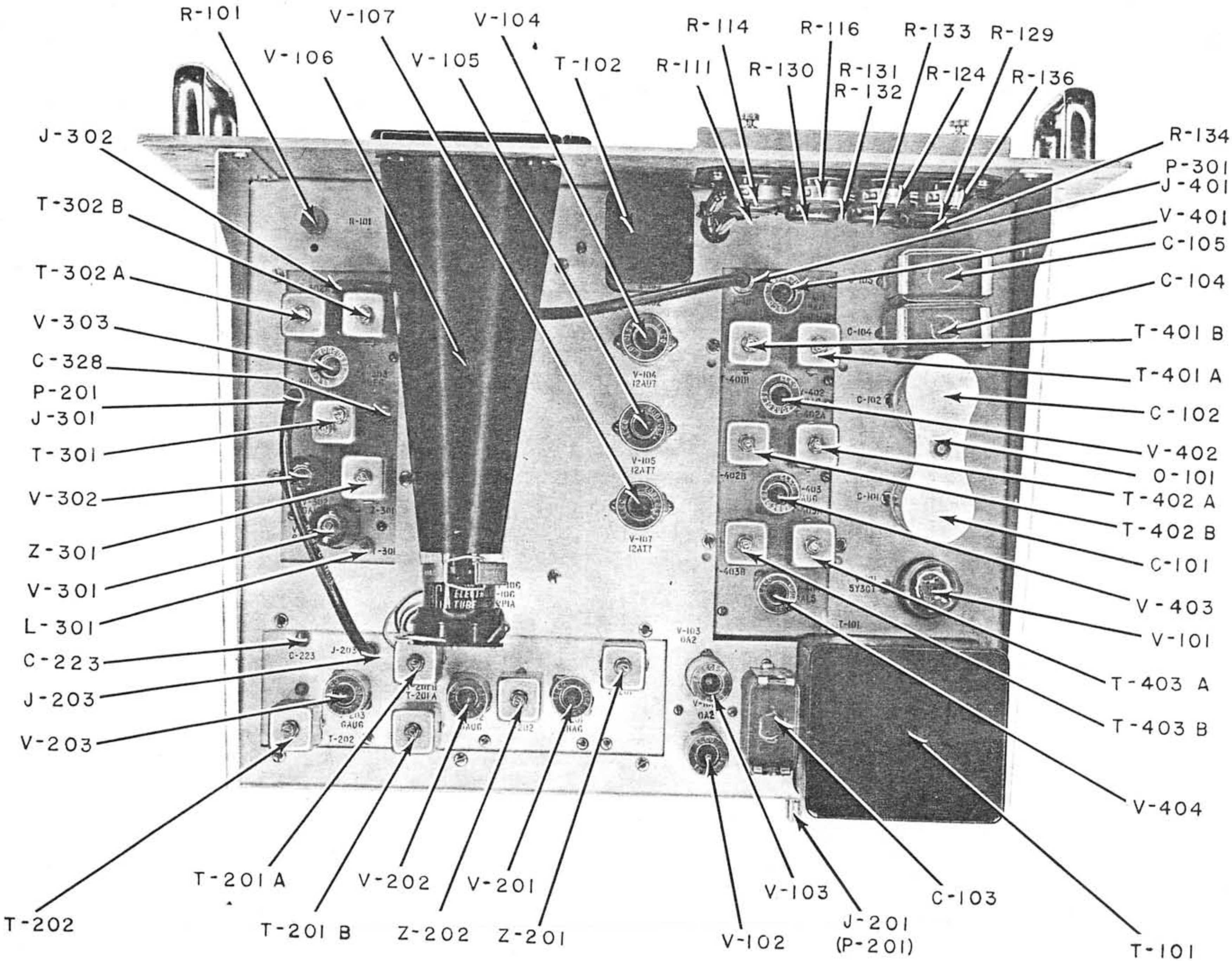


Figure 4. Top View of Main Chassis, Spectrum Display Unit

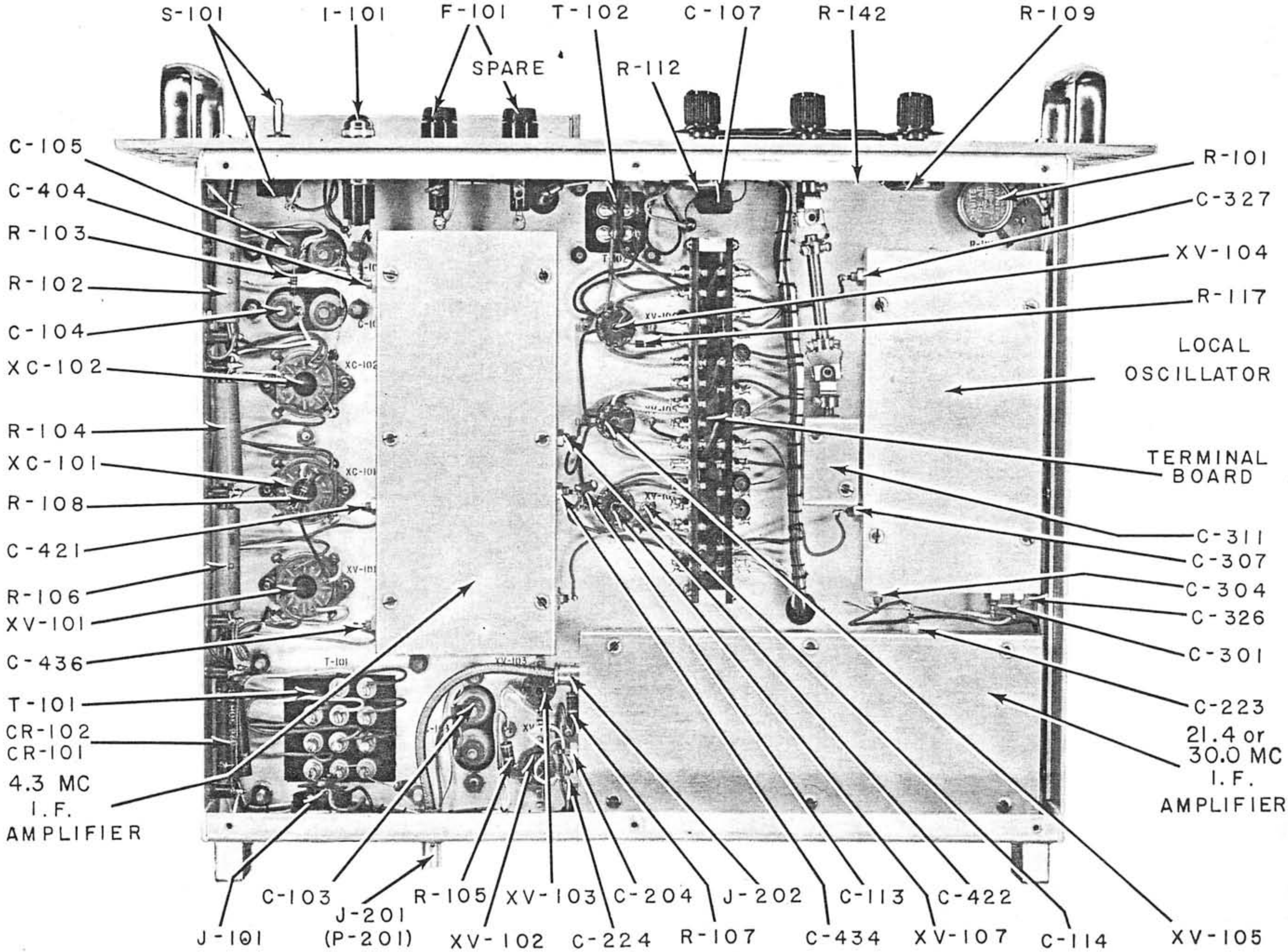


Figure 5. Bottom View of Main Chassis, Spectrum Display Unit

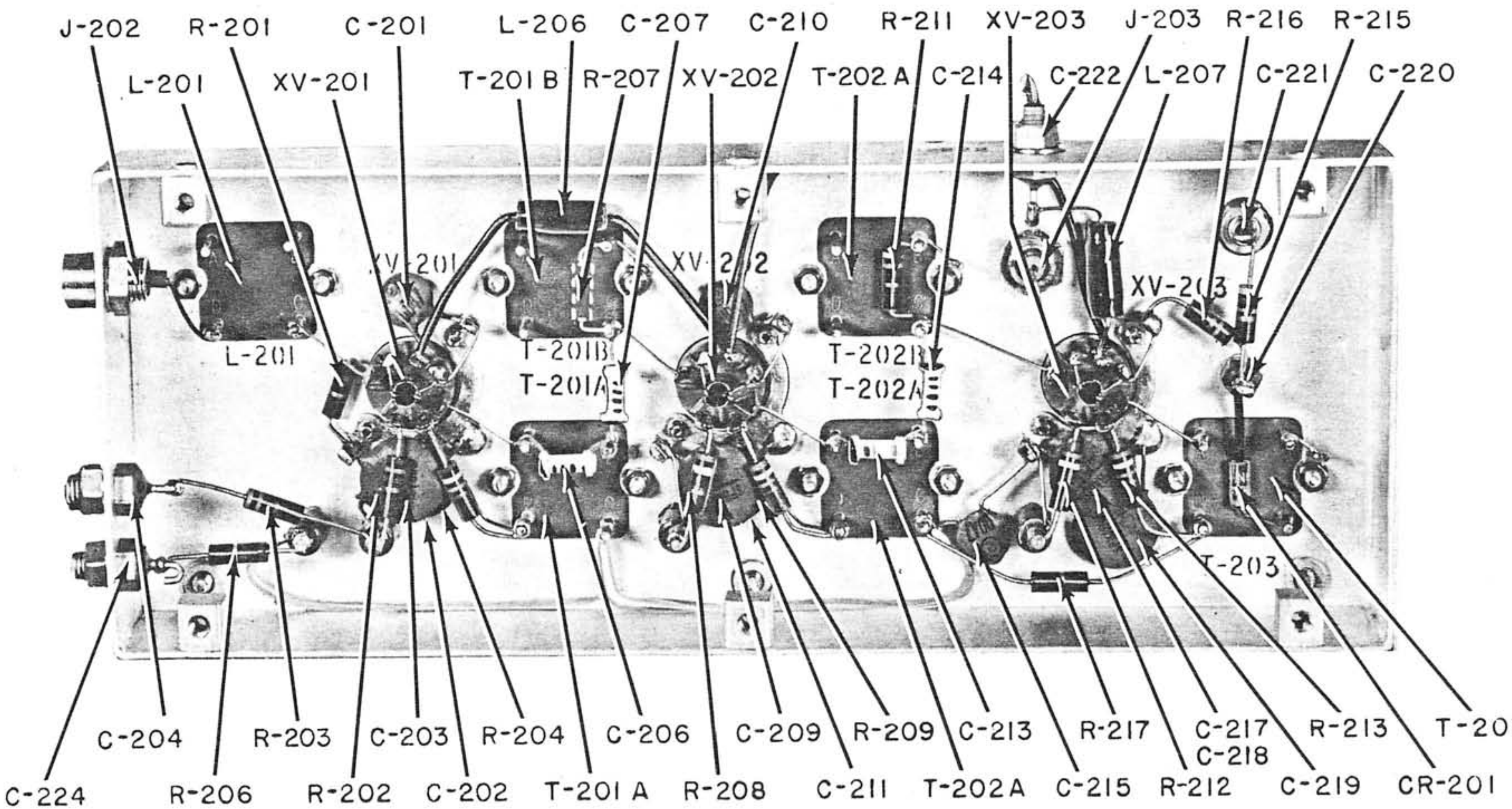


Figure 6. Type "A" I.F. (21.4 mc) Amplifier Chassis, Spectrum Display Unit

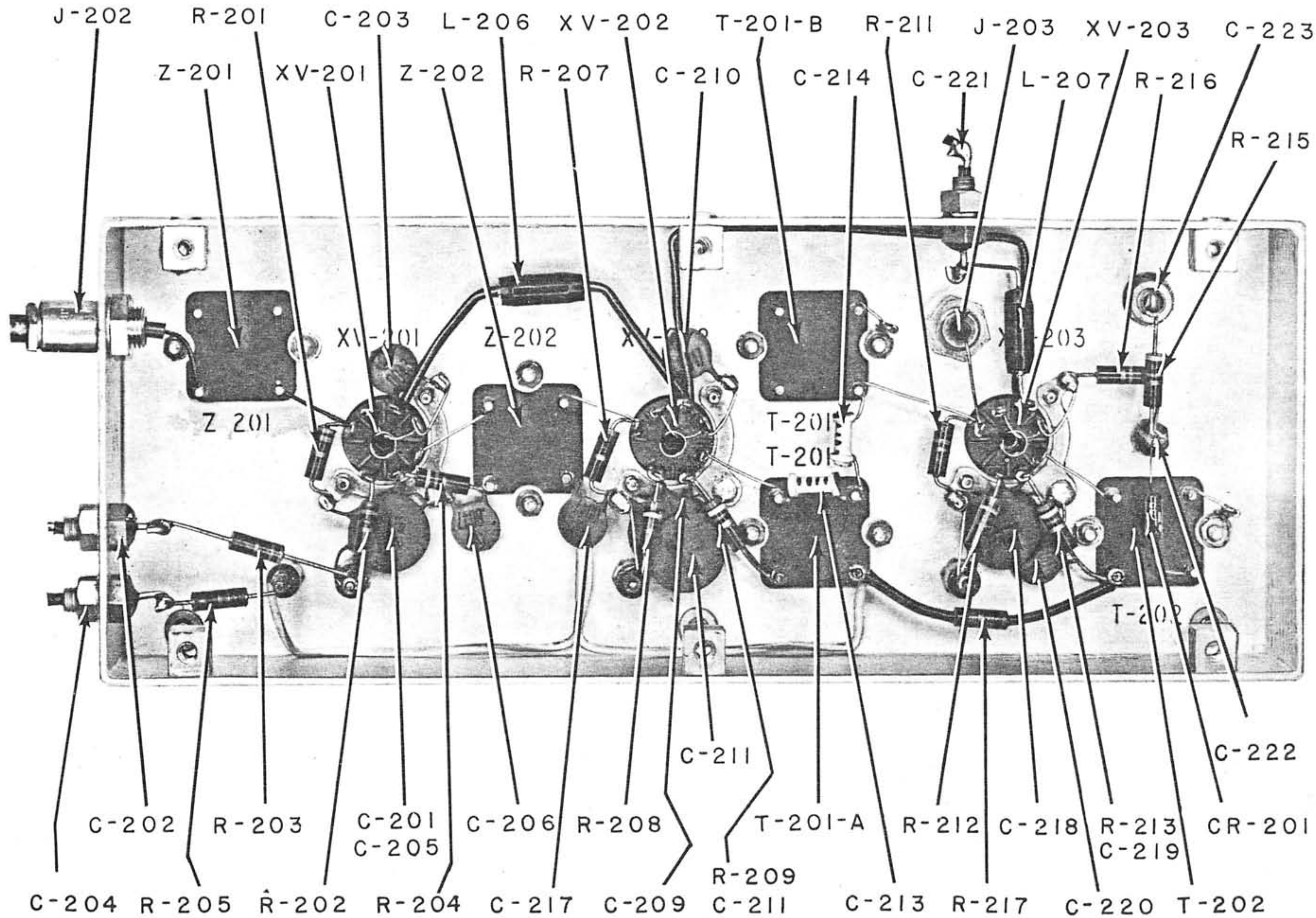


Figure 7. Type "B" I.F. (30.0 mc) Amplifier Chassis, Spectrum Display Unit

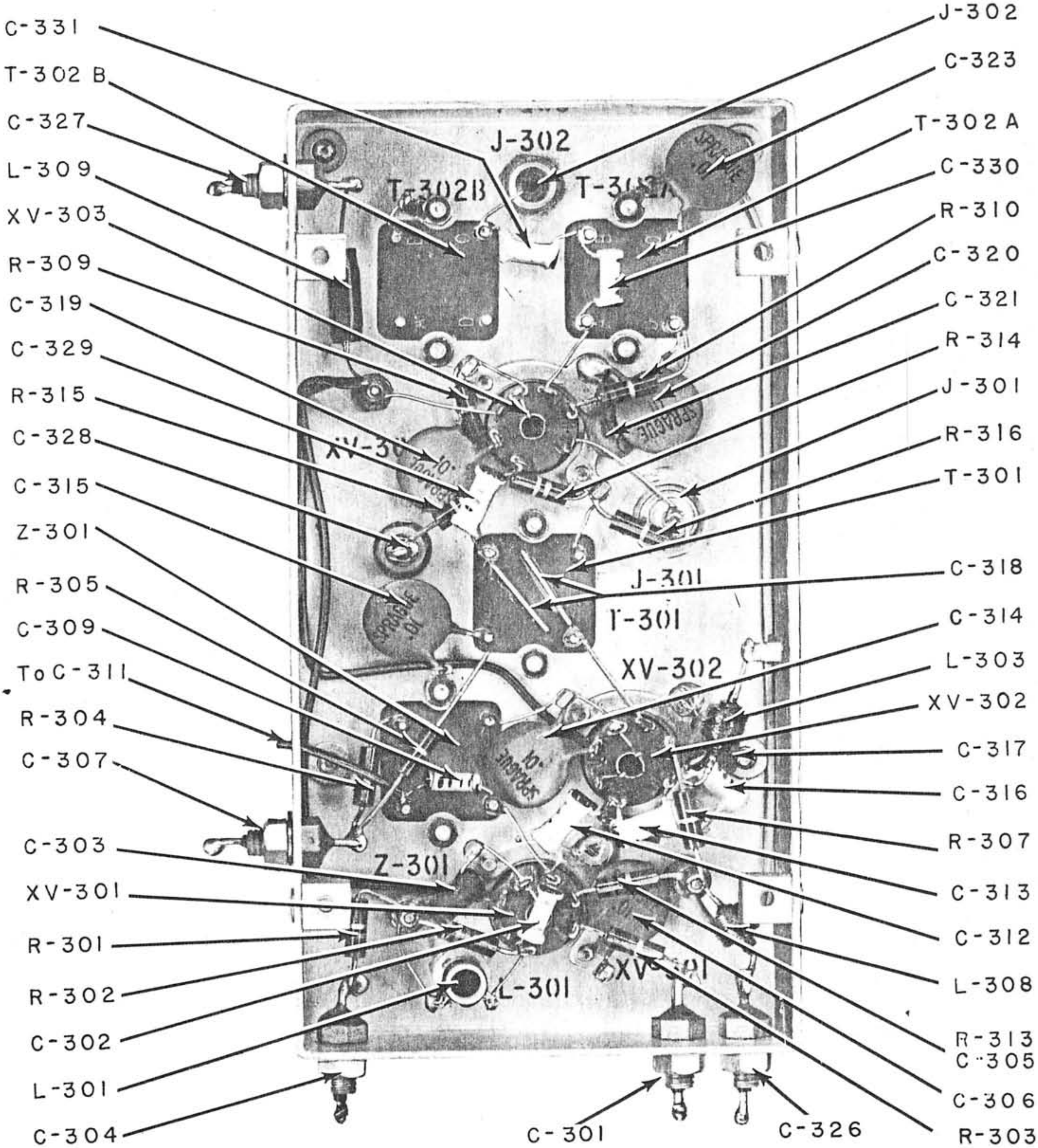


Figure 8. Local Oscillator Chassis, Spectrum Display Unit

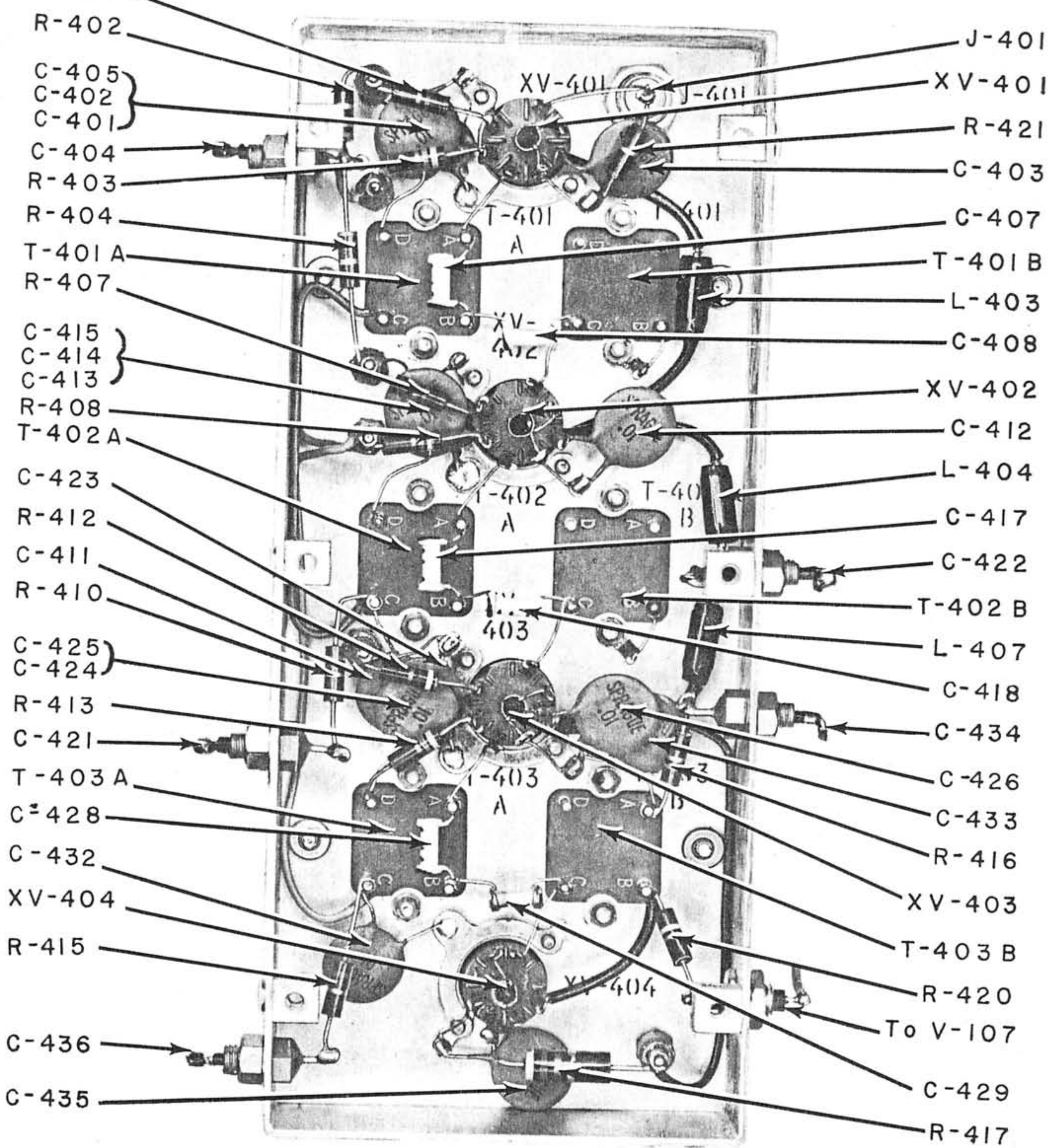


Figure 9. 4.3 mc I.F. Amplifier, Spectrum Display Unit

Figure 10. Terminal Boards, Spectrum Display Units.

SECTION 5

MAINTENANCE PARTS LIST

SPECTRUM DISPLAY UNITS, ALL MODELS

When ordering replacement parts from NEMS-CLARKE COMPANY which are not available from a local supplier, give the equipment name and type number, the symbol number, and the description of each item ordered.

Replacement parts which will be supplied against an order may not be exact duplicates of the original parts. However, only minor differences in the electrical or mechanical characteristics will be involved, and, consequently will in no way impair the operation of the equipment.

Note

Values of items not common to all Spectrum Display Units having a 21.4 MC (Type A) chassis are tabulated in Table 5 following.

The specifications for these items are listed in the parts list in the same manner as other items, except for value, which will be indicated by an asterisk (*) for reference to this table.

TABLE 5. COMPONENT VARIATIONS OF 21.4 MC (TYPE A) FIRST I.F. AMPLIFIERS

Spectrum Display Unit	*C-206*	*C-207*	*C-213*	*C-214*	*R-201*	*R-207*	*R-211*
200-1	10 μμf	15 μμf	10 μμf	10 μμf	4.7 K	16 K	2.0 K
200-2	10 μμf	12 μμf	6.8 μμf	10 μμf	2.7 K	Not used	4.3 K
300-1	15 μμf	22 μμf	10 μμf	18 μμf	3.0 K	47 K	2.7 K
300-4	15 μμf	22 μμf	10 μμf	18 μμf	2.7 K	33 K	2.4 K
Since additional variations occur in the components of the SDU's with 30 MC (Type B) First I.F. Chassis, a separate tabulation for these parts appears in the parts list.							
200-3 & 300-3	See C-201 thru C-223 and R-201 thru R-217 in the parts list.						

Circuit Symbol Number		*Description and Manufacturer*
Type A IF Chassis	*Type B IF Chassis*	
C-204, 222, 224, 301, 307, 404, 421, 422, 434, 436		CAPACITOR, fixed, ceramic, 1000 μμf, MRC, 500V. Sprague 514C1.
	C-204	Same as C-202
C-205		CAPACITOR, part of T-201A, not separately replaceable.
	C-205, to C-206	Same as C-203
C-206*		CAPACITOR, fixed, ceramic: (*), ±5%, 500V. Erie NPO-A.
C-207*		CAPACITOR, fixed, ceramic: (*), ±5%, 500V. Erie NPO-A.
	C-207	CAPACITOR, part of Z-202, not separately replaceable.
C-208		CAPACITOR, part of T-201B, not separately replaceable.
	C-208	CAPACITOR, part of Z-202, not separately replaceable.
C-209		Same as C-202
C-210	C-209	Same as C-201
	C-210	Same as C-203
C-211		Same as C-202
	C-211	Same as C-201
C-212		CAPACITOR, part of T-202A, not separately replaceable.
	C-212	Same as C-203
C-213*		CAPACITOR, fixed, ceramic: (*), ±5%, 500V. Erie NPO-A.
	C-213, 214	CAPACITOR, fired, ceramic; 10 μμf, ±10%, 500V. Erie NPO-A.
C-214*		CAPACITOR, fixed, ceramic: (*), ±5%, 500V. Erie NPO-A.
	C-214	Same as C-213
C-215		Same as C-201
	C-215	CAPACITOR, part of T-201A, not separately replaceable.
C-216		CAPACITOR, part of T-202B, not separately replaceable.
	C-216	CAPACITOR, part of T-201B, not separately replaceable.
C-217		Same as C-202
	C-217	Same as C-203
C-218	C-218	Same as C-201

*Refer to Table 5 for values applying to each type of SDU.

Circuit Symbol Number		*Description and Manufacturer*
Type A IF Chassis	*Type B IF Chassis*	
C-219		Same as C-202
	C-219	Same as C-203
C-220		CAPACITOR, fixed, ceramic, standoff: 470 μμf, MRC, 500V. Sprague 507C8A.
	C-220	Same as C-203
C-221, 304, 328		CAPACITOR, fixed, ceramic, feedthru: 47 μμf, ±20%, 500V. Sprague 514C11A.
	C-221	Same as C-202
C-222		Same as C-204
	C-222	CAPACITOR, fixed, ceramic, 470 μμf, MRC, 500V. Sprague 507-C8A.
C-223		Same as C-201
	C-223	CAPACITOR, fixed, ceramic, feedthru: 47 μμf, ±20%, 500V. Sprague 514C11A.
C-224	Not used.	Same as C-204
C-225	Not used.	Same as C-201

C-301	Same as C-204
C-302	CAPACITOR, fixed, ceramic: 3.9 μμf, ±0.25 μμf, 500V. Erie NOP-A.
C-303, 326, 327	CAPACITOR, fixed, ceramic: 1000 μμf, ±10%, 500V. Erie GP2-331.
C-304	Same as C-221
C-305	Same as C-202
C-306	Same as C-201
C-307	Same as C-204
C-308	CAPACITOR, part of Z-301, not separately replaceable.
C-309	CAPACITOR, fixed, ceramic: 15 μμf, ±5%, 500V. Erie NPO-A.
C-310	Not used
C-311	CAPACITOR, variable, air dielectric: 1.5-5 μμf, 750V, 60C, AC. Hammarlund MAC-5.
C-312, 313, 316, 329	CAPACITOR, fixed, ceramic: 33 μμf, ±5%, 500V. Erie NPO-T.

Circuit Symbol Number	*Description and Manufacturer*
C-313	Same as C-312
C-314 to C-315	Same as C-202
C-316	Same as C-312
C-317	Same as C-201
C-318	CAPACITOR, variable, air dielectric: Bus wires between pins A and C of T-301, not separately replaceable.
C-319 to C-320	Same as C-202
C-321	Same as C-201
C-322	CAPACITOR, part of T-302A, not separately replaceable.
C-323	Same as C-202
C-324 to C-325	CAPACITOR, part of T-302B, not separately replaceable.
C-326 to C-327	Same as C-303
C-328	Same as C-221
C-329	Same as C-312
C-330, 331, 407, 408, 417, 418, 428	CAPACITOR, fixed, ceramic: 1.5 $\mu\mu$f, $\pm$0.1 $\mu\mu$f, 500V. Erie NPO-A.
C-331	Same as C-330
C-401	Same as C-202
C-402	Same as C-201
C-403	Same as C-202
C-404	Same as C-204
C-405	Same as C-202
C-406	CAPACITOR, part of T-401A, not separately replaceable.
C-407 to C-408	Same as C-330

Circuit Symbol Number	*Description and Manufacturer*
C-409 to C-410	CAPACITOR, part of T-401B, not separately replaceable.
C-411 to C-413	Same as C-202
C-414	Same as C-201
C-415	Same as C-202
C-416	CAPACITOR, part of T-402A, not separately replaceable.
C-417 to C-418	Same as C-330
C-419 to C-420	CAPACITOR, part of T-402B, not separately replaceable.
C-421 to C-422	Same as C-204
C-423	Same as C-202
C-424	Same as C-201
C-425 to C-426	Same as C-202
C-427	CAPACITOR, part of T-403A, not separately replaceable.
C-428	Same as C-330
C-429	CAPACITOR, fixed, ceramic: 1.2 $\mu\mu$f, $\pm$0.1 $\mu\mu$f, 500V. Erie NPO-A.
C-430 to C-431	CAPACITOR, part of T-403B, not separately replaceable.
C-432 to C-433	Same as C-202
C-434	Same as C-204
C-435	Same as C-202
C-436	Same as C-204

Circuit Symbol Number	*Description and Manufacturer*
CR-101, 102	RECTIFIER, selenium: half-wave circuit, single phase; half-wave rectification; 780V AC, RMS. max. input: 315V, DC; 5 ma max. output. Sarkes-Tarzian A-302; Type 026-30H-QC.
CR-102	Same as CR-101
CR-201	DIODE, CRYSTAL, germanium: 60V continuous reverse working voltage; 5-ma at +1 volt forward current; 100 K reverse resistance at 50V. Raytheon CK-705/IN66.
E-101, 102, 103	KNOB, black bakelite: round, with pointer; set-screw type, for ¼″ shaft. Molded Insulation VIZ-A.
E-104 to E-105	KNOB, black bakelite: round, for ¼″ shaft. Waldon 1450.
F-101 to F-102	FUSE, slo-blo: 1-amp, 250V. Type 3AG. Littlefuse 313-001.
I-101	LAMP, incandescent: 6-8 V. 0.15 amp; bayonet base, T-3¼ bulb, clear. G.-E #47.
J-101	CONNECTOR, receptacle: 15 amp at 125V, AC. Hubbel 7486.
J-201	CONNECTOR, receptacle, RF: type UG-291/U.
J-202	CONNECTOR, coaxial terminal, RF: type MX-1684/U. IPC 1025.
J-203, 302	CONNECTOR, coaxial terminal, RF: Type MX-1530/U. IPC 1050.
J-301	CONNECTOR, receptacle, RF: Type UG-1094/U.
J-302	Same as J-203.
J-401	Same as J-301.
L-201	(Type A, IF) COIL, RF, variable: NEMS-CLARKE dwg/no. AB-17,612 (Type B, IF) COIL, RF: part of Z-201, not separately replaceable.
L-202	(Type A) COIL: part of T-201A, not separately replaceable. (Type B) COIL: part of Z-202, not separately replaceable.
L-203	(Type A) COIL: part of T-201B, not separately replaceable. (Type B) COIL: part of T-201A, not separately replaceable.
L-204	(Type A) COIL: part of T-202A, not separately replaceable. (Type B) COIL: part of T-201B, not separately replaceable.
L-205	(Type A) COIL: part of T-202B, not separately replaceable.
L-205A, B	(Type B) COIL: part of T-202, not separately replaceable.
L-206, 207, 309, 403, 404, 407	CHOKE, RF: 2.8 μh. NEMS-CLARKE part/dwg no. A-16,225.
L-207	Same as L-206
L-301	COIL, RF; 6.5-10.6 μh, 1.25 ohms DC resistance; 29 turns Litz wire #6/44; single wound; with tuning capacitor. Cambridge Thermionic Corp. X-2060-3.

Circuit Symbol Number	*Description and Manufacturer*
L-302	COIL: part of Z-301, not separately replaceable.
L-303	CHOKE, RF: 75 μh, 3.8 ohms DC resistance. Wilco 1075-15.
L-304 to L-305	COIL: part of T-301, not separately replaceable.
L-306	COIL: part of T-302A, not separately replaceable.
L-307	COIL: part of T-302B, not separately replaceable.
L-308	CHOKE, RF: 240 μh, 502 ohms DC resistance. Wilco 3240-15.
L-309	Same as L-206
L-401	COIL: part of T-401A, not separately replaceable.
L-402	COIL: part of T-401B, not separately replaceable.
L-403 to L-404	Same as L-206
L-405	COIL: part of T-402A, not separately replaceable.
L-406	COIL: part of T-402B, not separately replaceable.
L-407	Same as L-206
L-408	COIL: part of T-403A, not separately replaceable.
L-409	COIL: part of T-403B, not separately replaceable.
O-101	CLAMP, capacitor: NEMS-CLARKE part/dwg no. A-15,686.
O-102 to O-103	SHIELD, electron tube: (for 7-pin, min., T-5½ envelope) Type TS-102U03. Elco Corp. 149.
O-104 to O-105, 107	SHIELD, electron tube: (for 9-pin, min., RETMA envelope style 6½); type TS-103U02. Elco Corp. 191.
O-106	SHIELD, cathode-ray tube: (for 3RP1-A C.R.T.); type S-3001. Jan Hardware.
O-107	Same as O-104
O-201 to O-203, 401, 402, 403	SHIELD, electron tube: (for 7-pin min., T-5½ envelope) type TS102U02.
O-301 to O-303	SHIELD, electron tube: (for 7-pin, min., T-5½ envelope) Collins 66J-2.

Circuit Symbol Number	*Description and Manufacturer*
O-401 to O-403	Same as O-201
O-404	SHIELD, electron tube: (for 7-pin, min., T-5½ envelope) (JAN) TS102U01. Elco 12.
P-201, P-301	CONNECTOR, plug, RF: Progress Electronics UG-260/U.
P-301	Same as P-201.
R-101	RESISTOR, variable, composition: 500 ohms, ±10%, 2 W. Ohmite CLU-5011-SD4040L.
R-102, 104, 106	RESISTOR, fixed, wirewound, inductive winding: 5 K, ±5%, 10 W. Sprague NIT.
R-103	RESISTOR, fixed, composition: 47 K, ±10%, ½ W. Allen-Bradley EB-4731.
R-104	Same as R-102
R-105, 107	RESISTOR, fixed, composition: 470 ohms, ±10%, 1 W. Allen-Bradley GB-4711.
R-106	Same as R-102
R-107	Same as R-105
R-108, 142, 301, 416	RESISTOR, fixed, composition: 10 K, ±10%, ½ W. Allen-Bradley EB-1031.
R-109	RESISTOR, fixed, composition: 10 K, ±10%, 2 W. Allen Bradley JB-1031, F3040.
R-110	RESISTOR, fixed, composition: 1.8 Meg, ±10%, ½ W. (JAN) RC20GF185K.
R-111	RESISTOR, variable, composition: 1 meg, ±20%, 2 W. Allen-Bradley JLU-1052, SD4040L.
R-112, 129	RESISTOR, variable, composition: 500 K, ±10%, 2 W. Allen-Bradley JLU-5041, P3040.
R-113	RESISTOR, fixed, composition: 1.5 K, ±5%, ½ W. Allen-Bradley EB-1521.
R-114, 116	RESISTOR, variable, composition: 10 K, ±10%, 2 W. Allen-Bradley JLU-1031.
R-115, 310	RESISTOR, fixed, composition: 6.8 K, ±10%, ½ W. Allen-Bradley EB-6821.
R-116	Same as R-114
R-117, 206, 303, 401, 407	RESISTOR, fixed, composition: 100 ohm, ±10%, ½ W. Allen-Bradley EB-1011.
R-118	RESISTOR, fixed, composition: 2 meg, ±5%, ½ W. Allen-Bradley EB-2055.

Circuit Symbol Number	*Description and Manufacturer*
R-119 to R-120	RESISTOR, fixed, composition: 150 K, ±5%, ½ W. Allen-Bradley EB-1545.
R-121, 123, 138, 312, 406, 411	RESISTOR, fixed, composition: 470 K, ±10%, ½ W. Allen-Bradley EB-4741.
R-122	RESISTOR, fixed, composition: 33 K, ±5%, ½ W. Allen-Bradley EB-3335.
R-123	Same as R-121
R-124	RESISTOR, variable, composition: 25 K, ±10%, 2 W. Allen-Bradley JLU-2531.
R-125, 139, 140	RESISTOR, fixed, composition: 100 K, ±5%, ½ W. Allen-Bradley EB-1025.
R-126 to R-127	RESISTOR, fixed, composition: 8.2 K, ±5%, ½ W. Allen-Bradley EB-8225.
R-128, 215, 216	RESISTOR, fixed, composition: 47 K, ±5%, ½ W. Allen-Bradley EB-4735.
R-129	Same as R-112
R-130	RESISTOR, variable, composition: 50 K, ±10%, 2 W. Allen-Bradley JU-5031.
R-131	RESISTOR, fixed, composition: 120 K, ±10%, ½ W. Allen Bradley EB-1241.
R-132	RESISTOR, fixed, composition: 56 K, ±10%, ½ W. Allen-Bradley EB-5631.
R-133	RESISTOR, variable, composition: 250 K, ±10%, 2 W. Allen-Bradley JU-2541, P-3040.
R-134	RESISTOR, fixed, composition: 330 K, ±10%, 1 W. Allen-Bradley GB-3341.
R-135	RESISTOR, fixed, composition: 160 K, ±5%, 1 W. Allen-Bradley GB-1645.
R-136	RESISTOR, variable, composition: 5 K, ±10%, 2 W. Allen-Bradley JLU-5021, SD-4040L.
R-137	RESISTOR, fixed, composition: 36 K, ±5%, ½ W. Allen-Bradley EB-3635.
R-138	Same as R-121.
R-139 to R-140	Same as R-125
R-141	RESISTOR, fixed, composition: 27 K, ±5%, ½ W. Allen-Bradley EB-2735.
R-142	Same as R-108

Circuit Symbol Number		Description and Manufacturer
Type A IF Chassis	*Type B IF Chassis*	
R-201*		RESISTOR, fixed, composition: (*), ±5%, ½ W. (JAN) RC20GF (*)J.
	R-201	RESISTOR, fixed, composition: 3.3 K, ±5%, ½ W. (JAN) RC20GF335J; Allen-Bradley EB-3325.
R-202	R-202	RESISTOR, fixed, composition: 130 ohms, ±5%, ½ W. (JAN) RC20GF131J; Allen-Bradley EB-1315.
R-203	R-203	RESISTOR, fixed, composition: 33 ohms, ±5%, ½ W. (JAN) RC20GF330J; Allen-Bradley EB-3305.
R-204, 306, 403, 408	R-204, 306	RESISTOR, fixed, composition: 24 K, ±5%, ½ W. (JAN) RC20GF243J; Allen-Bradley EB-2435.
R-205		RESISTOR, part of T-201A, not separately replaceable.
	R-205	RESISTOR, fixed, composition: 100 ohms, ±5%, ½ W. (JAN) RC20GF101K; Allen-Bradley EB-1015.
R-206		Same as R-117
	R-206	RESISTOR, part of Z-202, not separately replaceable.
R-207*		RESISTOR, fixed, composition: (*), ±5%, ½ W. (JAN) RC20GF(*)J.
	R-207	RESISTOR, fixed, composition: 3 K, ±5%, ½ W. (JAN) RC20GF302J; Allen-Bradley EB-3025.
R-208, 212, 412	R-208, 212, 412	RESISTOR, fixed, composition: 390 ohms, ±5%, ½ W. (JAN) RC20GF391J; Allen-Bradley EB-3915.
R-209, 213, 413	R-209, 213, 413	RESISTOR, fixed, composition: 39 K, ±5%, ½ W. (JAN) RC20GF393J; Allen-Bradley EB-3935.
R-210		RESISTOR, part of T-202A, not separately replaceable.
	T-210	RESISTOR, part of T-201A, not separately replaceable.
R-211*		RESISTOR, fixed, composition: (*), ±5%, ½ W. (JAN) RC20GF(*)J.
	R-211	RESISTOR, fixed, composition: 15 K, ±5%, ½ W. (JAN) RC20GF153J. Allen-Bradley EB-1535.
R-212	R-212	Same as R-208
R-213	R-213	Same as R-209
R-214		RESISTOR, part of T-203, not separately replaceable.
	R-214	RESISTOR, part of T-202, not separately replaceable.

*Refer to Table 5 for values applying to each type of SDU.

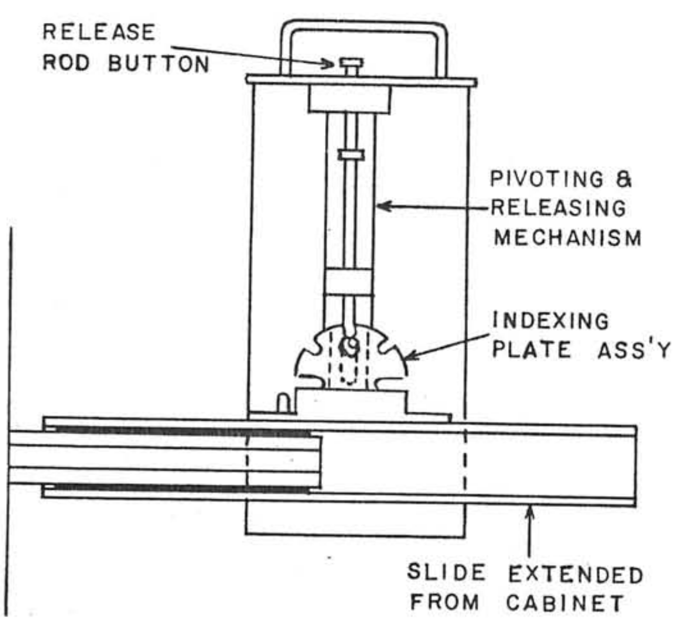
Circuit Symbol Number		*Description and Manufacturer*
Type A IF Chassis	*Type B IF Chassis*	
R-215 to R-216	R-215 to R-216	Same as R-128
R-217, 304, 305, 307	R-217, 304, 305, 307	RESISTOR, fixed composition: 1 K, 10%, ½ W. (JAN) RC20GF102K; Allen-Bradley EB-1021.
R-301		Same as R-108
R-302		RESISTOR, fixed, composition: 330 ohms, ±5%, ½ W. (JAN) RC20GF331J; Allen-Bradley EB-3315.
R-303		Same as R-117
R-304 to R-305		Same as R-217
R-306		Same as R-204
R-307		Same as R-217
R-308		RESISTOR, part of T-301, not separately replaceable.
R-309		RESISTOR, fixed, composition: 150 ohms, ±10%, ½ W. (JAN) RC20GF151K; Allen-Bradley EB-1511.
R-310		Same as R-115.
R-311		RESISTOR, part of T-302A, not separately replaceable.
R-312		RESISTOR, part of T-302B, not separately replaceable.
R-313, 410, 415		RESISTOR, fixed, composition: 270 ohms, ±10%, ½ W. (JAN) RC20GF271K; Allen-Bradley EB-2711.
R-314 to R-315		RESISTOR, fixed, composition: 100K, ±10%, ½ W. (JAN) RC20GF104K. Allen-Bradley EB-1045.
R-316, 421		RESISTOR, fixed, composition: 1 meg, ±5%, ½ W. (JAN) RC20GF105J. Allen-Bradley EB-1055.
R-401		Same as R-117
R-402, 404		RESISTOR, fixed, composition: 33 ohms, ±10%, ½ W. (JAN) RC20GF330K, Allen-Bradley EB-3301.
R-403		Same as R-204
R-404		Same as R-402
R-405		RESISTOR, part of T-401A, not separately replaceable.

Circuit Symbol Number	*Description and Manufacturer*
R-406	RESISTOR, part of T-401B, not separately replaceable.
R-407	Same as R-117
R-408	Same as R-204
R-409	RESISTOR, part of T-402A, not separately replaceable.
R-410	Same as R-313
R-411	RESISTOR, part of T-402B, not separately replaceable.
R-412	Same as R-208
R-413	Same as R-209
R-414	RESISTOR, part of T-403A, not separately replaceable.
R-415	Same as R-313
R-416	Same as R-108
R-417	RESISTOR, fixed, composition: 4.7 ohms, ±10%, 1 W. (JAN) RC20GF4R7K; Allen-Bradley EB-4R71.
R-418 to R-419	RESISTOR, part of T-403B, not separately replaceable.
R-420	RESISTOR, fixed, composition: 220 K, ±10%, ½ W. (JAN) RC20GF224K; Allen-Bradley EB-2241.
R-421	Same as R-316
T-101	TRANSFORMER, power: NEMS-CLARKE part/dwg no. AC-17,745.
T-102	TRANSFORMER, output: NEMS-CLARKE part/dwg. no. AB-17,744.
T-201A	(Type A, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,614. (Type B, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,989.
T-201B	(Type A, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,613. (Type B, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,987.
T-202	(Type B, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,985.
T-202A	(Type A, IF Chassis) Same as T-201A.
T-202B	(Type A, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,615.
T-203	(Type A, IF Chassis) TRANSFORMER, IF: NEMS-CLARKE dwg/no. AB-17,611.
T-301	TRANSFORMER, IF: NEMS-CLARKE part/dwg no. AB-17,910.
T-302A, 401A, 402A, 403A	TRANSFORMER, IF: NEMS-CLARKE part/dwg no. AB-17,553.

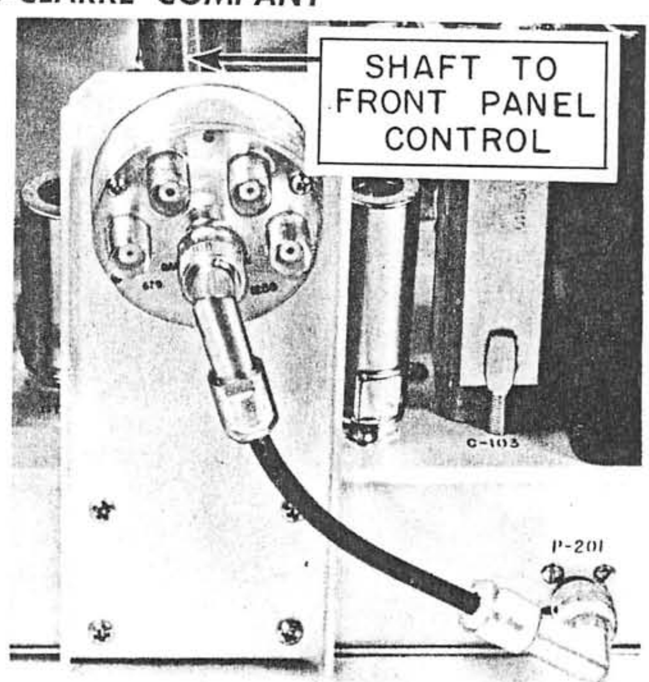
Circuit Symbol Number	*Description and Manufacturer*
T-302B, 401B, 402B	TRANSFORMER, IF: NEMS-CLARKE part/dwg no. AB-17,625.
T-401A	Same as T-302A
T-401B	Same as T-302B
T-402A	Same as T-302A
T-402B	Same as T-302B
T-403A	Same as T-302A
T-403B	TRANSFORMER, IF: NEMS-CLARKE part/dwg no. AB-17,624.
V-101	TUBE, electron: 5Y3GT.
V-102	TUBE, electron: OA2.
V-103	Same as V-102
V-104	TUBE, electron: 12AU7A.
V-105	TUBE, electron: 12AT7.
V-106	TUBE, electron: 3RP1-A.
V-107	Same as V-105
V-201	TUBE, electron: 6BA6.
V-202	TUBE, electron: 6BU6.
V-203	Same as V-202
V-301	TUBE, electron: 6AH6
V-302	Same as V-202
V-303	TUBE, electron: 6BE6.
V-401 to V-402	Same as V-201
V-403	Same as V-202
V-404	TUBE, electron: 6AL5.

Circuit Symbol Number	*Description and Manufacturer*
W-101	CABLE, connecting, power: NEMS-CLARKE part/dwg. no. AA-19,709.
XF-101 to XF-102	FUSEHOLDER, bakelite: (for 3AG fuse) Bussman HKP
XI-101	LAMPHOLDER, min. bayonet base: green lens. Dialco 81410-112
XC-101 XC-102 XV-101	SOCKET, electron tube: octal. (JAN) TS101P01.
XV-102 to XV-103	SOCKET, electron tube: 7 pin, min. Elco BR-151-BC.
XV-104 to XV-105	SOCKET, electron tube: 9 pin, min. Elco BR-283-BC.
XV-201 to XV-203	Same as XV-102
XV-301 to XV-303	Same as XV-102
XV-401 to XV-404	Same as XV-102
Z-201	(Type B, IF Chassis) FILTER, IF: input. NEMS-CLARKE part/dwg no. AB-17,988.
Z-202	(Type B, IF Chassis) FILTER, IF: interstage. NEMS-CLARKE part/dwg no. AB-17,986.
Z-301	FILTER, IF: interstage. NEMS-CLARKE part/dwg. no. AB-17,909.

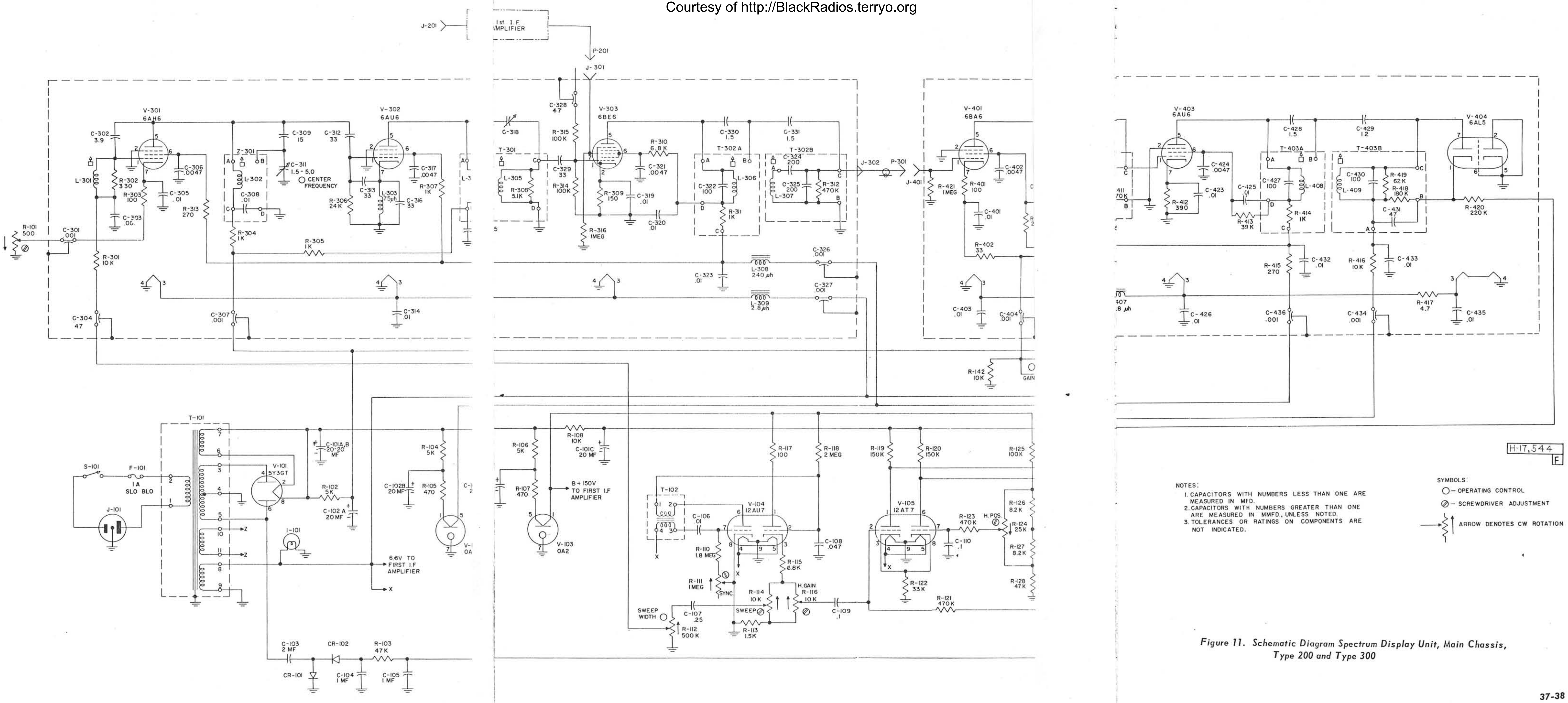
ACCESSORIES FOR SPECTRUM DISPLAY UNITS AVAILABLE FROM NEMS-CLARKE COMPANY



SMT Slide Mounting Assembly



SWK-100 Switch Kit Assembly



NOTES:

1. CAPACITORS WITH NUMBERS LESS THAN ONE ARE MEASURED IN MFD.
2. CAPACITORS WITH NUMBERS GREATER THAN ONE ARE MEASURED IN MMFD., UNLESS NOTED.
3. TOLERANCES OR RATINGS ON COMPONENTS ARE NOT INDICATED.

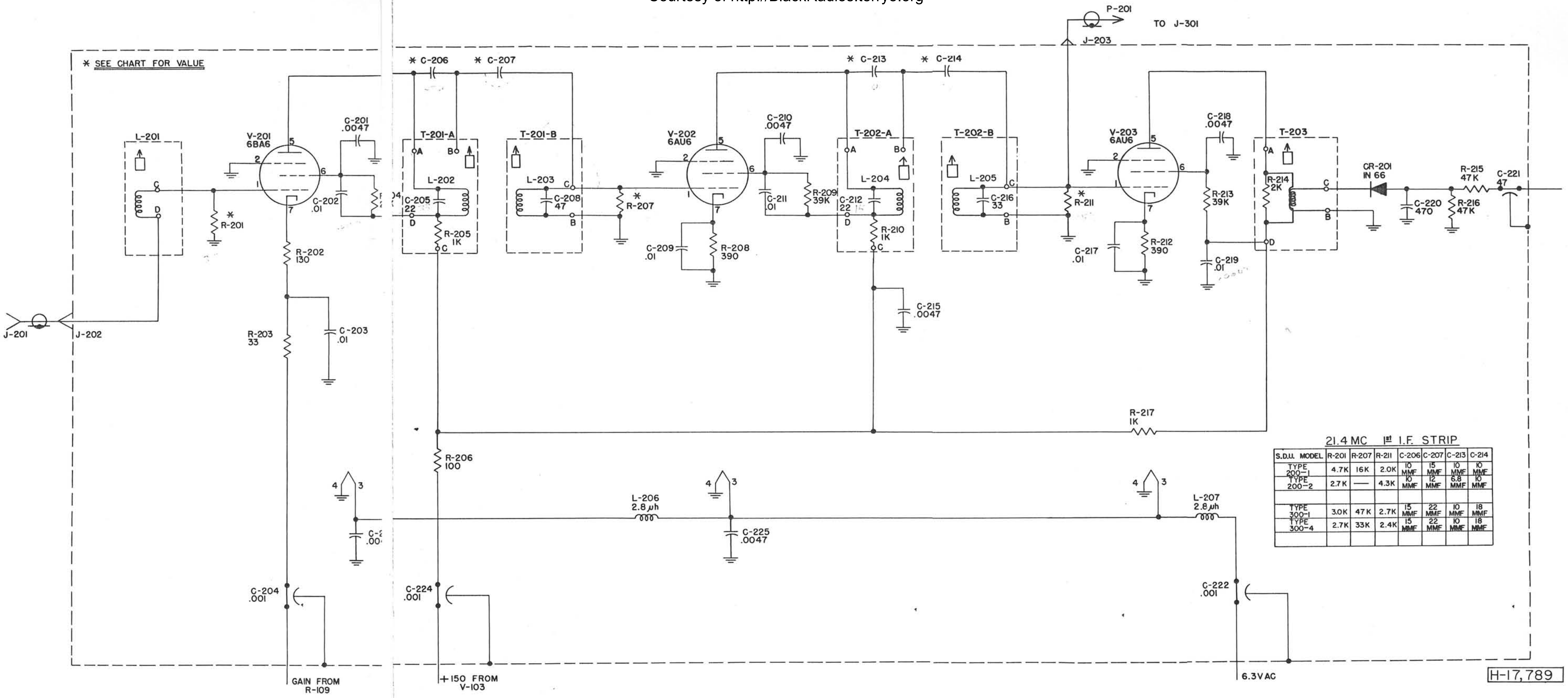
SYMBOLS:

○ – OPERATING CONTROL

⊘ – SCREWDRIVER ADJUSTMENT

ARROW DENOTES CW ROTATION

Figure 11. Schematic Diagram Spectrum Display Unit, Main Chassis, Type 200 and Type 300



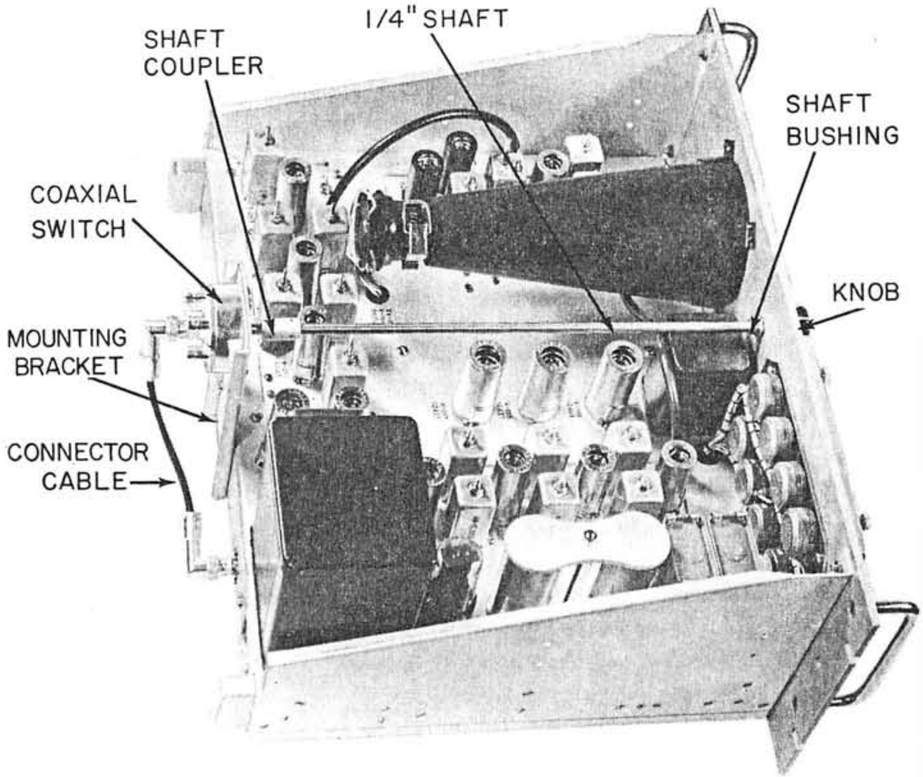
21.4 MC 1st I.F. STRIP

S.D.U. MODEL	R-201	R-207	R-211	C-206	C-207	C-213	C-214
TYPE 200-1	4.7K	16K	2.0K	10 MMF	15 MMF	10 MMF	10 MMF
TYPE 200-2	2.7K	—	4.3K	10 MMF	12 MMF	6.8 MMF	10 MMF
TYPE 300-1	3.0K	47K	2.7K	15 MMF	22 MMF	10 MMF	18 MMF
TYPE 300-4	2.7K	33K	2.4K	15 MMF	22 MMF	10 MMF	18 MMF

NOTES:
1. CAPACITORS WITH NUMBERS LESS THAN 1.0 ARE IN MFD.
2. CAPACITORS WITH NUMBERS MORE THAN 1.0 ARE IN MMFD.
3. TOLERANCES AND RATINGS OF COMPONENTS NOT INDICATED.

Figure 11A. Schematic Diagram 21.4 MC I.F. Amplifier, Spectrum Display Units (Type A)

NEMS-CLARKE MODEL SWK-100 SWITCH KIT



The SWK-100 Switch Kit mounted on a Nems-Clarke Spectrum Display Unit

* * *

The Nems-Clarke Model SWK-100 Switch Kit consists of a coaxial switch and related hardware for attachment to any Nems-Clarke Spectrum Display Unit. As supplied without modification, the SDU receives a signal from one receiver through a coaxial connector on the rear apron of the SDU chassis; with the SWK-100 Switch Kit attached, the SDU can be used in conjunction with as many as four receivers, any one of which can be selected by means of a front panel selector knob.

KIT COMPONENTS

The following parts are included in the SWK-100 Switch Kit:

1 aluminum mounting bracket	4 mounting screws, lock washers	1 1/4-inch shaft
1 coaxial switch	1 shaft bushing, nut and lock washer	1 shaft coupler, set screw
1 connector cable	1 panel marker plate	1 selector knob

ASSEMBLY INSTRUCTIONS

Mount the switch bracket on the rear apron of the SDU chassis by means of the four mounting screws and lock washers. No drilling is necessary as four tapped holes are already provided. Mount the coaxial switch in the hole provided in the aluminum bracket. Use the lock washer under the nut, and make sure the switch is mounted securely so that it will not turn in the hole. Mount the marker plate on the front panel by means of the bushing, nut, and lock washer. Note that the marker plate is keyed to a slot in the panel opening, and can be mounted in only one position. As the bushing is inserted, the key tab will be bent into proper position in the slot. Tighten the bushing nut securely so that the bushing will not rotate in the hole. Insert the 1/4-inch shaft through the bushing, and attach to the coaxial switch shaft by means of the shaft coupler. Make sure the flats on the shafts line up properly, and tighten the set screws securely. Mount the knob on the front end of the shaft, making sure it is aligned correctly with the proper switch positions. Using the connector cable, connect switch output (center connector) to J-201 on the rear apron of the SDU chassis.

IF outputs from four receivers may now be connected to the four switch input connectors, and the unit is ready for operation.

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