TECHNICAL MANUAL

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR DUAL RECEIVER ET-A TYPE NUS 5961

HEADQUARTERS, DEPARTMENT OF THE ARMY
SEPTEMBER 1976

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the 165-volt dc

power supply circuits, or on the 120-volt ac

line connections. Serious injury or death

may result from contact with these points.

DON'T TAKE CHANCES

EXTREMELY DANGEROUS VOLTAGES

EXIST IN THE FOLLOWING UNITS:

Dual Parametric Amplifier NUS 5300-7 or NUS 6580-2	1000 Volts DC
Preselector and Mixer Drawer NUS 5963-3, -4, -12, -13	165 Volts DC
Power Supply and Fan Assembly NUS 5968-1, -3	165 Volts DC
IF and Baseband Drawer NUS 5965-3, -5, -6, -7, -8	150 Volts DC

Technical Manual)
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No. 11-5820-583-14)

HEADQUARTERS
DEPARTMENT OF THE ARMY
Washington, DC, 6 September 1976

OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT, AND GENERAL SUPPORT MAINTENANCE MANUAL FOR DUAL RECEIVER ET-A TYPE NUS 5961

REPORTING OF ERRORS

You can improve this manual by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 202 (Recommended Changes to Publications and Blank Forms) should be mailed direct to the Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, New Jersey 07703.

This technical manual is an authentication of the manufacturer's commercial literature and does not conform with the format and content specified in AR 310-3, Military Publications. The technical manual does, however, contain available information that is essential to the operation and maintenance of the equipment.

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PREFACE

This manual describes the dual receiver used at the mainline and tributary sites. It provides installation instructions, operating procedures, theory of operation, and maintenance information. Theory of operation is described at the equipment level, and emphasis is placed on the interrelation of the modules rather than on circuit details. The modules are described in Section VII.

The dual receiver conforms to a modular concept and is maintained to the direct support (3rd echelon) level. Maintenance to this level of support is concerned with localizing trouble to a particular module. When the trouble is localized, replace the defective module. Refer to Instruction Manual for Test Facilities Kit MK-884/GRC-81(V), TM 11-6625-647-14/1 and -14/2 for maintenance information on the modules.

The dual receiver is a component equipment in the ET-A communications system. The following is a list of publications pertaining to the ET-A communications system component equipments.

MANUAL TITLE	MANUAL NUMBER
Maintenance Control Group AN/GSA-99(V)1 through AN/GSA-99(V)12 (NUS 6283)	11-5820-570-14
Operator's Manual for Center, Communications Operations AN/MSQ-76(V)1 through AN/MSQ-76(V)3 and AN/GSQ-106(V)1 through AN/GSQ-106(V)3 (Console Local Equipment)	11-5820-571-10
Radio Set AN/FRC-113(V)1 through AN/FRC-l3(V)ll (NUS 6060)	11-5820-572-14
Multiplexer Set AN/FCC-40 through AN/FCC-54	11-5820-573-15
Nodal Point Receiver (NUS 8021/8024)	11-5820-574-14
Console, Communication Control OA-8149/MRC-114(V) through OA-8154/MRC-114(.V) (NUS 5972-5, -6)	11-5820-575-14
Console Training Facility (NUS 8423)	11-5820-576-14
Switching Set, Communications AN/MSQ-74(V)1 through AN/MSQ-74(V)10 and AN/MSQ-74(V)12 (Console Remote Equipment) (NUS 7640)	11-5820-577-14
Center, Communications Operations AN/MSQ-76(V)1 through AN/MSQ-76(V)3 and AN/GSQ-106(V)1 through AN/GSQ-106(V)3 (Console Local Equipment)	11-5820-578-24
Communication Group OA-8319/MSM (NUS 6052-23G1)	11-5820-578-14-1
Power Amplifier Group AN/MRA-15 (NUS 7561)	11-5820-579-15
Electronic Tube Cooler, ET-A Type 15-27-32. 5	11-5820-579-15-1
Amplifier-Power Supply AM-4832/FRC-113(V) (NUS 6061-3)	11-5820-580-14
Transmitter (NUS 5951)	11-5820-581-14
Console, Communication Control OA-7695/GRC and OA-7696/GRC (NUS 5972-3, -7)	11-5820-582-14
Dual Receiver (NUS 5961)	11-5820-583-14
Maintenance Control Group AN/GSA-100 (NUS 6284)	11-5820-585-14
Tributary Terminal Set AN/FSC-34 (NUS 7957)	11-5820-587-15
Amplifier-Power Supply AM-4419/GRC (NUS 8013 -2)	11-5820-603-14
ET-A Mainline Site Manual	11-5895-376-14-1
ET-A Tributary Site Manual	11-5895-376-14-2
ET-A Site Equipment, Towers and Antennas	11-5895-376-14-3
Test Facilities Kit MK-884/FRC-81( )	11-6625-647-14

CROSS REFERENCE OF EQUIPMENT NAMES

Manufacturer's Designation	Nomenclature
Dual Receiver NUS 5961-9	
Dual Receiver NUS 5961-10	
Dual Receiver NUS 5961-12	
Dual Receiver NUS 5961-13	
Dual Receiver NUS 5961-15	
Dual Receiver NUS 5961-16	
Dual Receiver NUS 5961-19	
Dual Receiver NUS 5961-20	
Oscillator- Multiplier NUS 3753-6	Amplifier-Oscillator AM-4404/GRC
Oscillator-Multiplier NUS 3753-7	Amplifier-Oscillator AM-4405/GRC
Mixer-Preamplifier NUS 3760-6	Amplifier- Mixer AM-4407/GRC
70-Mc IF Amplifier NUS 3761-5	Amplifier, Intermediate Frequency AM- 4408/GRC
70-Mc Demodulator NUS 3763-2	Demodulator Module MD-660/GRC
Frequency Multiplier NUS 3765-4	Frequency Multiplier RF-189/GRC
9.8-Mc IF Amplifier NUS 5251-23	Amplifier, Intermediate Frequency AM-4409/GRC
Second Mixer-Local Oscillator NUS 5251-31	Mixer-Oscillator CV-2021/GRC
9.8-Mc Demodulator NUS 5252-31	Demodulator Module MD-659/GRC
Dual Parametric Amplifier Drawer Assembly NUS 5299-2	
Dual Parametric Amplifier NUS 5300-7	Amplifier, Parametric AM-4831/FRC-113V
Klystron Power Supply NUS 5352-2	Klystron Power Supply PP-4442/GRC
Klystron Chassis NUS 5353-2	
Pre-Regulator NUS 5354	
Reflector Regulator NUS 5355-1	
Beam Regulator NUS 5356	
Isolating Devices Assembly NUS 5358-6	
Isolating Devices Assembly NUS 5358-8	
Cabinet Assembly NUS 5962-13	Rack, Electrical Equipment MT-3555/GRC
Cabinet Assembly NUS 5962-14	Rack, Electrical Equipment MT-3556/GRC
Cabinet Assembly NUS 5962-16	Rack, Electrical Equipment MT-3557/GRC
Preselector and Mixer Drawer NUS 5963-3	
Preselector and Mixer Drawer NUS 5963-4	
Preselector and Mixer Drawer NUS 5963-12	
Preselector and Mixer Drawer NUS 5963-13	

CROSS REFERENCE OF EQUIPMENT NAMES (cont)

Manufacturer's Designation	Nomenclature
Preselector and Mixer Drawer Assembly NUS 5964-1	
Preselector and Mixer Drawer Assembly NUS 5964-2	
IF and Baseband Drawer NUS 5965-3	
IF and Baseband Drawer NUS 5965-5	
IF and Baseband Drawer NUS 5965-6	
IF and Baseband Drawer NUS 5965-7	
IF and Baseband Drawer NUS 5965-8	
IF and Baseband Drawer Assembly NUS 5966-2	
Bandpass Filter NUS 5967-6	Filter, Bandpass F-1045/GRC
Power Supply and Fan Assembly NUS 5968-1	
Power Supply and Fan Assembly NUS 5968-3	
9.8-Mc AGC Amplifier NUS 5969-1	Control, Amplifier C-6742/GRC
70-Mc AGC Amplifier NUS 5969-4	Control, Electrical Frequency C- 6740/GRC
Baseband Amplifier NUS 5970-3	Amplifier, Audio Frequency-Radio Frequency AM- 4429/GRC
+150/165 Volt Power Supply NUS 5974-1	
+5 Volt Power Supply NUS 5975-1	Power Supply PP-4429/GRC
+15 Volt Power Supply NUS 5975-31	Power Supply PP-4430/GRC
-30 Volt Power Supply NUS 5975-41	Power Supply PP-4431/GRC
Ancillary Equipment Drawer Assembly NUS 6058	
Ancillary Equipment NUS 6062-2	
Ancillary Equipment NUS 6062-23	
70-Mc Threshold Extension NUS 6455	Threshold Extension PL-1114/GRC
Parametric Amplifier Cavity Assembly NUS 6457-1	
Parametric Amplifier Cavity Assembly NUS 6457-2	
Parametric Amplifier Cavity Assembly NUS 6457-3	
9.8-Mc Threshold Extension NUS 6579	Threshold Extension PL-1115/GRC
Dual Parametric Amplifier NUS 6580-2	Amplifier, Parametric AM-4410/GRC
Dual Parametric Amplifier Drawer Assembly NUS 6581-2	

CROSS REFERENCE OF EQUIPMENT NAMES (cont)

Manufacture's Designation	Nomenclature
70-Mc Phase combiner and Alarm NUS 8315-1	Control-Indicator C-6738/GRC
9.8-Mc Phase Combiner and Alarm NUS 8316-1	Control-Indicator C-6737/GRC
70-Mc Redundant AGC Amplifier NUS 8317-1	Amplifier, Automatic Gain Control AM- 4402/GRC
9.8-Mc Redundant AGC Amplifier NUS 8318-1	Amplifier, Automatic Gain Control AM- 4403/GRC
-30 Volt Power Supply NUS 8797G3	Power Supply PP-4431A/GRC
+5 Volt Power Supply NUS 8797G4	Power Supply PP-4429A/GRC
+15 Volt Power Supply NUS 8797G5	Power Supply PP-4430A/GRC
+150/165 Volt Power Supply NUS 8798G1	Power Supply PP-4750/GRC
De-Emphasis Assembly C2336717G1	
De-Emphasis Assembly C2336719G1	
De-Emphasis Assembly C2336720G1 NUS 5958-3	
IF Filter D2338037G1 NUS 6453-2	Filter, Intermediate Frequency F-1179/GRC
De-Emphasis Assembly C1260278	

SECTION I

DESCRIPTION AND LEADING PARTICULARS

1-1. SCOPE OF MANUAL.

1-2. This instruction manual provides information on Dual Receiver NUS 5961. The equipment is built by ITT Federal Laboratories, Nutley, N. J. Included herein is information on description and theory of operation of the receiver, and instructions for its installation, operation, and maintenance. A separate manual is included (in Section VII) for each module contained in the receiver.

1-3. DESCRIPTION.

1- 4. OVERALL EQUIPMENT.

1-5. BASIC RECEIVER. The basic NUS 5961 receiver is a dual diversity receiver operating in the 4400- to 5000-mc frequency range. The receiver employs either single conversion (70-mc if frequency) or double conversion (70-mc first if frequency and 9. 8-mc second if frequency). The single conversion receiver is a broadband receiver and has a bandwidth compatible with multi-channel voice frequency operation. The double conversion receiver is a narrowband receiver and is used for single or dual voice frequency channels.

1-6. VARIATIONS ON THE BASIC RECEIVER. There are eight variations to the NUS 5961 dual receiver. Single conversion receivers have six variations (NUS 5961-12, -15, -16,-17, -19, and -20) and double conversion receivers have three variations (NUS 5961-9,-10, and-13). Six receivers (NUS 5961-9,-13, -15, -16, -19, and -20) are equipped for tropospheric scatter operation. Each tropospheric scatter receiver configuration consists of two dual receiver cabinets (figure 1-1) interconnected for quadruple diversity operation. NUS 5961-9, -15, and -20 receivers employ a Dual Parametric Amplifier at the rf input. NUS 5961-13, -16, and -19 receivers employ an RF Panel in place of the Dual Parametric Amplifier. NUS 5961-9, -13, -15, and -16 have a threshold extension module at the demodulator input. Two receivers (NUS 5961-10 and 12) are equipped forline-of-sight operation. The 5961-12 takes the place of a 5961-17 receiver which was used in the initial system equipment. The 5961-17 is identical to the 5961-12 except in the alarm circuit wiring. Throughout this book the description and instructions for the 5961-12 receiver apply for the 5961-17 receiver. Each line-of-sight receiver configuration consists of one dual receiver cabinet (figure 1-2) operating in dual diversity fashion. The line-of-sight receivers include an ancillary drawer. This drawer contains back-up (redundant) demodulator and baseband amplifiers permitting one section of the dual receiver to continue operation in the event of a failure in the other section. Power requirements for the ancillary drawer make necessary a second power supply drawer which also provides redundancy. All eight receiver variations are summarized in table 1-1.

1-7. DRAWERS AND PANELS.

1-8. DISTRIBUTION PANEL. The Distribution Panel provides a means of connecting the IF and Baseband drawer with the central equipment cabinet. The baseband amplifier output of the IF and Baseband drawer (and the Ancillary Equipment drawer when applicable) is connected to the Distribution Panel through a length of coaxial cable and a coaxial attenuator which terminates in a BNC coaxial fitting. This fitting which is on the front of the Distribution Panel is connected to the central equipment cabinet by means of an additional length of coaxial cable.

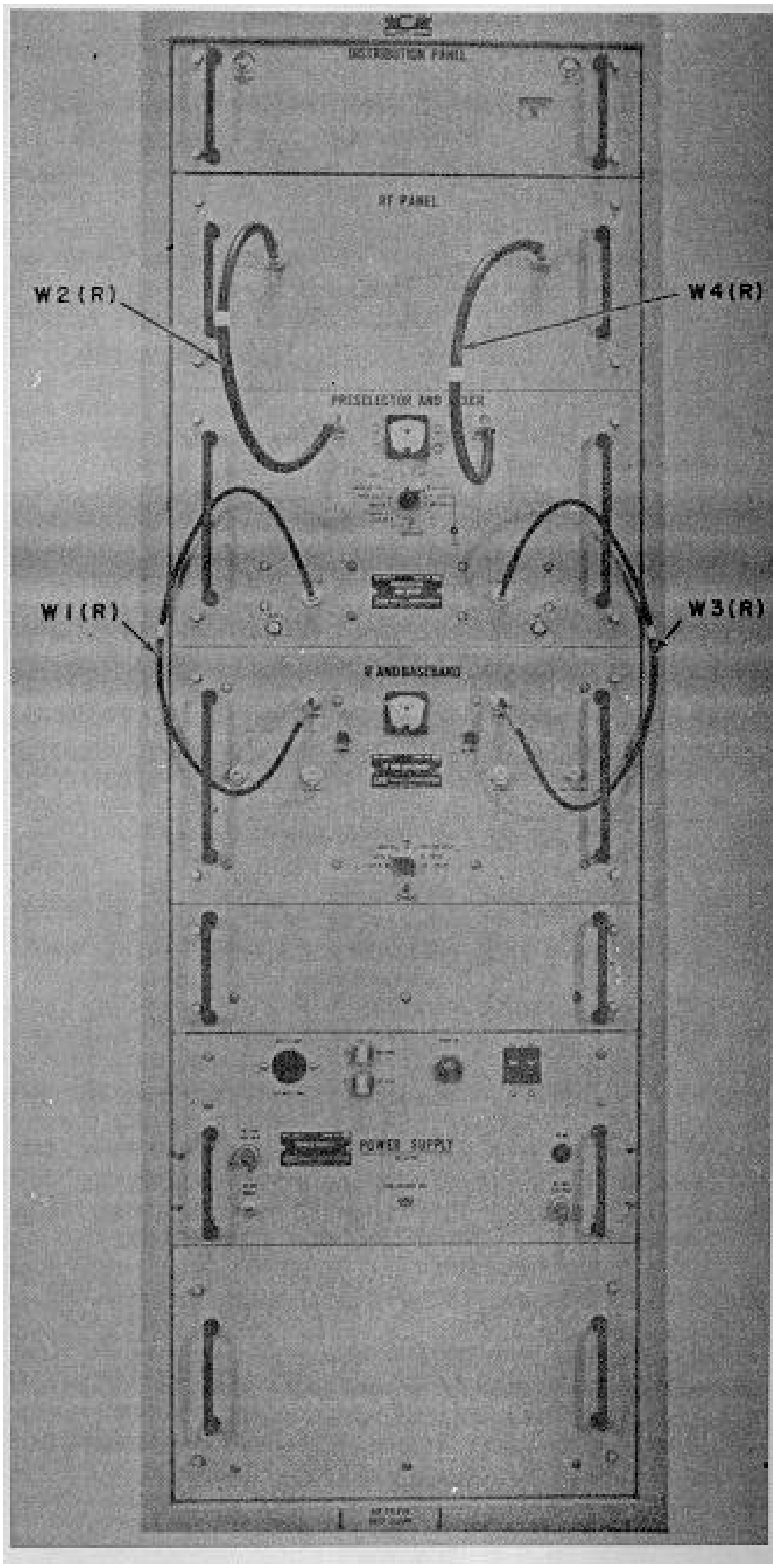


Figure 1-1. Dual Receiver Cabinet, Tropospheric Scatter Configuration

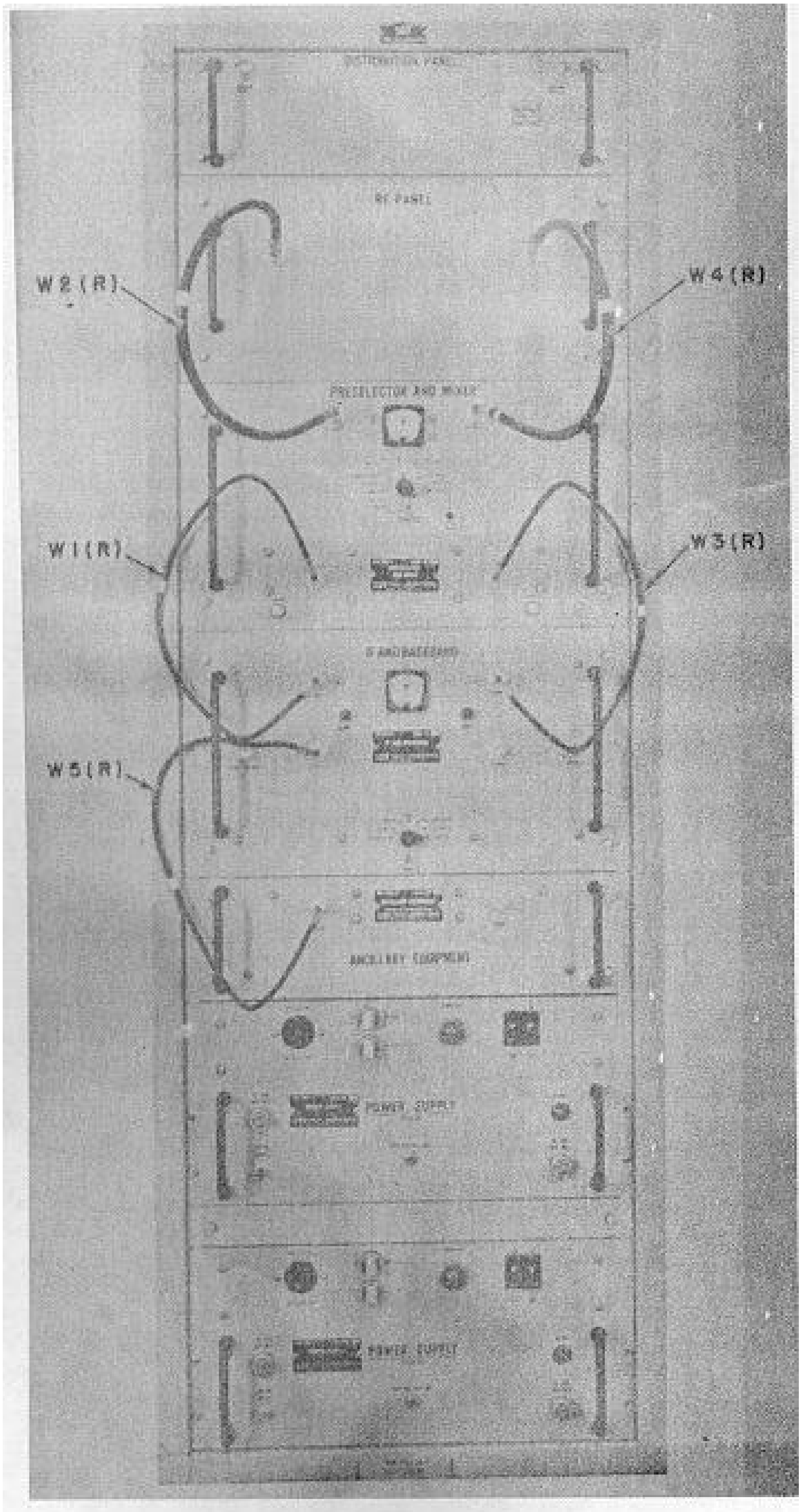


Figure 1-2. Dual Receiver Cabinet, Line-Of-Sight Configuration

TABLE 1-1. RECEIVER VARIATIONS

Variation	Description
NUS 5961-13	Single or dual channel, tropospheric scatter, quadruple diversity, double conversion with threshold extension
NUS 5961-12 (17)	Multi-channel, line-of-sight, dual diversity, single conversion with Ancillary Equipment drawer
NUS 5961-9	Single or dual channel, tropospheric scatter, quadruple diversity, double conversion with parametric amplifier and threshold extension
NUS 5961-10	Single or dual channel, line-of-sight, dual diversity, double conversion with Ancillary Equipment drawer
NUS 5961-15	Multi-channel, tropospheric scatter, quadruple diversity, single conversion with parametric amplifiers and thresh-old extension
NUS 5961-16	Multi-channel, tropospheric scatter, quadruple diversity, single conversion with threshold extension
NUS 5961-19	Multi-channel, tropospheric scatter, quadruple diversity, single conversion
NUS 5961-20	Multi-channel, tropospheric scatter, quadruple diversity, single conversion with parametric amplifiers

1-9. RF PANEL. The RF Panel and Dual Parametric Amplifier drawer are used interchangeably depending upon the reception characteristics at specific sites. At sites having poor reception characteristics, the Dual Parametric Amplifier is used. The RF Panel covers the receiver input waveguides to the Preselector and Mixer drawer in receivers not using parametric amplifiers. The panel houses two straight waveguide sections, two waveguide-to-coaxial line adapters and two sections of RG-9B/U coaxial cable. The straight waveguide sections feed the adapters and the adapters feed the cables which are connected to the RF Panel. The coaxial fittings on the front of the RF Panel are connected to coaxial fittings on the front panel of the Preselector and Mixer drawer with the RG-9B/U coaxial cable.

1-10. DUAL PARAMETRIC AMPLIFIER DRAWER. The Dual Parametric Amplifier drawer receives rf signals from the antennas and provides low-noise amplification to improve the overall receiver carrier-to-noise ratio. The Dual Parametric Amplifier contains rf, monitoring, fault, and power circuits. The rf circuits contain two amplifier channels. The channels are independent except for a common klystron source of pumping frequency. Each channel amplifies one of the signals in a diversity reception system. The Dual Parametric Amplifier contains equipment indicated in a. through e. below. Refer to paragraph 1-25 for modifications.

a. A dual parametric amplifier drawer assembly with klystron metering and alarm circuits.
b. Two parametric amplifier cavity assemblies.
c. One klystron power supply.
d. Two isolating device assemblies (used on NUS 5300-7 only).

e. Two electrically switchable circulators with a common dc switching power supply (used on 6580-2 only).

1-11. PRESELECTOR AND MIXER DRAWER. The Preselector and Mixer drawer receives the outputs of the Dual Parametric Amplifier drawer or RF Panel and mixes these signals with locally generated rf signals to produce 70-mc if signals. The if signals are applied to the IF and Baseband drawer. The Preselector and Mixer drawer contains the following types of modules:

a. Mixer-preamplifier
b. Oscillator- multiplier
c. Frequency multiplier
d. IF Filter (not used in double conversion receivers)

1-12. In tropospheric scatter receiver configurations NUS 5961-9 and 13, a power divider is connected to the output of the frequency multiplier module.

1-13. IF AND BASEBAND DRAWER (SINGLE CONVERSION RECEIVERS). The IF and Baseband drawer amplifies, combines, and demodulates the two if signals to produce a common baseband output. This drawer also produces the automatic phase control (APC) voltages for the associated oscillator-multiplier modules in the Preselector and Mixer drawer. The if amplifiers and phase combiners are duplicated to accommodate both receiving sections. The if and Baseband drawer includes the modules listed below: (Refer to table 1-2 to determine the number of modules used in each single conversion receiver configuration.)

a. 70-mc if amplifier
b. 70-mc phase combiner and alarm
c. AGC amplifier
d. 70-mc demodulator
e. De-emphasis assembly
f. Baseband amplifier
g. Threshold extension (not used in all receivers)

1-14. IF AND BASEBAND DRAWER (DOUBLE CONVERSION RECEIVERS). The IF and Baseband drawer mixes the 70-mc if signals with internally-generated signals to produce 9. 8-mc second if signals. These signals are amplified, combined and demodulated to produce a common baseband output. The IF and Baseband drawer includes the modules listed below: (Refer to table 1-2 to determine the number of modules used in each double conversion receiver configuration.)

a. Second mixer-local oscillator
b. 9.8-mc bandpass filter
c. 9.8-mc if amplifier
d. 9.8-mc phase combiner
e. AGC amplifier
f. 9.8-mc threshold extension module (not used in all receivers)
g. 9.8-mc demodulator
h. Baseband amplifier

1-15. ANCILLARY EQUIPMENT DRAWER. The Ancillary Equipment drawer is used only in line-of-sight receivers. It receives the combined if signal from the IF and Baseband drawer and demodulates the signal to produce a second (redundant) baseband output. This baseband output is applied to the central equipment cabinet as baseband B. The Ancillary Equipment drawer includes the following modules:

a. Demodulator
b. Baseband amplifier
c. De-emphasis assembly (not used in double conversion receiver)

1-16. POWER SUPPLY DRAWER. The Power Supply drawer contains the power supplies which furnish operating voltages for the modules in the Preselector and Mixer and IF and Baseband drawers. A fan assembly is incorporated in the Power Supply drawer to provide air circulation. Two complete power supply and fan assembly drawers are used in line-of-sight receivers. The receiver wiring is arranged so that each half of a dual LOS receiver is fed from a separate power supply to improve reliability. Channels 1 and 2 are powered by power supplies No. 1 (upper) and No. 2 (lower), respectively. The Power Supply (and fan assembly) drawer includes the following:

a. High-voltage (150-165 vdc) power supply
b. +15 vdc power supply (not used in double conversion receivers)
c. +5 vdc power supply (not used in single conversion receivers)
d. -30 vdc power supply
e. Fan assembly

1-17. <u>EQUIPMENT SUPPLIED</u>.

1-18. The equipment supplied in each receiver configuration varies. Table 1-2 lists the receiver equipment by type and quantity.

TABLE 1-2. DRAWER, MODULE, AND PANEL COMPLEMENT

Drawer, Module, or Panel	Dual Receiver NUS 5961								
	Single Conversion Receivers						Double Conversion Receivers		
	NUS	-12(17)	-15	-16	-19	-20	-9	-10	-13
RF Panel	-----	1		1	1				
Dual Parametric Amplifier	6580-2		1			1	1		
Drawer Assembly	6581-2		1			1	1		
Klystron Power Supply	5352-2		1			1	1		
Klystron Chassis	5353-2		1			1	1		
Preregulator	5354		1			1	1		
Reflector Regulator	5355-1		1			1	1		
Beam Regulator	5356		1			1	1		
Parametric Amplifier Cavity Assy	6457-3		2			2	2		

TABLE 1-2. DRAWER, MODULE, AND PANEL COMPLEMENT (continued)

Drawer, Module, or Panel	Dual Receiver NUS 5961								
	Single Conversion Receivers						Double Conversion Receivers		
	NUS	-12(17)	-15	-16	-19	-20	-9	-10	-13
Dual Parametric Amplifier	5300-7		1			1	1		
Drawer Assembly	5299-2		1			1	1		
Klystron Power Supply	5352-2		1			1	1		
Klystron Chassis	5353-2		1			1	1		
Preregulator	5354		1			1	1		
Reflector Regulator	5355-1		1			1	1		
Beam Regulator	5356		1			1	1		
Parametric Amplifier Cavity Assembly	6457-1		1			1	1		
Parametric Amplifier Cavity Assembly	6457-2		1			1	1		
Isolating Devices Assembly	5358-6		1			1	1		
Isolating Devices Assembly	5358-8		1			1	1		
Preselector and Mixer Drawer	5963-12		1	1	1	1			
Preselector and Mixer Drawer	5963-13	1							
Preselector and Mixer Drawer	5963-3						1		1
Preselector and Mixer Drawer	5963-4							1	
Drawer Assembly	5964-1		1	1	1	1	1		1
Drawer Assembly	5964-2	1						1	
Oscillator-Multiplier	3753-7	2	2	2	2	2			
Oscillator-Multiplier	3753-6						1	2	1
Mixer-Preamplifier	3760-6	2	2	2	2	2	2	2	2
Frequency Multiplier	3765-4	2	2	2	2	2	1	2	1
IF Filter	-----	2	2	2	2	2			
IF and Baseband Drawer	5965-3				1	1			
IF and Baseband Drawer	5965-5		1	1					
IF and Baseband Drawer	5965-6						1		1
IF and Baseband Drawer	5965-7							1	
IF and Baseband Drawer	5965-8	1							
Drawer Assembly	5966-2	1	1	1	1	1	1	1	1
70-MC IF Amplifier	3761-5	2	2	2	2	2			

TABLE 1-2. DRAWER, MODULE, AND PANEL COMPLEMENT (continued)

Drawer, Module, or Panel	Dual Receiver NUS 5961								
	Single Conversion Receivers						Double Conversion Receivers		
	NUS	-12(17)	-15	-16	-19	-20	-9	-10	-13
9.8-MC IF Amplifier	5251-23						2	2	2
70-MC AGC Amplifier	5969-4		1	1	1	1			
9.8-MCAGC Amplifier	5969-1						1		1
70-MC Redundant AGC Amplifier	8317-1	1							
70-MC Phase Combiner and Alarm	8315-1	2	2	2	2	2			
9.8-MC Redundant AGC Amplifier	8318-1							1	
9.8-MC Phase Combiner and Alarm	8316-1						2	2	2
70-MC Demodulator	3763-2	1	1	1	1	1			
9.8-MC Demodulator	5252-31						1	1	1
De-Emphasis (See Table 1-4) Assembly	-----	1	1	1	1	1			
Second Mixer-Local Oscillator	5251-31						2	2	2
Bandpass Filter	5967-6						2	2	2
Baseband Amplifier	5970-3	1	1	1	1	1	1	1	1
70-MC Threshold Extension	6455		1	1					
9.8-MC Threshold Extension	6579						1		1
Ancillary Equipment	6062-23	1							
Ancillary Equipment	6062-2							1	
Drawer Assembly	6058	1						1	
70-MC Demodulator	3763-2	1							
9.8-MC Demodulator	5252-31							1	
De-Emphasis (See Table -4) Assembly	--------	1							
Baseband Amplifier	5970-3	1						1	
Power Supply and Fan Assembly	5968-3	2	1	1	1	1			
Power Supply and Fan Assembly	5968-1						1	2	1
+150/165 Volt Power Supply	5974-1 or 8798G1	2	1	1	1	1	1	2	1
+15 Volt Power Supply	5975-31or 8797G5	2	1	1	1	1			

TABLE 1-2. DRAWER. MODULE. AND PANEL COMPLEMENT (continued)

Drawer, Module, or Panel	Dual Receiver NUS 5961								
	Single Conversion Receivers						Double Conversion Receivers		
	NUS	-12(17)	-15	-16	-19	-20	-9	-10	-13
+5 Volt Power Supply	5975-1 or 8797G4						1	2	1
-30 Volt Power Supply	5975-41 or 8797G3	2	1	1	1	1	1	2	1
Cabinet Assembly	5962-13		1			1	1		
Cabinet Assembly	5962-14			1	1				1
Cabinet Assembly ·	5962-16	1						1	

*NUS 5300-7 may be used in place of NUS 6580-2

1-19. SPECIFICATIONS.

1-20. The overall receiver specifications are listed in table 1-3. Table 1-4 lists the type of de-emphasis network used in the receiver for each of the multi-channel systems. No de-emphasis network is required for single-channel systems.

TABLE 1-3. OVERALL RECEIVER SPECIFICATIONS

Characteristics	Specification
Frequency range	4400-5000 mc
Input impedance	50 ohms nominal
Output impedance	75 ohms
Noise figure (without external preselector)	4. 0 db max (with parametric amplifier) 11 db max (without parametric amplifier)
IF center frequency	70 mc (single conversion receivers); 1st, 70 mc; 2nd, 9.8 mc (double conversion receivers)
Multiplex channels used	24, 36, 48, 60, 72, and 120 frequency diversion multiplex (single 1 or 2 channels (double conversion receivers)
Type of reception	Space diversity FM
Primary power	120 + 5% vac, 47-63 cps, single phase

TABLE 1-4. DE-EMPHASIS ASSEMBLY SELECTION LIST

Channel Capacity	De-Emphasis Network Assembly
24-36	C2336717
48-60	C2336719
72-120	C2336720
180-240	C1260278

1-21. MECHANICAL DESIGN FEATURES.

1-22. Each receiver cabinet is 62-1/2 inches high, 22 inches wide, and 22 inches deep. All drawers are mounted on slide rails for accessibility and locked in the cabinet by four quarter-turn fasteners. Cable retractors are provided. A drawer may be completely removed from the cabinet by removing the screws which secure the drawer to the slide rails, and by disconnecting the respective cables.

1-23. Continuous metering and monitoring facilities, and the coaxial fittings required to accomplish signal inter-drawer connections are provided on the front panels of the drawers. Additional metering and monitoring facilities are provided on subpanels incorporated within the drawers. Cabinet power, signal input and central equipment connections are made through the top of the cabinet.

1-24. All the elements within the drawers are contained in plug-in modules. Any module can easily be removed from a drawer for servicing.

SECTION II

INSTALLATION

2-1. GENERAL.

2-2. This section describes the installation of the Dual Receiver NUS 5961 and includes instructions for inspection, initial application of power, and initial adjustment. All drawers, modules, and panels are completely assembled, wired, and installed at the factory. The receiver cabinets are installed in the shelter before shipment.

2-3. COMPONENT INTERCONNECTIONS.

2-4. The power connections for the Power Supply drawer and the signal and power connections for the Dual Parametric Amplifier drawer assembly (NUS 6580-2 or NUS 5300-7) are illustrated in the module portion (Part II) of this manual. Most of the connections shown in the schematic diagrams in Section IV have been made at the factory. The drawer and cabinet interconnections for tropospheric scatter receivers are described in paragraph 2-5. The drawer interconnections for line-of-sight are described in paragraph 2-6. Before making the connections described in paragraph 2-5 or 2-6 make sure that the following shelter cable connections have been made at the top of the tropospheric scatter receiver cabinets or the line-of-sight receiver cabinet. (Refer to the Radio Shelter Equipment Manual TD 64-273.) At tropospheric scatter receiver (cabinet A) connect:

a. Cable W40 to AC POWER jack J1, in the distribution box behind the Distribution Panel. (See figures 2-1 and 2-2.)

b. Cable W51 to central equipment cabinet ALARM INTERCON jack J2 in the distribution box.

c. Cable W54 to QUAD DIVERSITY INTERCON jack J7 in distribution box.

d. Cable W62 to BASEBAND OUTPUT jack J3 on Distribution Panel (figure 2-2).

e. Cable W82 to OSC LOCK jack J4 (figure 2-2). This connection is made at double conversion tropospheric scatter receivers NUS 5961-9 and 13 only.

f. Cable W80 (RG62A/U) for dual conversion or W81 (RG59B/U) for single conversion receivers to the QUAD DIVERSITY connector J15 on the right side of the IF and Baseband front panel drawer.

NOTE

This is a critical-length cable and no substitution should be made.

At tropospheric scatter receiver (cabinet B) connect:

a. Cable W41 to AC POWER jack J1, in distribution box behind Distribution Panel.

b. Cable W52 to central equipment cabinet ALARM INTERCON jack J2 in distribution box.

c. Cable W54 to QUAD DIVERSITY INTERCON jack J7 in distribution box.

d. Cable W63 to BASEBAND OUTPUT jack J3.

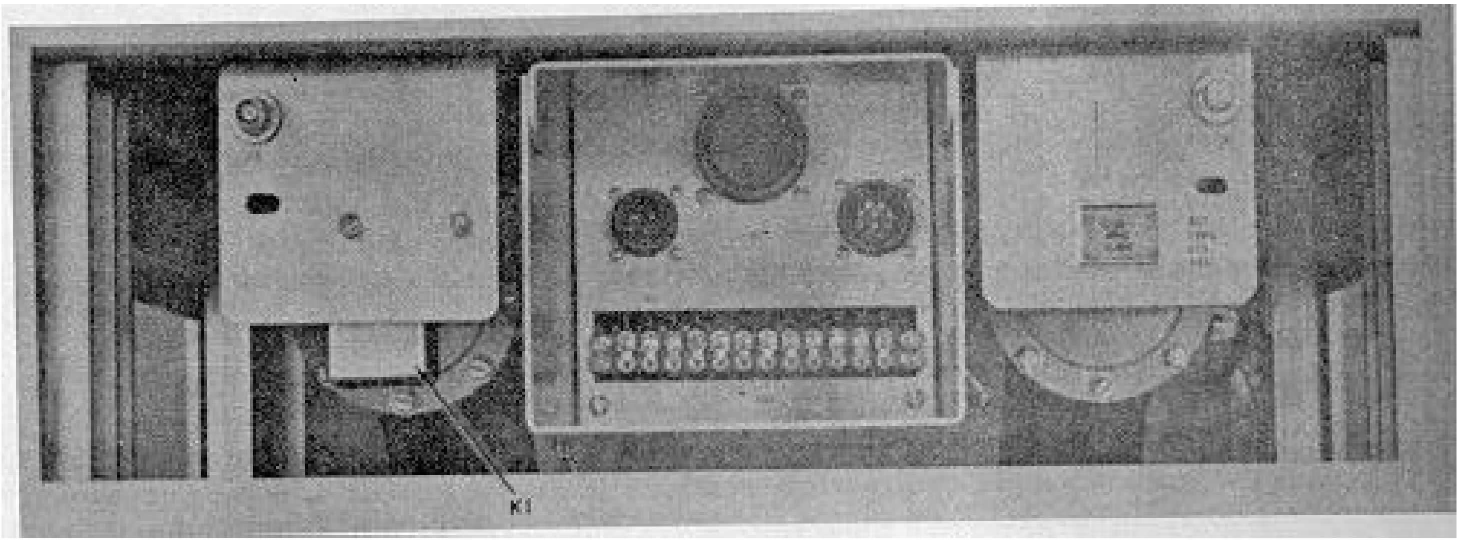


Figure 2-1. Tropospheric Scatter Receiver Cabinet Distribution Box

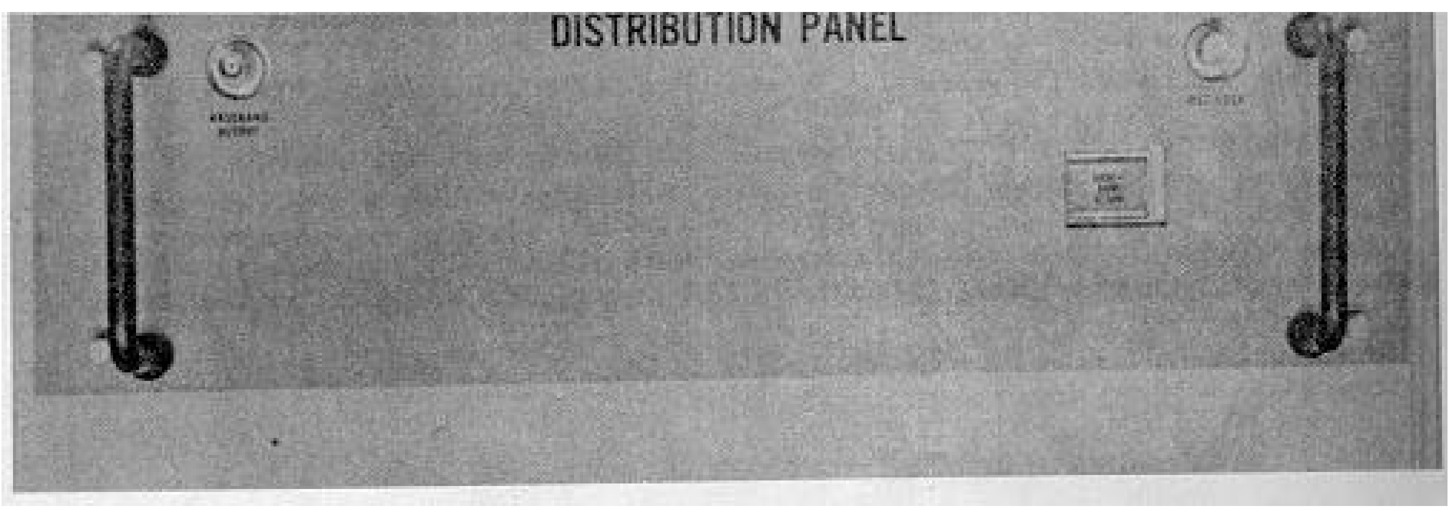


Figure 2-2. Tropospheric Scatter Receiver Cabinet Distribution Panel

e. Cable W82 to OSC LOCK jack J4.

NOTE

This connection is made at double conversion tropospheric scatter receivers NUS 5961-10 and 13 only.

f. Cable W80 for dual conversion or W81 for single conversion receivers to QUAD DIVERSITY connector J19 on left side of the IF and Baseband front panel.

At line-of-sight receiver cabinet connect:

a. Cable W40 to AC POWER jack J1 in distribution box behind Distribution Panel. (See figures 2-3 and 2-4.)

b. Cable W41 to AC POWER jack J8 in distribution box.

c. Cable W56 to CEC ALARM INTERCON jack J2 in distribution box.

d. Cable W57 to CEC ALARM INTERCON jack J9 in distribution box.

e. Cable W62 to BASEBAND A OUTPUT jack J3 on Distribution Panel (figure 2-4).

f. Cable W63 to BASEBAND B OUTPUT jack J4 on distribution panel.

2-5. TROPOSPHERIC SCATTER RECEIVERS (QUADRUPLE DIVERSITY). Proceed as follows:

a. On receiver A, connect RF OUTPUT 1 (J12) and RF OUTPUT 2 (J11) connectors of Dual Parametric Amplifier drawer (figure 2-5 or 2-6) or RF Panel (J1, J2 of figure 2-7) to RF INPUT 1 (J1) and RF INPUT 2 (J2) connectors on front panel of Preselector and Mixer drawer (figure 2-8) with RG-9B/U cables W4 and W2, respectively.

b. Connect IF OUTPUT 1 (J3) and IF OUTPUT 2 (J4) connectors on front panel of Preselector and Mixer drawer to IF INPUT 1 (J14) and IF INPUT 2 (J16) connectors on front panel of IF and Baseband drawer (figure 2-9) with RG-59/U cables, W3 and W1, respectively.

c. Repeat steps a and b for receiver B.

2-6. LINE-OF-SIGHT RECEIVERS (DUAL DIVERSITY). Proceed as follows:

a. Perform steps a and b of paragraph 2-5.

b. Connect TE OUTPUT connector on front panel of IF and Baseband drawer to TE INPUT connector on front panel of Ancillary Equipment drawer (figure 2-10) with RG-59/U cable W5.

2-7. <u>TEST EQUIPMENT REQUIRED</u>.

2-8. Table 2-1 is a list of the test equipment required.

TABLE 2-1. TEST EQUIPMENT REQUIRED

Quantity	Test Equipment	Type
1	Counter	HP 524C or CMC 2565-A
1	Converter	HP 525A
1	Decoupler	A2331266G1 (B2386863 used when CMC counter is used)
1	Noise Source	HP G347-A
1	Noise Figure Meter	HP 342-A
1	Variable Attenuator	Kay Electric 31-0
1	10 db Waveguide Attenuator	B 2330793 G1
1	SHF Signal Generator	HP 618B with Cable Assembly AC-16Q.
1	Waveguide to Coax Adapter	HP G281-A
1	RF Voltmeter	HP 410B
1	Tee BNC Adapter	UG 274/U
1	AGC Alignment Bias Supply	A 2339490
1	Power Divider	B 2288125
2	75 ohm BNC Termination	A 2334876 G1
1	R. F. Power Meter	HP 430C
1	Thermistor Mount	HP 477B
1	Female-to-Female N Type Adapter	UG 29B/U
1	Female-to-Female BNC Adapter	UG 914/U
1	Oscilloscope	Tektronix 541-A
1	Preamplifier	Tektronix CA or L
1	Multimeter	Simpson 260
1	50 ohm Waveguide Termination	HP G910A
1	Frequency Selective Voltmeter	Sierra 125B
1	Noise Generator-Receiver	AN/GSM-161A

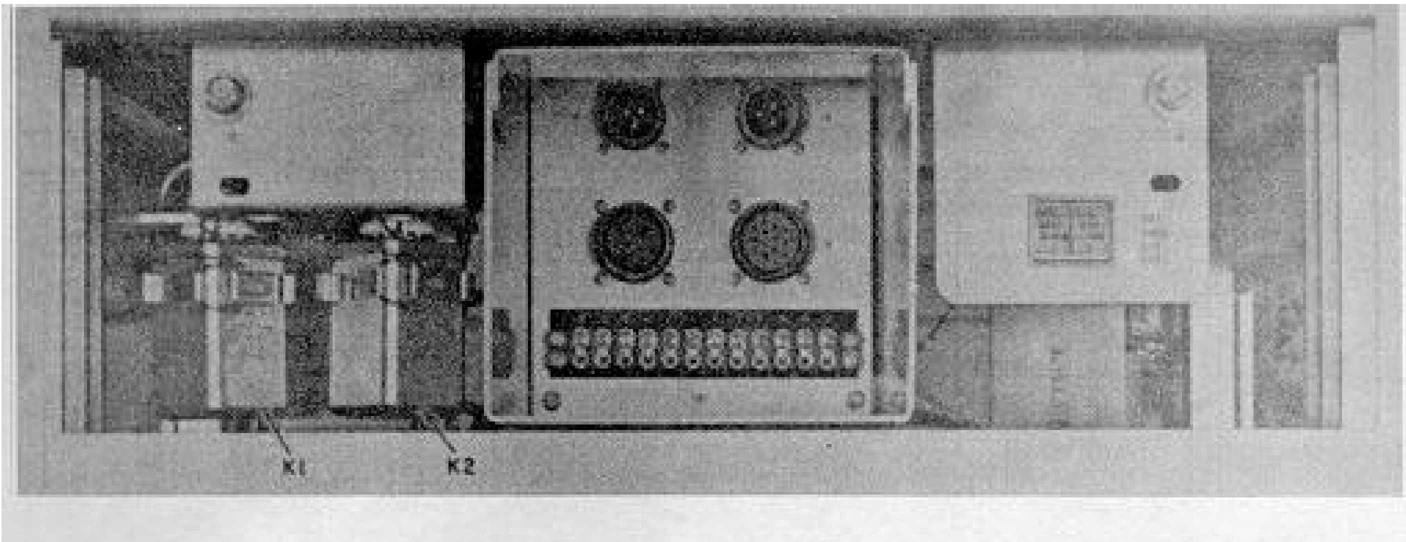


Figure 2-3. Line-Of Sight Receiver Cabinet Distribution Box

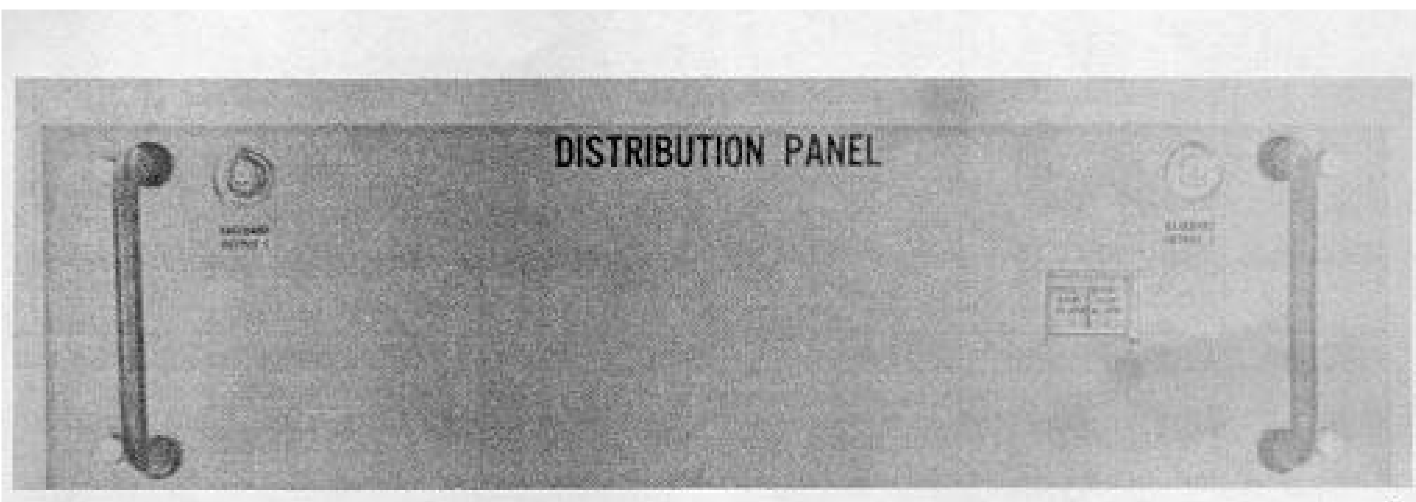


Figure 2-4. Line-Of-Sight Receiver Cabinet Distribution Panel.

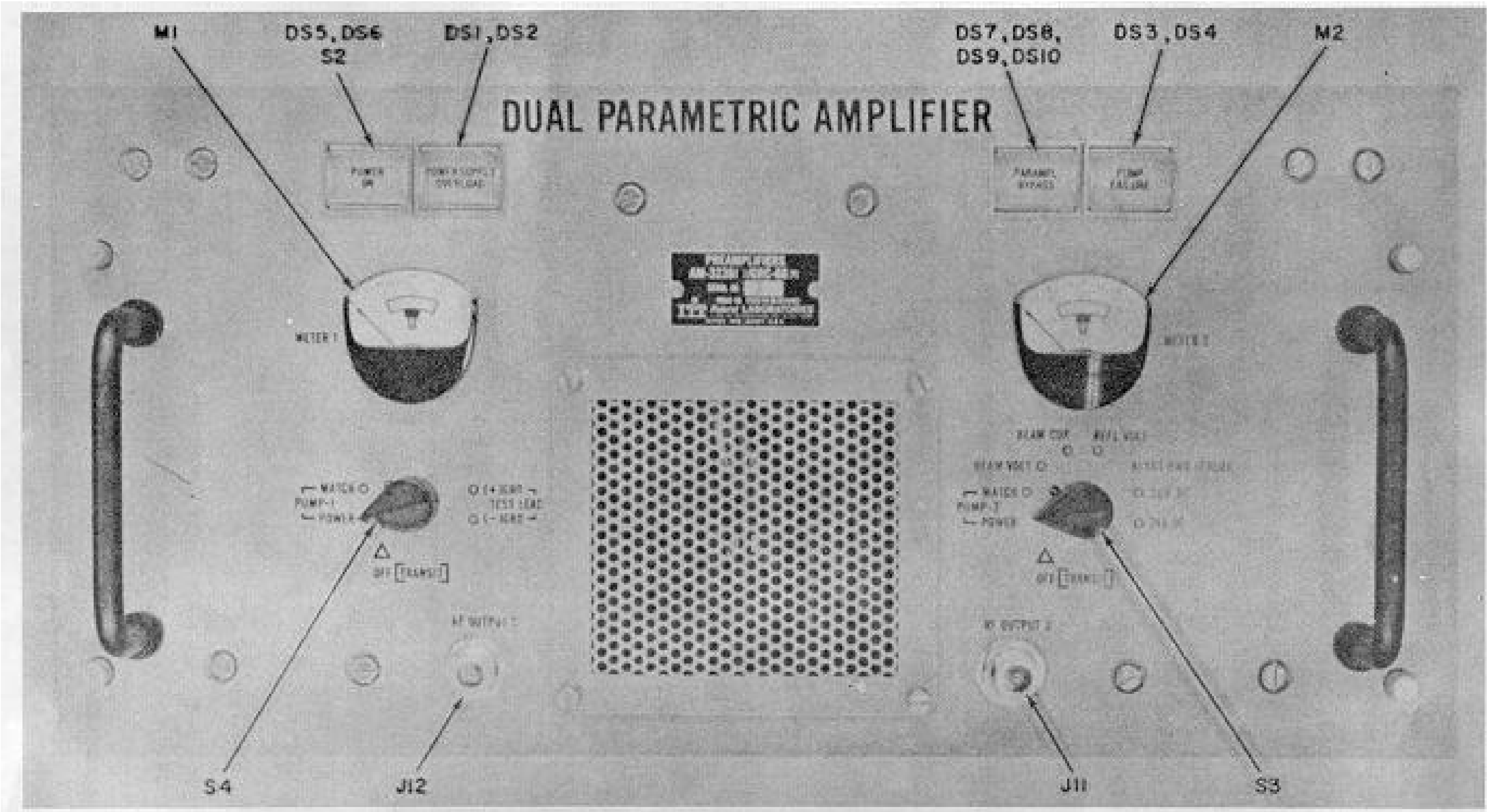


Figure 2-5. Dual Parametric Amplifier Drawer (NUS 6580-2) Front Panel

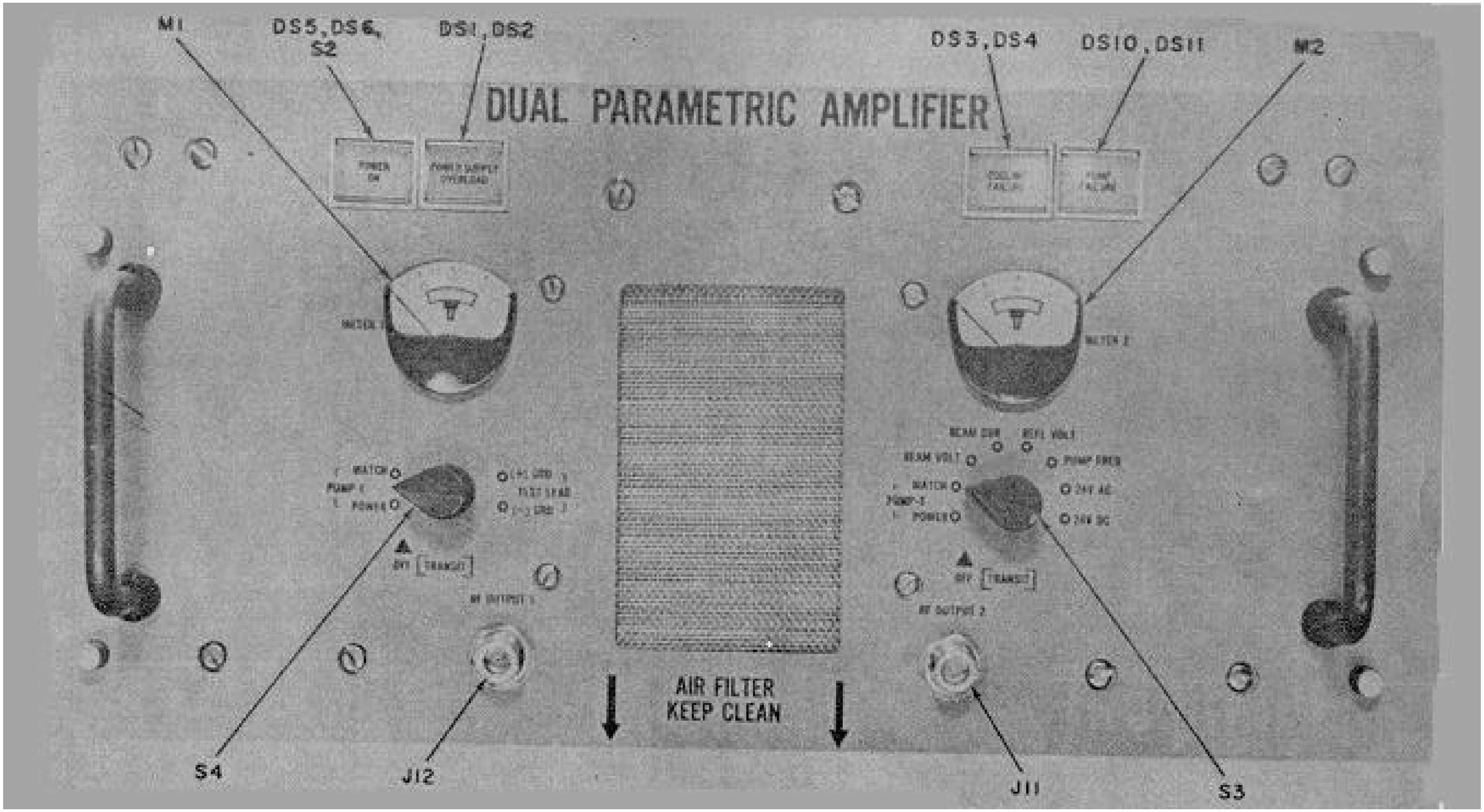


Figure 2-6. Dual Parametric Amplifier Drawer (NUS 5300-7) Front Panel

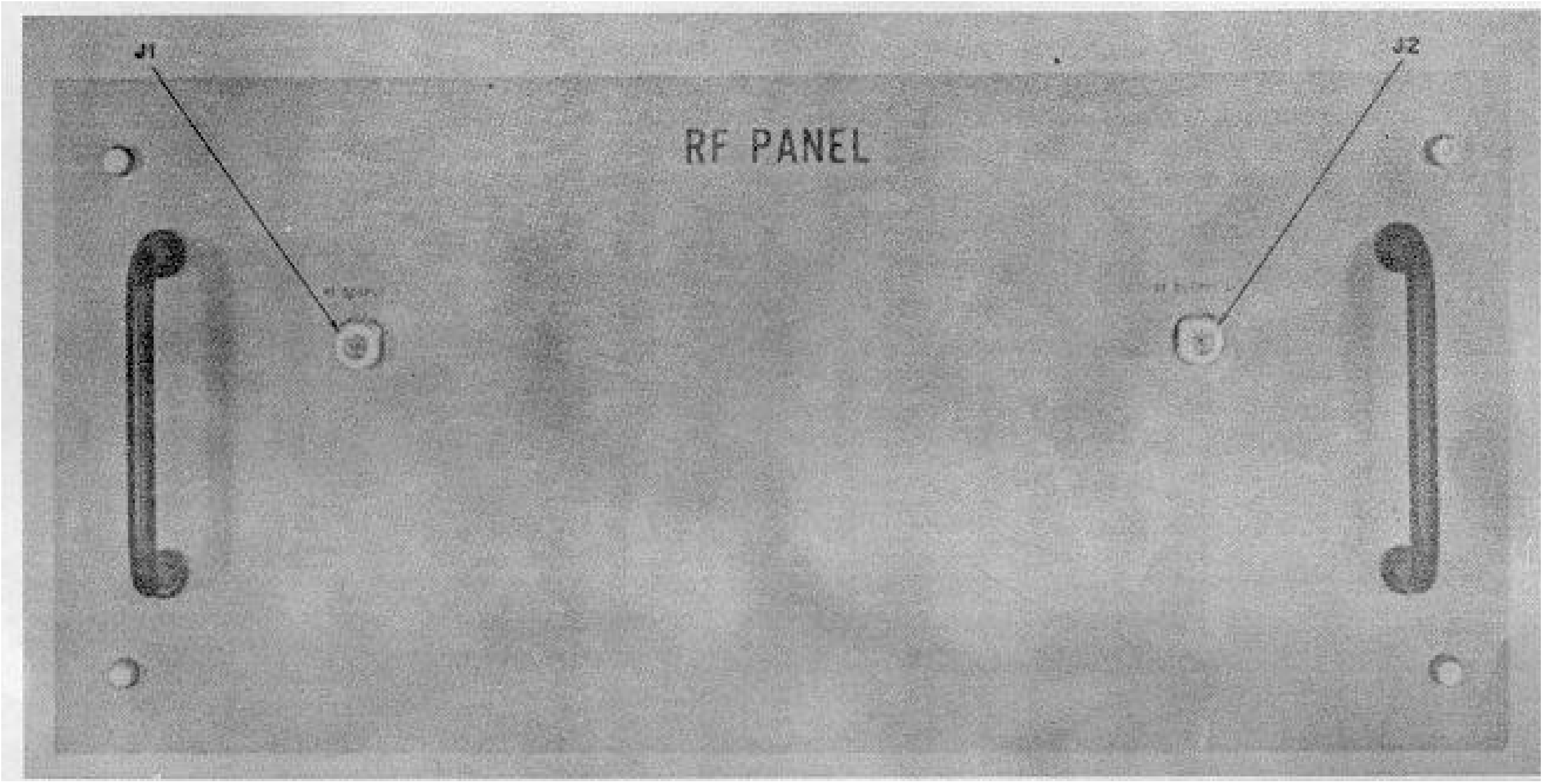


Figure 2-7. RF Panel, Front View

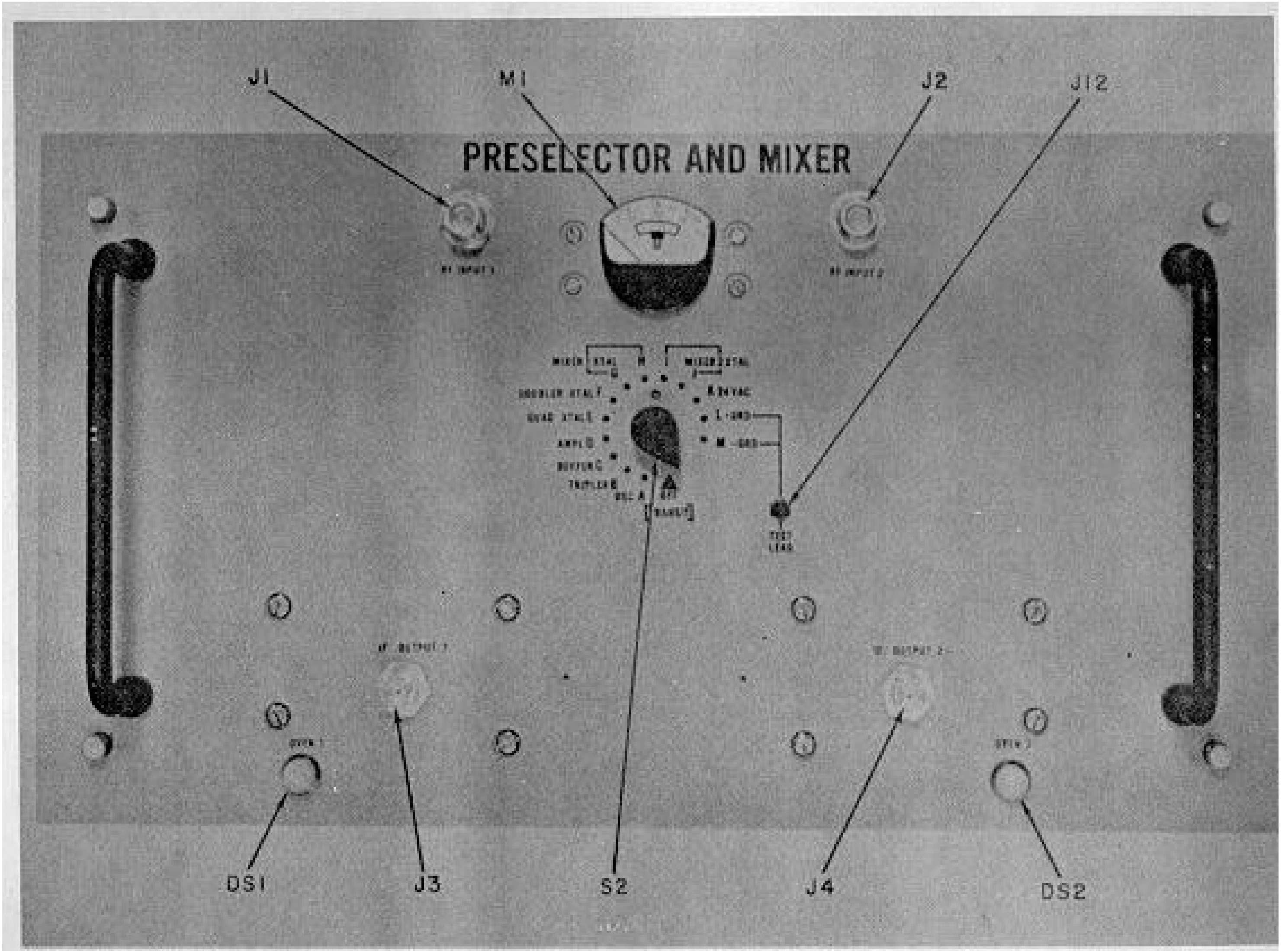


Figure 2-8. Preselector and Mixer Drawer, Front Panel

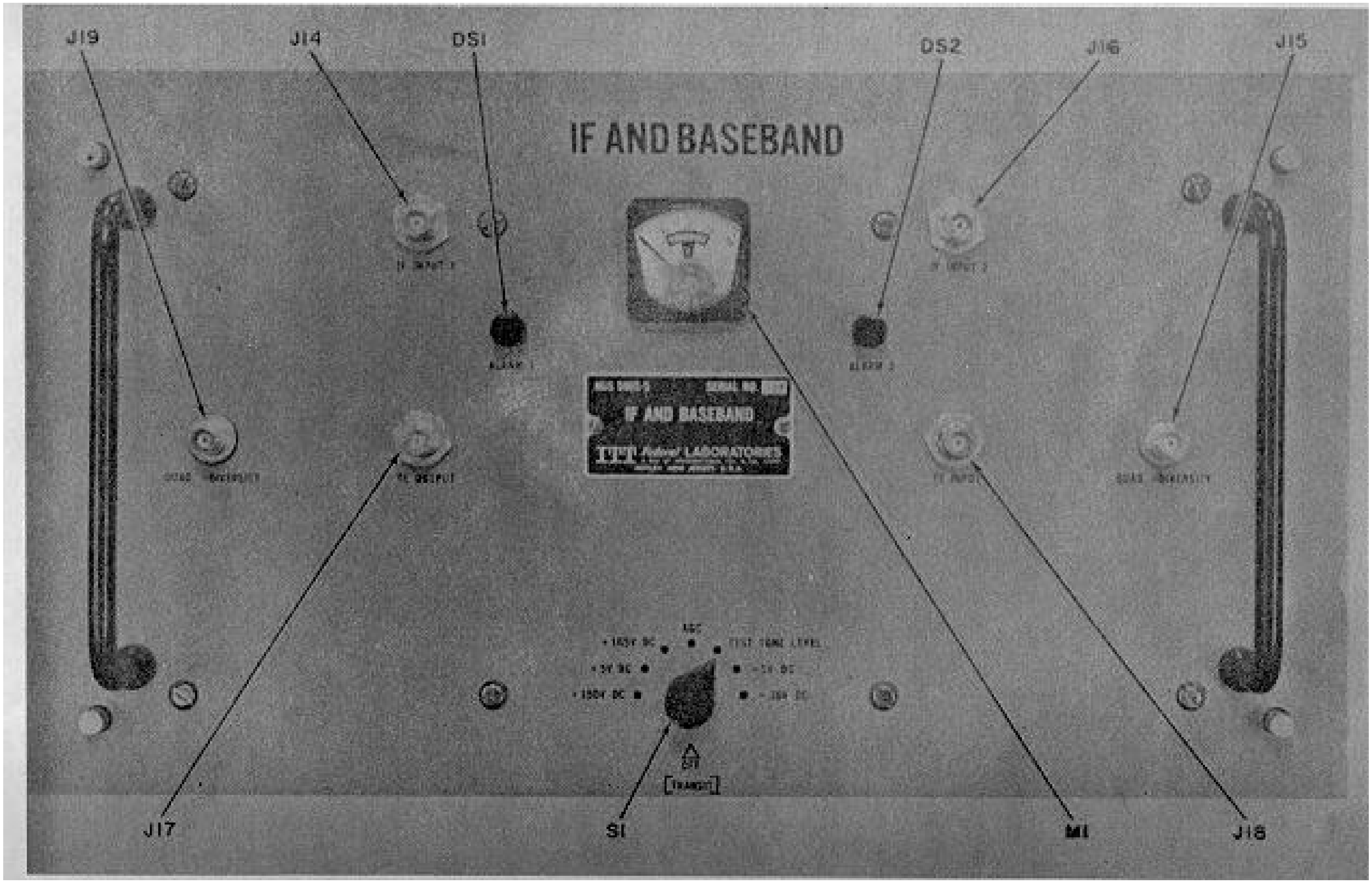


Figure 2-9. IF and Basebound Drawer, Front Panel

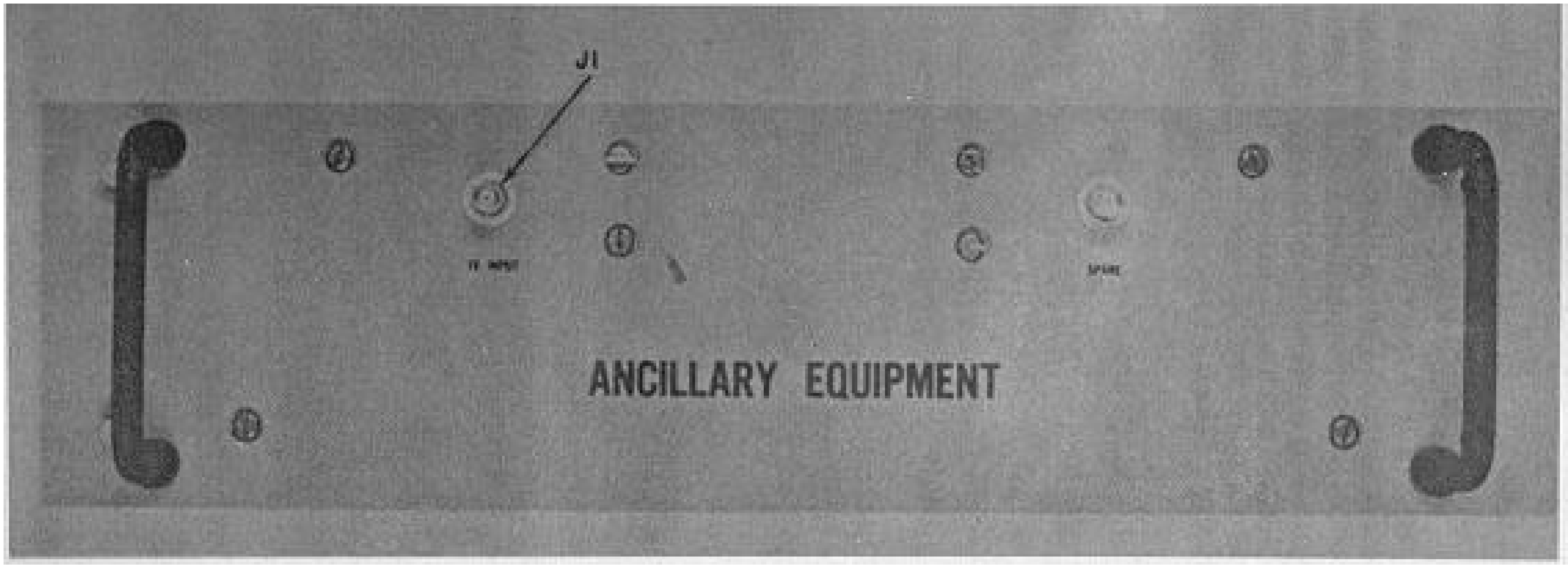


Figure 2-10. Ancillary Equipment Drawer, Front Panel

2-9. INSPECTION.

2-10. Perform the following inspection procedures:

a. Check that main circuit breaker CB1 on power supply front panel (figure 2-11) is in OFF position. For line-of-sight receivers check CB1 on each Power Supply front panel.

b. Check that all drawers and modules are interconnected in accordance with the schematic and interconnection diagrams.

c. Check each drawer (see figures 2-12 through 2-15) to ensure that all modules are properly secured, all cables are connected, and all tubes are seated properly in their sockets. Figures 2-16 through 2-24 show the module and cable locations in the Preselector and Mixer drawers, the IF and Baseband drawers, and the Ancillary Equipment drawers for all the receiver configurations. The module and cable locations in the Power Supply (NUS 5968-1 or NUS 5981-1) and Dual Parametric Amplifier (NUS 5300-7 or NUS 6580-2) drawers are covered in the module portion of this manual. (Refer to Section VII.)

2-11. INITIAL APPLICATION OF POWER.

2-12. TROPOSPHERIC SCATTER RECEIVERS (QUADRUPLE DIVERSITY). Proceed as follows:

a. Check that the MAIN circuit breakers and receiver circuit breakers in shelter power boxes 1 and 2 are in the ON position. (Refer to the Radio and Equipment Shelter Manual TD 64-273.)

b. In receiver A, set MAIN circuit breaker CB1 on Power Supply drawer front panel to ON. (See figure 2-11.) Check for the following:

1. Blown fuses.
2. Overload indication.
3. POWER ON lamp DS1 on.
4. Blower fan operation in Power Supply drawer. (An interlock permits blower operation only when drawer is closed.)
5. OVEN 1 and OVEN 2 (single conversion receivers only) lamps DS1 and DS2 on Preselector and Mixer drawer (figure 2-8) on.

NOTE

After a few minutes of operation the OVEN 1 and OVEN 2 (single conversion receivers only) lamps should cycle on and off to indicate crystal oven temperature stabilization.

c. Set AC ON-RESET switch S1 on Power Supply drawer front panel to AC ON position. AC ON lamp I3 should light.

d. Allow 15 minutes for warmup.

e. On Preselector and Mixer drawer front panel, rotate meter function selector switch S2 to M-GRD position.

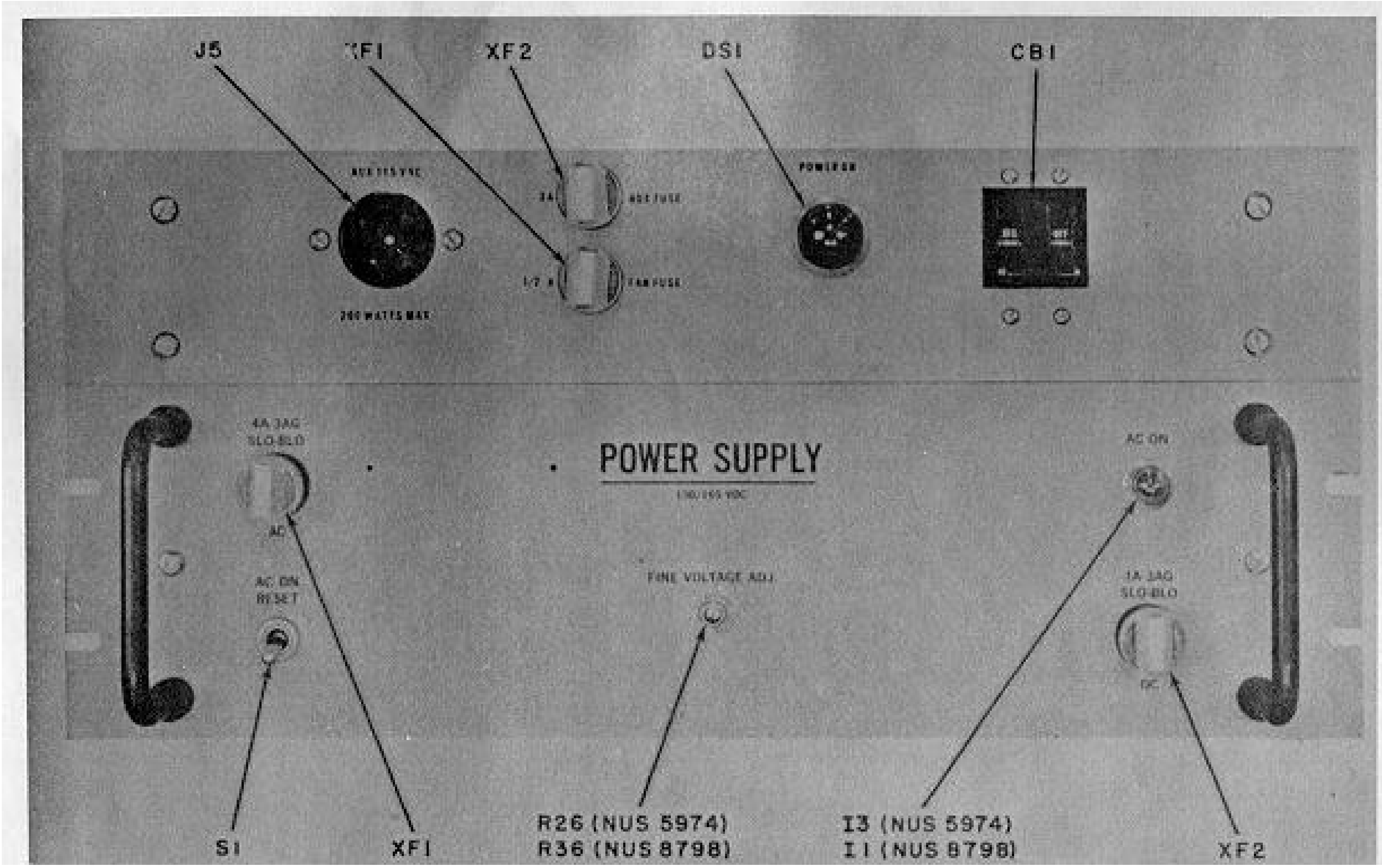


Figure 2-11. Power Supply Front Panel

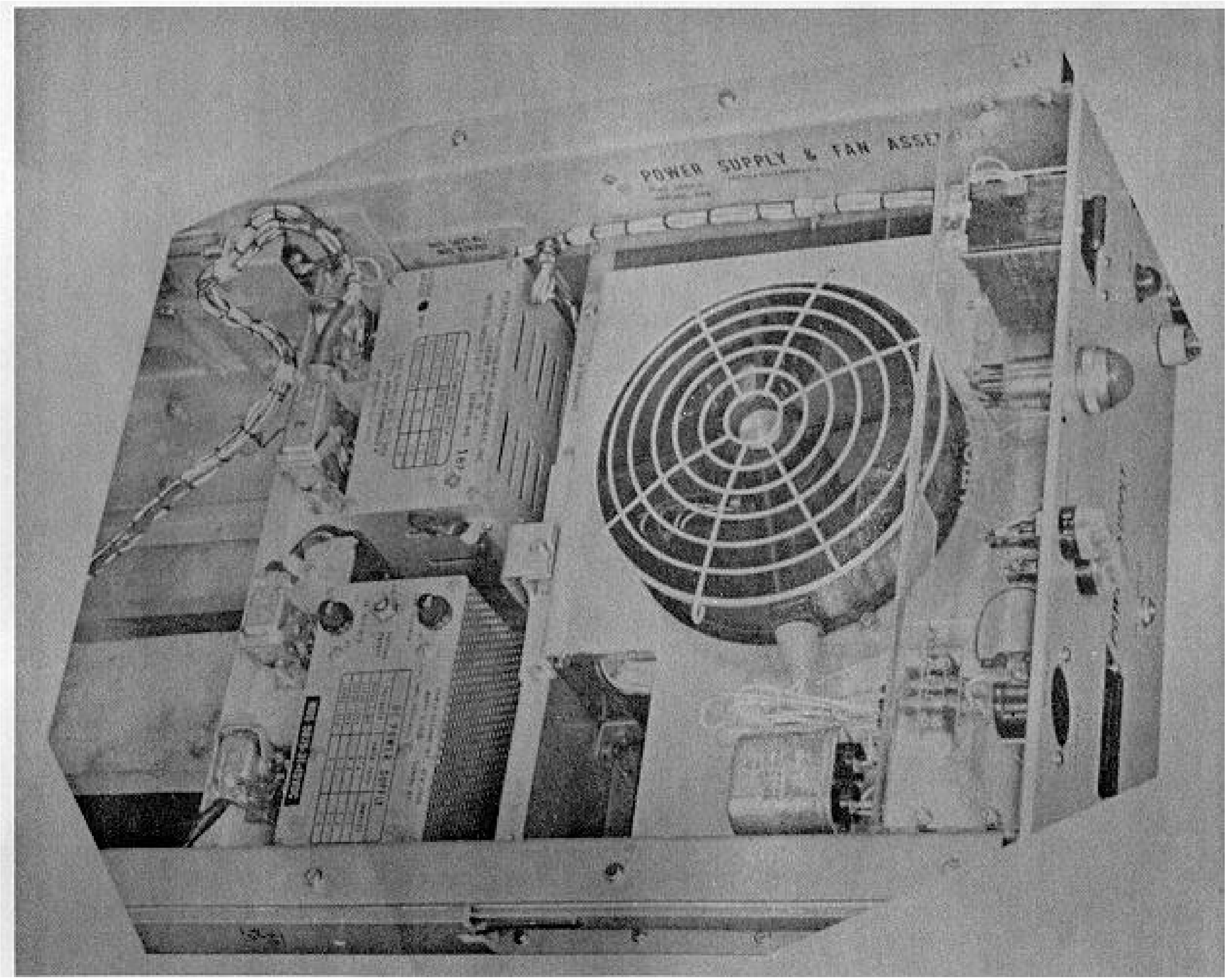


Figure 2-12. Power Supply Drawer, Top View.

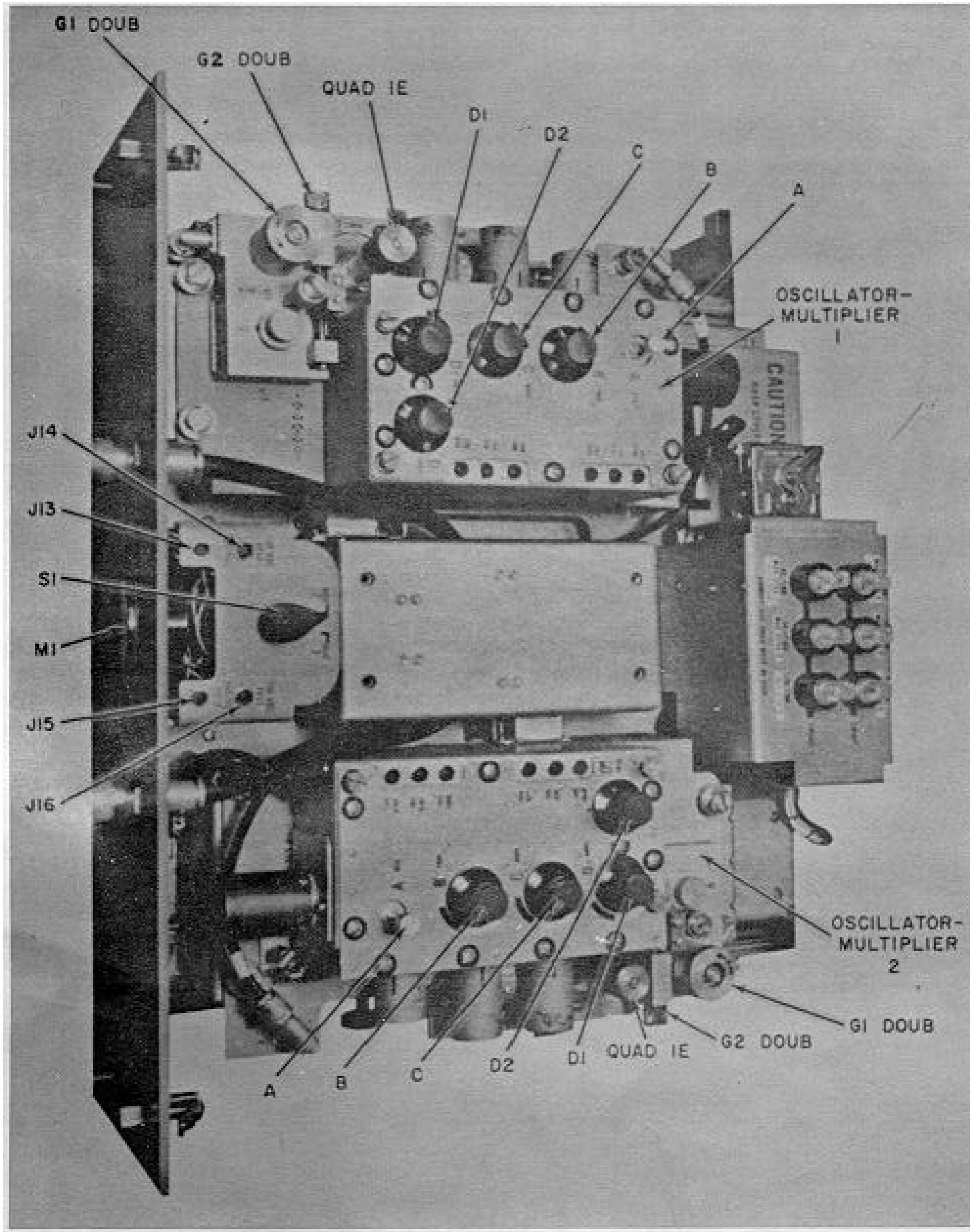


Figure 2-13. Preselector and Mixer Drawer, Single Conversion, Top View

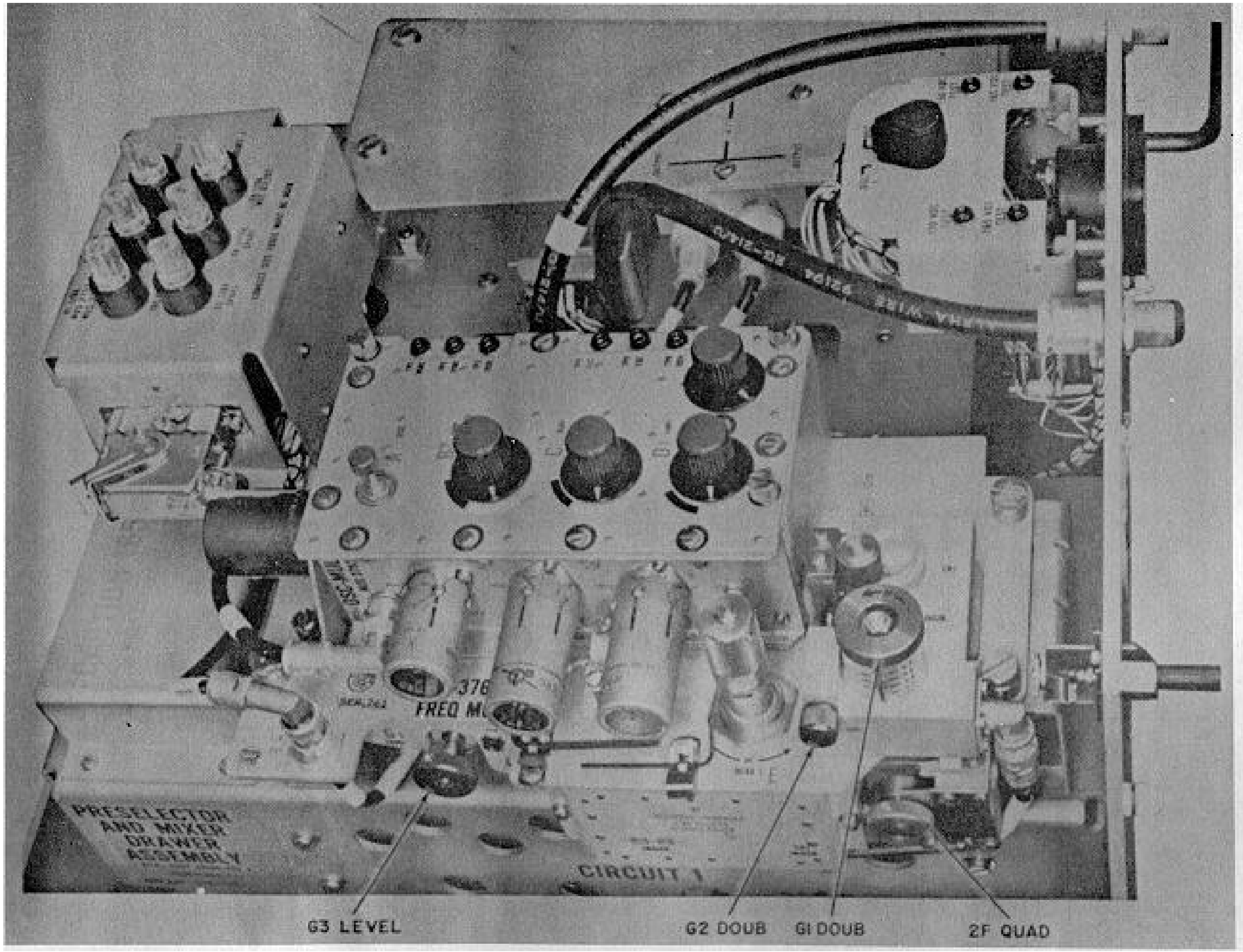


Figure 2-14. Preselector and Mixer Drawer, Double Conversion, Top View

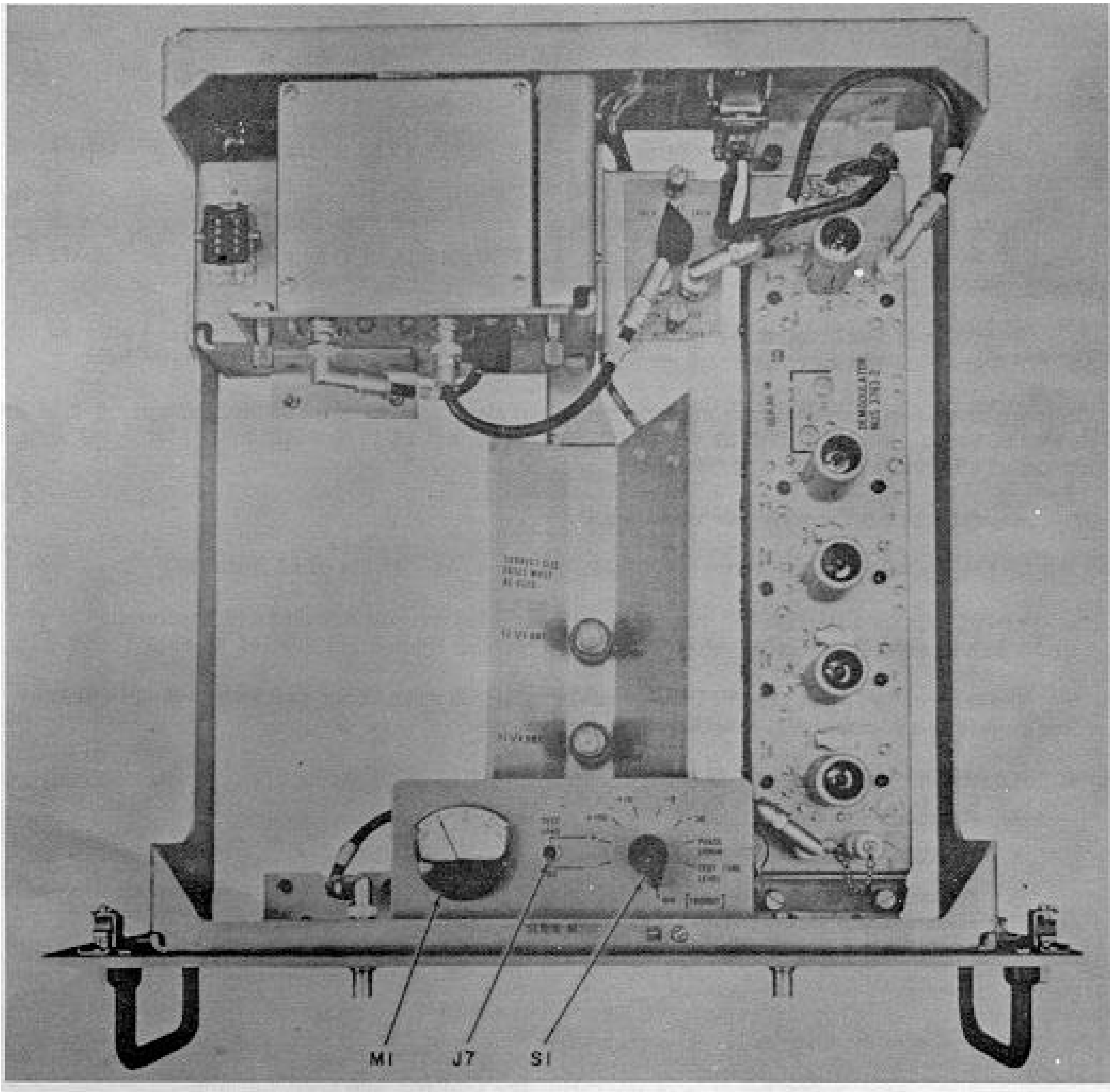


Figure 2-15. Ancillary Equipment Drawer, Top View

f. Successively connect jumper between the meter TEST LEAD jack J12 (figure 2-8) and the following test points on the Preselector and Mixer drawer subpanel (figure 2-13).

1. 150 VDC TEST (J14)
2. 150 VDC TEST (J16)
3. 165 VDC TEST (J13)
4. 165 VDC TEST (J15)

g. Observe meter M1 following each test point interconnection. Meter M1 should indicate 50 ± 10 in each case.

h. On Preselector and Mixer front panel, rotate switch S2 to K24 VAC position. Meter should indicate 50 ± 10.

i. On IF and Baseband drawer front panel, successively rotate meter function selector switch S1 to ± 150 VDC, +5 VDC, ± 165 VDC, - 5 VDC, and -30 VDC positions. Meter M1 should indicate 50 ± 10 for each switch position.

j. Where Dual Parametric Amplifier is used, depress POWER ON pushbutton switch S2 on Dual Parametric Amplifier front panel. POWER ON lamps DS5 and DS6 should light.

k After a 15-minute warmup period, successively rotate meter switch S3 (figure 2-5 or 2-6) to BEAM VOLT, BEAM CUR, REFL VOLT, 24 VAC, and 24 VDC positions. Meter M2 should indicate 50 ± 10 for each switch position.

l. Repeat steps a through j on receiver B.

2-13. LINE-OF-SIGHT RECEIVERS (DUAL DIVERSITY). Proceed as follows:

a. Check that the MAIN circuit breakers and receiver circuit breakers in shelter power boxes 1 and 2 are in the ON position. (Refer to the Radio and Equipment Shelter Manual TD 64-273.)

b. In the receiver, set MAIN circuit breaker CB1 on each of the two Power Supply drawer front panels to ON position. Check for the following:

1. Blown fuses.
2. Overload indication.
3. POWER ON lamps DS1 on in both drawers.
4. Blower fans in both drawers operating. (An interlock permits blower operation only when drawer is closed.)
5. OVEN 1 and OVEN 2 lamps lit on Preselector and Mixer drawer front panel (figure 2-8).

NOTE

After a few minutes of operation the OVEN 1 and OVEN 2 lamps should cycle on and off to indicate crystal oven temperature stabilization.

c. Set AC ON-RESET switches S1 on both Power Supply drawer front panels to AC ON position. The AC ON lamp I3 on each panel should light.

d. Allow 15 minutes for warmup and perform steps e through i of paragraph 2-10.

e. On Ancillary Equipment drawer subpanel (figure 2-15), successively rotate meter function selector switch S1 to ± 150, ± 15, -5, and -30 positions. Meter M1 should indicate 100 ± 20 for each switch position.

2-14. INITIAL ADJUSTMENT. Adjustments to the receiver (e. g., frequency alignment) are described in Section VI. Unless the receiver has been detuned, no preoperational adjustments are required.

2-15. When the equipment is being tuned to frequency for the first time after installation, it will be necessary to perform the external preselector frequency, parametric amplifier gain, oscillator multiplier and frequency multiplier frequency, agc and apc alignments, and to check the threshold extension and baseband amplifier alignments. When performing these alignments and checks, it will not be necessary to perform the steps in the alignment procedures which are associated with maintaining traffic on the air (i. e., setting of the CEC switching unit and breaking down to dual and reconnecting to quad after each alignment step).

2-16. MODULE SWITCH POSITIONS. For normal operation the module switches should be in the positions shown in table 2-2.

TABLE 2-2. MODULE SWITCH POSITIONS FOR NORMAL OPERATION

Module	Switch	Position
Parametric Amplifier	1 PARAMPL 1 NORM-BYPASS	NORM
Parametric Amplifier 2	PARAMPL 2 NORM-BYPASS	NORM
IF Amplifier	AGC	EXT
Phase Combiner	ALM TEST	PHASE
	DELAY	ON
	VCO SW (NOTE)	POS if carrier is 4.7Gc or above
		NEG if carrier is below 4.7Gc
AGC Amplifier	AUTO-MAN	AUTO
AGC Amplifier	QUAD-DUAL	QUAD

NOTE

VCO switch is present in single conversion receivers NUS 5961-12, -15, -16, -17, -19, -20 only.

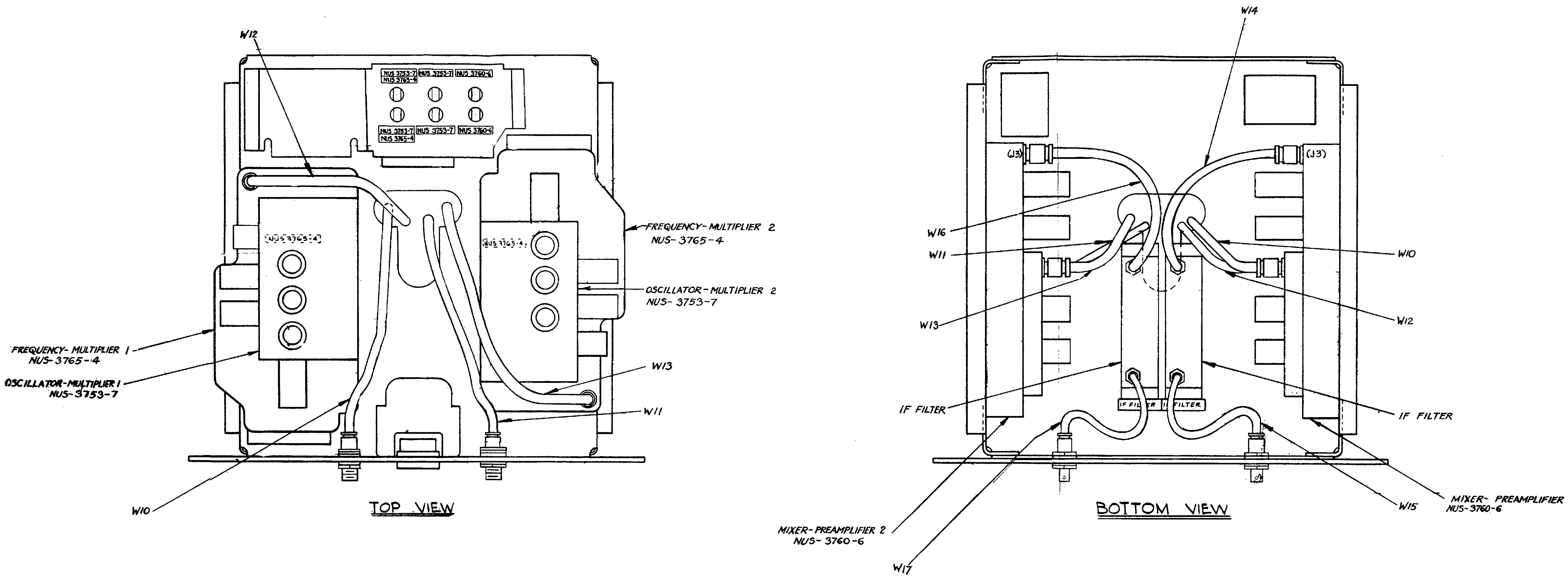


Figure 2-16. **Preselector and Mixer Drawers (NUS 5961-12, -15, -17, -19, -20 Receivers) Module and Cable Location Diagram**

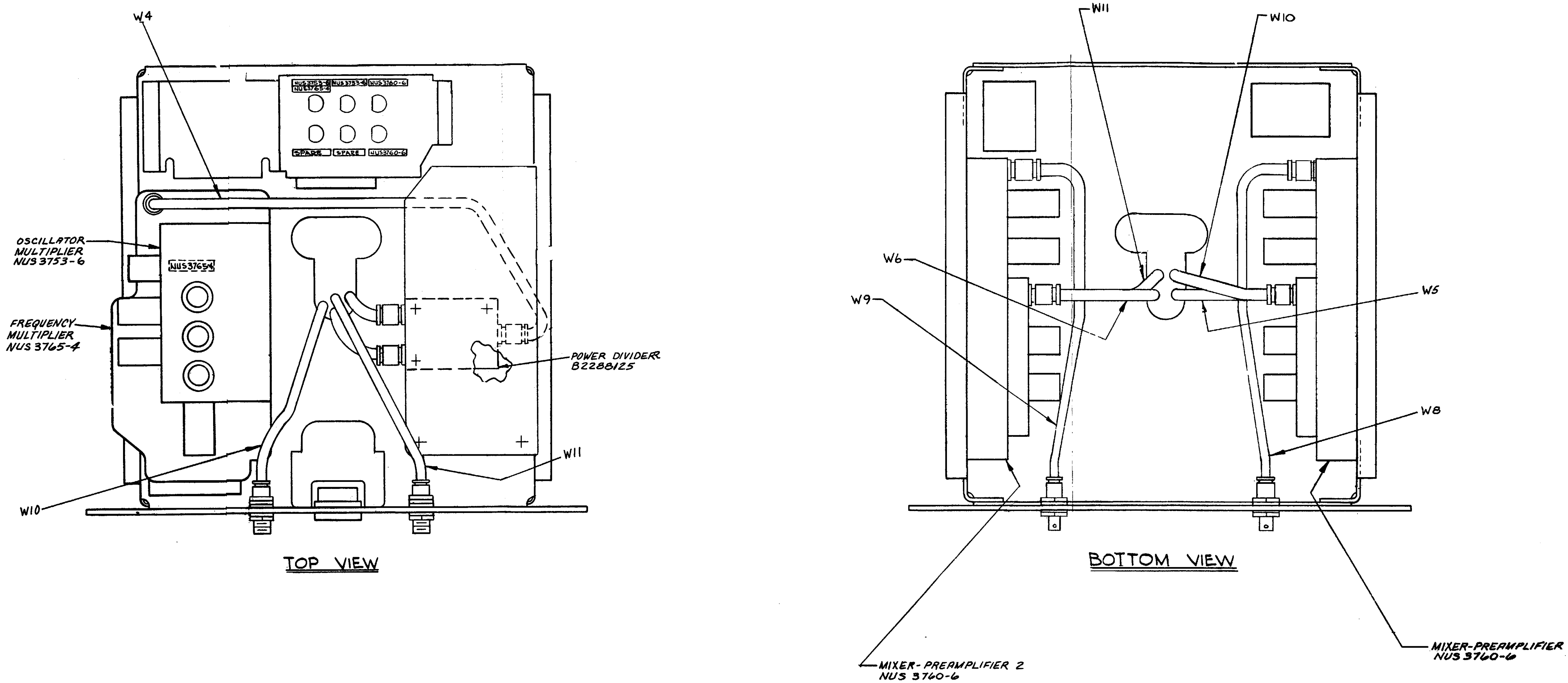


Figure 2-17. Preselector and Mixer Drawers (NUS 5961-9, -13 Receivers) Module and Cable Location Diagram

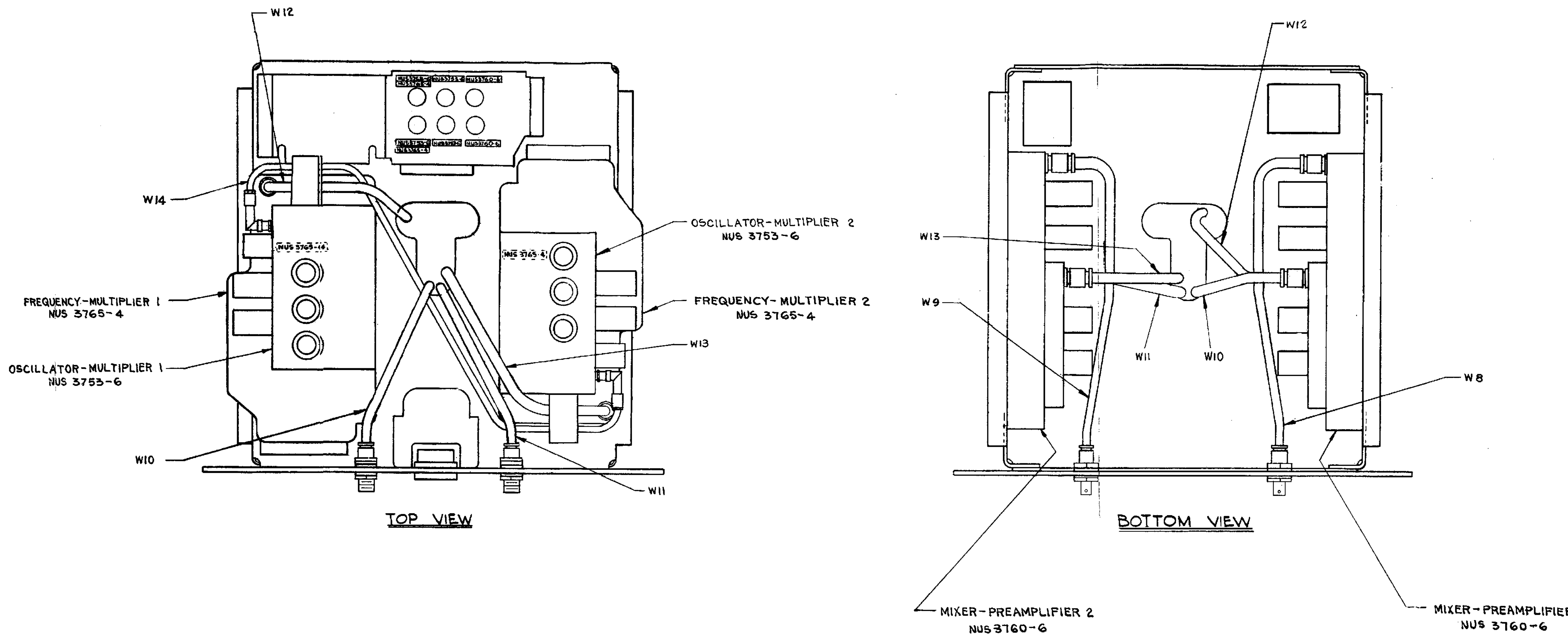


Figure 2-18. Preselector and Mixer Drawers (NUS 5961-10, Receivers) Module and Cable Location Diagram

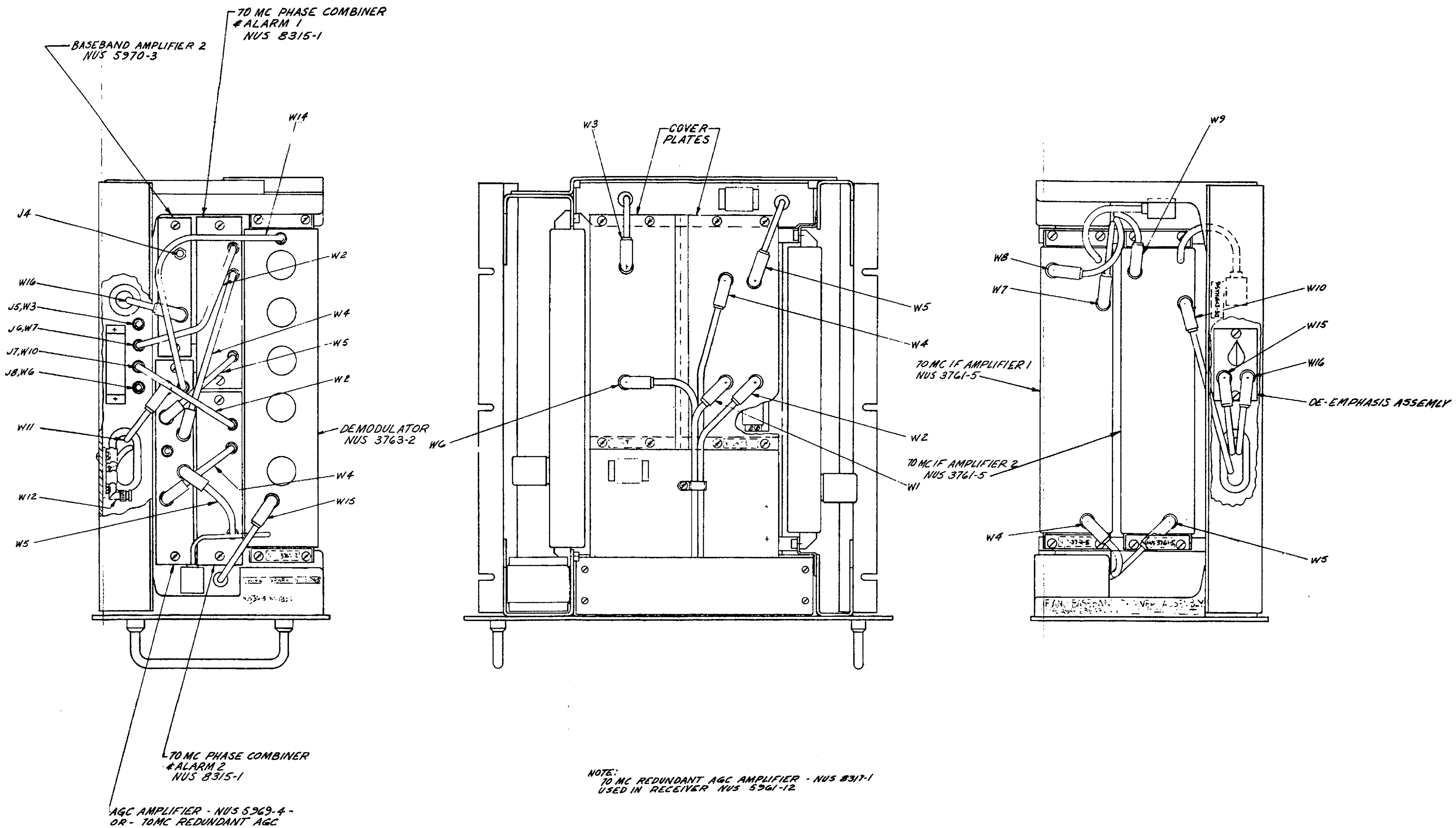
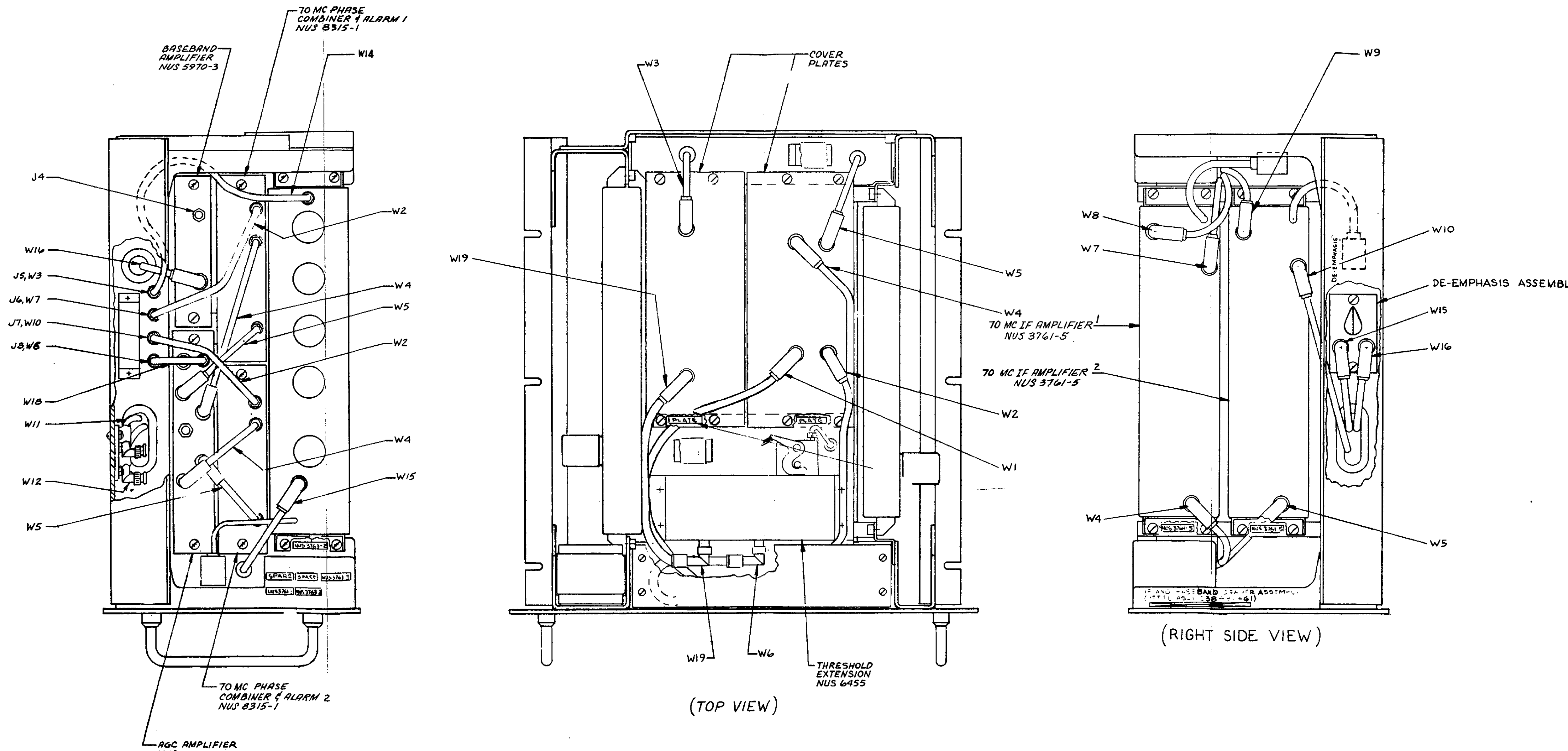


Figure 2-19. IF and Baseband Drawers (NUS 5961-12, -17, -19, -20 Receivers)) Module and Cable Location Diagram



(LEFT SIDE VIEW)

Figure 2-20. IF and Baseband Drawers (NUS 5961-15, -16, Receivers) Module and Cable Location Diagram

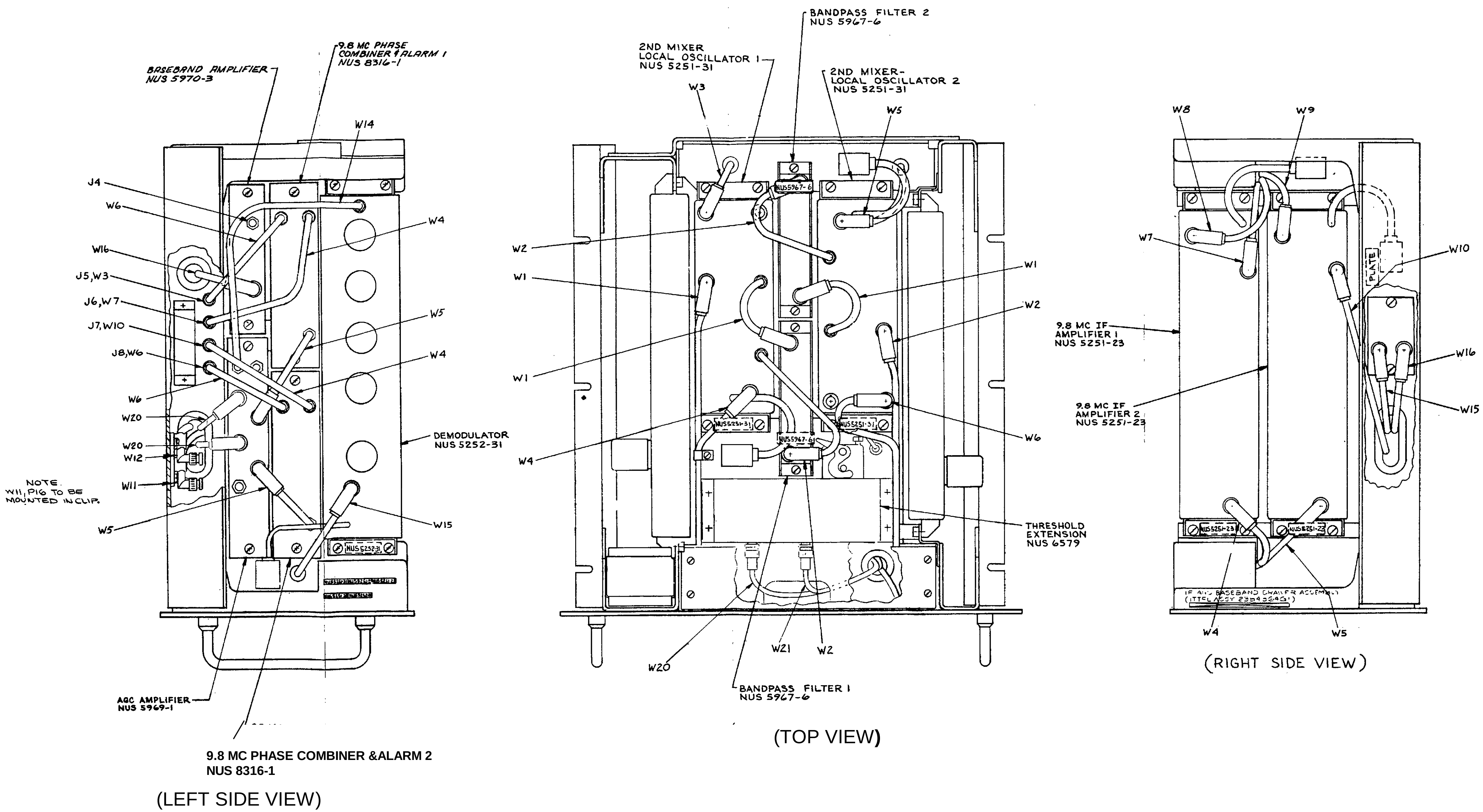


Figure 2-21. IF and Baseband Drawers (NUS 5961-9, -13, Receivers) Module and Cable Location Diagram

SECTION III

OPERATING INSTRUCTIONS

3-1. GENERAL.

3-2. This section describes the operating instructions for the receiver. These procedures are confined to equipment turn-on and equipment turn-off procedures. In addition, table 3-1 lists the controls, indicators, connectors, test points, metering facilities, and their functions.

3-3. CONTROLS, INDICATORS, CONNECTORS, AND TEST POINTS.

3-4. Refer to table 3-1 for the controls, indicators, connectors, test points, and metering facilities used by operating personnel for adjustment and operating purposes. The illustrations in Section II and figures 3-1 through 3-6 illustrate the controls, indicators, connectors, test points, and metering facilities in the cabinets and cabinet drawers. Also, many of the module test points are shown. Module test points not listed in table 3-1, are covered in the appropriate module discussion given in this manual. (Refer to Section VII.)

3-5. EQUIPMENT TURN-ON.

3-6. Turn on the receiver by setting circuit breaker CB1 on Power Supply front panel to the on position. (See figure 2-11.)

3-7. EQUIPMENT TURN-OFF.

3-8. Turn off the receiver by setting circuit breaker CB1 on Power Supply front panel to the off position. (See figure 2-11.)

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS

Panel marking	Reference designation	Type	Figure reference	Function
DISTRIBUTION PANEL (TROPOSPHERIC SCATTER RECEIVERS)				
BASEBAND OUTPUT	J3	BNC connector	2-2	Output connector for baseband signal.
OSC LOCK	J4	BNC connector	2-2	Provides oscillator lock cross-connection between Preselector and Mixer drawers (oscillator-multiplier modules) in each receiver cabinet (double conversion tropospheric scatter receivers only). OSC LOCK connector is spare on single conversion tropospheric scatter receivers.
BASEBAND ALARM	DS2 and DS4	Indicator	2-2	Lights red if receiver output is excessively noisy or if the 4-kc pilot tone is absent.
DISTRIBUTION PANEL (LINE-OF-SIGHT RECEIVERS)				
BASEBAND OUTPUT A	J3	BNC connector	2-4	Output connector for baseband signal A.
BASEBAND OUTPUT B	J4	BNC connector	2-4	Output connector for baseband signal B.
BASEBAND ALARM A	DS1 and DS3	Indicator	2-4	Lights red if receiver A output is excessively noisy or if the 4-kc pilot tone is absent.
BASEBAND ALARM B	DS2 and DS4	Indicator	2-4 .	Lights red if receiver B output is excessively noisy or if the 4-kc pilot tone is absent

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
				DUAL PARAMETRIC AMPLIFIER DRAWER NUS 6580-2 OR NUS 5300-7
METER 1	M1	Meter	2-5, 2-6	Monitors following when S4 is in indicated positions: a. PUMP 1 POWER: pump power applied to parametric amplifier 1 b. PUMP 1 MATCH: impedance match between klystron (pump) and parametric amplifier 1 cavity assembly c. TEST LEAD + GRD: voltage applied to jack J2 (fig. 3-1 or 3-2) d. TEST LEAD - GRD: voltage applied to jack J3 (fig. 3-1 or 3-2)
None	S4	Rotary switch	2-5, 2-6	Function selector switch for METER 1
METER 2	M2	Meter	2-5, 2-6	Monitors following when 53 is in indicated positions: a. PUMP 2 POWER: pump power applied to parametric amplifier 2 b. PUMP 2 MATCH: impedance match between klystron (pump) and parametric amplifier 2 cavity assembly c. BEAM VOLT: klystron beam voltage

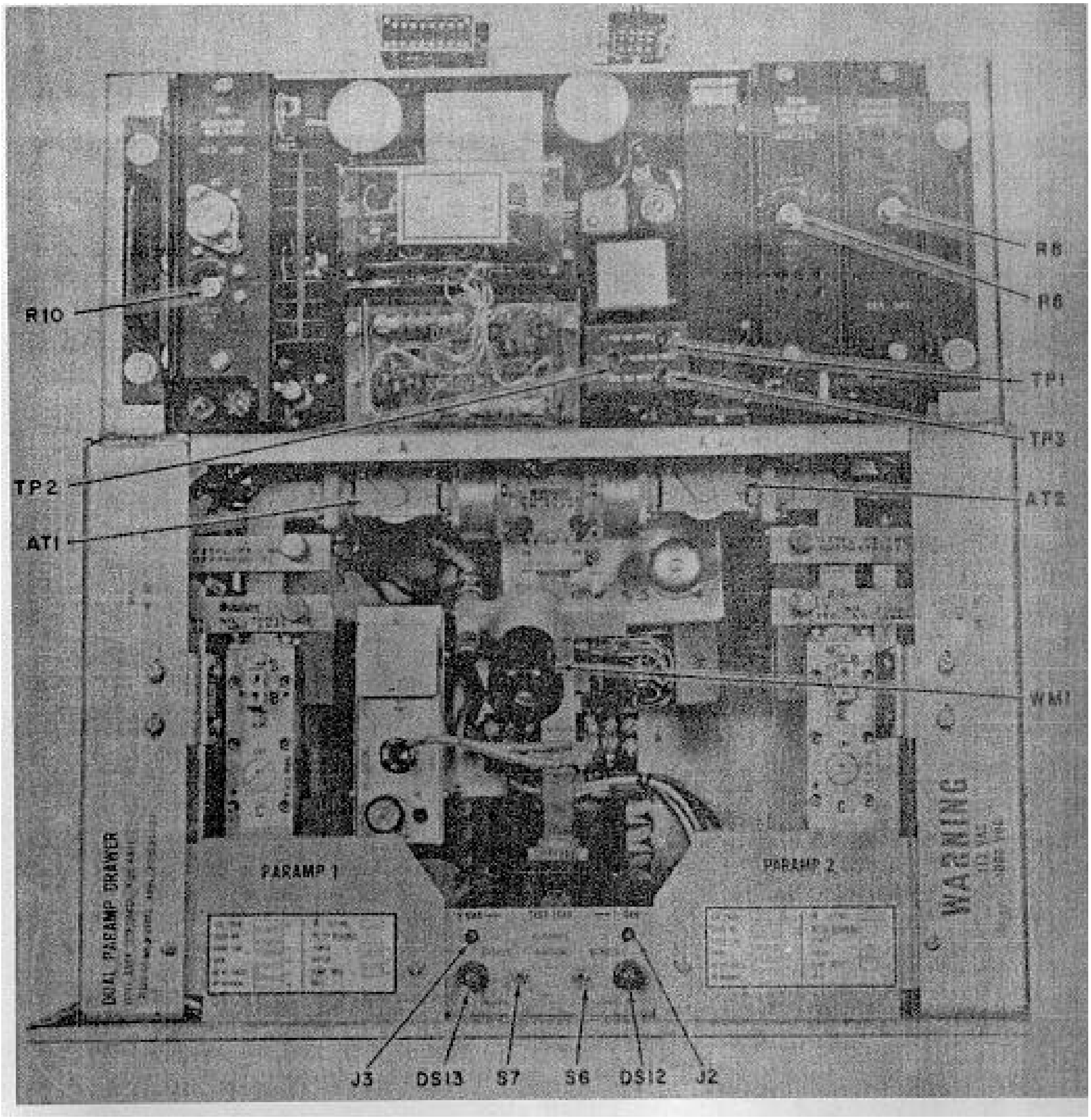


Figure 3-1. Dual Parametric Amplifier (NUS 6580-2) Top View

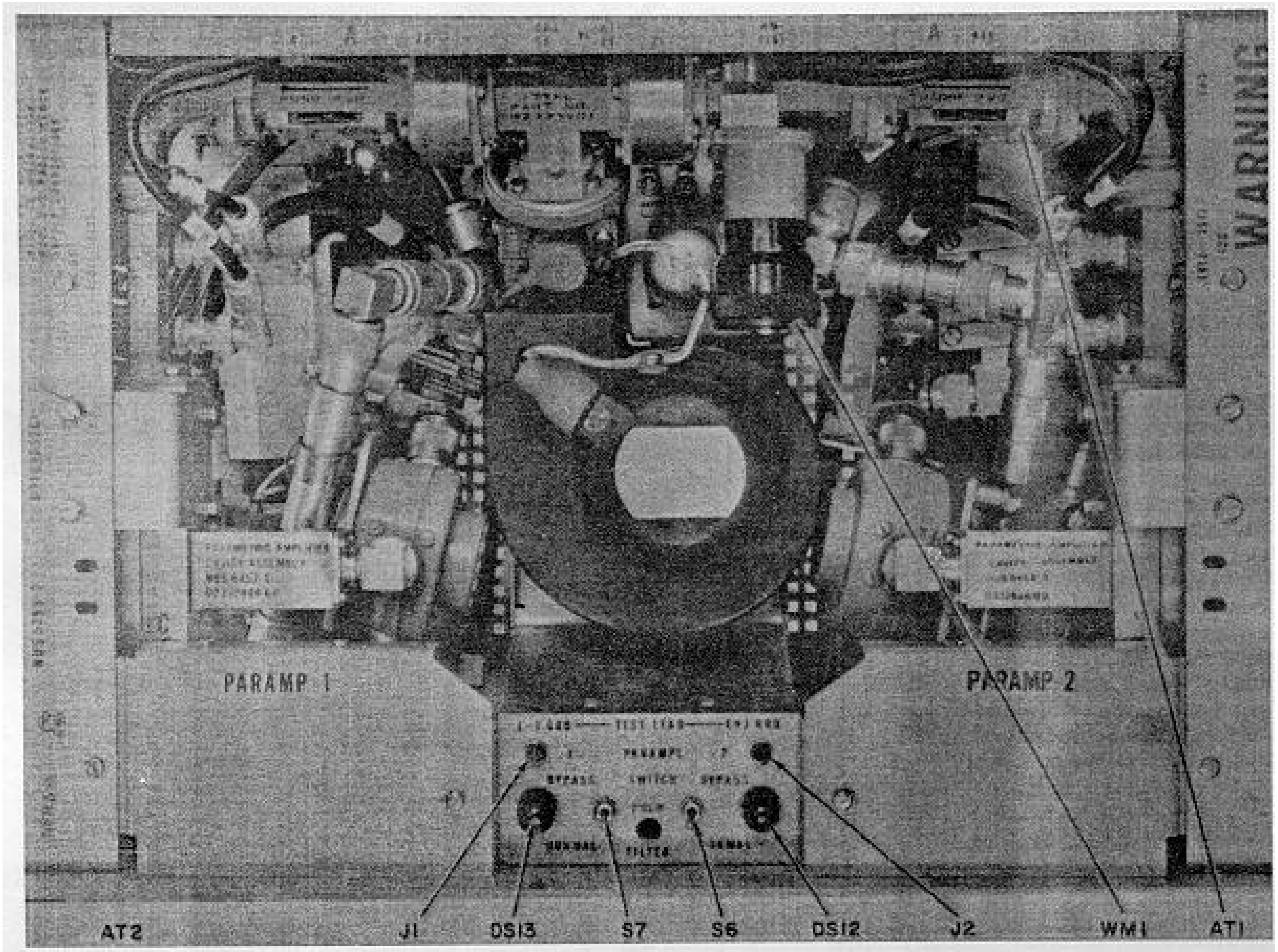


Figure 3-2. Dual Parametric Amplifier Drawer (NUS 5300-7) Top View

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

DUAL PARAMETRIC AMPLIFIER DRAWER NUS 6580-2 OR NUS 5300-7

Panel marking	Reference designation	Type	Figure reference	Function
				d. BEAM CUR: klystron beam current e. REFL VOLT: klystron reflector voltage f. KLYST POWER (FREQ): klystron frequency, in conjunction with WM-1, and power (NUS 6580-2, figure 2-5) PUMP. FREQ: klystron frequency, in conjunctionwithWM-1, and power (NUS 5300-7, figure 2-6) g. 28V AC: ac input voltage (NUS 6580-2, figure 2-5) 24V AC: ac input voltage (NUS 5300-7, figure 2-6) h. 24V DC: dc input voltage
None	S3	Rotary switch	2-5, 2-6	Function selector switch for METER 2
POWER ON	S2, DS5, DS6	Pushbutton switch and incandescent lamps	2-5, 2-6	Turns power and lights on when depressed
POWER SUPPLY OVERLOAD	DS1, DS2	Incandescent lamps	2-5, 2-6	When lit, it indicates overload in klystron power supply

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
DUAL PARAMETRIC AMPLIFIER DRAWER NUS 6580-2 OR NUS 5300-7				
PARAMPL BYPASS	DS7 thru DS10	Incandescent lamps	2-5	Indicates when either or both PARAMPL BYPASS switches (S6 and S7) are in BYPASS positions
COOLING FAILURE	DS3, DS4	Incandescent lamps	2-6	When lit, it indicates excessive klystron heating
PUMP FAILURE	DS3, DS4	Incandescent lamps	2-5	Indicates when klystron power is lost
PUMP FAILURE	DS10, DS11	Incandescent lamps	2-6	Indicates when klystron power is lost
RF OUTPUT	J12	Type N connector	2-5, 2-6	Rf output jack for parametric amplifier 1
RF OUTPUT 2	J11	Type N connector	2-5, 2-6	Rf output jack for parametric amplifier 2
PARAMPL 1 BYPASS-NORMAL	S7	Toggle switch	3-1 or 3-2	In NORMAL position, input signal is applied to parametric amplifier 1 cavity assembly In BYPASS position, input signal bypasses cavity assembly
PARAMPL 1 BYPASS	DS13	Incandescent lamp	3-1 or 3-2	Indicates when PARAMPL 1 NORM-BYPASS switch is in BYPASS position
PARAMPL 2 BYPASS-NORMAL	S6	Toggle switch	3-1 or 3-2	In NORMAL position, input signal is applied to parametric amplifier 2 cavity assembly

TABLE 3-1. CONTROLS CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

DUAL PARAMETRIC AMPLIFIER DRAWER NUS 6580-2 OR NUS 5300-7 (cont)

Panel marking	Reference designation	Type	Figure reference	Function
				In BYPASS position, input signal bypasses cavity assembly
PARAMPL 2 BYPASS	DS12	Incandescent lamp	3-1 or 3-2	Indicates when PARAMPL 2 NORM-BYPASS switch is in BYPASS position
+GRD	J2	Pin jack (Test point)	3-1, 3-2	Provides for insertion of test lead for monitoring module test points
-GRD	J3	Pin jack (Test point)	3-1, 3-2	Provides for insertion of test lead for monitoring module test points
None	WM1	Wavemeter	3-1, 3-2	Monitors klystron frequency in conjunction with M2
AT1	AT1	Waveguide attenuator	3-1	Sets the level of the pump frequency for parametric amplifier 2 (NUS 6580-2, figure 3-1)
AT1	AT1	Waveguide attenuator	3-2	Sets the level of the pump frequency for parametric amplifier 2 (NUS 5300-7, figure 3-2)
AT2	AT2	Waveguide attenuator	3-1	Sets the level of the pump frequency for parametric amplifier 2 (NUS 6580-2, figure 3-1)

TABLE 3-1. CONTROLS CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
DUAL PARAMETRIC AMPLIFIER DRAWER NUS 6580-2 OR NUS 5300-7				
AT2	AT2	Waveguide attenuator	3-2	Sets the level of the pump frequency for parametric amplifier 1 (NUS 5300-7, figure 3-2)
*PRE-REG VOLT ADJ	R10	Variable resistor	3-1	Adjusts output of the pre-regulator in the klystron supply
*BEAM VOLTAGE ADJ	R8	Variable resistor	3-1	Adjusts output of the beam regulator in the klystron power supply
*REFLECTOR VOLTAGE ADJ	R8	Variable resistor	3-1	Adjust output of the reflector regulator in the klystron power supply
+PRE-REG INPUT	TP1	Pin jack (Test point)	3-1	Monitors the input voltage (+24 vdc) to the pre-regulator
- BEAM REG INPUT	TP2	Pin jack (Test point)	3-1	Monitors the beam regulator input voltage
-REFL REG INPUT	TP3	Pin jack (Test point)	3-1	Monitors the reflector regulator input voltage.
RF PANEL				
RF OUTPUT 1	J1	Type N connector	2-7	Provides for connection of rf between waveguide and preselector and mixer drawer
RF OUTPUT 2	J2	Type N connector	2-7	Provides for connection of rf between waveguide and preselector and mixer drawer

***On module**

TABLE 3-1. CONTROLS CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
PRESELECTOR AND MIXER DRAWER				
RF INPUT 1	J1	Type N connector	2-8	Provides rf input connection from parametric amplifier 1 or RF Panel
RF INPUT 2	J2	Type N connector	2-8	Provides rf input connection from parametric amplifier 2 or RF Panel
None	M1	Meter	2-8	Monitors following when S2 is in indicated positions: a. OSC A, TRIPLER B, BUFFER C, and AMPL D: oscillator-multiplier module stage tuning b. QUAD XTAL E and DOUBLER XTAL F: frequency multiplier module stage tuning c. MIXER 1 XTAL G and H and MIXER 2 XTAL I and J: crystal currents of mixer-preamplifier module d. K 24VAC: ac input voltage e. L + GRD and M - GRD: permits + or - 6hecks by TEST LEAD jack J12
TEST LEAD	J12	Pin jack (Test point TP1)	2-8	Provides for insertion of test lead for monitoring test points on sub-panel and modules on M1

TABLE 3-1. CONTROLS CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
PRESELECTOR AND MIXER DRAWER (cont)				
IF OUTPUT 1	J3	BNC connector	2-8	Provides if output connection
IF OUTPUT 2	J4	BNC connector	2-8	Provides if output connection
OVEN 1	DS1	Incandescent lamp	2-8	Indicates when OSC 1 crystal oven is drawing current
OVEN 2	DS2	Incandescent lamp	2-8	Indicates when OSC 2 crystal oven is drawing current (not used in NUS 5961-9, 13 receivers)
None	S1	Rotary switch	2-13	Transfers meter M1 between OSC 1 and OSC 2 for tuning adjustments (OSC 2) is not used in NUS 5961-9 and 13 receivers)
165 VDC	J13	Pin jack (Test point TP2)	2-13	Permits monitoring +165 vdc applied to oscillator 1 module when lead from front-panel TEST LEAD (J12) is connected
165 VDC	J15	Pin jack (Test point TP4)	2-13	Permits monitoring +165 vdc applied to oscillator 2 module when lead from front-panel TEST LEAD (J12) is connected
150 VDC	J14	Pin jack (Test point TP3)	2-13	Permits monitoring +150 vdc applied to oscillator 1 module when lead from front-panel TEST LEAD (J12) is connected

TABLE 3-1. CONTROLS CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
PRESELECTOR AND MIXER DRAWER (cont)				
150 VDC	J16	Pin jack (Test point TP5)	2-13	Permits monitoring +150 vdc applied to oscillator 2 module when lead from front-panel TEST LEAD (J12) is connected
*A OSC	L2	Variable inductor	2-13	Tunes oscillator-multiplier oscillator stage
*B TRIP	C9	Variable capacitor	2-13	Tunes oscillator-multiplier tripler stage
*C BUFF	C17	Variable capacitor	2-13	Tunes oscillator-multiplier buffer stage
*D1 AMPL	C26	Variable capacitor	2-13	Tunes oscillator-multiplier output stage (plate)
*D2 CPLG	C42	Variable capacitor	2-13	Provides pre-set coupling between oscillator-multiplier and frequency multiplier
*QUAD 1 E	C1	Variable capacitor	2-13	Tunes frequency multiplier VI grid
*G1 DOUB	C11	Tuning plunger	2-13	Tunes cavity Z3 of frequency multiplier
*G2 DOUB	C12	Tuning plunger	2-14 (3-3, bottom)	Tunes cavity Z3 of frequency multiplier
*QUAD 2F	C10	Tuning plunger	2-14	Tunes cavity Z2 of frequency multiplier
*G3 LEVEL	AT1	Attenuator	2-14	Controls frequency multiplier output level

*** On module**

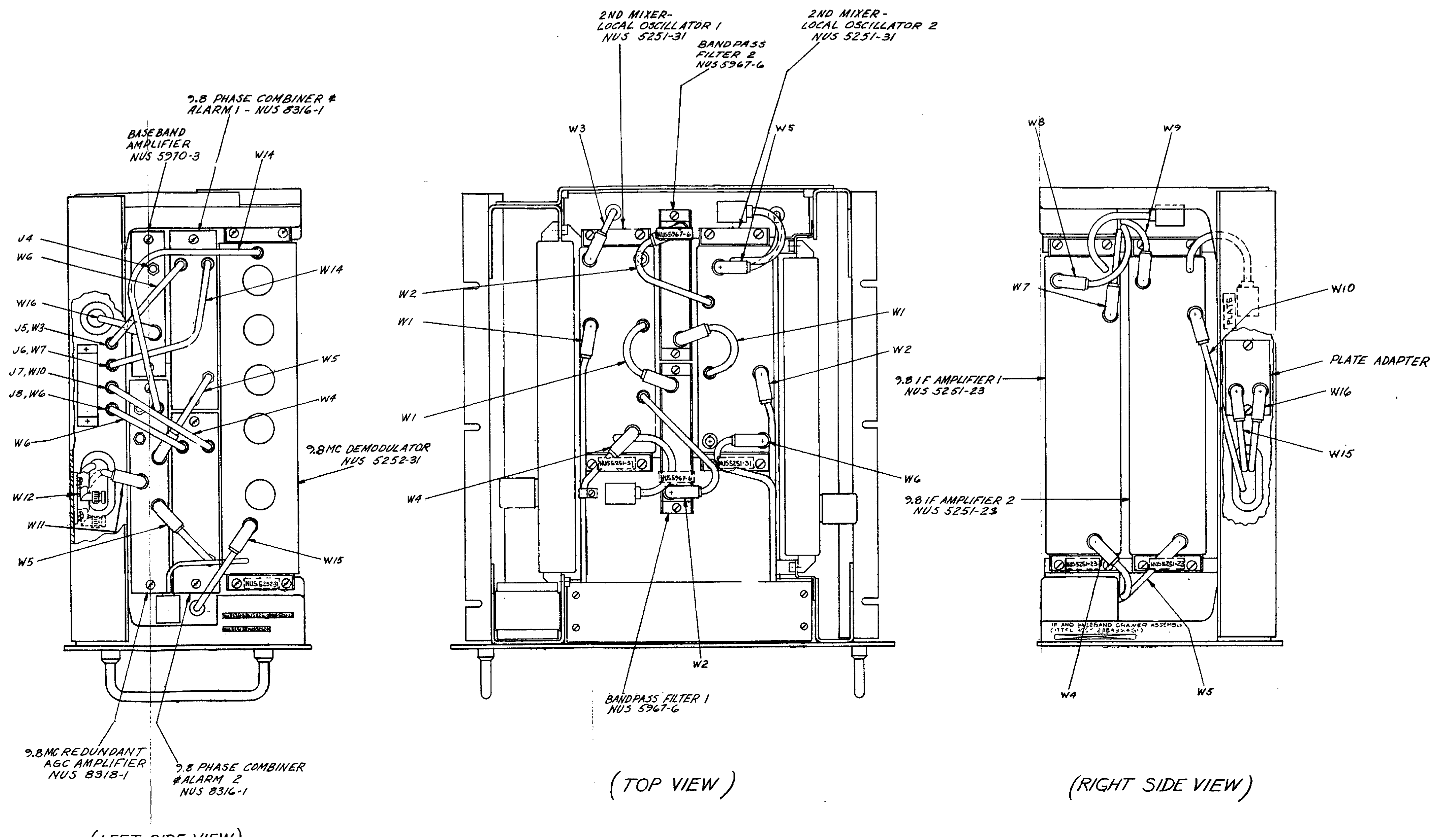


Figure 2-22. IF and Baseband Drawer (NUS 5961-10 Receiver) Module and Cable Location Diagram

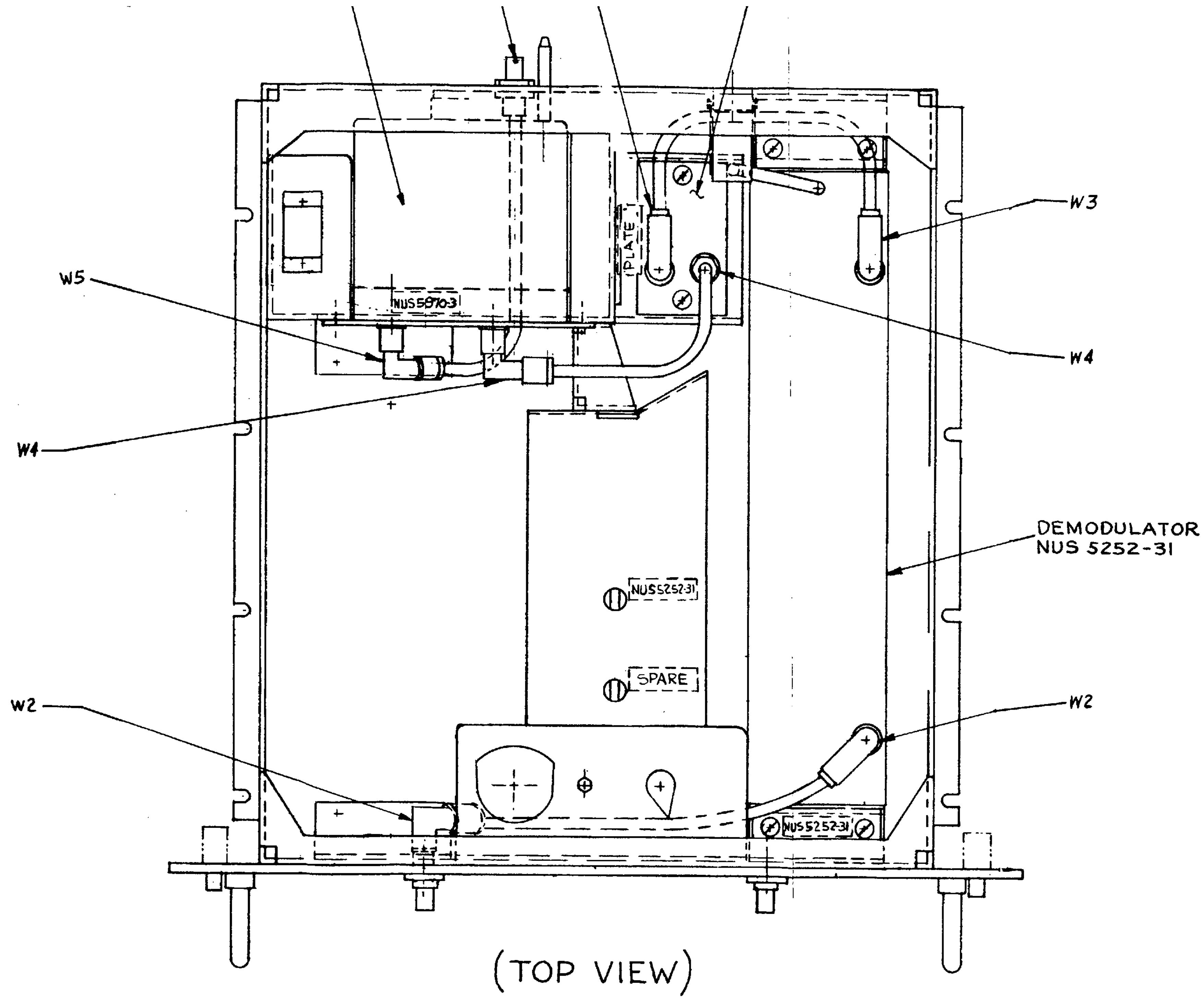


Figure 2-23. Ancillary Equipment Drawer (NUS 5961-10 Receiver) Module and Cable Location Diagram

Figure 2-23. Ancillary Equipment Drawer (NUS 5961-10 Receiver) Module and Cable Location Diagram

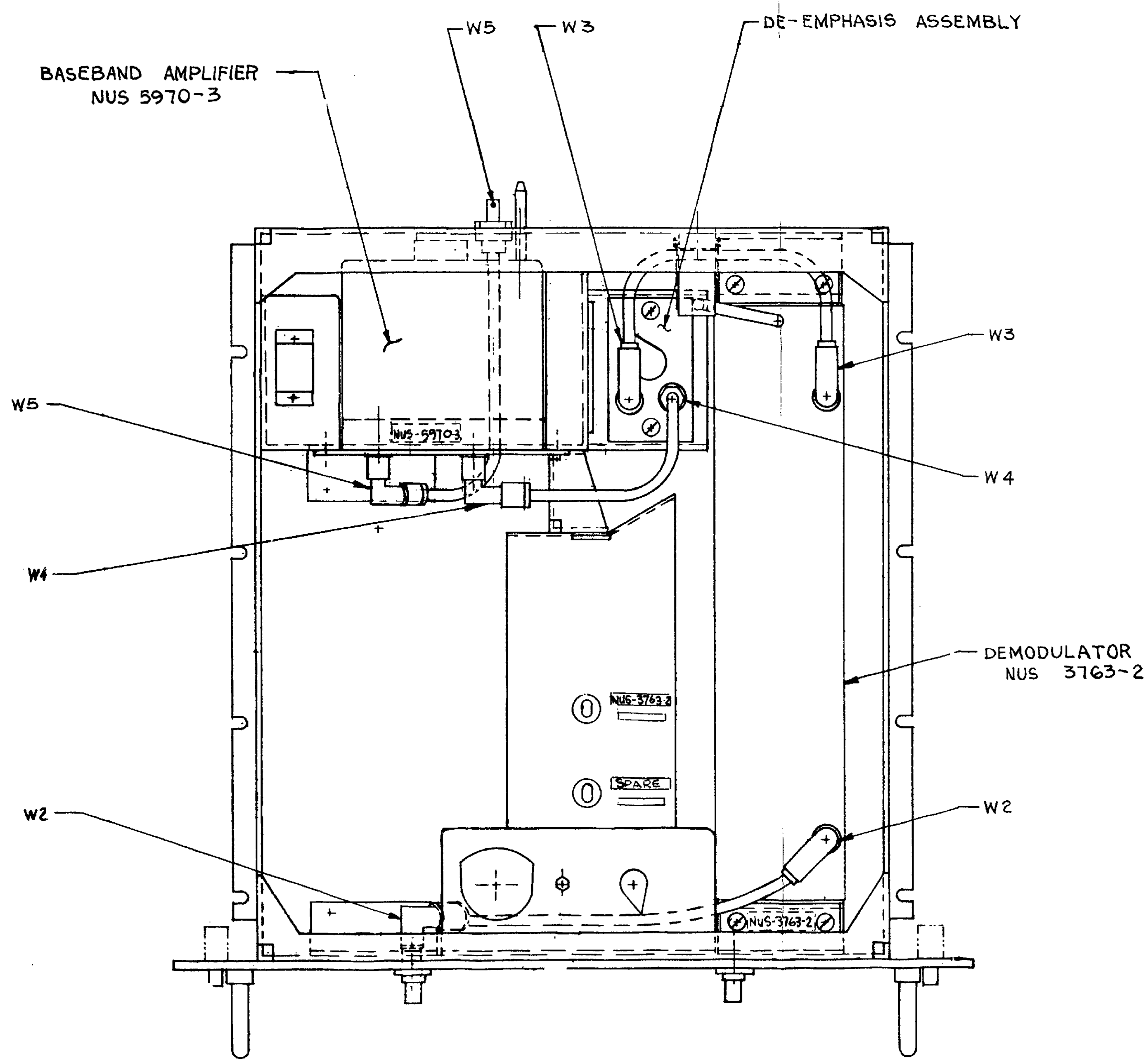


Figure 2-24. Ancillary Equipment Drawer (NUS 5961-12 Receiver) Module and Cable Location Diagram

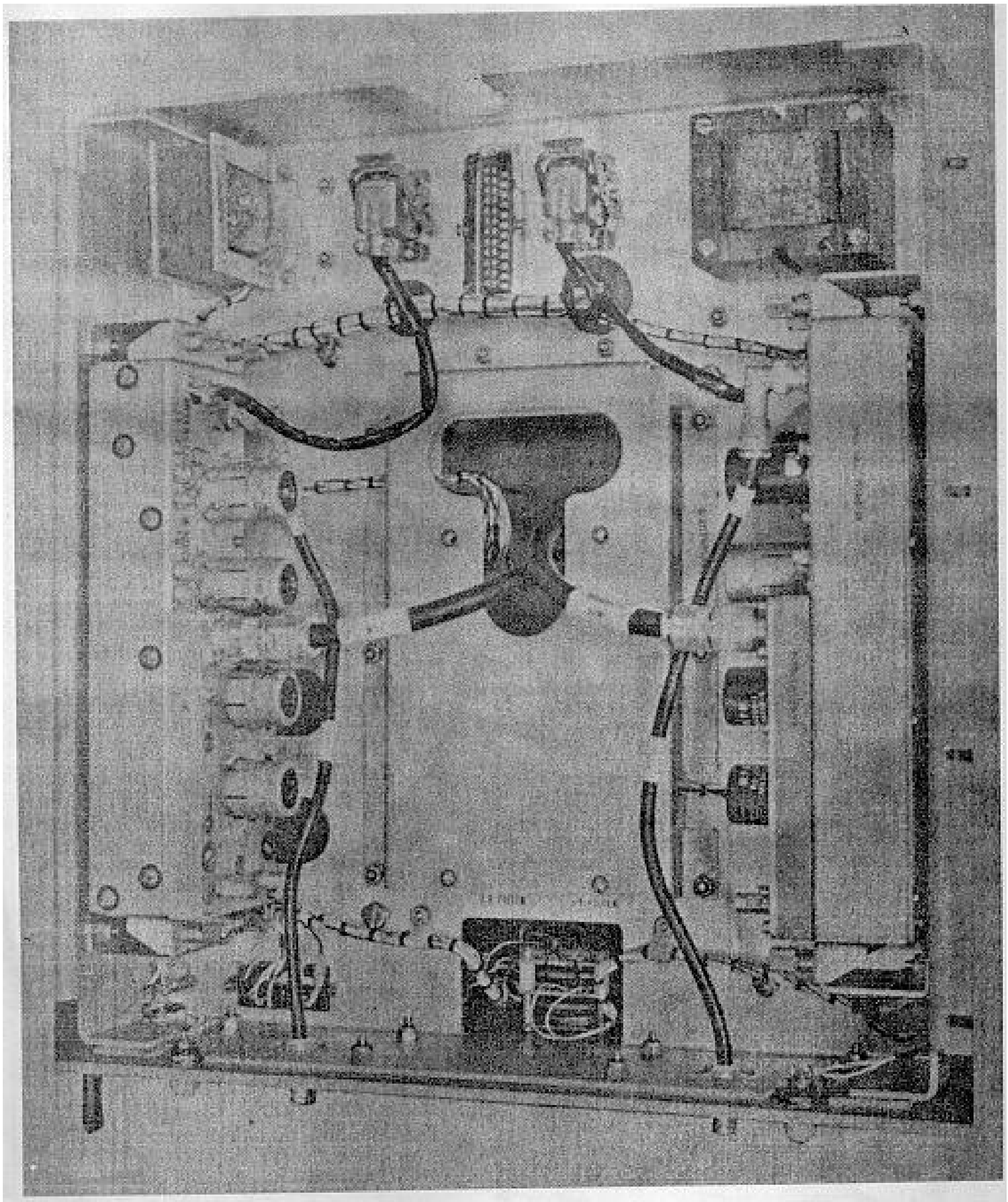


Figure 3-3. Preselector and Mixer Drawer, Bottom View

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel Marking	Reference designation	Type	Figure reference	Function
IF AND BASEBAND DRAWER				
ALARM 1	DS1	Indicator	2-9	Lights red to indicate an excessive apc voltage condition or loss of if signal in channel 1
ALARM 2	DS2	Indicator	2-9	Lights red to indicate an excessive apc voltage condition or loss of if signal in channel 2
IF INPUT 1	J14	BNC connector	2-9	Provides input connection for intermediate frequency 1
IF INPUT 2	J16	BNC connector	2-9	Provides input connection for intermediate frequency 2
QUAD DIVERSITY (left)	J19	BNC connector	2-9	Provides cross-connection between (left) IF and Baseband drawers for quadruple-diversity operation receiver B (tropo receiver only)
QUAD DIVERSITY (right)	J15	BNC connector	2-9	Same as above for receiver A
TE OUTPUT	J17	BNC connector	2-9	Provides cross-connection between IF and Baseband drawer and Ancillary Equipment drawer (LOS receivers only)
TE INPUT	J18	BNC connector	2-9	Not Used
None	M1	Meter	2-9	Monitors the following depending on switch S1 position: a. +150 VDC: 150 vdc power applied to IF and Baseband drawer

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel Marking	Reference designation	Type	Figure reference	Function
IF AND BASEBAND DRAWER				
None	M2	Meter	3-4 or 3-5	b. +5 VDC: 5 vdc (NUS 5961-9, 10, and 13 receivers) or 15 vdc (NUS 5961-12, 15, 16, 19, and 20 receivers) applied to IF and Base- band drawer. c. +165 VDC: 165 vdc power applied to IF and Baseband drawer d. AGC: Combined agc voltage e. TEST TONE LEVEL: relative pilot tone level f. -5 VDC: -5 vdc power produced in IF and Baseband drawer g. -30 VDC: -30 vdc power applied to IF and Baseband drawer Monitors the following depending on switch S2 position: a. TEST LEAD -: positive voltages b. TEST LEAD +: negative voltages c. APC 1: apc voltage applied to local oscillator 1

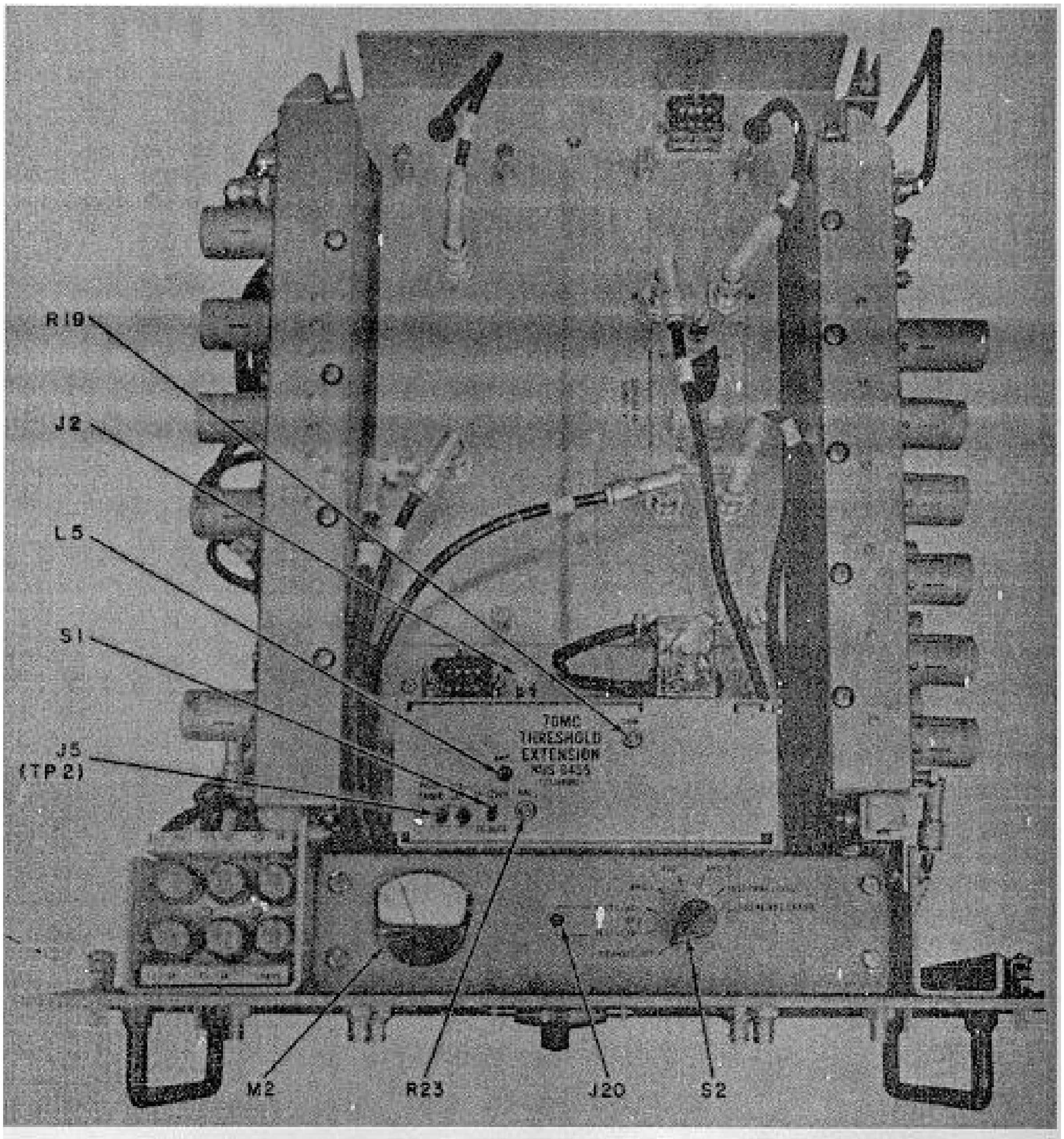


Figure 3-4. IF and Baseband Drawer,(Single Conversion Receiver) Top View

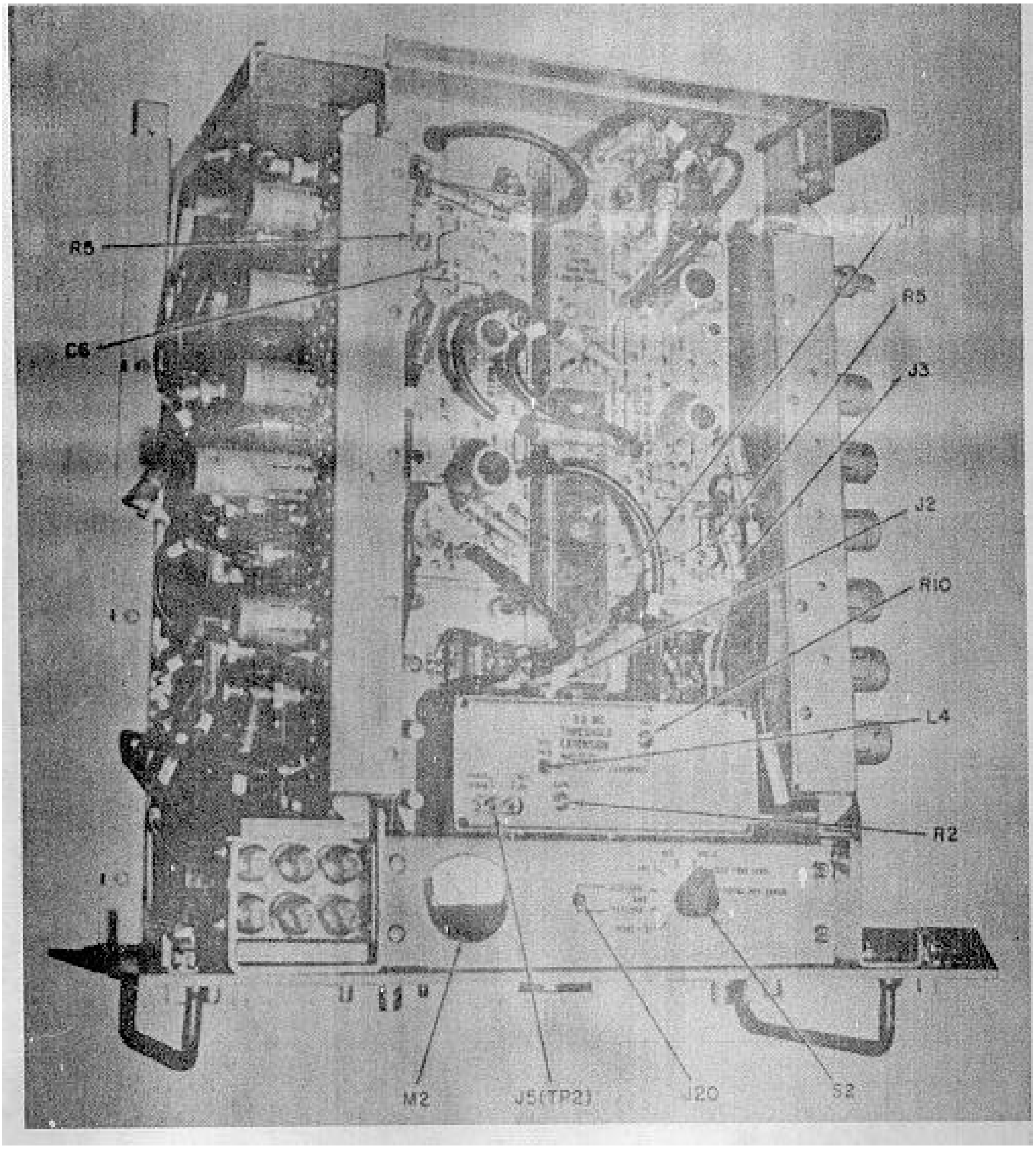


Figure 3-5. IF and Baseband Drawer,(Double Conversion Receiver) Top View

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel Marking	Reference designation	Type	Figure reference	Function
IF AND BASEBAND DRAWER				
				d. AGC: combined age voltage e. APC 2: apc voltage applied to local oscillator 2 f. TEST TONE LEVEL: relative level of pilot tone g. TOTAL APC ERROR: total apc error voltage
None	S2	Rotary switch	3-4 or 3-5	Function selector switch for meter M2
None	J20	Pin jack	3-4 or 3-5	Provides for insertion of test lead for checking module test points
*L O FREQ	J1	Connector, coaxial	3-5	Test point for measuring frequency of oscillator in second mixer-local oscillator module (NUS 5961-9, 10, and 13 receivers)
*L O FREQ	C6	Capacitor, variable	3-5	Coarse adjustment, local oscillator frequency, second mixer-local oscillator module, (NUS 5961-9, 10, and 13 receivers)
*Ø ERROR	R5	Resistor, variable	3-5	Fine adjustment of LO frequency second mixer-local oscillator module, (NUS 5961-9, 10, and 13 receivers)
*GAIN	R19	Resistor, variable	3-4	Adjusts gain of threshold extension, NUS 6455 (70 mc)

* On module

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel Marking	Reference designation	Type	Figure reference	Function
IF AND BASEBAND DRAWER				
BAL	R23	Resistor, variable	3-4	Permits balance of phase detector in threshold extension, NUS 6455 (70 mc)
OSC FREQ	L5	Indicator, variable	3-4	Adjusts frequency of oscillator in threshold extension, NUS 6455 (70 me)
*PHASE ERROR	J5(TP2)	Pin jack	3-4	Permits measurement of dc phase error voltage in threshold extension, NUS 6455 (70 mc)
48-120 CH 24-36 CH	S1	Switch	3-4	Permits selection of channel width in threshold extension, NUS 6455 (70 mc)
*BASEBAND TEST	J2	Connector, coaxial	3-4	Permits measurement of detected signal in threshold extension, NUS 6455 (70 mc)
*GAIN	R2	Resistor, variable	3-5	Adjusts gain of threshold extension, NUS 6579-1 (9.8 mc)
*BAL	R10	Resistor, variable	3-5	Permits balance of phase detector in threshold extension, NUS 6579-1 (9.8 mc)
*OSC FREQ	L4	Indicator, variable	3-5	Adjusts frequency of oscillator in threshold extension, NUS 6579-1 (9.8 mc)
*PHASE ERROR	J5 (TP2)	Pin jack	3-5	Permits measurement of dc phase error voltage threshold extension, NUS 6579-1 (9.8 mc)

* On module

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel Marking	Reference designation	Type	Figure reference	Function
		IF AND BASEBAND DRAWER		
BASEBAND TEST	J2	Connector, coaxial	3-5	Permits measurement of detected signal in threshold extension, NUS 6579-1 (9.8 mc)
*GAIN	R80	Resistor, variable	3-6	Adjusts if amplifier gain, NUS 3761-4 (70 mc)
*AGC	R70	Resistor, variable	3-6	Adjusts if amplifier agc loop gain, NUS 3761-4 (70 mc)
*AGC	S1	Switch, rotary	3-6	Selects mode of agc operation of if amplifier, NUS 3761-4 (70 mc)
*GAIN	R82	Resistor, variable	3-7	Adjusts if amplifier gain, NUS 5251-23 (9.8 mc)
*AGC	R70	Resistor, variable	3-7	Adjusts if amplifier agc loop gain, NUS 5251-23 (9. 8 mc)
*AGC	S1	Switch, rotary	3-7	Selects mode of agc operation of if amplifier, NUS 5251-23 (9.8 mc)
*Ø-L ALM TEST (70 mc)	S2	Switch, rotary	3-8	Selects phase or level circuitry in phase combiner to drive combiner alarm circuit, NUS 8315
*DELAY	S3	Switch, toggle	3-8	Enables or disables 5-10 second time delay in phase combiner alarm circuit, NUS 8315 (70 mc)
*VCO SW	S1	Switch, rotary	3-8	Selects positive or negative control voltage (or none) to be fed from phase combiner to L. O. NUS 8315 (70 mc)

* On module

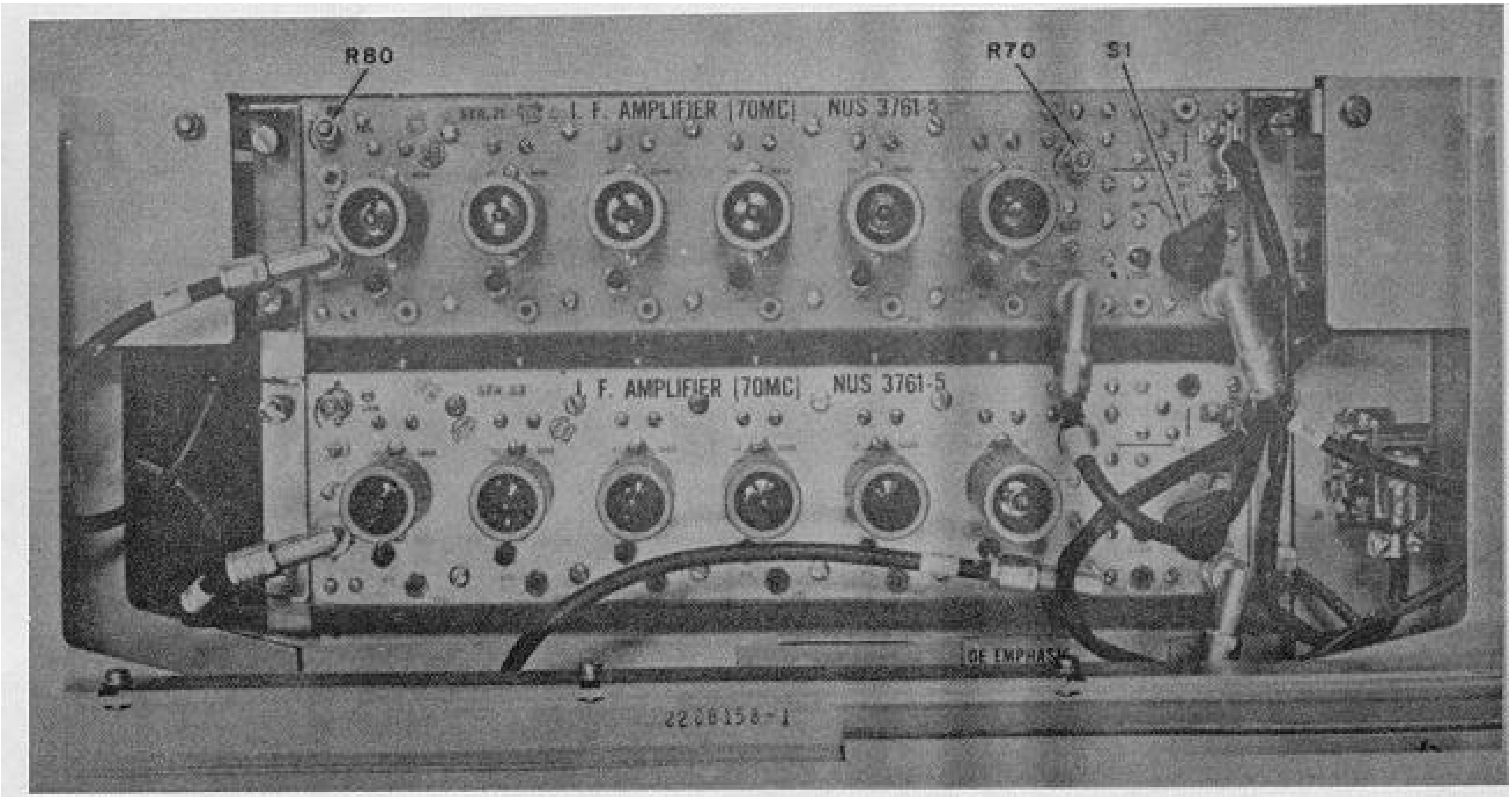


Figure 3-6. IF and Baseband Drawer, (Single Conversion Receiver) Right Side

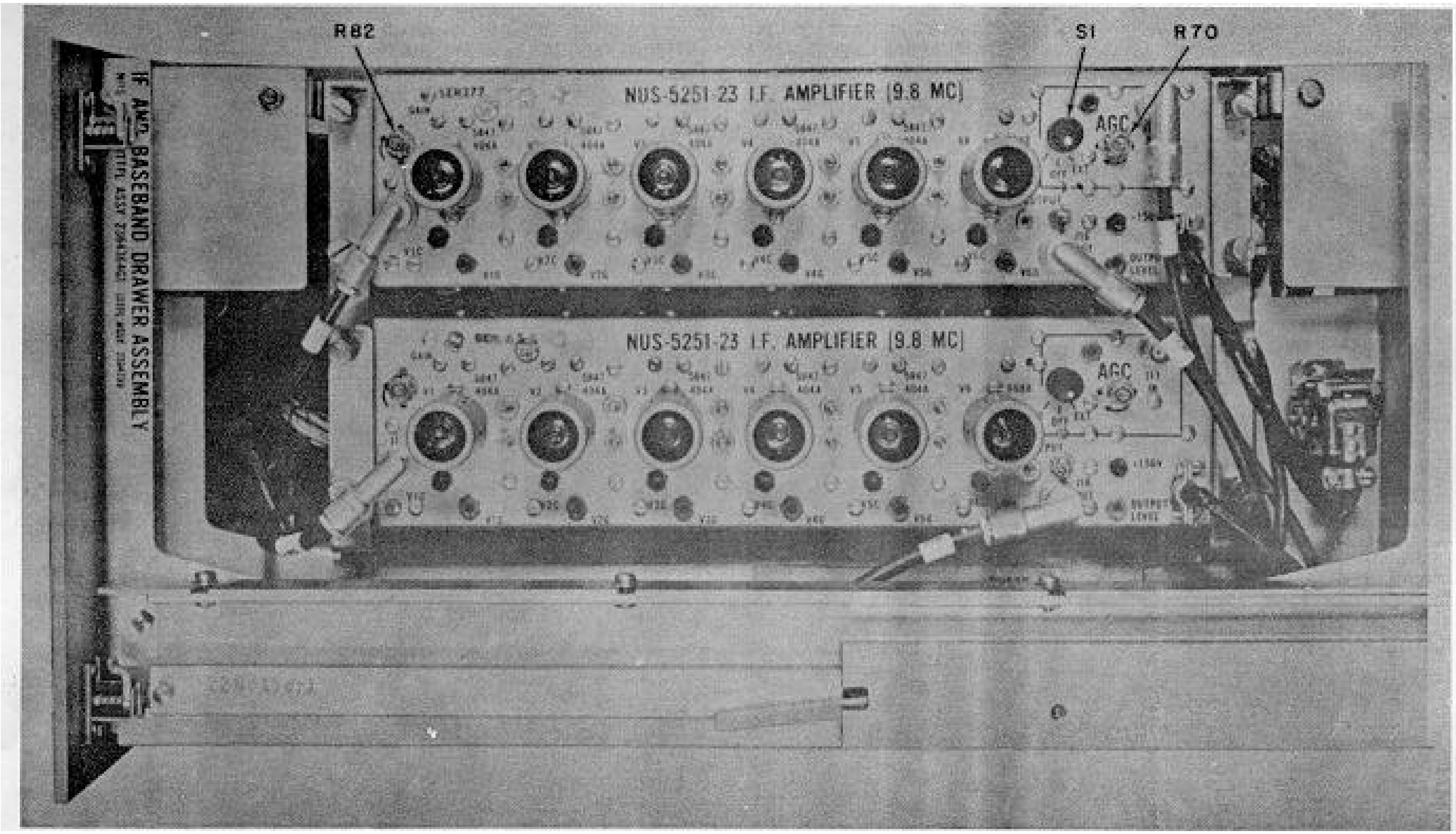


Figure 3-7. IF and Baseband Drawer,(Single Conversion Receiver) Right Side

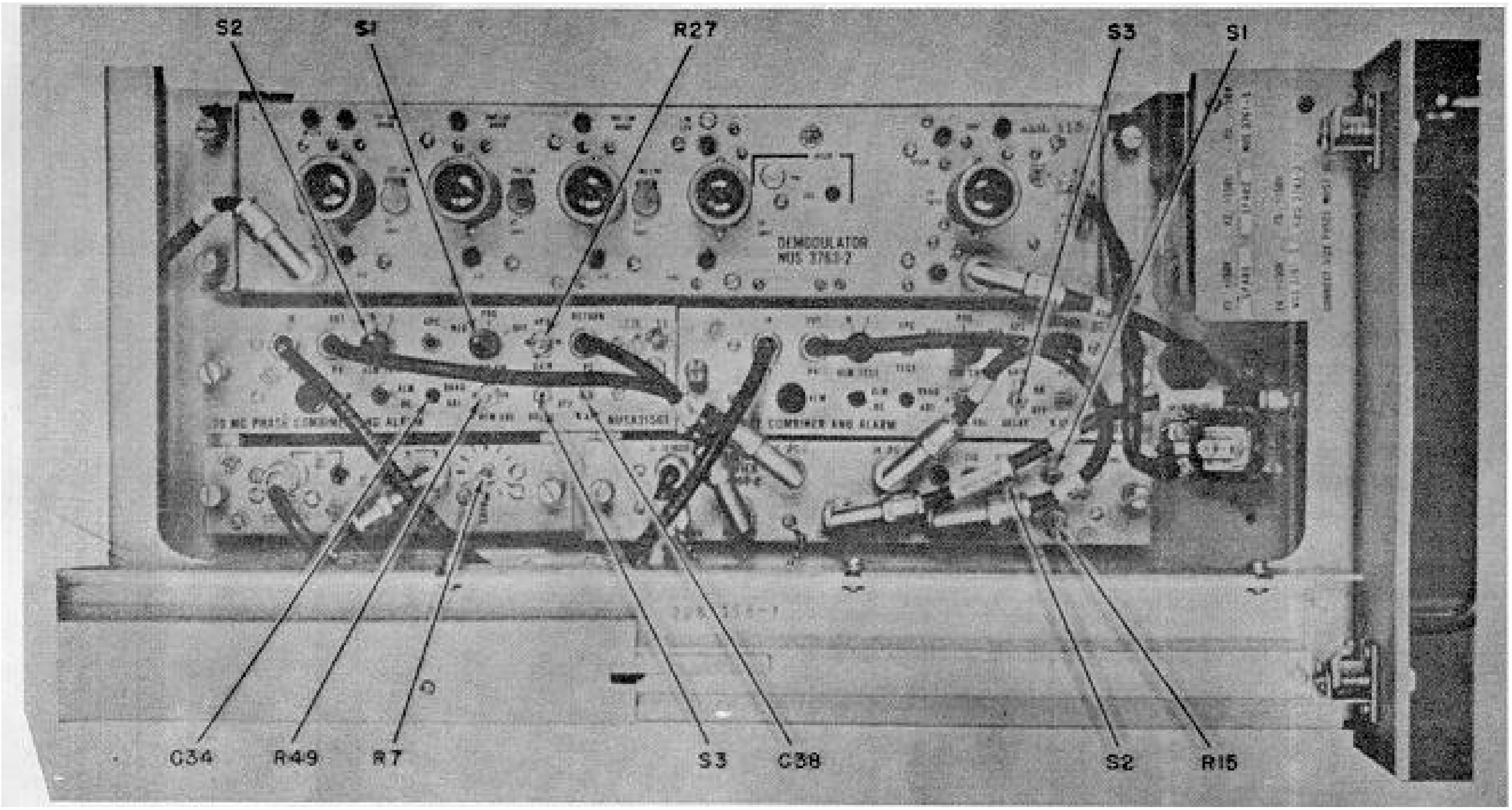


Figure 3-8. IF and Baseband Drawer,(Single Conversion Receiver)
Left Side

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel Marking	Reference designation	Type	Figure reference	Function
IF AND BASEBAND DRAWER				
*APC GAIN	R27	Resistor, variable	3-8	Sets apc loop gain, NUS 8315 (70 mc)
*QUAD ADJ	C34	Capacitor, variable	3-8	Sets operating point of phase alarm, NUS 8315 (70 mc)
*Ø ALM ADJ	R49	Resistor, variable	3-8	Sets level of phase alarm operating point, NUS 8315 (70 mc)
*Ø ADJ	C38	Capacitor, variable	3-8	Sets phase comparator to proper operating point, NUS 8315 (70 mc)
*Ø-L ALM TEST	S1	Switch, rotary	3-9	Selects phase or level circuitry in phase combiner to drive combiner alarm circuit NUS 8316 (9.8 mc)
*DELAY	S2	Switch, toggle	3-9	Enables or disables 5-10 second delay in phase combiner alarm circuit, NUS 8316 (9. 8 mc)
*ALM ADJ	R28	Resistor, variable	3-9	Sets level of alarm operating point, NUS 8316 (9.8 mc)
*QD	R58	Resistor, variable	3-9	Sets operating point of phase alarm, NUS 8316 (9.8 mc)
*FREQ	C20	Capacitor, variable	3-9	Sets phase comparator to proper operating point, NUS 8316 (9.8 mc)
*GAIN	R45	Resistor, variable	3-9	Sets apc loop gain, NUS 8316 (9.8 mc)

* On module

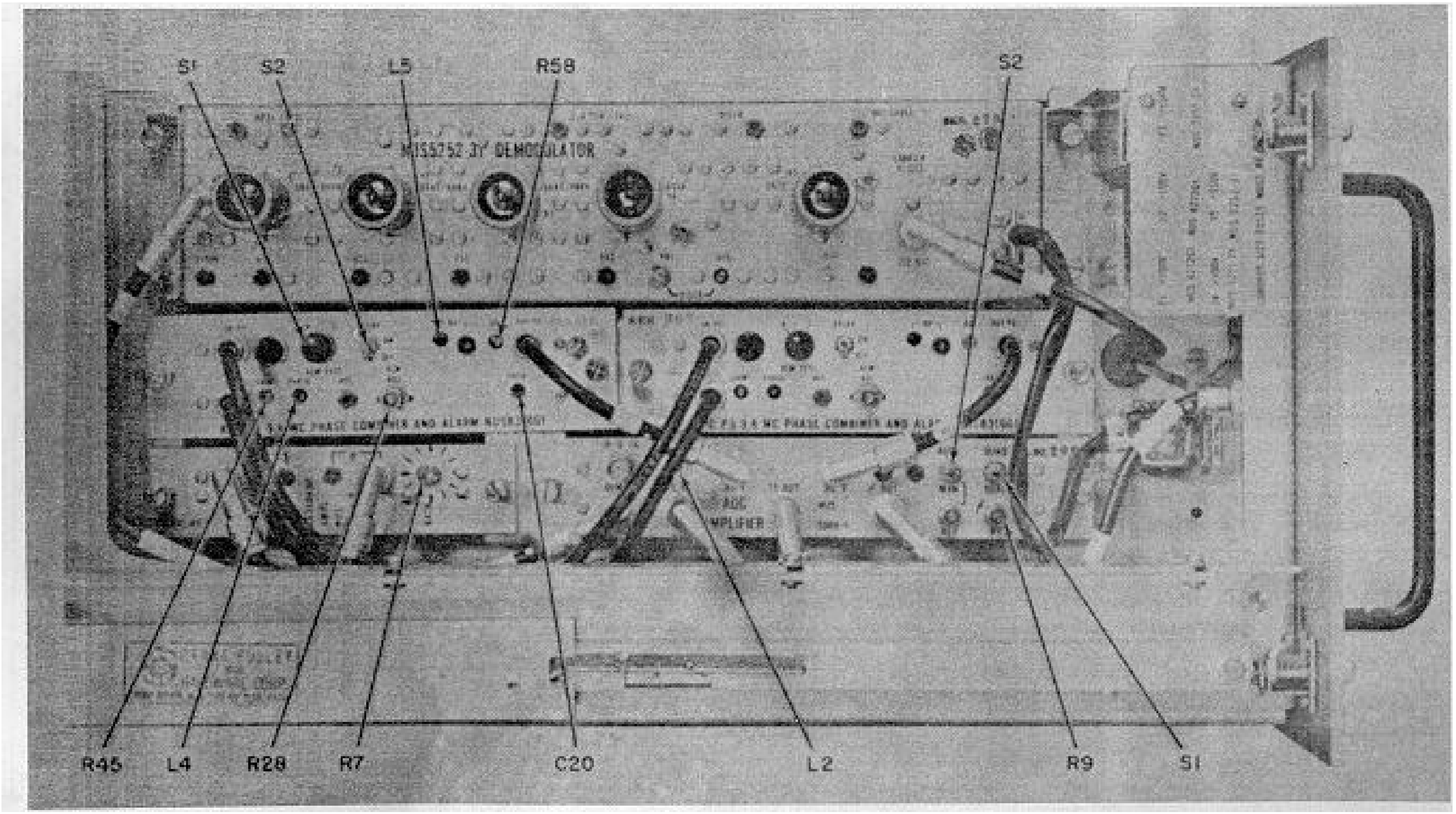


Figure 3-9. IF and Baseband Drawer (Double conversion Receiver) Left Side

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
IF AND BASEBAND DRAWER (cont)				
*PHASE	L4	Inductor, variable	3-9	Peaks incoming if signal to phase combiner, NUS 8316 (9.8 mc)
*BA	L5	Inductor, variable (factory set)	3-9	Peaks signal from combine point to phase combiner, NUS 8316 (9.8 mc)
*QUAD-DUAL	S1	Switch, toggle	3-8	Connects or disconnects cross-connect age circuit to other cabinet, NUS 5969-4 (70 mc)
*AUTO-MAN	S2	Switch, toggle	3-8	Selects automatic or manual operation of agc amplifier, NUS 5969-4 (70 mc)
*Below DUAL QUAD switch	R15	Resistor, variable	3-8	Sets agc delay in agc amplifier, NUS 5969-4 (70 mc)
*QUAD DUAL	S1	Switch, toggle	3-9	Connects or disconnects cross-connect age circuit to other cabinet, NUS 5969-1 (9.8 mc)
*AUTO-MAN	S2	Switch, toggle	3-9	Selects automatic or manual operation of agc amplifier, NUS 5969-1 (9.8 mc)
*R9	R9	Resistor, variable	3-9	Sets agc delay in agc amplifier, NUS 5969-1 (9.8 mc)
*TUNE	L2	Inductor, variable	3-9	Peaks the input if signal to the agc amplifier, NUS 5969-1 (9.8 mc)
*GAIN	R7	Resistor, variable	3-8 OR 3-9	Sets gain of baseband amplifier, NUS 5970-3

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
ANCILLARY EQUIPMENT DRAWER (LINE-OF-SIGHT RECEIVERS)				
TE INPUT	J1	BNC connector	2-10	Provides cross-connection between Ancillary Equipment drawer and IF and Baseband drawer
None	M1	Meter	2-15	Used in conjunction with meter function selector switch S1 to monitor operating voltages, phase error, and test tone level.
None	S1	Rotary switch	2-15	Used in conjunction with meter M1. Selects among operating voltages, phase error, and test tone level.
None	J7	Jack	2-15	Permits positive or negative voltage to be monitored in accordance with the position of switch S1. In the TEST +GRD position, negative voltage may be monitored. In the TEST -GRD position, positive voltages may be monitored.
POWER SUPPLY AND FAN ASSEMBLY DRAWER (TOP PANEL)				
AUX 115 VAC	J5	Convenience outlet	2-11	Provides source of 120 vac for test equipment
AUX FUSE	XF2	Indicating fuse holder	2-11	Lights when fuse F2 blows due to overloading of convenience outlet

TABLE 3-1. CONTROLS, CONNECTORS, INDICATORS, AND TEST POINTS (CONTINUED)

Panel marking	Reference designation	Type	Figure reference	Function
POWER SUPPLY AND FAN ASSEMBLY DRAWER (TOP PANEL)(cont)				
FAN FUSE	XF1	Indicating fuse holder	2-11	Lights when fuse F2 blows due to overloading of fan circuit
POWER ON	DS1	Incandescent lamp	2-11	Lights when CB1 is actuated
None	CB1	Circuit breaker	2-11	On/off switch and protective device for power supply
POWER SUPPLY AND FAN ASSEMBLY DRAWER (BOTTOM PANEL)				
AC	XF1	Indicating fuse holder	2-11	Lights when F1 blows due to ac overload in 150/165 vdc power
AC ON	I3(NUS 5974) I1(NUS 8798)	Neon lamp	2-11	Lights when ac power is applied to 150/165 vdc power supply
AC ON RESET	S1	Switch	2-11	Controls application of power to 150/165 vdc power supply
FINE VOLTAGE ADJ	R26(NUS5974) R36(NUS 8798)	Potentiometer	2-11	Permits adjustment of 150/165 vdc supply output
DC	XF2	Indicating fuse holder	2-11	Lights when fuse F2 blows due to dc overload in 150/165 vdc power supply

SECTION IV

THEORY OF OPERATION

4-1. GENERAL.

4-2. This section describes the theory of operation of the single conversion and double conversion receiver configurations. Descriptions of the receiver configurations are on the block diagram level. The diversity combining technique of the receivers is explained, followed by a description of the receiver circuits on a signal flow basis. The single conversion receiver configurations are described first.

4-3. SINGLE CONVERSION RECEIVERS.

4-4. The single conversion receiver configurations consists of four tropospheric scatter receiver configurations (NUS 5961-15, -16, -19, and-20) and one line-of-sight receiver configuration (NUS 5961-12 or-17). Each receiver configuration is described in the following paragraphs. For the purpose of clarity, individual receiver channels are identified as follows:

Channel A1: left/top/rear channel of receiver A

Channel A2: right/bottom/front channel of receiver A

Channel B1: left/top/rear channel of receiver B (tropospheric scatter receiver only)

Channel B2: right/bottom/front channel of receiver B (tropospheric scatter receiver only)

4-5. SINGLE CONVERSION TROPOSPHERIC SCATTER RECEIVER CONFIGURATIONS (Figure 4-1).

4-6. The single conversion tropospheric scatter receiver is operated in quadruple diversity and employs two pairs of single conversion receiver channels (70-mc if frequency). Since both pairs of receiver channels are identical, only one pair is shown in figure 4-1. The QUAD cross-connect cables interconnect the four receiver channels for quadruple diversity operation. Each pair of channels (A1 and A2 or B1 and B2) share a common agc amplifier, threshold extension module (NUS 5961-15 and-16 receivers only), demodulator, de-emphasis assembly, and baseband amplifier. All four receiving channels employ separate local oscillator, mixer-preamplifier, IF filter, if amplifier, and phase combining modules. In addition, each NUS 5961-15 or-20 receiver includes a parametric amplifier in each of the receiving channels. Each NUS 5961-16 or-19 receiver employs an RF Panel in place of the parametric amplifiers. The RF Panel couples the input rf carriers directly to the local oscillator and mixer circuits.

4-7. SINGLE CONVERSION LINE-OF-SIGHT RECEIVER CONFIGURATION (Figure 4-2).

4-8. Single conversion line-of-sight receiver NUS 5961-12 operates in a dual diversity and employs one pair of single conversion channels (70-mc if frequency). The receiver contains essentially the same modules as the tropospheric scatter receiver, except the Dual Parametric Amplifier drawer and threshold extension module are not used. The RF Panel is used in place of the Dual Parametric Amplifier drawer. Also, the line-of-sight receiver contains additional (redundant) demodulator, de-emphasis, and baseband amplifier modules in an Ancillary Equipment drawer. The combined if signal is applied to the demodulator, de-emphasis, and baseband modules in the IF and Baseband drawer and the Ancillary Equipment drawer to be demodulated and amplified. The output of the IF and Baseband drawer is designated BASE BAND OUTPUT 1 and the output of the Ancillary Equipment drawer is designated BASEBAND OUTPUT 2. Power requirements for the Ancillary drawer made the second power supply necessary.

4-9. DIVERSITY COMBINING.

4-10. Within the receiver, rf channels A1 and A2 function in dual diversity operation. Channel A1 and A2 if signals are combined so that they are always added in phase at a combined if output point in the agc amplifier. Tropospheric scatter receivers operate in quadruple diversity and the combined if output of receiver A is bridged to the combined if output (channels B1 and B2) of receiver B through a coaxial cable.

4-11. Phase combining is accomplished by amplifying the if output of each individual radio channel and comparing each output with the combined if output in a phase detector located in the phase-combiner module. The resultant error signal automatic phase control (apc) is fed back to the associated oscillator multiplier, Correcting its frequency to obtain phase locking with the common if output. The if outputs of each channel, now phase-locked and proportional to the rf input signals, are added and applied to the demodulator through the threshold extension module (when used), demodulated, and applied to the baseband amplifier through the deemphasis network.

4-12. SINGLE CONVERSION RECEIVER CIRCUITS,

413. The single conversion receiver circuits are described in the following paragraphs.

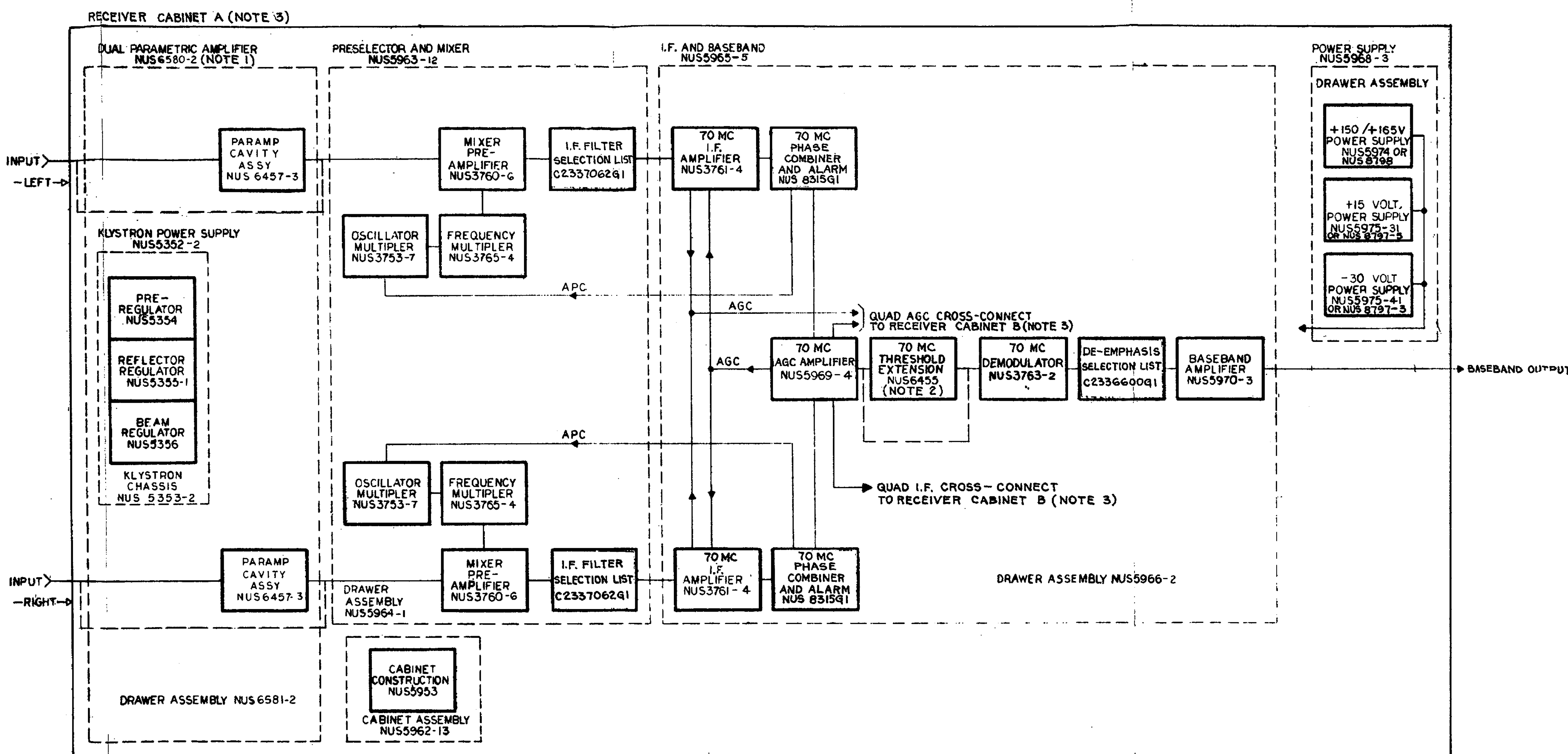
4-14. INPUT CIRCUITS. The receiver input circuits are in the waveguide runs between the antenna feedhorns and receiver cabinet, and consist of an arrangement of circulators and preselectors which effectively isolates the receiver from the transmitter while permitting the desired duplex signal flow to and from the antennas. The circulators and preselectors are not shown in the receiver block diagrams because of the varied configurations used.

4-15. DUAL PARAMETRIC AMPLIFIER (NUS 5961-15 and-20 Receivers). Each Dual Parametric Amplifier increases the sensitivity of the associated receiving channel by 7 db. The channel A1and channel A2 rf input signals are applied to their respective cavity assemblies through waveguide-to-coaxial line adapters and isolating devices assemblies (NUS 5300-7 Dual Parametric Amplifier) or circulators (NUS 6580-2 Dual Parametric Amplifier). The isolating devices assembly or circulator perform the same function. They transfer an input signal from the input port to the cavity assembly input port with virtually no attenuation and provide high attenuation in the reverse direction. Thus, the input signal coming from the antenna feedhorn sees a low-impedance path to the cavity and the amplified signal returning from the cavity sees a high-impedance path to the antenna feedhorn. Each cavity utilizes a varactor diode to achieve low-noise amplification. The amplified channel A1and A2 signals are applied to the mixer-preamplifiers in the Preselector and Mixer drawer.

4-16. LOCAL OSCILLATOR AND MIXER CIRCUITS. The local oscillator and mixer circuits consist of an oscillator-multiplier, a frequency multiplier, and a mixer-preamplifier for each channel. Since the channel $A_1$and channel A_2 local oscillator and mixer circuits operate in an identical manner, the following description applies to both.

4-17. Oscillator-Multiplier. The oscillator-multiplier includes an oven-mounted quartz crystal which feeds a frequency tripler and two cascaded amplifier stages. The output of the last amplifier stage is applied to the frequency multiplier. The crystal oven is thermostatically controlled and maintains a constant temperature of 75 $\pm$ 1 degrees C (167± degrees F) over an ambient temperature range between -55 and +70 degrees C (-67 and +158 degrees F) to ensure a frequency stability of 10 parts per million (0.001 percent). The selection of the quartz crystal depends on the operating frequency of the receiver.

4-18. Frequency Multiplier. The frequency multiplier receives the output of the oscillator-multiplier and provides a frequency multiplication of 32. The output of the oscillator-multiplier is applied to a grounded-grid frequency quadrupler which is mounted in a radial cavity.



NOTES:
1. DUAL PARAMETRIC AMPLIFIER NUS 5300-7 MAY BE USED IN PLACE OF DUAL PARAMETRIC AMPLIFIER NUS 6580-2 IN RECEIVERS NUS 5961-15 AND 20. THE DUAL PARAMETRIC AMPLIFIER IS NOT USED IN RECEIVERS NUS 5961-16 AND 19 (SEE DOTTED LINE CONNECTIONS.)
2. THE THRESHOLD EXTENSION MODULE IS USED IN RECEIVERS NUS 5961-15 AND 16 ONLY. SEE DOTTED LINE CONNECTION FOR RECEIVERS NUS 5961-19 AND 20.
3. RECEIVER CABINET B IS IDENTICAL TO RECEIVER CABINET A.

Figure 4-1. Single Conversion Tropo Receivers (NUS 5961-15, -16, -19, -20) Block Diagram

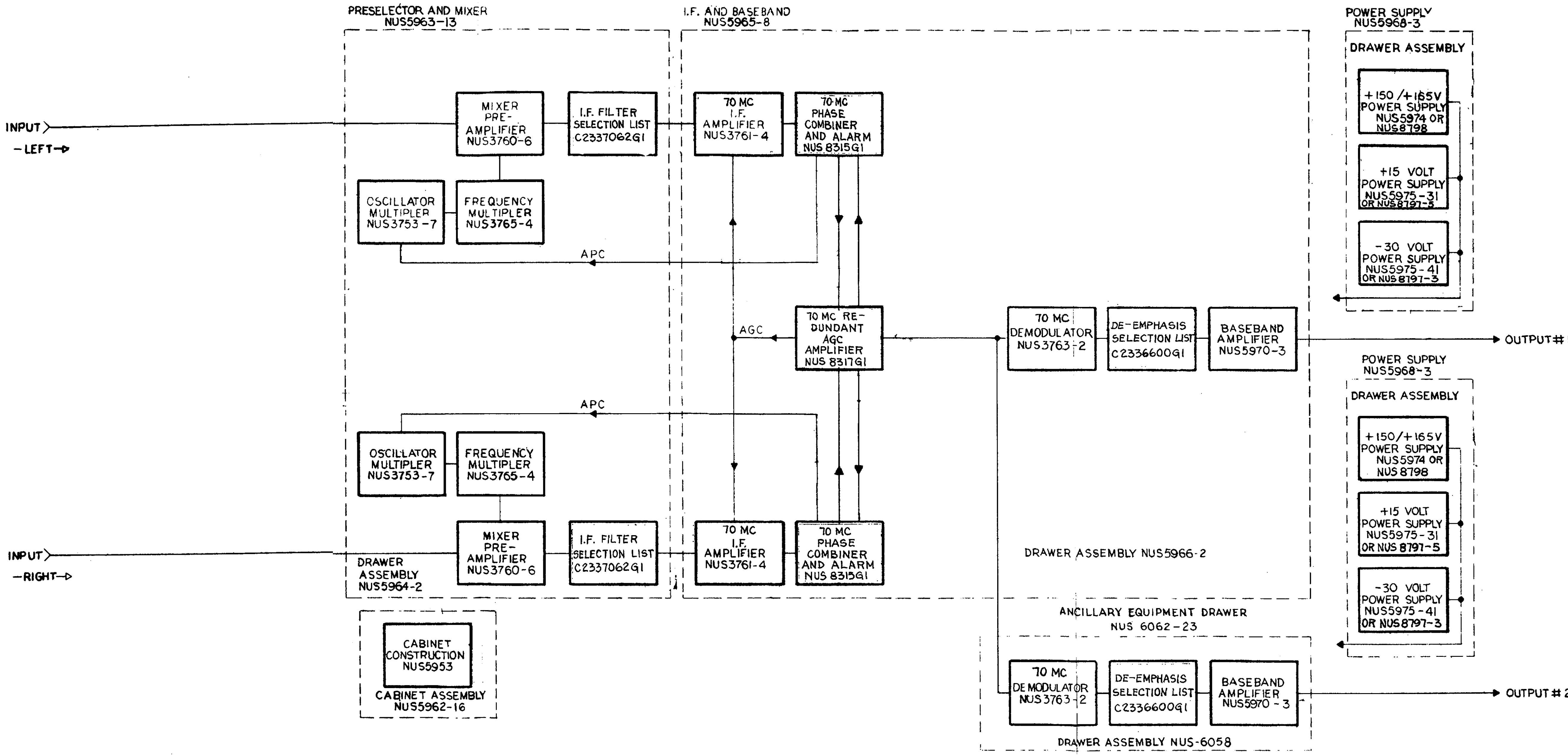


Figure 4-2. Single Conversion Line-Of-Sight Receiver (NUS 5961-12, -17) Block Diagram

This cavity is tuned to the fourth harmonic of the oscillator-multiplier output. Following the frequency quadrupler are two additional cavities which provide frequency quadrupling and doubling, respectively. The output of the doubler cavity is applied to the mixer-preamplifier where it is mixed with the parametric amplifier or RF Panel output to produce a 70-mc if output.

4-19. Mixer-Preamplifier. The mixer-preamplifier includes a hybrid mixer and preamplifer. The hybrid mixer combines the parametric amplifier or RF Panel output with the output of the frequency multiplier. The resulting 70-mc if signal is amplified by the preamplifier and applied to an associated if amplifier through an if filter.

4-20. IF FILTERS. The if filters remove noise from the 70-mc if outputs of the mixer preamplifiers before they are amplified by the if amplifiers. Since the bandwidth of each filter is much narrower than the if passband, the noise is substantially reduced while the 70-mc signals are virtually unaffected. In this manner, the signal-to-noise ratio is greatly improved.

4-21. 70-MC IF AMPLIFIERS. The if amplifier for each receiving channel consists of a six-stage cascade voltage amplifier which receives the 70-mc if signal from its respective if filter and provides approximately 60 db of amplification with a 3-db bandwidth of 17 mc. Each if amplifier incorporates positive grid stabilization with cathode degeneration and internal AGC circuitry. The output of each if amplifier is applied to its respective phase combiner.

4-22. 70-MC PHASE COMBINER AND ALARM. The 70-mc phase combiner and alarm module in each path permits the channel A1and A2 70-mc if signals to be added in phase at a common if output point in the AGC amplifier. In each phase combiner and alarm module, the output of its associated if amplifier module is amplified and compared with the combined if output in a phase detector. The resulting error (apc voltage) signal is applied to the associated oscillator multiplier to correct the instantaneous phase difference and frequency drift until the if amplifier out-put is phase-locked with the combined if output from the AGC amplifier. Each phase combiner and alarm module also provides an alarm indication, in the form of a lighted alarm indicator, in the event of an excessive apc voltage or loss of the if signal. The if output of each phase combiner and alarm module is applied to the agc amplifier.

4-23. 70-MC AGC AMPLIFIER (NUS 5961-15, -16, -19, and-20 receivers). The 70-mc agc amplifier module is used in tropospheric scatter receivers NUS 5961-15, -16, -19, and-20. The agc amplifier provides automatic and manual gain-control voltages for the if amplifiers. An AUTO-MAN switch selects either of these voltages for application to the if amplifiers. A DUAL-QUAD switch is provided to facilitate the interconnection of two agc amplifier outputs for quadruple diversity reception through the quadruple diversity cross-connect cable. The agc amplifier also serves as the addition point for all if outputs and as such provides a combined output for application to the threshold extension module or demodulator module. The automatic gain control (age) voltage is produced by an if level detector. The common if output is applied to the if level detector through an emitter follower. A potentiometer is used to set the detector delay voltage which controls the combined output level. The detector produces a dc voltage which is applied to the AUTO-MAN switch through a second emitter follower. This voltage is applied to the if amplifiers when the AUTO-MAN switch is set to the AUTO position. The manual gain control voltage is developed by a potentiometer which forms part of a voltage divider. The variable dc voltage at the arm of the potentiometer is applied to the if amplifiers when the AUTO-MAN switch is set to the MAN position.

4-24. 70-MC REDUNDANT AGC AMPLIFIER. The 70-mc redundant agc amplifier is used in line-of-sight-receiver NUS 5961-12, (-17). The agc amplifier provides automatic and manual gain-control voltages for the if amplifiers. An AUTO-MAN switch selects either of these voltages for application to the if amplifiers. The agc amplifier also serves as the addition point for all if outputs and provides a combined output for the demodulator modules in the IF and Baseband and Ancillary Equipment drawers. The 70-mc redundant agc amplifier combines two if input signals in a reversed power divider and applies the combined signal to two independent agc channels. The combined input signals are also separated at a second power divider and appear at the signal output terminals at a level which is 3 db below the level of the in-put signals. The two identical agc channels rectify the combined if signals and produce two dc gain control signals. These two signals are combined and appear at the output terminals for routing to the if amplifiers.

4-25. 70-MC THRESHOLD EXTENSION. The threshold extension module is used in tropospheric scatter receivers NUS 5961-15 and-16. The threshold extension module lowers the noise threshold of the common if output by effectively narrowing the noise bandwidth. This improvement in threshold is about 3 db. The threshold extension module includes a 70-mc input amplifier, a phase detector, a low-pass filter, a dc amplifier, a 70-mc VCO (voltage-controlled oscillator), and a buffer amplifier. The combined if output of the agc amplifier is applied to the phase detector through the 70-mc input amplifier. The phase detector compares the combined output with a locally-generated 70-mc signal. The locally-generated signal is obtained from the VCO and is applied to the phase detector through the buffer amplifier. When a phase difference exists between the combined input and the locally-generated signal, the phase detector produces an error voltage. This voltage is applied to the low-pass filter which rejects noise, transients, harmonics and other spurious signals. After filtering, the error voltage is amplified by the dc amplifier and changes the frequency of the VCO to correspond with the combined input. The VCO output, now phase-locked with the common if output, is applied to the demodulator through the buffer amplifier.

4-26. 70-MC DEMODULATOR. The demodulator accepts the combined 70-mc frequency-modulated signal. It limits the amplitude of this signal, demodulates it with low distortion, and couples the detected baseband signal thus recovered through a cathode follower to the de-emphasis assembly. The demodulator employs three stages of amplification and limiting to prevent appreciable variation of input amplitude from reaching the discriminator. The out-put of the third limiter drives the discriminator through a fourth amplifier and a 70-mc double-tuned transformer.

4-27. DE-EMPHASIS ASSEMBLIES. The de-emphasis assembly provides a means of selecting the baseband frequency de-emphasis required to complement the pre-emphasis of the transmitted signal. Either of two types of baseband de-emphasis may be chosen by a selector switch on each de-emphasis assembly. A third position of the selector switch permits operation without de-emphasis (refer to table 1-4 for de-emphasis assembly selection).

4-28. BASEBAND AMPLIFIER. The baseband amplifier amplifies the baseband output of the de-emphasis assembly to a level suitable for use by the central equipment cabinet. Each baseband amplifier incorporates two stages of amplification and an emitter follower output stage. The baseband input is applied to a potentiometer which is used to apply a pre-determined portion of the input to the base of the first amplifier stage, thereby controlling the baseband output level. The emitter follower provides impedance matching to the central equipment cabinet. Negative feedback is provided between the emitter follower and the first amplifier stage to improve overall stability and frequency response.

4-29. DOUBLE CONVERSION RECEIVERS.

4-30. The double conversion receiver configurations consist of two tropospheric scatter configurations (NUS 5961-9 and 13) and one line-of-sight configuration (NUS 5961-10). Each receiver configuration is described in the following paragraphs. For the purpose of clarity, individual receiver channels are identified as follows:

Channel A1: Left channel of receiver A

Channel A2: Right channel of receiver A

Channel B1: Left channel of receiver B (tropospheric scatter receivers only)

Channel B2: Right channel of receiver B (tropospheric scatter receivers only)

4-31. DOUBLE CONVERSION TROPOSPHERIC SCATTER RECEIVER CONFIGURATIONS (Figure 4-3).

4-32. The double conversion tropospheric scatter receiver operates in quadruple diversity and employs two pairs of double conversion receiver channels (70-mc 1st if frequency and 9.8-mc 2nd if frequency). Since both pairs of receiver channels are identical, only one pair is shown in figure 4-3. The QUAD cross-connect cables interconnect the four receiver channels for quadruple diversity operation. Each pair of channels (A1 and A2 or B1 and B2) share a common oscillator-multiplier, frequency-multiplier, power divider, agc amplifier, threshold extension module, demodulator, and baseband amplifier. All four receiving channels employ a separate mixer-preamplifier, second mixer local oscillator, if filter, if amplifier, and phase combiner. In addition, the NUS 5961-9 receiver includes a parametric amplifier in each of the receiving channels. The NUS 5961-13 receiver employs RF Panels in place of the Dual Parametric Amplifiers. The RF Panels couple the input rf carriers directly to the mixer-preamplifiers.

4-33. DOUBLE CONVERSION LINE-OF-SIGHT RECEIVER CONFIGURATIONS (Figure 4-4).

4-34. The double conversion line-of-sight receiver NUS 5961-10 operates in dual diversity and employs one pair of double conversion receiver channels (70-mc 1st if frequency and 9.8-mc 2nd if frequency). The receiver contains essentially the same modules as the double conversion tropospheric scatter receiver, except that the parametric amplifier drawer and threshold extension module are not used. The RF Panel is used in place of the parametric amplifiers. Also, the line-of-sight receiver employs an oscillator-multiplier and frequency-multiplier in each receiving channel. In addition, the line-of-sight receiver contains an additional (redundant) set of demodulator, de-emphasis, and baseband amplifier modules in an Ancillary Equipment drawer. The combined if signal is applied to the demodulator, de-emphasis, and baseband modules in the IF and Baseband drawer and the Ancillary Equipment drawer to be demodulated and amplified. The output of the IF and Baseband drawer is designated BASE-BAND OUTPUT 1 and the output of the Ancillary Equipment drawer is designated BASEBAND OUTPUT 2. Power requirements for the Ancillary drawer made the second power supply necessary.

4-35. DIVERSITY COMBINING.

4-36. Within the receiver, receiving channels A1and A2 function in dual diversity operation. The channels A1and A2 signals are combined at the agc amplifier so that they are always added in phase at a common output point. Tropospheric scatter receivers are operated in quadruple diversity and the combined output of receiver A is bridged to the combined output (channels B1 and B2) of receiver B. Phase combining is accomplished by amplifying the if output of each individual channel and comparing each output with the combined output if signal in a phase detector located in the phase combiner module. The resulting error signal (apc) is fed back to the associated second mixer-local oscillator, correcting its frequency to obtain phase locking with the common if output. The if channels, now phase-locked and proportional to the rf input signals, are added and applied to the demodulator through the threshold extension module (when used), demodulated and then applied to the baseband amplifier.

4-37. DOUBLE CONVERSION RECEIVER CIRCUITS.

4-38. The double conversion receiver circuits are described in the following paragraphs.

4-39. INPUT CIRCUITS. The description for the input circuits is the same as for single conversion receiver input circuits (see paragraph 4-14).

4-40. DUAL PARAMETRIC AMPLIFIER. The Dual Parametric Amplifier is used in double conversion receiver configuration NUS 5961-9. Refer to paragraph 4-15 for the circuit description.

4-41. 1ST LOCAL OSCILLATOR AND MIXER CIRCUITS (TROPOSPHERIC SCATTER RECEIVERS). The 1st local oscillator and mixer circuits for channels A1and A2 of the tropospheric scatter receivers consist of one oscillator-multiplier, one frequency-multiplier, one power divider, and two mixer-preamplifiers. The oscillator-multiplier module, frequency-multiplier module, and power divider network are common to both channels. The oscillator-multipliers in the receiver system are locked to the same frequency through the oscillator lock cross-connect cable. A separate mixer-preamplifier module is provided for each channel. The module descriptions for each module are covered in paragraphs 4-17 through 4-19. The power divider network is a three-arm coaxial device which splits the output of the frequency multiplier module into two paths for application to the mixer-preamplifier modules. The attenuation introduced is 3 db. Each mixer-preamplifier mixes the out-put from the power divider with the rf input signal to produce a 70-mc first if output signal. Each 70-mc if output signal is applied to the associated 2nd mixer local oscillator.

4-42. 1ST LOCAL OSCILLATOR AND MIXER CIRCUITS (LINE-OF-SIGHT RECEIVERS). The 1st local oscillator and mixer circuit for the line-of-sight receiver consists of an oscillator-multiplier, a frequency-multiplier, and a mixer-preamplifier for each channel. The description of each circuit is covered in paragraphs 4-17 through 4-19. Each of the 70-mc 1st if signals, generated by the local oscillator and mixer circuits, is applied to the associated 2nd mixer local oscillator.

4-43. SECOND MIXER-LOCAL OSCILLATOR. Each second mixer-local oscillator incorporates a 60.2-mc oscillator, an external bandpass filter, and an output amplifier. The 70-mc if signal from the associated mixer-preamplifier is applied to the mixer where it is mixed with the rf signal generated by the oscillator. This produces the 9.8-mc 2nd if signal. The 9.8-mc 2nd if signal is applied to the associated if amplifier through the bandpass filter and output amplifier.

4-44. BANDPASS FILTER. Each bandpass filter increases the signal-to-noise ratio of the associated receiver channel by restricting the bandwidth. At the 3-db points, each filter has a bandwidth of 200 kc. The output of each filter is applied to an if amplifier through the output amplifier in the associated 2nd mixer-local oscillator module.

4-45. 9.8-MC IF AMPLIFIER. The 9.8-mc if amplifier for each receiving channel consists of a 6-stage cascade voltage amplifier which receives the 9.8-mc 2nd if signal from its respective 2nd mixer-local oscillator and provides approximately 64 db of amplification. Each if amplifier incorporates positive grid stabilization with cathode degeneration and internal agc circuitry. The output of each if amplifier is applied to its respective phase combiner.

4-46. 9.8-MC PHASE COMBINER AND ALARM. Each 9.8-mc phase combiner and alarm module permits the appropriate if signal to be added in phase at a common if output point in the agc amplifier. In each phase combiner and alarm module, the output of the associated if amplifier is amplified and compared with the combined if output in a phase detector. The resulting apc voltage is applied to the associated 2nd mixer-local oscillator to adjust the oscillator frequency until the if amplifier output is phase-locked with the combined if output of the agc amplifier. Each phase combiner and alarm module also provides an alarm indication, in the event of an excessive apc voltage or loss of if signal. The if output of each phase combiner and alarm module is applied to the agc amplifier.

4-47. 9.8-MC AGC AMPLIFIER. The 9.8-mc agc amplifier is used in tropospheric scatter receivers NUS 5961-9 and-13. The circuit description is essentially the same as for the 70-mc agc amplifier. (Refer to paragraph 4-23.)

4-48. 9.8-MC REDUNDANT AGC AMPLIFIER. The 9.8-mc redundant agc amplifier is used in line-of-sight receiver NUS 5961-10. The amplifier provides automatic gain control (age) voltages for the if amplifiers. The amplifier also serves as the addition point for both if out-put signals and provides a combined output for the demodulator modules in the IF and Baseband and Ancillary Equipment drawers. The 9.8-mc redundant agc amplifier consists of two independent amplifier, detector, and emitter follower stages with power to each supplied by separate power supplies. The dc agc output voltage of the two emitter followers are tied in parallel so that a loss of either agc amplifier path, or either power supply will not result in a loss of agc voltage.

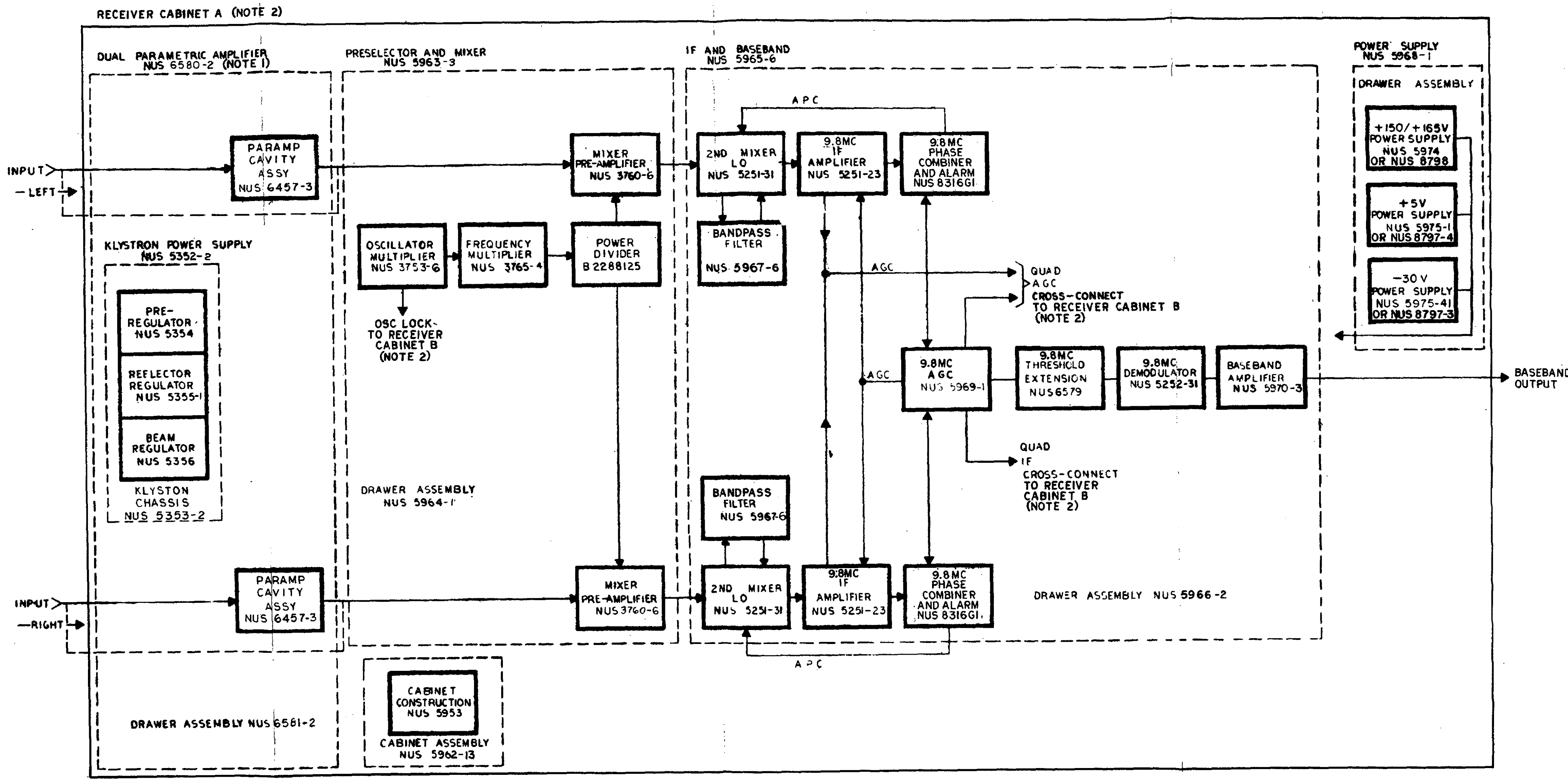
4-49. 9.8-MC THRESHOLD EXTENSION. The 9.8-mc threshold extension module is used in tropospheric scatter receivers NUS 5961-9 and-13. The threshold extension module lowers the receiver threshold of the combined if output by narrowing the noise bandwidth. This improvement in threshold is about 3 db. The combined if output of the agc amplifier is applied to a phase detector where it is compared to a locally generated 9. 8-mc if signal. When a phase difference exists between the combined if and locally generated signals, the phase detector produces an error voltage. This voltage is applied to a low pass filter which rejects noise, transients, harmonics, and other spurious signals. After filtering, the error voltage changes the frequency of the locally generated signal to correspond with the combined if signal. The locally generated signal, now phase locked with the common if signal, is applied to the demodulator.

4-50. 9.8-MC DEMODULATOR. The demodulator accepts the combined 9.8-mc signal. It limits the amplitude of this signal and demodulates it with low distortion. The resulting base-band signal is applied to the baseband amplifier. Each demodulator employs three stages of amplification and limiting to prevent appreciable variation of input amplitude from reaching the discriminator. The output of the third limiter drives the discriminator through a fourth amplifier and fm detector circuit.

4-51. BASEBAND AMPLIFIER. The circuit description is the same as given in paragraph 4-28.

4-52. ELECTRICAL THEORY.

4-53. The electrical components and inter-drawer connections within the receiver cabinets are illustrated in figures 4-5, 4-6, and 4-7. Figure 4-5 covers the tropospheric scatter receiver configurations and figures 4-6 and 4-7 cover the line-of-sight receiver configurations. The drawer schematics and module interconnections are illustrated in figures 4-8 through 4-22. These drawer schematics and module interconnection diagrams cover all receiver configurations.



NOTES:
1. DUAL PARAMETRIC AMPLIFIER NUS 5300-7 MAY BE USED IN PLACE OF DUAL PARAMETRIC AMPLIFIER NUS 6580-2 IN RECEIVER NUS 5961-9. THE DUAL PARAMETRIC AMPLIFIER IS NOT USED IN RECEIVER NUS 5961-13.
2. RECEIVER CABINET B IS IDENTICAL TO RECEIVER CABINET A.

Figure 4-3. Double Conversion Tropo Receivers (NUS 5961-9, -13) Block Diagram

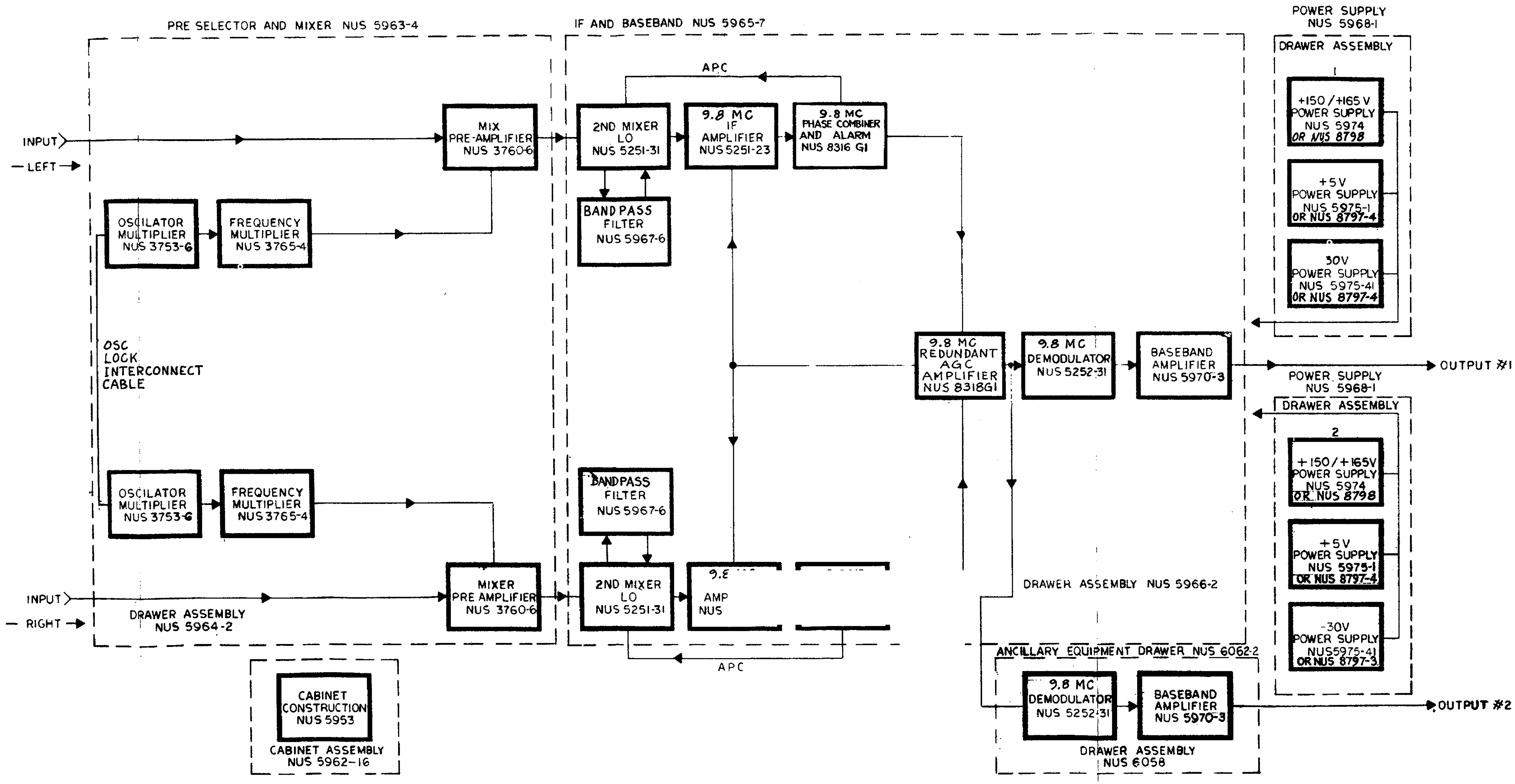
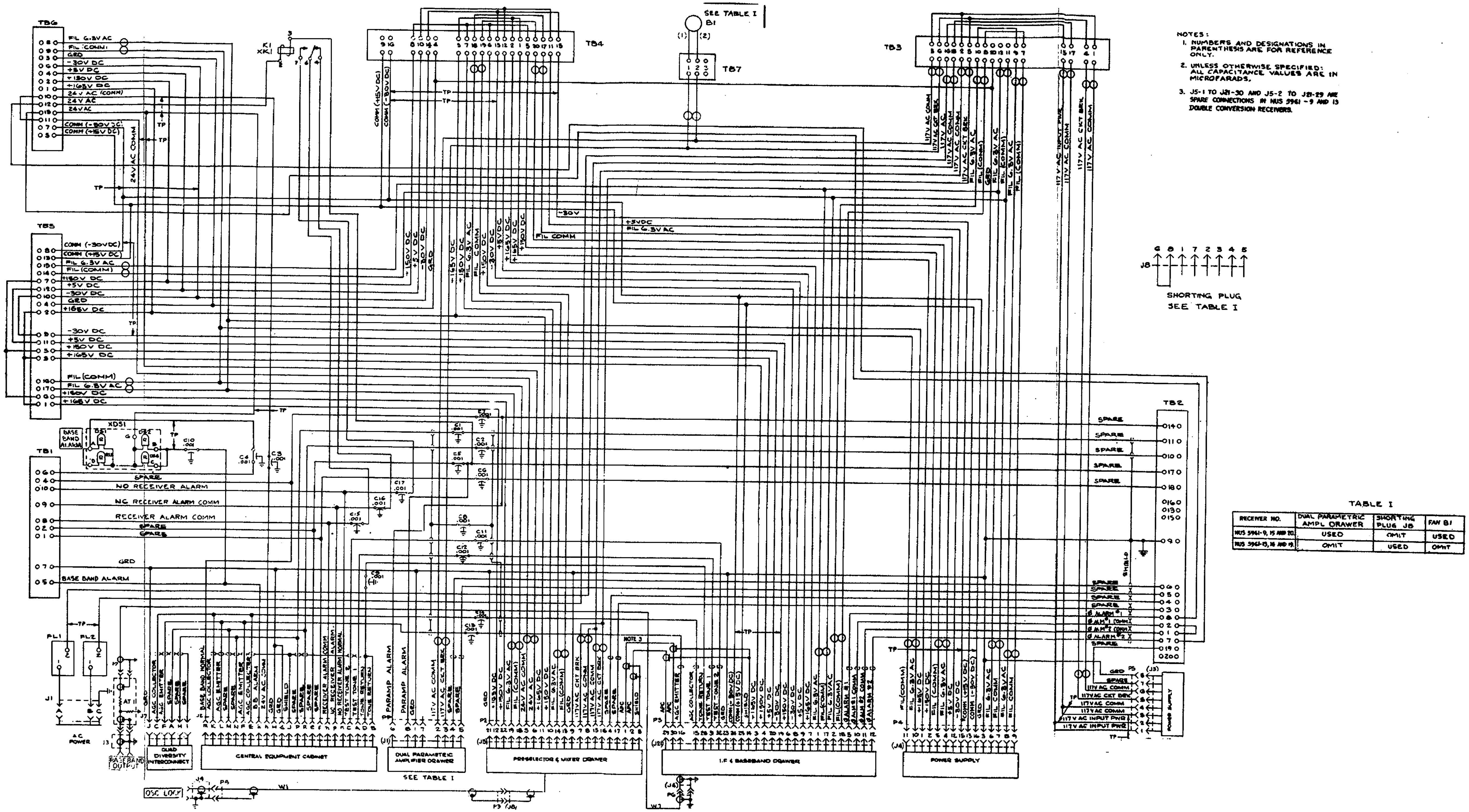


Figure 4-4. Double Conversion Line-Of-Sight Receiver (NUS 5961-10) Block Diagram



RECEIVER NO.	DUAL PARAMETRIC AMPL DRAWER	SHORTING PLUG J8	FAN B1
NUS 5961-9, 15 AND 20.	USED	OMIT	USED
NUS 5961-13, 16 AND 19.	OMIT	USED	OMIT

Figure 4-5. Tropo Dual Receiver Cabinet, Schematic Diagram

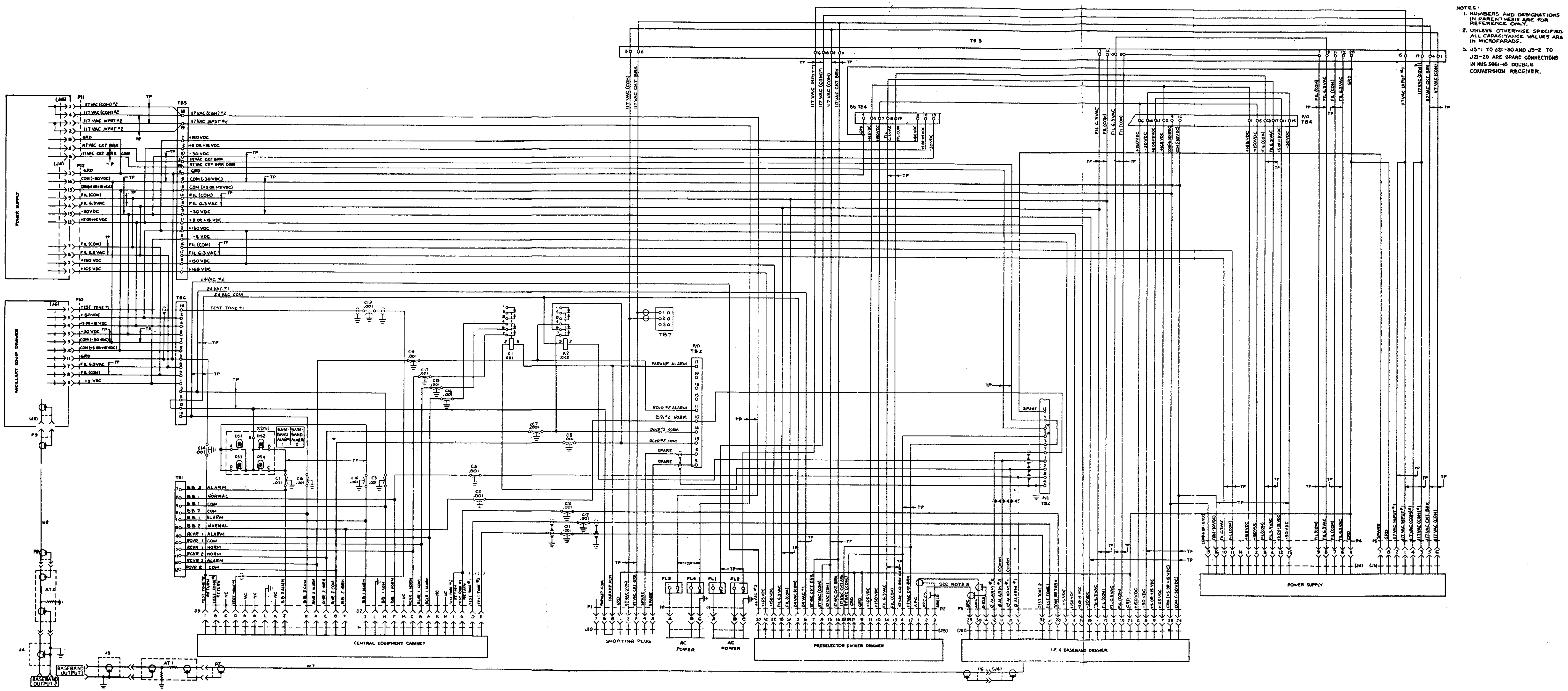


Figure 4-6. Line-Of-Sight Dual Receiver Cabinet (NUS 5962-15, -16) Schematic Diagram

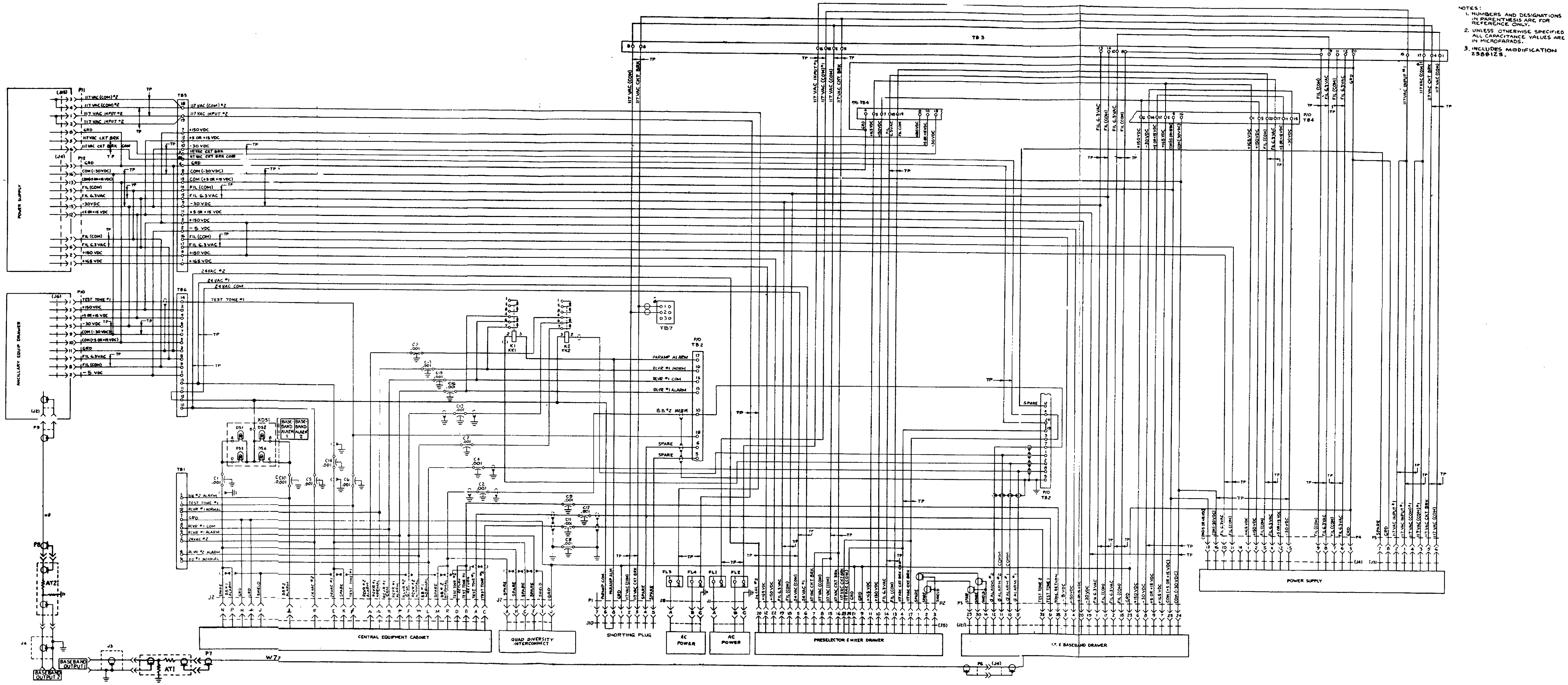


Figure 4-7. Line-Of-Sight Dual Receiver Cabinet (NUS 5961-17) Schematic Diagram

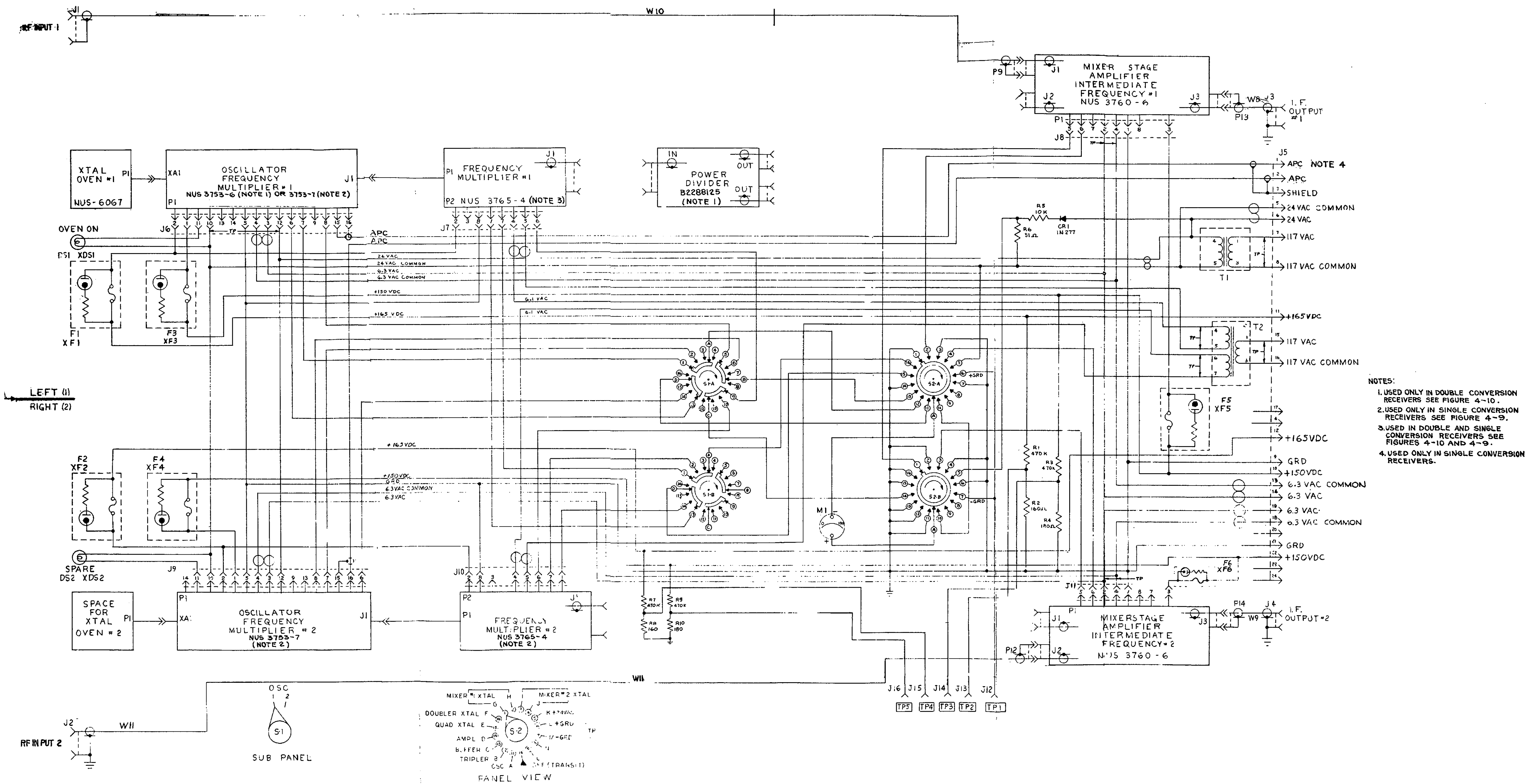


Figure 4-8. Preselector and Mixer Drawer (NUS 5961-1) Tropo Receiver, Schematic Diagram

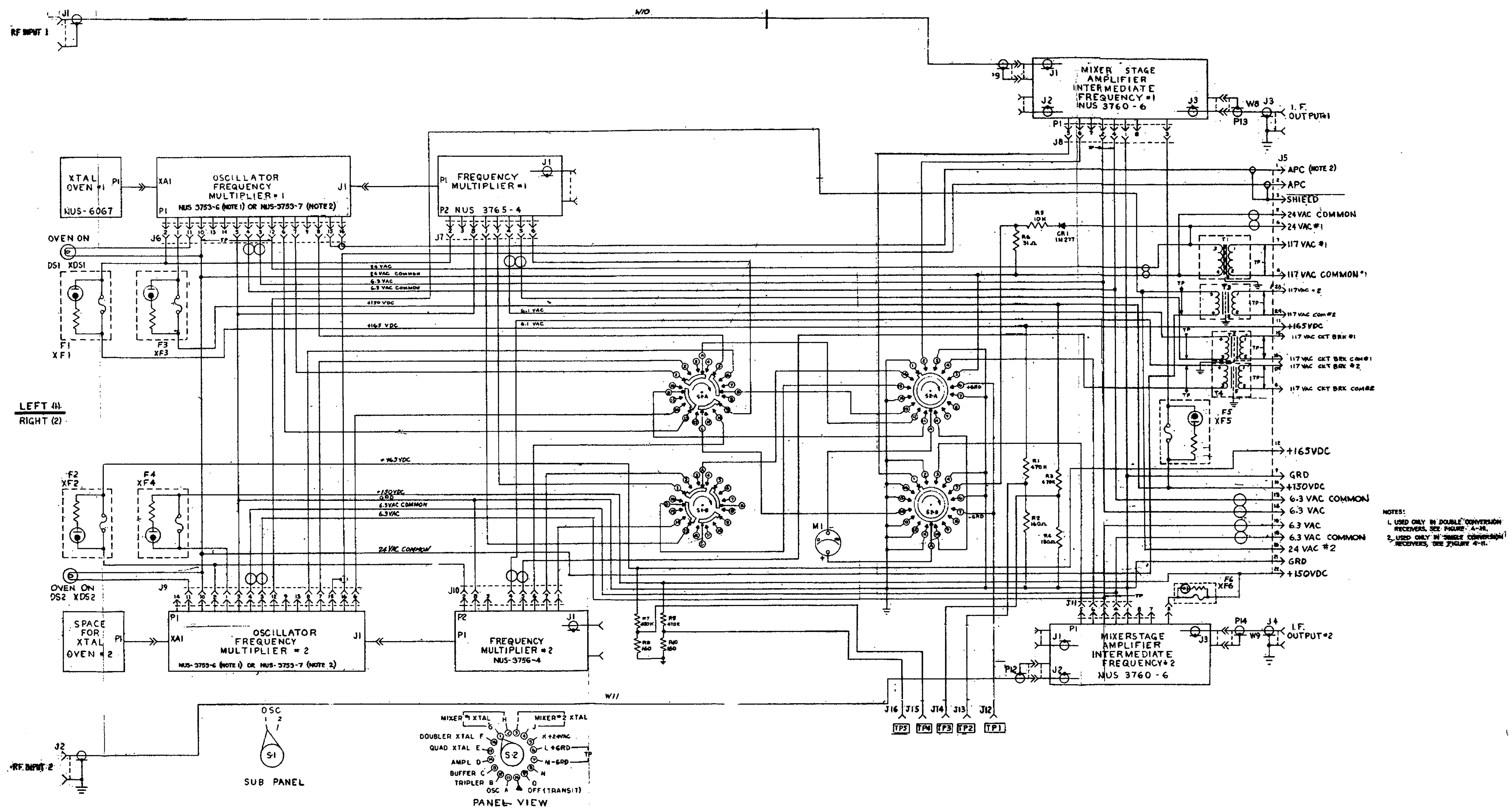


Figure 4-9. Preselector and Mixer Drawer (NUS 5964-2) Line-Of-Sight Receiver, Schematic Diagram

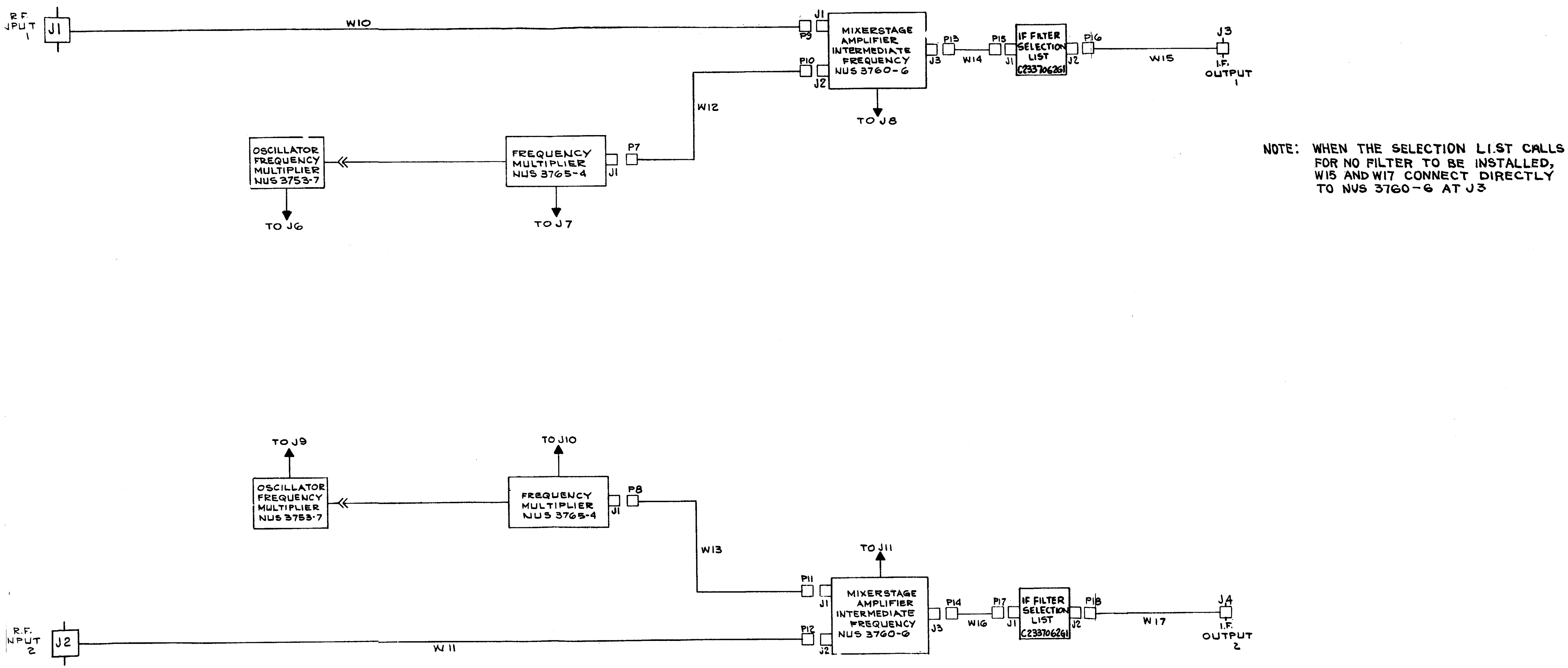


Figure 4-10. Preselector and Mixer Drawer (NUS 5963-12, -13) Tropo and LOS Single Conversion Receivers, Interconnecting Diagram

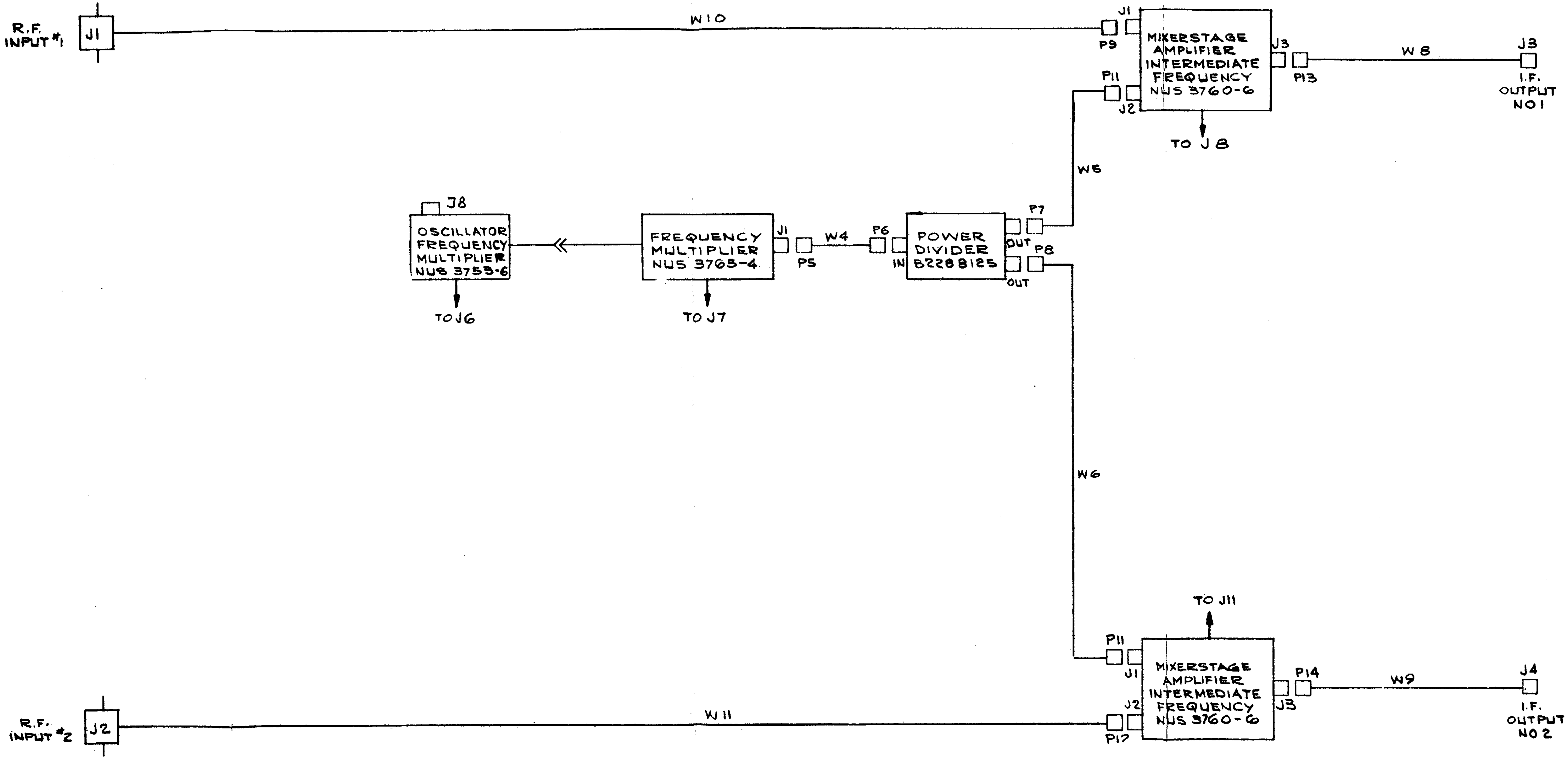


Figure 4-11. Preselector and Mixer Drawer (NUS 5963-3) Tropo Double Conversion Receivers, Interconnecting Diagram

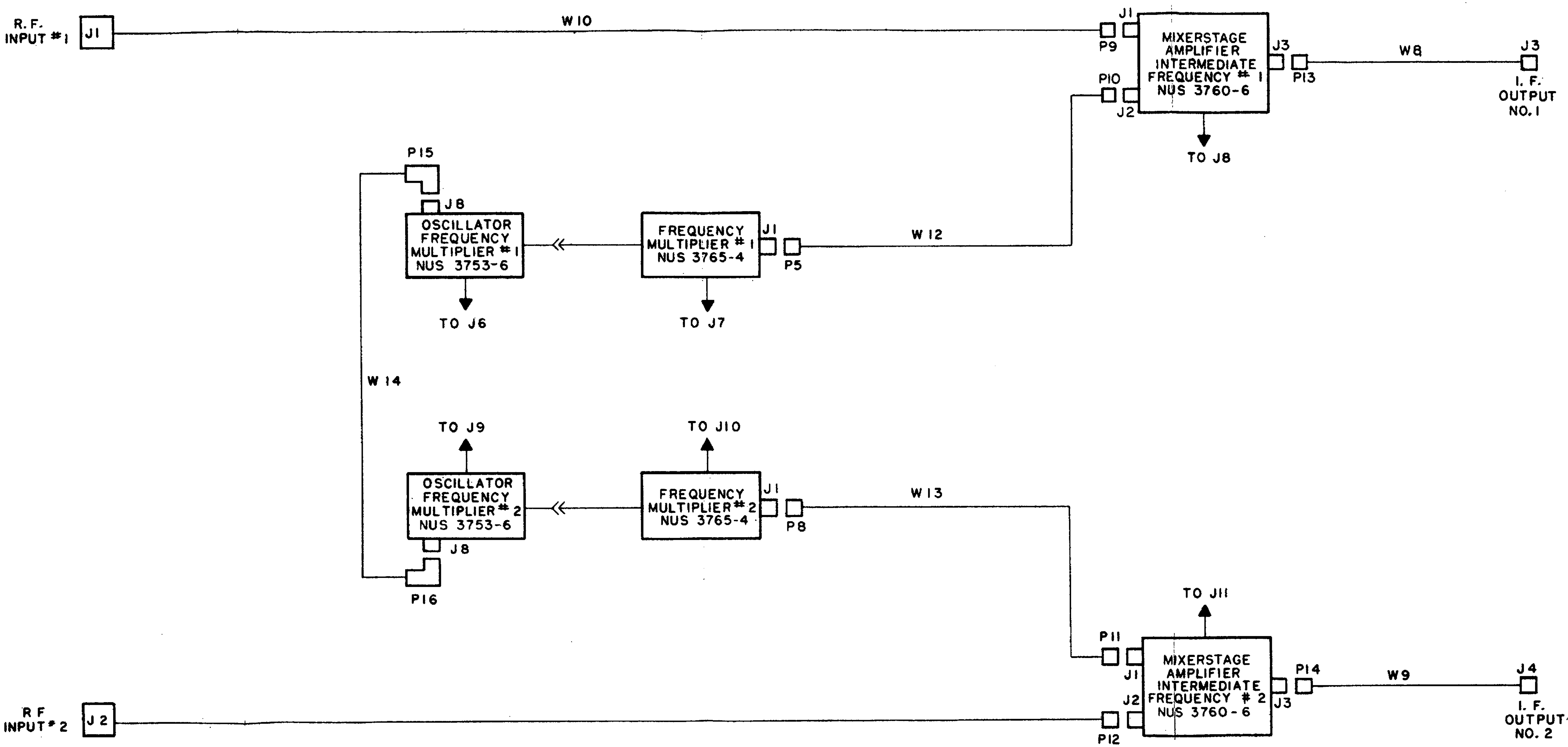


Figure 4-12. Preselector and Mixer Drawer (NUS 5963-4) LOS Double Conversion Receiver, Interconnecting Diagram

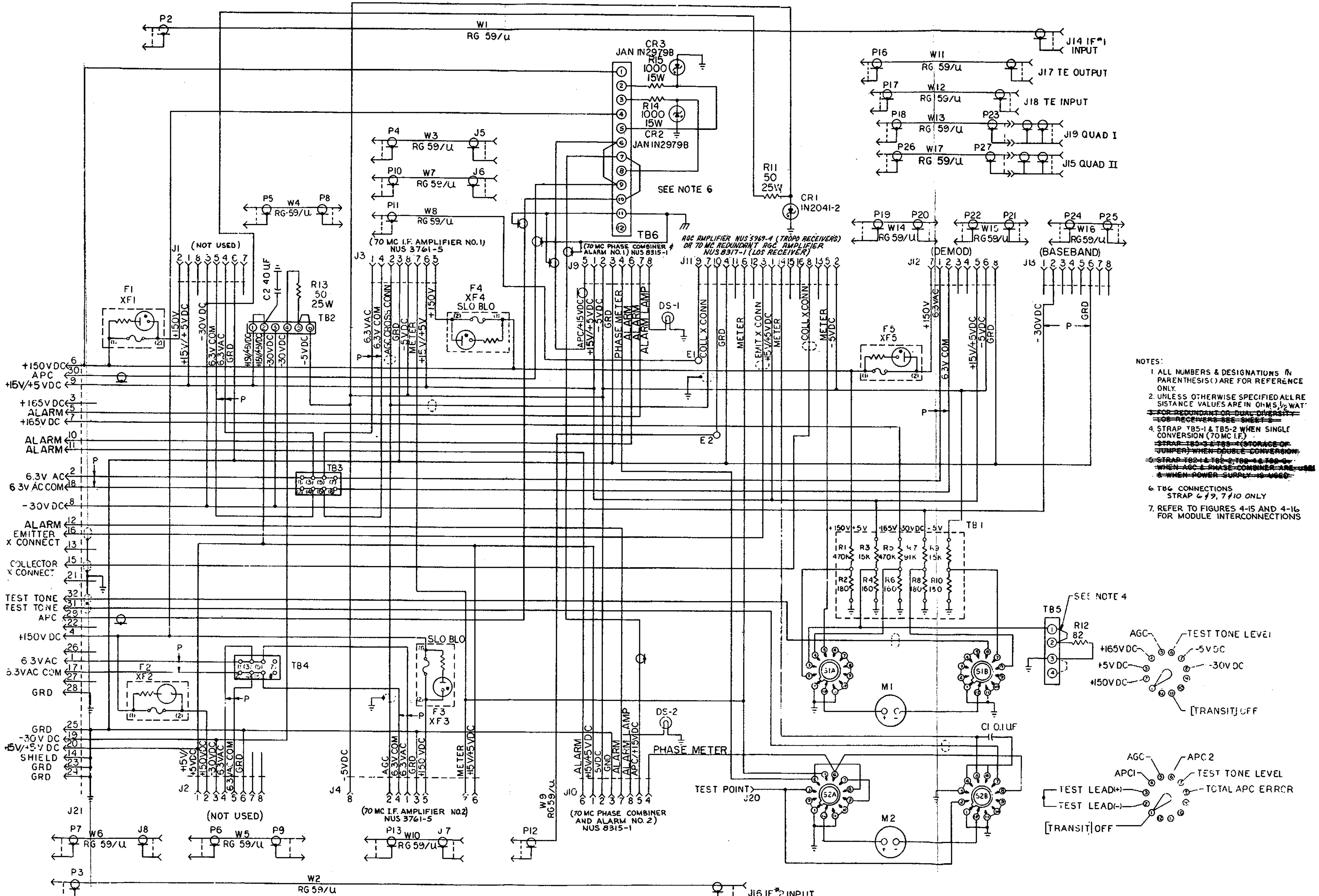


Figure 4-13. IF and Baseband Drawer (NUS 5965-3) Single Conversion Tropo Receiver, Schematic Diagram

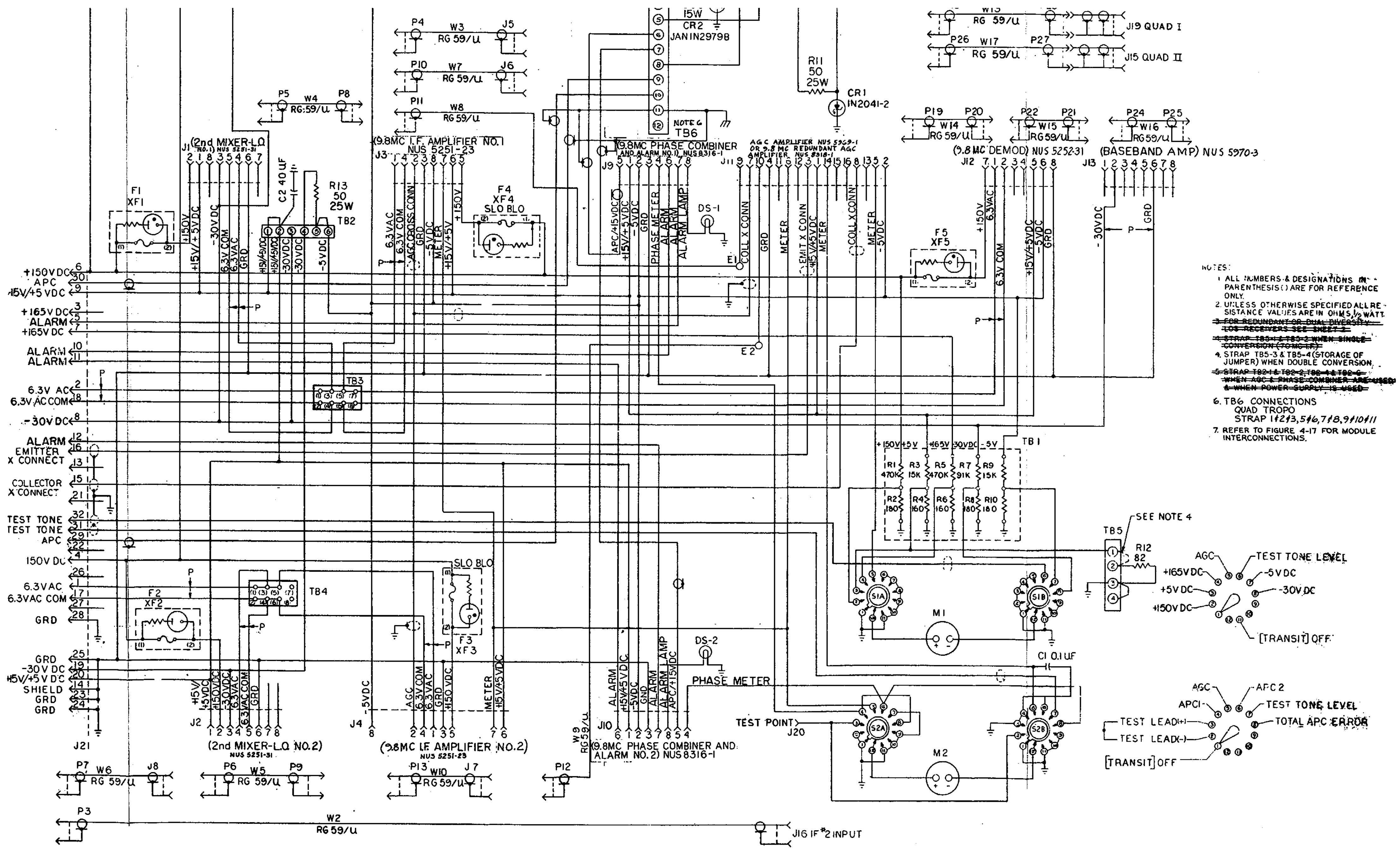


Figure 4-14. IF and Baseband Drawer (NUS 5965-6) Double Conversion Tropo Receiver, Schematic Diagram

Figure 4-14. IF and Baseband Drawer (NUS 5965-6) Double Conversion Tropo Receiver, Schematic Diagram

4-35/4-36

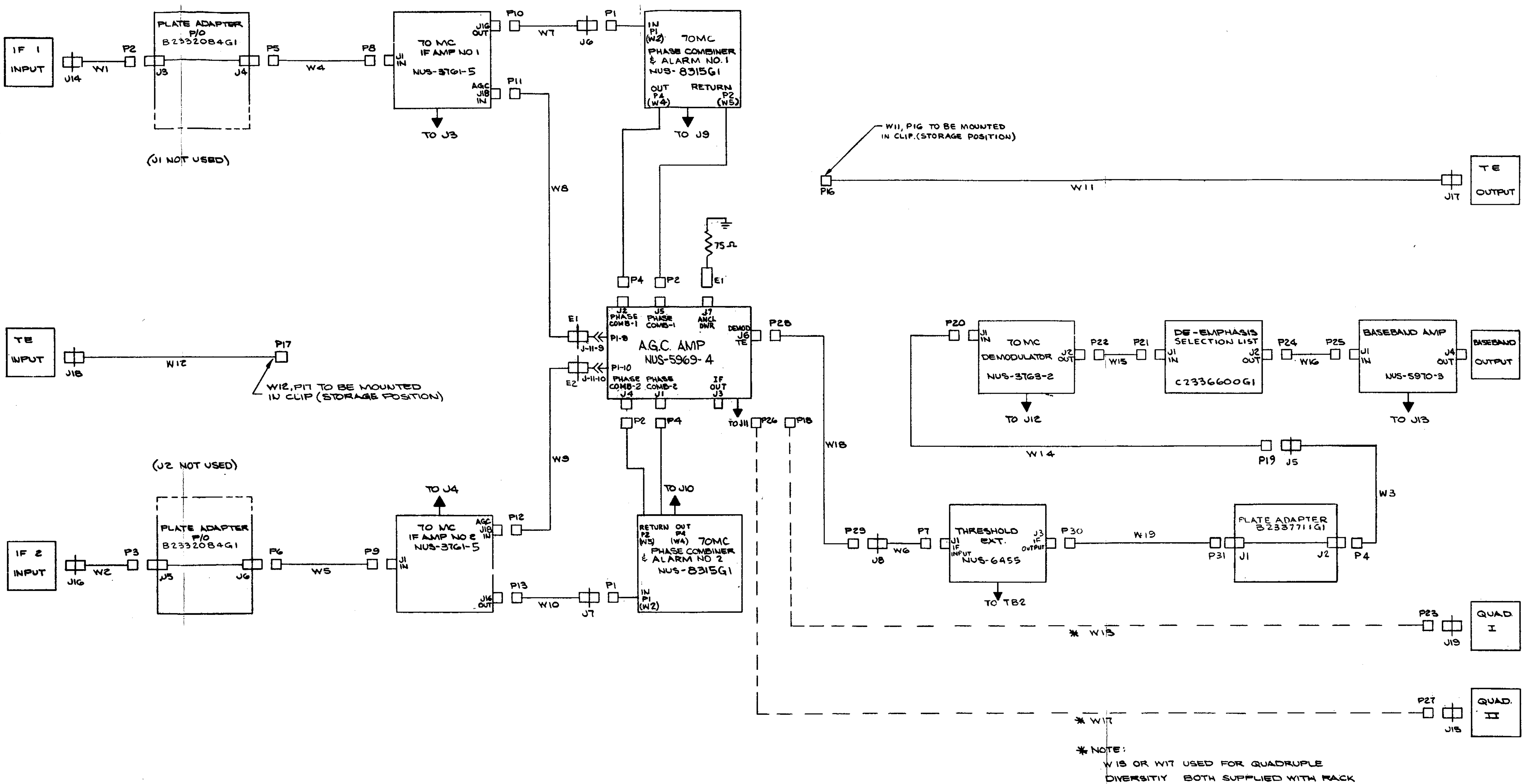


Figure 4-15. IF and Baseband Drawer (NUS 5965-5) Single Conversion Tropo Receivers With Threshold Extension, Interconnecting Diagram

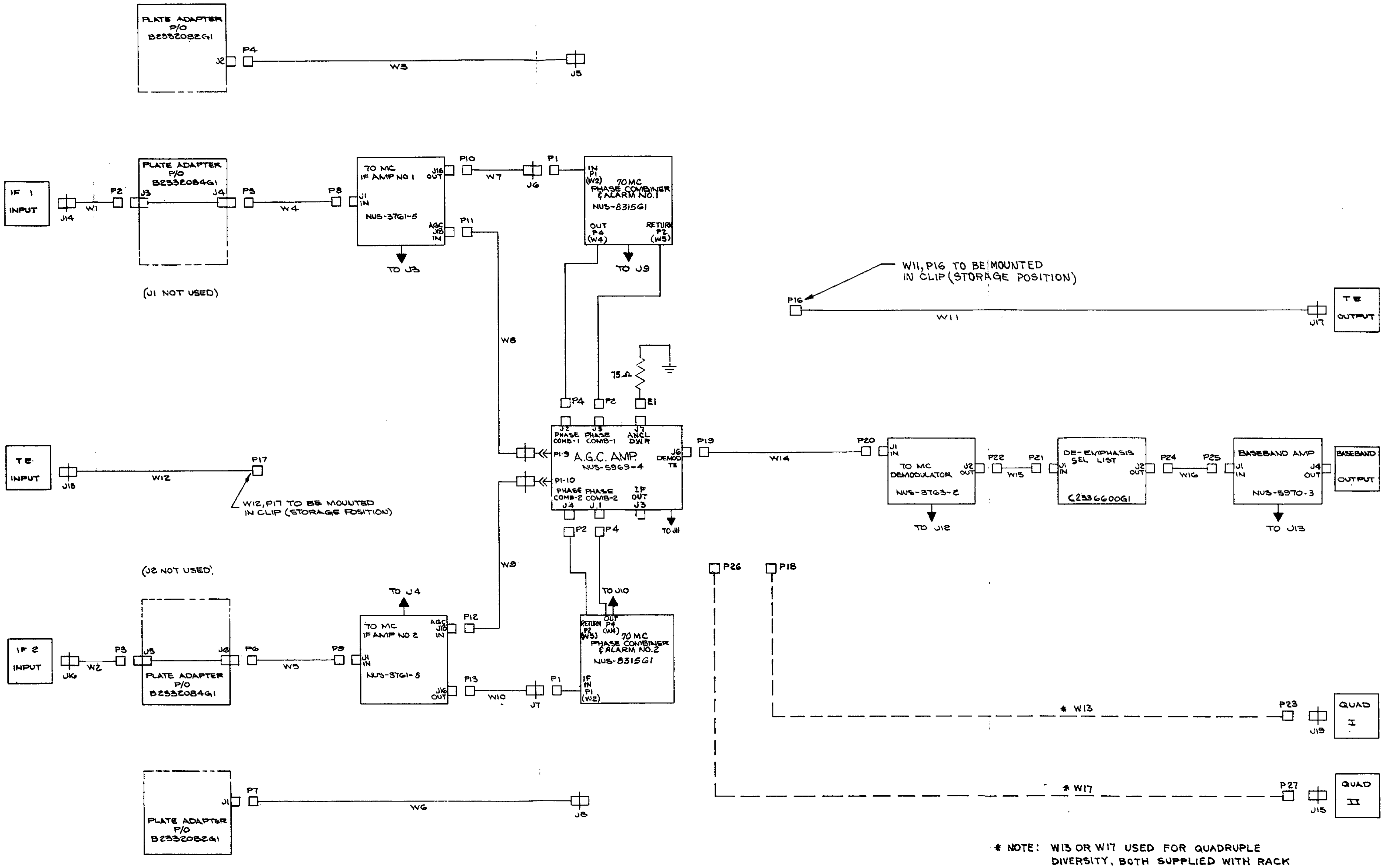


Figure 4-16. IF and Baseband Drawer (NUS 5965-3) Single Conversion Tropo Receiver Without Threshold Extension, Interconnecting Diagram

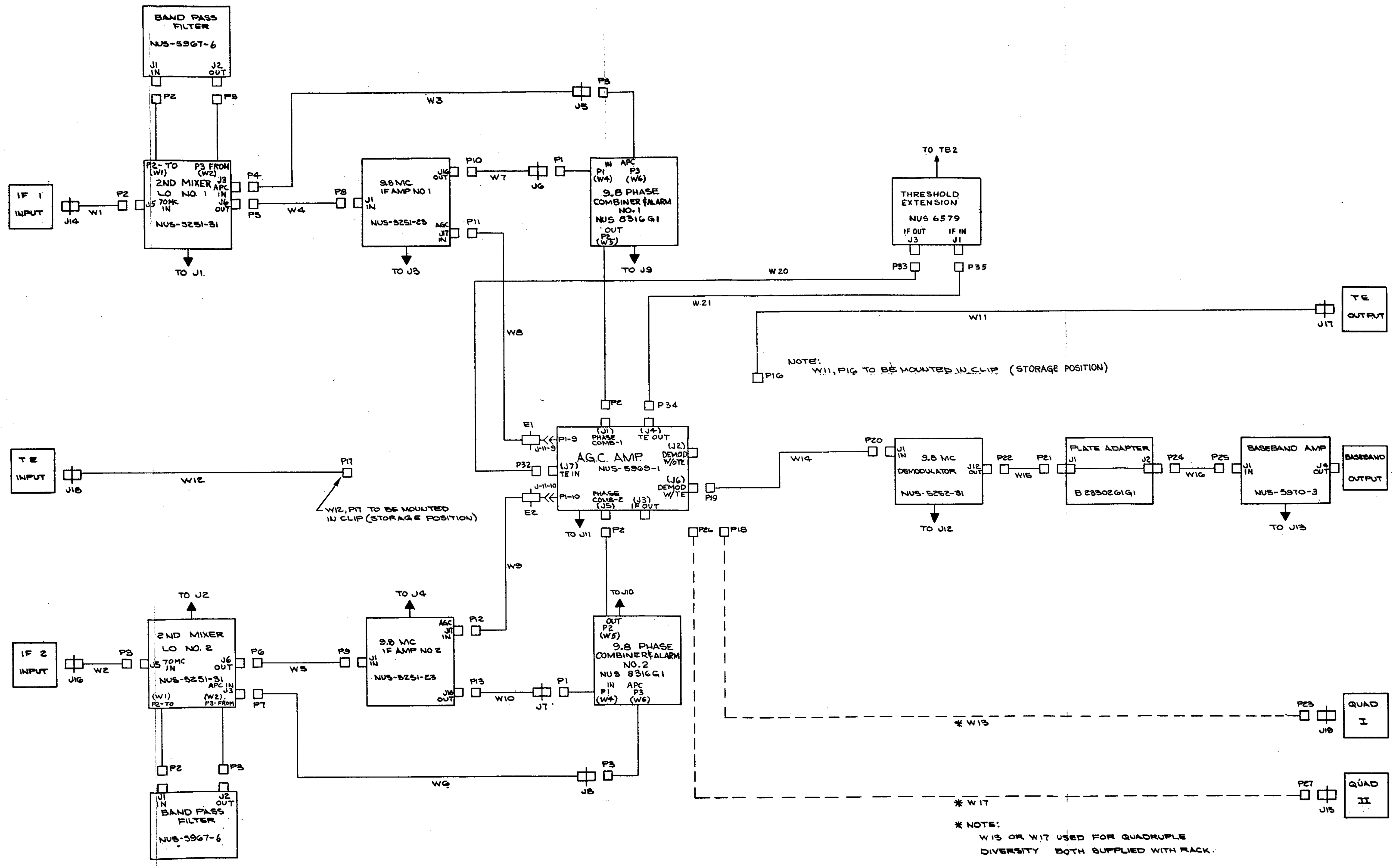


Figure 4-17. IF and Baseband Drawer (NUS 5965-6) Tropo Double Conversion Receivers, Interconnecting Diagram

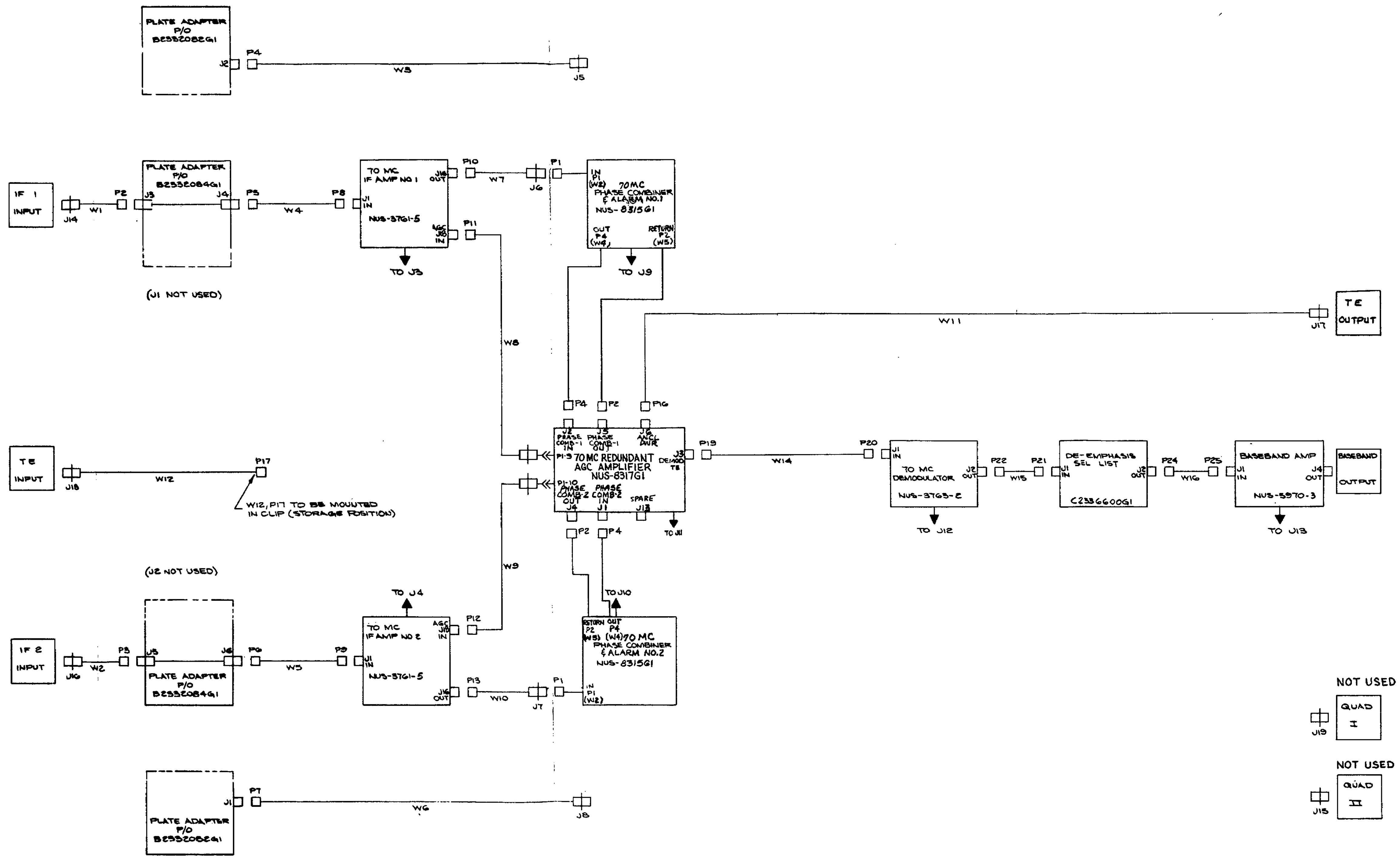


Figure 4-18. IF and Baseband Drawer (NUS 5965-8) LOS Single Conversion Receiver, Interconnecting Diagram

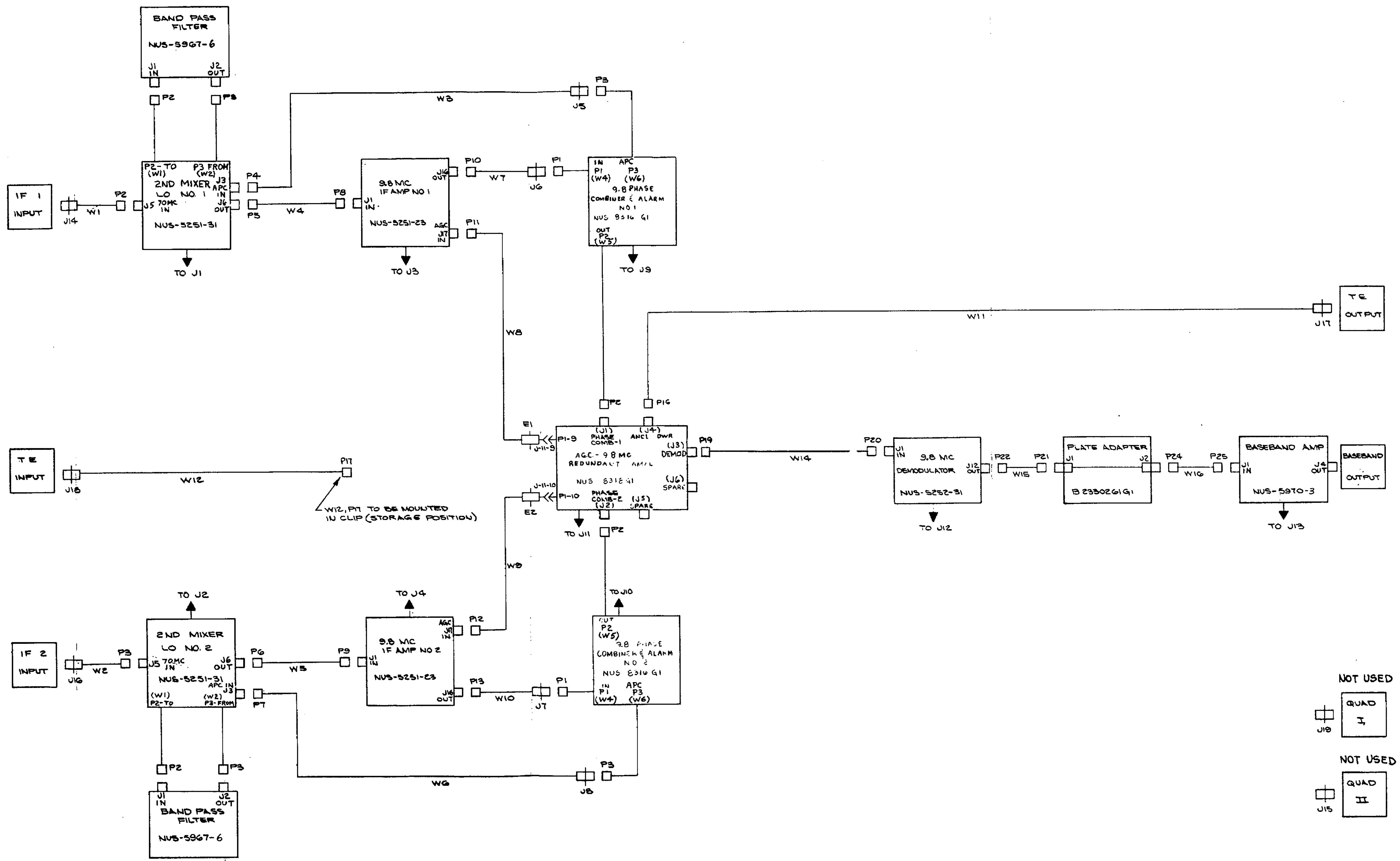
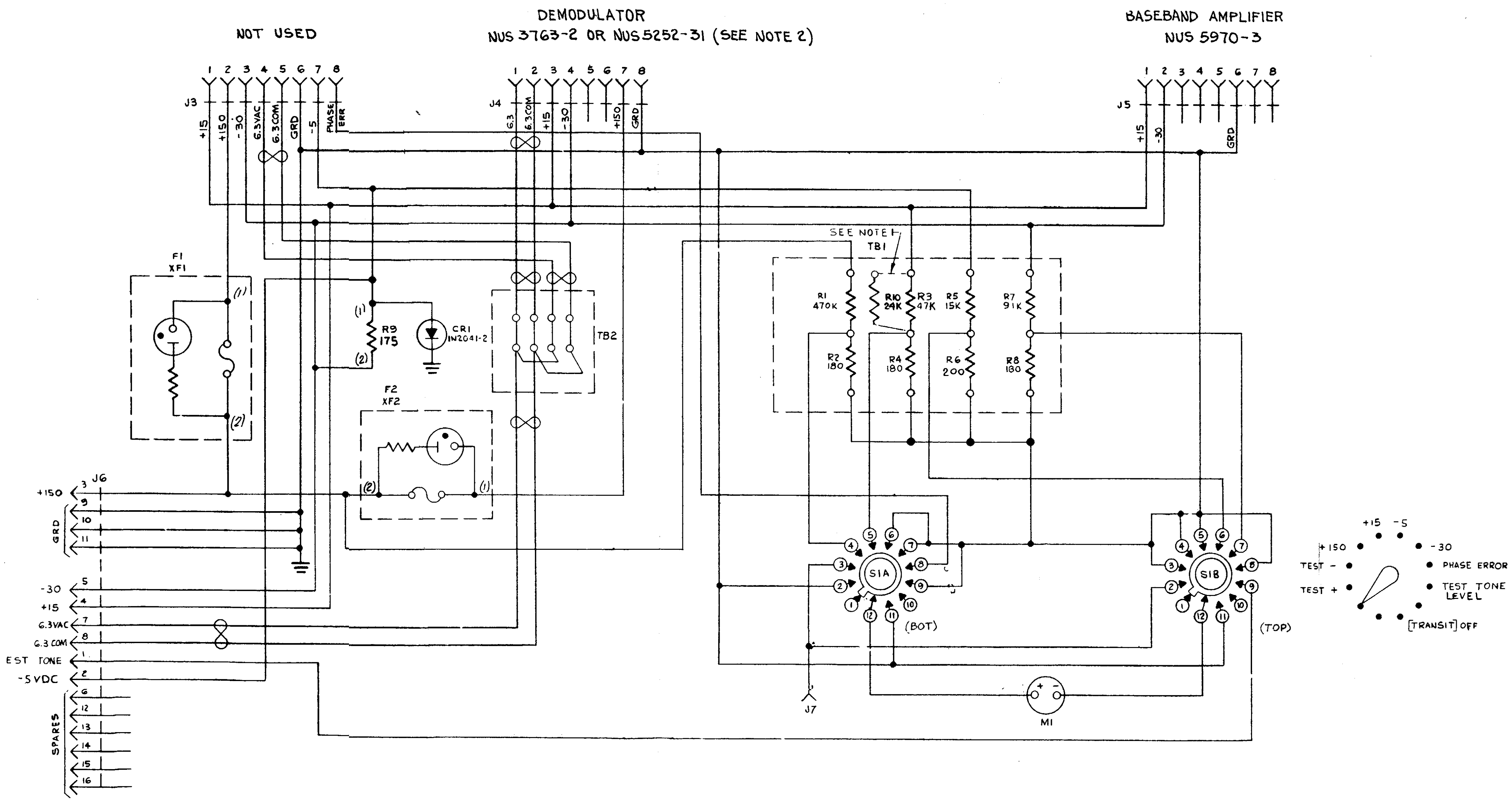


Figure 4-19 IF and Baseband Drawer (NUS 5965) LOS Double Conversion Receiver, Interconnecting Diagram



NOTES:

1. PARALLEL R10 AND R3 ON TB1 WITH JUMPER WIRE WHEN 9.8 MC DEMODULATOR (NUS 5252-31) IS USED
2. NUS 3763-2 IS USED IN SINGLE CONVERSION RECEIVER (SEE FIGURE 4-21) AND NUS5252-31 IS USED IN DOUBLE CONVERSION RECEIVER (SEE FIGURE 4-22)
3. INCLUDES MODIFICATION 2388004.

Figure 4-20. Ancillary Equipment Drawer (NUS 6058) Line-of-Sight Receiver, Schematic Diagram

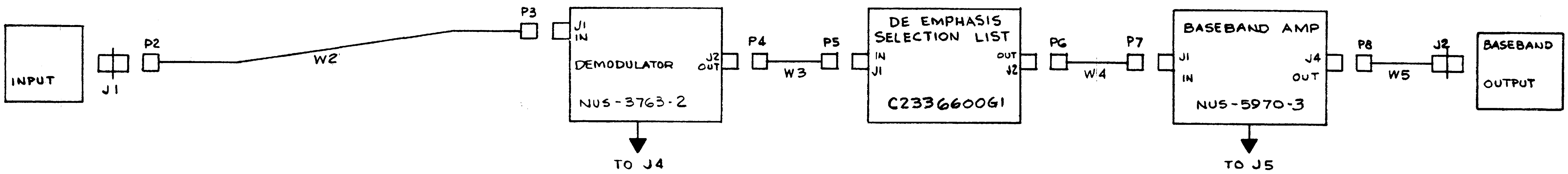


Figure 4-21. Ancilllary Equipment Drawer (NUS 6062-2) LOS Single Conversion Receiver, Interconnecting Diagram

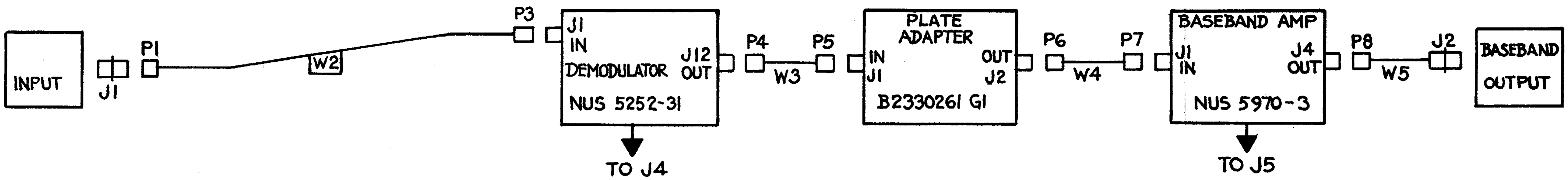


Figure 4-22. Ancillary Equipment drawer (NUS 6062-2) LOS Double Conversion Receiver, Interconnecting Diagram

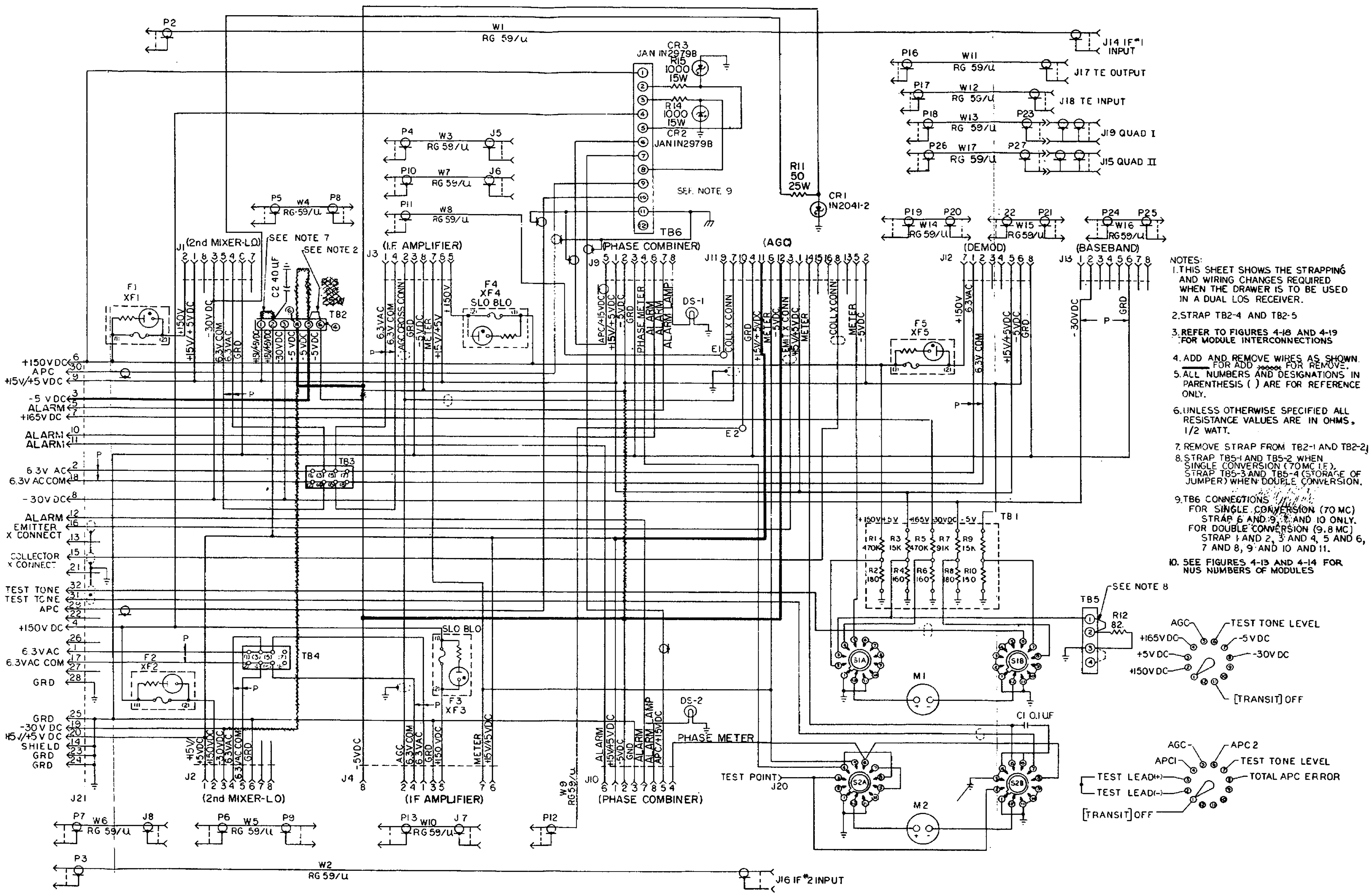


Figure 4-23. IF and Baseband Drawer (NOS 5965-7, -8) Line-of-Sight Receiver, Schematic Diagram

SECTION V

MAINTENANCE

5-1. GENERAL.

5-2. This section contains preventive and corrective maintenance procedures for the receiver and a listing of alignment procedures necessary when modules are replaced.

5-3. SPECIAL PRECAUTIONS TO BE OBSERVED.

5-4. The following paragraphs include information which is of greatest importance in the maintenance of traffic flow in the system.

NOTE

No unnecessary adjustment should be made at any time in any receiver.

5-5. TRANSMITTER FAILURES. In the case of a transmitter failure at the opposite end of the link, receiver rf channels associated with the failed rf path must be deactivated to remove the noise contribution from the affected channels. This deactivation is accomplished by removing the if cable at the input to the IF and Baseband Drawer of the receiver channel(s) not receiving signal. Upon correction of the transmit difficulty the associated receiver channels are returned to full operation.

5-6. INTERPRETATION OF APC METER READINGS. Table 5-1 is included to assist in interpreting the meaning of the APC meter readings. The right hand column indicates the nature of the corrective action required.

5-7. CRITERIA FOR READJUSTMENT OF PHASE LOCK. The criteria for determining whether or not to make the necessary adjustment to phase lock shall be as follows:

NOTE

Each line on the meter equals 10 divisions.

a. If an individual APC meter reading differs from any other individual APC meter reading by more than 30 divisions, adjustment of the phase lock shall be carried out according to the appropriate procedure.

b. If the TOTAL APC meter reading(s) differ from zero by more than 15 divisions, adjustment of the phase lock shall be carried out according to the appropriate procedure.

c. If the individual APC meter readings are equal but are different from zero by more than 15 divisions, the site at the opposite end of the link shall be notified to check the transmitter frequency.

5-8. It is to be thoroughly understood that the diversity receiver system is to be maintained such that drifts in phase lock are corrected prior to the system going out-of-lock. This is accomplished by reviewing the apc meter readings each time they are read and taking corrective action if necessary. Under no circumstances should the diversity system be allowed to drift out-of-lock before corrective maintenance is applied. The operator is cautioned not to interpret a level alarm as an out-of-lock condition (refer to Section VI in this manual).

TABLE 5-1. INTERPRETATION OF APC METER READINGS

APC A1, A2, B1, B2 Meter Readings	TOTAL APC A, Meter Readings	Reason	Corrective Action
* Readings Equal and Zero (±15)	Readings Zero (±15)	Alignment has been correctly performed, system is locked and is providing optimum performance. Incoming carrier frequency is correct.	None
Readings Equal but not Zero	Readings Zero (±15)	Incoming carrier frequency is high, or incoming carrier frequency is low. (It is remotely possible that all Receiver local oscillators or 2nd local oscillators in double conversion receivers) have drifted by the same amount.	Advise opposite end of link to adjust transmitter, crystal and/or modulator frequency to correct value. (If transmitted frequency is correct, adjust phase-lock of receiver by utilizing the appropriate procedure.)
Readings unequal	Readings not Zero	Receiver local oscillator (or 2nd local oscillator in double conversion receiver) frequencies have drifted. (In the frequency diversity case the transmitter local oscillator frequencies could also be at fault.)	Adjust phase-lock of receiver by utilizing the appropriate procedure.
A_1 and A_2 Equal but not Zero; B_1 and B_2 Equal and opposite polarity from A_1 and A_2	Quad Receiver Readings Zero (± 15); Dual Receiver Readings not Zero	Double conversion receiver first local oscillators out-of-lock.	Adjust first local oscillator frequencies and lock check by appropriate procedure.

* NOTE: An out-of-lock receiver can also have meter readings that approximate zero.

5-9. APC METER FLUCTUATIONS. Under certain signal conditions on the tropospheric scatter paths the apc meter will fluctuate slightly. In these cases the operator should use a median value as being representative of a steady state condition. As the tropo signals become lower in level, the observed fluctuations will normally increase in rate and severity. LOS and diffraction paths should exhibit little or no ape meter fluctuation.

5-10. IMPROPER ADJUSTMENT OF RECEIVER LOCAL OSCILLATOR. Operator adjustment of the receiver local oscillator frequency on a particular channel will affect other channels. Awareness of the normalcy of this interaction will avoid confusion and unnecessary out-of-lock conditions. For example, a movement of ape Al meter indication in a given direction will cause apc A2 to move in the opposite direction. In the quadruple diversity configuration, adjustment of receiver A will also have an effect on receiver B and vice versa. In this case an adjustment of ape A1,for example, not only affects ape A2, but causes apc B1 and B2 to move. It is for this reason that indiscriminate receiver local oscillator adjustment will in most cases lead the operator farther from, rather than closer to a perfect lock condition. If readjustment is necessary, the operator should follow only the prescribed procedure.

5-11. OSCILLATOR MULTIPLIER LOCK IN DOUBLE CONVERSION RECEIVERS. Operator adjustment of the receiver 1st oscillator frequency will affect the condition of 1st L. O. Lock which may not be discernible as a receiver phase lock alarm or as an excess noise alarm. It is imperative that adjustment of the 1st L..O. frequency be done only when absolutely necessary and according to the prescribed procedure.

5-12. The first L. O. lock condition should be periodically checked. It can best be observed on an oscilloscope, as a random frequency sine wave signal appearing on a detector bridged to the OSC LOCK cross-connect cable.

5-13. THRESHOLD EXTENSION. Operator adjustment of the receiver threshold extension oscillator frequency will affect receiver performance which may not be discernible as an excess noise alarm. It is imperative that adjustment of the T. E. oscillator frequency be done only when absolutely necessary and according to the prescribed procedure. The condition of T. E. oscillator lock should be periodically checked as prescribed.

5-14. AGC, APC AND PARAMETRIC AMPLIFIER GAIN ALIGNMENT. All operators are cautioned against undue recourse to realignment of the age and ape systems. The ape (phase combiner) alignment is extremely stable, and once set should remain aligned indefinitely. Realignment is only necessary upon failures that require age amplifier or phase combiner module replacement. The age system will exhibit a small long term drift caused primarily by tube aging. Age alignment should therefore be implemented only on a periodic basis, or upon failures that require module replacement. Low parametric amplifier gain should not be interpreted as a malfunction of the age system.

5-15. CHANGES IN APC METER READINGS WITH CRYSTAL OVEN CYCL ING. The cycling of the crystal ovens will be noticeable in the receiver ape meter readings. Normally the meter readings are not expected to vary with oven cycling by more than five divisions, with the average variation being three divisions. If larger fluctuations are noted that are correlated with crystal oven cycling, this might indicate a faulty crystal oven thermostat.

5-16. PREVENTIVE MAINTENANCE.

5-17. Preventive maintenance consists of a series of procedures that are performed at regular intervals to ensure satisfactory receiver performance. These routines and their suggested intervals of performance are listed in table 5-2. The intervals are based on continuous operation.

TABLE 5-2. PREVENTIVE MAINTENANCE ROUTINES

Cycle	Routine	Para.
Daily	Metering checks	5-18
When possible	Cleaning	5-22
Monthly	Air filter maintenance	5-26
	Module test point checks	5-20
Quarterly	Alignment	6-1
	Inspection	5-24

5-18. METERING CHECKS

5-19. With the receiver in operation, use the appropriate front or subpanel meter and associated selector switch to check the power applied to the Dual Parametric Amplifier, Preselector and Mixer, IF and Baseband, and the Ancillary Equipment drawers. Following this, check the agc and apc voltages and T. E. lock in the IF and Baseband drawer and the VSWR of parametric amplifiers I and 2 in the Dual Parametric Amplifier drawer. The normal meter readings, the selector switch and meter, and the selector switch position used for each test are listed in tables 5-3 through 5-5. Any meter reading which differs substantially from the corresponding reading in these tables or the previous reading as recorded in the log indicates an operating condition which should be corrected or investigated. The locations of the selector switches, meters, and test points are illustrated in Sections II and III.

TABLE 5-3. POWER CHECKS

Check	Switch Selector	Selector Switch Position	Meter	Meter Reading
DUAL PARAMETRIC AMPLIFIER DRAWER (NUS 6580-2 OR NUS 5300-7)				
Klystron beam voltage	S3	BEAM V	METER 2	50 ± 10
Klystron beam current	S3	BEAM CUR	METER 2	50 ± 10
Klystron reflector voltage	S3	REFL V	METER 2	50 ± 10
Klystron power	S3	KLYSTRON PWR (FREQ) on NUS 6580-2 or PUMP FREQ on NUS 5300-7	METER 2	50 ± 10
28 vac or 24 vac	S3	28 vac on NUS 6580-2 or 24 vac on NUS 5300-7	METER 2	50 ± 10
24 vdc	S3	24 vdc	METER 2	50 ± 10
Pre-regulator input	S4	(-)GRD (with test lead connected between (-)GRD TEST LEAD test point J3 and +PRE-REG INPUT test point TP1)	METER 1	25 ± 10

TABLE 5-3. POWER CHECKS (CONTINUED)

Check	Switch Selector	Selector Switch Position	Meter	Meter Reading
DUAL PARAMETRIC AMPLIFIER DRAWER (NUS 6580-2 OR NUS 5300-7) (cont)				
Beam regulator input	S4	(+GRD (with test lead connected between (+)GRD TEST LEAD test point J2 and -BEAM REG INPUT test point TP2)	METER 1	60 ±10
Reflector regulator input	S4	(+)GRD (with test lead connected between (+)GRD TEST LEAD test point J2 and -REFL REG test point TP3)	METER 1	60 ±10
Circulator Power Supply (NUS 6580-2 only)	S4	(-)GRD (with test lead connected between (-)GRD TEST LEAD test point J3 and J2 on circulator power supply	METER 1	50 ±10
PRESELECTOR AND MIXER DRAWER				
24 vac	S2	24 VAC	M1	50 ± 10
+165 vdc (channel 1)	S2	-GRD (with test lead connected between TEST LEAD test point TP1 (J12) and 165 VDC test point TP2 (J13))	M1	50 ± 10
+150 vdc (channel 1)	S2	-GRD (with test lead connected between TEST LEAD test point TP1 (J12) and 150 VDC test point TP3 (J14))	M1	50 ±10
+ 165 vdc (channel 2)	S2	-GRD (with test lead connected between TEST LEAD test point TP1 (J12) and 165 VDC test point TP4 (J15))	M1	50 ± 10
+ 150 vdc (channel 2)	S2	-GRD (with test lead connected between TEST LEAD test point TP1 (J12) and 150 VDC test point TP5 (J16))	M1	50 ±10

TABLE 5-3. POWER CHECKS (CONTINUED)

Check	Switch Selector	Selector Switch Position	Meter	Meter Reading
IF AND BASEBAND DRAWER				
+ 150 vdc	S1	+150 VDC	M1	50 ±10
+15 vdc (single conversion receivers) or +5 vdc (double conversion receivers)	S1	+15 VDC/+5 VDC	M1	50 ±10
+165 vdc	S1	+165 VDC	M1	50 ± 10
-5 vdc	S1	-5 VDC	M1	50 ± 10
-30 vdc	S1	-30 VDC	M1	50 ± 10
ANCILLARY EQUIPMENT DRAWER (LINE-OF-SIGHT RECEIVERS ONLY)				
+150 vdc	S1	+150 VDC	M1	100 ± 20
+ 15 vdc	S1	+ 15 VDC	M1	100 ± 20
-5 vdc	S1	-5 VDC	M1	100 ± 20
-30	S1	-30 VDC	M1	100 ± 20

TABLE 5-4. AGC, APC AND TEST TONE CHECKS

Check	Switch Selector	Switch Position	Meter	Meter Reading
AGC	S1 or S2	AGC	M1 or M2	Varies with signal strength (Note 1)
APC channel 1	S2	APC 1	M2	0 ± 20 } (See note 4 for NUS 5961-9, -10 and -13
APC channel 2	S2	APC 2	M2	0 ± 20
Total APC	S2	TOTAL APC ERROR	M2	0 ± 10
TEST TONE	S1	TEST TONE LEVEL	M1	50 ± 10
TEST TONE	S2	TEST TONE LEVEL	M2	100 ± 20 (Note 2)
PHASE ERROR	S2	TEST LEAD	M2	Same as last recorded in log. (Note 3)

Note 1. On LOS receivers check the meter readings of all three positions of the channel test switch on the redundant agc amplifier. They should be the same in all positions. If not, replace the agc.

Note 2. The test tone meter reading is derived from the tone receiver in the CEC and the value shown applies for a setting at the tone receiver dc test jack of 0.95 vdc.

Note 3. To perform this test, connect a tip jack test lead from TE PHASE ERROR tip jack to TEST LEAD jack on the subpanel of the drawer. See TABLE 5-10, step 32.

Note 4. An additional check that should be performed on double conversion quad diversity receivers (if APC 1 and APC 2 are off on the same side of zero and TOTAL APC ERROR is zero) is to repeat the APC 1 and APC 2 readings on cabinet B(A). If the APC readings in the two cabinets are displaced on opposite sides of zero there is a very strong possibility that the crystals in the 1st LO's are out of lock. Refer to lock alignment procedure to correct the out-of-lock condition. For dual diversity double conversion receivers, if the readings on APC 1 and APC 2 are displaced on opposite sides of zero and a TOTAL APC ERROR exists, the 1st LO crystal lock should be checked and corrected, if necessary.

TABLE 5-5. PARAMETRIC AMPLIFIER CHECKS

Check	Switch Selector	Switch Position	Meter	Meter Reading
Parametric amplifier 1	S4	PUMP 1 POWER PUMP 1 MATCH	M1 M1	See Note 1 +10 MAX.
Parametric amplifier 2	S3	PUMP 2 POWER	M2	See Note 1
		PUMP 2 MATCH	M2	+ 10 MAX.
Klystron frequency	S3	KLYSTRON PWR (FREQ)	M2	Adjust WM1 wavemeter for dip on meter. Read frequency on WM1. Record in log. See Note 2. Offset WM1 two turns after reading is taken.

Note 1. Reading is recorded on a decal behind front panel. The reading is a function of the particular cavity assembly, frequency, and gain adjustment and should be observed for change from the previous reading rather than compared against an absolute limit.

Note 2. The reading of frequency on the wavemeter should be compared with the previously recorded reading. If a continuous change in frequency occurs over a short period it is an indication that the klystron is failing.

5-20. MODULE TEST CHECKS.

5-21. The module test point checks may be performed using the integral meters on the Preselector and Mixer, IF and Baseband drawer and Ancillary Equipment drawer (line-of-sight receivers only). When using the integral meter, set the selector switch associated with the meter for a positive or negative ground, as required, and connect a patch cord between the test point to be checked and the jack associated with the meter. Table 5-6 lists typical module test point readings with a -50 dbm cw input to each receiver input.

TABLE 5-6. TYPICAL MODULE TEST POINT READINGS

Test Point		Integral Meter Reading	
Oscillator Multiplier		NUS 3753-7	NUS 3753-6
TP1	V1AC	25-45	25-45
TP2	V1BC	40-60	40-60
TP3	+ 150V	35-55	40-60
TP4	V2C	40-60	40-60
TP5	V3C	45-60	45-65
TP6	+ 165V	40-60	40-60
Frequency Multiplier NUS 3765-4			
TP7	+ 165V	40-60	
TP8	V1C	45-75	
Mixer-Preamplifier NUS 3760-6			
TP9	V1C	40-60	
TP10	V2C	40-60	
TP11	+ 150V	30-50	
TP12	V3C	40-60	
TP13	V4C	40-60	
2nd Mixer Local Oscillator NUS 5251-31 (Double Conversion Receivers Only)			
J3	+ 150	+ 150	
J10	V2C	85-115	
J4	V1C	85-115	
9.8-MC Demodulator NUS 5252-31 (Double Conversion Receivers Only)			
J10	V5C	70-100	
J8	V4C	70-100	
J6	V3C	70-100	
J5	V2C	70-100	
J4	V1C	70-100	
J3	+150V	85-115	

TABLE 5-6. TYPICAL MODULE TEST POINT READINGS

Test Point		Integral Meter Reading
70-MC Demodulator NUS 3763-2 (Single Conversion Receivers Only)		
J12	150V	85-115
J4	V1C	60-80
J6	V2C	60-80
J8	V3C	65-85
J11	V4C	90-110
J13	V5C	80-110
70-MC IF Amplifier NUS 3761-5 (Single Conversion Receivers Only)		
J3	V1C	40-60
J5	V2C	40-60
J7	V3C	40-60
J9	V4C	40-60
J11	V5C	80-110
J13	V6C	80-110
J15	150 V	80-100
9.8-MC IF Amplifier NUS 5251-23 (Double Conversion Receivers Only)		
J3	V1C	40-60
J5	V2C	40-60
J7	V3C	40-60
J9	V4C	40-60
J11	V5C	20-40
J13	V6C	20-40
J15	+150V	85-115
70-MC AGC Amplifier NUS 5969-4 (Single Conversion Receivers Only)		
J10	(TP3)	85-115
J11	(TP4)	40-60
J12	(TP5)	85-115
9. 8-MC AGC Amplifier NUS 5969-1 (Double Conversion Receivers Only)		
TP1	(J8)	110-150
TP2	(J9)	150

5-22. CLEANING.

5-23. The receiver should be cleaned only when it is possible to do so without impairing the traffic-carrying ability of the equipment. At the time that alignment is performed, the receiver is normally placed in a condition which allows partial shutdown, and the cleaning of the shut-down equipment can be accomplished at this time. Use a lint-free cloth and a soft brush. The alignment can be performed after cleaning.

5-24. INSPECTION OF DETAIL PARTS.

5-25. Table 5-7 outlines the procedures to be followed for the inspection of detail parts, which should be done under the same conditions that are observed when doing cleaning.

TABLE 5-7. INSPECTION OF DETAIL PARTS

Detail Parts	Procedure
Resistors	Check for discoloration due to heating.
Capacitors	Check for distortion of case, discoloration, and leakage.
Switches and controls	Check action, detent tension, corrosion, mounting and connections.
Meters	Check for free and quick needle action.
Cables and wiring	Check for cracked or otherwise impaired insulation, and loose clamps and strain reliefs.
Connectors	Check for bent or broken pins and defective insulation.
Terminal boards	Check for defective terminals.

5-26. AIR FILTER MAINTENANCE.

5-27. Air filter maintenance is important for proper operation of the receiver. The lack of proper maintenance (cleaning or replacement) of air filters can cause an equipment breakdown due to excessive heating. Replace and clean the air filters in the Dual Parametric Amplifier drawer NUS 5300-7 (when used) and at the base of the receiver cabinets at monthly intervals. The air filters are to be removed and replaced by spare filters. To clean a dirty filter, wash thoroughly with strong soap, detergent, or solvent. Rinse and dry. Dip in S. A. E. 30, or heavier, oil and drain for 24 hours.

5-28. <u>CORRECTIVE MAINTENANCE</u>

5-29. GENERAL

5-30. Corrective maintenance is required when a fault in the operation of the receiver is definitely not connected with a fading condition or a failure at the transmitting end of the link.

5-31. REMOVAL AND REPLACEMENT.

5-32. Modules. To remove a module, turn off the receiver, disconnect all electrical connections to the module, and remove the captive screws securing the module to the drawer chassis. Replace a module by reversing the procedure. Table 5-8 shows alignments to be performed after replacing any module.

TABLE 5-8. TUBE OR MODULE REPLACEMENT ALIGNMENT

Tube or Module Replacement	Alignment	Para. No.	
		Single Conversion	Double Conversion
Parametric Amplifier	Parametric amplifier gain and noise figure	6-21	6-21
Klystron	Klystron check, replacement and tuning -	6-41 through	6-45
Oscillator multiplier and frequency multiplier	Oscillator multiplier, frequency multiplier alignment	6-19	6-50
Mixer-preamplifier	Mixer-preamplifier gain and noise figure	6-22	6-22
	AGC alignment		
	Quad receiver	6-23	6-56
	Dual receiver	6-25	6-58
IF filter	None		
IF amplifier	AGC alignment*		
	Quad receiver	6-23	6-55 and 6-57
	Dual receiver	6-25	6-55 and 6-56
Phase combiner	AGC alignment*		
	Quad receiver	6-23	6-57
	Dual receiver	6-25	6-58
	APC alignment*		
	Quad receiver	6-26	6-60
	Dual receiver	6-28	6-61
	Phase alarm alignment		
	Quad receiver	6-29	6-63
	Dual receiver	6-32	6-64
	Level alarm alignment		
	Quad receiver	6-34	
	Dual receiver	6-35	none

TABLE 5-8. TUBE OR MODULE REPLACEMENT ALIGNMENT (CONTINUED)

Tube or Module Replacement	Alignment	Para. No.	
		Single Conversion	Double Conversion
AGC amplifier	AGC alignment*		
	Quad receiver	5-49	6-57
	Dual receiver	5-50	6-58
	APC alignment*		
	Quad receiver	5-52	
	Dual receiver	5-53	None
Threshold extension	Threshold extension alignment	6-36	6-70
Demodulator, de-emphasis network, baseband amplifier	Baseband levels	6-39	6-68
Threshold extension check	Threshold extension frequency check	6-37	6-70
RF filter check	RF filter alignment	6-40	6-40
Best-in-lock alignment	Best-in-lock alignment		
	Quad receiver	6-18	6-52
	Dual receiver	6-17	6-52

* Perform alignment of all channels. On quad receivers the alignments specified for one channel should be performed on only one channel at a time. This condition will maintain triple diversity reception.

5-33. OSCILLATOR CRYSTALS. Remove an oscillator crystal as follows:

a. Loosen the three case locking screws.

b. Rotate crystal oven case counterclockwise until case lock releases. Lift case from oven.

c. Remove the two screws from the oven top cover..

d. Lift off top cover while holding crystal between holding clips. This action permits crystal to be removed from crystal socket.

e. Remove crystal from top cover holding clips.

5-34. Install new crystal as follows:

CAUTION

Do not attempt to force the crystal into the crystal socket. Excessive pressure may damage the crystal pins.

a. Insert new crystal between oven top cover holding clips.

b. Holding top cover holding clips to prevent crystal from dropping, carefully insert crystal into crystal socket and replace top cover.

c. Replace screws securing top cover to oven.

d. Place oven case over oven and rotate in clockwise direction until case lock engages, then tighten case locking screws.

5-35. TROUBLE ANALYSIS

5-36. Table 5-9 shows the fault indicator light combinations that indicate either link troubles or receiver troubles. The cross-correlation point in the table corresponding to a given set of fault lights that are on and a specified receiver type in use gives the starting point in the steps of table 5-10 to be followed to find the drawer, module, or tube in trouble.

5-37. Before starting any troubleshooting procedure, it should be noted that certain troubles require breaking down to dual (or to single channel in LOS configurations) and that other troubles require locking out the baseband in trouble. These conditions are covered in table 5-10.

TABLE 5-9. RECEIVER FAULT INDICATIONS BY ALARM LIGHTS

Alarm location and name	Lighted indicator lights																						
CEC-RECEIVER A	X		X		X	X			X		X	X		X		X	X	X	X	X	X	X	X	
CEC-RECEIVER B		X		X			X	X		X	X		X		X	X	X	X	X	X	X	X		X
CEC Noise Rec A									X											X	X	X		
CEC Noise Rec B										X										X	X	X		
Rec. Cab A BASEBAND ALARM			X						X		X			X						X	X	X		
Rec. Cab B BASEBAND ALARM				X						X	X				X					X	X	X		
Rec. Cab A if and bb ALARM 1					X							X		X		X		X			X	X		
Rec. Cab A if and bb ALARM 2						X							X	X			X		X		X	X		
Rec. Cab B if and bb ALARM 1							X								X	X			X			X		
Rec. Cab B if and bb ALARM 2								X							X		X	X				X		
Rec. A PUMP FAILURE																							X	
Rec. B PUMP FAILURE																								X
	For above indications enter TABLE 5-10 at step shown below.																						
<u>Receiver Configuration</u> Quadruple Diversity																							
Single conversion 70 mc i.f. NUS 5961-15, 16, 19,20.	1	1	3	3	15	15	15	15	29	29	53			41	41	53	53	53	53	33		53	41	41
Double conversion 9.8 mc i.f. NUS5961-9,13.	1	1	3	3	20	20	20	20	29	29	53			27	27	53	53	53	53	33		53	41	41
Dual diversity line-of-sight																								
Single conversion 70 mc i.f. NUS 5961-12, 17.	1	1	3	3					29	29	53	15	15							39	53			
Double conversion 9.8 mc i. f. NUS 5961-10.	1	1	3	3					29	29	53	20	20							39	53			

Note 1. BASEBAND ALARM'S A and B are in single cabinet in LOS configuration.
Note 2. ALARM 1 and ALARM 2 in LOS cabinet correspond to channel A and B.
Note 3. Paramp PUMP FAILURE alarm may cause other lights to indicate alarm conditions. There are too many possible combinations to be listed. The PUMP FAILURE should be corrected before proceeding to any other alarm.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
1	24 vac power circuit	a. On front panel of pre-selector-mixer drawer set meter switch to K24 VAC position. b. Meter should read between 40 and 60.	a. Check cabinet alarm relay K1 (or K1 or K2 LOS cabinet) for operation and proper seating. b. Check wiring to CEC. c. Check for + 15 vdc at CR2 or CR3 in if and bb drawer. d. Check for other alarm circuit failure.	a. Check POWER ON light DS1. b. If DS1 is lit, check 24 vac transformer for burnout or open connection. c. If DS1 is not lit, proceed to step 2.
2	115 vac power	a. Check that circuit breaker CB1 is in the on position. b. If cabinet is in quad configuration, break down to dual. c. If cabinet is LOS, disconnect if output cable from IF OUT jack J16 of channel that is off.	a. Power input to cabinet is off. b. Check shelter circuit breakers. c. After power is restored, allow warmup time and ensure proper phase lock before restoring to quad(or dual if LOS).	a. Reset CB1. If it stays on, trouble was temporary overload. b. If CB1 does not stay on, troubleshoot for shorted cables or power supply input circuits. c. After restoring power circuits to normal, allow warmup time and ensure proper phase lock before reconnecting to quad (dual if LOS).
3	Post-combination signal failure	a. Check power supply voltage indications on front panel meter on if and bb drawer. b. Check fuse F5 in if and bb drawer. c. If LOS receiver, check meter indications on ancillary drawer (baseband B only). d. If LOS receiver, check fuse F2 inside ancillary drawer (baseband B only).	a. On CEC, select good channel to carry traffic and set AUTO-MAN switch to MAN. b. Proceed to step 4.	a. On CEC, select good channel to carry traffic and set AUTO-MAN switch to MAN if all power supplies are on. b. If fuse F5 (or F2) blown, replace. c. If fuse blows, replace the demodulator. d. If +150/165v power supply is off, try RESET AC. e. If resetting does not restore the power supply to normal, check for shorts on output of power supply.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
3 (cont)		e. If any power supply is off, for quad configuration break down to dual and if LOS, disconnect the if output cable from J16 on the affected if amplifier.		f. If there are no shorts on the output of the power supply, replace it. g. If a +15v, +5v or -30v supply is off, try resetting with CB1. h. Repeat steps e and f for the affected supply. i. Check CR2 and CR3 in if and bb drawer for + 15 volts in double conversion receivers. j. If +15 volts is off, troubleshoot and repair +15 volt circuit.. k. After curing the trouble, ensure proper phase lock after warmup time, before reconnecting to quad (or dual if LOS). l. Reset CEC AUTO-MAN switch to AUTO.
4	Pilot tone circuit.	a. On if and bb drawer front panel, set meter switch to TEST TONE. b. Meter should read between 40 and 60.	Alarm circuit has failed in pilot tone receiver area.	Proceed to step 5.
5	Pilot tone circuit.	a. Use Sierra selective volt meter and bnc tee. b. Check for minimum of 20 millivolts of 4 kc signal at output jack of baseband amplifier.	Pilot tone circuit in CEC is defective or cables from baseband amplifier to CEC are defective. Check baseband attenuator AT1 in cabinet.	Proceed to step 6 if threshold extension module is used. If not used, proceed to step 7.
6	Threshold extension module	Check on TE module for 4 kc at BASEBAND TEST jack. Level should be 10 millivolts minimum.	Proceed to step 7.	a. Proceed to step 11 for single conversion receivers. b. Replace TE in double-conversion receivers and align. c. Reset CEC AUTO-MAN switch to AUTO.

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TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
7	Baseband amplifier	a. Check for 4 kc signal at input to baseband amplifier b. If single-conversion receiver, level should be 3 mv. minimum. c. If double-conversion receiver, level should be 30 mv minimum.	a. Replace baseband amplifier. b. Recheck baseband amplifier gain setting per alignment procedure before resetting CEC AUTO-MAN switch to AUTO.	a. For single-conversion receivers proceed to step 8. b. For double-conversion receivers proceed to step 12.
8	Cables	Use Sierra sel. vm. and check for 3 mv minimum of 4 kc signal at output jack of demodulator. Use bnc tee.	Check cables W15, W16 and de-emphasis network. Replace, if necessary.	Proceed to step 9.
9	70-mc demodulator	Check for approximately 0.5-volt 70-mc signal at input jack of demodulator. Use bnc tee.	a. Replace demodulator. b. Check baseband levels before resetting CEC AUTO-MAN switch to AUTO.	Proceed to step 10 if TE is used. If not used proceed to step 11.
10	Cables	Check for approximately 0.5-volt of 70-mc signal at J1 on adapter plate B2337711G1 inside top of if and bb drawer. Use bnc tee.	Check cables W3, W14 and adapter plate cable. Replace, if necessary.	a. Replace TE module if W19 is good. b. Realign TE module before resetting CEC AUTO-MAN switch to AUTO.
11	Cables. 70-mc AGC amplifier	Check for approximately 0.5 volt 70 mc signal at DEMODTE jack J6 on AGC amplifier. Use bnc tee.	Check W14. Replace, if necessary.	a. Break down to dual. b. Replace AGC amplifier. c. Realign combiner and AGC. d. Reconnect for quad. e. Reset CEC AUTO-MAN switch to AUTO.
12	Cables	Check for 30 mv minimum 4 kc signal at output of demodulator. Use bnc tee.	Check cables W15, W16 and adapter plate B2330261G1. Replace, if necessary.	Proceed to step 13.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
13	9. 8-mc demodulator	Check for approximately 0.5-volt 9.8-mc signal at input jack of demodulator. Use bnc tee.	a. Replace demodulator. b. Recheck baseband levels before resetting CEC AUTO-MAN switch to AUTO.	a. If TE is used, proceed to step 14a. b. If TE is not used, proceed to step 14b.
14	Cables	a. Check for approximately 0.5-volt 9. 8-mc signal at DEMOD W/TE jack on AGC amplifier. Use bnc tee. b. Check for approximately 0.5-volt 9. 8-mc signal at DEMOD W/O TE jack on AGC amplifier. Use bnc tee.	a. Check cable W14. Replace, if necessary. b. Reset CEC AUTO-MAN switch to AUTO.	a. Check cable W20. b. If W20 is good, replace TE. c. Align replacement TE. d. Reset CEC AUTO-MAN switch to AUTO.
15	Precombination 70-mc signal.	a. Break down to dual. b. On affected combiner, set ∅-L switch to L. c. On affected combiner, set DELAY switch to OFF. d. Alarm light should go out.	a. Set ∅-L switch to ∅. If alarm light lights, go to step 16. b. If light does not light in∅ position, or if some other∅ light lights, go to step 17.	a. Check fuses in if and bb drawer and in Preselector and Mixer drawer. b. If fuses are normal, proceed to step 18 for quad receivers and step 46 for LOS receivers.
16	Excessive drift. 70-mc combiner.	a. Position the if and bb subpanel switch to the APC showing the alarm light. b. On the associated oscillator-multiplier in the preselector-mixer drawer, adjust OSC A control. c. The APC meter should swing smoothly above or below zero and should swing smoothly to zero when OSC A is on frequency. If the meter drops suddenly from a high value to zero, OSC A is not on frequency and should be readjusted.	a. Fault was excessive drift. b. Return all switches to normal positions and reconnect to quad.	a. If meter readings do not change when adjusting OSC A and alarm light remains on, replace the combiner. b. If meter readings change smoothly but alarm light remains on, check the adjustment of ∅ ALM ADJ potentiometer. c. If alarm adjustment cannot be made, replace the combiner.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
16 (cont)		d. When meter reads zero per paragraph c the alarm light should be off.		
17	Phase lock 70 mc	a. The presence of a phase alarm in quad that disappears after breaking down to dual or that appears in a different cabinet or channel after breaking down to dual is most likely to be an out-of-lock condition in the crystal oscillator area. It can be caused by a broken wire in the dc path or a faulty combiner. b. Use the counter with the proper decoupler and measure the frequency at J8 on the oscillator multiplier of channel 1 of the cabinet not carrying traffic. Record the frequency. c. Change the setting of the OSC A control slightly on channel 2 of the same cabinet. d. The frequency of channel 1 should change. If it does, reset OSC A of channel 2 until the frequency of channel 1 is the recorded frequency. e. Repeat steps b, c and d, reversing the channels	A change in frequency in the channel being measured indicates that correction voltage is being applied to the measured channel.	a. A failure of a channel oscillator to change in frequency when the other channel in the cabinet is varied indicates that the control dc voltage from the APC is missing. b. Set the sub-panel meter switch in the if and bb drawer to the APC corresponding to the suspected channel. c. Vary the alternate channel and observe the meter. It should swing above and below zero smoothly. d. If the meter does not swing, the combiner is bad for the channel to which the meter is set. e. If the meter swings, shut off the power, remove V1 of the oscillator -multiplier and check continuity from pin 7 of the tube socket to APC TEST on the corresponding phase combiner. f. Replace the combiner if bad, repair open wire or bad oscillator multiplier. g. Apply power, allow warmup, check for proper phase lock and reconnect to quad.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
17 (cont)		f. If each channel changes the frequency of the other, switch the cabinets at the CEC and check out the channels of the second cabinet. See indications columns for interpretation of data.		
18	70-mc combiner	a. In if and bb drawer set ∅-L switches on both combiners to L. b. Disconnect cables W7 W10 from if OUT jacks. c. Connect W10 to upper if amp J16 and W7 to lower if amp J16. d. The alarm lamp on the affected channel should go out.	a. Reconnect the cables to their original positions. b. Leave the switches in L position. c. Proceed to step 19.	a. Reconnect the cables to their original positions. b. Replace the combiner that originally showed the alarm. c. Realign the APC and AGC. d. Return all switches to normal and reconnect to quad.
19	70-mc if amplifier	a. On the front panel of the if and bb drawer, disconnect the cables from IF INPUT 1 and IF INPUT 2. b. Connect the IF INPUT 1 cable to IF INPUT 2 and the IF INPUT 2 cable to IF INPUT 1. c. The alarm lamp on the affected channel should go out.	a. Reconnect the cables to their original positions. b. Leave the switches in L position. c. Proceed to step 27.	a. Reconnect cables to original positions. b. Replace the if amplifier in the affected channel. c. Check AGC alignment of the IF amplifier. d. Reset all switches to normal. e. Reconnect to quad.
20	Precombination 9. 8-mc signal.	a. Break down to dual. b. On affected combiner, set ∅-L switch to L. c. On affected combiner, set DELAY switch to OFF. d. The alarm light should go off.	a. Set ∅-L switch to ∅. If alarm light lights go to step 21. b. If the ∅ light does not come back on, or if some other ∅ light comes on, proceed to step 22.	a. Check fuses in if and bb drawer and in Preselector and Mixer drawer. b. If fuses normal proceed to step 23 for quad receivers or step 46 for LOS receivers.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
21	Excessive drift or defective combiner.	a. Position the if and bb sub panel switch to the APC showing the alarm light.- b. On the associated 2nd mixer LO adjust the LO FREQ control. c. The APC meter should swing smoothly above and below zero and center on zero when the FREQ control is properly adjusted. d. When the meter has been centered per paragraph c the alarm light should be off.	a. Fault was excessive drift. b. Return all switches to normal positions and reconnect to quad.	a. If meter readings do not change when adjusting LO FREQ control but alarm light stays on, replace the combiner. b. If meter readings change normally but alarm light remains on, check the adjustment of ALM ADJ potentiometer. c. If alarm adjustment cannot be made, change the combiner. d. Align APC. e. Reconnect to quad.
22	Phase lock 9.8 mc	a. Perform the instructions as stated in step 17, but make frequency measurement at J1 on the 2nd LO FREQ control. b. For troubles found follow the abnormal indications columns for step 22 (this step).	Same as step 17.	a. A failure of a 2nd LO to follow a change in frequency when the alternate 2nd LO is varied is an indication that the control diode is not receiving control voltage or is defective. b. Set the sub-panel meter switch in the if and bb drawer to the APC corresponding to the suspected channel, and disconnect the APC cable from jack J3 of the associated 2nd LO. c. Vary the alternate channel 2nd LO FREQ control and observe the meter. It should swing above and below zero smoothly. d. If the meter does not swing, the combiner is bad for the channel to which the meter is set.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
22 (cont)				e. If the meter swings, use a multimeter to observe the dc voltage swing at the end of the APC cable disconnected from J3 on the 2nd LO. f. If the voltage swings at the end of the APC cable, replace the 2nd LO and filter. g. If no voltage is on the end of the cable check the cable. h. When the trouble is cured, check for phase lock and reconnect to quad.
23	9.8 MC COMBINER	a. In if and bb drawer set 0-L switches to L on both combiners. b. Disconnect cables W7 and W10 from if OUT jacks J16. c. Connect W10 to upper if amps jack J16 and W7 to lower if amp jack J16 d. The alarm lamp on the affected channel should go out.	a. Reconnect the cables to their original positions. b. Leave the switches in L positions. c. Proceed to step 24.	a. Reconnect the cables to their original positions. b. Replace the combiner that originally showed the alarm. c. Realign the APC and AGC d. Return all switches to normal and reconnect to quad.
24	9.8-mc if amplifier	a. Inside the if and bb drawer disconnect cables W4 and W5 from if amplifier input jacks J1 IN. b. Connect W4 to lower if amp J1 IN and W5 to upper if amp J1 IN. c. The alarm light on the affected channel should go out.	a. Reconnect the cables to their original positions b. Leave the switches in L position. c. Proceed to step 25.	a. Return cables to original positions. b. Replace the if amplifier in the affected channel. c. Check AGC alignment of the replaced amplifier. d. Reset all switches to normal. e. Reconnect to quad.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
25	9.8 mc 2nd mixer LO	a. Use frequency counter and BNC cable. Connect cable to jack J1 of 2nd mixer LO and measure frequency b. Set LO FREQ control so counter reads 60.2 mc.	Disconnect cable from J1 and proceed to step 26	a. Check tubes in 2nd mixer LO. If tube trouble replace tube; otherwise replace 2nd mixer LO and filter and realign. b. After realignment reconnect for quad operation. Be sure all switches are returned to normal position.
26	2nd mixer LO and filter.	a. On the front panel of the if and bb drawer, disconnect the cables from IF INPUT 1 and IF INPUT 2. b. Connect the IF INPUT 1 cable to IF INPUT 2 and the IF INPUT 2 cable to IF INPUT 1. c. The alarm light on the affected channel should go out.	a. Reconnect the cables to their original positions. b. Leave the switches in L positions. c. Proceed to step 27.	a. Replace the 2nd mixer LO and its associated filter for the affected channel. (The filter is matched to the mixer and cannot be tested separately) b. Allow warmup time and set the LO on frequency with the counter, c. Check combined operation in dual before reconnecting to quad. d. Be sure that all switches are returned to normal before connecting to quad.
27	Preselector and Mixer drawer	a. On the front panel of the Preselector and Mixer drawer, set meter switch to measure crystal current in positions G and H or I and J, according to which channel is showing the alarm indication. b. For double conversion receivers check all four readings. c. The readings should be between 15 and 75	a. Proceed to step 28 for single channel loss of signal. b. Proceed to step 41 for two channel loss of signal in dual.	a. If the readings for the affected channel are low, retune the LO chain, b. If retuning the LO chain does not work, disconnect the LO input to the mixer and try the other LO. c. If neither LO drives the mixer properly, replace the mixer. d. If the LO is not operating properly, replace the oscillator-multiplier on frequency-multiplier, according to which shows trouble.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
27 (cont)				e. For double-conversion receivers reverse the connections of the cables on the output of the power divider to check it. If power divider is normal check the cables by reversing the cable ends at the mixers. f. After curing the trouble, make sure all switches are normal and reconnect to quad.
28	Preselector Mixer or Parametric Amplifier.	a. On the Dual Parametric Amplifier front panel (or RF Panel if paramp is not used) disconnect the cables from RF OUTPUT 1 and RF OUTPUT 2. b. Connect the cable originally on RF OUTPUT 1 to RF OUTPUT 2, and the cable originally on RF OUTPUT 2 to RF OUTPUT 1. c. The alarm light on the affected channel should go out.	a. If paramp is not used, the trouble is in the waveguide adapter or the waveguide from the antenna b. If paramp is used,. realign the paramp. c. If the gain of the paramp is normal after realignment, the trouble is in the waveguide or out of the receiver cabinet. d. Reconnect for quad operation after the trouble has been corrected.	a. Check the cable feeding the RF to the preselector-mixer. b. If the cable is good, replace the preselector-mixer. c. Realign the replacement unit and reconnect for quad operation.
29	Post-combination noise.	a. In CEC, select good channel to carry traffic and set AUTO-MAN switch to MAN. b. Disconnect baseband amplifier output cable from base band amplifier of affected channel. c. Noise receiver alarm light should go out.	Reconnect output cable and proceed to step 30.	a. Noise receiver or associated circuits in CEC have failed. b. After correction of trouble reset AUTO-MAN switch to AUTO.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
30	Post-combination noise	a. Disconnect demodulator output cable. b. Noise receiver alarm light should go out.	a. If TE is used reconnect cable and proceed to step 31. b. If TE is not used replace the demodulator. c. Reset AUTO-MAN switch to AUTO.	a. The baseband amplifier is noisy or the -30 volt power supply is noisy. b. After replacing the noise module, reset the AUTO-MAN switch to AUTO.
31	Post-combination noise.	a. Disconnect the demodulator input cable. b. The noise receiver alarm light should go out.	Reconnect input cable and proceed to step 32.	a. Replace the demodulator . b. Reset AUTO-MAN switch to AUTO.
32	Post-combination noise.	a. On the TE, connect the tip jack test lead to TP2 PHASE ERROR and to TEST LEAD on the sub-panel of the drawer. Set the meter switch to TEST LEAD b. Adjust the oscillator. frequency control. Be sure that it swings the meter reading smoothly on each side of zero. Adjust it to give the same reading as last recorded. c. The noise receiver alarm light should go out.	a. Remove the tip jack test lead. b. Reset the AUTO-MAN switch to AUTO.	a. Replace the TE module. b. Realign the replacement TE. c. Reset the AUTO-MAN switch to AUTO.
33	Pre-combination noise.	a. Break down to dual. b. One of the noise receiver alarm lights should go out.	Proceed to step 34.	a. The noise receiver circuit in the CEC is defective. b. After the noise receiver circuit is returned to normal operation, reconnect to quad.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
34	Pre-combination noise.	a. In the cabinet that corresponds to the alarm condition on the noise receiver, observe the noise receiver light b. On the front panel of the if and bb drawer, disconnect the cable from IF INPUT 1. c. Reconnect the cable to IF INPUT 1 and disconnect the cable from IF INPUT 2. d. Reconnect the cable to IF INPUT 2.	If the noise receiver alarm light went out when either cable was disconnected, proceed to Step 37.	If the noise receiver alarm light did not go out at any time when cables were disconnected, proceed to Step 35.
35	Pre-combination noise, IF and BB drawer	a. Observe the noise receiver alarm light. b. In the if and bb drawer, set combiner 1 (rear) 0-L switch to L. c. Reset combiner 1 0-L switch to 0. Set combiner 20-L switch to L. d. Set combiner 1 0-L switch to L.. e. Reset both switches to 0.	a. If the noise receiver alarm light went out where either switch was in L position, proceed to Step36. b. If the alarm light went out only when both switches were in L position, proceed to Step 38.	a. If the noise receiver alarm light did not go out at any time when the switches were in L position, replace the AGC amplifier in the 70-mc receiver. b. In the 9. 8-mc receiver check the combine point cables. c. When trouble is cured, reconnect to quad.
36	Pre-combination noise, IF and BB drawer.	a. In the affected channel(from step 35) disconnect the cable from the if input jack to the if amplifier	a. Replace the 2nd mixer- LO for that channel(including filter). b. Align the new 2nd mixer. c. Reconnect to quad.	a. Replace the if amplifier for that channel. b. Align the AGC for the new IF amplifier. c. Reconnect to quad.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
37	Pre-combination noise, preselector mixer drawer.	a. In the affected channel (from Step 34), if paramp is used, place in bypass. b. The noise receiver alarm light should go out. c. Reconnect to quad.	a. Realign the paramp b. If the circuit is still noisy when paramp is aligned, check the paramp diode and replace if necessary; otherwise replace the paramp.	a. Replace the preselector mixer in single conversion receivers. b. Check the power divider in double conversion receivers by reversing the two cables on the power divider output. Replace the divider or the preselector-mixer, whichever is noisy. c. Realign the new preselector if replaced. d. Reconnect to quad.
38	Pre-combination noise, common circuit.	a. In the paramp, place both channels in bypass, b. The noise receiver alarm light should go out.	a. Check the paramp pump power circuits for noise. b. Replace modules if necessary. c. Reconnect to quad.	a. Realign the LO chain with particular attention to the offset of QUAD 1E and QUAD 2F. b. If still noisy replace, oscillator-multiplier or frequency-multiplier. c. Reconnect to quad.
39	Pre-combination noise, LOS	a. In the if and bb drawer, switch the ∅-L switch on the rear combiner to L. Observe the noise receiver alarm lights. b. Reset the rear combiner ∅-L switch ∅. Switch the ∅-L switch on the front combiner to L. Observe the noise receiver alarm lights. c. Reset the front combiner ∅-L switch to ∅. d. The noise receiver alarm lights should go off for step a or b.	a. In the CEC, set the SEL -switch to the channel where the ∅-L switch had no effect and set the AUTO-MAN switch to MAN. b. Proceed to step 40.	a. If the noise receiver lights stayed on, the trouble is in the CEC alarm or noise receiver circuits. b. Consult the CEC instruction book.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
40	Pre-combination noise LOS	a. On the bad channel, in order, disconnect and reconnect the following cables until one is found that turns off the noise receiver alarms. 1. RF INPUT to pre selector-mixer.- 2. IF INPUT to if and bb drawer. 3. IF input to if amplifier for double conversion only. 4. IF output from if amplifier. 5. Combiner input to AGC.	a. When a cable is found that turns off the noise alarm, the module that the cable came from should be replaced except for the RF INPUT cable, where the trouble could be the cable, the waveguide assembly or out of the cabinet. b. For the IF INPUT cable, check both the preselector-mixer and the LO chain before replacing either. c. Realign where necessary.(See alignment procedure.) d. Reset AUTO-MAN switch in CEC to AUTO.	a. Check for noisy power supplies and replace where necessary. b. Reset AUTO-MAN switch in CEC to AUTO.
41	Paramp pump alarm failure.	On METER 2, check BEAM VOLT, BEAM CUR, REFL VOLT, KLYST PWR (FREQ) and frequency as indicated on wavemeter WM1. IMPORTANT NOTE: If it is necessary to shut down the paramp by removal of its KLYSTRON PWR power supply for any extended length of time, the power supply bypass cable C2385875G1 should be installed so that power is available to operate the paramp bypass circuits. This cable is mounted on the back of the paramp drawer with two clips.	Alarm failure, pump circuit. Check 24V AC on meter. If normal, check interconnections.	a. If POWER SUPPLY OVER-LOAD indicator is on, try resetting POWER ON, then proceed to Step 42. b. If not, perform the following applicable steps: 1. If beam voltage, beam current and reflector voltage appear normal but no reading is obtained for(FREQ) replace CR3. 2. If beam voltage and reflector voltage appear normal, but beam current is low or zero and power is low or zero, replace klystron. Realign paramp.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
41 (cont)				3. If beam voltage, reflector voltage and beam current all appear normal but frequency is off scale, replace klystron. Realign paramp. 4. If beam voltage and beam current are normal but reflector reading is low or zero, replace reflector regulator. Realign paramp. 5. If reflector voltage appears normal, but beam voltage is low or zero and beam current is low or zero, replace beam regulator. Realign paramp. 6. If reflector voltage and beam voltage are both low or zero, but +24VDC is normal, replace paramp power supply assembly. Realign paramp. 7. If reflector voltage, beam voltage and +24 volt dc are all low or zero, replace pre-regulator. Realign paramp.
42	Paramp power supply component failure or klystron failure	Turn off POWER ON switch on paramp drawer. Remove plastic cover over terminal board TB7. Loosen the five screws holding the klystron connecting wires and take off the wires. Physically	Turn power off. Replace klystron with new one. Replace cover on TB7 and turn power back on. If overload returns replace overload interrupter relay K3 in paramp power supply.	Leave klystron disconnected, turn power off and proceed to Step 43.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
42 (cont)		separate the wires from the terminal board and replace the cover but do not tighten cover screws. Turn POWER ON switch on. Check for beam voltage and reflector voltage after time delay relay has operated (approx. 45 seconds). Overload light should not light.		
43	Paramp power supply component failure.	Replace pre-regulator and turn power on. After time delay relay operates, check for beam voltage and reflector voltage. Overload lights should not light.	Turn power off. Remove cover from TB7 and reconnect klystron wires. Replace cover, tighten down cover and turn power on. If overload light lights replace overload interrupter relay K3.	Leave klystron disconnected. Turn power off and proceed to Step 44.
44	Beam regulator	Replace beam regulator and turn power on. After time delay relay operates, check for beam voltage and reflector voltage. Overload light should not light.	Turn power off. Remove cover from TB7 and reconnect klystron wires. Replace cover, tighten down cover and turn power on. If overload light lights replace overload interrupter relay K3.	Leave klystron disconnected. Turn power off and proceed to Step 45.
45	Reflector regulator	Replace reflector regulator. Turn power on. After time delay relay operates, check for beam voltage and reflector voltage. Overload light should not light.	Turn power off. Remove cover from TB7 and reconnect klystron wires. Replace cover, tighten down cover and turn power on. If overload light lights replace overload interrupter relay K3.	Turn power off. Reconnect klystron to TB7 and make sure cover is tight over TB7. Replace power supply assembly. Return all connections for quad operation after realignment of paramps.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
46	Pre-combination signal failure line of sight.	a. In CEC, select the good channel to carry traffic and set AUTO-MAN switch to MAN. b. On the subpanel of the pre selector-mixer drawer. position the switch to OSC 1 or OSC 2, whichever is the bad channel. c. On the front panel of the preselector-mixer drawer, position the meter switch to read crystal currents of the bad channel (i.e. G-H or I-J).	a. For double conversion receivers proceed to Step 47. b. For single conversion receivers proceed to Step 51.	a. In the pre-selector-mixer drawer check the + 150 volt and + 165 volt readings on the meter using tip jack test lead. b. In single and double conversion receivers, disconnect the affected (bad) channel combiner cable marked OUT P2 from the AGC amplifier. c. In double conversion receivers, disconnect cable W14 from J8 on the two oscillator-multipliers and connect a 100 ohm termination to each jack. d.. In single conversion receivers, disconnect the cable to IF INPUT of the affected channel from the front panel of the IF and BB drawer. e. Align the LO chain of the bad channel. f. If the LO chain will not work properly, replace the bad module, crystal or cable. g. When the trouble has been cured, remove the terminations if used, connect all cables back to normal positions and check APC error. h. Reset AUTO-MAN switch in CEC to AUTO.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
47	Pre-combination signal failure	a. Use the frequency counter to measure the frequency of the 2nd LO. b. The frequency should be 60.2 mc.	a. Disconnect the counter. b. Proceed to step 48.	a. Check the fuse for the bad channel in the if and bb drawer (F1 or F2). Replace, if necessary. b. In the bad channel, disconnect combiner cable OUT P2 from the AGC amplifier. c. In the affected channel, disconnect the APC cable from J3 on the 2nd LO. d. If the 2nd LO cannot be set to 60.2 mc, replace it (with filter). e. Allow warmup time (20 minutes) and set on frequency. f. Reconnect OUT P2 cable and APC cable and check for APC error. Correct if necessary. g. Reset CEC AUTO-MAN switch to AUTO.
48	Pre-combination signal failure double conversion line of sight.	a. In the affected (bad) channel, disconnect the combiner cable marked OUT P2 from its jack on the AGC amplifier. This jack will be referred to as the open combiner jack on the AGC amplifier. b. Disconnect the AGC cable from the bad channel if amplifier jack J17. c. Place if amplifier AGC switch on INT.	a. Disconnect the if cable from the adapter on the end of the test cable and reconnect the if cable to J16 on the if amplifier. b. Proceed to Step 49.	a. Replace the combiner. b. Disconnect the test cable from the AGC and from the if output cable. c. Reconnect the IF output cable to J16. d. Return all switches in the if and bb drawer to normal; reconnect the AGC cable to J17 on the if amplifier and align the APC. e. Reset CEC AUTO-MAN switch to AUTO.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
48 (cont)		d. Use a piece of RG 59 cable (cont) with a bnc connector on each end as a test cable (approx. 2 feet). e. Connect one end of the test cable to the open combiner jack on the AGC amplifier. Put a bnc female to female adapter on the other end of the cable. f. Disconnect the cable from if OUT jack J16 and connect this cable to the test cable. g. The combiner alarm light should go out.		
49	Pre-combination signal failure double conversion line of sight.	a. Remove the adapter from the end of the test cable and connect the cable to a Kay 31-0 attenuator with 20 db attenuation. b. Disconnect the if input cable from J1 on the if amplifier. c. Connect the Kay attenuator (use a short piece of cable if necessary) to if amplifier J1 IN. d. The combiner alarm light should go out.	a. Disconnect the Kay attenuator from J1 IN on if amplifier and reconnect the if amplifier input cable to J1. b. Proceed to Step 50.	a. Disconnect the Kay attenuator from if amplifier J1 IN. b. Disconnect the test cable from open combiner jack on the AGC amplifier. c. Reconnect combiner cable OUT P2 to the open combiner jack on the AGC amplifier. d. Replace the if amplifier. e. Realign APC and AGC. f. Return all switches in if and bb drawer to normal. g. Reset CEC AUTO-MAN switch to AUTO.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
50	Pre-combination signal failure double conversion line of sight.	a. Disconnect the test cable from the open combiner jack on the AGC amplifier. Leave the Kay attenuator attached to the cable. b. On transmitter B, push AUTO-MAN SELECT to MAN. and MOD SELECT to B channel to carry traffic. c. On the 70 mc modulator in transmitter A disconnect the cable from J4 OUT. Connect decoupler A2331266G1 or B2386863 to the modulator output jack J4 OUT. e. Connect the Kay attenuator and the test cable to the decoupler. f. On the if and bb drawer disconnect the cable from the bad channel at IF INPUT on the front panel. g. With 20 db loss in the attenuator, connect the test cable to IF INPUT of the bad channel on the front panel of the if and bb drawer. h. The combiner alarm should go out.	a. Disconnect the test cable from the receiver and modulator. b. Reconnect the modulator output cable to J4 OUT in transmitter A. c. Select AUTO on AUTO- MAN SELECT switch on transmitter B. d. Reconnect the cable to IF INPUT on the front panel of the if and bb drawer of the receiver. e. Replace the preselector-mixer f. Reset AGC switch on if amplifier to EXT. g. Reconnect the AGC cable to the AGC jack on the if amplifier. h. Reconnect combiner cable OUT P2 to the open combiner jack on the AGC amplifier. i. Check for phase error. Correct if necessary. j. Reset CEC AUTO-MAN switch to AUTO.	a. Disconnect the test cable from the receiver and modulator. b. Reconnect the modulator output cable to J4 OUT in transmitter A. c. Select AUTO on AUTO-MAN switch on transmitter B d. Reconnect the cable to IF INPUT on the front panel of the if and bb drawer of the receiver. e. Replace the 2nd mixer LO. f. Reconnect combiner cable OUT P2 to the open combiner jack on the AGC amplifier and the AGC g. Perform AGC and APC alignment per alignment procedure. h. Reset CEC AUTO-MAN switch to AUTO.
51	Pre-combination signal failure single conversion line of sight.	a. In the affected (bad) channel disconnect the combiner cable marked OUT P4 from the AGC amplifier. b. Disconnect the AGC cable from the bad channel if amplifier at J18.	a. Disconnect the test cable from the if amplifier output cable and reconnect this cable to J16 OUT on the if amplifier. b. Proceed to Step 52.	a. Disconnect the test cable from the if amplifier output cable and reconnect this cable to J16 OUT on the if amplifier. b. Replace the combiner.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
51 (cont)		c In the bad channel place if amplifier AGC switch on INT. d. On transmitter B, push AUTO-MAN SELECT to MAN and MOD SELECT to B channel to carry traffic. e. On the 70 mc modulator in transmitter A, disconnect the cable from J4 OUT. f. Connect decoupler A2331266G1 or B2386863 to the modulator output jack J4 OUT. g. Connect the Kay attenuator an the test cable to the decoupler. Set the attenuator on to 0 db loss. h. On the if amplifier in the bad channel, disconnect the if output cable from J16 OUT and connect this cable to the test cable from the Kay attenuator. i. The combiner alarm light should go out.		c. Return all switches in the if and bb drawer to normal, reconnect the AGC cable to J18 on the if amplifier and align the APC. d. Reset CEC AUTO-MAN switch to AUTO. e. Disconnect the Kay attenuator and the test cable from J4 OUT on modulator of transmitter A. f. Reconnect modulator output cable to J4 OUT in transmitter A. g Select AUTO on AUTO-MAN switch on transmitter B..
52	Pre-combination signal failure single conversion line of sight.	a. On the if and bb front panel, disconnect the cable from IF INPUT of the bad channel. b. Set the Kay attenuator for 20 db of loss and connect the test cable to the open INPUT jack on the if and bb IF drawer front panel. c. The combiner alarm light should go out.	a. Disconnect the test cable and Kay attenuator from the modulator J4 OUT and from the IF INPUT jack. b. Reconnect the modulator output cable to modulator J4 OUT. c. Reset transmitter B AUTO-MAN switch to AUTO.	a. Disconnect the test cable and Kay attenuator from the modulator J4 OUT and from the IF INPUT jack. b. Reconnect the modulator output cable to modulator J4 OUT. c. Reset transmitter B AUTO-MAN switch to AUTO. d. Reconnect the if input cable to the IF INPUT jack on the front panel of the if and bb drawer.

TABLE 5-10. RECEIVER TROUBLESHOOTING CHART (cont)

Step	Probable Fault	Instructions	If Indication Is Normal	If Indication Is Abnormal
52 (cont)			d. Reconnect the IF input cable to the IF INPUT jack on the front panel of the if and bb drawer. e. Reset if amplifier AGC switch to EXT and reconnect the AGC cable to J18. f. Replace the preselector-mixer. g. Reset ∅C switch to ∅ and DELAY switch to ON. h. Reconnect combiner cable OUT P4 to the ∅C jack on the AGC amplifier. i. Reset CEC AUTO-MAN switch to AUTO.	e. Reset ∅C switch to ∅ and DELAY switch to ON. f. Replace the if amplifier. g. Reconnect combiner cable OUT P4 to the ∅C jack on the AGC amplifier. h. Realign the APC and AGC. i. Reset CEC AUTO-MAN switch to AUTO.
53	Unknown or transmitter off air at other end of link.	a. Break down to dual if quad. b. Break down to single if dual LOS. c. If alarm light pattern changes then refer to pattern for dual or single channel loss of signal.	Reconnect to quad or dual after determining that trouble is in link.	Check all meter readings, especially AGC per channel by temporarily disconnecting IF amplifier AGC cable and switching AGC switch to INT on each channel one at a time.

SECTION VI

ALIGNMENT

6-1. GENERAL.

6-2. This section contains information and procedures for the alignment of the various receiver configurations.

6-3. PRELIMINARY STEPS.

6-4. Before any alignment procedure, review the information in paragraph 5-3 and its associated tables. In addition, check table 2-1 which lists the test equipment required and table 5-8 which lists the alignment procedures used after tube or module replacement.

6-5. CALIBRATION OF HP 618 SHF GENERATOR.

6-6. This procedure is included to ensure that the signal generator is used properly. When using a two-way power divider (B2288125) together with the signal generator and its associated cable (AC-16Q or equivalent), both output ports of the power divider must be connected by equal lengths of RG214 cable to the RF INPUTS of the receiver. There will be a 3-db power splitting loss and a 0.3-db per foot cable loss (RG 214 cable) between the power divider and RF INPUT of the receiver. Set up the following equipment as described. Do not turn on until directed.

EQUIPMENT REQUIRED

SHF signal generator	HP 618B
Cable assembly (gray)	AC-16Q; if not available RG214 cable (approx. 6 ft.)
RF power meter	HP 430C
Thermistor mount	HP 477B
Female-to-male N type adapter	

a. On signal generator:

1. Attach the cable assembly to RF OUTPUT. If another 6-foot cable is used in place of AC-16Q, the calibration is valid for that cable only.
2. Set OUTPUT ATTEN TO -127 dbm (or maximum attenuation).
3. Select the receiver frequency (or other frequency of interest).
4. Set the MOD SELECTOR switch to CW.
5. Set the FM AMPLITUDE to OFF.

b. On the power meter, when using HP 477B thermistor:

1. Set BOLO TEMP COEF to NEG.
2. Set BOLO RES to 200 ohm.
3. Set RANGE to 0 DBM (1.0 MW).
4. Set BIAS CURRENT to OFF.

5. Rotate COARSE and FINE ZERO SET controls fully counterclockwise.

6. Connect the thermistor mount and the female-to-female N type adapter to BOLOMETER jack.

c. Turn on the equipment and allow 20 minutes of warm-up time.

d. Calibrate the ZERO SET and POWER SET controls on the signal generator. (Refer to Signal Generator Instruction Book.)

e. Refer to Power Meter Instruction Book and apply rf power by connecting the signal generator cable to the thermistor through the female-to-female N-type adapter.

NOTE

Since the thermistor is a temperature sensitive element, excessive temperature changes of the surroundings or excessive handling can affect the accuracy of results.

f. Make the ZERO (0 mw) adjustment on the power meter.

g. Increase the output of the signal generator by adjusting OUTPUT ATTEN until a reading of 1 mw is obtained on the power meter.

h. Adjust the POWER SET control for 0 dbm on the signal generator attenuator. Note the reading of power set meter on signal generator.

i. Set OUTPUT ATTEN to -127 DBM. The power meter should indicate 0 mw. If drift has taken place, go back to step f.

j. The power available at the end of the cable is now calibrated against the attenuator dial setting with the power set meter indicating the same value as noted in step h.

6-7. ALIGNMENT OF SINGLE CONVERSION RECEIVER (DUAL AND QUAD).

6-8. Each receiver is aligned with all the modules in their drawers and with power provided by the integral power supplies. Align each receiver as described in the following paragraphs.

6-9. RECEIVER CONVERSION PROCEDURES.

6-10. QUAD TO DUAL CONVERSION OF A QUAD RECEIVER UNDER NORMAL TRAFFIC CONDITIONS. This procedure separates a quad receiver into two separate independent dual receivers. The steps listed below should be followed in exact order to prevent possible interruption of communications. Normal traffic can be carried by the dual receiver not being aligned. Receiver A is the receiver being aligned and receiver B is the receiver not being aligned. This connotation is used throughout this paragraph. Steps a through f completely isolate dual receiver A from dual receiver B. The operator can perform any and all maintenance checks on receiver A. Receiver B should not be adjusted.

a. Set the CEC switching unit to B position and CEC AUTO-MAN switch to MAN.

b. Disconnect the IF and Baseband drawer cables from the IF INPUT 1 and IF INPUT 2 front panel jacks on receiver A.

c. Set the DUAL/QUAD switches on each agc amplifier to DUAL.

d. Disconnect the if cross-connect cable from IF OUT jack on agc amplifier of receiver B.

e. Disconnect the if cross-connect cable from IF OUT jack on agc amplifier of receiver A.

f. Reconnect the IF and Baseband drawer if input cables originally disconnected in step b.

6-11. DUAL TO QUAD INTEGRATION OF A QUAD RECEIVER UNDER NORMAL TRAFFIC CONDITIONS. This procedure integrates the two separated dual receivers into a quad receiver. Receiver B is the dual receiver carrying traffic, whereas receiver A is the dual receiver just aligned. If receiver B has just been aligned then reverse the roles of receivers A and B.

a. Disconnect the IF and Baseband drawer if input cables at the IF INPUT 1 and IF INPUT 2 front panel jacks on receiver A.

b. Note the position of the VCO switches (POS or NEG) on both phase combiners in receiver A and set both VCO switches to OFF.

c. Connect the if cross-connect cable to IF OUT on the agc amplifier in receiver A.

d. Connect the if cross-connect cable to IF OUT on the agc amplifier in receiver B.

e. Set the DUAL/QUAD switches on each agc amplifier to QUAD.

f. Set the inside panel meter switch on the IF and Baseband drawer of receiver B to TOTAL APC ERROR position.

g. Connect an oscilloscope to the APC TEST red tip jack in the phase combiner in channel B1. Observe the scope pattern which should be a straight line with perhaps some 60-cycle hum and ripple. This is the in-lock condition. Out-of-lock is indicated by a sinusoidal best frequency. An out-of-lock frequency beat may appear occasionally due to an extreme signal fade, but will immediately disappear when the received signal returns to a higher level.

h. Slowly adjust the A control on either of the oscillator-multipliers in receiver B until the TOTAL APC ERROR meter reading is zero and the scope indicates an in-lock condition. Another indication of in-lock is the ability of the APC ERROR meter reading to go back and forth through zero as the A control on the oscillator-multiplier is slowly adjusted back and forth.

i. Connect a counter through an appropriate capacitive decoupler to J8 on either oscillator-multiplier in receiver B and measure the crystal frequency on the counter.

j. Connect the counter and decoupler to J8 on each oscillator-multiplier in turn in receiver A and adjust the A control, if necessary, on each oscillator-multiplier for the same crystal frequency ± 20 cps as measured in step i for receiver B. Remove the counter and decoupler.

k. Set both receivers A and B inside panel meter selector switches in IF and Baseband drawers to APC-1 position.

l. Set the VCO switch on each phase combiner to the appropriate POS or NEG position as noted in step b.

NOTE

If the incoming carrier frequency is above the local oscillator frequency, switch to POS. If the incoming carrier frequency is below the local oscillator frequency, switch to NEG.

m. Connect channel A1 IF and Baseband drawer if input cable.

n. Adjust channel A1 oscillator-multiplier A control so that both APC 1 meter readings are the same and the scope shows an in-lock condition.

o. Set the inside panel meter selector switch in IF and Baseband drawer of receiver A to TOTAL APC ERROR.

p. Connect channel A2 IF and Baseband drawer if input cable.

q. Adjust channel A2 oscillator-multiplier A control so that the TOTAL APC ERROR meter reading is zero.

r. Check the APC 1 and APC 2 meter readings in receivers A and B. The meters should read zero ± 10. If not, disconnect the IF and Baseband drawer if input cables on receiver A and repeat steps f, g, h and steps k through q.

NOTE

Oven cycling may produce frequency drifts causing apc errors. The operator should be aware of this condition when performing the above alignment.

s. Set the CEC switching unit to the appropriate A or B position and CEC AUTO-MAN switch to AUTO.

6-12. DUAL RECEIVER A TO DUAL RECEIVER B CONVERSION UNDER NORMAL TRAFFIC CONDITIONS. This procedure permits the switchover of traffic with minimum chance of error from dual receiver B to dual receiver A enabling alignment of dual receiver B. The point of view taken here is that dual receiver A has just been aligned and that dual receiver B requires alignment.

a. Connect the IF and Baseband drawer if input cables in receiver A, and insure that the VCO switches on each phase combiner are in the appropriate POS or NEG position.

NOTE

If the incoming carrier frequency is above the local oscillator frequency, switch to POS. If the incoming carrier frequency is below the local oscillator frequency, switch to NEG.

b. Connect an oscilloscope to the APC TEST red tip jack on channel A1 phase combiner. Observe the scope pattern as per step 6-11 g for in-lock condition.

c. Set the inside panel meter selector switch in the IF and Baseband drawer of receiver A to TOTAL APC ERROR.

d. Slowly adjust the A control of either oscillator multiplier in receiver A until the panel meter reads zero. The scope should indicate an in-lock condition.

e. Set the CEC switching unit to A position. Dual receiver A is now carrying the traffic and dual receiver B is ready for alignment.

6-13. DUAL TO SINGLE CHANNEL CONVERSION OF A DUAL RECEIVER UNDER NORMAL TRAFFIC CONDITIONS. This procedure converts a standard dual receiver into one channel to be aligned. Channel 1 is designated as the channel to be aligned, with channel 2 designated as the channel that is carrying traffic. The Ancillary Equipment drawer output is carrying traffic.

a. Set the CEC switching unit to A priority.

b. Disconnect cable at the IF OUT jack on the if amplifier in channel 2.

c. Disconnect cable at the TE INPUT jack on the front panel of the Ancillary Equipment drawer and terminate the end of this cable with a 75 ohm load.

d. Connect a cable between the IF OUT jack on the if amplifier in channel 2 to the TE INPUT jack on the front panel in the Ancillary Equipment drawer.

e. Set the AGC switch on the if amplifier in channel 2 to INT.

f. Set the CEC switching unit to B priority. Channel 2 is now carrying traffic through B priority and channel 1 is ready to be aligned.

6-14. SINGLE TO DUAL INTEGRATION UNDER NORMAL TRAFFIC CONDITIONS. This procedure integrates the individual channels of a dual receiver to form the dual. Channel 1 is designated as the channel that was just aligned, and channel 2 is designated as the channel that was carrying traffic.

a. Set the CEC switching unit to A priority.

b. Disconnect the if cable between the IF OUT jack on the if amplifier in channel 2 and the TE INPUT jack on the front panel of the Ancillary Equipment drawer and reconnect the normal if cable to the Ancillary Equipment drawer.

NOTE

The 75-ohm load must be disconnected.

c. Set the AGC switch on the if amplifier in channel 2 to EXT.

d. Note the position of the VCO switch on each phase combiner and set them to OFF.

e. Connect a counter through a capacitive decoupler to J8 on the oscillator multiplier in channel 1. Measure the frequency.

f. Repeat step e for channel 2.

g. Reconnect the counter to the oscillator multiplier that was farthest away from the specified crystal frequency and adjust the A control on this oscillator multiplier so that its frequency is within $\pm$ 20 cps of the other oscillator multiplier. If the frequencies measured in steps e and f are initially within $\pm$ 20 cps of each other, then an adjustment of the A control is unnecessary.

h. Reset the VCO switch on each phase combiner to the POS or NEG position as noted in step d.

i. Set the inside panel meter selector switch in IF and Baseband drawer to TOTAL PHASE ERROR position.

j. Connect the normal if cable to the IF OUT jack on the if amplifier in channel 2.

k. Observe the TOTAL PHASE ERROR meter reading and adjust channel 1 or 2 oscillator multiplier A control for a reading of zero on the meter.

NOTE

Adjust the A control back and forth to insure that the TOTAL PHASE ERROR can go back and forth through zero. This insures that the receiver is in-lock.

6-15. CONVERSION OF NORMAL TRAFFIC FROM CHANNEL 2 TO CHANNEL 1 OF A DUAL RECEIVER. This procedure assumes that channel 1 has been aligned and that channel 2 requires alignment. This procedure also assumes that the traffic remains in the Ancillary Equipment drawer and that traffic is received through B priority.

a. Set the CEC switching unit to A priority.

b. Disconnect the if cable going from the if amplifier OUTPUT jack in channel 2 to the agc amplifier E MOD jack in the Ancillary Equipment drawer.

c. Set the AGC switch on the if amplifier in channel 2 to EXT.

d. Connect the normal if cable to the if amplifier IF OUT jack in channel 2, then immediately disconnect the if cable at the if amplifier IF OUT jack in channel 1.

NOTE

It is important to disconnect the if cables in the above mentioned order.

e. Set the AGC switch on the if amplifier in channel 1 to INT.

f. Connect an if cable between the IF OUT jack on the if amplifier in channel 1 to the TE INPUT jack on the front panel of the Ancillary Equipment drawer.

g. Set the CEC switching unit to B priority.

6-16. <u>LOCAL OSCILLATOR CHAIN ALIGNMENT UNDER NORMAL TRAFFIC CONDITIONS</u>.

6-17. Perform the procedures detailed in the following paragraphs for oscillator multiplier, frequency multiplier, and best in-lock alignments.

6-18. OSCILLATOR MULTIPLIER AND FREQUENCY MULTIPLIER ALIGNMENT.

6-19. This procedure removes one channel at a time from the receiver permitting alignment of the disconnected local oscillator chain, and also shows how the channel can be integrated back into the receiving system of a dual or quad receiver.

a. On the channel to be aligned, disconnect the cable from the IF INPUT jack at the front of the IF and Baseband drawer. Note the setting of the VCO switch on the phase combiner module in that channel and set it to OFF.

b. Set the selector switch in the Preselector and Mixer drawer to OSC 1 position for channel 1 (OSC 2 for channel 2).

c. Rotate the meter function switch to the following positions and adjust the corresponding tuning controls for a maximum indication on the front panel meter.

SWITCH POSITION	TUNING CONTROL
OSC A	A
TRIPLER B	B
BUFFER C	C
AMPL D	D1

d. Carefully readjust tuning controls A, B, C, and D1 for maximum indications on the front panel meter with the meter function switch in positions A through D respectively.

NOTE

Do not adjust control D2.

e. Rotate the meter function switch to QUAD XTAL E position. Adjust QUAD 1E control for maximum meter indication.

f. Rotate QUAD 1E control clockwise until the meter indication decreases approximately 6 per cent. This peak is very sharp, so the tuning must be offset for more stable operation.

g. Rotate meter function switch to DOUBLER XTAL F position. Adjust QUAD 2F control for maximum indication.

NOTE

It may be necessary to repeat the above step several times to obtain the absolute maximum.

h. Rotate QUAD 2F control counterclockwise until the reading decreases approximately 6 percent.

i. Set the function switch to MIXER 1 XTAL G position (MIXER 2 XTAL I for channel 2 position) and adjust G1 and G2 doubler controls for a maximum meter indication. There is considerable interaction between G1 and G2 and they must be adjusted a number of times to produce a maximum indication.

j. Adjust G3 level control so that crystal currents indicated by meter positions G and H average 50. For channel 2, meter positions I and J are applicable.

k. Measure the crystal frequency at J8 of the oscillator multiplier using a counter, converter, and the correct decoupler. The frequency must be within 250 cps of the specified crystal frequency. If the frequency does not fall within specified limits, repeat the alignment. If still not successful, replace the crystal.

l. Connect the counter through the capacitive decoupler to J8 on the oscillator multiplier of one of the remaining channels. Measure this frequency.

m. Reconnect the counter and decoupler to J8 on the oscillator multiplier of the channel being aligned.

n. Slowly adjust the A control on this oscillator multiplier until the frequency is with 20 cps of the frequency measured in step 1 on one of the remaining channels.

o. Disconnect the counter and decoupler and set the VCO switch on the phase combiner to the setting noted in step a.

p. Connect the IF and Baseband drawer IF input cable disconnected in step a.

q. Set the selector switch in the IF and Baseband drawer containing the channel being aligned to TOTAL APC ERROR.

r. Adjust the A control on the oscillator multiplier being aligned for a TOTAL APC ERROR meter reading of zero.

NOTE

To be certain that the channel has locked to the remaining channels a slow back and forth rotating of the oscillator multiplier A. control will cause the TOTAL APC ERROR meter reading to go back and forth through zero.

s. Repeat steps a through j for the remaining channels as necessary.

6-20. BEST IN-LOCK ALIGNMENT.

6-21. This procedure permits a frequency adjustment of the local oscillator chain that provides optimum frequency alignment of each local oscillator chain, thereby permitting an optimum in-lock condition.

6-22. DUAL RECEIVER. Proceed as follows:

a. Repeat paragraph 6-19, steps a through k for channel 1. Note the oscillator multiplier frequency for the peak tuned condition.

b. Repeat paragraph 6-19 steps 1 through p.

c. Repeat paragraph 6-19, steps (a) through (k) for channel 2. Note the oscillator multiplier crystal frequency for the peak tuned condition.

d. If the oscillator multiplier frequency for the peak tuned condition in channel 1 is within 250 cps of the peak tuned frequency in channel 2, then adjust each A control setting so that each oscillator multiplier frequency is midway between the peak tuned frequencies (± 20 cps) as noted in steps a and c.

e. If the peak tuned frequencies are not within ± 250 cps of each other, replace the crystal or the tubes (one by one) in the oscillator multiplier whose frequency is furthest away from the specified crystal frequency until the 250 cps frequency difference specification is met. Then repeat step d.

f. Repeat steps o through r.

6-23. QUAD RECEIVER. Proceed as follows:

a. Repeat paragraph 6-19, steps (a) through (k) for channel A1. Note the oscillator multiplier frequency for the peak tuned condition.

b. Repeat paragraph 6-19, (1) through (r).

c. Repeat steps (a) and (b) for each of the remaining three channels in turn.

d. If the peak tuned oscillator multiplier frequencies are within 250 cps of each other, then obtain an average peak tuned frequency (f_1+f_2+f_3+f_4) and proceed directly to step (h).

e. If the range of peak tuned oscillator multiplier frequencies exceeds 250 cps, then repeat paragraph 6-19, steps (a) through (k) for the channel causing the wide frequency separation. If the peak tuned frequency cannot be correctly adjusted, change the crystal and/or the tubes until the peak tuned frequency is within the 250 cps specification.

f. Repeat paragraph 6-19, (1) through (r) to re-establish the quad receiver.

g. Repeat steps (e) and (f) for each of the channels that exceeded the 250 cps difference frequency specification. Obtain a new average peak tuned oscillator multiplier frequency.

h. Disconnect the IF and Baseband drawer if input cables at the front panel of receiver B and set channel B1 and B2 phase combiner VCO switches to OFF.

i. Connect an oscilloscope to the APC TEST red tip jack on the phase combiner in channel A1.

j. Connect a counter through a capacitive decoupler to J8 of the oscillator multiplier in channel A1.

k. Set the IF and Baseband panel meter selector switch in receiver A to TOTAL APC ERROR.

l. Adjust the A control in channel A1 oscillator multiplier so that the following conditions occur:

1. The oscillator multiplier frequency approaches the average peak tuned frequency of step d or g, whichever applies.
2. The TOTAL APC ERROR does not exceed ± 20 during the A control adjustment.
3. The scope indicates an in-lock condition.

m. Slowly adjust the A control of channel A2 oscillator multiplier for zero TOTAL APC ERROR.

n. Repeat steps (1) and (m) as often as necessary to obtain the average peak tuned oscillator multiplier frequency for a zero TOTAL APC ERROR and an in-lock condition.

o. Disconnect the counter and capacitive decoupler from channel A1 oscillator multiplier, and readjust channel A1 A control for zero TOTAL APC ERROR if necessary.

p. Connect the counter and decoupler to J8 of the oscillator multiplier in channel B1.

q. Adjust channel B1 oscillator multiplier A control for the average peak tuned frequency ± 20 cps last observed in step (n). Disconnect the counter and decoupler.

r. Set the IF and Baseband drawer panel meter selector switches to APC 1 positions in receivers A and B.

s. Set the VCO switch in channel B1 phase combiner to the appropriate POS or NEG position.

t. Connect channel B1 IF and Baseband drawer if input cable to IF INPUT.

u. Adjust channel B1 oscillator multiplier A control for equal APC 1 meter readings, which should be within zero ± 15. Check scope for in-lock condition.

v. Connect the counter and decoupler to J8 on channel B2 oscillator multiplier.

w. Adjust channel B2 oscillator multiplier A control for the average peak tuned frequency (± 20 cps) and disconnect the counter and decoupler.

x. Set the channel B2 phase combiner VCO switch to appropriate POS or NEG position.

y. Set the IF and Baseband drawer panel meter selector switch in receiver B to TOTAL APC ERROR.

z. Connect channel B2 IF and Baseband drawer if input cable to IF INPUT jack.

aa. Adjust channel B2 oscillator multiplier A control for zero TOTAL APC ERROR. Check scope for in-lock condition.

bb. Check each APC 1 and APC 2 meter position in receivers A and B for a zero (+ 15) meter reading. If one of the meter readings exceeds + 15, then adjust the A control in the corresponding oscillator multiplier for a zero (+ 15) reading. If a zero (+ 15) meter reading in each of the APC 1 and APC 2 positions cannot be obtained, then the problem may be oven cycling or poor alignment. If poor alignment, repeat the entire procedure.

6-24. ALIGNMENT OF PARAMETRIC AMPLIFIER GAIN AND NOISE FIGURE MEASUREMENT.

6-25. Proceed as follows:

NOTE

Measurements or alignments other than gain and noise figure are required only when the klystron or other parts of the Dual Parametric Amplifier drawer are replaced due to failure. An actual or imminent failure can be detected through day-by-day monitoring of the Dual Parametric Amplifier meter readings.

The pump klystron frequency is checked by rotating the knob on the wavemeter in the parametric amplifier drawer until a dip is indicated on the front panel meter in PUMP FREQ (or KLYST PWP FREQ) position. The frequency should be 14, 400 ± 20 mc (4 divisions on the dial). After the reading has been obtained, offset the wavemeter knob by two turns.

For trouble-shooting and alignment details refer to paragraph 6-58.

a. On the channel to be aligned, disconnect the output of the if amplifier at J16. Also note the setting of the VCO switch on the phase combiner and set it to OFF.

b. Disconnect the receiver waveguide of the channel to be aligned at the quick-disconnect joint and connect the noise source through a 10 db waveguide attenuator.

c. Set up the remainder of the test equipment as shown in figure 6-1.

d. Turn the test equipment on, allowing 10 minutes warm-up time.

e. Set the signal generator to the correct frequency and calibrate the ZERO and POWER SET Controls.((Refer to paragraph 6-5.) With the MOD SELECTOR switch on CW, adjust the output level to -50 dbm as read on signal generator attenuator dial.

f. On the noise figure meter, adjust the front panel controls as follows: INPUT (MC) 70, NOISE SOURCE to OFF, METER FUNCTION to NOISE FIGURE.

g. Adjust the Kay attenuator for 50 db.

h. Place the NORMAL/BYPASS switch of the parametric amplifier (channel under alignment) to BYPASS.

i. On the back of the noise figure meter place the AUTO/MANUAL switch to MANUAL, adjusting the Kay attenuator to maintain the meter mid-scale. Adjust the signal generator frequency for a peak. Record the noise figure meter reading.

j. Decrease the signal generator level by 15 db.

k. Place the NORMAL/BYPASS switch to NORMAL.

l. Adjust the signal generator output level to get back the midscale reading obtained in step i. Read the attenuator dial. The reading should be 65 ± 1 dbm, equivalent to a gain of 15 ± 1 db. If obtained, proceed to step t. If not obtained, perform all following steps.

m. Set the signal generator output attenuator to -65 dbm and place the NORMAL/BYPASS switch to NORMAL.

n. After unlocking the PUMP POWER attenuator, located at the rear of the drawer, adjust the attenuator dial a fraction of a division in the required direction. (Increasing numbers mean increased pump power and therefore higher gain.)

o. Adjust the idler tuning control C for a peak on the noise figure meter.

CAUTION

If control C is difficult to turn, loosen the locking plate screws slightly.

p. Adjust the B1 and B2 pump matching controls for minimum reading on the MATCH front panel meter of the channel under alignment. Repeat the idler tuning control C peaking.

q. A midscale reading of step i on the noise figure meter corresponds at this time to a parametric amplifier gain of 15 db. If obtained, carefully lock the PUMP POWER attenuator.

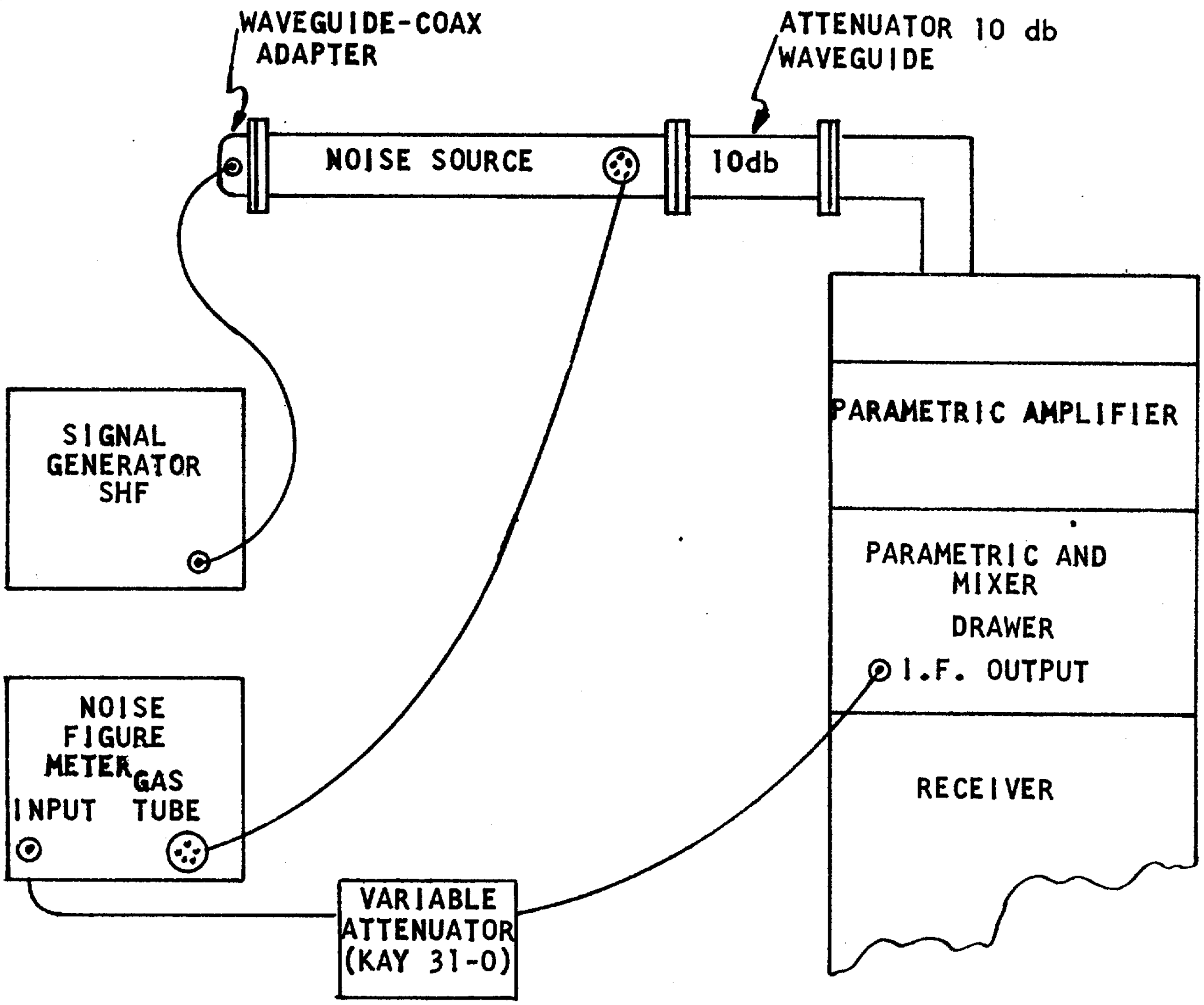


Figure 6-1. Parametric Amplifier Gain and Noise Figure Measurements Test Setup

r. If not obtained, repeat steps n through o.

s. Recheck the gain by performing steps e through 1.

t. Place the MOD SELECTOR switch on the signal generator to OFF.

u. On the noise figure meter place the AUTO/MANUAL switch to AUTO, METER FUNCTION to CURRENT - 4 MA and the NOISE SOURCE to GAS TUBE.

v. Adjust the CURRENT control for a reading of 250 ma.

w. Set the METER FUNCTION switch to ZERO and INF and adjust these controls for proper meter indications.

x. Set the METER FUNCTION switch to NOISE FIGURE and with the NOISE SOURCE switch in GAS TUBE, read the noise figure, subtracting 10 db to correct for the 10 db attenuator placed at the noise source output. The noise figure shall be 4 db maximum.

y. If not obtained, repeat the entire procedure and trouble-shoot if required.

z. Restore the channel to operating condition (refer to step a).

aa. Repeat this procedure for other channels.

6-26. ALIGNMENT OF MIXER-PREAMPLIFIER GAIN AND NOISE FIGURE MEASUREMENT (performed on all receiver configurations).

6-27. Proceed as follows:

a. On the channel to be aligned, disconnect the output of the if amplifier at J16. Also note the setting of the VCO switch on the phase combiner and set it to OFF.

b. Disconnect the receiver waveguide of the channel to be aligned at the quick-disconnect joint, and connect the noise source. Also bypass the 4.4 mc if filter using a female-to-female bnc adapter.

c. Set-up the test equipment as shown in figure 6-2.

d. Turn the test equipment ON, allowing 10 minutes warm-up time.

e. Set the signal generator to the correct frequency and calibrate the ZERO and POWER SET controls. Set the MOD SELECTOR switch to OFF.

f. On the noise figure meter:

1. Set the INPUT (MC) switch to 70.
2. To adjust the gas tube current, set the NOISE SOURCE switch to CURRENT-4MA. Adjust the CURRENT control for 250ma.
3. Set the AUTO/MANUAL on the back of the noise figure meter to AUTO.
4. Set the METER FUNCTION switch to ZERO and INF and adjust these controls for proper meter indications.

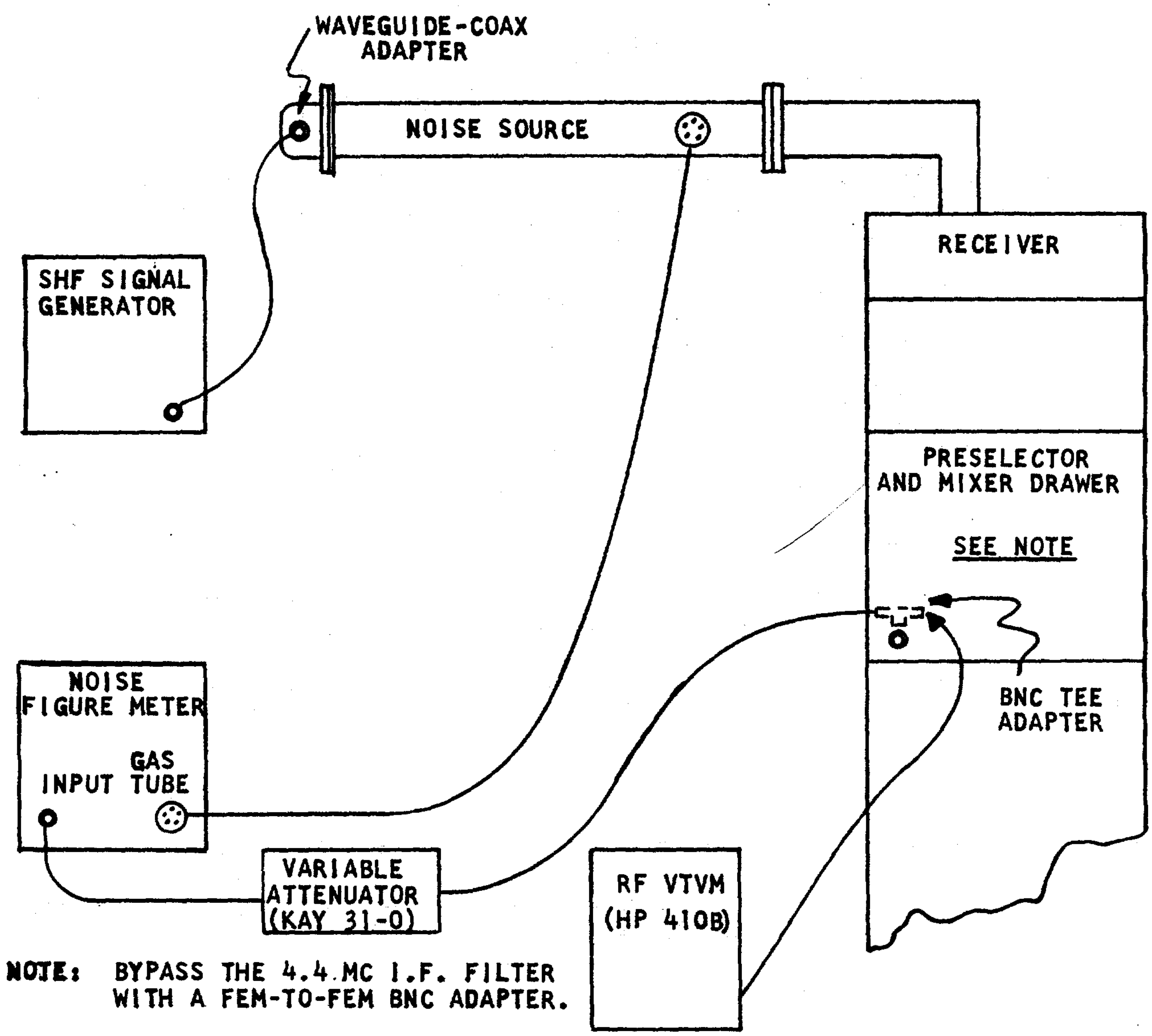


Figure 6-2. Mixer-Preamplifier Gain and Noise Figure Measurements Test Setup

g. Place the METER FUNCTION switch to NOISE FIGURE and with the NOISE SOURCE switch on GAS TUBE read the uncorrected noise figure, having performed instruction 1 or 2 given below for different receiver configurations:

1. On receiver with parametric amplifier, place the NORMAL/BYPASS switch to BYPASS and take a reading. Noise figure meter shall read 10 db maximum. To understand how this reading was obtained, see the sample calculation given below:

<u>Sample Calculation - For reference only. Do Not Perform.</u>

Required noise figure = 10 db -2 db + 3 db = 11 db.

Where: The noise figure meter reading = 10 db

Bypass cabling and switch loss = 2 db

Undesired sideband contribution =3 db

2. On receiver without parametric amplifier take a reading. Noise figure meter shall read 8 db maximum.

h. If the correct noise figure has not been obtained, resort to trouble-shooting methods.

i. Place the NOISE SOURCE switch to OFF, insert maximum attenuation on the Kay attenuator and place the AUTO/MANUAL switch on the noise figure meter to MANUAL.

j. Set the MOD SELECTOR switch on the signal generator to CW. Adjust the level as read on the attenuator dial to 5 mv (-33 dbm).

CAUTION

Make sure that the signal generator has been calibrated properly, according to paragraph 6-5.

k. Take out attenuation on the Kay attenuator and simultaneously adjust the signal generator frequency control for a peak on the noise figure meter.

l. Attach the rf vtvm to the tee connector at IF output. Zero the meter and select the 1 vrms scale.

m. On receiver with parametric amplifiers, place the NORMAL/BYPASS switch to BYPASS.

n. Read the vtvm (with the Kay attenuator set for 50 db and connected as shown in figure 6-2) the reading shall be 0.60 vrms minimum.

o. If not obtained, resort to trouble-shooting procedures.

p. When the correct gain is obtained, restore the channel to operating condition (refer to step a).

q. Repeat this procedure for other channels.

6-28. <u>AGC ALIGNMENT UNDER NORMAL TRAFFIC CONDITIONS</u>.

6-29. These procedures assume that the parametric amplifiers are aligned for 15 db $\pm$ 1 db gain.

6-30. QUAD RECEIVER.

6-31. Proceed as follows:

a. Perform the quad to dual conversion as per paragraph 6-10.

NOTE

If receiver B is to be aligned, then reverse the roles of A and B in paragraph 6-10 and in the following steps.

b. Disconnect the IF and Baseband drawer if input cable for the channel not being aligned.

c. Set the AGC switch on the if amplifier in the channel being aligned to OFF.

d. Note the setting of the VCO switch on the phase combiner in the channel being aligned. Set it to OFF.

e. Connect the signal generator to the RF INPUT of Preselector and Mixer drawer in the channel being aligned. Calibrate the signal generator and set the level to approximately -30 dbm. Refer to paragraph 6-5.

f. Temporarily disconnect the if cable of the channel being aligned at the IF OUTPUT jack in the Preselector and Mixer drawer. Connect a counter in its place.

g. Adjust the frequency of the signal generator to obtain 70 mc 0.1 mc on the counter. Disconnect the counter and reconnect the if cable.

h. Set the level of the signal generator to the low level alignment rf input level (column 2), as specified in table 6-1 for the appropriate receiver configuration.

i. Disconnect the cable at AGC IN on the if amplifier in the channel being aligned.

j. Connect the bias voltage supply to AGC IN on the if amplifier in the channel being aligned.

k. Set the bias voltage supply to the low level alignment bias voltage as specified in table 6-1 for the appropriate receiver configuration, This voltage in the stated range is identical for all if amplifiers operating in the given receiver configuration for the low level alignment.

l. Set the agc potentiometer on the if amplifier fully clockwise.

m. Connect a 75-ohm load and a 70-mc high impedance detector on a bnc tee connector to IF OUT on the agc amplifier in receiver A.

n. Set the inside panel meter selector switch in the IF and Baseband drawer of receiver A to TEST LEAD (+).

o. Connect a test lead from the 70 mc high impedance detector to the TEST LEAD (+) black tip jack.

p. Adjust the GAIN potentiometer at the input of the if amplifier for a reading of 100 on the inside panel meter.

TABLE 6-1. RECEIVER ALIGNMENT

Receiver Configuration			Low Level Alignment		High Level Alignment			Levels and Settings for Threshold Extension Alignment			
Type	PARAMP	IF Filter (4.4mc)	RF Input Level	Bias Voltage	RF Input Level	Bias Voltage	NPR Atten Setting	NPR Noise Gen. Output Level	Low Pass Filter	High Pass Filter	Slot for NPR
Dual or Quad	Yes	Yes	-79 dbm	14 ±.2 vdc	-29 dbm	4.5 ± .2 vdc	31	+2.0 dbm	300 kc	60 kc	290 kc
Dual or Quad	Yes	No	-76 dbm	14 ± .2 vdc	-26dbm	4.5 ± .2 vdc	30	+2.3 dbm	552 kc	60 kc	534 kc
Dual or Quad	No	Yes	-86dbm	14 ±.2 vdc	-36 dbm	4.5 ± .2 vdc	31	+2.0 dbm	300 kc	60 kc	290 kc
Dual or Quad	No	No	-83 dbm	14 ± .2 vdc	-33 dbm	4.5 ± .2 vdc	30	+2.3 dbm	552 kc	60 kc	534 kc

q. Set the bias voltage supply to the high level alignment bias voltage as specified in table 6-1. This voltage in the stated range is identical for all if amplifiers operating in the given receiver configuration for the high level alignment.

r. Set the level of the signal generator to the high level alignment rf input level as specified in table 6-1.

s. Adjust the agc potentiometer on the if amplifier for a reading of 100 on the inside panel meter.

t. Disconnect the bias voltage supply from AGC IN on the if amplifier and set the AGC switch to EXT.

u. Connect the normal agc cable to AGC IN on the if amplifier.

v. Observe the meter reading on the inside panel meter and adjust R15-AUTO potentiometer on the agc amplifier for a meter reading of 100.

w. Repeat steps b through u, if necessary, for the second channel of the dual receiver being aligned.

x. Remove the 75-ohm load, bnc tee and 70-mc detector.

y. If no further alignment on the quad receiver is necessary, then proceed directly to step (ac). If the remaining dual receiver requires alignment proceed as follows.

z. Disconnect the signal generator, reconnect the rf input cables, and perform the conversion as per paragraph 6-12.

aa. Repeat steps b through x for the second dual receiver.

ab. Disconnect the signal generator and reconnect the rf input cables.

ac. Perform the dual to quad conversion as specified in paragraph 6-11.

6-32. DUAL RECEIVER.

6-33. Proceed as follows:

a. Perform the dual to single channel conversion as per paragraph 6-13.

NOTE

Channel 2 is now carrying the traffic and channel 1 is ready to be aligned. If channel 2 requires alignment, then reverse the roles of channels 1 and 2.

b. Set the agc switch on the if amplifier in channel 1 to OFF.

c. Connect the signal generator to the RF INPUT of the Preselector and Mixer drawer in channel 1. Calibrate and set the signal generator level to -30 dbm. (Paragraph 6-5.)

d. Temporarily disconnect the if cable of channel 1 at the IF OUTPUT jack in the Preselector and Mixer drawer and connect a counter in its place.

e. Adjust the frequency of the signal generator to obtain 70 mc ± 0.1 mc on the counter. Disconnect the counter and reconnect the if cable.

f. Set the level of the signal generator to the low level alignment rf input level, table 6-1, for the appropriate receiver configuration.

g. Disconnect the cable at AGC IN of the if amplifier in channel 1.

h. Connect the bias voltage supply to AGC IN of the if amplifier in channel 2.

i. Set the bias voltage supply to the low level alignment bias voltage, as per table 6-1, for the appropriate receiver configuration. This voltage in the stated range is identical for all if amplifiers operating in the given receiver configuration for the low level alignment.

j. Set the age potentiometer on the if amplifier in channel 2 fully clockwise.

k. Set the inside panel meter selector switch in the IF and Baseband drawer to TEST LEAD (+).

l. Connect a test lead from the rf tip jack on 'the age amplifier to the TEST LEAD (+) black tip jack.

m. Adjust the GAIN potentiometer at the input of the if amplifier in channel 1 for a reading of 100 on the inside panel meter.

n. Set the bias voltage supply to the high level alignment bias voltage, table 6-1.

o. Set the signal generator to the high level alignment rf input level as per table 6-1.

p. Adjust the agc potentiometer on the if amplifier in channel 1 for a reading of 100 on the inside panel meter.

q. Disconnect the bias voltage supply from AGC IN and set the AGC selector switch to EXT. on the if amplifier in channel 1.

r. Connect the normal agc cable to AGC IN on the if amplifier in channel 1.

s. Observe the meter reading on the inside panel meter and adjust R15 potentiometer on the agc amplifier for a meter reading of 100.

t. If no further alignment on the dual receiver is necessary, then proceed directly to step y. If channel 2 requires alignment, then proceed as follows.

u. Disconnect the signal generator and reconnect the rf input cables.

v. Perform the conversion as per paragraph 6-15.

w. Repeat steps b through s for channel 2.

x. Disconnect the signal generator and reconnect the rf input cables.

y. Perform the single to dual conversion as per paragraph 6-14.

6-34. APC ALIGNMENT UNDER NORMAL TRAFFIC CONDITIONS.

6-35. These procedures assume that the agc has been aligned. For this alignment the HP 618B signal generator must provide a stability of ± 100 kc or better. If the HP 618B generator fails to provide this stability, then a translation oscillator in conjunction with one of the transmitters may be used. Also, the received signal itself, if greater than 6 db above threshold, may be used.

6-36. QUAD RECEIVER

6-37. Proceed as follows:

a. Perform the quad to dual conversion as per paragraph 6-10.

b. Disconnect the IF and Baseband drawer if input cable for the channel not being aligned.

c. Set the inside panel meter selector switch in the IF and Baseband drawer to the APC position corresponding to the channel being aligned.

d. Connect the signal generator to the RF INPUT of the Preselector and Mixer drawer for the channel being aligned. Calibrate (refer to paragraph 6-5) and set the level to approximately -30 dbm.

e. Temporarily disconnect the if cable of the channel being aligned at the IF OUTPUT jack in the Preselector and Mixer drawer and connect in its place a counter.

f. Adjust the frequency of the signal generator to obtain 70 mc ± 0.05 mc on the counter. Disconnect the counter and reconnect the if cable.

g. Adjust the Ø-ADJ capacitor in the phase combiner of the channel being aligned for a zero APC meter reading.

h. Repeat steps b through g if necessary for the second channel.

i. At this point, if the phase alarm requires alignment, then perform paragraph 6-43.

j. At this point, if the level alarm requires alignment, then perform paragraph 6-46.

NOTE

Phase or level alarm alignment is not generally required unless the phase combiner or AGC module is replaced. Further, note that the received signal cannot be used for phase alarm alignment unless it is nearly constant (does not exhibit troposcatter fades) and is at least 6 db above single channel threshold without threshold extension. In addition, level alarm alignment must be accomplished with the HP 618 B signal generator or the transmitter and translation oscillator set-up.

k. If no further alignment on the quad receiver is necessary, then proceed directly to step o. If the remaining dual receiver requires alignment, then proceed as follows.

l. Disconnect the signal generator and reconnect the normal rf input cables.

m. Perform the receiver conversion as specified in paragraph 6-12.

n. Repeat steps b through j for the second dual receiver.

o. Disconnect the signal generator and reconnect the rf input cables,

p. Perform the dual to quad conversion as specified in paragraph 6-11.

6-38. DUAL RECEIVER.

6-39. Proceed as follows:

a. Perform the dual to single channel conversion as per paragraph 6-13.

NOTE

Channel 2 is now carrying traffic and channel 1 is ready to be aligned.

b. Connect the signal generator to the RF INPUT of Preselector and Mixer drawer for channel 1. Calibrate (as per paragraph 6-5) and set the level to approximately -30 dbm.

c. Temporarily disconnect the if cable of channel 1 at the IF OUTPUT jack on the Preselector and Mixer drawer and connect in its place a counter.

d. Adjust the frequency of the signal generator to obtain 70 mc ± 0.05 mc on the counter. Disconnect the counter and reconnect the if cable.

e. Set the inside panel meter on the IF and Baseband drawer to APC-1 position.

f. Adjust the Ø -ADJ capacitor in the phase combiner of channel 1 for a zero APC-1 meter reading.

g. If no further alignment on the dual receiver is required, then proceed directly to step k. If channel 2 requires alignment, then proceed as follows.

h. Disconnect the signal generator and reconnect the normal rf input cable.

i. Perform the receiver conversion as per paragraph 6-15.

j. Repeat steps b through f for channel 2.

k. Disconnect the signal generator and reconnect the normal rf input cable.

l. Perform the single to dual integration as per paragraph 6-14.

6-40. ALARM ALIGNMENT UNDER NORMAL TRAFFIC CONDITIONS.

6-41. This procedure assumes that the apc and agc for the dual or quad receivers have been aligned. For a quad receiver alignment the HP 618B signal generator must provide a stability of + 100 kc or better. If the HP 618B signal generator fails to provide this stability, then a translation oscillator in conjunction with one of the receivers must be used. Also, the received signal itself can be used for the quad phase alarm alignment if it is nearly constant in level and at least 6 db above single channel receiver threshold without the threshold extension. The quad level alarm alignment must use the generator or the transmitter and translation oscillator combination. For a dual receiver the phase alarm alignment must use the received signal, whereas the level alarm alignment does not require any external generators.

6-42. PHASE ALARM.

6-43. QUAD RECEIVER. Proceed as follows:

a. Perform the quad to dual conversion as per paragraph 6-10.

b. Set the inside panel meter for the dual receiver being aligned to APC 1 position.

c. Connect the signal generator to both rf inputs of the Preselector and Mixer drawer through a power divider.

d. Calibrate (refer to paragraph 6-5) and set the receiver input level to approximately -30 dbm.

e. Temporarily disconnect one of the if cables of the dual receiver being aligned at the IF OUTPUT jack in the Preselector and Mixer drawer and connect a counter in its place.

f. Adjust the frequency of the signal generator to obtain 70 mc $\pm$ 0.10 mc on the counter. Disconnect the counter and reconnect the if cable.

g. Connect an oscilloscope to the APC TEST red tip jack in channel A1 phase combiner in the dual receiver being aligned and observe the scope pattern for an in-lock condition.

h. Set the DELAY switch on both phase combiners to OFF.

i. Connect a dc vtvm to the ALM DC blue tip jack in channel A1 phase combiner. This dc vtvm is used to aid the alignment by noting the dc voltage at which alarming occurs.

j. Slowly vary channel A1 oscillator multiplier A control and observe both the APC 1 meter reading on the inside panel meter and the dc alarm voltage.

k. As the APC 1 meter reading increases (positively or negatively) the dc alarm voltage should drop very slightly. Continue turning the A control until the alarm light for channel A1 turns ON. Note the dc alarm voltage reading at the point of alarm and use this level as an aid in alignment.

NOTE

> The alarm light for channel A2 may turn ON before the alarm light for channel A1. Disregard this indication at this time and continue the A control variation observing the channel A1 alarm light.

l. Observe the APC 1 reading with the alarm light turned ON in channel A1.

m. Repeat steps j, k and 1 but adjust channel A1 oscillator multiplier A control in the opposite direction. The APC 1 meter reading should swing back through zero to the opposite polarity observed in step k. The dc alarm voltage should first increase and decrease and, when the alarm light turns ON, should read the same as the dc alarm voltage reading noted in step k.

n. If the APC 1 meter readings observed in steps l and m read +50 +5 and -50 ,5 at the point when the alarm lights turned ON then the phase alarm for this phase combiner is properly aligned. Therefore, proceed directly to step p.

o. If the APC 1 meter readings were not +50 ± 5 and -50 ± 5, then alternately adjust channel A1 phase combiner QUAD ADJ capacitor and Ø -ALARM ADJ potentiometer until these readings are obtained.

p. Set the inside panel meter selector switch to TOTAL APC ERROR and adjust channel A1 oscillator multiplier A control for a zero apc meter reading.

q. Repeat steps b through p for channel A2 if necessary.

NOTE

These steps need to be repeated for channel A2 only if channel A2 phase combiner is replaced or if a misalignment is suspected.

r. If the second dual receiver does not need be aligned, proceed directly to step v. Otherwise continue as follows.

s. Disconnect the signal generator and reconnect the normal rf cables.

t. Perform the receiver conversion as specified in paragraph 6-12.

u. Repeat steps b through q for the second dual receiver.

v. Disconnect the signal generator and reconnect the normal rf cables.

w. Perform the dual to quad conversion as specified in paragraph 6-11.

6-44. DUAL RECEIVER. The signal used in the phase alarm alignment is the received signal. Since a dual receiver is used on line-of-sight links only, it is assumed that the received signals are of relatively constant level and at least 6 db above single channel receiver threshold. The normal dual receiver configuration is maintained throughout this alignment.

a. Connect an oscilloscope to the apc red tip jack on channel A1 phase combiner and observe the scope for an in-lock condition.

b. Set the inside panel meter selector switch to APC 1 position and connect a dc vtvm to the ALM DC blue tip jack on channel A1 phase combiner.

c. Set the ALM DELAY switch on each phase combiner to OFF.

d. Slowly adjust the A control on either oscillator multiplier. Check the APC 1 meter reading, the dc vtvm, and the alarm light for channel A1.

e. As the APC 1 meter reading increases (positively or negatively) the dc alarm voltage should drop very slightly. Continue turning the A control until the alarm light for channel A1 turns on. Insure an in-lock condition.

NOTE

The alarm light for channel A2 may turn ON before the alarm light for channel A1. Disregard this indication at this time and continue the A control variation observing the channel A1 alarm light.

f. Observe the APC 1 meter reading and dc alarm voltage, when the alarm light turns on in channel A1.

g. Repeat steps d, e and f but turn the same oscillator multiplier A control in the opposite direction. The APC 1 meter reading should swing back through zero to the opposite polarity observed in step f. The dc alarm voltage should first increase, then decrease, and, when the alarm light in channel A1 again turns on, should read the same as the dc alarm voltage noted in step f.

h. If the APC 1 meter readings observed in steps f and g read +50 ±5 and -50 ±5 at the point when the alarm light turned on then the phase alarm for the combiner in channel A1 is properly aligned. Therefore, proceed directly to step j.

i. If the APC 1 meter readings were not +50 + 5 and -50 + 5, then alternately adjust channel A1 phase combiner QUAD ADJ capacitor and Ø -ALARM ADJ potentiometer until these readings are obtained.

j. Set the inside panel meter selector switch in the IF and Baseband drawer to TOTAL APC ERROR and adjust the A control on the same oscillator multiplier for a zero APC meter reading.

k. Set the inside panel meter selector switch to APC 2 position and repeat steps a through j for channel A2.

NOTE

The A control on the same oscillator multiplier as for channel A1 alignment can be used for channel A2 alignment. The only requirement is that the in-lock condition be maintained.

l. Disconnect the oscilloscope and dc vtvm and set the ALM DELAY switches to ON.

6-45. LEVEL ALARM.

6-46. QUAD RECEIVER. Proceed as follows:

a. Perform the quad to dual conversion as per paragraph 6-10.

b. Disconnect both receiver waveguide rf inputs at the quick-disconnect joints for the dual receiver being aligned.

c. Connect a signal generator to the rf input of the Preselector and Mixer drawer of the channel not being aligned.

d. Calibrate (refer to paragraph 6-5) and set the input level to approximately -30 dbm.

e. Temporarily disconnect the if cable at the IF OUTPUT jack of the channel not being aligned on the Preselector and Mixer drawer and connect a counter in its place.

f. Adjust the frequency of the signal generator to obtain 70 mc ± 0.05 mc on the counter. Disconnect the counter and reconnect the if cable.

g. Set the signal generator level for an rf input level as per the low level alignment rf input level in table 6-1 for the appropriate receiver configuration.

h. Connect a dc vtvm to the ALM DC blue tip jack on the phase combiner of the channel being aligned.

i. Set the Ø-L switch on the phase combiner in the channel being aligned to L position and the DE LAY switch to OFF.

j. Momentarily disconnect the IF and Baseband drawer if input cable on the channel not being aligned and connect a 75 ohm-load to J3 on the age amplifier.

k. On the top of the IF and Baseband drawer unscrew the four captive screws securing the left plate and raise the plate exposing the top of the phase combiners.

l. If the alarm light (in the channel being aligned) is on then adjust R20 potentiometer (located on top of the phase combiner through one of the three exposed cover holes) clockwise until the alarm light turns off. Then adjust R20 counterclockwise until the light turns ON. If the alarm light is OFF then adjust R20 until the light turns ON. Note the ALM DC vtvm reading at which the alarm light turned ON.

m. Reconnect the if cable disconnected in step j.

n. Adjust R20 in the phase combiner in the channel being aligned for an ALM DC vtvm reading that is as close as possible to 20 per cent below the dc vtvm reading for the alarm light to turn on or off as noted in step r. For example, if the dc vtvm reading noted in step 1 is +0.5 vdc then adjust R20 for the dc vtvm reading of +0.4 vdc (20 per cent below +0.5 vdc) or as near +0.4 vdc as possible.

o. Reset the Ø -L switch back to Ø position and the delay switch back to ON.

p. Repeat steps c through o for the second channel if necessary.

q. Reconnect the left plate in the IF and Baseband drawer originally disconnected in step k.

r. Disconnect the signal generator and reconnect the normal rf cable. Remove the 75-ohm load at J3 on the agc amplifier and set the delay switch back to ON.

s. Reconnect the receiver waveguide rf inputs at the quick-disconnect joints.

t. If no further alignment is required on the quad receiver, proceed directly to step w. If the remaining dual receiver requires a level alarm alignment, proceed as follows.

u. Perform the receiver conversion as per paragraph 6-12.

v. Repeat steps b through s for the second dual receiver.

w. Perform the dual to quad integration as per paragraph 6-11.

6-47. DUAL RECEIVER. Proceed as follows:

a Perform the dual to single channel conversion as per paragraph 6-13.

b. Disconnect the rf input to channel 1 by disconnecting the waveguide quick-disconnect at channel 1 input.

c. Connect a dc vtvm to channel 1 phase combiner ALM DC (blue tip jack).

d. Set the Ø -L switch on channel 1 phase combiner to L position and set the DELAY switch to OFF.

e. On top of the IF and Baseband drawer, unscrew the four captive screws securing the left plate and raise the plate exposing the top of the phase combiners.

f. If the alarm light for channel 1 is on, adjust R20 potentiometer (located on top of the phase combiner through one of the three exposed cover holds). Turn clockwise until the alarm light turns off. Then adjust R20 counterclockwise until the light turns on. If the alarm light is off, then adjust R20 until the light turns on. Note the ALM DC vtvm reading at which the alarm light turns on.

g. Adjust R20 counterclockwise until the ALM DC voltage is 10 per cent below the dc voltage noted in step f. For example, if the dc voltage noted in step f is +0.5 vdc then R20 is adjusted for +0.45 vdc, which is 10 per cent below +0.5 vdc.

h. On channel 1 phase combiner, set the DELAY switch back to ON and the Ø -L switch to Ø.

i. Reconnect the receiver waveguide rf input at the quick disconnect joint of channel 1.

j. If the second channel requires alignment, proceed to step k. If no further alignment is required, proceed to step m.

k, Perform the receiver conversion as per paragraph 6-15.

l. Repeat steps b through i for channel 2.

m. Perform the single to dual integration as per paragraph 6-14.

6-48. <u>THRESHOLD EXTENSION ALIGNMENT UNDER NORMAL TRAFFIC CONDITIONS</u>.

6-49. This alignment procedure assumes that the receiver agc and receiver and test transmitter baseband gains are aligned. For a complete alignment the threshold extension must be aligned with the translation oscillator and transmitter test system. Further, this procedure assumes that the threshold extension in dual receiver A is being aligned.

6-50. THRESHOLD EXTENSION FREQUENCY CHECK.

6-51. Proceed as follows:

a. Once the threshold extension has been aligned, normal day-to-day checks require that the threshold extension phase error be periodically checked to insure that threshold extension frequency drifts do not degrade threshold extension operation. Set the inside panel meter selector switch in IF and Baseband drawer to TEST LEAD (-).

b. Connect a short jumper lead from the PHASE ERROR (blue tip jack) on the threshold extension to the TEST LEAD (-) (black tip jack) near the inside panel meter.

c. Observe the meter reading and adjust the OSC FREQ control, if necessary, on the threshold extension so that the meter reading corresponds to the reading on the decal on the threshold extension.

d. Disconnect the test lead.

6-52. QUAD OPERATION.

6-53. Proceed as follows:

a. Perform the quad to dual conversion as per paragraph 6-10.

b. Connect one of the translation oscillator outputs to the rf input jack on channel A1 of the Preselector and Mixer drawer.

c. Set the translation oscillator test system for an output level greater than -35 dbm into the receiver.

d. Disconnect the IF and Baseband drawer if input cable for channel A2.

e. Connect the npr test equipment to the test transmitter baseband input and receiver A baseband output as illustrated in figure 6-3. (Refer to TM 11-6625-1565-14-1 for npr test set)

f. Insure that the correct low pass and high pass filters, as per table 6-1, are in the npr noise generator for the appropriate receiver configuration.

g. Insure that the npr noise generator is set to the correct output level and that the attenuator in the filter unit is set to the correct attenuation as per table 6-1.

h. Set the inside panel meter to TEST LEAD (-) and connect a test lead from the threshold extension phase error blue tip jack to the test lead (-) black tip jack.

i. Bypass the threshold extension by disconnecting the short jumper cable at DEMOD-TE BNC jack on the agc amplifier in dual receiver A and connecting a BNC cable from DEMOD-TE jack directly to the DEMOD IF input jack.

j. Measure the npr in the appropriate slot, as per table 6-1, for the appropriate receiver configuration.

k. Set the threshold extension GAIN potentiometer to maximum clockwise position and adjust the threshold extension potentiometer for a zero threshold extension phase error meter reading.

l. Disconnect the if cable that bypassed the threshold extension in step i and reconnect the normal short jumper if cable to DEMOD-TE on the agc amplifier and the normal if cable to the IF IN jack on the demodulator to put the threshold extension back in the signal path.

m. Observe the threshold extension phase error meter reading and the npr. Adjust the OSC FREQ control on the threshold extension for best npr in the correct slot. The npr should come within 1 db of the npr obtained in step j. without threshold extension.

n. Slowly adjust the threshold extension GAIN counterclockwise and observe the change in npr.

o. Readjust the threshold extension OSC FREQ control for the best npr as was obtained in step m.

p. Continue alternately adjusting the GAIN pot and OSC FREQ control until any further counterclockwise rotation of the GAIN potentiometer cannot be fully compensated by the OSC FREQ control to bring the npr back to the value measured in step m.

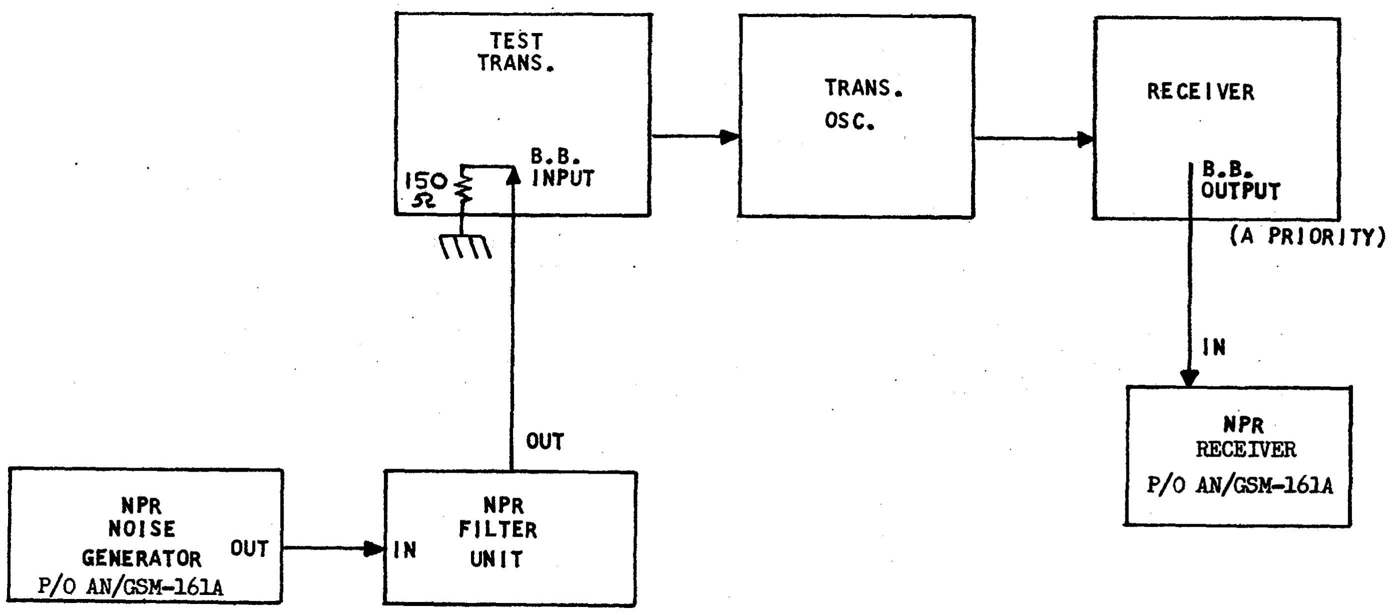


Figure 6-3. Threshold Extension Test Setup

q. Disconnect the short cable from DEMOD-TE on the agc amplifier and readjust the threshold extension BAL control, if necessary, for a zero threshold extension phase error meter reading.

r. Reconnect the short cable back to IF OUT on the age amplifier.

s. Readjust threshold extension GAIN and OSC FREQ control so that the GAIN control is as far counterclockwise as possible with the no degradation in npr from the value measured in step j.

t. Disconnect the transmitter and translation oscillator test system and reconnect the normal rf input cables on the Preselector and Mixer drawer.

u. Disconnect the npr equipment and the 150-ohm load from the test transmitter and receiver A and reconnect the normal cables.

v. Reconnect the IF and Baseband drawer if input cable in channel A2.

w. If the threshold extension in the second dual receiver requires alignment, perform the receiver conversion as per paragraph 6-12 and repeat steps b through v for dual receiver B. If the second threshold extension does not require alignment proceed directly to step x.

x. Perform the dual to quad integration as per paragraph 6-11.

6-54. INITIAL ADJUSTMENT OF RECEIVER BASEBAND LEVEL.

6-55. This adjust falls essentially in the category of system alignment. It is to be performed only as a result of module replacement (see table 5-8) and then only with system control approval.

NOTE

When performing this adjustment on a line-of-sight receiver, bear in mind that receiver A is equivalent to channel 1 and receiver B is equivalent to channel 2.

a. Calibrate and set the frequency selective voltmeter as follows:

Line impedance	600 ohms
Bandwidth	250 cps
Frequency	4-kc

b. Using the frequency selective voltmeter, measure the 4-kc pilot tone at the XMT MON jack on the central equipment cabinet. The level should be 2.4 mv. Make no adjustments at this time if this level is not obtained. For the purpose of this adjustment, record the level obtained.

c. On mod (rf) switchover drawer place the SELECT switch to the transmitter to carry traffic and the AUTO/MANUAL switch to MANUAL.

d. On the transmitter not carrying traffic, disconnect the output of the 70-mc modulator at J4.

e. On jack J4 place the capacitive decoupler (A2331266), followed by a length of RG 59 cable, and the Kay attenuator. (The decoupler is used to lower the modulator output to a level which does not exceed the attenuator rating.)

f. Terminate the Kay attenuator with a 75-ohm BNC termination, using a tee BNC adapter.

g. Connect the rf vtvm to the tee adapter and adjust the attenuator to obtain 0.35 ± 0.05 vrms on the vtvm.

h. Remove the vtvm, tee and the 75-ohm termination.

i. Select receiver B to carry traffic by placing the switches on the central equipment cabinet switching unit to MAN SEL B.

j. On receiver A disconnect the input to the 70-mc demodulator at J1 (on receivers using threshold extension, disconnect at J1 of the threshold extension) and through a length of RG 59 cable, connect the Kay attenuator to J1.

k. Using the frequency selective voltmeter, measure the 4-kc pilot tone at the RCVR A MON jack on the central equipment cabinet. The level shall be 5 times the level obtained in step b. If required, adjust the receiver A baseband amplifier GAIN control.

l. Restore the receiver A connection broken in step j.

m. Repeat steps i through 1 for the other receiver.

6-56. ADJUSTMENT OF RF BANDPASS FILTER (PRESELECTOR).

6-57. This alignment is performed only for:

a. Initial shelter check-out.

b. New unit installation.

c. Annually, as routine maintenance.

d. As required, when a malfunction is suspected.

NOTE

Setting the preselector controls according to the calibration information provided will normally produce satisfactory results. Therefore, steps h, i, and k can be omitted unless the noise figure as specified in step j cannot be obtained. In this case, the operator may use the entire procedure to obtain acceptable performance until the faulty preselector can be repaired or replaced.

The noise figure measured at the shelter port is also a function of receiver cabinet performance.

a. Locate the rf bandpass filter (preselector) calibration curves in the manufacturer's instruction books. The preselectors are serialized. Use the correct book for the unit to be adjusted.

b. Unlock the micrometer of the preselector to be adjusted and set it to the number obtained from the calibration curve for the correct receiver frequency. (One type of preselector has four micrometer controls which are located under separate covers. These will have to be removed for the adjustment.)

c. The noise figure measurement is made outside the shelter.

CAUTION

When working on channels which use ports B or D (waveguide runs with circulator), turn off the 1 kw power amplifier (in 1 watt shelters, the transmitter) feeding the port to be used. Advise the adjoining station of this fact.

d. Shut off the output of the pressurizer-dehydrator associated with the waveguide(s) under test by closing the applicable outlet valve.

e. Disconnect the external waveguide to provide access to the port.

f. Set up the test equipment according to figure 6-4.

g. Allow 10 minutes warm-up time and calibrate the noise figure meter.

h. Set up the multimeter inside the shelter, using the 1 milliampere scale. Connect it in the most convenient way to RECORDER OUTPUT jack on the back of the noise figure meter.

i. Adjust the preselector micrometer(s) for a minimum noise figure. This corresponds to a minimum reading on the multimeter.

j. Noise figure shall be:

1. 6 db maximum on receivers with parametric amplifiers (Subtract 10 db to correct the reading for the 10 db waveguide attenuator.)
2. 13 db maximum on receivers without parametric amplifiers.

k. Record the new micrometer setting. If this new setting corresponds to a frequency, which is more than 5-mc away from the receiver operating frequency, repeat the adjustment.

l. Lock the micrometer(s), making certain that the multimeter reading is not affected during this process. (If applicable, replace the micrometer covers.)

m. Restore the channel to operation.

n. Repeat the procedure for other channels.

6-58. DUAL PARAMETRIC AMPLIFIER KLYSTRON CHECK, REPLACEMENT, AND TUNING.

6-59. The dual parametric amplifier is delivered with a new klystron installed. Since the life of the klystron (depending on the model used) varies from 500 to 5000 hours, periodic checks are required and resulting meter readings should be recorded. Klystron failure is preceded by symptoms of a noticeable frequency shift and reduced power output occurring over a period of several days.

6-60. KLYSTRON CHECK.

6-61. When in doubt about the performance of the klystron, periodically check and record the following:

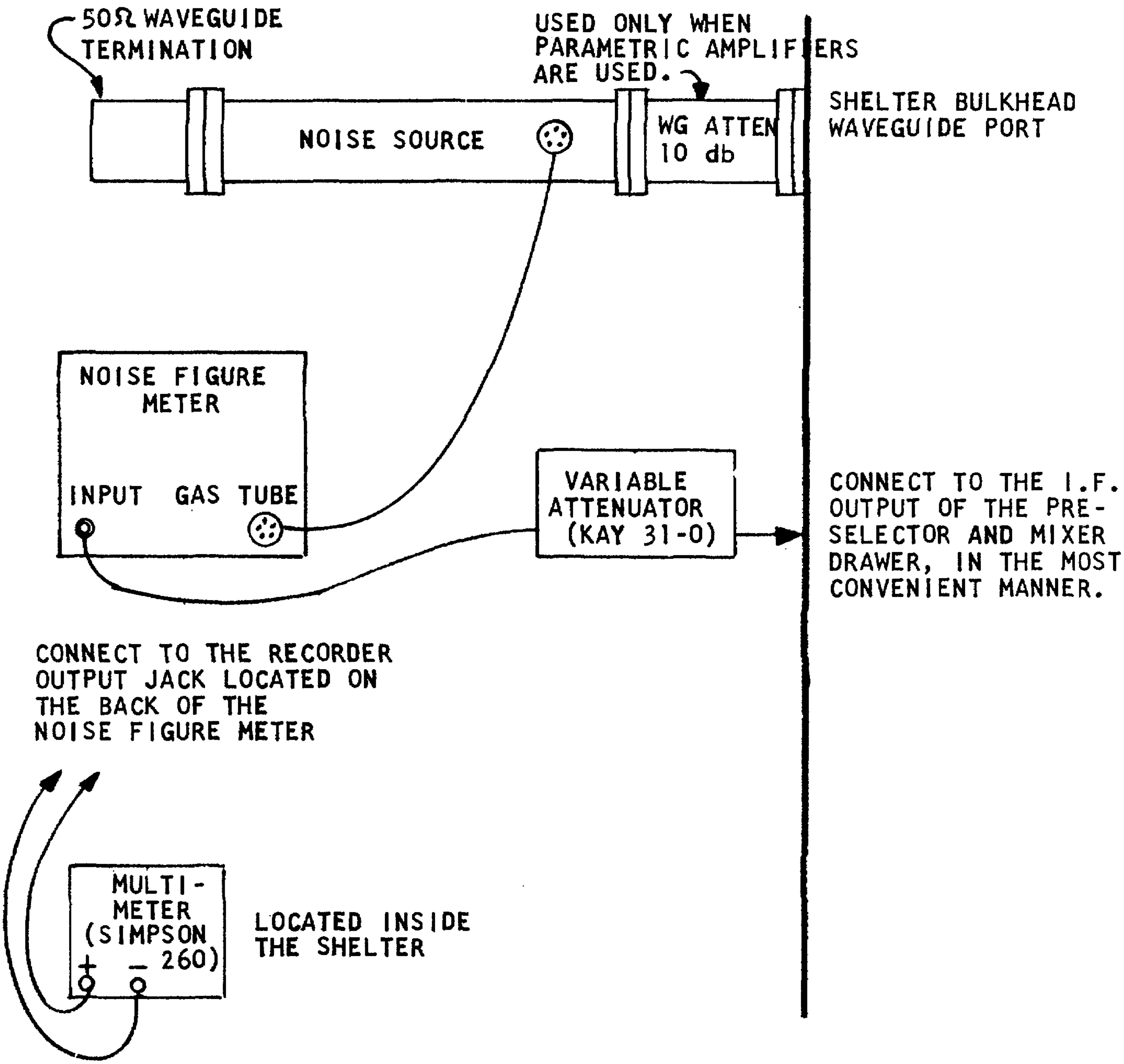


Figure 6-4. Receiver Preselector Adjustment Test Setup

Check	Meter Position
Klystron Power	PUMP FREQ on S3 (or KLYST PWR (FREQ) on S3)
Klystron Frequency	PUMP FRE Q on S3 (or KLYST PWR (FREQ) on S3) using wavemeter
Klystron Current	BEAM CURR on S3
Klystron running time (from station log)	________________________
Change in klystron power with reflector voltage	________________________

NOTE

A shift in supply voltages (mainly the reflector voltage) causes a frequency shift and also a decrease of. klystron output power. If the output power can be restored by varying the reflector voltage, it indicates a drift of voltages in the klystron power supply. The supply should be investigated and replaced, if necessary.

A degradation in klystron power noticeable over a time interval of a few hours justifies the replacement of the klystron.

6-62. KLYSTRON REPLACEMENT.

6-63. Follow this procedure for installation of a new klystron.

WARNING

High voltages are present. Never remove any terminals from the klystron when power is on. As soon as the POWER ON switch is pushed, the reflector voltage (up to 1000 volts) is present in the klystron circuit even before the time delay relay applies the beam voltage.

a. Turn off power by pushing POWER ON switch.

b. Turn the outer ring of klystron quick disconnect counterclockwise (lift lock if engaged) and remove klystron from the waveguide assembly.

c. Hold klystron firm and remove thermistor, ground lead and power connectors. For ease in removal and replacement of power connectors fold back rubber sleeve portion covering reflector and base portion of klystron.

NOTE

For installation of new klystron reverse above procedure. Be careful not to touch or damage the mica window.

d. Make sure klystron flange is lined up with waveguide assembly and tighten ring on waveguide quick disconnect, turning it clockwise.

e. Check thermistor and ground lead. The heat sensing surface should sit firmly against the klystron body.

6-64. KLYSTRON TUNING.

6-65. Klystron tuning is accomplished by a screwdriver adjustment on the klystron cavity using the wavemeter in the dual parametric amplifier drawer as follows:

a. Apply power to the dual parametric amplifier drawer and allow 20 minutes for warmup.

NOTE

Approximately 45 seconds after turn-on, the time delay relay in the power supply applies the beam voltage in the klystron.

b. Rotate selector switch S3, on the front panel to BEAM V position. METER 2 should indicate 50 ± 10 division.

c. Rotate selector switch S3 to BEAM CUR position. METER 2 should indicate 50 ± 10.

d. Rotate selector switch S3 to RE FL V position. METER 2 should indicate 50 ± 10.

e. Rotate selector switch S3 to the PUMP FREQ position and adjust REFL VOLT ADJ control on the REFLECTOR REGULATOR (located on the transistorized klystron power supply) for maximum reading on METER 2.

f. Slowly tune wavemeter until a dip is obtained on METER 2. Wavemeter should indicate 14.4 gc ± 20 mc which corresponds to 4 divisions).

NOTE

If wavemeter does not indicate 14.4 gc perform step g.

g. As required, alternately increase or decrease klystron frequency with cavity adjustment screw and tune wavemeter for dip on METER 2 until a frequency reading of 14.4 gc is obtained. (Clockwise rotation of the tuning screw increases the frequency.)

NOTE

After each adjustment on the cavity adjustment screw, adjust the REFL VOLT ADJ control on the REFLECTOR REGULATOR for a maximum reading on METER 2. Be sure to use the following sequence to obtain the optimum results:

1. Offset the wavemeter
2. Adjust the klystron screw
3. Adjust the reflector voltage
4. Measure with the wavemeter
5. Offset the wavemeter

6-66. PUMP FAILURE ALARM SETUP.

6-67. Proceed as follows:

a. Set potentiometer marked ALARM SENS (R17) and potentiometer marked FREQ METER (R14) fully clockwise. The front panel meter M2 with switch S3 in position PUMP FREQ should read 70 divisions, minimum. If it does not, replace CR 3 (D4101). If this does not give the required reading, replace the klystron.

b. With S3 in PUMP FREQ position and wavemeter detuned, reduce reading on METER M2 with ALARM SENS (R17) to 65 divisions.

c. Reduce reading on METER M2 to 50 ± 5 divisions. This adjustment should be done carefully because it serves as a reference.

6-68. ALIGNMENT OF DOUBLE CONVERSION RECEIVER (DUAL AND QUAD).

6-69. Each receiver is aligned with all modules in their drawers and with power provided by the integral power supplies. Align each receiver as described in the following paragraphs. Refer to table 5-8 for alignment required after tube or module replacement.

6-70. RECEIVER CONVERSION PROCEDURES.

6-71. The procedures for conversion of quad-to-dual, dual-to-dual, dual-to-single and the reverse are included in the alignment operations as required.

6-72. LOCAL OSCILLATOR CHAIN ALIGNMENT UNDER NORMAL TRAFFIC CONDITIONS.

6-73. Perform the procedures detailed in the following paragraphs for oscillator multiplier, frequency multiplier, and best in-lock alignments.

6-74. OSCILLATOR MULTIPLIER AND FREQUENCY MULTIPLIER ALIGNMENT.

6-75. Proceed as follows:

a. On the CEC, set AUTO-MAN switch to MAN, and select the channel to carry traffic.

b. Disconnect the oscillator crossconnect cable from J8 on each oscillator multiplier.

c. On the cabinet to be aligned, disconnect the cables from the IF INPUT jacks at the front of the IF and Baseband drawer.

d. Set the selector switch in the Preselector and Mixer drawer to OSC 1 position.

e. Rotate the meter function switch to the following positions and adjust the corresponding tuning controls for a maximum indication on the front panel meter.

SWITCH POSITION	TUNING CONTROL
OSC A	A
TRIPLER B	B
BUFFER C	C
AMPL D	D1

f. Carefully readjust tuning controls A, B, C, and D1 for maximum indications on the front panel meter with the meter function switch in positions A through D respectively.

NOTE

Do not adjust control D2.

g. Rotate the meter function switch to QUAD XTAL E position. Adjust QUAD 1E control for maximum meter indication.

h. Rotate QUAD 1E control clockwise until the meter indication decreases approximately 6 per cent. This peak is very sharp, so the tuning must be offset for more stable operation.

i. Rotate meter function switch to DOUBLER XTAL F position. Adjust QUAD 2F control for maximum indication.

NOTE

It may be necessary to repeat this step several times to obtain the absolute maximum.

j. Rotate QUAD 2F control counterclockwise until the reading decreases approximately 6 per cent.

k. Set the function switch to MIXER 1 XTAL G position and adjust G1 and G2 doubler controls for a maximum meter indication. There is considerable interaction between G1 and G2 and they must be adjusted a number of times to produce a maximum indication.

l. Adjust G3 level control so that crystal currents indicated by meter positions G and H average 50.

m. Measure the crystal frequency at J8 of the oscillator multiplier using a counter, converter and the correct decoupler. The frequency shall be within 250 cps of the specified crystal frequency. If the frequency does not fall within specified limits, repeat the alignment. If still not successful, replace crystal or tube V1.

n. Reconnect the cables to the IF INPUT jacks of the IF and Baseband drawer.

o. On the CEC, select the channel just aligned.

p. Repeat steps c through m for the unaligned cabinet.

6-76. LOCK ALIGNMENT.

6-77. Proceed as follows:

a. Connect a BNC tee to J8 of one oscillator multiplier. On one side of this tee connect a capacitive decoupler, and on the other side of the tee connect the oscillator cross-connect cable.

b. On the capacitive decoupler connect a BNC tee. On one side of this tee connect IF Level Detector (test equipment part no. C2336637) and on the other side of the tee connect a frequency counter. On the output of the detector connect an oscilloscope.

c. Connect the oscillator crossconnect cable to J8 of the other oscillator multiplier.

d. The oscilloscope should show essentially a straight line. If a beat (sawtooth or sine wave) of random frequency appears, the oscillators are out-of-lock.

e. Adjust either oscillator multiplier OSC A control until the oscillators lock, as indicated on the oscilloscope by the disappearance of the random frequency beat.

NOTE

> Observe OSC A meter readings while adjusting OSC A controls. If either shows a drop of more than 50 per cent from peak reading observed during step e, paragraph 6-75, when tuning, repeak and use the other oscillator to obtain lock.

f. When lock occurs, check the frequency on the counter. Alternately adjust each of the OSC A controls in small increments, to bring frequency to nominal operating frequency ± 50 cps. Make sure lock is maintained during this procedure by observing the pattern on the oscilloscope. Record the frequency.

CAUTION

> If either oscillator meter reading drops more than 50 per cent from peak reading observed during step e, paragraph 6-75, replace the crystal or V1.

g. Repeak controls B through G for both receivers, making sure lock is maintained.

h. It is important that the locked oscillators be symmetrically centered in the lock range. This is to be checked and adjusted to the proper point.

i. After step g is completed, alternately observe the counter and oscilloscope while adjusting the OSC A control of channel A. Turn OSC A control slowly clockwise until the oscillator goes out of lock. Repeat the process to check the frequency just before the out-of-lock condition occurs. Record this frequency. Return the control to the point that gives the same reading in frequency as recorded in step f. Repeat the same process but turn OSC A control counterclockwise. After obtaining the two readings for the out-of-lock condition in both directions, determine the difference between each of these readings and the reading from step f. The differences should be no less than 50 cps. Return the control to the frequency obtained in step f.

j. Repeat step i for channel B. Compare the differences in readings for both channel A and channel B. If both centers of the out-of-lock ranges for the channels are on the same side of the reading obtained from step f average the readings of the centers and use this new average for the new nominal frequency for step f, but make sure it is still within the * 50 cps requirement. Repeat steps i and j for both channels until they are symmetrical for lock range.

k. If the out-of-lock range centers are on opposite sides of the reading in step f, average the two centers and obtain a new frequency for step f. Repeat step i for each channel, to be sure that the lock range is plus and minus a minimum of 50 cps from the frequency determined above and is symmetrical; If this requirement can not be met, replace the crystals or tubes (V1).

l. Repeak controls B through G.

m. Reconnect the cables to the IF INPUT jacks on the front panel of the IF and Baseband drawer.

n. Set sub-panel meter switches of each IF and Baseband drawer to TOTAL APC ERROR. Observe and record the two readings.

o. Disconnect and remove the BNC tee from the oscillator multiplier. Reconnect the cross-connect cable to J8.

p. Observe the TOTAL APC ERROR readings. If the two readings are essentially unchanged, the oscillator lock is being maintained. If one reading is positive and the other negative by more than 5 divisions (compared to readings of step n) readjust OSC A controls as in step f until readings correspond to the readings recorded in step n.

q. Return to quad operation.

6-78. ALIGNMENT OF PARAMETRIC AMPLIFIER GAIN AND NOISE FIGURE MEASUREMENT.

6-79. This procedure is described in paragraph 6-24.

6-80. ALIGNMENT OF MIXER-PREAMPLIFIER GAIN AND NOISE FIGURE MEASUREMENT.

6-81. This procedure is described in paragraph 6-26.

6-82. AGC ALIGNMENT OF 9.8-MC IF AMPLIFIER.

NOTE

> It is necessary to disconnect the cable from J17 on the if amplifier module, prior to setting the AGC switch to OFF or INT. Conversely, it is necessary to set the AGC switch to EXT, prior to connecting the AGC cable (W8 or W9) to J17. Failure to adhere to this precaution will result in system outage.

6-83. This alignment is performed on one channel at a time and repeated for the other channel or channels in succession.

a. Select one channel to be aligned. All the following instructions apply to this channel only.

b. Disconnect the cable at IC-1 or)C-2 jack (J1 or J5) of the agc amplifier. Disconnect at J1 when aligning channel 1, or at J5 when aligning channel 2.

c. Disconnect the cable at J17 of the if amplifier to be aligned.

d. Set the AGC switch on this if amplifier to OFF.

e. Set the GAIN potentiometer on the phase combiner for this channel to full counterclockwise position.

f. Set the AGC potentiometer on the if amplifier maximum clockwise.

g. Connect the counter to J1 on the 2nd mixer LO.

h. Set the 2nd mixer LO to 60.2 mc ± 1.0 kc by adjusting the LO FREQ and/or 0 ERROR controls on the 2nd mixer LO.

NOTE

LO FREQ is a coarse control and 0 ERROR is a fine control.

i. Connect the high voltage jack of the reference voltage supply to J17 of the if amplifier.

j. Set the high voltage of the reference voltage supply to 13. 0 volts and lock the potentiometer control. This voltage will be identical for all if amplifier gain alignments and therefore should not be further adjusted until all channels have been aligned.

NOTE

Should the reference voltage supply not be available, dry cell batteries (D-size) may be substituted. For 13 volts, eight cells should be used. (Each cell is approximately 1.6 vdc, open circuited.) The final voltage must be checked and should be 13 volts (+1).

k. Connect a BNC tee, a 75-ohm load, and the if level detector (test equipment part no. C2336637) to the end of the phase combiner output cable which was disconnected in step b.

l. Set the meter switch on the inside panel of the IF and Baseband drawer to TEST LEAD +.

m. Connect a test lead from the if level detector to the test point jack of the IF and Baseband drawer sub-panel meter.

NOTE

Use the <u>same</u> meter for the alignments of <u>all</u> if amplifiers.

n. Calibrate, and set the level from the signal generator to about -40 dbm. (Refer to paragraph 6-5 for signal generator calibration.) Connect the signal generator to the RF INPUT of the Preselector and Mixer drawer for the channel being aligned.

o. Connect a counter to the IF OUTPUT for this channel on the front panel of the Preselector and Mixer drawer.

p. Adjust the frequency of the signal generator to obtain 70 mc (+ 15 kc) on the counter. Disconnect the counter and reconnect the IF OUTPUT cable to the drawer.

NOTE

Due to the narrow if filter bandwidth (200 kc) and inherent drift of the signal generator, it is absolutely necessary to check the signal generator frequency (step p) immediately prior to performing steps r and w.

q. Set the level of the signal generator to -100 dbm.

r. Adjust the GAIN potentiometer at the input of the if amplifier for a reading of 50 on the sub-panel meter.

s. Connect the low voltage jack of the reference voltage supply to J17 of the if amplifier.

t. Set the low voltage of the reference voltage supply to 3. 0 volts and lock the potentiometer control. This voltage will be identical for all if amplifier agc gain alignments and therefore should not be further adjusted until all channels have been aligned.

NOTE

Should the reference voltage supply not be available, D-size dry cell batteries may be substituted. For three volts, two cells should be used. (Each cell is approximately 1.6 vdc, open circuited.) The final voltage must be checked and should be 3.0 volts (± 0.5).

u. Repeat steps o and p.

v. Set the level of the signal generator to -60 dbm.

w. Adjust the AGC potentiometer of the if amplifier for a reading of 50 on the sub-panel meter.

x. Set the GAIN potentiometer on the phase combiner to maximum clockwise position.

y. Disconnect the reference voltage supply from J17 on the if amplifier. Do not reconnect the agc cable at this time.

z. Disconnect the signal generator and connect the normal rf input to the Preselector and Mixer drawer.

aa. Set the AGC switch on the if amplifier to EXT.

ab. Connect the agc cable to J17 on the if amplifier.

ac. Reconnect the cable to the agc amplifier which was disconnected in step b. (Connect to J1 for Channel 1 or J5 for Channel 2).

ad. Restore the channel to operation, taking appropriate steps to insure a good phase lock condition. (Refer to paragraph 6-96.)

6-84. AGC LEVEL ADJUSTMENT OF THE 9.8-MC AGC AMPLIFIER.

6-85. QUADRUPLE DIVERSITY RECEIVER.

This procedure assumes that the if amplifiers have been aligned.

a. Select the dual receiver to be aligned.

b. At the CEC set the AUTO-MAN switch on the switching unit to MAN and select the receiver which is to continue carrying traffic.

NOTE

The following steps apply only to the receiver being aligned, unless otherwise specified.

c. Disconnect the if crossconnect cable at IF OUT jack (J3) of both agc amplifiers.

d. Set the DUAL-QUAD switch on both agc amplifiers to DUAL.

e. Connect a BNC tee connector to agc amplifier J3 in the receiver to be aligned.

f. Connect a 150-ohm termination to J3 of the agc amplifier in the receiver that is to continue carrying traffic.

g. Disconnect the IF OUT cable from J16 of channel 2 if amplifier.

h. Set GAIN potentiometer on channel 1 phase combiner to full counterclockwise position.

i. Connect the counter to J1 on channel 1 2nd mixer LO.

j. Set the 2nd mixer LO to 60.2 mc (+ 1. 0 kc) by adjusting LO FREQ and/or 0 ERROR controls.

NOTE

LO FRE Q is a coarse control and 0 ERROR is a fine control.

k. Set GAIN potentiometer on channel 1 phase combiner to maximum clockwise position.

l. Calibrate, and set the level from the signal generator to about -40 dbm. (Refer to paragraph 6-5 for signal generator calibration.) Connect signal generator to channel 1 RF INPUT of the Preselector and Mixer drawer.

m. Connect a counter to IF OUTPUT 1 on the front panel of the Preselector and Mixer drawer.

n. Adjust the frequency of the signal generator to obtain 70 mc (± 15 kc) on the counter. Disconnect the counter and reconnect the IF OUTPUT cable to the drawer.

o. Set the level from the signal generator to -75 dbm.

p. Connect the if level detector (test equipment part no. C2336637) and a 150 ohm load to the BNC tee at J3 of the agc amplifier.

q. Set the meter switch on the inside panel of the IF and Baseband drawer to TEST LEAD +.

r. Connect a test lead from the if level detector to the test point jack of the If and Baseband drawer sub-panel meter.

NOTE

Use the same meter for the alignment of both agc amplifiers.

s. Adjust the agc gain potentiometer R9 for a reading of 60 on the meter.

t. Replace the cable removed in step g, and disconnect the signal generator.

u. Remove the BNC tee, if detector, and the 150-ohm loads from the agc amplifiers.

v. Set the DUAL-QUAD switches on the agc amplifiers to QUAD.

w. Connect the if cross-connect cable to J3 of both age amplifiers.

x. Insure a proper phase lock condition in the receiver. (Reference paragraph 6-96)

6-86. DUAL DIVERSITY RECEIVER.

6-87. The redundant 9.8 mc agc amplifier NUS 8318 is equipped with a switch which allows each section of the unit to be checked independently. For normal operation the selector switch is set to NORMAL. This procedure assumes that the if amplifiers have been aligned.

NOTE

This alignment will be performed using prevailing link carrier signal. Normal precautions and reasonable care should be exercised to avoid interrupting customer service. If a signal is not available on the link, proceed with the alignment utilizing the quadruple diversity receiver alignment procedure.

a. Disconnect the 150-ohm load from IF OUT jack (J3) on the agc amplifier and replace it with a BNC tee connector.

b. Connect the if level detector, test equipment dwg. C2336637, and the 150-ohm load to the BNC tee.

c. Connect a test lead from the if level detector to the test point jack of the IF and Baseband drawer sub-panel meter.

d. Set the meter switch on the inside panel of the IF and Baseband drawer to TEST LEAD +.

e. Disconnect the if output cable from J16 of channel 2 if amplifier.

f. Set GAIN potentiometer on channel 1 phase combiner to full counterclockwise position.

g. Connect the counter to J1 on channel 1 2nd mixer LO.

h. Set the 2nd mixer LO TO 60.2 mc (± 1.0 kc) by adjusting LO FREQ (coarse) and/or 0 ERROR (fine) controls.

i. Set GAIN potentiometer on channel 1 phase combiner to maximum clockwise position.

j. Adjust the age gain potentiometer R9 for a reading of 60 on the meter.

k. Set the selector switch to Al and A2, noting that the subpanel meter reading remains at approximately 60. Return the switch to NORMAL.

l. Replace the cable removed in step e.

m. Remove the BNC tee connector from J3 of the agc amplifier and replace, the 150-ohm load.

n. Insure a proper phase lock condition in the receiver, as per paragraph 6-96.

6-88. 9.8-MC PHASE COMBINER ALIGNMENT.

6-89. QUADRUPLE DIVERSITY RECEIVER.

This procedure assumes that the if amplifiers and agc amplifier have been aligned.

a. Select one dual receiver to be aligned.

b. On the CEC, set switching unit to MAN and select the baseband which is to continue carrying traffic.

NOTE

The following steps apply only to the receiver being aligned, unless otherwise specified.

c. Disconnect the if cross-connect cable at IF OUT jack (J3) of both agc amplifiers.

d. Set the DUAL-QUAD switch on both agc amplifiers to DUAL.

e. Disconnect the cable from IF INPUT 1 of the IF and Baseband drawer.

f. At the transmitters isolate the modulator which is not carrying traffic.

g. Disconnect the input to this modulator at J1 IN.

h. Disconnect the output of this modulator at MOD OUT (J4) by removing cable W14 or W22, whichever is used. Do not disconnect the BNC tee.

i. Connect counter to modulator output at J4 through the decoupling network.

j. Set the modulator frequency to 70 mc (± 15 kc), and disconnect counter.

k. Connect a coax test cable to the modulator at J4 through the decoupling network.

l. Connect the other end of this test cable to the variable if Kay attenuator set for maximum attenuation.

m. Connect the attenuator output to the IF INPUT 1 jack of channel 1 on the front panel of the receiver IF and Baseband drawer.

n. Disconnect the cables (W7 and W10) from the IF OUT jacks (J16) of both if amplifiers. Using a BNC tee connector, connect the two cables just removed to the IF OUT jack (J16) of if amplifier 1.

o. Set GAIN potentiometer on channel 1 phase combiner to full counterclockwise position.

p. Connect counter to J1 on channel 1 2nd mixer LO.

q. Set channel 1 2nd mixer LO to 60.2 mc (± 1.0 kc) by adjusting the LO FREQ (coarse) and/or 0 ERROR (fine) controls.

r. Set GAIN potentiometer on channel 1 phase combiner to maximum clockwise position.

s. Repeat steps o through r for channel 2.

t. Set the IF and Baseband drawer sub-panel meter switch to AGC.

u. Adjust the variable if attenuator for an agc meter reading as close to 90 as can be obtained.

v. Set the TUNE coil on the agc amplifier to maximum clockwise position.

w. Set the FREQ control on both phase combiners to the maximum clockwise position. Then adjust these controls four full turns counterclockwise.

x. Set the IF and Baseband drawer sub-panel meter to APC 1. Adjust the PHASE control on phase combiner 1 for a zero meter reading. See note below.

y. Repeat step x for channel 2.

NOTE

If an APC reading on the sub-panel meter cannot be adjusted, to zero with the PHASE control, the FREQ control should be adjusted from the position preset in step w to give a reading slightly beyond zero. The PHASE control should then be backed off to produce the zero reading.

z. Connect the dual receiver for normal operation.

aa. Adjust the TUNE coil on the agc amplifier fully counterclockwise.

ab. Phase lock the receiver. (Refer to paragraph 6-96.)

ac. If the newly aligned receiver appears to operate satisfactorily repeat the procedure for the other receiver cabinet, being sure to first switch to the correct baseband on the CEC switching unit.

ad. When both receiver cabinets have been aligned, and all cables have been put back to their proper positions, disconnect the test setup from the output of the modulator that was utilized and reconnect the modulator cables.

ae. Reset both DUAL-QUAD switches to QUAD.

af. Reconnect the if cross-connect cable at J3 on both of the agc amplifiers.

ag. Assure that a good phase lock condition exists. (Refer to paragraph 6-96.)

ah. Should an offset in the individual apc meter readings occur in the same direction for all channels, the tune coils on the agc amplifiers may be adjusted to obtain readings nearer to zero. Reset the CEC switching unit for normal operation.

6-90. DUAL DIVERSITY RECEIVER.

6-91. This procedure assumes that the if amplifiers and agc amplifier have been aligned.

a. On the CEC, set switching unit to MAN and select baseband B.

b. Disconnect IF OUT cable W7 from if amplifier 1 at J16.

c. Disconnect agc cable (W8) at J17 on if amplifier 1.

d. Set AGC switch on if amplifier 1 to INT.

e. Disconnect input to demodulator 1 at J1.

f. Terminate the cable removed in step e with a 270-ohm load.

g. Using a coax test cable, connect if amplifier 1 OUT (J16) directly to demodulator 1 IN (J1).

h. On the CEC switching unit select baseband A..

i. Disconnect IF OUT cable W10 from if amplifier 2 at J16. Using a BNC tee connect this cable (W10) and the cable disconnected in step b (W7) to the IF OUT jack (J16) of if amplifier 2.

j, Disconnect the channel 2 IF INPUT cable from the front panel of the IF and Baseband drawer.

k. At the transmitter, isolate the modulator which is not carrying traffic.

l. Disconnect the input to this modulator at J1 IN.

m. Disconnect the output of this modulator at MOD OUT (J4) by removing cable W14 or W22, whichever is used. Do not disconnect the BNC tee.

n. Connect counter to modulator output at J4 through the decoupling network.

o, Set the modulator frequency to 70 mc (+ 15 kc), and disconnect counter.

p. Connect a coax test cable to the modulator at J4 through the decoupling network.

q. Connect the other end of this test cable to a variable Kay attenuator set for maximum attenuation.

r. Connect the attenuator output to the IF INPUT jack of channel 2 on the front panel of the receiver IF and Baseband drawer.

s. Set GAIN potentiometer on channel 2 phase combiner to full counterclockwise position.

t. Connect counter to J1 on 2nd Mixer LO of channel 2.

u. Set 2nd Mixer LO of channel 2 to 60.2 mc (+ 1. 0 kc) by adjusting the LO FREQ (coarse) and/or 0 ERROR (fine) controls.

v. Repeat steps s through u for channel 1.

w. Set IF and Baseband drawer sub-panel meter switch to AGC.

x. Adjust the variable Kay attenuator for an agc meter reading as close to 90 as can be obtained.

y. Set the TUNE coil of the agc amplifier to maximum clockwise position.

z. Set the FREQ control on both phase combiners to the maximum clockwise position. Then adjust these controls four full turns counterclockwise.

aa. Set the IF and Baseband drawer sub-panel meter to APC 2. Adjust the PHASE control on phase combiner 2 for a zero meter reading. See NOTE below.

ab. Repeat step aa for channel 1.

NOTE

If an apc reading on the sub-panel meter cannot be adjusted to zero with the PHASE control, the FREQ control should be adjusted from the position preset in step aa to give a reading slightly beyond zero. The PHASE control should then be backed off to produce the zero reading.

ac. Disconnect IF OUT cables W7 and W10 from jack J16 of if amplifier 2, and remove the BNC tees

ad. Connect IF OUT cable (W10) to if amplifier 2 OUT (J16).

ae. Disconnect the test setup from the IF INPUT jack of channel 2 on the front panel of the IF and Baseband drawer, and reconnect the if cable from the Preselector and Mixer drawer disconnected in step j.

af. On CEC switching unit set SEL switch to baseband B.

ag. On if amplifier 1 set AGC switch to EXT. Reconnect the agc cable (W8) to J17 on if amplifier 1.

ah. Disconnect the temporary connection between demodulator 1 and if amplifier 1 installed in step g.

ai. Remove the 270-ohm load installed in step f and reconnect the cable to the demodulator 1 input.

aj. Set GAIN potentiometer on channel 2 phase combiner to maximum clockwise position.

ak. Reconnect the IF OUT cable (W7) to the IF OUT (J16) of if amplifier 1.

al. Assure that a good phase lock condition exists. (Refer to paragraph 6-96.)

am. Reset the CEC switching unit for normal operation.

an. When both receiver channels have been aligned and all cables have been put back to their proper positions, disconnect the test setup from the output of the modulator that was utilized and reconnect the modulator cables.

6-92. <u>9.8-MC PHASE AND IF LEVEL ALARM ALIGNMENT.</u>

6-93. QUADRUPLE DIVERSITY RECEIVER.

NOTE

This procedure produces a condition whereby the phase alarm will occur prior to the receiver actually going out-of-lock. The probability of outage due to an actual out-of-lock condition is greatly reduced by giving advance warning of an impending out-of-lock condition.

6-94. This procedure assumes that the if amplifiers, agc amplifiers and phase combiners have been aligned.

a. Select one dual receiver to be aligned.

b. On the CEC, set switching unit to MAN and select the baseband which is to continue carrying traffic.

c. Disconnect the if cross-connect cable at IF OUT jack (J3) of both age amplifiers. Connect a 150-ohm load to jack J3 of each agc amplifier.

d. Set the DUAL-QUAD switch on both age amplifiers to DUAL.

NOTE

The following steps apply only to the receiver being aligned unless otherwise specified.

e. Disconnect the IF OUTPUT cables from the front panel of the Preselector Mixer drawer of the receiver being aligned.

f. Connect the two IF OUTPUT cables disconnected in step e to a BNC tee.

g. At the transmitters, isolate the modulator which is not carrying traffic.

h. Disconnect the input to this modulator at J1 IN.

i. Disconnect the output of this modulator at MOD OUT (J4) by removing cable W14 or W22, whichever is used. Do not disconnect the BNC tee.

j. Connect the frequency counter to modulator output at J4 through the decoupling network.

k. Set the modulator frequency to 70 mc (* 15 kc).

l. Disconnect the frequency counter.

m. Connect a coax test cable to the modulator at J4 through the decoupling network.

n. Connect the other end of this test cable to a variable Kay attenuator, set for maximum attenuation.

o. Connect the attenuator output to the BNC tee that was inserted in step f.

p. Set GAIN potentiometers on channel 1 and 2 phase combiners to full counterclockwise position.

q. Connect counter to J1 on channel 1 2nd mixer LO.

r. Set 2nd mixer LO of channel 1 to 60. 2 mc (± 1. 0 kc) by adjusting the LO FREQ (coarse) and/or 0 ERROR (fine) controls.

s. Repeat steps q and r for 2nd mixer LO of channel 2.

t. Set GAIN potentiometers on channel 1 and 2 phase combiners to maximum clockwise position.

u. Set the IF and Baseband drawer sub-panel meter switch to AGC.

v. Adjust the variable Kay attenuator for an agc meter reading as close to 90 as can be obtained.

w. Assure that channel 1 phase combiner ALM TEST switch (S1) is in the 0 position.

x. Set channel 1 phase combiner ALM ADJ (R28) to maximum clockwise position.

y. Set channel 1 phase combiner QD control (R58) to mid-position.

z. Repeat steps w through y for channel 2 phase combiner.

aa. Check readings of APC 1, APC 2, and TOTAL APC. These should read 0 (± 10).

NOTE

The 10 corresponds to 1 division mark on the meter.

ab. On channel 1 phase combiner set alarm DELAY switch to OFF.

ac. Monitor APC 1 reading on IF and Baseband drawer sub-panel meter.

ad. Slowly vary 2nd mixer LO FREQ control on channel 1 to produce a +25 reading for APC 1. While varying the frequency, turn ALM ADJ (R28) of channel 1 phase combiner in a counterclock-wise direction until the alarm light comes on at an APC 1 reading of approximately +25.

ae. Determine the APC 1 meter reading in the negative direction at which the alarm light comes on. If the difference between the (+) and (-) meter readings exceeds 5 divisions, adjust QD control (R58) of channel 1 phase combiner until the (+) and (-) readings at which the alarm occurs are as nearly equal as possible.

af. Adjust 2nd mixer LO on channel 1 frequency to obtain an APC 1 reading of +25.

ag. Set ALM ADJ (R28) on channel 1 phase combiner such that the alarm light just comes on.

ah. Adjust 2nd mixer LO on channel 1 frequency for a TOTAL APC ERROR reading of 0. The alarm light should go out.

ai. Vary the frequency to produce a negative APC 1 reading. The alarm light should come on at an APC 1 reading of -25.

aj. Set 2nd mixer LO on channel 1 frequency for a TOTAL APC ERROR reading of 0. Alarm light should go on.

NOTE

There is some interaction between ALM ADJ (R28) and QD (R58). Steps ad through aj may have to be repeated to get a proper alignment. Proper operation has been achieved when the alarm lamps light at individual APC readings of 25.

ak. Repeat steps ab through aj for receiver channel 2 monitoring APC 2 and adjusting channel 2 phase combiner and 2 mixer LO.

al. Set ALM TEST switch (S1) on channel 1 phase combiner to L position. Alarm light should remain out.

am. Disconnect the coax cable from the IF INPUT jack for channel 1 on IF Baseband drawer front panel. Alarm light on phase combiner 1 should come on.

an. Reconnect cable disconnected in step am. Alarm light should go out.

ao. Reset ALM TEST switch (S1) on channel 1 phase combiner to 0.

ap. Repeat steps al to ao for channel 2 phase combiners.

aq. Set ALM DELAY switch on both phase combiners to ON.

ar. Repeat step al to ap. Alarm light action should be the same but delayed by 5 to 10 seconds.

as. Set ALM TEST switch (S1) on both phase combiners to 0 position.

at. Disconnect the test setup installed in steps o and f and reconnect the two if cables between IF OUTPUT on the Preselector and Mixer drawer and IF INPUT on the IF and Baseband drawer.

au. Repeat alignment of alarms for the other receiver cabinet, being sure to first switch to the correct baseband on the CEC switching unit.

av. When both receiver cabinets have been aligned, and all cables have been put back to their proper positions, disconnect the test setup from the output of the modulator that was utilized and reconnect the modulator cables.

aw. Reset both DUAL-QUAD switches to QUAD.

ax. Disconnect the two 150-ohm loads from J3 on the agc amplifiers and reconnect the if cross-connect cable.

ay. Assure that a good phase lock condition exists. (Refer to paragraph 6-96.)

az. Reset the CEC switching unit for normal operation.

6-95. DUAL DIVERSITY RECEIVER.

NOTE

This procedure produces a condition whereby the phase alarm will occur prior to the receiver actually going out of lock. The probability of outage due to an actual out-of-lock condition is greatly reduced by giving advance warning of an impending out-of-lock condition.

This procedure assumes that the if amplifiers, age amplifiers and phase combiners have been aligned. This alignment will be performed using prevailing link carrier signal. Normal precautions and reasonable care should be exercised to avoid interrupting customer service. If a signal is not available on the link, proceed with the alignment utilizing the quadruple diversity receiver alignment procedure.

a. Set channel 1 phase combiner GAIN potentiometer fully counterclockwise.

b. Connect a frequency counter to J1 of 2nd mixer LO of channel 1.

c. Set channel 1 2nd mixer LO to 60.2 mc (+ 1 kc) by adjusting the LO FREQ (coarse) and/or 0 -ERROR (fine) controls.

d. Set channel 1 phase combiner GAIN potentiometer maximum clockwise.

e. Repeat steps a through d for channel 2 phase combiner and 2nd mixer LO.

f. Set channel 1 phase combiner ALM TEST switch (S1) to 0 position.

g. Set channel 1 phase combiner ALM ADJ (R28) to maximum clockwise position.

h. Set channel 1 phase combiner QD adjust (R58) to mid-position.

i. Repeat steps f through h for channel 2 phase combiner.

j. Check readings of APC 1, APC 2, and TOTAL APC on the IF and Baseband drawer sub-panel meter. These should read 0 (+ 10).

k. On channel 1 phase combiner set alarm DELAY switch to OFF.

l. Monitor APC 1 reading on IF and Baseband drawer sub-panel meter.

NOTE

Traffic is present at all times during this alarm alignment, so the variation in the 2nd mixer LO frequency should be made very slowly and with great care. This will prevent a possible out-of-lock condition. At no time should the 2nd mixer LO be varied to produce an individual apc reading in excess of 30.

m. Slowly vary channel 1 2nd mixer LO frequency on channel 1 to produce a +25 reading for APC 1. While varying the frequency, turn ALM ADJ (R28) of phase combiner 1 in the counter-clockwise direction until the alarm light comes on at an APC 1 reading of approximately+ 25 divisions.

n. Determine the APC 1 meter reading in the negative direction at which the alarm light comes on. If the difference between the plus and minus meter readings exceeds 5 divisions, adjust QD control (R58) of channel 1 phase combiner until the plus and minus readings at which the alarm occurs are as nearly equal as possible.

o. Adjust 2nd mixer LO frequency on channel 1 to obtain an APC 1 reading of +25.

p. Set ALM ADJ (R28) on phase combiner 1 such that the alarm light just comes on.

q. Adjust 2nd mixer LO frequency on channel 1 for a TOTAL APC ERROR reading of 0. Alarm light should go out.

r. Vary the frequency to produce a negative APC 1 reading. The alarm light should come on at an APC 1 reading of -25.

s. Set 2nd mixer LO frequency on channel 1 for a TOTAL APC ERROR reading of 0. Alarm light should go out.

NOTE

There is some interaction between ALM ADJ (R28) and QD (R58). Steps m through s may have to be repeated to get a proper alignment. Proper operation has been achieved when the alarm lamps light at individual APC readings of ± 25.

t. Repeat steps k through s for receiver channel 2, monitoring APC 2 and adjusting channel 2 phase combiner and 2nd mixer LO.

u. Set ALM TEST switch (S1) on channel 1 phase combiner to L position. Alarm light should remain out.

v. Disconnect the coax cable from the IF INPUT jack for channel 1 on the IF and Baseband drawer front panel. Alarm light on channel 1 phase combiner should come on.

w. Reconnect cable removed in step v. Alarm light should go out.

x. Reset ALM TEST switch (S1) on channel 1 phase combiner to 0.

y. Repeat steps u through x for channel 2 phase combiner.

z. Set alarm DELAY switch on both phase combiners to ON.

aa. Repeat steps u through y. Alarm light action should be the same, but delayed by approximately 5 to 10 seconds.

ab. Set ALM TEST switch (S1) on both phase combiners to 0 position.

ac. Assure that a good phase lock condition exists. (Refer to paragraph 6-96.)

6-96. PHASE LOCKING PROCEDURE, DOUBLE CONVERSION, DUAL OR QUADRUPLE DIVERSITY RECEIVER.

6-97. This procedure assumes that the if amplifiers, agc amplifiers and phase combiners have been aligned. This alignment is performed on one channel at a time and repeated for the other channel or channels in succession.

a. Select one channel to be aligned. All the following instructions apply to this channel only.

b. Disconnect the if output cable (W7 or W10) from the IF OUT jack (J16) on the if amplifier of the channel being aligned.

c. Set the GAIN potentiometer of the phase combiner of this channel to the full counterclockwise position.

d. Connect counter to J1 on the 2nd mixer LO of the channel being aligned.

e. Set the 2nd mixer LO Frequency to 60. 2 mc (+ 1. 0 kc) by adjusting the LO FRE Q (coarse) and/or 0 ERROR (fine) controls.

f. Remove the counter from J1 of the 2nd mixer LO.

g. Reset the GAIN potentiometer on the phase combiner to the maximum clockwise position.

h. Reconnect the if output cable to the IF OUT jack (J16) on the if amplifier.

i. Repeat the above procedure for each of the channels to be aligned.

j. When all channels have been aligned, check readings of APC 1, APC 2, and TOTAL APC on the IF and Baseband drawer sub-panel meter. These should read 0 (± 10).

k. Set the IF and Baseband drawer sub-panel meter to APC 1 or 2 according to the channel being aligned. Note the reading.

NOTE

This alignment is being performed with prevailing link carrier signals. Normal precautions and reasonable care should be exercised to avoid interrupting customer service. This alignment greatly depends on the level of the available signal. One indication of the quality of the link signal level is the agc reading on the sub-panel meter. A reading of 90 or less is generally indicative of a level less than 10 db above single channel threshold. For low level conditions the apc meter reading will swing much less than the ± 25 divisions called for below. To avoid creating an out-of-lock condition, the apc meter reading is swung slowly no more than + 5 divisions when a low level condition prevails.

l While observing the APC meter reading, adjust the LO FREQ control on the 2nd mixer LO and note that the apc meter reading can be swung smoothly across zero at least ± 25 divisions. Be sure to reset the apc meter to its original reading as noted in k above before adjusting another 2nd mixer LO.

m. Ability to perform step 1 on all if channels is an indication of a good phase locked condition.

<u>6-98. 9.8-MC PHASE COMBINER PHASE AND LEVEL ALARM OPERATION.</u>

6-99. The phase combiner module is equipped with both phase (0) and level (L) alarms. To determine which alarm has occurred, proceed as follows:

a. On the phase combiner indicating the alarm, turn the 0-L switch to L.

b. If the alarm lamp goes out, the alarm is being caused by an out-of-lock condition. Steps should be taken to properly phase lock the receiver. (Reference paragraph 6-96.)

c. If the alarm lamp remains on, the alarm is being caused by loss of level. The component modules, such as if amplifier, local oscillator, parametric amplifier, etc., of that particular channel should be checked for proper operation.

d. Return the 0-L switch to 0.

6-100. INITIAL ADJUSTMENT OF RECEIVER BASEBAND LEVEL.

NOTE

This procedure assumes that the transmitter deviation has been aligned.

6-101. QUADRUPLE DIVERSITY RECEIVER.

6-102. Proceed as follows:

a. Select one dual receiver (baseband) to be aligned.

b. On the CEC, set switching unit to MAN and select the baseband which is to continue carrying traffic.

c. Disconnect the if cross-connect cable at IF OUT jack (J3) of both agc amplifiers.

d. Set the DUAL-QUAD switch on both agc amplifiers to DUAL.

e. Connect a 150-ohm load to jack J3 of each agc amplifier.

NOTE

The following steps apply only to the receiver being aligned unless otherwise specified.

f. Disconnect the if cables from IF INPUT 1 and 2 on the front panel of the IF and Baseband drawer.

g. Disconnect the IF OUTPUT cable from J16 of the channel 1 if amplifier.

h. Disconnect the agc cable from J17 of the channel 1 if amplifier.

i. Set the agc switch on channel 1 if amplifier to INT.

j. Disconnect the input to demodulator at J1.

k. Using a test cable connect the output of the channel 1 if amplifier directly to the input of the demodulator.

l. At the transmitter, isolate the modulator which is not carrying traffic.

m. Disconnect the output of this modulator at MOD OUT (J4) by removing cable W14 or W22, whichever is used. Do not disconnect the BNC tee.

n. Connect a coax test cable to the modulator at J4 through a decoupling network.

o. Connect the other end of this cable to a variable Kay attenuator, set for maximum attenuation.

p. Connect the attenuator output to the IF INPUT jack of channel 1 on the front panel of the IF and Baseband drawer.

q. Adjust the variable Kay attenuator for 40 db attenuation.

r. Calibrate, and set the selective voltmeter as follows:

Line Impedance	600 ohm
Bandwidth	250 cps
Frequency	4 kc

s. Using the selective voltmeter, measure the 4-kc pilot tone at the XMT MON jacks of the channel being adjusted on the central equipment cabinet. The level should be 24 mv.

NOTE

Make no adjustments at this time if this level is not obtained. For the purpose of this adjustment, record the level obtained.

t. Connect the selective voltmeter to the RCVR MON jack on the central equipment cabinet associated with the baseband being aligned.

u. Adjust the GAIN control on the receiver baseband amplifier that is being aligned to obtain a reading on the selective voltmeter that is one half the level recorded in step n.

v. Restore equipment to normal operation, and repeat the procedure for the other baseband.

6-103. DUAL DIVERSITY RECEIVER.

6-104. Proceed as follows:

a. Select one baseband to be aligned.

b. On the CEC, set the switching unit to MAN and select the baseband which is to continue carrying traffic.

NOTE

The following steps apply only to the Receiver channel being aligned unless otherwise specified. It should be further noted that the demodulator and baseband amplifier for channel 2 are located in the ancillary drawer.

c. Disconnect the IF INPUT cable for the channel being aligned from the front panel of the IF and Baseband drawer.

d. Disconnect the IF OUT cable from J16 of the if amplifier.

e. Disconnect the agc cable from J17 of the if amplifier.

f. Set the AGC switch on the if amplifier to INT.

g. Disconnect the input to the demodulator at J1.

h. Using a test cable connect the output of the if amplifier directly to the input of the demodulator.

i. At the transmitter, isolate the modulator which is not carrying traffic.

j. Disconnect the output of this modulator at MOD OUT (J4) by removing cable W14 or W22, whichever is used. Do not disconnect the BNC tee.

k. Connect a coax test cable to the modulator at J4 through a decoupling network.

l. Connect the other end 6f this cable to a variable Kay attenuator, set for maximum attenuation.

m. Connect the attenuator output to the IF INPUT jack on the front panel of the IF and Baseband drawer.

n. Adjust the variable Kay attenuator for 40 db attenuation.

o. Calibrate, and set the selective voltmeter as follows:

Line Impedance	600 ohm
Bandwidth	250 cps
Frequency	4 kc

p. Using the selective voltmeter measure the 4-kc pilot tone at the XMT MON jack of the channel being adjusted on the central equipment cabinet. The level shall be 24 mv.

NOTE

Make no adjustments at this time if this level is not obtained. Record the level obtained.

q. Connect the selective voltmeter to the RCVR MON jack on the central equipment cabinet associated with baseband being aligned.

r. Adjust the GAIN control on the receiver baseband amplifier being aligned to obtain a reading on the selective voltmeter that is one half the level recorded in step p.

s. Restore equipment to normal operation, and repeat the procedure for the other baseband.

6-105. THRESHOLD EXTENSION ALIGNMENT.

6-106. Proceed as follows:

a. Select one threshold extension to be aligned.

b. On the CEC, set switching unit to MAN and select the baseband which is to continue carrying traffic.

c. Set the sub-panel meter to TEST LEAD +.

d. Connect a test lead between the sub-panel meter and OSC LEV test point (TP1) in the threshold extension module. The meter should read greater than 50.

e. Remove the if input cable (W21) from the threshold extension. (For the module in the IF and Baseband drawer, this can be conveniently done by removing the cable (W21) from the TE OUT jack on the agc amplifier. For the module in the Ancillary Equipment drawer, this can be conveniently done by removing the cable from J1 on the threshold extension module.)

f. Connect a test lead between the sub-panel meter and PHASE ERROR test point (TP2) on the threshold extension module.

g. Adjust the GAIN ADJ control to its approximate midway position.

h. Adjust the BAL control (R23) on the threshold extension module for a zero reading.

i. Using a BNC tee connector, connect a counter to the demodulator input.

j. Adjust the OSC FREQ control on the threshold extension module for a reading of 9.8 mc (+ 1 kc) on the counter.

k. Repeat steps h (balance) and j (frequency) until a zero meter reading is obtained at the required frequency.

l. Reconnect the if input cable to the threshold extension module.

NOTE

To perform the following steps it is necessary for signal to be present in the receiver.

m. Adjust the OSC FRE Q control on the threshold extension module for a zero meter reading. Adjust the control back and forth and note that the meter reading can be swung smoothly across zero. If at anytime the meter reading exceeds ± 5, readjust the OSC FREQ control to obtain zero.

n. Set the sub-panel meter to TEST TONE.

o. Adjust the GAIN ADJ potentiometer counterclockwise until the reading on the sub-panel meter falls to about 3/4 of its initial reading.

p. Adjust the OSC FREQ control for a peak indication on the meter.

q. Adjust the GAIN ADJ potentiometer clockwise until the meter reading stops increasing. From this point continue to turn the GAIN ADJ clockwise an additional 1/8 of a rotation (45 degrees).

r. Set the sub-panel meter to TEST LEAD +.

s. Repeat step m.

t. Restore the receiver to normal operation.

6-107. ADJUSTMENT OF RF BANDPASS FILTER (PRESELECTOR).

6-108. This procedure is described in paragraph 6-56.

6-109. DUAL PARAMETRIC AMPLIFIER KLYSTRON CHECK, REPLACEMENT, AND TUNING.

6-110. This procedure is described in paragraph 6-58.

SECTION VII

MODULES

GENERAL.

This section contains a general description, a circuit description and schematic and parts location diagrams for each of the modules used in the dual receivers. For maintenance data refer to TM 11-6625-647-14.

OSCILLATOR- MULTIPLIER
NUS 3753-6 and NUS 3753-7

DESCRIPTION

Oscillator-multiplier NUS 3753-6 forms the initial stage of the signal-frequency generator in the transmitter and receivers; it is mounted in the modulator-exciter drawer of the transmitter or the preselector and mixer drawer of the receiver. Oscillator-multiplier NUS 3753-7 forms the initial stage of the local oscillator used in the receiver; it is mounted in the preselector and mixer drawer. The circuits employed in these units are identical, except for three additional components incorporated into the receiver version (NUS 3753-7) to permit application of an automatic-phase-control voltage to the crystal oscillator. The output frequency of the unit is multiplied to the gigacycle range. Pertinent characteristics of these modules are as follows:

Oscillator frequency range:	
NUS 3753-6	47.29167 to 50.62500 mc (in transmitter)
	46.56250 to 51.35417 mc (in receiver)
NUS 3753-7	46.56250 to 51.35417 mc
Frequency tolerance	+0.005%
Output frequency range:	
NUS 3753-6	141.87501 to 151.87500 mc (in transmitter)
	139.68750 to 154.06251 mc (In receiver)
NUS 3753-7	139.68750 to 154. 06251 mc
Output impedance	1000 ohms, nominal
R-f output:	
NUS 3753-6	40 vrms, min over entire range
NUS 3753-7	40 vrms, min, at 139.68750 mc
	35 vrms, min, at 154.06251 mc
Ambient temperature range	-10 to +45 deg C
Input power requirements	6.3 vac at 1.1 amp
	24 vac at 2.0 amp
	+ 150 vdc at 20 ma
	+ 165 vdc at 100 ma

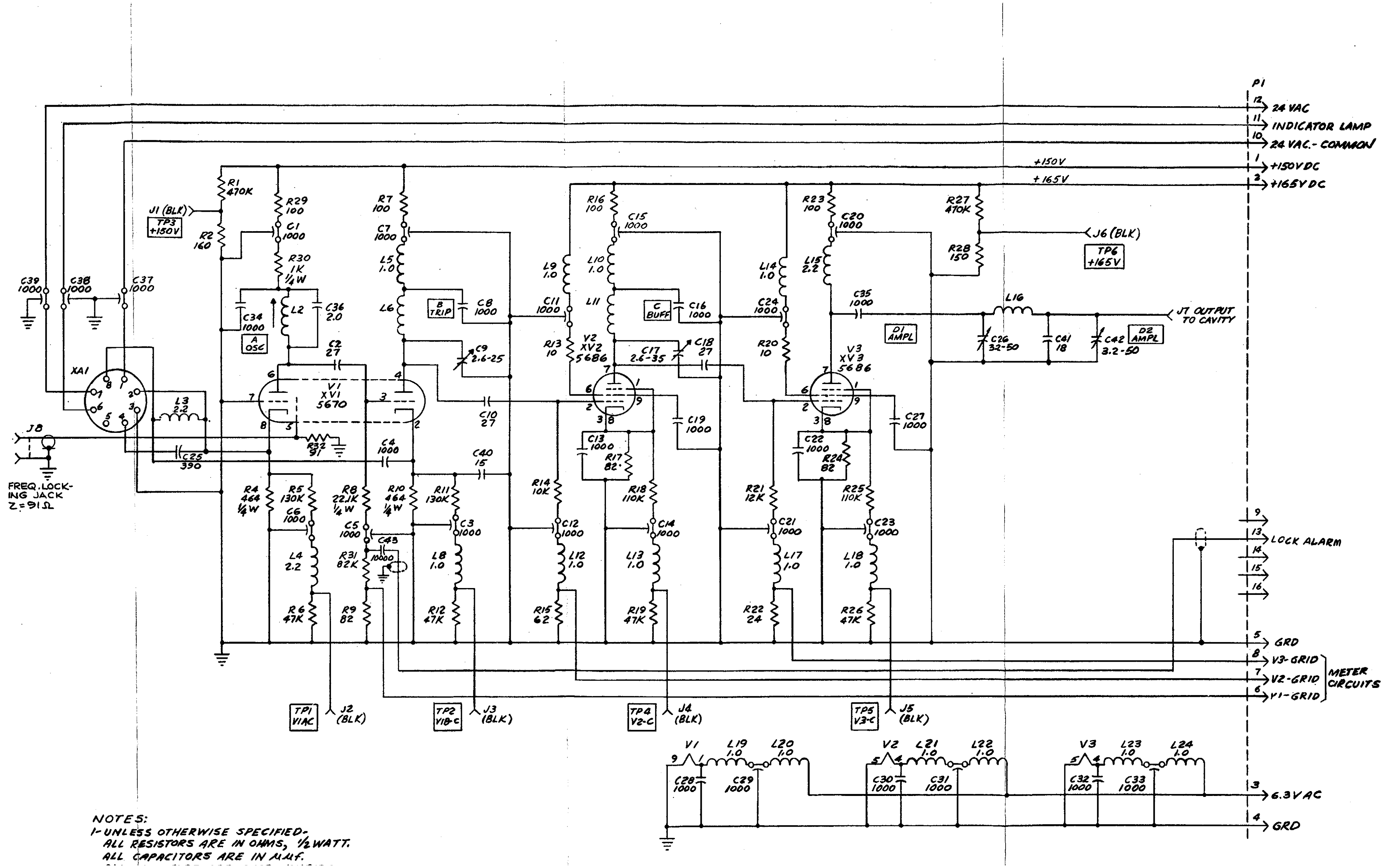
NUS 3753-6 and NUS 3753-7

CIRCUIT DESCRIPTION (Figures 1 through 5)

Oscillator-Multiplier. Oscillator-multiplier stage V1 employs a Butler-type oscillator as the signal generator for the basic frequency. Inductor L2 forms a parallel resonant circuit with C36 and the plate-to-ground capacitance of tube V1A. When D2 is adjusted to resonate the fifth overtone frequency of the crystal, the circuit starts oscillating. The rf voltage developed across the plate circuit of VIA is coupled through capacitor C2 to the grid of V1B. Stage V1B triples the frequency. The voltage that is developed at the cathode of V1B is fed back through capacitor C4 and the crystal to the cathode of VIA, providing the required regenerative feedback. An automatic phase control voltage is applied to the grid of VIA (in NUS 3753-7 units only) through pin 16 of plug P1 to phase-lock the oscillator frequency with that of the combined if output signal. The oscillator also is locked to the frequency of an associated oscillator-multiplier module by signal injection from jack J8 to the internal shield of the tube at pin 5. The output of V1B, developed across the parallel resonant circuit of capacitor C9 and inductor L6, is applied to the following stage.

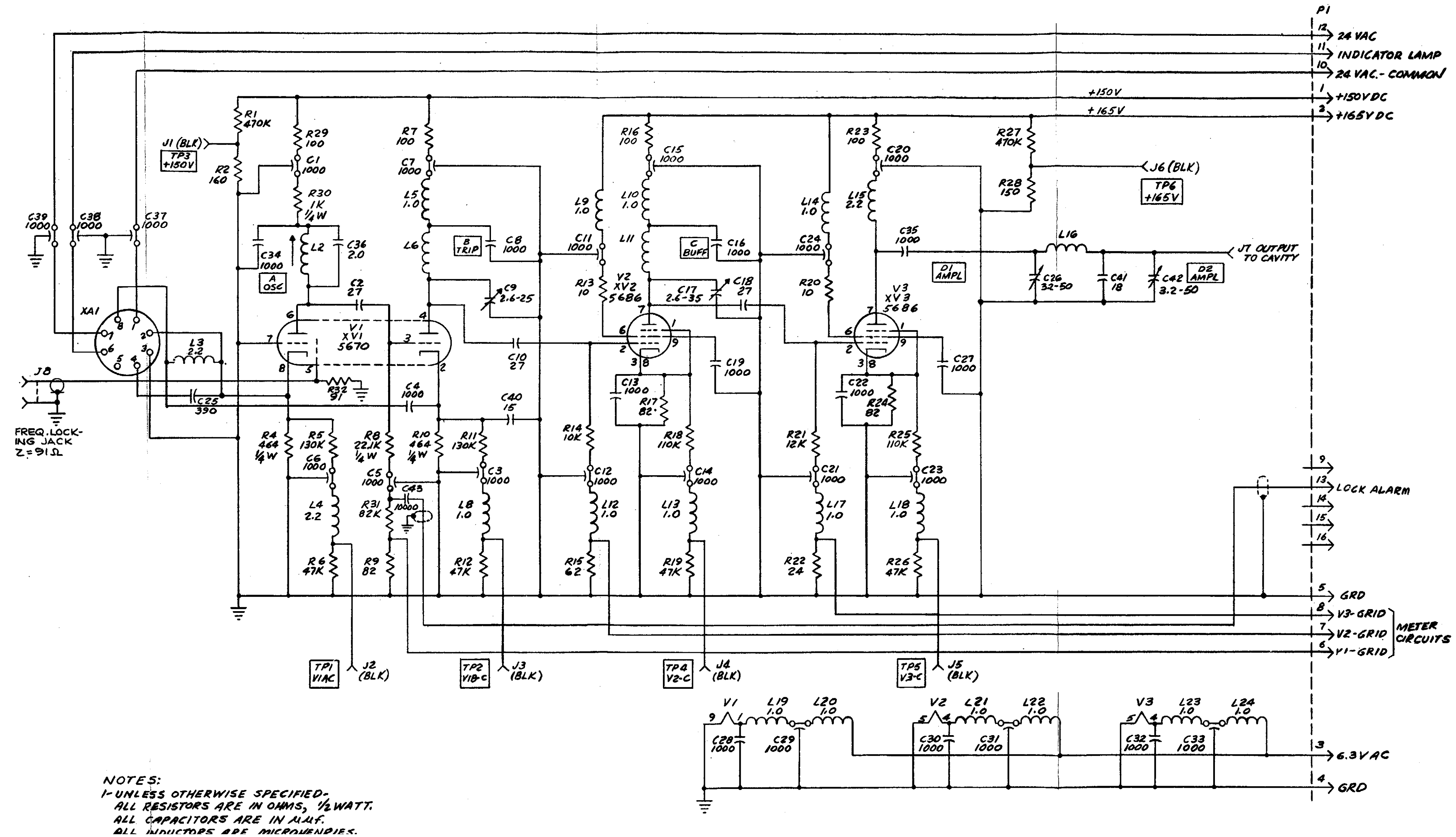
Buffer Amplifier. The signal (approximately 15 mw) developed in the plate circuit of V1B is fed through capacitor C10 to the grid of buffer amplifier V2. Tube V2 is operated class B. The required bias voltages are developed in its grid (grid leak) and cathode circuits., This stage amplifies the signal level to approximately 250 mw and provides isolation between the oscillator and the power amplifier. Its output, developed across inductor L11 and capacitor C17, is coupled through capacitor C18 to the grid of the power amplifier.

Power Amplifier. Power amplifier V3 operates class C. Its biasing voltages are developed in the grid (gridleak) and cathode circuits. The plate output of this stage consists of pinetwork L16 and capacitors C26, C41, and C42. The input level of 250 mw is amplified to an average power between 0,5 and 1.0 watt, depending upon module application and operating frequency. The output of the module is coupled to jack J7, a banana-type connector.



64-454-1

Figure1. Oscillator Multiplier NUS 3753-6, Schematic Diagram



64-454-4

Figure 2. Oscillator Multiplier NUS 3753-7, Schematic Diagram

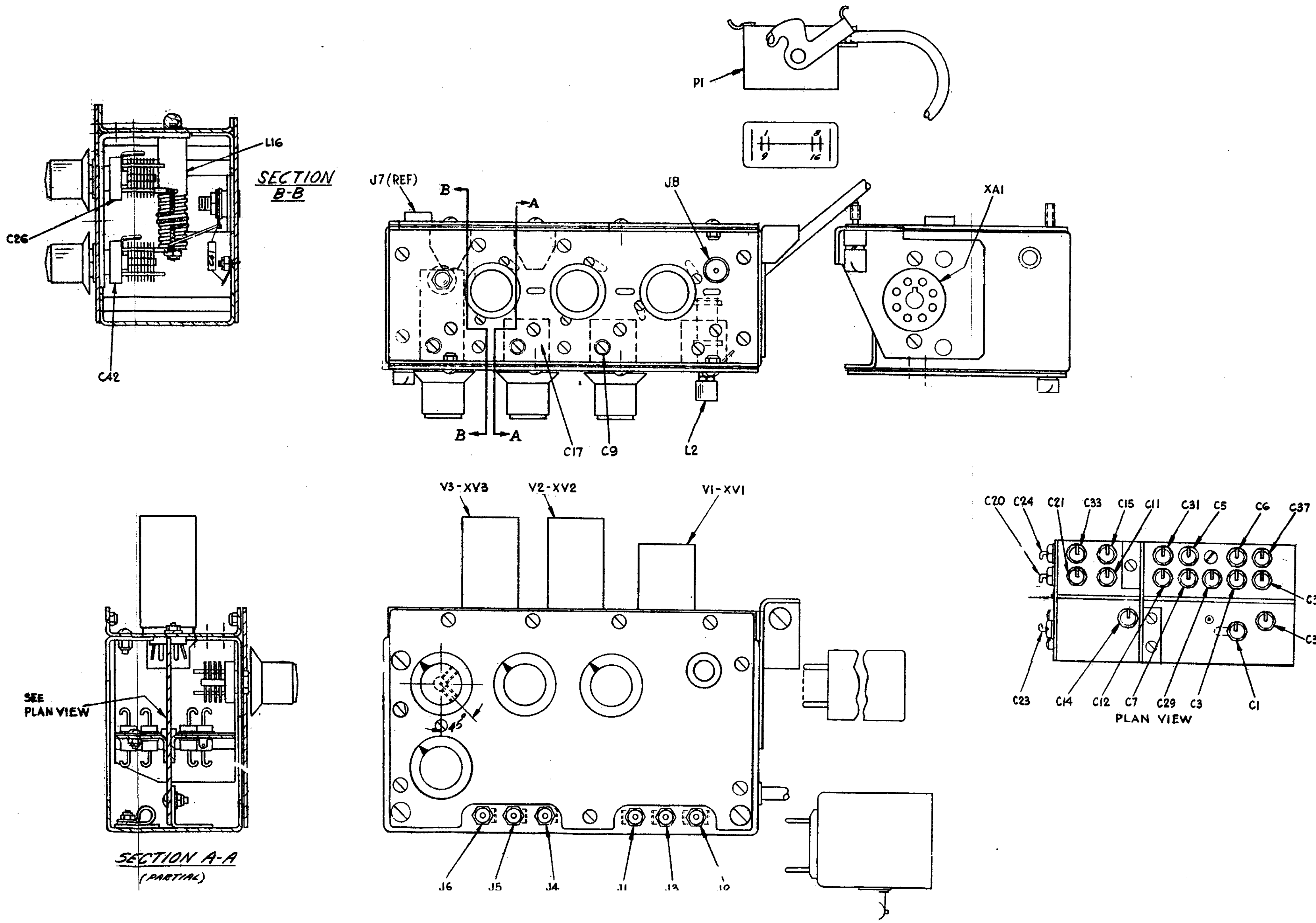


Figure 3. Oscillator Multiplier NUS 3753-6 and NUS 3753-7, Parts Location

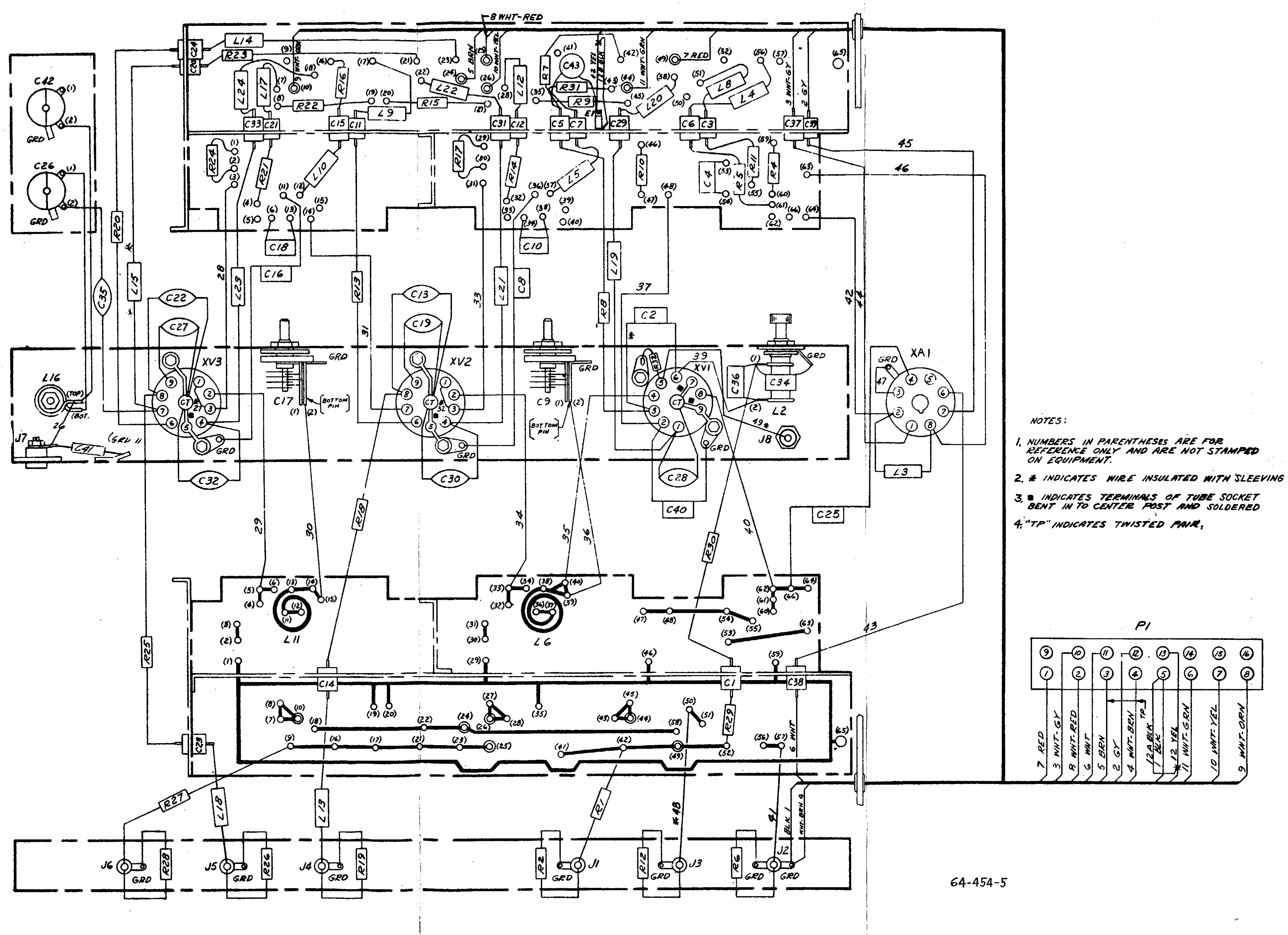


Figure 4. Oscillator Multiplier NUS 3753-6, Wiring Diagram

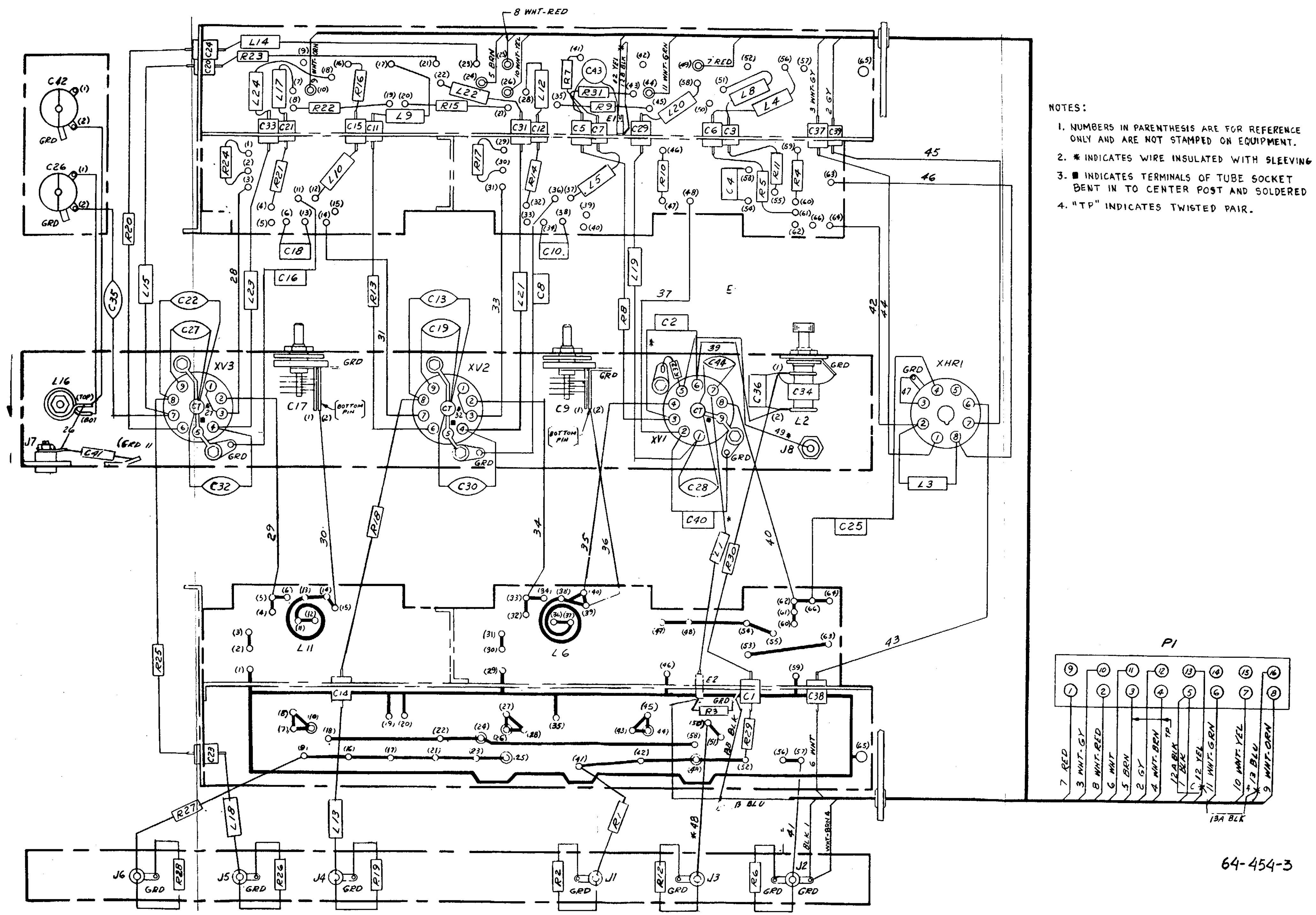


Figure 5. Oscillator Multiplier NUS 3753-7 Wiring Diagram

MIXER-PREAMPLIFIER
NUS 3760-6

DESCRIPTION

The mixer-preamplifier provides a means for mixing local oscillator rf signals to produce a 70-mc if. signal. This signal is then amplified and applied to the if. and baseband drawers. The circuits employed in this unit consist of hybrid mixer Z1, triode amplifiers V1 and V2, and pentode amplifiers V3 and V4. Pertinent characteristics of the module are as follows:

Input frequency	4,400 to 5,000 mc
Input impedance	50 ohms
Vswr	1.6 or less
Output impedance	75 ohms
Intermediate frequency	70 mc
Gain	44 ±4 db
3-db bandwidth	8 mc or greater
Noise figure	9 db or less
Power requirements	+ 150 vdc at 180 ma
	6.3 vdc at 1.2 amp

CIRCUIT DESCRIPTION (Figures 1 through 4)

Hybrid Mixer Z 1

In hybrid mixer Z1, the local oscillator signal is introduced through jack IN J2, and the rf signal is introduced through jack IN J1. The mixing of these two signals at the diodes results in a difference frequency of 70 mc which contains frequency-modulated baseband information.

The two mixer diodes are mounted in sockets on the hybrid mixer printed circuit board and are accessible when the mixer-preamplifier board is removed. Note the difference in polarity between the two crystals; CR1 is a IN21RF diode, and CR2 is a IN21F diode. For tuning purposes, the relative bias on CR1 and CR2 can be monitored at terminals P1-5 and P1-6, respectively.

The combination of L1, C3, L2, and C4 is a low-pass filter designed to remove the 70-mc signal from the CR1 current metering circuit. A similar combination of components (L3, C5, L4, and C6) serves as a low-pass filter for the CR2 current metering circuit. Capacitors C1 and C2 isolate the bias potentials for the two diodes from each other and from the if. signal. The if. output of the mixer is applied to grid of amplifier V1.

Amplifier V1. Amplifier V1 is a 5842 triode amplifier fed by the output of the hybrid mixer. Cathode bias is provided by R1, and the stage is tuned to the 70-mc if. by means of capacitor C9. The plate output is coupled through capacitor C12 to the cathode of amplifier V2. The cathode of V1 is monitored through V1C test point TP9.

Amplifier V2. Amplifier V2 is a 5842 triode amplifier employed as a grounded-grid amplifier. Together with amplifier V1, it forms a cascode preamplifier. Cathode bias is provided by resistor R5 in series with neutralizer coil L9. Tuning is provided by means of fixed-tuned network Z2, which functions as a double-tuned transformer and also provides interstage coupling. The output of network Z2 is connected to the grid of amplifier V3 and can be monitored through the V3G test point. The cathode of V2 can be monitored through the V2C test point.

Amplifier V3

Amplifier V3 is a 5847 amplifier. Cathode bias is provided by resistor R15. The grid of this stage has a dc stabilization potential derived from the voltage divider consisting of resistors R25 and R26 connected between + 150 volts and ground. With this arrangement, a reduction in cathode current produces a corresponding reduction in negative bias on the tube.

Tuning and output coupling is provided by tuned network Z3 (identical to Z2) used with amplifier V2. The output of Z3 is connected to the grid of amplifier V4. The output of V3 can be monitored through V3C test point TP12. The output of the tuned network can be monitored through V4G test point.

Amplifier V4

Amplifier V4 is a 5847 pentode output stage. Cathode bias is provided by R27. The grid of this stage has a dc potential derived from the voltage divider consisting of resistors R25 and R26. With this arrangement, a reduction in cathode current produces a corresponding reduction in negative bias on the tube.

The output of amplifier V4 is fed through capacitor C39 to a tuned circuit consisting of variable inductor L22 and capacitor C22. This circuit is tuned to 70 mc and its output is applied to OUT jack J3. The cathode of V4 can be monitored through V4C test point TP13.

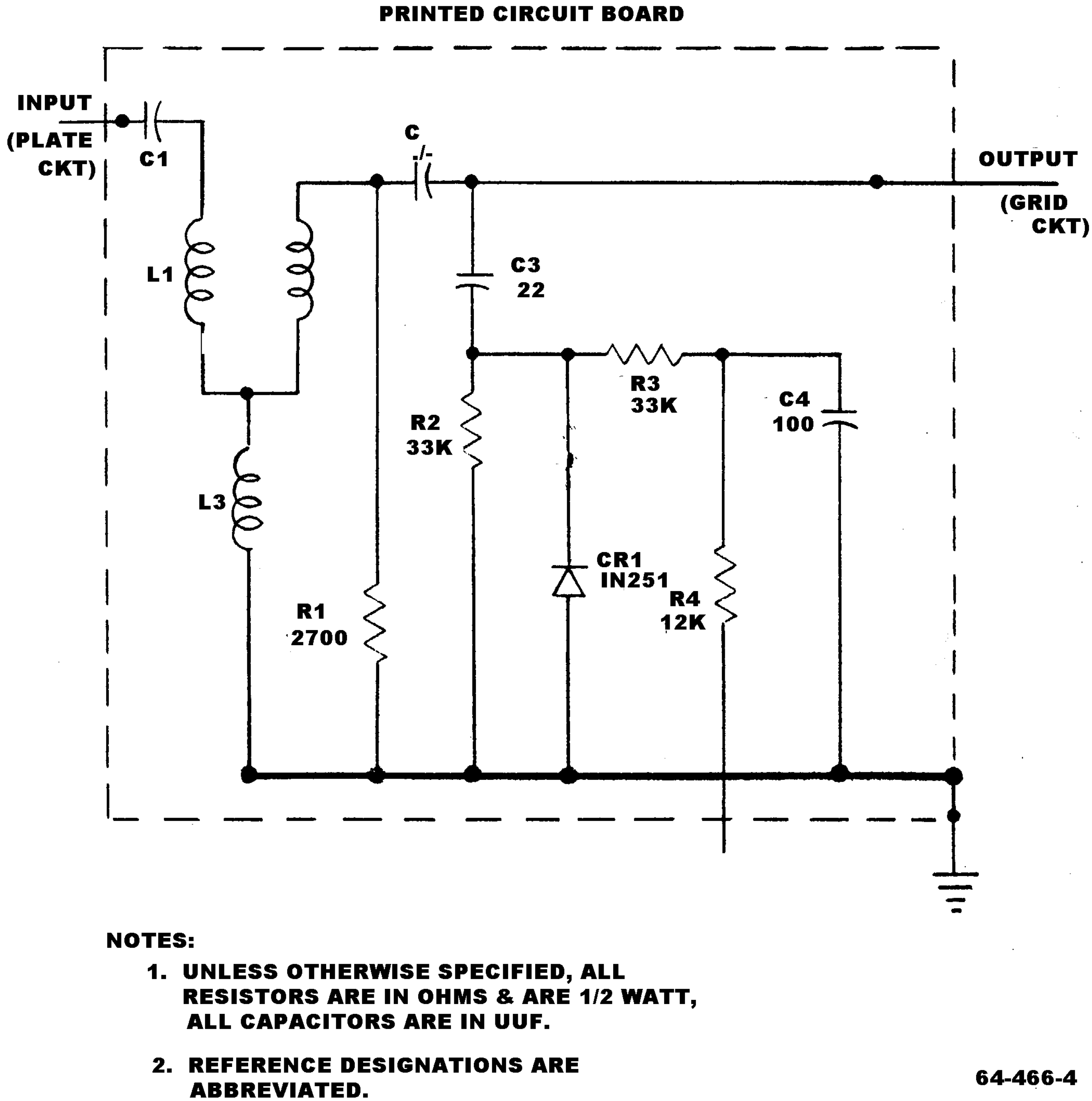


Figure 1. Mixer Preamplifier NUS 3760-6, Tuned Network Z2 andZ3, Schematic Diagram

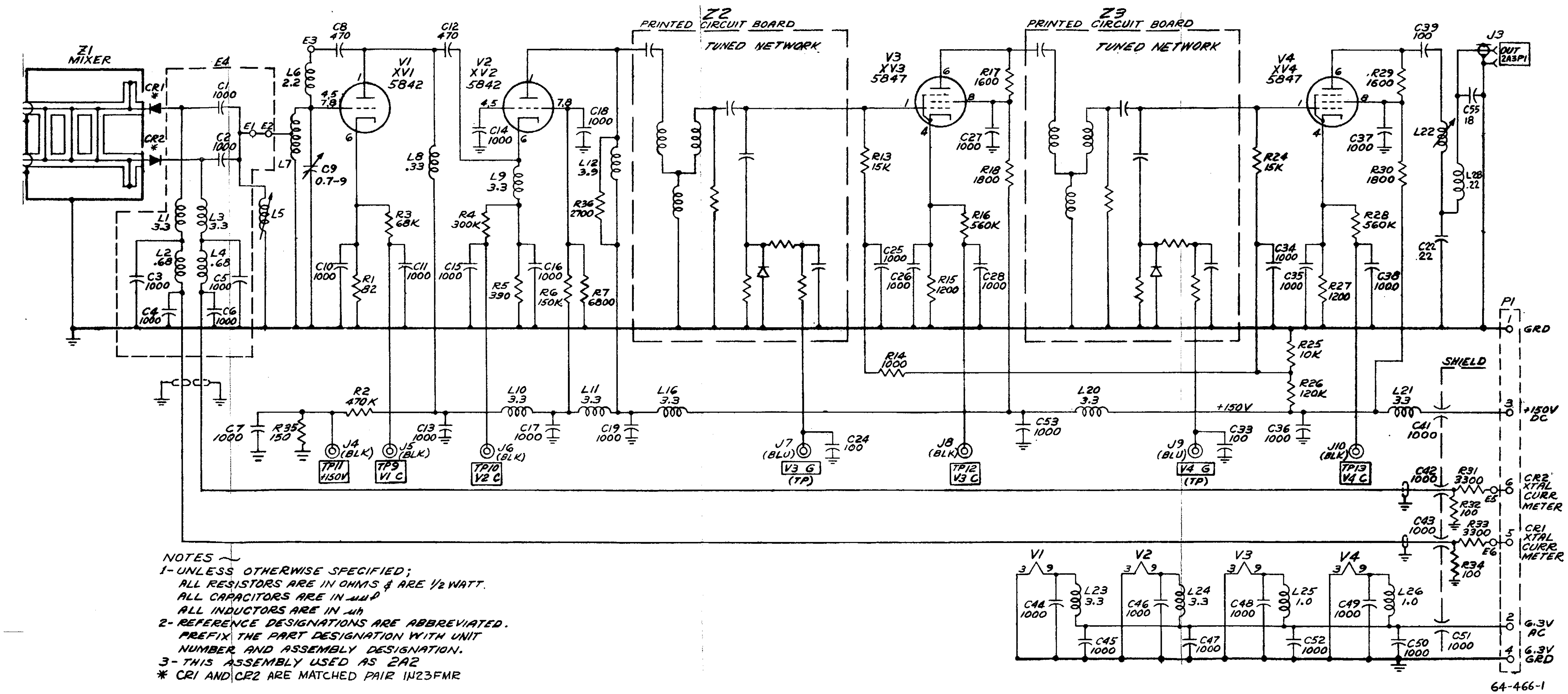


Figure 2. Mixer Preamplifier NUS 3760-6, Schematic Diagram

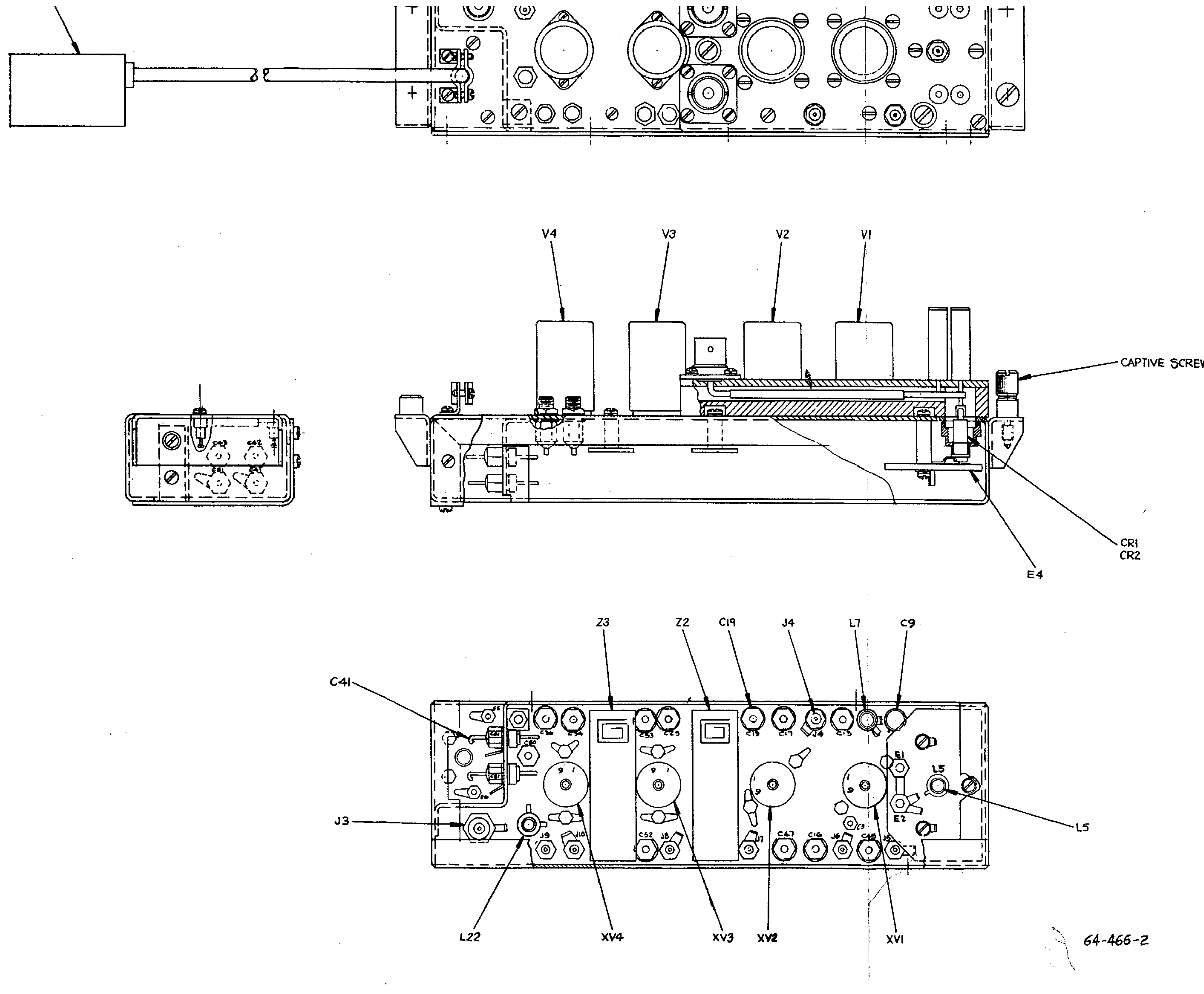


Figure 3. Mixer Preamplifier NUS 3760-6, Parts Location

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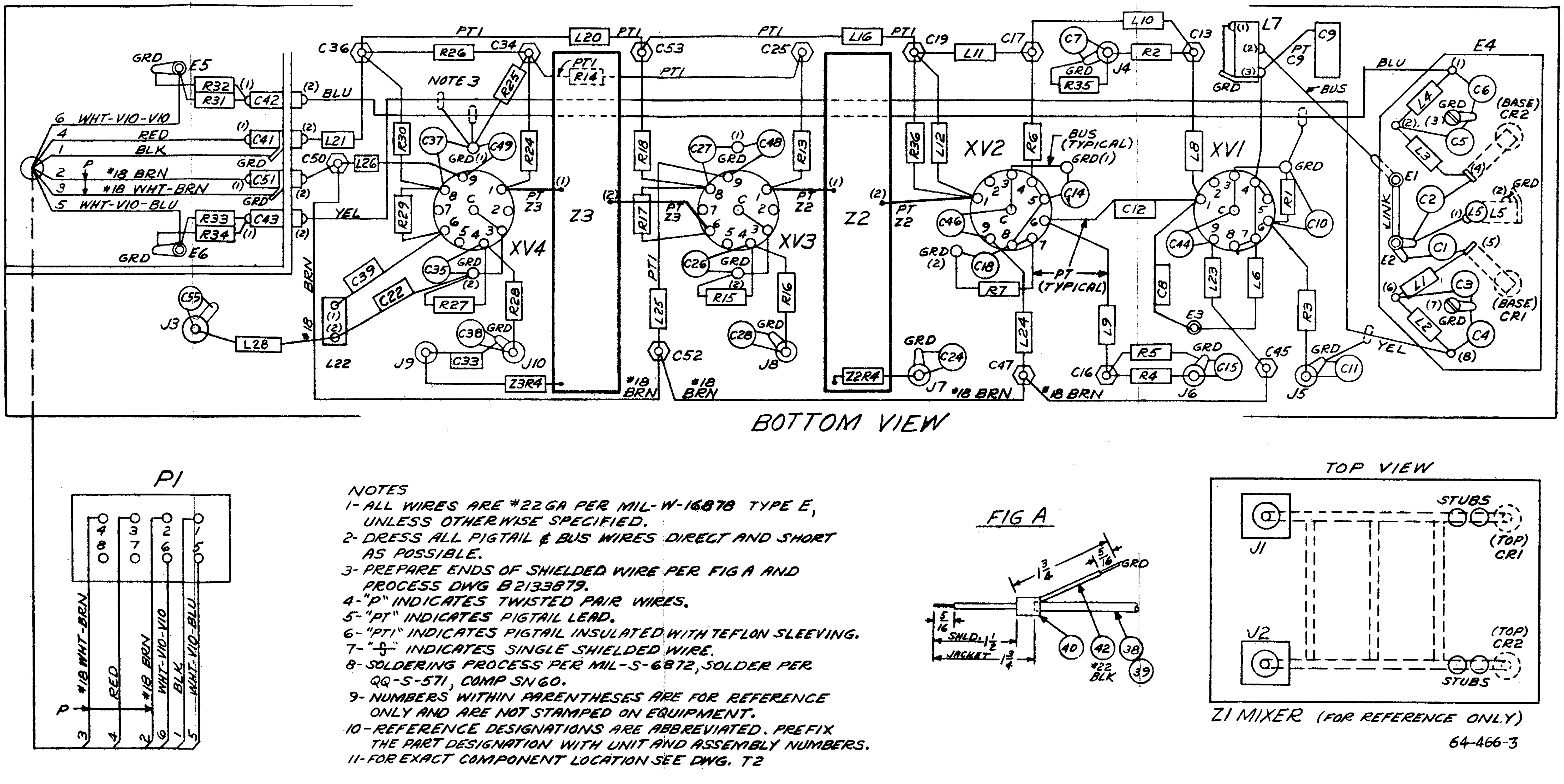


Figure 4. Mixer Preamplifier NUS 3760-6, Wiring Diagram

70-MC IF AMPLIFIER
NUS 3761-5

DESCRIPTION

The 70-mc if. amplifier is used in single conversion receivers. The unit is a six-stage amplifier which amplifies a 70-mc signal and feeds this signal at a nominal level of 0. 5 vrms to the output. The nominal gain of the amplifier is 60 db, with a 3-db bandwidth of 17 mc. The module includes inductive T-network interstage coupling, dc positive-grid stabilization with cathode degeneration, and automatic-gain-control (age) circuits. Pertinent characteristics of this module are as follows:

Center frequency	70 mc
Input level	100 A v to 1.0 volt
Output level	0.5 vrms
Input impedance	75 ohms
Output impedance	75 ohms
3-db bandwidth	17 mc
Voltage gain	60 db nominal
Power requirement	+ 150 vdc at 100 ma
	6.3 vac at 2 amp

CIRCUIT DESCRIPTION (Figures 1 through 4)

Amplifier V1

The 70-mc output signal is fed to INPUT jack J1 on the 70-mc amplifier. From jack J1, the 70-mc signal is applied to the grid of amplifier V1 through parasitic suppressor R79. The input level is adjusted by GAIN potentiometer R80 which, with AGC potentiometer R70, sets the agc gain characteristics. Amplifier V1 is tuned to 70 mc by INPUT coil L1. For tuning, the rectified input signal can be monitored through V1G test point J2.

Cathode bias is provided by resistor R8. The control grid is maintained at a positive dc voltage with respect to ground (negative with respect to cathode). This potential is supplied by agc amplifier Q1 through grid resistor R4 and can be adjusted by AGC potentiometer R70. When the input signal level is low, the grid voltage is high and the quiescent cathode current through cathode resistor R8 provides a small, negative grid-to- cathode bias. When the input signal level is high, the grid voltage supplied by the agc amplifier is reduced. Reduced grid voltage decreases the cathode voltage to a small value. This causes a more negative bias and results in less gain in the stage. To cause the grid to become more negative with respect to the cathode, the cathode is biased by the positive voltage developed across the voltage divider formed by resistors R6 and R8. Capacitor C7 bypasses cathode resistor R8, providing degeneration only for the dc voltage developed across R8. Signal gain remains high.

The plate output of VI is applied to the grid of amplifier V2 through tuned network Z 1, which functions as a double-tuned transformer and provides interstage coupling. The output of the stage can be monitored through V2G test point J4.

Amplifiers V2, V3, and V4. Amplifiers V2, V3, and V4 are similar in design and function to amplifier V1, except that they lack a parasitic suppression resistor in the grid circuits. The tuned networks and test points associated with these amplifiers are as follows:

Amplifier	Tuned network	Grid test point	Cathode test point
V2	Z2	J4	J5
V3	Z3	J6	J7
V4	Z4	J8	J9

Amplifier V5. Amplifier V5 is similar in design and function to amplifiers V2 through V4, except that in place of the agc provision, it employs dc stabilization. This maintains a constant gain of the stage as the tubes age. Since tube aging takes the form of cathode-current reduction, the tube biasing voltages are applied so that a reduction in cathode current is converted into a compensating change in cathode-to-grid bias. This is accomplished by using a high-value resistor, R52, in the cathode circuit and applying a positive potential to the grid. The cathode-resistance-and-grid-voltage combination produces a normal cathode-to-grid bias under initial operating conditions. As the cathode current falls off due to aging, the voltage will decrease proportionally. Since the grid voltage is fixed, the decrease in cathode voltage will cause a reduction in negative bias. The drop in bias will permit an increase in cathode current, which will rise until an equilibrium between bias potential and cathode current is attained. The positive grid potential is applied through grid resistor R50. This potential is developed from the B+ drop across the voltage divider consisting of resistors R71 and R72. The grid and cathode of amplifier V5 can be monitored through V5G and V5G test points J10 and J11, respectively.

Amplifier V6. Amplifier V6 is similar in design and function to amplifier V5 except that in place of a printed-circuit tuned network, an output circuit made up of individual components is employed. This output circuit consists of a single-tuned resonant circuit which includes OUTPUT variable coil L17 and capacitor C57. The output of the if amplifier is applied through OUTPUT jack J16. This output, rectified by diode CR7, can be monitored through OUTPUT LEVEL test point J14. The grid and cathode of amplifier V6 can be monitored through V6G and V6C test points J13 and J15, respectively.

AGC Circuits. The agc circuits include AGC switch S1 and agc amplifier Q1. The agc amplifier receives one of three inputs depending upon the position of S1. With S1 in the EXT position, Q1 receives an agc voltage developed by an external source. In the INT position, Q1 receives a dc voltage proportional to the if amplifier output level. In the OFF position, the base of Q1 is grounded through resistor R74. The portion of the output of Q1 developed at the arm of AGC potentiometer R70 is applied to amplifiers V1 through V4. The entire output of Q1 is applied to terminal P1-2, providing agc cross connections. Relay K1 opens the agc circuit in the absence of +150 volt dc power so that failure of the 150-volt power supply for one drawer will not affect the agc action in the other drawer.

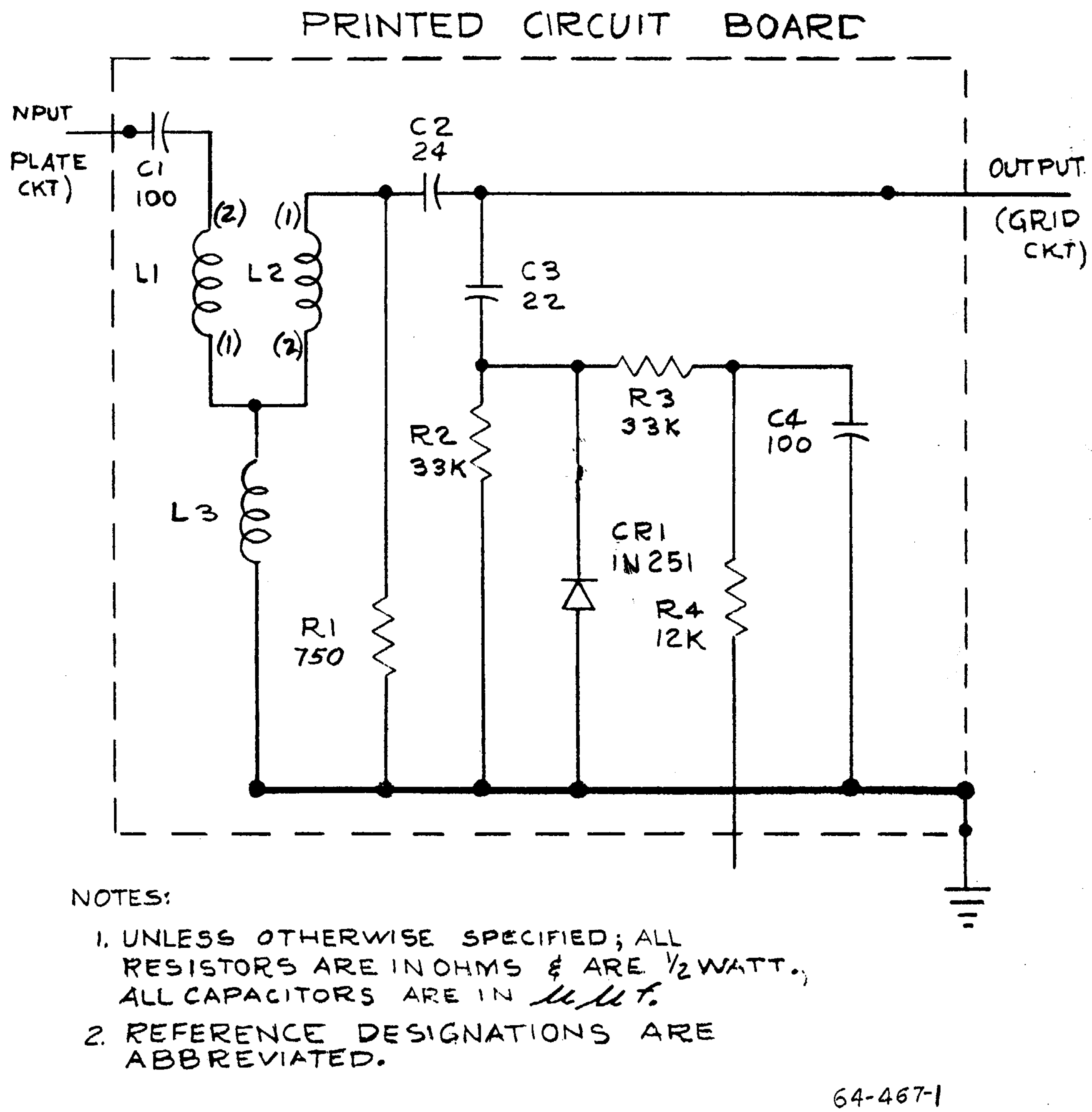


Figure 1. 70-Mc If Amplifier NUS 3761-5, Tuned Network (Z1 through Z5)

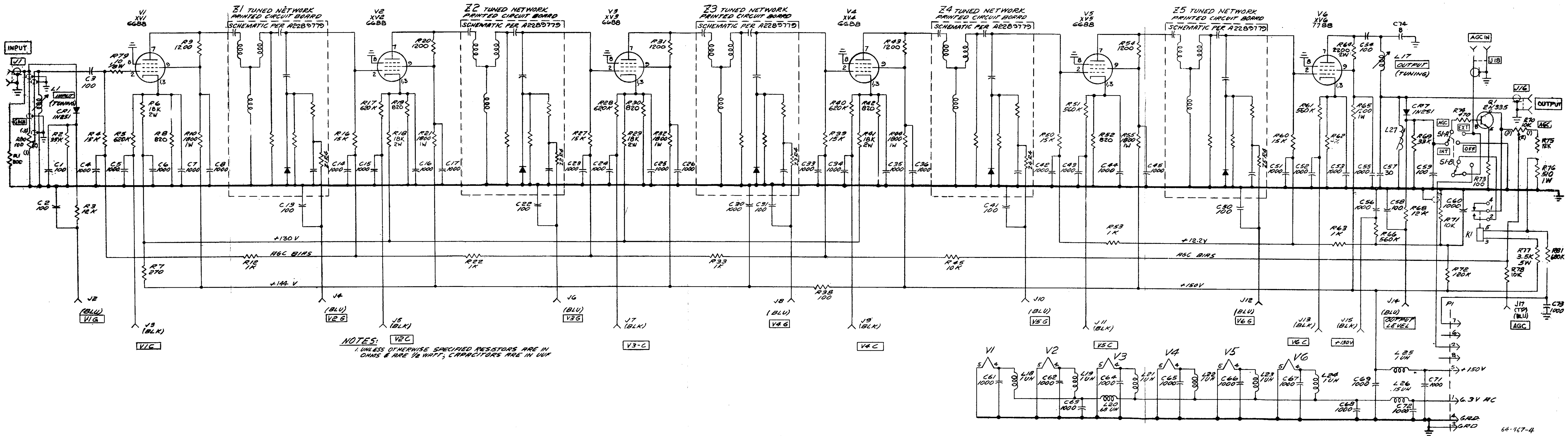
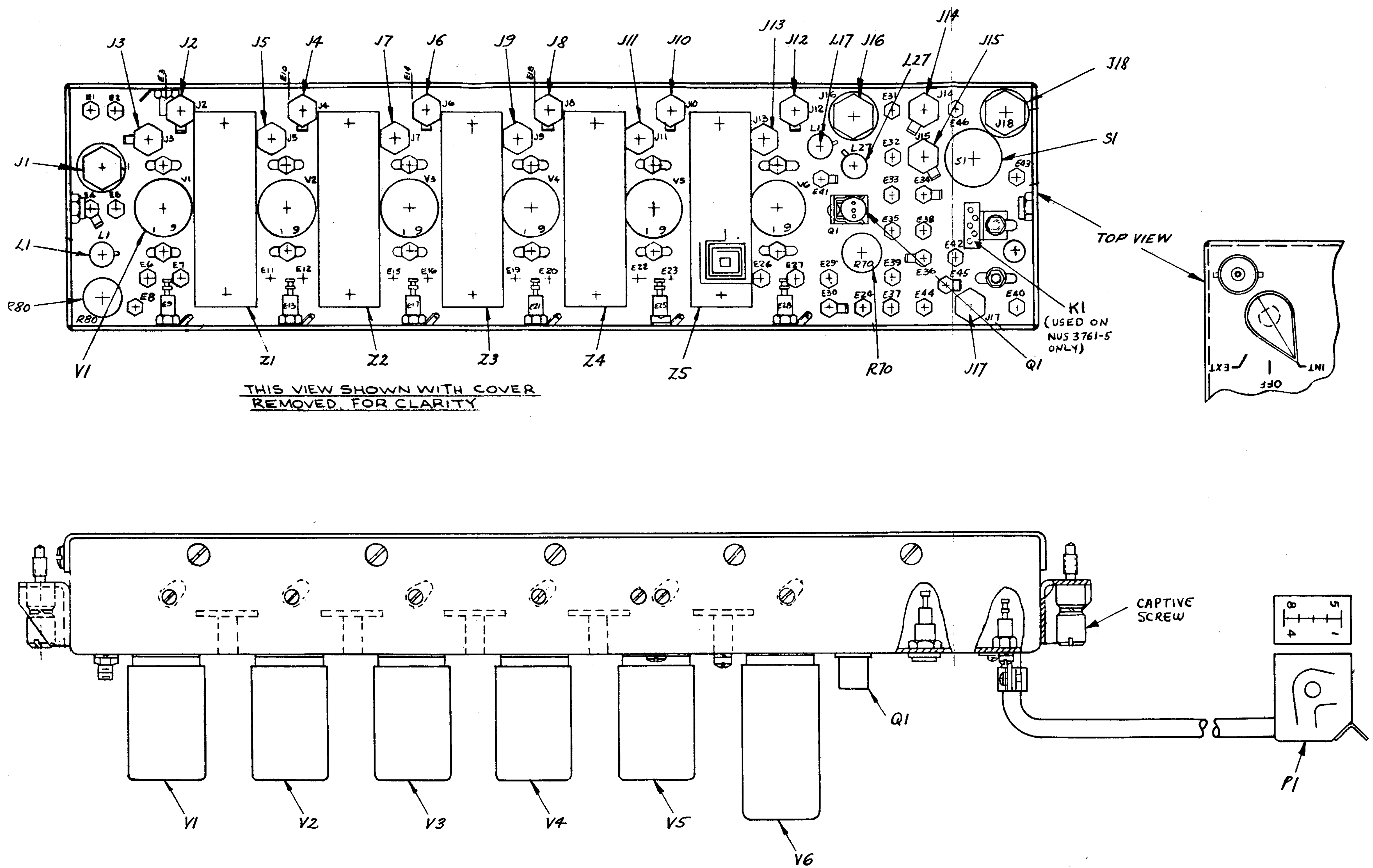
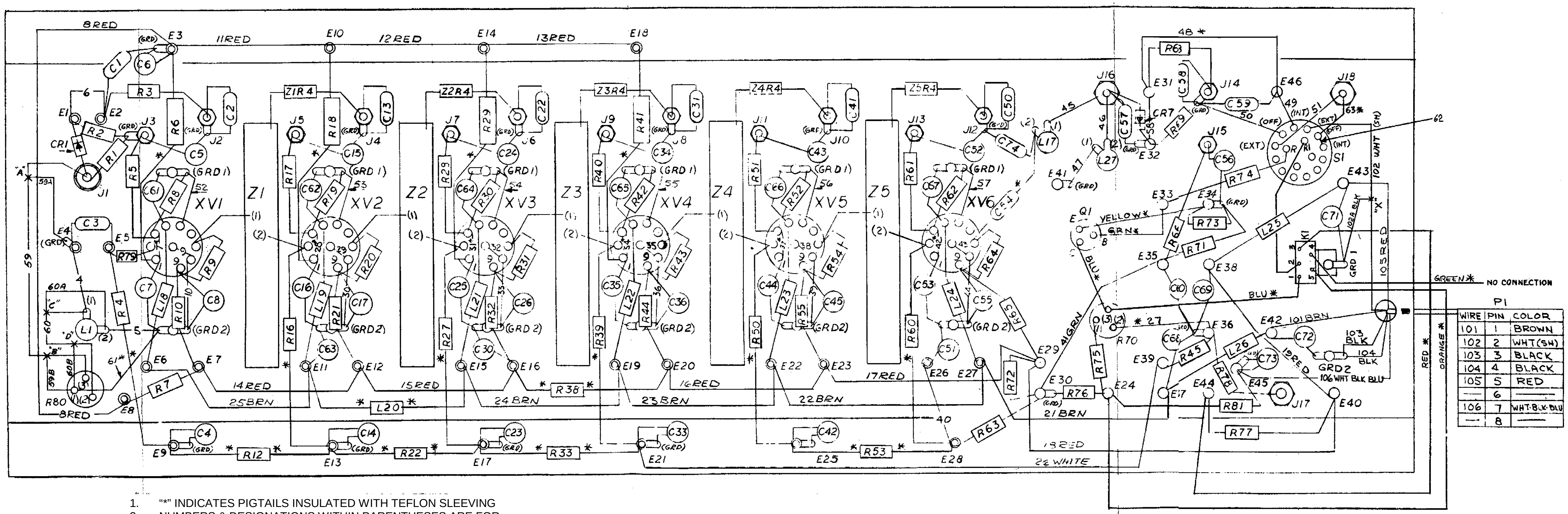


Figure 2. 70-Mc IF Amplifier NUS 3761-5, Schematic Diagram



64-467-2

Figure 3. 70-Mc If Amplifier NUS 3761-5, Parts location



1. "*" INDICATES PIGTAILS INSULATED WITH TEFLON SLEEVING
2. NUMBERS & DESIGNATIONS WITHIN PARENTHESES ARE FOR REFERENCE ONLY.

Figure 4. 70-Mc If Amplifier NUS 3761-5, Wiring Diagram

70-MC DEMODULATOR
NUS 3763-2

DESCRIPTION

The 70-mc demodulator is a module of the single conversion receiver used in tropospheric scatter and line-of-sight microwave links. It is mounted in the if and baseband drawer assembly. The demodulator removes amplitude modulation from a 70-mc intermediate frequency signal by limiting, detects baseband signals from the frequency modulation, and provides the input to de-emphasis and baseband amplifier circuits. The module is a hybrid configuration using both electron tube circuits and semi-conductor printed circuits. Pertinent characteristics of the module are as follows:

If. center frequency	70-mc
Input voltage level	100 mv min.
Input impedance	75 ohms
Output impedance	150 ohms
Sensitivity	0.1 volt/mc
Power requirements	+ 150 vdc at 85 ma
	6.3 vac at 1. 5 a

CIRCUIT DESCRIPTION (Figures 1 through 3)

Tuned Amplifiers. Phase-combined fm signals with a center frequency of 70-mc are received at connector J1 and amplified by tuned amplifier stages V1 through V3. Limiters in the plate circuit of each amplifier limit the amplitude of the amplified signal. Input signals, rectified by diode CR1, can be monitored at INPUT LEVEL test connector J3. Biasing of the tuned amplifiers is developed in the cathode circuits which also provide signal monitoring connections. Variable inducters (L3, L7, and L12) in the plate circuit of each amplifier allow tuning of the stage for optimum coupling of the complex signal. The output of each tuned amplifier is capacitively coupled to a limiter circuit.

Limiters. The first limiter circuit includes diodes CR2 and CR3 with their associated components. The cathode of diode CR2 is connected to a positive potential at the junction of the voltage divider formed by resistors R17 and R19. Positive limiting is effected when positive signal excursions exceed the positive voltage at diode CR2 and cause it to conduct. Grounded diode CR3 provides negative limiting when negative excursions of the output signal exceed the diode forward breakdown voltage and cause it to conduct. A test reference voltage proportional to the current conduction through diode CR3 is developed at connector J5 to indicate the degree of signal limiting. The second and third limiters are functionally identical to the first limiter. Zener diode CR11 sets the positive limiting potential at diodes CR4 and CR6. The output of each limiter is capacitively coupled to the grid of the following amplifier. Limiting is provided at each stage of amplification to prevent appreciable variation of the signal amplitude from reaching the discriminator.

NUS 3763-2

Discriminator. The output of the third limiter stage is applied to the grid of discriminator driver V4. The grid is biased from the same source used to bias diodes CR4 and CR6. This ensures stability of the signal level applied to the discriminator. The output of amplifier V4l is applied to the discriminator transformer (L16-L17) through capacitor C49. When an unmodulated 70 mc if signal is applied to the discriminator transformer secondary (L17), the voltages at each end of L17 are equal and opposite in phase, and 90 out of phase with the voltage across the primary (L16). Therefore, the voltages developed across diode rectifiers CR9 and CR10 are equal, and zero output results. As the input signal changes in frequency, the phase of the voltage developed across the discriminator transformer varies so that the voltage developed across diodes CR9 and CR10 are no longer equal. This produces unequal diode currents, and an output voltage is developed across discriminator load resistor R40. This voltage changes with frequency and becomes positive when the input signal goes above 70-mc and negative when it goes below 70-mc. The discriminator output includes both a baseband and a dc potential. The baseband is coupled through capacitor C57 to the grid of cathode follower V5. The dc potential, representing the relative frequency of the if, can be monitored at DISCR test connector J14.

Cathode Follower. The baseband signal from the discriminator is matched to the output line through twin-triode cathode follower V5. The dc cathode signal voltage is accessible at test connector J13. The baseband signal is coupled through capacitor C64 to OUT connector J2.

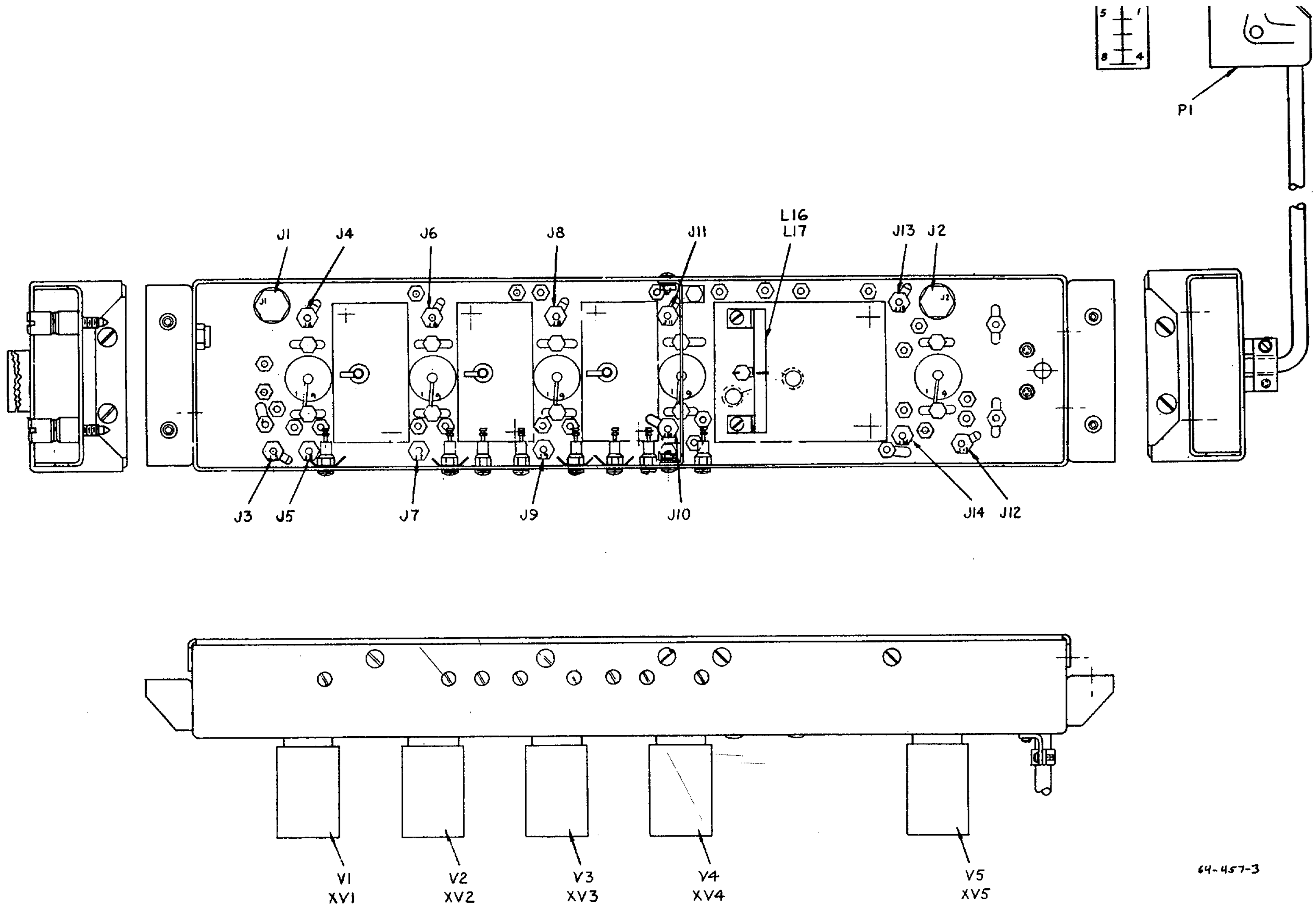


Figure 1. 70-Mc Demodulator NUS 3763-2, Parts Location

Figure 1. 70- Mc Demodulator NUS 3763-2, Parts Location

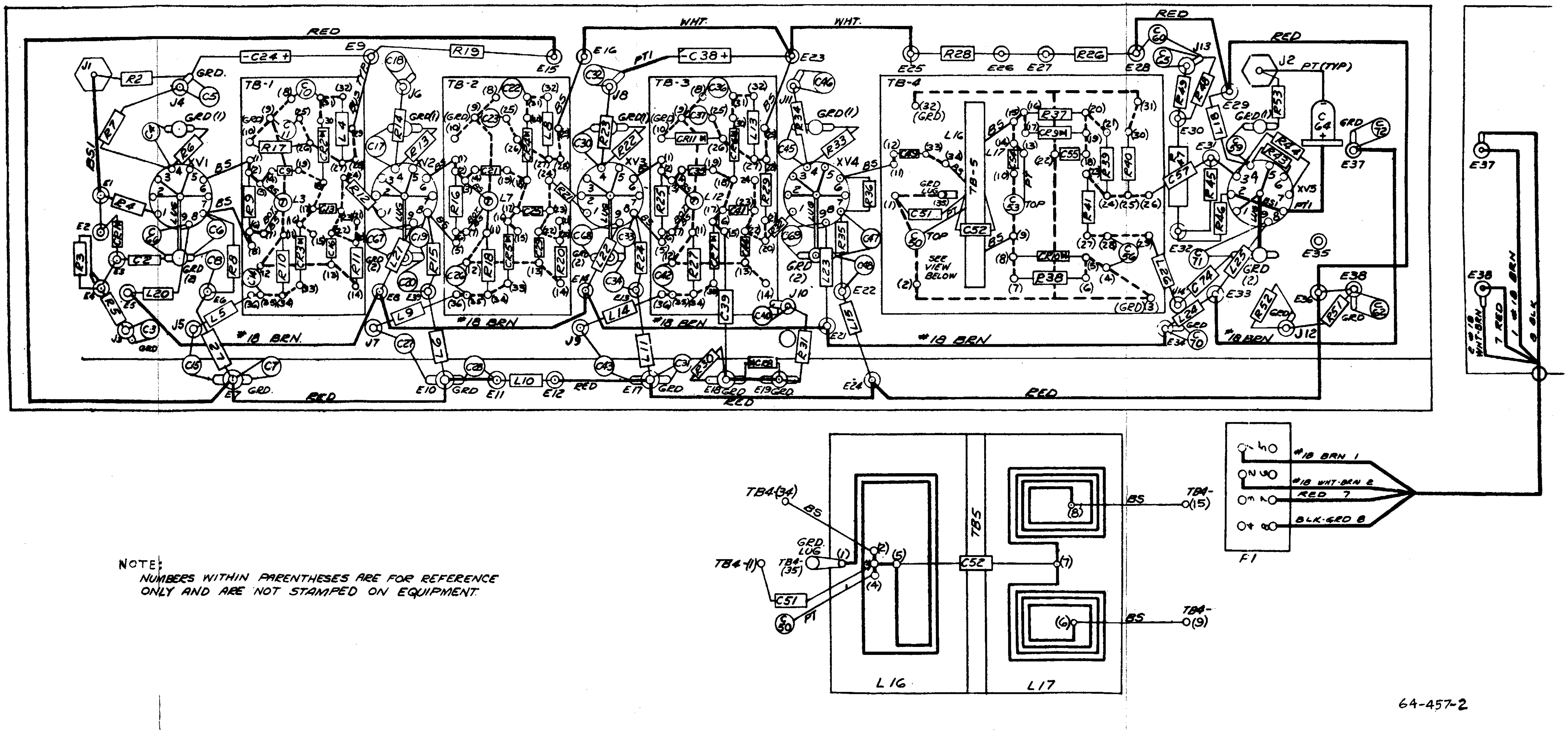


Figure 2. 70.-Mc Demodulator NUS 3763-2, Wiring Diagram

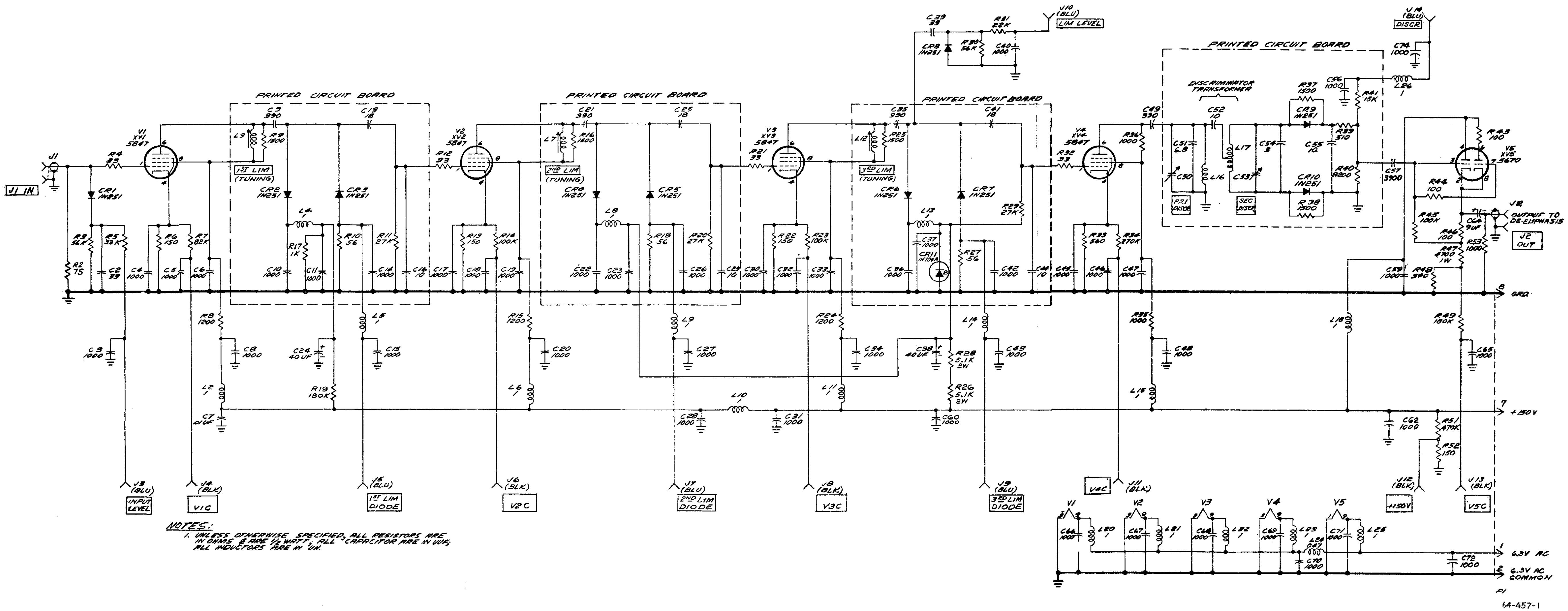


Figure 3. 70-Mc Demodulator NUS 3763-2, Schematic Diagram

FREQUENCY MULTIPLIER
NUS 3765-4

DESCRIPTION

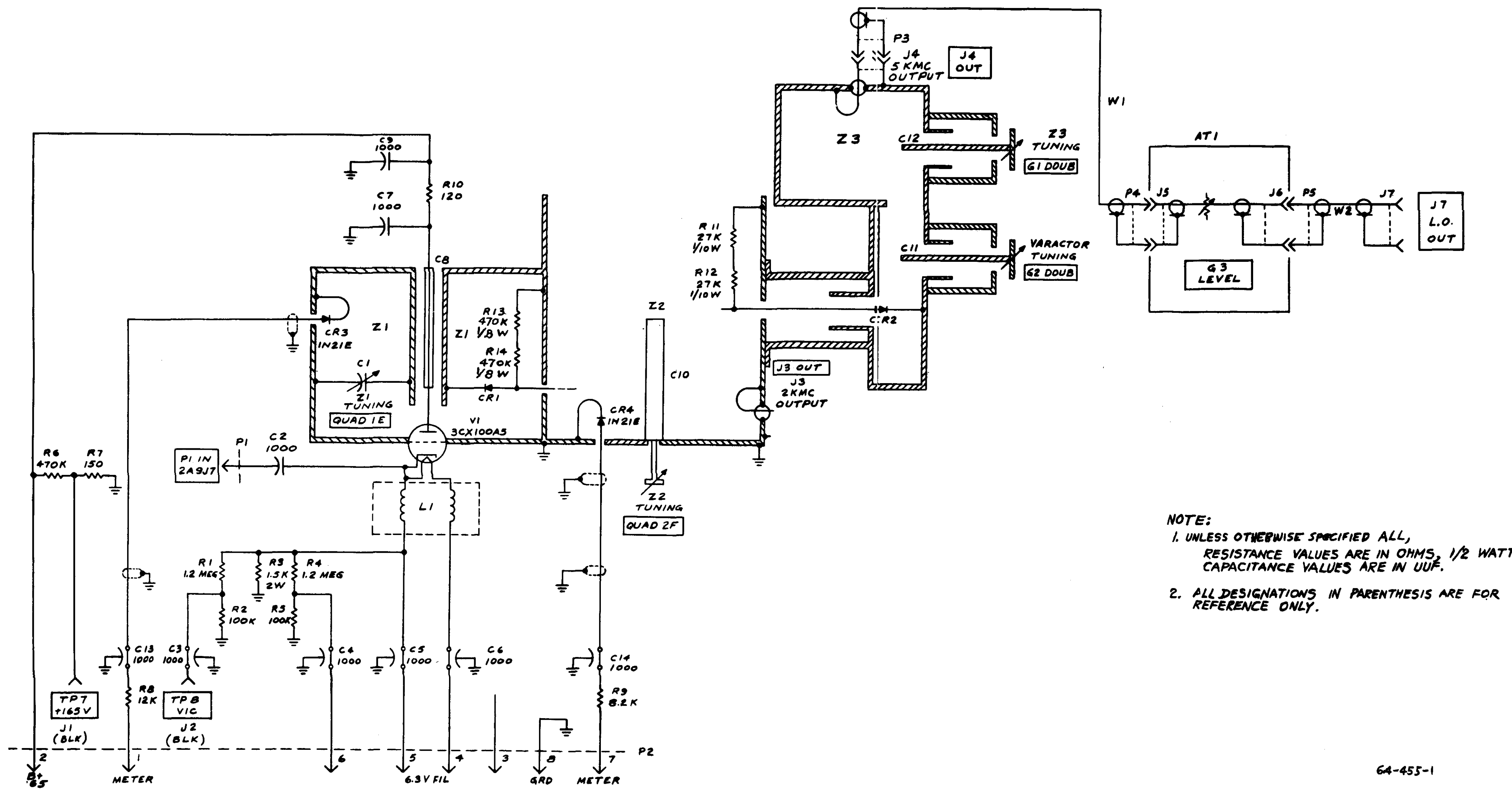
The frequency multiplier forms the final stage of the local oscillator of the dual receiver; it is mounted on the preselector and mixer drawer chassis. The module consists of three waveguide cavity frequency multiplier stages (quadruplers V1 and CR1 and doubler CR2). The output signal of the oscillator-multiplier module provides the input to this unit, which multiplies the frequency by a factor of 32 to the 4. 4 to 5. 0-gc range. Test point metering jacks are provided for the cathode current and plate voltage of the tube. Pertinent characteristics of the frequency multiplier are as follows:

Input frequency range	139. 6875 to 154. 0625 mc
Input signal level	1 w
Input impedance	1950 ohms nominal
Output frequency range	4. 47 to 4. 93 gc
Output power	5 mw minimum
Input power requirements	+165 vdc at 22 ma,
	6. 3 vac at 1 a

CIRCUIT DESCRIPTION (Figures 1 and 2)

Quadrupler Stages V1 and CR1. Triode V1 is a 3CX100OA5 grounded-grid frequency quadrupler mounted in cavity Z1. The grid circuit of V1 is tuned to the fourth harmonic of the input frequency by QUAD 1E capacitive tuning adjustment C1. Varactor diode CR1 is the plate circuit of the amplifier is the non-linear element which distorts the signal to produce harmonic frequencies. The rf energy from CR1 is coupled to cavity Z2, which is tuned to the fourth harmonic of the Z1 output by QUAD 2F capacitive tuning plunger C10. Diodes CR3 and CR4, mounted on probes in Z1 and Z2 respectively, provide monitoring of the two quadruplers. The output of Z2 is coupled to varactor diode CR2.

Doubler Stage CR2. Doubler cavity Z3 is double-tuned to the second harmonic of its in- put by DOU13 G1 and G2 capacitive tuning plungers C12 and C11. Varactor diode CR2 is the non-linear element which produces the harmonics. Energy from Z3 is coupled through an inductive loop to connector J4 and routed through attenuator AT1 to L. O. OUT connector J7.



Frequency 1. Frequency Multiplier NUS 3765-4, Schematic

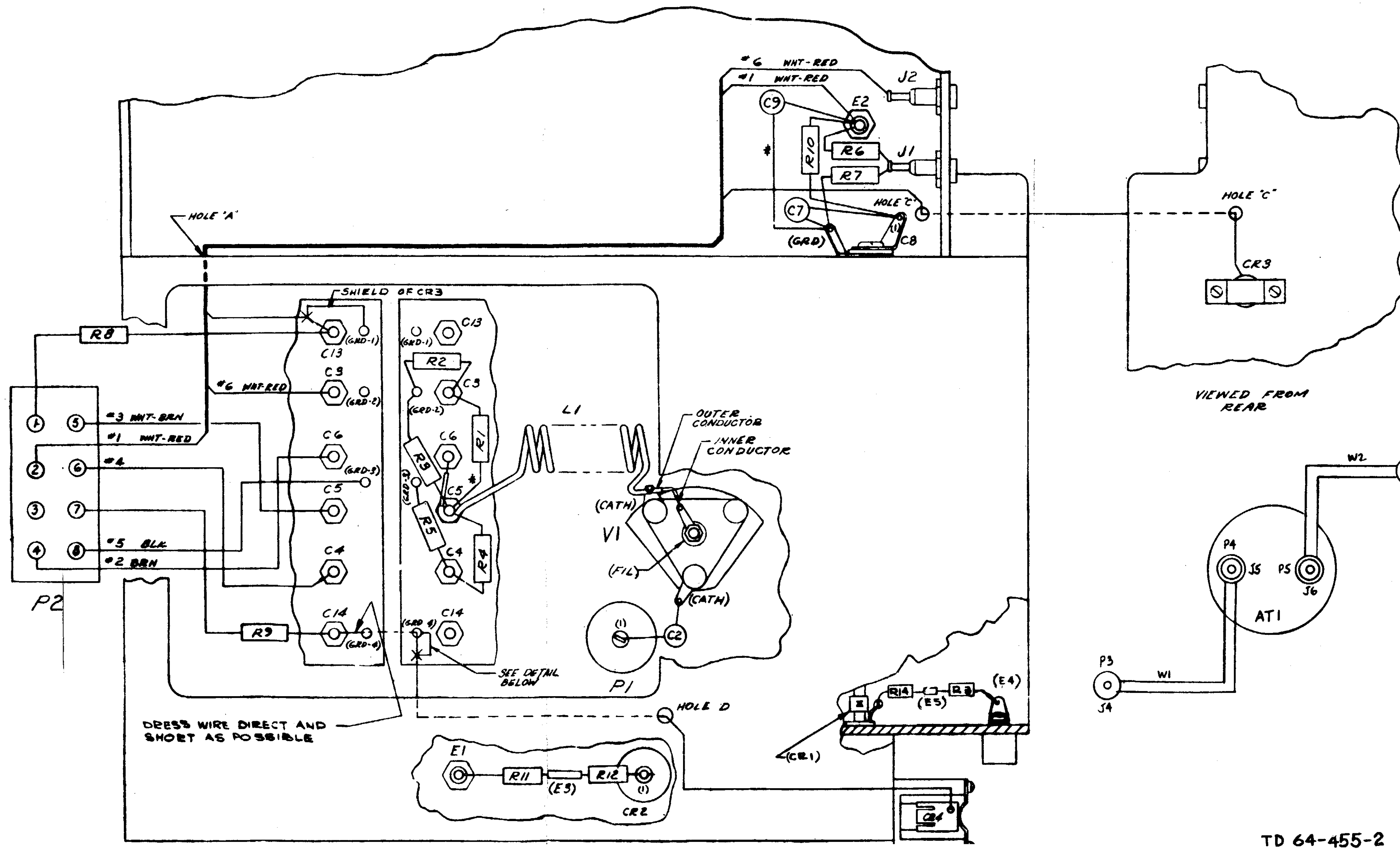


Figure 2. Frequency Multiplier NUS 3765-4, Wiring Diagram

9.8- MC IF AMPLIFIER
NUS 5251-23

DESCRIPTION

The 9.8-mc if. amplifier is a six-stage cascade voltage amplifier. The amplifier receives a 9.8-mc signal from the associated second mixer-local oscillator module (NUS 5251-31) and feeds the signal at a nominal level of 0. 65 vrms to the associated phase combiner module NUS 8316. The gain of the amplifier is approximately 64 db. Design features include inductive tee network interstage coupling, dc positive grid stabilization with cathode degeneration, and internal automatic gain control (agc) circuits. All detail parts of the if. amplifier are mounted in a chassis which is secured in the if. and baseband drawer by captive screws. Pertinent characteristics of the if. amplifier are as follows:

Center frequency	9.8 mc
3 db bandwidth	5 mc
Input level	1 vrms maximum
Output level	0.65 vrms
Input impedance	75 ohms
Output impedance	75 ohms
Voltage gain	64 ± 4 db
Power requirements	+150 vdc at 100 ma; 6.3 vac at 2 a

CIRCUIT DESCRIPTION (Figures 1 and 2)

Amplifiers V1through V4

The 9. 8-mc output from the associated second mixer-local oscillator is fed to IN jack J1 on the if. amplifier. From jack J1, the 9.8-mc if. signal is applied to the grid of amplifier V1 through GAIN control R82 and parasitic suppressor R79. Gain control R82 allows adjustment for the input level which together with AGC control R70, sets the age-gain characteristic. Diode CR1 provides a rectified input level which can be monitored at V1G test point J2.

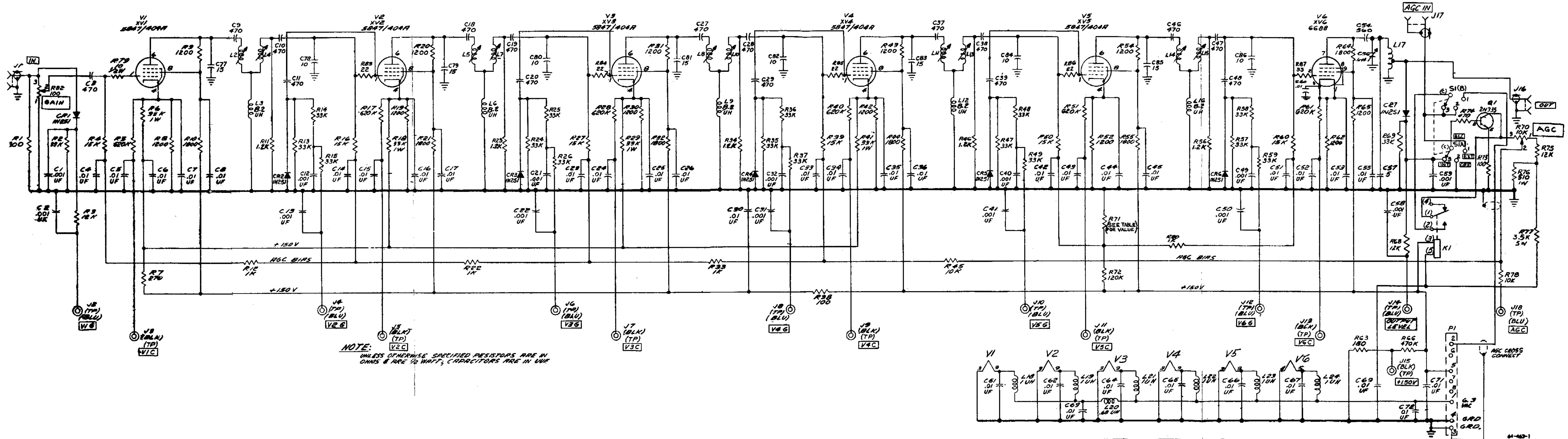
The cathode of V1 is biased at a positive potential developed across resistor R8, which forms a voltage divider with R6. The control grid is maintained at a positive dc potential (negative with respect to cathode) supplied by agc amplifier Q1 through grid resistor R4. During low input signal levels the grid is more positive, resulting in a small bias voltage. During high input signal levels the grid voltage becomes less positive due to the drop in feedback voltage from the agc amplifier. The increase in bias results in a decrease in amplifier gain for high level signals. The cathode voltage can be monitored at V1C, test point J3.

The plate output of V1 is applied to the grid of amplifier V2 through a tuned network (inductors L2, L3, and L4) which functions as a double-tuned transformer and provides interstage coupling. Diode CR2 provides a rectified output of the stage which can be monitored at V2G, test point J4. Amplifiers V2, V3, and V4 are similar in design and function to amplifier V1.

Amplifier V5. Amplifier V5 employs dc stabilization; agc is not provided for this stage. Dc stabilization maintains a constant gain of the stage as the tube ages. Since tube aging results in cathode current reduction, the tube biasing voltages are applied so that a reduction in cathode current is converted into a compensating change in bias. This is accomplished by using a relatively high-value resistor, R52, in the cathode circuit and applying a positive potential to the grid. The cathode resistance and the grid voltage combination produces a normal bias under initial operating conditions. As the cathode current decreases through aging, the cathode voltage decreases proportionally. Since the grid voltage is fixed, the decrease in cathode voltage causes a reduction in bias. The bias reduction tends to increase the cathode current until an equilibrium between bias potential and cathode current is attained. The positive grid potential, applied through grid resistor R50, is developed across resistor R71, which forms a voltage divider with R72. The grid and cathode voltages of amplifier V5 can be monitored through V5G and V5C test points J10 and J11, respectively.

Amplifier V6. Amplifier V6 is similar in design and function to amplifier V5 except that, in place of a three-inductor tuned network, an output circuit consisting of a single inductor and capacitor is employed. The output circuit is a single-tuned resonant circuit which includes tapped coil L17 and variable capacitor C56. The output of the if. amplifier unit is applied through OUTPUT jack J16 to the associated phase combiner. The output, rectified by diode CR7, can be monitored through OUTPUT LEVEL test point J14. The grid and cathode voltages of amplifier V6 can be monitored through V6G and V6C test points, J12 and J13, respectively.

AGC Circuits. The agc circuits include agc amplifier Q1 and its associated components. With AGC switch S1 in the AGC OFF position, the base of Q1 is grounded and the function is inoperative. In the OFF position an external agc voltage can be applied to J17 for alignment purposes. In this position, Q1 is bypassed and the external voltage at J17 is applied directly to the agc bus through AGC potentiometer R70. With S1 in the EXT position Q1 receives the agc input voltage from jack J17. A portion of the output from Q1 is supplied to amplifiers V1 through V4 through AGC control R70. The output of Q1 is also applied to terminal P1-2, providing the agc cross connection for diversity operation. With S1 set to AGC INT, transistor Q1 receives its input from amplifier V6. Relay K1 opens the agc cross connect circuit in the absence of + 150 vdc power so that failure of the 150-volt power supply for one drawer will not affect the agc action in the other drawer.



PART NO.	R71 VALUE
2282905G1	1200 OHMS
2282905G2	5100 OHMS

Figure 1. 9.8- Mc If Amplifier NUS 5251-23, Schematic Diagram

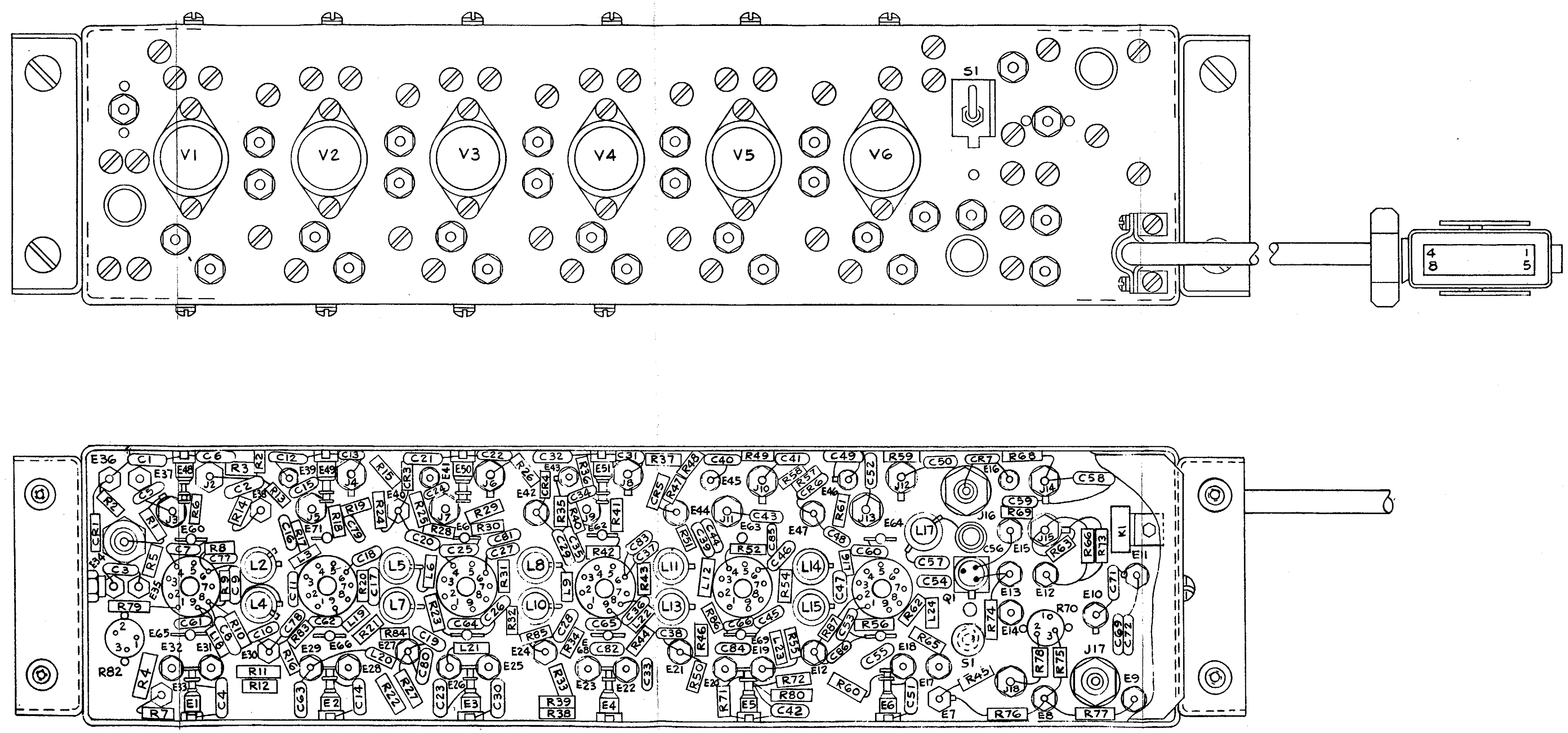


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Figure 2. 9.8-Mc If Amplifier NUS 5251-23 Parts Layout

SECOND MIXER-LOCAL OSCILLATOR
NUS 5251-31

DESCRIPTION

The second mixer-local oscillator is used in single channel, double conversion receivers. It receives a 70-mc if. signal and mixes it with a locally generated 60.2-mc rf signal to produce a 9. 8-mc if, signal. Automatic phase control (apc) circuitry is provided in the module for control of the if,signal frequency. The second mixer-local oscillator is mounted in the if, and baseband drawer. Pertinent characteristics of this module are as follows:

Input frequency	70 mc
Output frequency	9.8 mc
Input impedance	75 ohms
Output impedance	75 ohms
Power requirements	6.3 vac at 1.5 amp
	+5 vdc at 75 ma
	-30 vdc at 75 ma
	+150 vdc at 50 ma

CIRCUIT DESCRIPTION (Figures 1 through 3)

Oscillator. The oscillator employs grounded-base amplifier Q1, emitter follower Q2, and the tuned tank circuit consisting of inductor L3, variable capacitor C6 (L. O. FREQ tuning control), capacitors C7 and C8, and varactor diode CR1. Oscillation is produced by coupling the signal from the collector of Q1 to its emitter through the tuned tank circuit and Q2. Sufficient positive feedback is provided by resistors R4, R6, and R7 to overcome circuit losses and sustain oscillation. The oscillator frequency may be monitored at L. O. FREQ connector J1. Automatic phase control (apc) of the oscillator is maintained by varactor diode CR1, which is connected in parallel with the oscillator tuned circuit. Diode CR1 is a device that exhibits the characteristics of a variable capacitor when it is reverse biased. The initial reverse-bias condition, which corresponds to zero apc voltage input, is established by the setting of 0 ERROR control R5. When an apc voltage is present at APC IN connector J3, it changes the reverse-bias condition for CR1 in accordance with its level and polarity. This action produces a corresponding capacitance change in the oscillator tuned circuit, thereby changing its resonant frequency.

Buffer Amplifier. Buffer amplifier Q3, a grounded-base amplifier, receives the oscillator output and drives grid No. 3 of mixer tube V1. The local oscillator signal, appearing across resistor R6 in the emitter load of Q2, is applied to the emitter of Q3 through resistor R10. The output of Q3 is applied to grid No. 3 of V1 through capacitor C15. Output tuning is accomplished by means of variable inductor L5, the L. O. OUT tuning control. The rectified output of Q3 may be monitored at L. O. OUTPUT test point J2.

Frequency Mixer. Frequency mixer V1 is a type 6AS6 mixer tube. The output of buffer amplifier Q3 is applied to grid No. 3, and the 70-mc if. signal appearing at 70 MC IN connector is applied to grid No. 1. As a result of this mixing, a 130.2-mc sum frequency and a 9. 8-mc difference frequency appear at the plate of V1. These frequencies are applied to an associated gaussian bandpass filter through connector P2. The bandpass filter rejects the sum frequency and passes the difference frequency to output amplifier V2. The output of V1 is tuned by variable capacitor C39. GAUSSIAN FILTER TUNE test point J8 provides a means of monitoring the output of V1. The output of the bandpass filter is tuned by variable inductor L14 (MIXER TUNING control). T he cathode of V1 may be monitored at V1C test point J4.

Amplifier. Amplifier V2 amplifies the 9. 8-mc output of the bandpass filter to a level suitable for use by the associated 9. 8-mc if, amplifier. The output of V2 is applied to the associated if. amplifier through OUT connector J6. Output tuning is accomplished by means of variable capacitor C37 (AMPL TUNE control). AMPL TUNE test point J12 provides a means of monitoring the rectified output of V2. The cathode of V2 may be monitored at V2C test point J10.

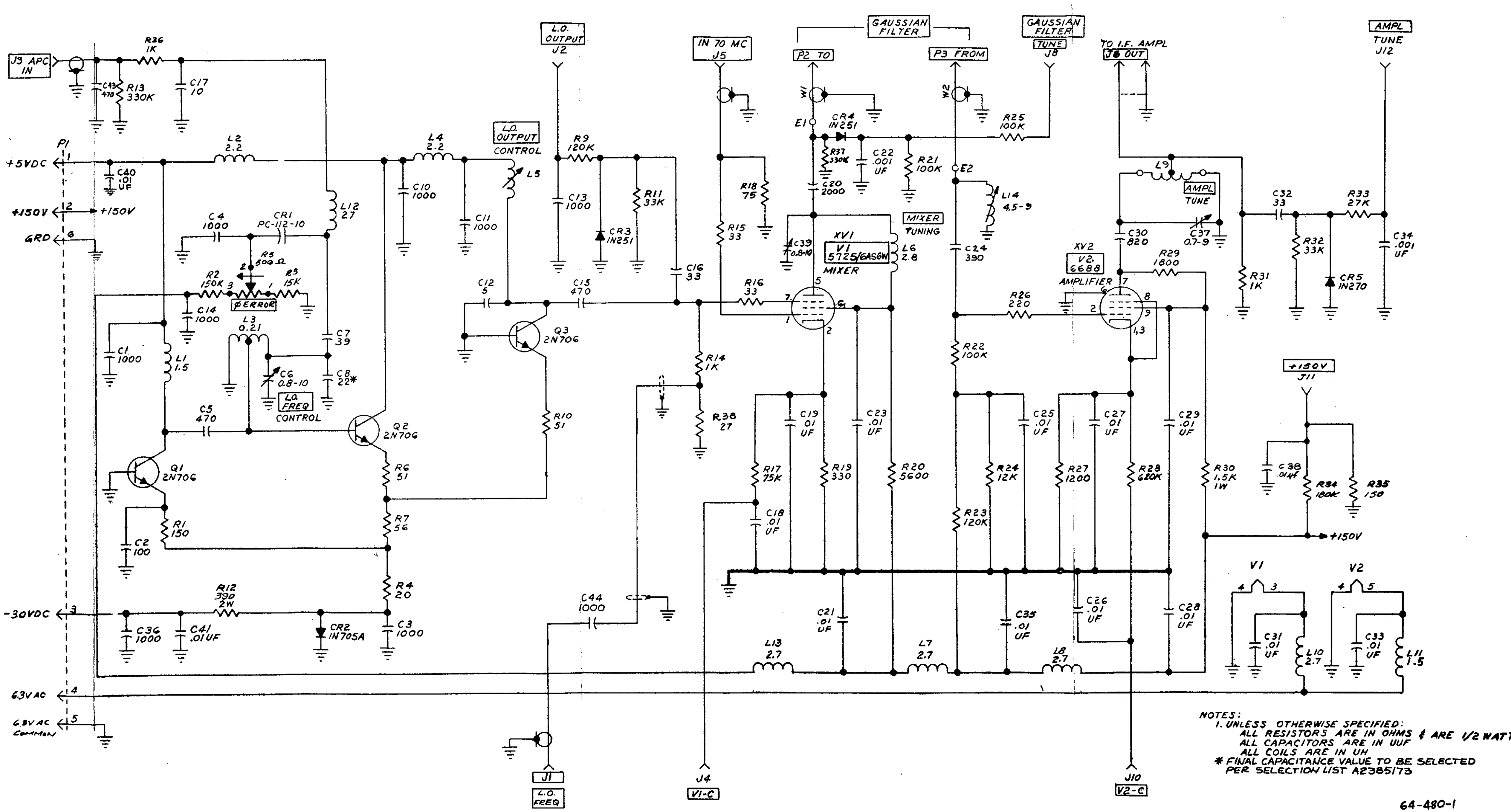

Figure 1. Second Mixer- Local Oscillator NUS 5251-31, Schematic Diagram

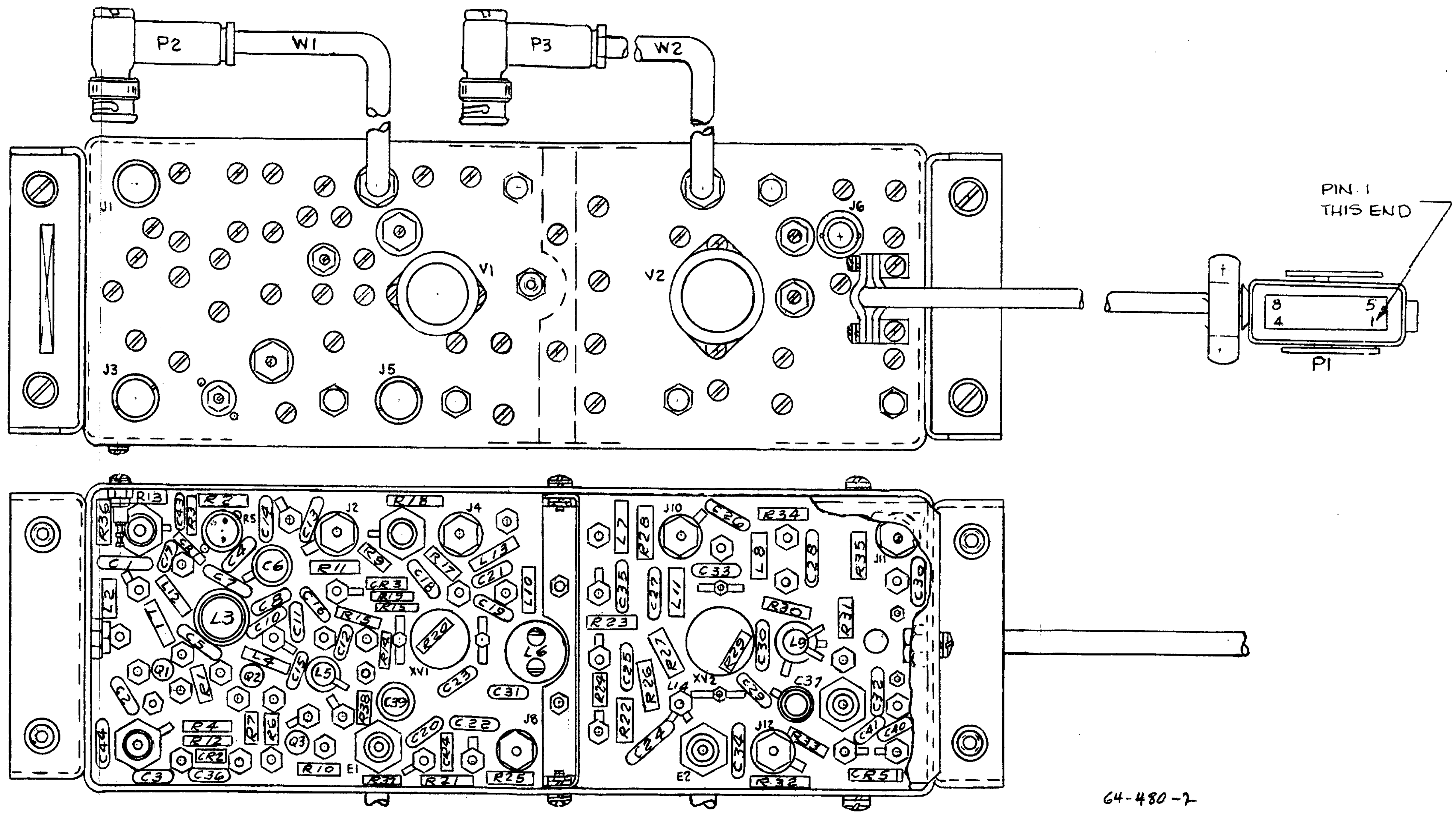

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Figure 2. Second Mixer- Local Oscillator NUS 5251-31, Parts Location

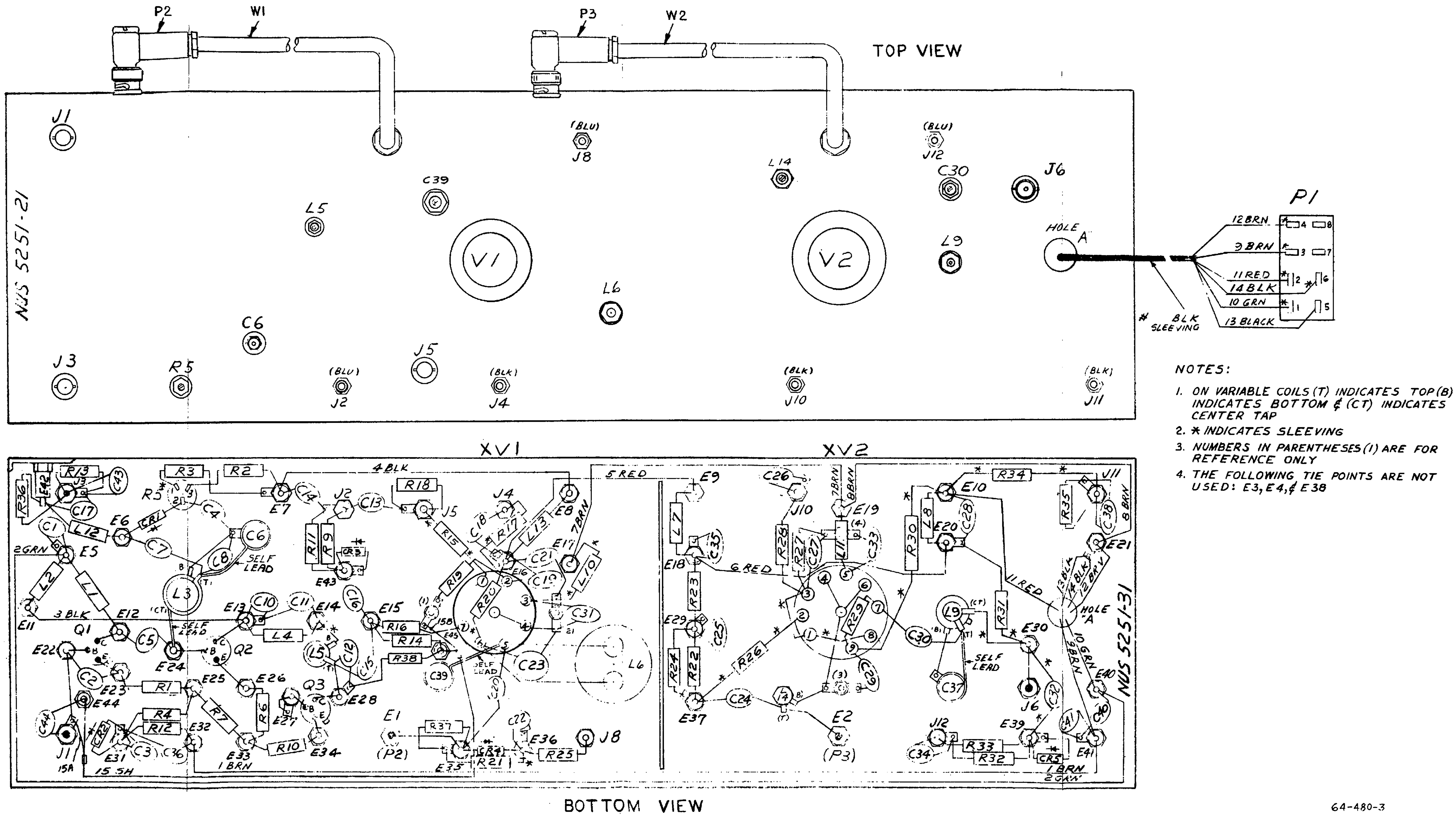

Figure 3. Second Mixer-Local Oscillator NUS 5251-31, Wiring Diagram

9.8-MC DEMODULATION
NUS 5252-31

DESCRIPTION

The 9. 8-mc demodulator contains four amplifier stages, three limiter stages, a Foster-Seeley type discriminator, a cathode-follower output stage, and associated components. The de- modulator accepts a 9. 8-mc frequency-modulated signal, limits the amplitude of this signal, demodulates the signal with low distortion, and couples the baseband thus recovered through a cathode follower to the following module. Three stages of amplification are employed, each followed by a limiter stage, to prevent any significant amplitude variation of the signal from reaching the discriminator. The output of the third limiter is amplified further before being fed to the discriminator. Pertinent characteristics of the demodulator are given below:

Center frequency	9.8 mc
Input level	0. 65 vrms
Input impedance	270 ohms
Output impedance	100 ohms
Discriminator bandwidth	1.4 mc
Sensitivity	1.0 v/mc
Power requirements	+150 vdc, 100 ma 6.3 vac, 1.9 amp

CIRCUIT DESCRIPTION (Figures 1 through 3)

Input Circuit. The 9. 8-mc input signal is fed to the module through IN jack J1 and passes through suppressor resistor R4 to the grid of first amplifier V1. The signal can be monitored at INPUT LEVEL test point J2, where it appears after detection by detector consisting of CR1, CR2, C1, R2, and R3.

First Amplifier V1 and Limiter CR2, CR3

Amplifier V1 is a type 5847 pentode. Resistor R1 is the grid load and inductor L9 tunes the grid circuit. Cathode bias is furnished by resistor R7 which is bypassed by capacitor C3. The plate circuit of V1 is tuned by inductor L1 which resonates with the circuit and tube capacitance's. The cathode voltage of V1 can be monitored at test point J4. The first limiter (diodes CR2 and CR3) is part of the plate load of V1. At low signal levels, V1 operates as a conventional tuned amplifier since diode conduction is negligible. At higher signal levels, the peak-to-peak plate voltage swing of V1 exceeds difference in bias between CR2 and CR3 and each diode conducts during part of the cycle. Diode CR2 conducts during the positive half cycle, clamping the positive peak to the bias voltage established by zener diode CR11. Diode CR3 conducts during the negative half cycle, clamping the negative peak to ground. The peak-to-peak swing is thereby limited to the level of the bias voltage established by CR11. The output of the first limiter is passed through a capacitive voltage divider (C10 and C11) which sends approximately one-third of limiter output voltage to second amplifier V2.

Second Amplifier V2 and Limiter CR4, CR5

Amplifier V2 also employs a type 5847 pentode. Except for the inclusion of a capacitor (C11) and the omission of an inductor in its grid circuit, it operates in exactly the same manner as first amplifier V1. The cathode voltage of V2 can be monitored at test point J5.

The second limiter (diodes CR4 and CR5) operates in an identical manner to the first limiter, limiting the positive and negative peaks in the plate voltage swing of V2 to the bias voltage established by CR11. The output of the second limiter is applied to third amplifier V3 the capacitive voltage divider consisting of capacitors C19 and C20.

Third Amplifier V3 and Limiter CR6, CR7

Amplifier V3 also employs a type 5847 pentode. Its operation is identical to that described for second amplifier V2. The cathode voltage of V3 can be monitored at test point J6.

The third limiter (diodes CR6 and CR7) operates in an identical manner to that described for the first limiter, limiting the positive and negative peaks in the plate voltage swing of V3 to the bias voltage established by CR11. The output of the third limiter is applied to fourth amplifier V4. The level of the signal obtained from the third limiter can be monitored at test point J7.

Fourth Amplifier V4. Fourth amplifier V4, is a type 6CL6 pentode. It furnishes gridleak bias limiting as well as amplification. Operation of the third limiter draws grid circuits from V4, developing a voltage across unbypassed grid-load resistor R34. Resistor R34 is a part of the grid network that includes resistors R35 and R36, bypass capacitors C40 and C43, and decoupling inductor L13. Because this bias voltage is proportional to the input signal level, it is degenerative and tends to suppress any amplitude-modulation component of the signal that may be present. The output of V4 is fed to the primary of discriminator transformer L8. The cathode level of V4 can be monitored at test point J8.

Discriminator CR9 and CR10. The discriminator stage uses diodes CR9 and CR10, operating in conjunction with double-tuned discriminator transformer L8 and related components to form a modified Foster-Seeley circuit. The limited 9. 8-mc if. signal from fourth amplifier V4 is applied to the primary of L8, which is resonated to 9.8 mc by C39. The secondary of L8 is tuned to the if. by C45. The top of the primary is connected to the center tap of the secondary. As a result of this connection, the voltage applied to CR9 is the sum of the voltages appearing at the primary and the upper half of the secondary. In addition, the voltage applied to CR10 is the sum of the voltages appearing at the primary and the lower half of the secondary. At the resonant frequency, the phase difference between the primary and secondary voltage is 90 degrees and the voltages applied to both diodes are equal (a, fig. 1). In this balanced condition, the diodes conduct equally, but on opposite half cycles. The resulting rectified voltages are equal, but of opposite polarity, and cancel each other. At frequencies other than resonance, the phase difference between the primary and secondary is not 90 degrees (b, fig. 1). For this condition, the voltages applied to the diodes are unequal (c or d, fig. 1). In this unbalanced condition, the diodes conduct unequally, producing a dc current which is proportional to the difference between the resulting rectified voltages. This current develops an output voltage across the discriminator load (resistors R41 through R43). If the voltage applied to CR9 is the larger of the two voltages, the discriminator output is positive. If the voltage applied to CR10 is the larger of the two voltages, the discriminator output is negative. The discriminator output may be monitored at test point J9.

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Cathode Follower V5. The baseband recovered from the if. signal by the discriminator is fed to both grids of low-distortion twin-triode cathode follower V5, a type 5670. Capacitor C51 couples the cathode output of V5, through an if. trap (inductor L7 and capacitor C61), to OUT jack J12. The cathode level of V5 can be monitored at test point J10, and the output at OUT LEVEL test point Jll.

If. Trap and Voltage Test Point. An if. trap, consisting of a parallel tuned circuit (inductor L7 and capacitor C61), is placed in series with the output signal to remove any if signal that may remain. When tuned to the if. center frequency of 9.8 mc by CARRIER REJECT inductor L7, it offers a high series impedance to the if. frequency while offering a low impedance path to all other frequencies. The +150 vdc power supply voltage applied to the module can be monitored at test point J3. When +150 vdc is present, a meter connected between J3 and ground will indicate approximately 48 mvdc due to the voltage divider action of resistors R55 and R56.

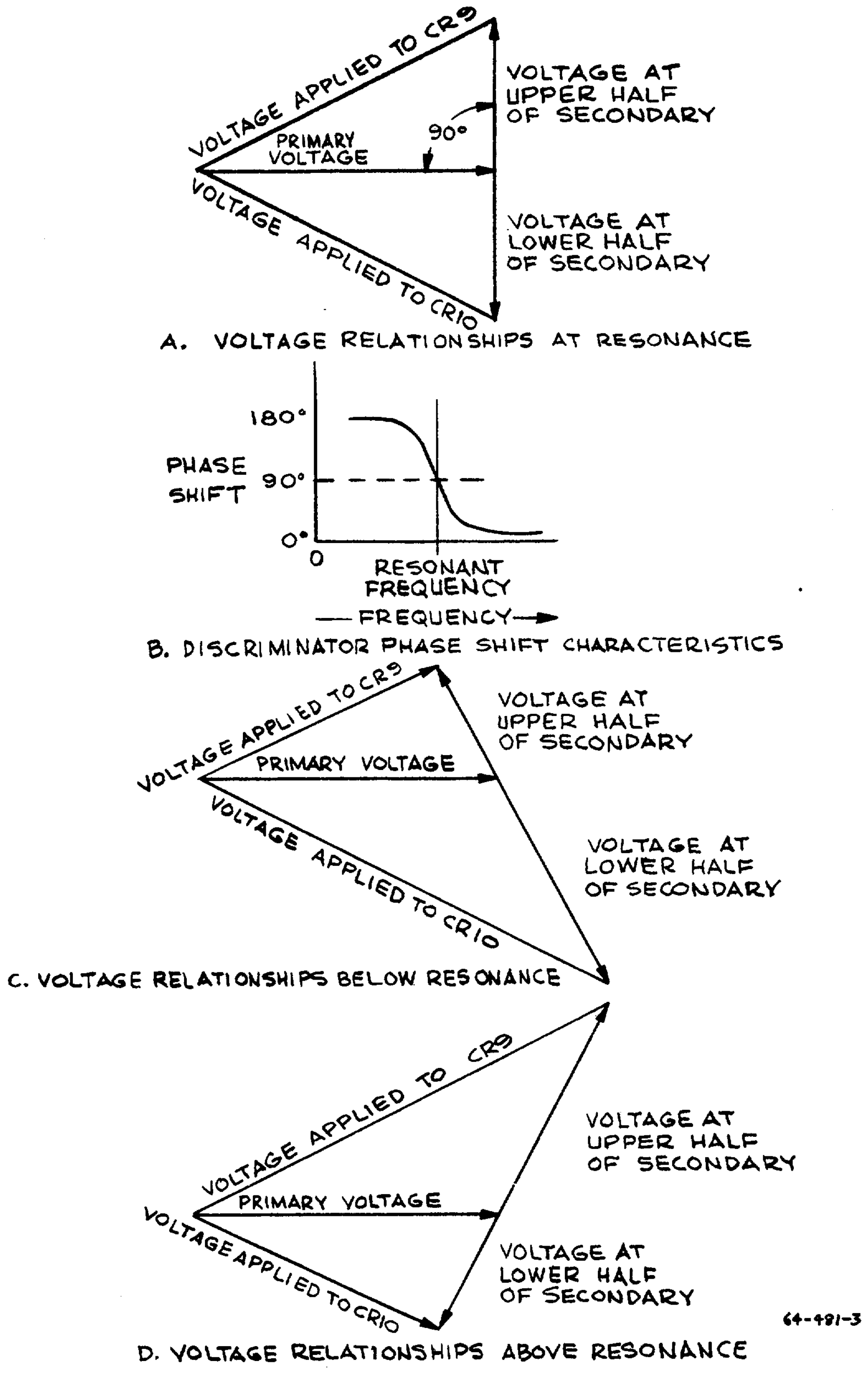

Figure 1. 9.8-Mc Demodulator NUS 5252-31, Voltage Relationships

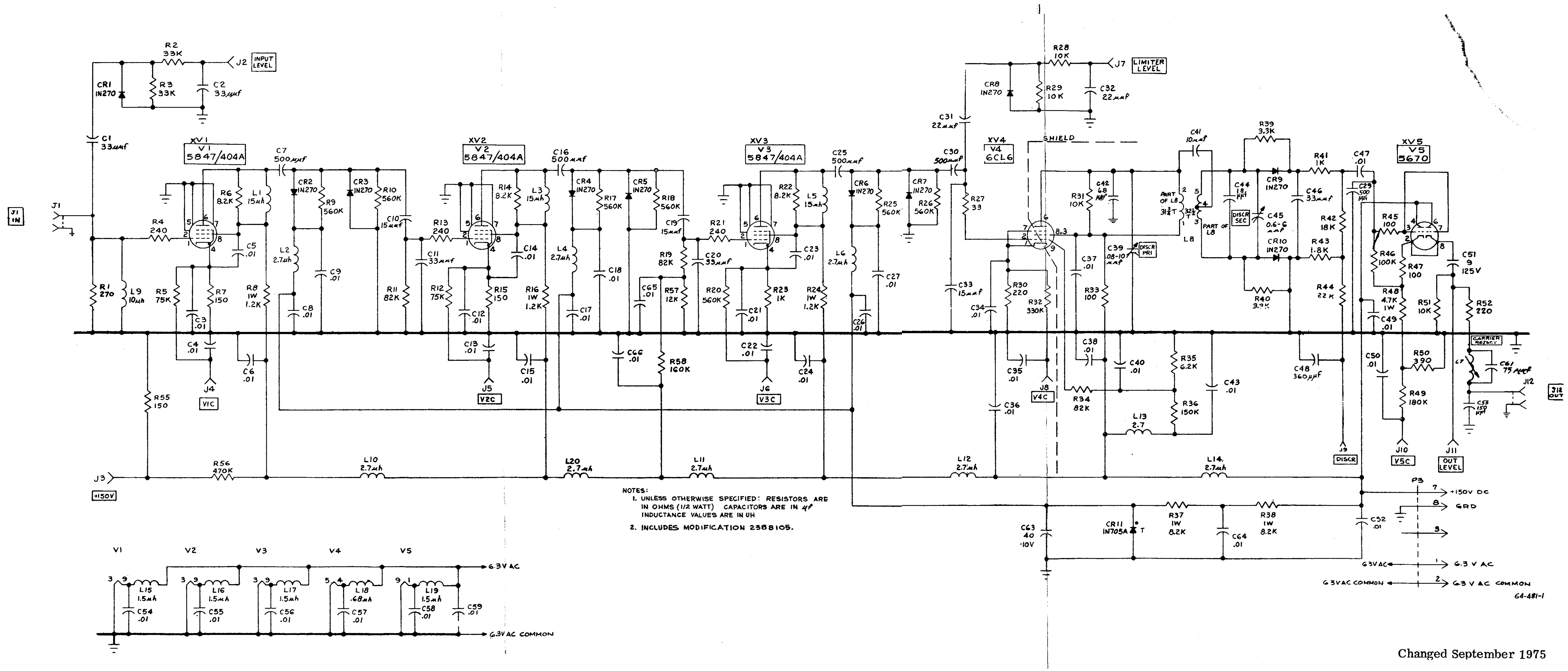

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Figure 2. 9.8-Mc Demodulator NUS 5252-31, Schematic Diagram

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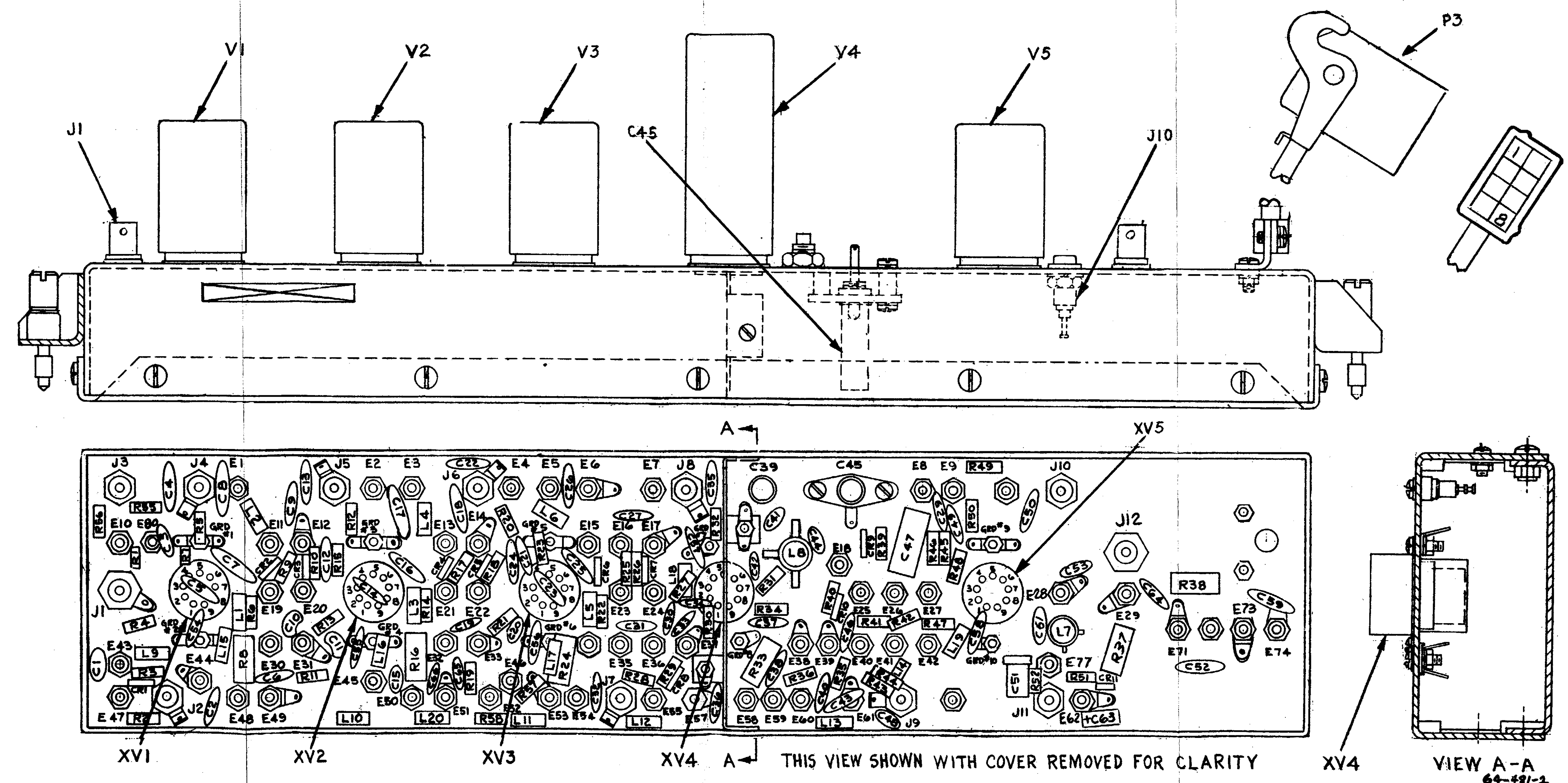


Figure 3. 9.8- Mc Demodulator NUS 5252-31, Parts Location

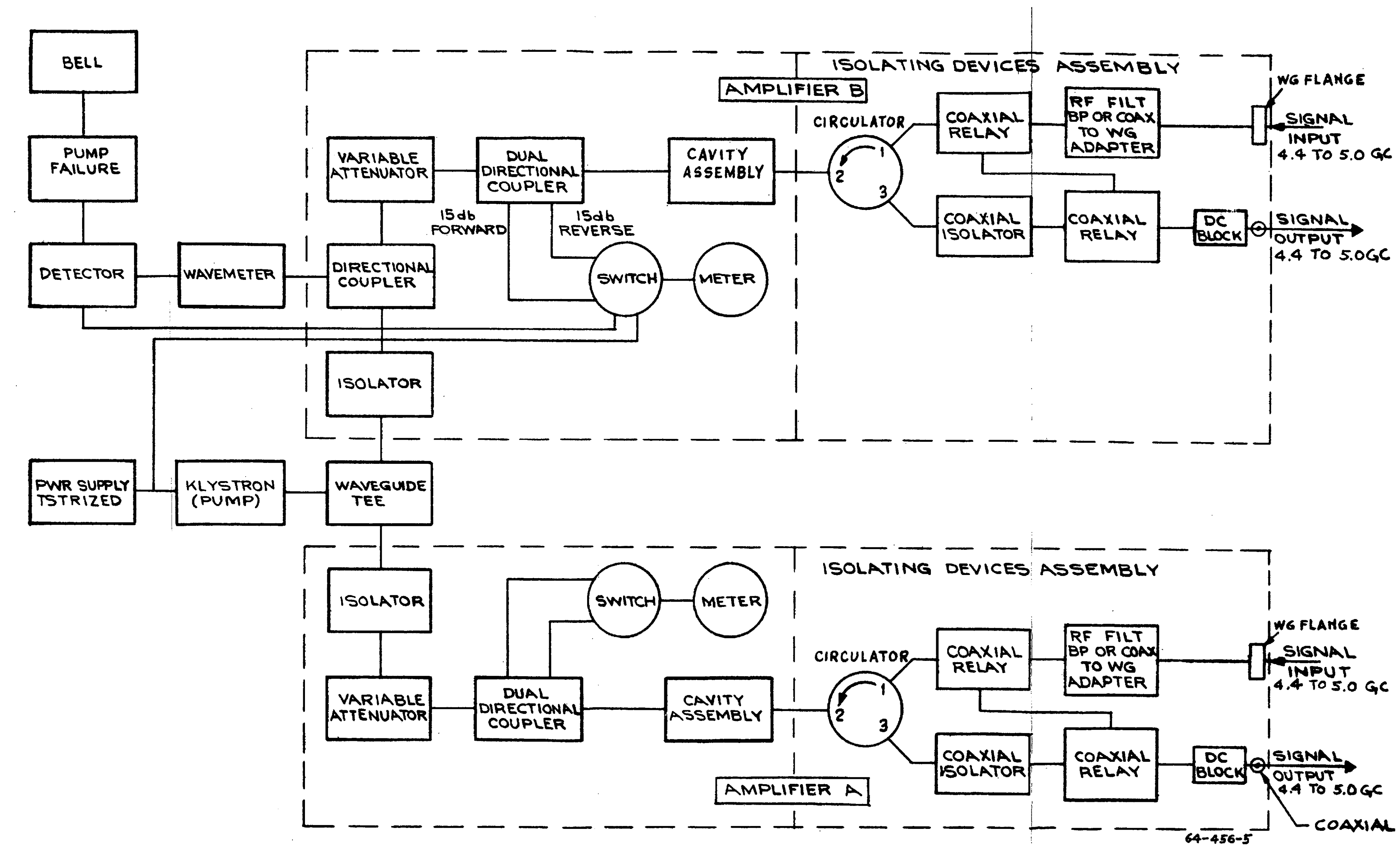


Figure 1. Typical Dual Parametric Amplifier Block Diagram

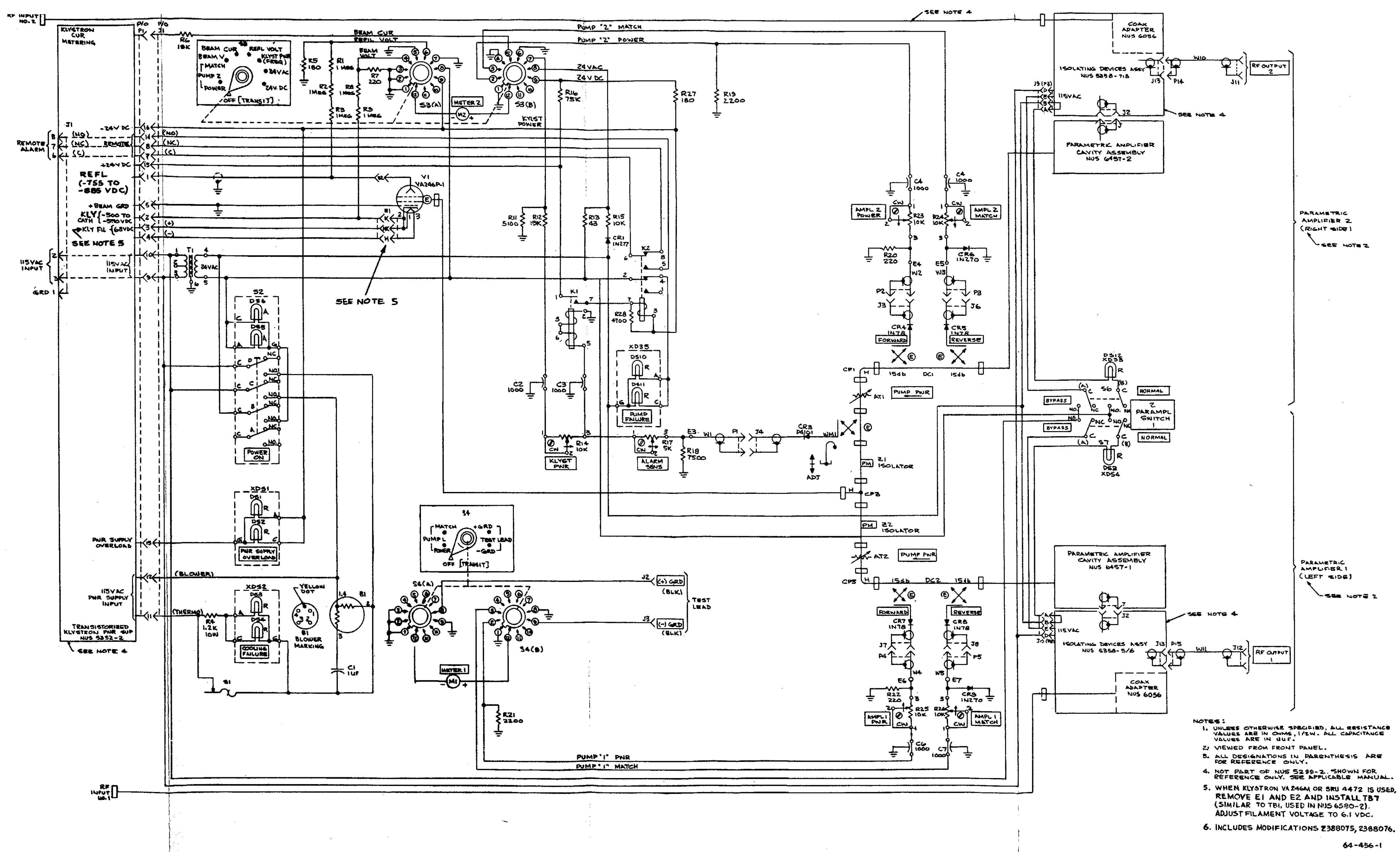


Figure 2. Dual Parametric Amplifier NUS 5300-7, Schematic Diagram

DUAL PARAMETRIC AMPLIFIERS
NUS 5300-7 AND NUS 6580-2

DESCRIPTION

The dual parametric amplifiers are used to provide low noise pre-amplification for tropospheric scatter receivers. Two types of dual parametric amplifiers are used: NUS 5300-7 and NUS 6580-2. The two types are similar and are used interchangeably. Each dual parametric amplifier contains two separate amplifiers each of which amplifies one of the signals in a diversity reception system. Pertinent characteristics of these amplifiers are as follows:

Input signal frequency	4.4 to 5. 0 gc
Bandwidth	20 mc minimum (NUS 6580-2)
15 mc minimum (NUS 5300-7)	
Noise figure	3.5 db maximum
Gain	14 to 16 db
Input impedance	50 ohms
Output impedance	50 ohms
Power requirements	115 vac

CIRCUIT DESCRIPTION, NUS 5300-7 (Figure 1, 2, and 4)

General. The dual parametric amplifier contains rf, monitoring, fault, and power circuits.

RF Circuits. The rf circuits contain two amplifier channels. The channels are independent except for a common source of pumping frequency. As the two channels are similar, only channel 2 is described.

A pumping frequency of 14.4 gc is generated by reflex klystron V1. The pumping frequency is applied through a section of waveguide to waveguide tee CP3. The waveguide divides the klystron output and supplies two equal outputs, one of which is fed to each channel.

The output for channel 2 is fed through isolator Zl to wavemeter WM1. The isolator is a ferrite device which isolates klystron Vl from changes in load impedance which can occur in other parts of the rf circuit. If the load on a klystron changes, its output frequency may shift.

Wavemeter WM1 consists of a directional coupler, an associated detector, and an absorption type frequency meter. The output of the directional coupler is rectified by diode CR3 and applied to the monitoring and fault circuits where it provides an indication of klystron output level and activates fault circuits if it decreases below a preset level. The absorption type frequency meter provides a means of measuring the klystron output frequency. When the frequency meter is tuned to the klystron output frequency, it causes a reduction in the output of diode CR3. The reduction appears as a dip in the indication of a meter which is part of the monitoring circuits.

Attenuator AT1 is used to set the level of the pumping frequency. The output of attenuator AT1 is applied through directional coupler DC1 to a parametric amplifier cavity assembly. The directional coupler provides a means of measuring the forward and reverse power levels within the waveguide. The forward power is measured when adjusting attenuator AT1. The reverse power is monitored to detect a poor impedance match.

The parametric amplifier cavity assembly contains the amplifying element (a varactor diode) which amplifies incoming signals. It receives the incoming signal via the isolating devices assembly, amplifies the signal, and feeds the amplified signal back to the isolating devices assembly.

The varactor diode is a special type of semiconductor diode which exhibits the diode. In the parametric amplifier cavity assembly, the pump frequency produced by klystron V1 is applied to the varactor diode and causes its capacitance, and therefore its capacitive reactance, to vary at the pump frequency.

The incoming signal is applied to the parametric amplifier cavity assembly via the isolating devices assembly. It is amplified because of the variations in capacitive reactance of the varactor diode caused by the pump frequency. Very little noise is added to the incoming signal because the amplification is produced by variations of a capacitive reactance rather than by variations of an electron stream as in conventional amplifiers.

The parametric amplifier cavity assembly contains three tuned sections: the first is tuned to the pump frequency, the second to the incoming signal frequency, and the third to the difference between the pump and signal frequencies. The first and second sections are tuned for maximum acceptance of their respective frequencies and the third section is tuned for maximum rejection of the difference frequency. The difference frequency is a result of the amplification process and must be eliminated.

The isolating devices assembly receives an incoming signal, feeds the incoming signal to the parametric amplifier cavity assembly, receives an amplified signal from the parametric amplifier cavity assembly, and supplies the amplified signal to RF OUTPUT 2 jack Jll. It isolates the incoming and output signals from each other and it prevents noise at the output from being fed back to the parametric amplifier cavity assembly.

The isolating devices assembly contains coaxial relays which can be used to bypass the parametric amplifier cavity assembly if that assembly fails. The coaxial relays are controlled by means of PARAMPL SWITCH 2 (S6). When the switch is set to NORMAL, the incoming signal is amplified; when the switch is set to BYPASS, the incoming signal is fed straight through the isolating devices assembly. The isolating devices assembly is described in a separate manual.

Monitoring Circuits. The monitoring circuits contain METER 2 (M2) and associated switching circuits are used to monitor the klystron output power, beam voltage, beam current and reflector voltage; the 24 vdc and 24 vac used in the dual parametric amplifier; and the forward and reverse power levels in the waveguide which feeds the parametric amplifier cavity assembly. The monitoring circuits are designed so that each level to be monitored will result in a normal meter indication of approximately 1/2 scale.

The klystron output power is monitored by means of a directional coupler which is part of wavemeter WM1. The output of the directional coupler is rectified by diode CR3 and the resulting dc voltage is developed across resistor R18. The dc voltage is then applied across a network comprising ALARM SENS control R17, KLYST PWR control R14, resistor R12, and resistor R11. The output of the network is applied to the meter. KLYST

PWR control R14 is used to calibrate the meter circuit. ALARM SENS control R17 is used to set the level applied to the fault alarm circuit. The ALARM SENS control must be adjusted before the KLYST PWR control is adjusted.

The power levels in the waveguide which feeds the parametric amplifier cavity assembly are monitored by means of directional coupler DCI. The outputs of the directional coupler, representing forward and reverse power, are rectified by diodes CR4 and CR5 respectively. The dc output of diode CR4 is applied through AMPL 2 POWER control R23 to the meter. Control R23 is used to calibrate the meter circuit. The dc output of diode CR5 is applied through AMPL 2 MATCH control R24 to the meter. Control R24 is used to calibrate the meter circuit.

Fault Circuits. The fault circuits provide indications of power supply overload, klystron cooling failure, and klystron failure.

If klystron V1 overheats, the contacts of thermostat S1 open, breaking the 115 vac supply to the klystron power supply and removing a bypass across COOLING FAILURE lamps DS5 and DS4, causing them to light.

If a power supply overload occurs, the klystron power supply will supply a ground to PWR SUPPLY OVERLOAD lamps DS1 and DS2, causing them to light. If klystron V1 fails, the output of the directional coupler which is part of Wavemeter WM1 will decrease, resulting in a decrease of the voltage applied to relay K1. This will cause relay K1 to deenergize, opening the circuit to relay K2. This, in turn, will cause relay K2 to deenergize. When relay K2 deenergizes, its contacts will supply 24 vac to PUMP FAILURE lamps DS10 and DS11, causing them to light. The contacts of relay K2 will also activate an external alarm.

Power Circuits. The power circuits include the klystron power supply and associated circuits. The klystron power supply itself is described in a separate manual.

A 115 vac input to the dual parametric amplifier is controlled by POWER ON switch S2. When the switch is set at ON, 115 vac is applied to the klystron power supply and to blower B1.

The 115 vac input is applied directly to transformer T1 where it is stepped down to 24 vac. The 24 vac is used to supply various indicator lamps.

The klystron power supply supplies outputs of 6.3 vdc, 24 vdc, -540 vdc nominal -840 or -890 vdc nominal. The 6.3 vdc supplies the klystron filament, the -540 vdc supplies the klystron cathode and the -840 or -890 vdc supplies the klystron reflector. The -540 vdc beam supply and -840 or -890 vdc reflector supplies are adjustable. The beam supply is preset to -540 vdc and the reflector supply is adjusted for maximum power output. The power supply is connected for -840 vdc nominal when a klystron type SRU 4472, VA246M, VA246P or VA246V is used and for -890 on early models where type VA92C or VA92J was used. The 24 vdc supplies part of the fault circuits.

A power supply bypass cable is mounted on the near of the chassis so that 115 vac can be applied to the bypass circuit in the event that the klystron power supply is removed for repair. The parametric amplifier automatically passes the incoming signal if the power supply fails but the insertion loss is one to three db greater than when the bypass circuit is operated.

Klystron. The Varian VA92C klystron ITT part no. 2334854 was used in the early production models of the NUS 5300-7 parametric amplifier. Changes were made to accommodate newer improved klystrons as they become available.

1. VA92J ITT part no. 2286046, directly interchangeable.

2. VA246V ITT part no. 2336612, required mod kit to provide 840 vdc reflector supply voltage.

3. VA246P ITT part nrio. 2334733 required additional mod kit to provide a terminal board for lead connections.

4. VA246M and SRU 4472, in addition to mod kits requires readjustment of filament supply to compensate for reduced heater current.

The NUS 6580-2 parametric amplifier was designed to use the VA246M or SRU4472 klystron.

CIRCUIT DESCRIPTION, NUS 6580-2 (Figures 1,3, and 5)

General. Dual parametric amplifier NUS 6580-2 is very similar to dual parametric amplifier NUS 5300-7 and only those circuits which differ will be described.

RF Circuits
Wavemeter WM1 is located at the input of the waveguide tee rather than at one of its outputs.

The isolating devices assemblies are replaced by circulators Z3 and Z4. Each circulator performs the same function as that of an isolating devices assembly. The signal switching is accomplished electromagnetically instead of with relays.

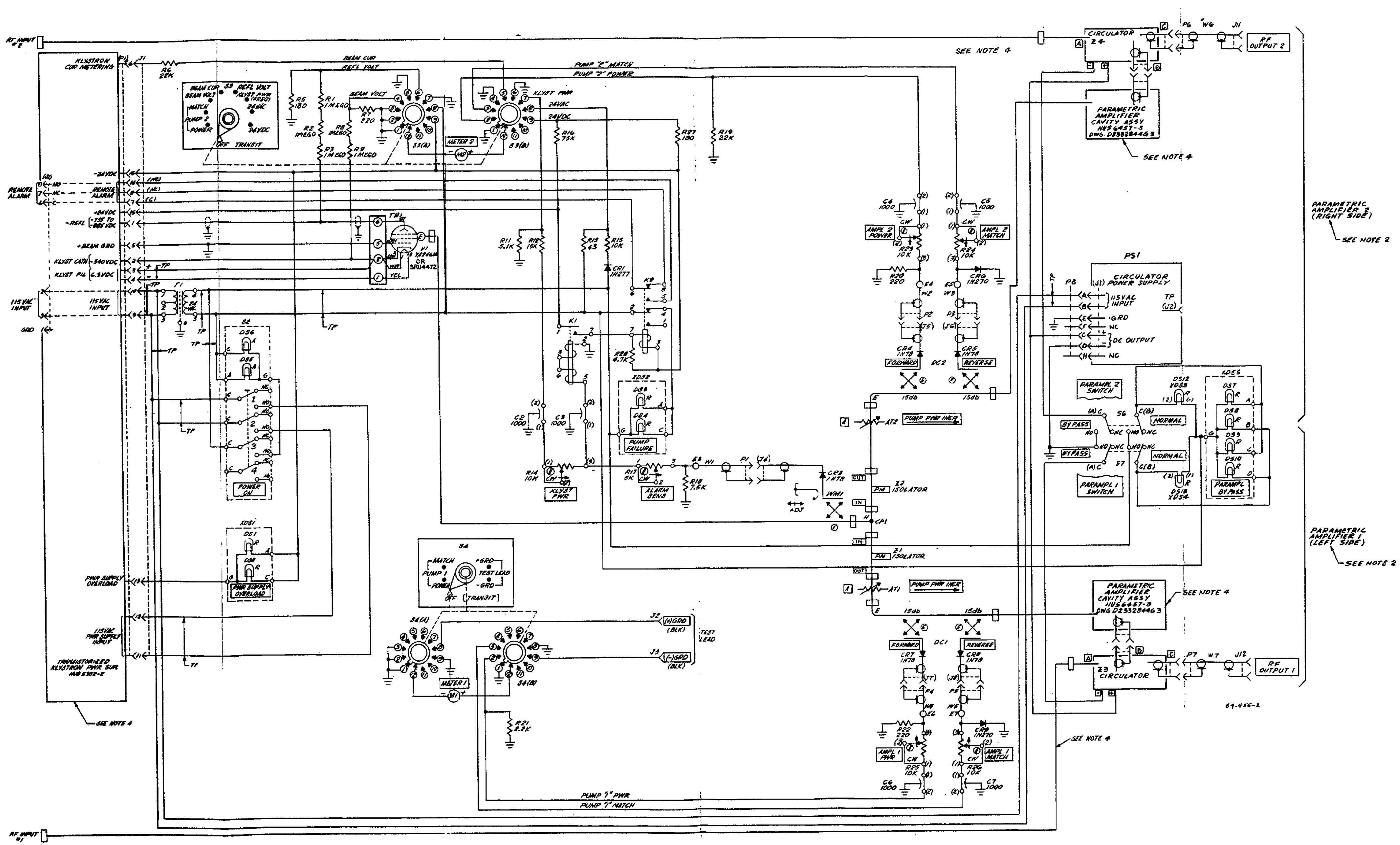
The circulator (Z4) consists of a waveguide assembly containing a ferrite assembly and associated electro-magnet in its interior. During normal operation, an incoming signal at point A (fig. 3) sees a low impedance to point B and a high impedance to point C and is therefore transferred to the parametric amplifier cavity assembly for amplification.

The amplified signal at point B sees a high impedance to point A and a low impedance to point C and is therefore transferred to RF OUTPUT 2 jack J11.

If the parametric amplifier cavity assembly fails, PARAMPL 2 SWITCH S6 is set to BYPASS and -13 $\pm$-0. 5 vdc is applied from CIRCULATOR supply PS1 to the electro-magnet within the circulator. This results in an incoming signal, at point A, seeing a high impedance to point C. Therefore, the incoming signal is transferred directly to RF OUTPUT 2 jack J11.

Power Circuits.

No klystron blower is included since the klystron is mounted to a convection cooled heat sink. Circulator power supply PS1 has been added. It supplies -13 $\pm$0. 5 vdc for controlling the ferrite assembly contained in circulators Z3 and Z4.



NOTES
1. UNLESS OTHERWISE SPECIFIED, ALL RESISTOR VALUES ARE IN OHMS, 1/2 W, ALL CAPACITOR VALUES ARE IN UUFS.
2. VIEWED FROM FRONT PANEL.
3. ALL DESIGNATIONS IN PARENTHESES ARE FOR REFERENCE ONLY.
4. ANY PART OF NUS 6581-2 SHOWN FOR REFERENCE ONLY.
5. S3 (S4 (B)) IS NEAREST FRONT PANEL.
6. TB2 THRU TB7 ARE NOT SHOWN.
7. E8 THRU E15 ARE NOT SHOWN.

Figure 3. Dual Parametric Amplifier NUS 6580-2, Schematic Diagram

1. Klystron power supply 5352-2 (2287473G2)
2. Angle bracket (2333967)
3. Screw (100606A112)
4. Lockwasher (107202)
5. Washer (200609H012)
6. Screw (100606A120)
7. Washer (2336137G1)
8. Nut (180376)
9. Stud (145005A116)
10. Cavity assembly 6457-1 (2332844G1)
11. Cavity assembly 6457-2 (2332844G2)
12. Isolation devices assembly 5358-6 (2333969G2)
13. Isolation devices assembly 5358-8 (2333970G2)
14. Screw (100607A120)
15. Washer (2336137G3)
16. Identification plate (2336374)
17. Screw (100603A106)
18. Washer (107136)
19. L. H. inner panel assembly (2335612G1)
20. R. H. inner panel assembly (2335613G1)
21. Screw (100605A116)
22. Screw (100605A112)
23. Washer (200504)
24. Connector J2 and J3 (757209)
25. Incandescent lamp DS12 and DS13 (MS25237-327)
26. Light socket XDS3 and XDS4 (2133825-G8)
27. Switch S6 and S7 (2133824)
28. Switch spacer (2287998)
29. Bracket (2288931G1)
30. Screw (100648A116)
31. Air filter (2284374)
32. Indicator switch S2 (2332072)
33. Indicator light XDS1, XDS2 and XDS5 (2332073)
34. Lens (2286172)
35. Lens (2286170)
36. Lens (2286171)
37. Lens (2288477)
38. Meter M1 and M2 (2173878)
39. Knob (325205H407)
40. Rotary switch S3 and S4 (2175639)
41. Washer (2288483G1)
42. Cable clamp (383064)
43. Screw (100606H120)
44. Washer (200505)
45. Nut (180142)
46. Washer (200504)
47. Nut (180103)
48. Front panel(2287867G1)
49. Screws (100648A116)
50. Connector E1 (2286247)
51. Connector E2 (2286246)
52. Thermostat S1 (2285908)
52A. Screw (100603A106)
52B. Lockwasher (107125)
53. Adapter block (2337020)
54. Screw (100603A120)
55. Lockwasher (107136)
56. Washer (200609H008)
57. Klystron VA-246 V1 (2336612G1)
58. Klystron VA-92 V1 (2286046)◊
59. Plate (2337500G1)
60. Screw (100603A124)
61. Nut (180080)
62. Adapter block (2337020)
63. Cable clamp (383063)
64. Screw (100606A110)
65. Lockwasher (107202)
66. Washer (200505)
67. Blower B1 (2285663)
68. Screw (100606A116)
69. Lockwasher (107202)
70. Blower pad (2285756)
71. Plenum assembly (2287261G1)
72. Screw (100605A116)
73. Connector J9 and J10 (2332070)
74. Bracket (2288035)
75. Screw (100606A116)
76. Connector J11 (UG-1590/U)
77. Connector P14 (UG-18C/U)
78. Cable marker (2289390G115)
79. RF cable W10 (RG-212/U)
80. Connector J12 (UG-1590/U)
81. Connector P15 (UG-18C/U)
82. Cable marker (2289390G116)
83. RF cable W11 (RG-212/U)
84. Washer (2288442G5)
85. Washer (2288483G4)
86. Angle bracket (2285937)
87. Screw (100706A146)
88. Nut (180142)
89. Diode CR4, CR5, CR7 and CR8 (1N78)
90. Directional coupler DC1 (2333902G2*)
91. Directional coupler DC2 (2333902G1**)
92. Screw (100605A110)
93. Lockwasher (107180)
94. Washer (200504)
95. Waveguide CP1 and CP5 (2284072)
96. Screw (100605A110)
97. Lockwasher (107180)
98. Attenuator AT1 (2334436G1***)
99. Attenuator AT2 (2334436G2+)
100. Screw (100605A110)
101. Lockwasher (107180)
102. Wavemeter WM1 (2334359)
103. Screw (100605A110)
104. Lockwasher (107180)
105. Ku band isolator Z1 (2334433‡)
106. Ku band isolator Z2 (2334434§)
107. Screw (100605A108)
108. Screw (100605A100)
109. Lockwasher (107180)
110. Quick disconnect (2286173)
111. Screw (100605A110)
112. Lockwasher (107180)
113. Locking clip (2288989)
114. Waveguide CP3 (2333901)
115. Bracket
116. Screw (100605A112)
117. Washer (2336137G2)
118. Cap (2285940)
119. Capacitor C1 (2280305)
120. Screw (100648A120)
121. Washer (200609H014)
122. Nut (180129)
123. Shield (2287919)
124. Screw (100605A112)
125. Lockwasher (107180)
126. Washer (200504)
127. Spacer (170050A212)
128. Screw (100705A112)
129. Terminal board TB6 (355638)
130. Screw (100602A108)
131. Lockwasher (107114)
132. Resistor R1, R2, R3, R8 and R9 (RC20GF105J)
133. Resistor R5 (RC20GF181J)
134. Resistor R6 (RC20GF183J)
135. Resistor R7 (RC20GF221J)
136. Terminal board TB4 and TB5 (355637)
137. Screw (100602A108)
138. Lockwasher (107114)
139. Terminal (362217)
140. Screw (100603A112)
141. Nut (180090)
142. Resistor R4 (Type RH-10 Dalohm)
143. Screw (100601A112)
144. Nut (180012)
145. Cable clamp (383066)
146. Screw (100605A112)
147. Washer (200504)
148. Screw (100606A116)
149. Relay K1 (2174999)
150. Nut (107873)
151. Lockwasher (107169)
152. Relay K2 (2173850-1)
153. Nut (107741)
154. Lockwasher (107125)
155. Transformer T1 (2285815)
156. Screw (100605A112)
157. Washer (200609H010)
158. Lockwasher (107169)
159. Nut (107873)
160. Connector P4 (UG-913/U)
161. Termination E6 (MX1684A/U)
162. Cable marker (2289390G30)
163. RF cable W4 (RG58C/U)
164. Connector P5 (UG-913/U)
165. Termination E7 (MX1684A/U)
166. Cable marker (2289390G31)
167. RF cable W5 (RG58C/U)
168. Connector P1 (UG-913/U)
169. Termination E3 (MX1684A/U)
170. Cable marker (2289390G34)
171. RF cable W1 (RG58C/U)
172. Connector P3 (UG-913/U)
173. Termination E5 (MX1684A/U)
174. Cable marker (2289390G32)
175. RF cable W3 (RG58C/U)
176. Connector P2 (UG-913/U)
177. Termination E4 (MX1684A/U)
178. Cable marker (2289390G33)
179. RF cable W2 (RG58C/U)
180. Washer (2288242G2)
181. Bottom cover (2285989G1)
182. Screw (100603A110)
183. Capacitor C2 thru C7 (2132685-1)
184. Lockwasher (2288466G1)
185. Washer (2288242G1)
186. Resistor R27 (RC20GF181J)
187. Terminal (362090)
188. Screw (100603A110)
189. Lockwasher (107125)
190. Nut (107741)
191. Side cover (2287751G1)
192. Screw (100603A110)
193. Lockwasher (107125)
194. Nut (107741)
195. Resistor R14, R23, R24, R25, R26 (RV6LAYSA103A)
196. Resistor R17 (RV6LAYSA502A)
197. Washer (2288483G5)
198. Resistor R20 (RC20GF221J)
199. Resistor R18 (RC20GF752J)
200. Resistor R13 (RC20GF430J)
201. Resistor R21 (RC20GF222J)
202. Resistor R28 (RC20GF472J)
203. Terminal board TB1, TB2 and TB3 (355637)
204. Screw (10060ZA106)
205. Lockwasher (107114)
206. Grommet (MS35489-11)
207. Chassis (2287705G1)
208. Connector J1 (2133374G2)
209. Screw (100603A112)
210. Nut (180090)
211. Bracket (2333968)
212. Screw (100606H120)
213. Cable clamp (383064)
214. Screw (100606A120)
215. Screw (100706A120)
216. Washer (200505)
217. Nut (180142)
218. Cable clamp (383066)
219. Screw (100706A120)
220. Washer (200505)
221. Nut (180142)
222. Cable clamp (383065)
223. Screw (100606A120)
224. Washer (200505)
225. Nut (180142)
226. Cable clamp (383068)
227. Screw (100706A120)
228. Washer (200505)
229. Nut (180142)
230. Wiring harness (2288992)
231. Rubber channel (2289093)
232. Grommet (330103H412)
233. Grommet (330103H416)
234. Chassis (2288993G1)

*replaces part number 2284068G2
**replaces part number 2284068G1
***replaces part number 2284070G1
+replaces part number 2284070G2
‡replaces part number 2284390
§replaces part number 2284521
◊obsolete part-replace with item 57 if defective

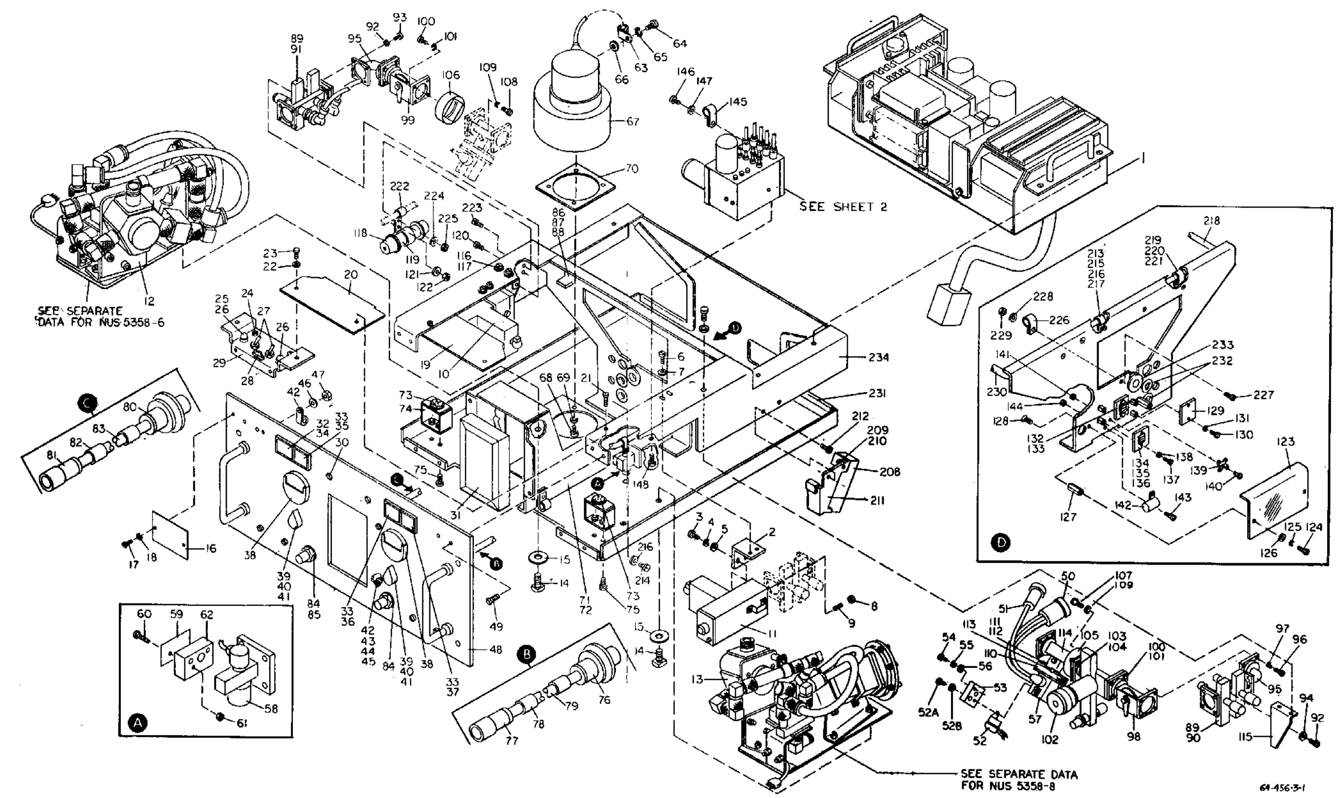


Figure 4 Dual Parametric Amplifier NUS 5300-7, Exploded View (Sheet 1 of 2)

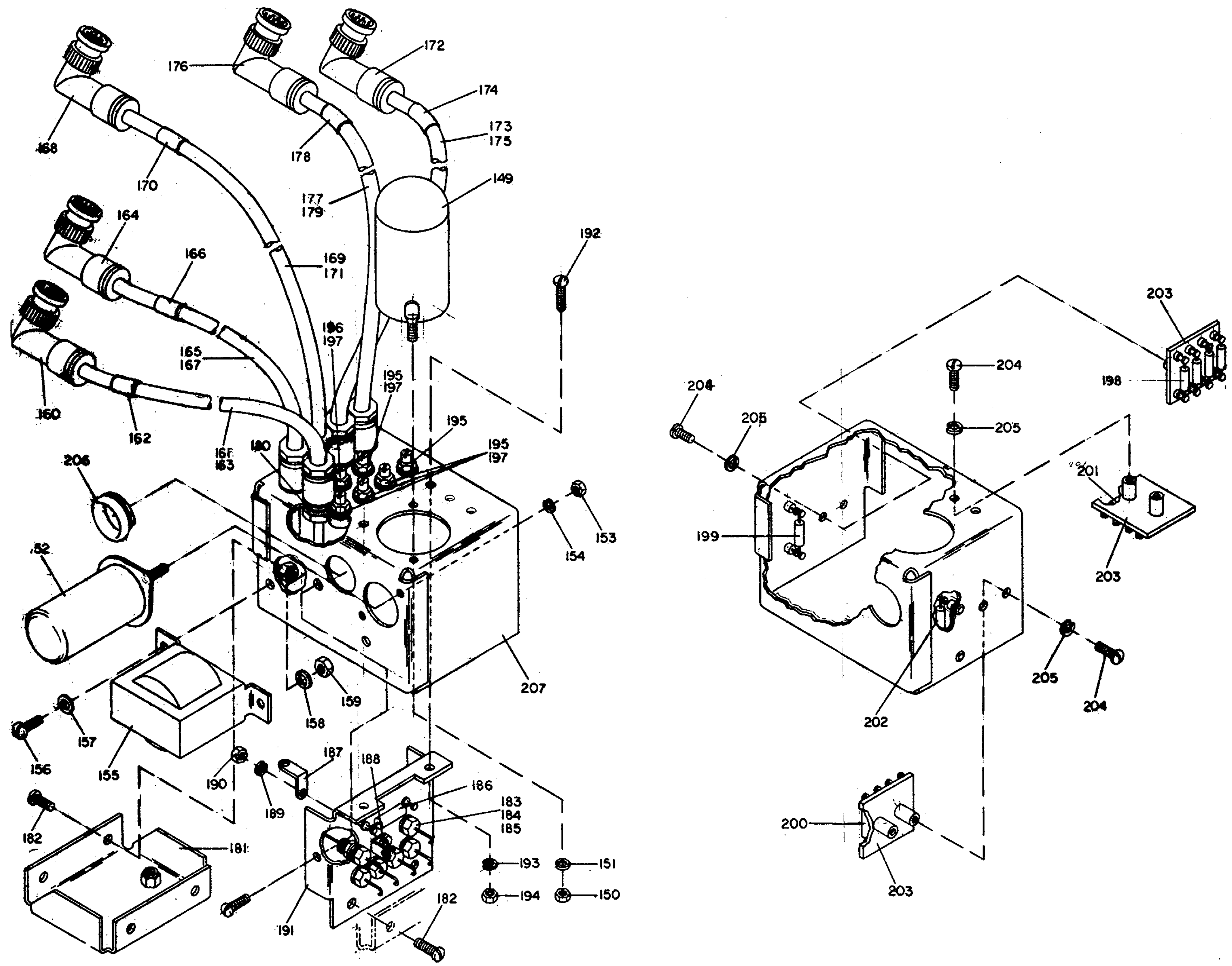


Figure 4. Dual Parametric Amplifier NUS 5300-7, Exploded View (Sheet 2 of 2)

1. Klystron power supply NUS 5352-2 (2287473G2)
2. Angle bracket (2335581G1)
3. Screw (MS35233-46)
4. Washer (MS15795-307)
5. Angle bracket (2335560G1)
6. Screw (MS35233-43)
7. Lockwasher (MS35338-80)
8. Washer (MS15795-307)
9. Nut (107873)
10. Lockwasher (MS35338-79)
11. Stud (145005A116)
12. Cavity assembly 6457-3 (2332844G3)
13. Identification plate (2385584G1)
14. Screw (MS35233-13)
15. Lockwasher (MS35338-78)
16. L. H. inner panel (2384603G1)
17. R. H. inner panel (2384606G1)
18. Screw (MS35233-28)
19. Washer (MS15795-305)
20. Connector J2 and J3 (MS16108-3A)
21. Incandescent lamp DS12 and DS13 (MS25237-327)
22. Light socket XDS3 and XDS4 (2133825G8)
23. Switch S6 and S7 (2133824G1)
24. Spacer (2287998G1)
25. Bracket (2335600G1)
26. Screw (MS35234-64)
27. Switch S2 (2336755G1)
28. Light socket XDS1 (2336756G1)
29. Light socket XDS5 (2336758G1)
30. Light socket XDS2 (2336757G1)
31. Meter M1 and M2 (2173878G1)
32. Knob (MS91528-1K2B)
33. Switch S3 and S4 (2175639G1)
34. Cable clamp (383063)
35. Nut (180142)
36. Washer (MS15795-307)
37. Grille (2335585G1)
38. Screw (130006A124)
39. Lockwasher (MS35338-80)
40. Handle (300080A240)
41. Screw (MS35234-64)
42. Lockwasher (MS35338-81)
43. Ferrule (472000A237)
44. Front panel (2335572G1)
45. Screw (MS35234-63)
46. Klystron V1 (2334732G1)
47. Screw (MS35233-31)
48. Lockwasher (MS35338-79)
49. Heat sink (2334742G1)
50. Screw (MS35233-79)
51. Lockwasher (MS35338-82)
52. Washer (MS15795-310)
53. Wavemeter WM1 (2334825G1)
54. Washer (2288242G5)
55. Connector J11 (UG-159C/U)
56. Connector P6 (2332071)
57. Cable marker (2335330G56)
58. Cable marker (2384852G1)
59. RF cable W6 (RG-212/U)
60. Connector J12 (UG-159C/U)
61. Connector P7 (2332071)
62. Cable marker (2335330G57)
63. Cable marker (2384852G2)
64. RF cable W7 (RG-212/U)
65. Disconnect (2385625G1)
66. Switching circulator Z3 and Z4 (2382918G1)
67. Screw (MS35233-45)
68. Lockwasher (MS35338-80)
69. Washer (MS15795-307)
70. Spacer (2385581G1)
71. Diode CR4, CR5, CR7, CR8 (1N78)
72. Directional coupler DC1 (2334680G1)
73. Directional coupler DC2 (2334678G1)
74. Screw (MS35233-27)
75. Lockwasher (MS35338-79)
76. Washer (MS15795-305)
77. Angle bracket (2335575G1)
78. Screw (100705A116)
79. Washer (MS15795-305)
80. Nut (180103)
81. Attenuator AT1 (2336798G1)
82. Attenuator AT2 (2336798G2)
83. Screw (MS35233-27)
84. Lockwasher (MS35338-79)
85. Ku band isolator Z1 (2334433G1)
86. Ku band isolator Z2 (2334434G1)
87. Screw (MS35233-27)
88. Lockwasher (MS35338-79)
89. Waveguide CP1 (2333901G1)
90. Shield (2335957G1)
91. Screw (MS35233-42)
92. Lockwasher (MS35338-80)
93. Washer (MS15795-307)
94. Spacer (170060A309)
95. Terminal board TB1 (355151)
96. Screw (MS35233-47)
97. Lockwasher (MS35338-80)
98. Terminal marker (456518)
99. Power supply PS1 (2383453G1)
100. Screw (MS35233-28)
101. Lockwasher (MS35338-79)
102. Washer (MS15795-305)
103. Cable clamp (383066)
104. Screw (MS35233-30)
105. Washer (MS15795-305)
106. Relay K1 (2174999G1)
107. Nut (107873)
108. Lockwasher (MS35338-79)
109. Relay K2 (2173850-1)
110. Nut (MS35649-44)
111. Lockwasher (MS35338-78)
112. Transformer T1 (2285815)
113. Screw (MS35233-28)
114. Lockwasher (MS35338-79)
115. Nut (107873)
116. Connector P4 (UG-913/U)
117. Termination E6 (MX1684A/U)
118. Cable marker (2335330G4)
119. RF cable W4 (RG-58C/U)
120. Connector P5 (UG-913/U)
121. Termination E7 (MX1684A/U)
122. Cable marker (2335330G5)
123. Cable marker (2384520G4)
124. RF cable W5 (RG-58C/U)
125. Connector P1 (UG-913/U)
126. Termination E3 (MX1684A/U)
127. Cable marker (2335330G1)
128. Cable marker (2384520G3)
129. RF cable W1 (RG-58C/U)
130. Connector P3 (UG-913/U)
131. Termination E5 (MX1684A/U)
132. Cable marker (2335330G3)
133. Cable marker (2384520G1)
134. RF cable W3 (RG-58C/U)
135. Connector P2 (UG-913/U)
136. Termination E4 (MX1684A/U)
137. Cable marker (2335330G2)
138. Cable marker (2384520G2)
139. RF cable W2 (RG-58C/U)
140. Washer (2288242G2)
141. Bottom cover (2335591G1)
142. Screw (MS35233-14)
143. Capacitor C2 through C7 (2132685-1)
144. Lockwasher (2288466G1)
145. Washer (2288242G1)
146. Resistor R27 (RC20GF181J)
147. Terminal (362090)
148. Screw (MS35233-14)
149. Lockwasher (MS35338-78)
150. Nut (MS35649-44)
151. Side cover (2335592G1)
152. Screw (MS35233-14)
153. Lockwasher (MS35338-78)
154. Nut (MS35649-44)
155. Resistor R14, R23, R24, R25 and R26 (RV6LAYSA103A)
156. Resistor R17 (RV6LAYSA502A)
157. Resistor R18 (RC20GF752J)
158. Resistor R28 (RC20GF472J)
159. Diode CR6 and CR9 (1N270)
160. Resistor R20 and R22 (RC20GF221J)
161. Resistor R13 (RC20GF510J)
162. Diode CR1 (1N277)
163. Resistor R15 (RC20GF103J)
164. Resistor R16 (RC20GF753J)
165. Resistor R12 (RC20GF153J)
166. Resistor R11 (RC20GF512J)
167. Resistor R19 and R21 (RC20GF222J)
168. Terminal board TB5, TB6 and TB7 (355637)
169. Screw (100602A106)
170. Lockwasher (107114)
171. Grommet (MS35489-11)
172. Chassis (2335589G1)
173. Screw (MS35233-45)
174. Washer (MS15795-307)
175. Shield (2287919G1)
176. Screw (MS35233-28)
177. Lockwasher (MS35338-79)
178. Washer (MS15795-305)
179. Spacer (170050A212)
180. Screw (100705A116)
181. Resistor R1, R2, R3, R8 and R9 (RC20GF105J)
182. Resistor R5 and R7 (RC20GF221J)
183. Resistor R6 (RC20GF223J)
184. Terminal board TB2, TB3, TB4 (355637)
185. Screw (100602A108)
186. Lockwasher (107114)
187. Terminal (362217)
188. Screw (MS35233-15)
189. Nut (180090)
190. Connector J1 (2133374G2)
191. Screw (MS35233-15)
192. Bracket (2333968G1)
193. Screw (MS35233-46)
194. Cable clamp (383064)
195. Screw (MS35233-46)
196. Screw (100706A120)
197. Washer (MS15795-307)
198. Nut (180142)
199. Cable clamp (383066)
200. Screw (100706A116)
201. Screw (100706A120)
202. Washer (MS15795-307)
203. Nut (180142)
204. Cable clamp (383068)
205. Screw (100706A120)
206. Washer (MS15795-307)
207. Nut (180142)
208. Wiring harness (2385579G1)
209. Rubber channel (2335586G1)
210. Grommet (MS35489-40)
211. Grommet (MS35489-43)
212. Chassis (2383315G1)

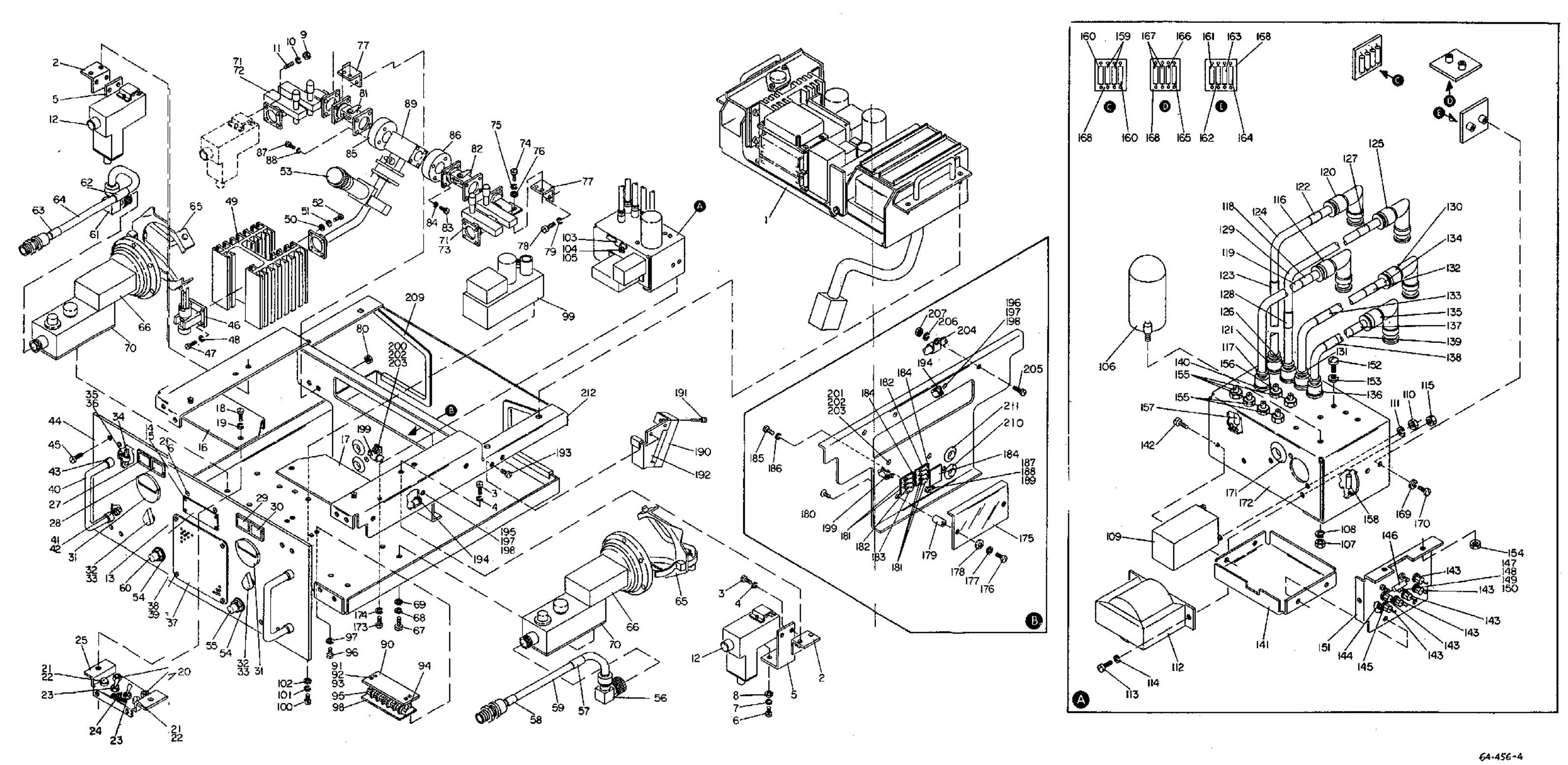


Figure 5. Dual Parametric Amplifier NUS 6580-2, Exploded View

KLYSTRON POWER SUPPLY
NUS 5352-2

DESCRIPTION (Figure 1)

The klystron power supply is used in dual parametric amplifiers NUS 5300-7 and NUS 6580-2 to supply all of the required dc operating voltages. Contained in the klystron power supply are three printed circuit plug-in assemblies, an overload protection circuit, a high voltage relay, a power converter circuit, and a thermal time delay relay. The three printed circuit assemblies consist of the pre-regulator, the beam regulator, and the reflector regulator.

Input ac power is applied through transformer T1 to the pre-regulator. The pre-regulator supplies regulated 30 vdc to the power converter circuit and through thermal time delay relay K2 to high voltage relay K1. The 24 vdc unregulated output is used by the overload indicating circuits. A sample of the -540 vdc output of the beam regulator is applied to pre-regulator. Any variation of this voltage from the acceptable limits is sensed by the pre-regulator which then corrects the level of the regulated dc output to the power converter circuit.

The power converter circuit includes a multivibrator and two rectifier circuits. The regulated 30 vdc from the pre-regulator is converted to ac by the multivibrator. This ac voltage is stepped-up and rectified. The outputs of the rectifier circuits, approximately 600 vdc, are applied to the reflector regulator and the beam regulator. The power converter circuit also supplies 6.3 vdc to energize the klystron filament.

The beam regulator receives the 600 vdc output of the power converter and provides a regulated -540 vdc output to the klystron beam circuit. Similarly, the reflector regulator receives the 600 vdc output from the power converter and provides a regulated 300 vdc to the klystron reflector circuit. The dc output return (common) lines of both the reflector regulator and beam regulator are routed through high voltage relay K1. This relay is controlled by thermal time delay relay K2. The thermal time delay relay keeps the common return line open until 25 to 60 seconds after the klystron power supply is energized.

Overload interrupter relay K3 protects all circuits of the klystron power supply from overload. In addition this relay completes a circuit to provide an overload indication at the dual parametric amplifier front panel.

Pertinent characteristics of the klystron power supply are as follows:

Input power:	114 to 122.4 vac, 47 to 63 cps
Pre-regulator output:	24 vdc unregulated
Reflector regulator output:	-275 to -370 vdc, adjusted to either -300 or -350 vdc
Beam regulator output:	-540 vdc
Beam current output:	60 to 70 milliamperes
Klystron filament:	5.85 to 6.35 volts, and 0. 475 to 0.52 amperes or 1.08 to 1.32 amperes

CIRCUIT DESCRIPTION (Figures 1 through 8)

Input Circuit (fig. 2). The ac power input to the klystron power supply is connected to P1-ll and 12 and applied through protective fuse F1 to the primary of transformer T1. Current limiting resistors R1 and R2 and 120 VAC LINE 1.5 AMP indicator DS1 are connected in parallel with fuse F1 and the lamp lights whenever the fuse fails. The output from the secondary of transformer T1 is applied to terminals P1-C and P1-D of the pre-regulator.

Pre-regulator (figs. 2 and 3). The pre-regulator consists of a full wave diode bridge rectifier, a voltage doubler and an electronic voltage regulator circuit.

Rectifier Circuit. The ac voltage from transformer T1 on the klystron power supply chassis is converted to 24 vdc by the full wave bridge rectifier consisting of diodes CR1 through CR4. Diodes CR6 and CR7 and capacitors C1 and C3 are connected as a voltage doubler to provide 48 vdc for bias of the electronic regulator and to provide the required 30 vdc output voltage. The unregulated 24 vdc output is filtered by inductor L1 and capacitor C2 on the chassis of the klystron power supply. It is then applied to overload relay K3 and to the collectors of transistors Q1, -Q3, and Q4 of the regulator circuit in the pre-regulator.

Regulator Circuit. Voltage regulation is provided by the circuit consisting of transistors Q1 through Q4 and associated components. This regulator does not directly correct for errors in the pre-regulator output, but rather corrects for variations in the -540 vdc output of the beam regulator. The voltage divider consisting of resistor R9, PRE REG VOLT ADJ control R10, and resistor R11 is connected between the -540 vdc output of the beam regulator and ground. Initially the PRE REG VOLT ADJ control R10 is set to provide the proper output from the pre-regulator. If subsequent variations of the -540 vdc beam regulator occur, that portion of the variation, or error, appearing at the wiper of R10 is applied to the base of error amplifier Q2. The emitter of Q2 is maintained at a constant reference voltage by zener diode CR5. A correction voltage which is proportional to the difference between the reference voltage and the error voltage is developed across resistor R5. This voltage is applied through the compound emitter follower consisting of Q1 and Q3 to series regulator Q4. This changes the internal resistance of Q4 accordingly and more or less current flows through Q4 to the load. Capacitors C2, C4, and C5 filter out high frequencies to prevent the regulator from correcting for high frequency transients. Zener diode CR8 provides overload protection for the transistors.

Output Circuit. The regulated dc output voltage developed across resistor R2 is taken from P1-E and applied through windings of transformer T2 on the klystron power supply chassis to bases of Q1 and Q2 of the power converter (multivibrator) circuit. The other regulated dc output voltage is developed across resistor R7 and taken from P1-F. This voltage is applied through other windings of transformer T2 to the collectors of Q1 and Q2 of the power converter circuit and to the coils of high voltage relay K1 and thermal time delay relay K2. Capacitor C1 on the klystron power supply chassis is connected between the common side of the output P1-M and the output at P1-F to filter this voltage.

Power Converter (fig. 2). The power converter consists of a multivibrator with associated output transformer, two full wave bridge rectifiers, one two-diode full wave rectifier, and associated filtering components. All components of the power converter are mounted on the chassis of the klystron power supply.

Multivibrator. The multivibrator consists of transistors Q1 and Q2 and the primary windings of transformer T2. Base and collector bias voltages for this circuit are provided by the pre-regulator. When power is initially applied, transients present in the circuit cause one transistor to conduct more than the other. Feedback due to inductive coupling between the primary windings of transformer T2, increases the conduction of this transistor and decreases the conduction of the other transistor. The maximum voltage output of the conducting transistor depends on the amplitude of the bias voltages supplied by the pre-regulator. When the conducting transistor reaches the maximum current flow possible with the applied bias voltage, the flow of current in the transformer windings reaches a steady state. This causes collapse of the magnetic field of the transformer and the subsequent opposite polarity induced voltage reverses the condition of the transistors. This action is repetitive and the ac voltage developed by this cycling between the two transistors is coupled to the secondary windings of transformer T2. Zener diodes CR1 and CR2 protect transistors Q1 and Q2 from the high reverse voltage transients resulting from the collapse of the transformer magnetic field. The ac voltage developed in the primary of transformer T2 is stepped up to approximately 550 vac across secondary windings, terminals 7 and 8, and terminals 9 and 10. Each of these windings supplies a full wave bridge rectifier. Capacitors C5 and C6 filter out any high frequency component present. At secondary winding terminals 11 and 12, the primary ac voltage is stepped down to approximately 10 vac. These terminals are connected to the two-diode fullwave rectifier.

Bridge Rectifiers. The bridge rectifier no. 1 consisting of diodes CR10 through CR13 and the bridge rectifier no. 2 consisting of diodes CR14 through CR17 receive the high voltage ac generated in the secondary windings of transformer T2. The high-voltage output of bridge rectifier 1 is filtered by a choke in parallel with a resistor, L4 and R24, and a pi filter, inductor L2 and parts of capacitor C4, and applied to the reflector regulator through terminal J4-E. The high-voltage dc output of bridge rectifier 2 is also filtered by a choke and pi filter (inductors L3 and L5, resistor R25 and capacitor C4. The filtered output of bridge rectifier 2 is applied to the beam regulator through terminal J5-E. These filtered outputs may be monitored through REFL REG INPUT test point TP3 (J8) and BEAM REG INPUT test point TP2 (J7), respectively.

Full Wave Rectifier. The full wave rectifier (diodes CR3 and CR4) rectifies the low voltage ac to provide the 6. 3 vdc required for the filament of the parametric amplifier klystron. Capacitor C3 and FILAMENT VOLT ADJ potentiometer R11 provide filtering. This control is used to adjust the level of the output voltage.

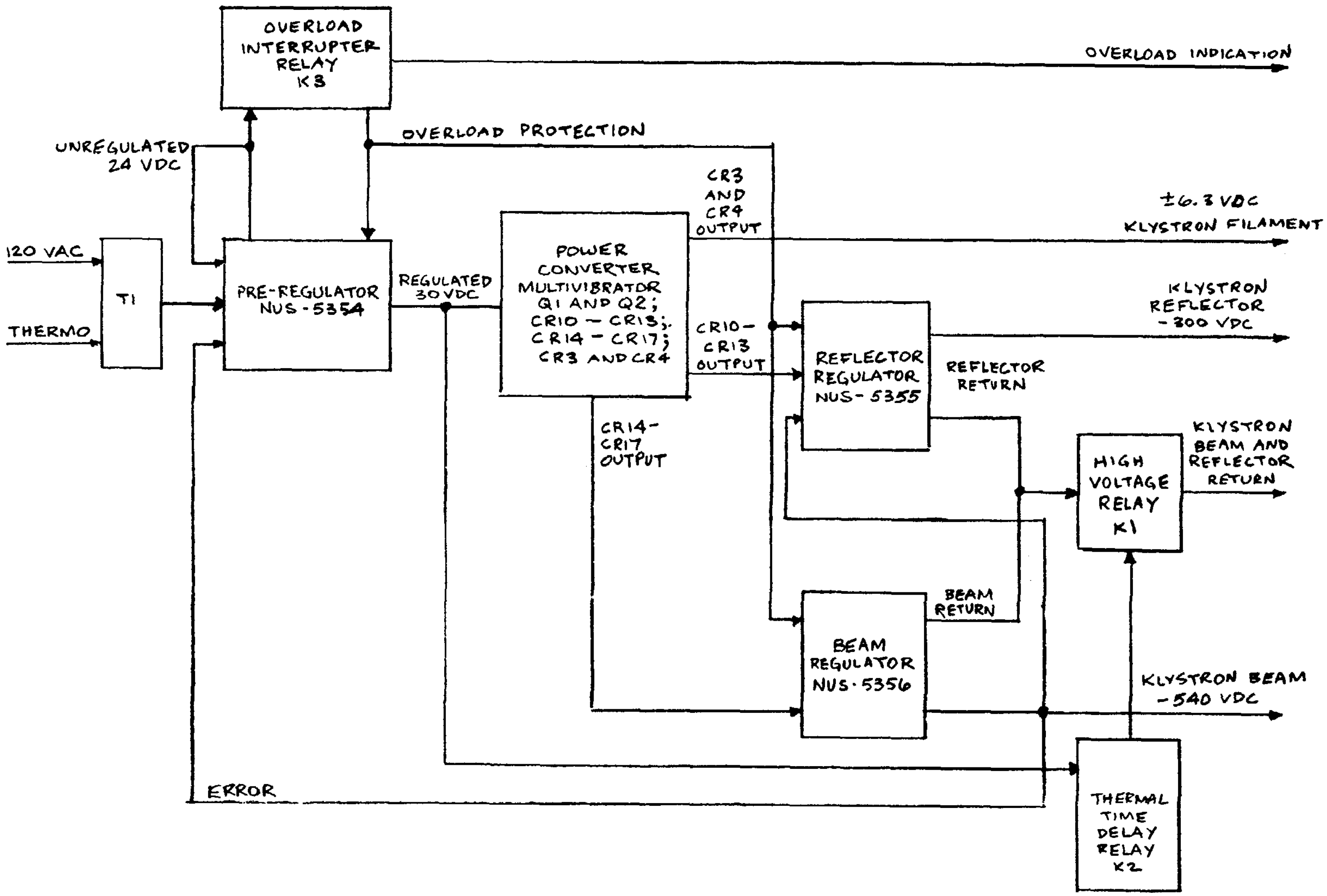
Beam Regulator and Reflector Regulator (figs. 2, 4, and 5). The beam regulator and the reflector regulator have the same basic electrical configuration. The values of several resistors differ to provide the different output voltages, approximately -540 vdc for the beam regulator and approximately -350 vdc for the reflector regulator. Both are energized by approximately 600 vdc. The circuit description that follows is keyed to the beam regulator. It is, however, equally applicable to the reflector regulator.

The beam regulator consists of transistors Q1 through Q4 and associated components. Transistors Q3 and Q4 are arranged as a differential amplifier. The voltage at the base of Q3 is held constant by a reference voltage developed across zener diode CR6. The base of Q4 receives a sample of the beam regulator output via a voltage divider comprising resistor R7, BEAM VOLTAGE ADJUST control R8, and resistor R9. Any change in the beam regulator output voltage causes a change at the base of Q4 and a corresponding change at the collector of Q3. The change at the collector of Q3 is applied to the base of series stage Q2 via emitter follower Q1. This results in a change in the collector resistance of Q2 which counteracts the original change in the beam regulator output voltage. Zener diode CR2 is externally connected to the positive output of beam regulator via pins N and B of plug P1. (Connectors J5 and J4 on the klystron power supply, for the beam regulator and reflector regulator, respectively.) Diode CR2 prevents the base voltage of transistor Q4 from exceeding approximately -36 vdc with respect to the positive output. Zener diode CR5 protects error amplifier Q1 and series regulator Q2 in the event of overload. Each regulator is further protected against overload by zener diodes mounted on the klystron power supply. These are diode CR19, protecting the beam regulator, and CR18, protecting the reflector regulator. Each diode is connected to the input and output pin of its regulator, P1-E and P1-N.

The output voltage of the reflector regulator is adjusted by REFLECTOR VOLTAGE ADJUST control R8. Except for this difference in nomenclature and the values of several components, the reflector regulator is identical to the beam regulator.

Output Circuits (figs. 1 and 2). The outputs of the regulators are taken from pins J5-N and J5-o, for the beam regulator, and from pins J4-N and D for the reflector regulator. The output of the beam regulator at J5-N is used for klystron current metering. The output at J5-D is applied back to the pre-regulator as an error input, to the klystron reflector via resistor R26 and P1-1, to the klystron cathode via the contacts of relay K1 and pin P1-2, and to the reflector regulator via pin J4-N. The output of the reflector regulator is taken from pin J4-D and applied to the klystron reflector via either resistor R27 or R28. The selection of resistor R27 or R28 (and the connection of the selected resistor to R26) determines whether the output of the reflector regulator will be 275 to 325 volts, or 310 to 370 volts at the junction of resistors R26 and R27 or R28. The selection to be made depends upon whether the klystron power supply is used to operate a VA-92 or a VA-246 type klystron. The outputs are available 25-to 60-seconds after the power supply is energized. This time delay is produced by thermal time delay relay K2 which takes from 25 to 60 seconds to energize after the voltage from the pre-regulator is applied. When this relay is energized, high voltage relay K1 is also energized through the contacts 4 and 7 of K2.

Overload Protection (figs. 1 and 2). Overload protection is supplied by overload relay K3 and by zener diode CR9 and an overload indication is supplied to the dual parametric amplifier. Zener diode CR9 is in parallel with the regulation circuits of the pre-regulator. In the event of an overload condition, the diode will break down, eliminating the danger to the pre regulator. Protection against long time overloads is provided by overload relay K3. This relay is connected so that in normal operation one of two coils is shorted out by the contacts (fig. 2). In this case, current is applied through the coil, from the output of the pre-regulator. In the event of a long term overload, the relay contacts are switched, both coils carry current, and the current is now applied directly back to the filter. This bypasses both the pre-regulator and zener diode CR9, protecting both. The relay remains locked until power is turned off. It is then automatically reset for proper operation, as the contacts revert to their no-overload condition.



64-461-1

Figure 1. Klystron Power Supply NUS 5352-2, Block Diagram

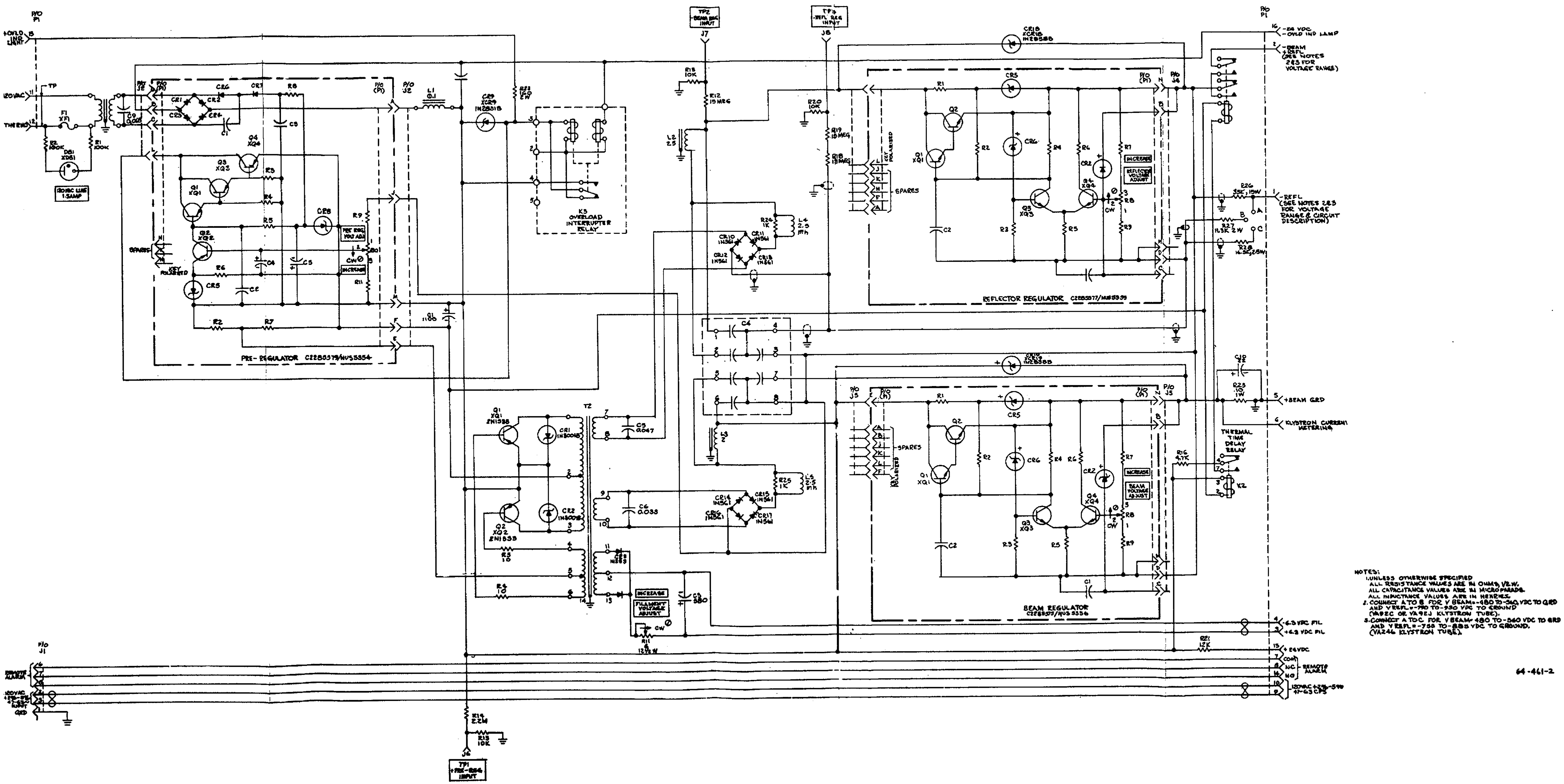


Figure 2. Klystron Power Supply NUS 5352-2, Schematic Diagram

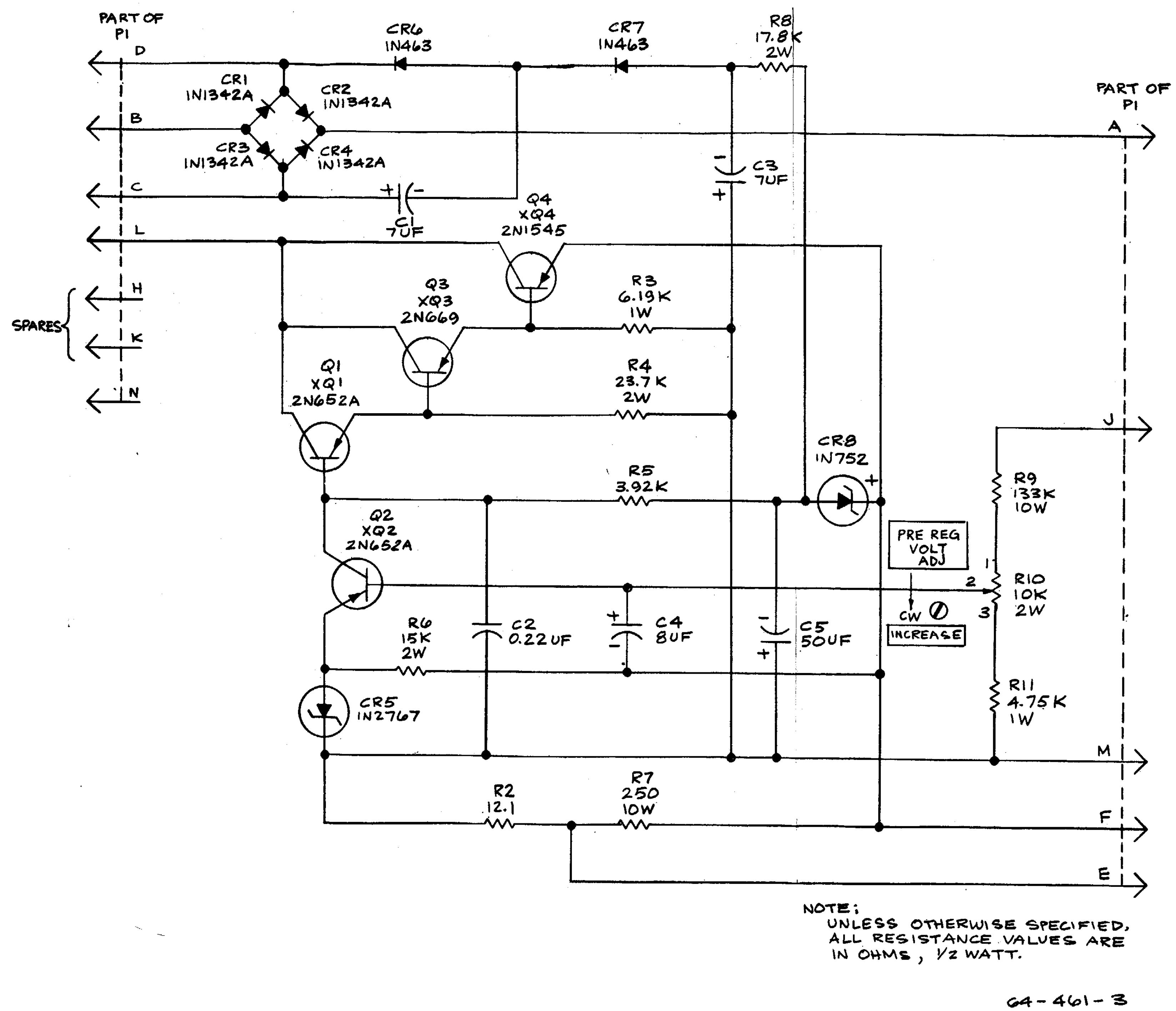


Figure 3. Pre-Regulator, Schematic Diagram

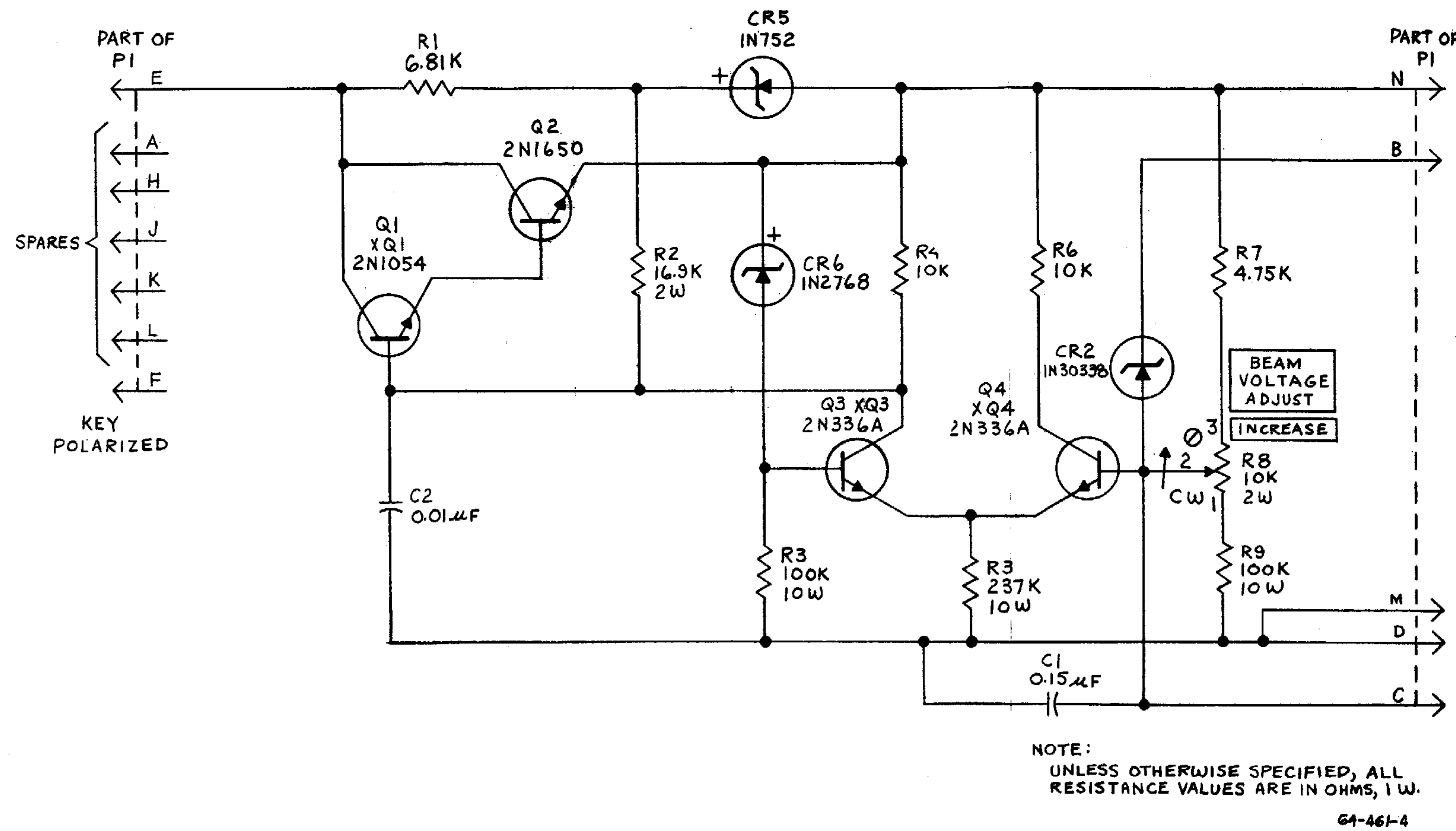


Figure 4. Beam Regulator, Schematic Diagram

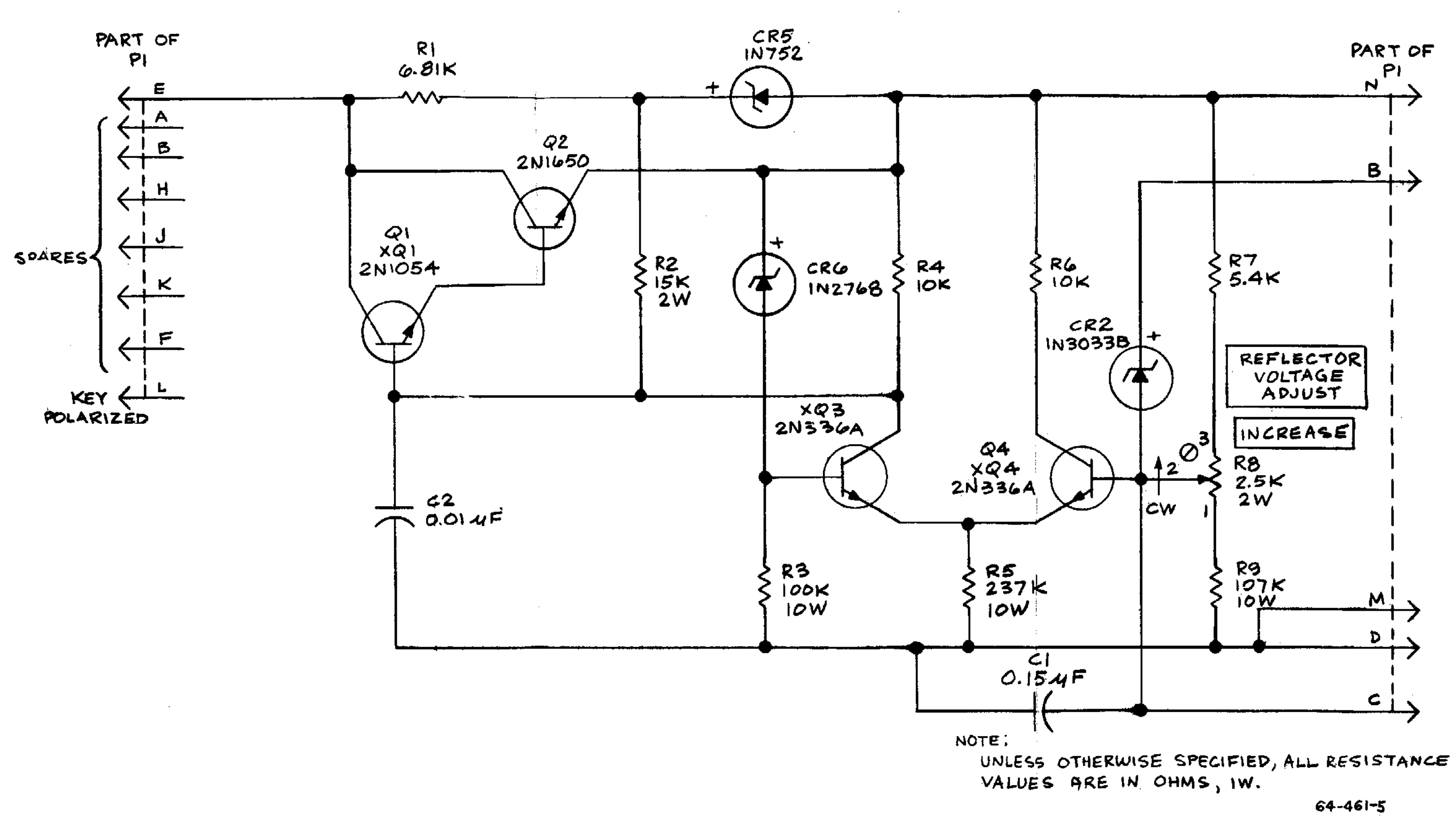


Figure 5. Reflector Regulator, Schematic Diagram

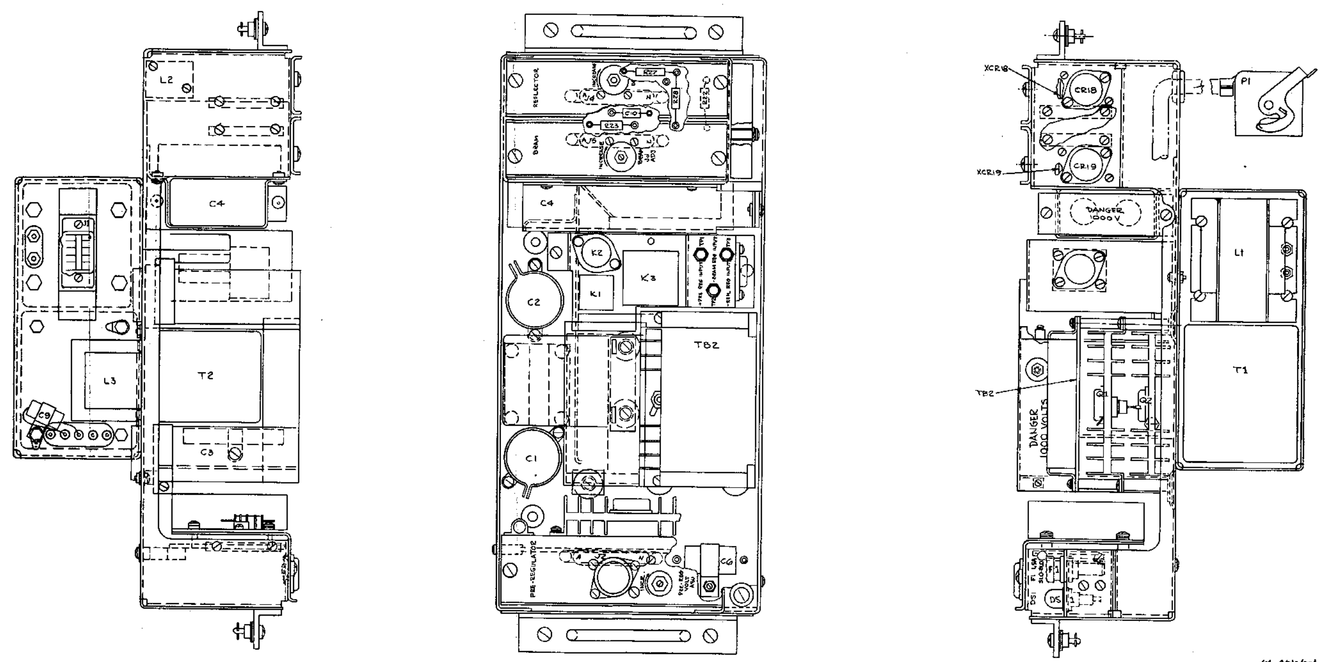
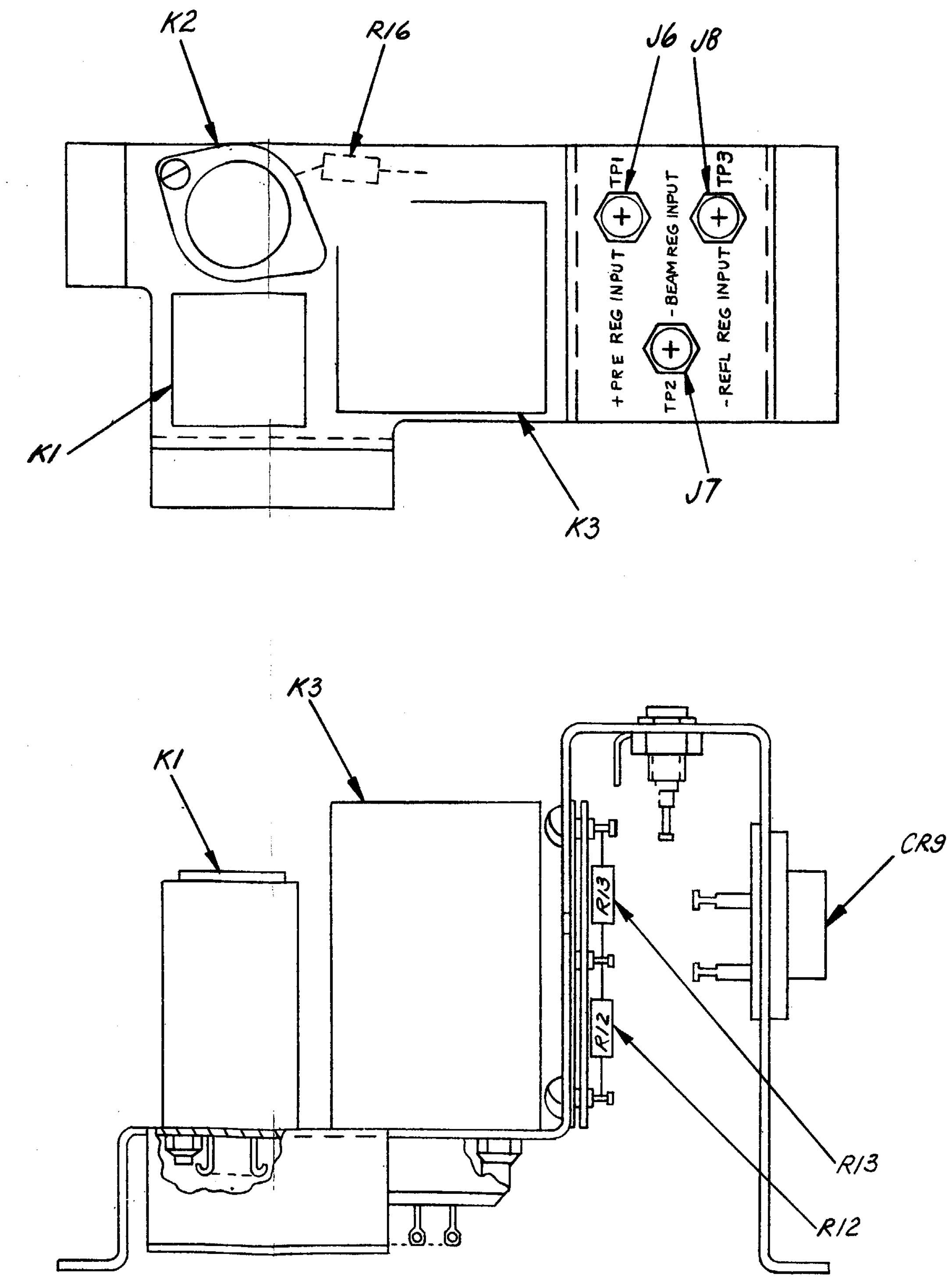


Figure 6. Klystron, Power Supply NUS 5352-2, Parts Location (Sheet 1 of 3)



64-461-6-2

Figure 6. Klystron, Power Supply NUS 5352-2, Parts Location (Sheet 2 of 3)

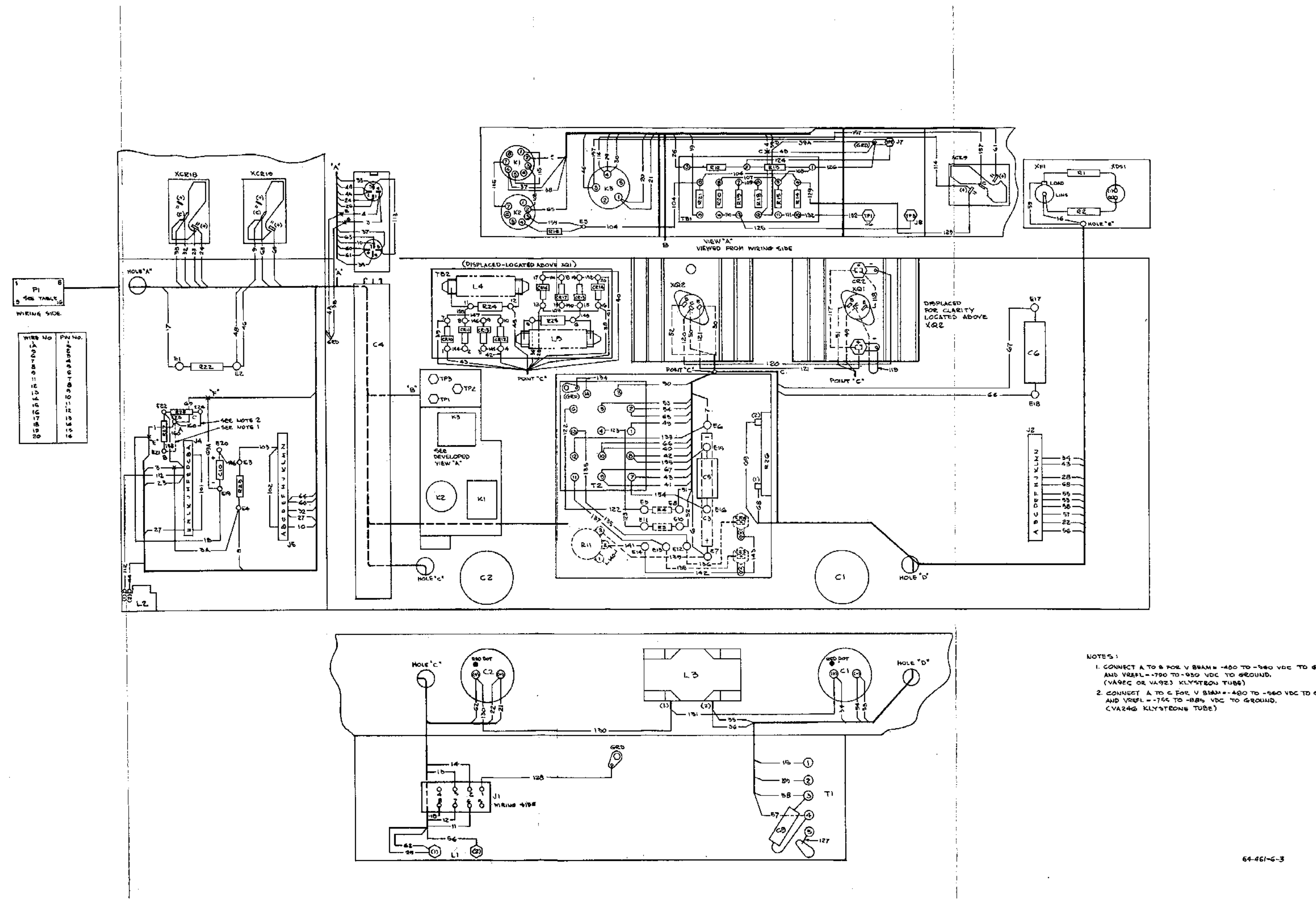


Figure 6. Klystron Power Supply NUS 5352-2, Parts, Location (Sheet 3 of 3)

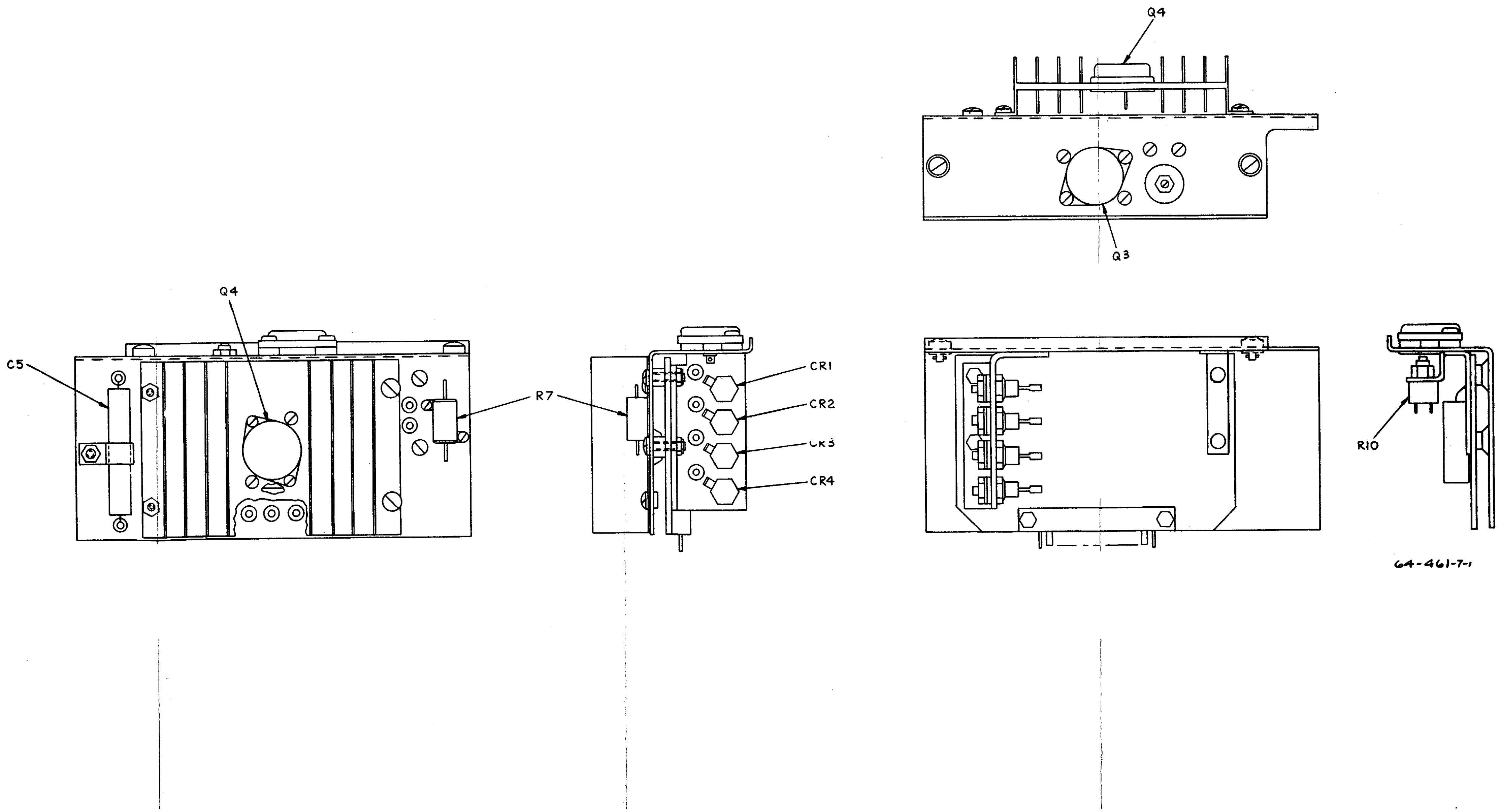


Figure 7. Pre-Regulator, Parts Location (Sheet 1 of 3)

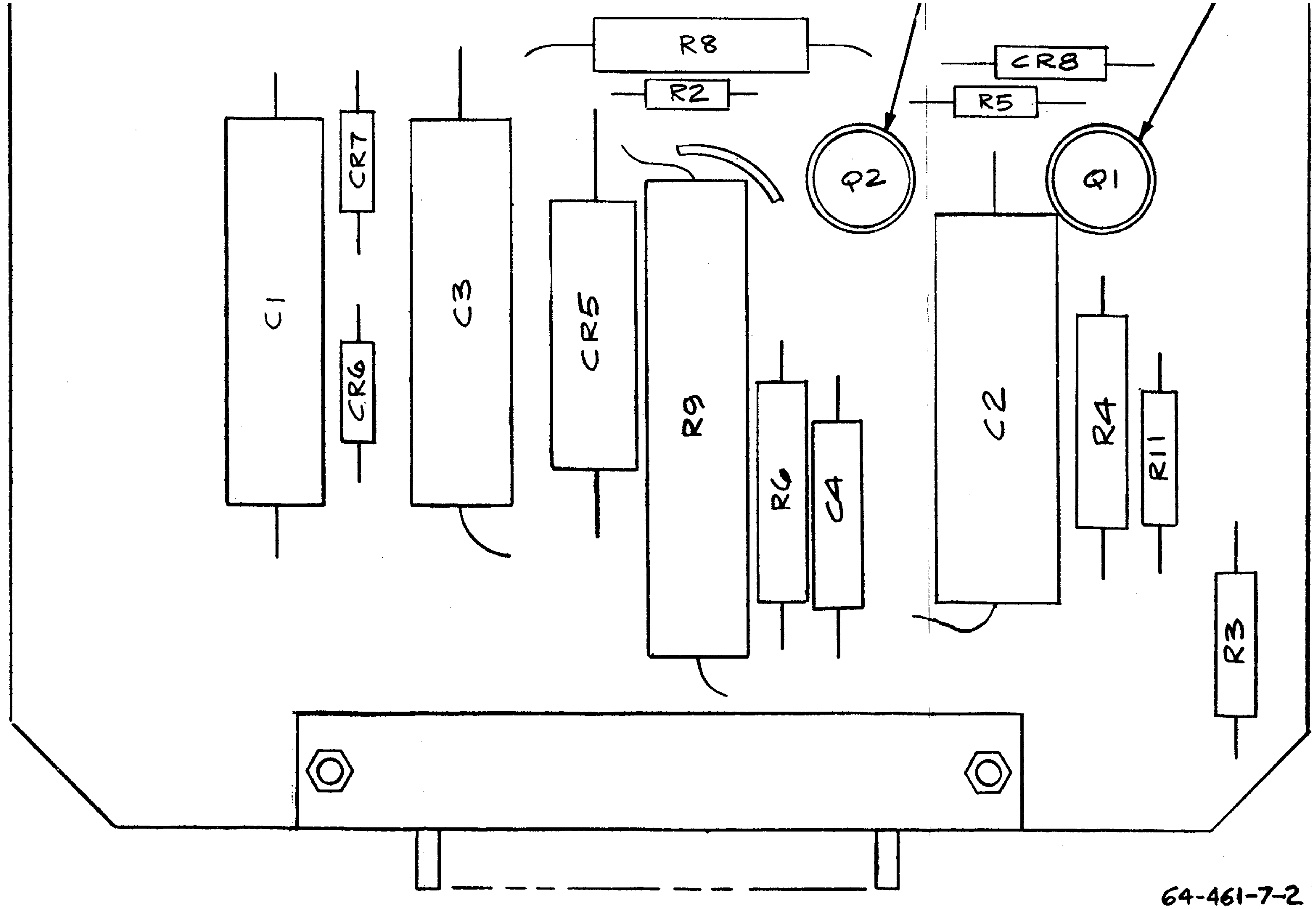


Figure 7. Pre-Regulator, Parts Location (Sheet 2 of 3)

Figure 7. Pre-Regulator, Parts Location (Sheet 2 of 3)

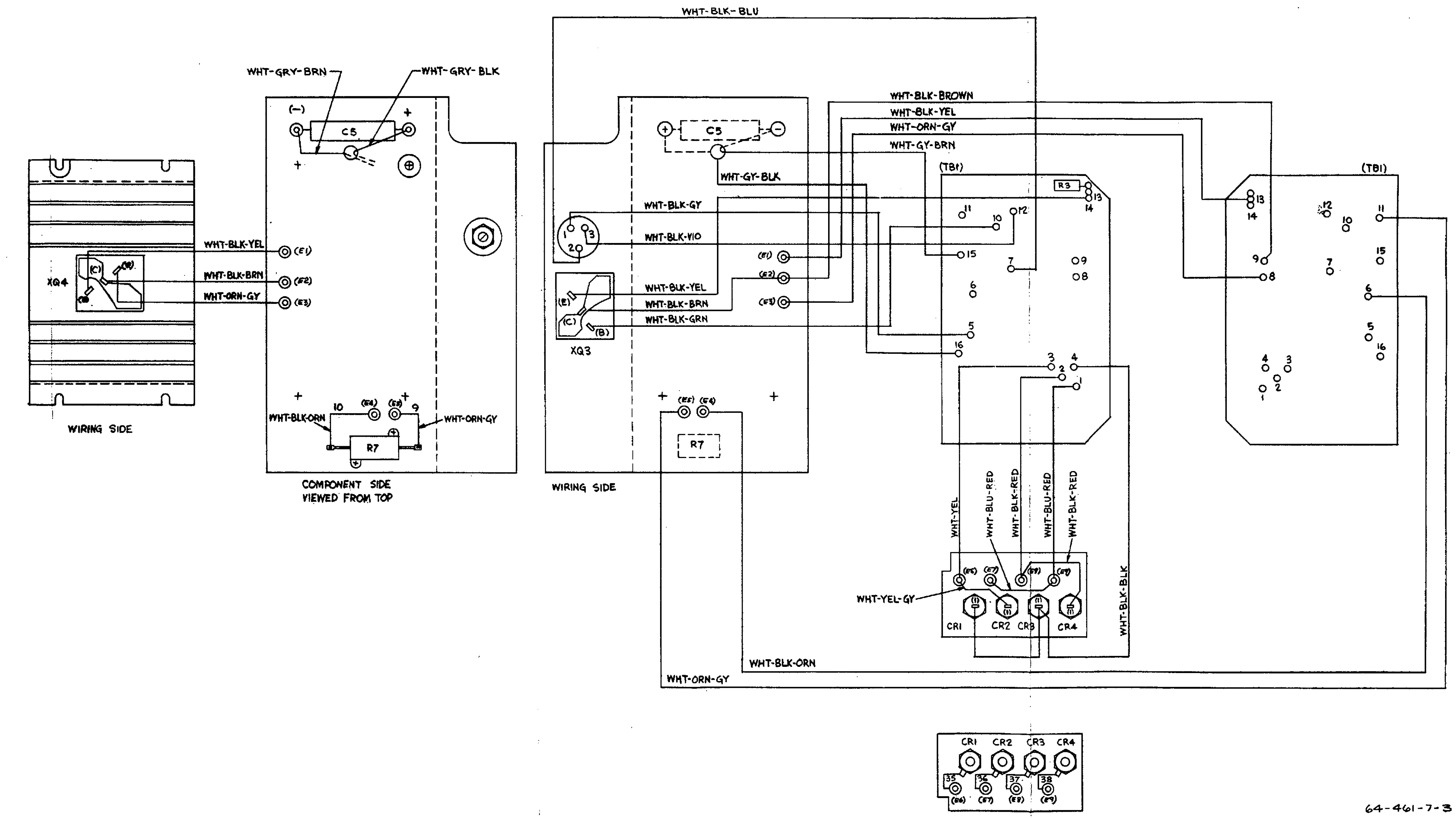


Figure 7. Pre-Regulator, Parts Location (Sheet 3 of 3)

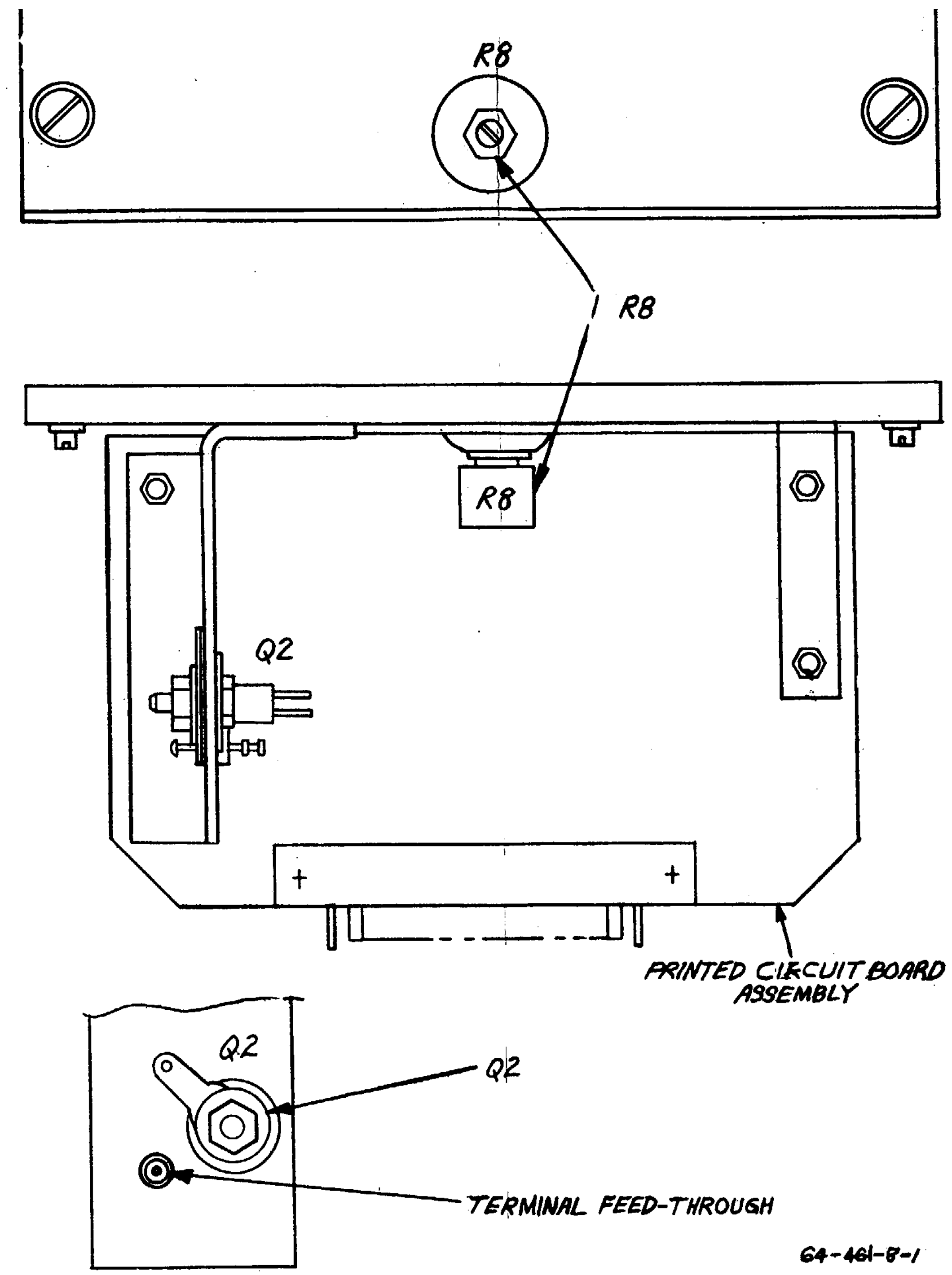


Figure 8. Beam Regulator and Reflector Regulator, Parts Location (Sheet 1 of 2)

Figure 8. Beam Regulator and Reflector
Regulator, Parts Location
(Sheet 1 of 2)

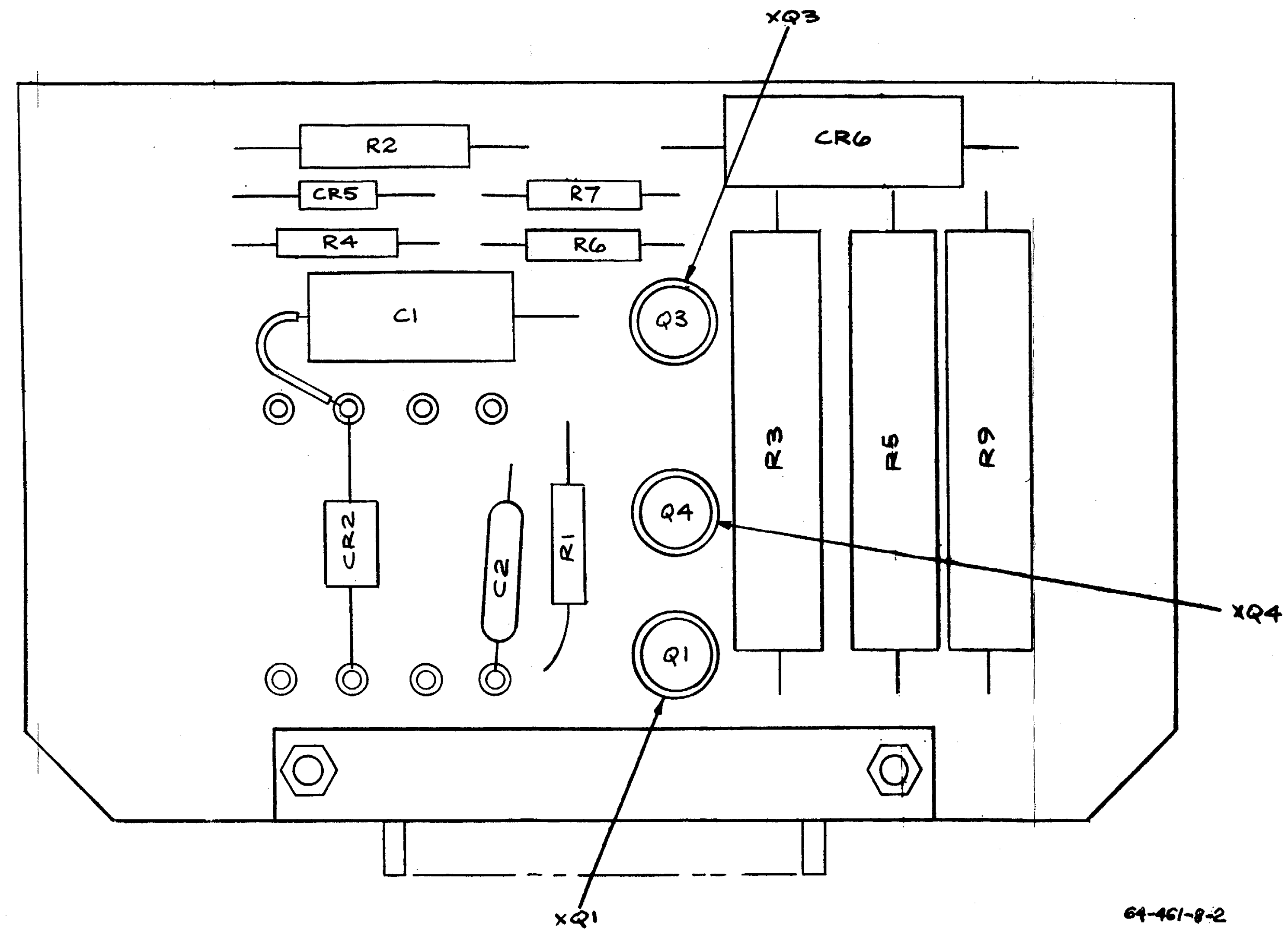


Figure 8. Beam Regulator and Reflector Regulator, Parts Location (Sheet 2 of 2)

ISOLATING DEVICES ASSEMBLIES
NUS 5358-6 and NUS 5358-8

DESCRIPTION

The isolating devices assembly provides isolation of an associated dual parametric amplifier from input and output circuit impedance variations. It also provides a means of by passing the parametric amplifier. The isolating devices assemblies differ physically only; they are electrically identical NUS 5358-6 is used for the left side and NUS 5358-8 is used for the right side of Dual Parametric Amplifier NUS 5300-7. Each isolating devices assembly incorporates two coaxial relays, a coaxial circulator, a coaxial isolator, and a dc blocking unit. Pertinent characteristics of these components are as follows:

Coaxial relays:

Frequency range	4400 to 5000 mc
Insertion loss	0. 2 db
Isolation	25 db min
Impedance	50 ohms
VSWR	1. 4 max.

Coaxial circulator:

Frequency range	4400 to 5000 mc
Isolation	22 db min
Insertion loss	0. 5 db max
Impedance	50 ohms
VSWR	1. 15 max

Coaxial isolator:

Frequency range	4000 to 7000 mc
Insertion loss	1 db max
Peak power	10 kw max
Average power	10 watts max
Input vswr	1. 15 nominal
Load vswr	2:1 max

NUS 5358-6 and NUS 5358-8

Dc blocking unit:

Impedance	50 ohms
Insertion loss	0. 2 db max
Average power rating	50 watts
Maximum power rating	1 kw

CIRCUIT DESCRIPTION (Figures 1 through 5)

The input signal from the antenna is applied to contacts of coaxial relay Ki through wave-guide-to-coax adapter Z5. Relays K1 and K2 can be actuated to bypass the parametric amplifier and feed the input signal directly to the output circuit of the module. Normally, the signal is applied to coaxial circulator Z1 through contacts of K1.

The circulator is a three-port ferromagnetic device which transfers energy from port 1 to port 2, from port 2 to port 3, and from port 3 to port 1 with essentially no attenuation in the forward direction and 22 db isolation in the reverse direction. The rf antenna signal is applied through port 1 to the parametric amplifier tuner, connected to port 2. The amplified signal from the tuner is thus isolated from the input circuit and routed to coaxial isolator Z2 through port 3 of the circulator. This property of the circulator isolates the input conductance of the parametric amplifier from variations in impedance which may exist on the input or output line, assuring that the gain of the parametric amplifier remains constant.

The isolator acts as a buffer between the circulator and the next stage of the receiver. It protects the isolating properties of the circulator by making its output impedance independent of the input impedance of the next receiver stage. The output of the isolator is fed through dc blocking unit Z4. This unit is a coaxial capacitor assembly which prevents the parametric amplifier cavity varactor bias from appearing at the output of the isolating devices assembly.

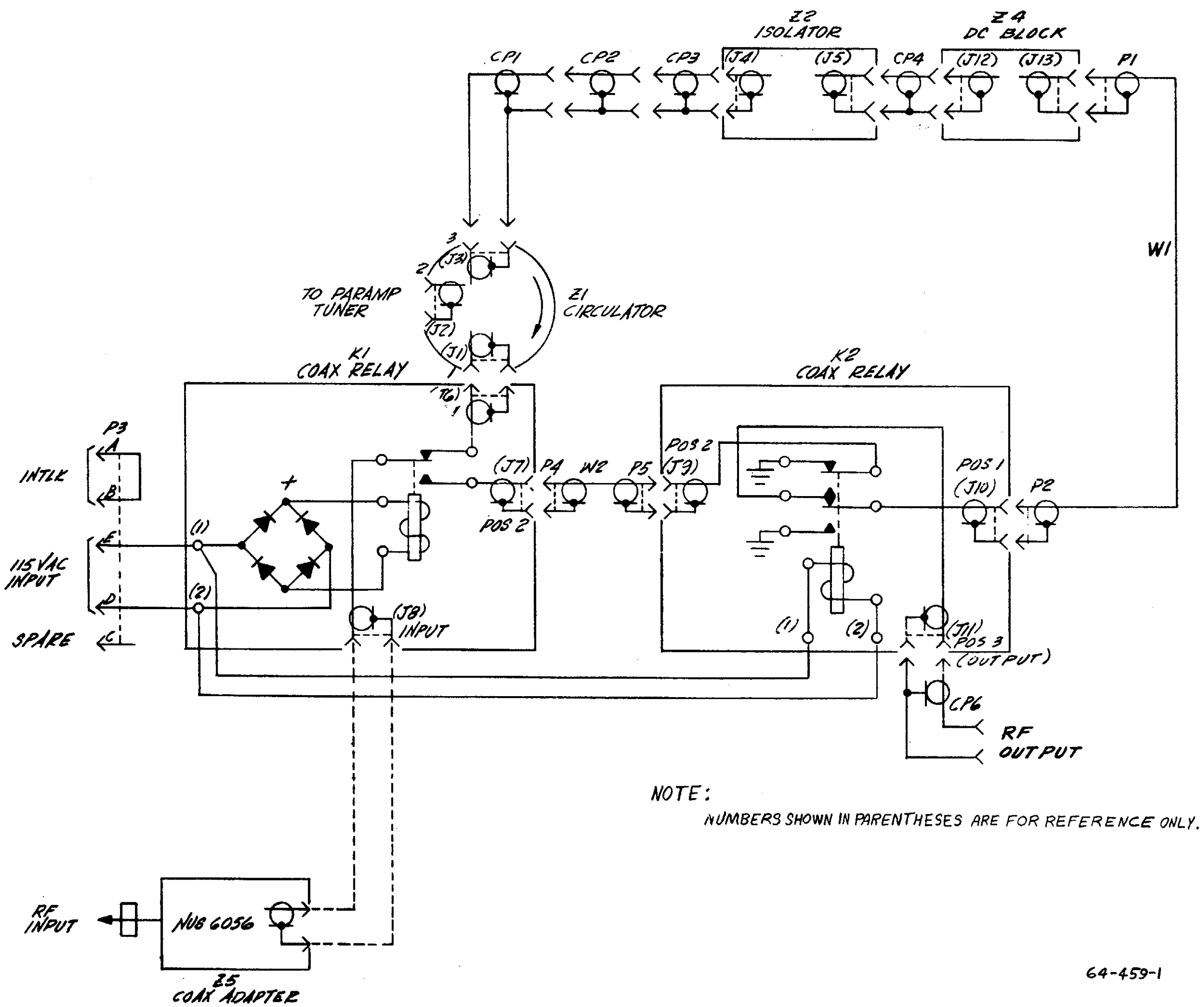
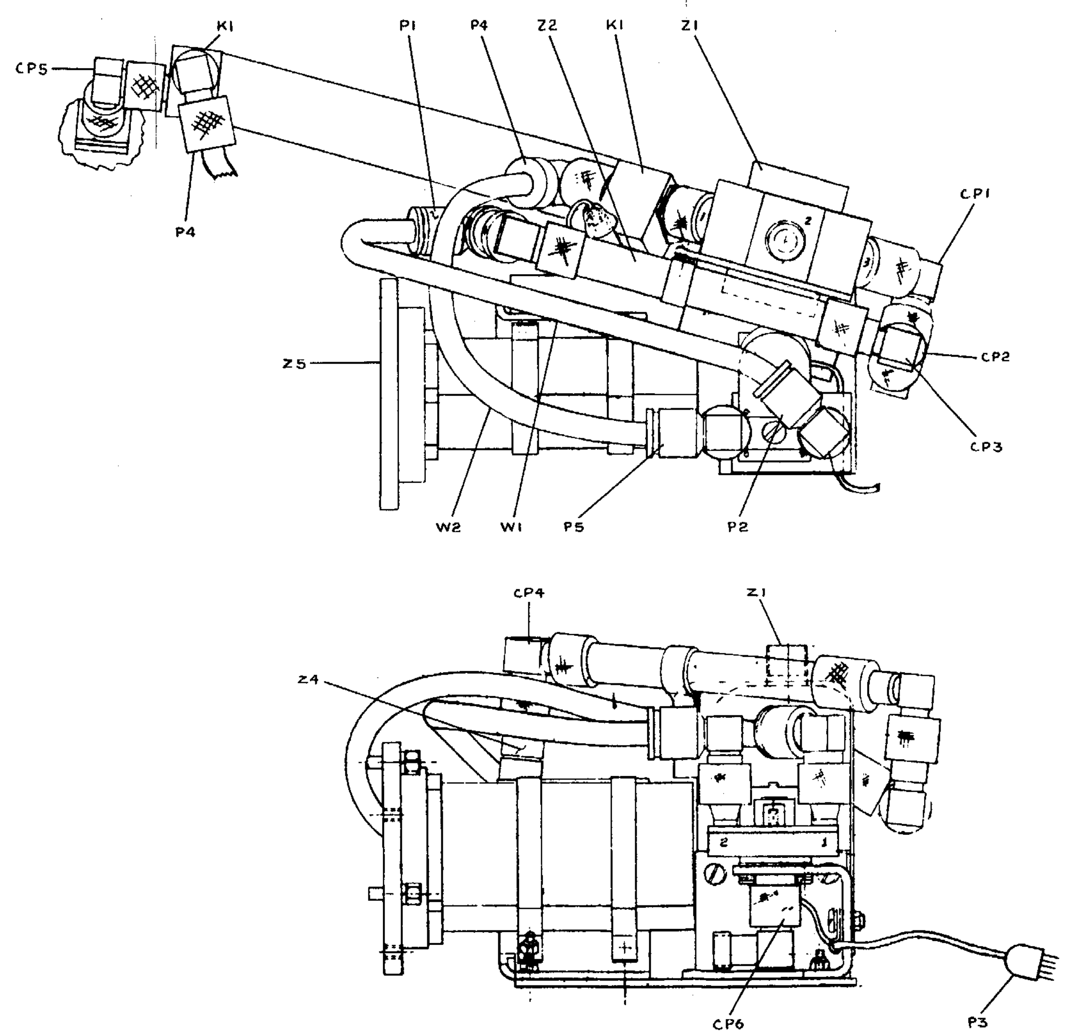
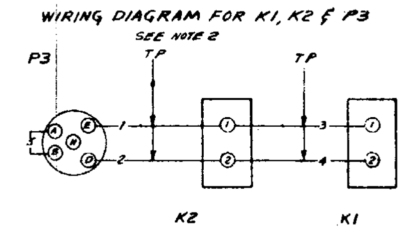


Figure 1. Isolation Devices Assemblies NUS 5358-6 and NUS 5358-8, Schematic Diagram



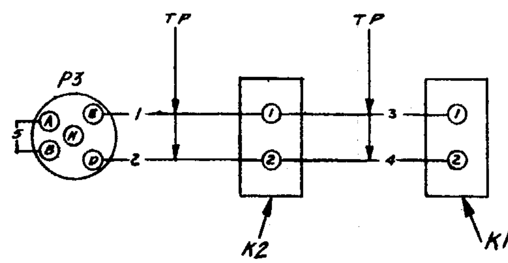


WIRING LIST FOR K1, K2 & P3

NO	COLOR & GAGE	FROM	TO	LENGTH	LM ITEM NO
1	WHT-GY } TP-18	P3 - E	K2 - 1	9.50	26
2	GY	P3 - D	K2 - 2	9.50	
3	WHT-GY } TP-18	K2 - 1	K1 - 1	5.00	26
4	GY	K2 - 2	K1 - 2	5.00	
5	BUS 20	P3	P3 - B	1.25	27

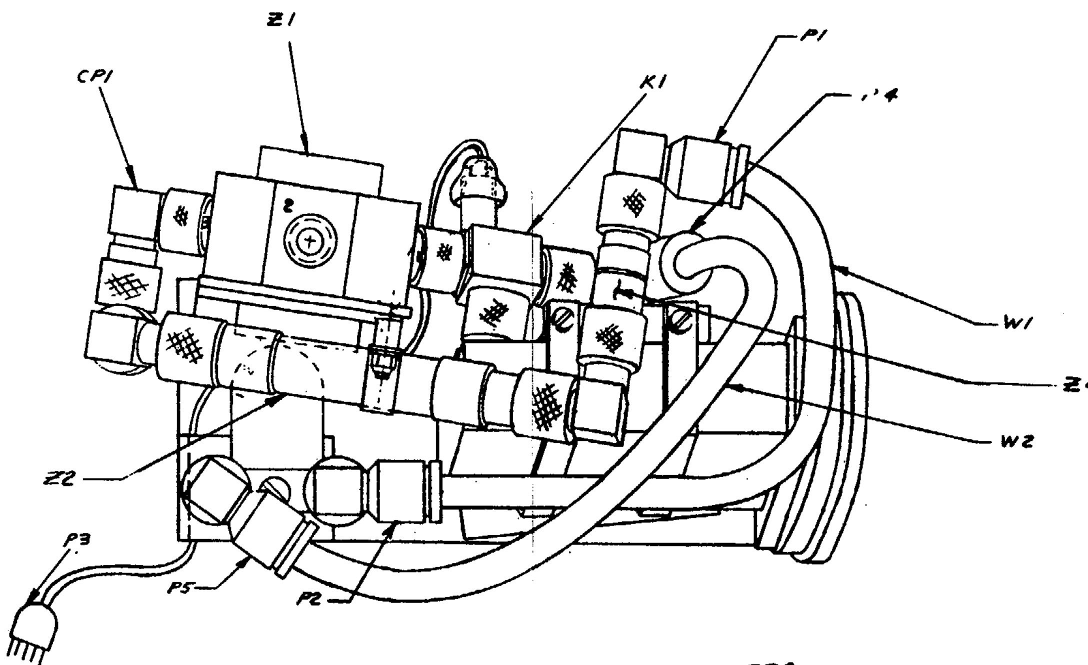
Figure 2. Isolation Devices Assemblies NUS 5358-6, Parts Location

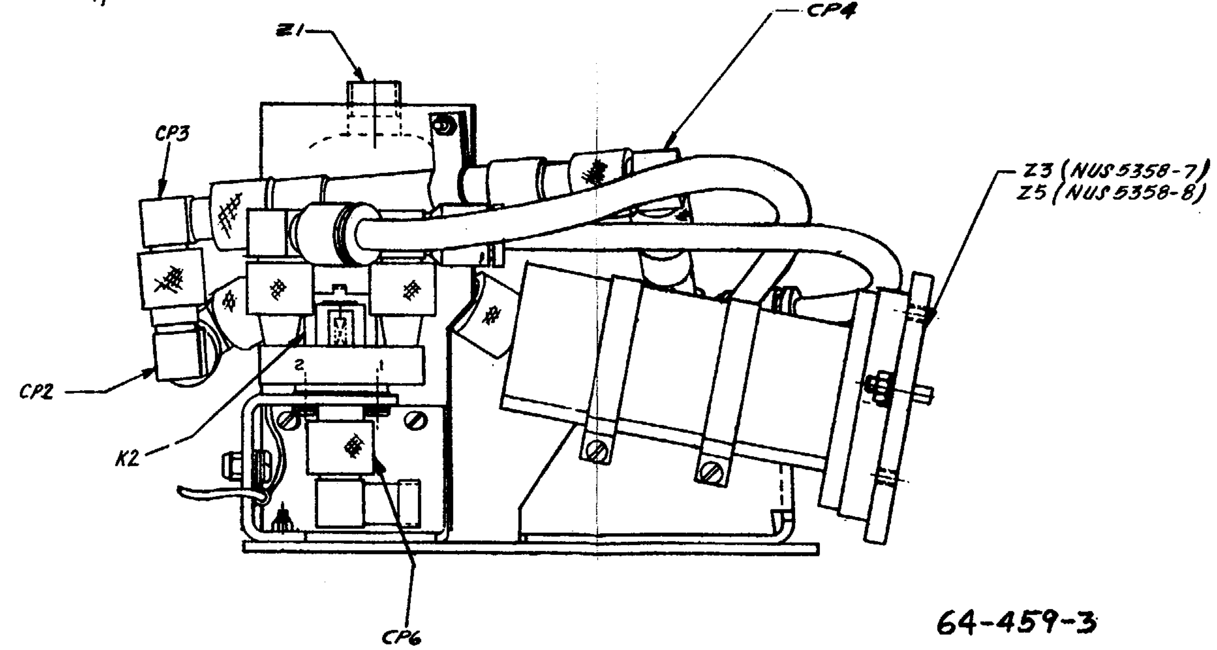
WIRING DIAGRAM FOR K1, K2 & P3



WIRING LIST FOR K1, K2 & P3

NO.	COLOR & GAGE	FROM	TO	LENGTH	LM ITEM NO
1	WHT-GY } TP-18	P3-E	K2-1	9.50	26
2	GY	P3-D	K2-2	9.50	
3	WHT-GY } TP-18	K2-1	K1-1	5.00	26
4	GY	K2-2	K1-2	5.00	
5	BUS 20	P3-A	P3-B	1.25	27





64-459-3

Figure 3. Isolation Devices Assemblies NUS 5358-8, Parts Location

1. Connector P4 and P5 (2332071)
2. Cable marker (2289390G111)
3. RF cable W2 (921153)
4. Connector P1 and P2 (2332071)
5. Cable marker (2289390G112)
6. RF cable W1 (921153)
7. DC block Z4 (2334376)
8. Adapter CP4 (755609)
9. Cable clamp (383430H022)
10. Nut (107917)
11. Deleted
12. Locknut (180132)
13. Isolator Z2 (2283268)
14. Adapter CP1, CP2, CP3, CP5 and CP6 (755609)
15. Relay K2 (2334377)
16. Screw (100603A110)
17. Lockwasher (107136)
18. Washer (200609H008)
19. Cable clamp (383440A004)
20. Screw (100606A120)
21. Washer (200609H012)
22. Connector P3 (2333443)
23. Mounting bracket (2333961G1)
24. Locknut (180132)
25. Relay K1 (2287686)
26. Circulator Z1 (2284496)
27. Screw (100603A116)
28. Lockwasher (107136)
29. Washer (200609H012)
30. Clamp (2333957)
31. Nut (180132)
32. Deleted
33. Deleted
34. Nut (107686)
35. Lockwasher (107224)
36. Guide pin (2335425)
37. Connector (2332714)
38. Screw
39. Lockwasher
40. Washer
41. Waveguide flange (MS90046-406B)
42. Waveguide (MS90035-95)
43. Mounting bracket (2333959G1)
44. Deleted
45. Locknut (180132)
46. Mounting plate (2333958G1)
47. Deleted
48. Screw (100606A120)
49. Washer (200609H012)
50. Deleted
51. Angle bracket (2333956)
52. Nut (180132)
53. Baseplate (2333960G1)

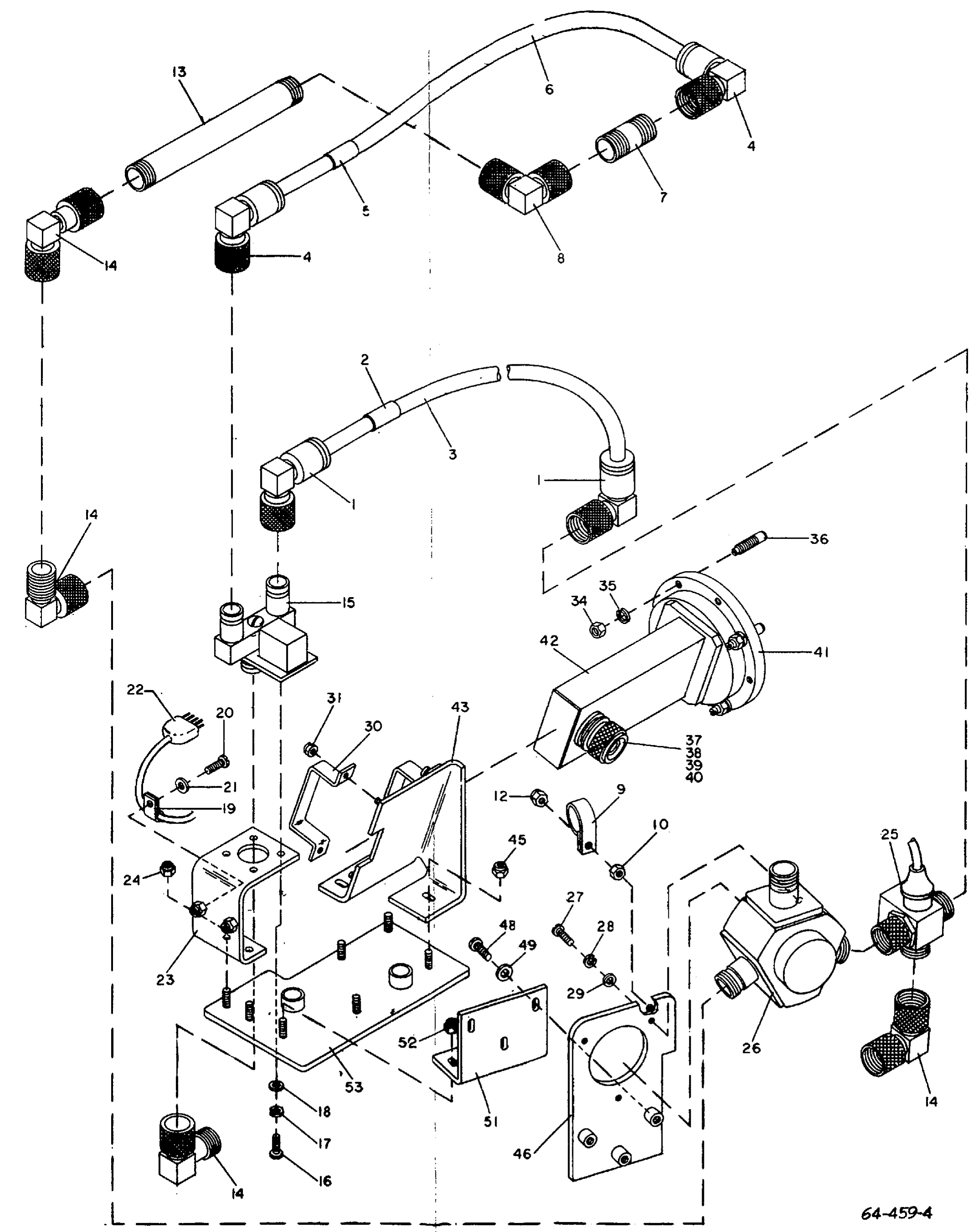


Figure 4. Isolation Devices Assemblies NUS 5358-6, Exploded View

1. Connector P4 and P5 (2332071)
2. Cable marker (2289390G113)
3. RF cable W2 (921153)
4. Connector P1 and P2 (2332071)
5. Cable marker (2289390G114)
6. RF cable W1 (921153)
7. DC block Z4 (2334376)
8. Adapter CP4 (755609)
9. Cable clamp (383430H022)
10. Nut (107917)
11. Washer (200609H012)
12. Spacer (170061A406)
13. Isolator Z2 (2283268)
14. Adapter CP1, CP2, CP3, and CP6 (755609)
15. Relay K2 (2334377)
16. Screw (100603A110)
17. Lockwasher (107136)
18. Washer (200609H008)
19. Cable clamp (383440A004)
20. Screw (100606A120)
21. Washer (200609H012)
22. Connector P3 (2333443)
23. Mounting bracket (2333961G1)
24. Locknut (180132)
25. Relay K1 (2287686)
26. Circulator Z1 (2284496)
27. Screw (100603A116)
28. Lockwasher (107136)
29. Washer (200609H012)
30. Deleted
31. Deleted
32. Clamp (2333963)
33. Screw (100606A120)
34. Nut (107686)
35. Lockwasher (107224)
36. Guide pin (2335425)
37. Connector (2332714)
38. Screw
39. Lockwasher
40. Washer
41. Waveguide flange (MS90046-406B)
42. Waveguide (MS90035-95)
43. Deleted
44. Mounting bracket (2333965G1)
45. Locknut (180132)
46. Deleted
47. Mounting plate (2333964G1)
48. Screw (100606A120)
49. Washer (200609H012)
50. Nut (180132)
51. Angle bracket (2333962)
52. Nut (180132)
53. Baseplate (2333966G1)

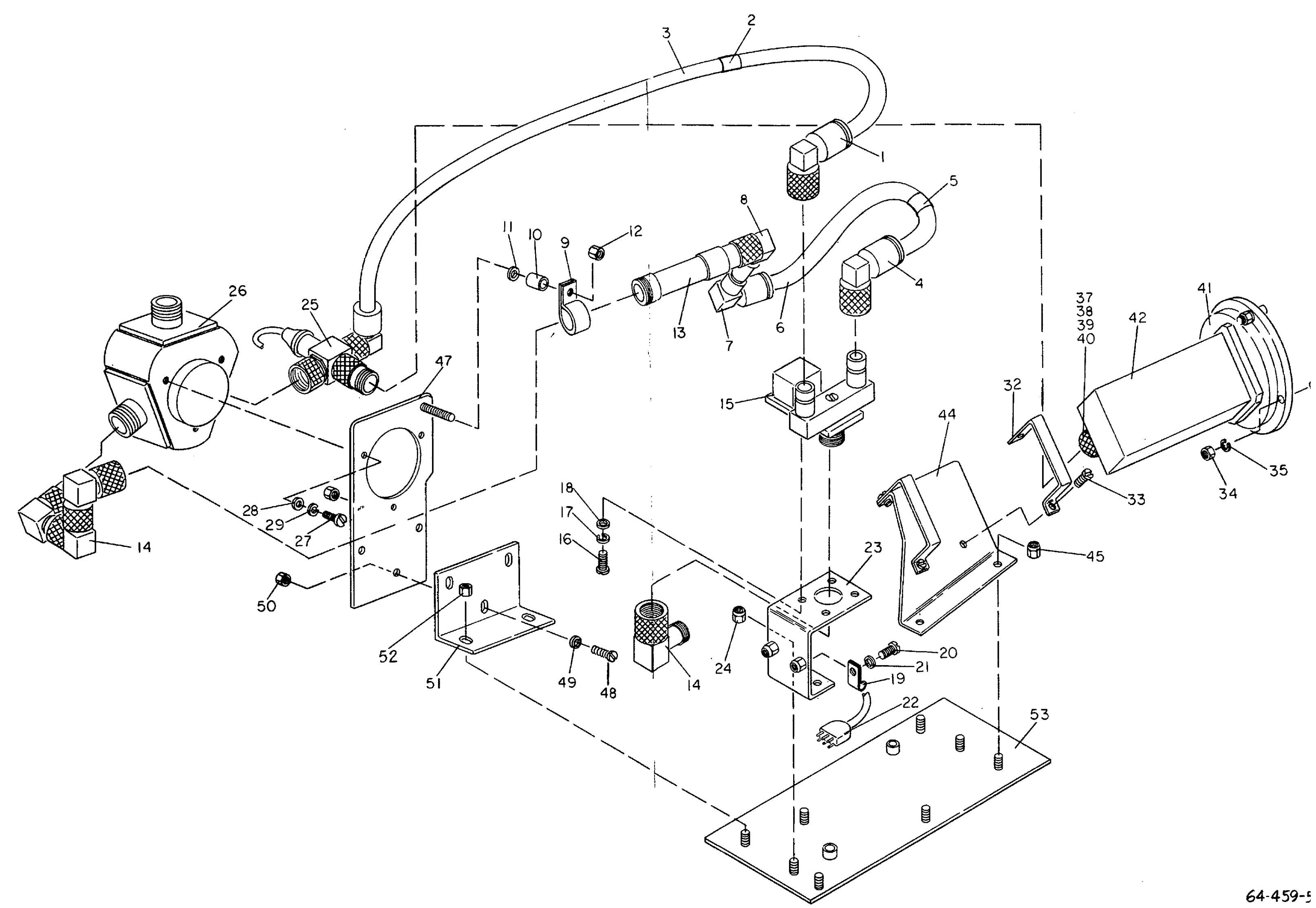


Figure 5. Isolation Devices Assemblies NUS 5358-8, Exploded View

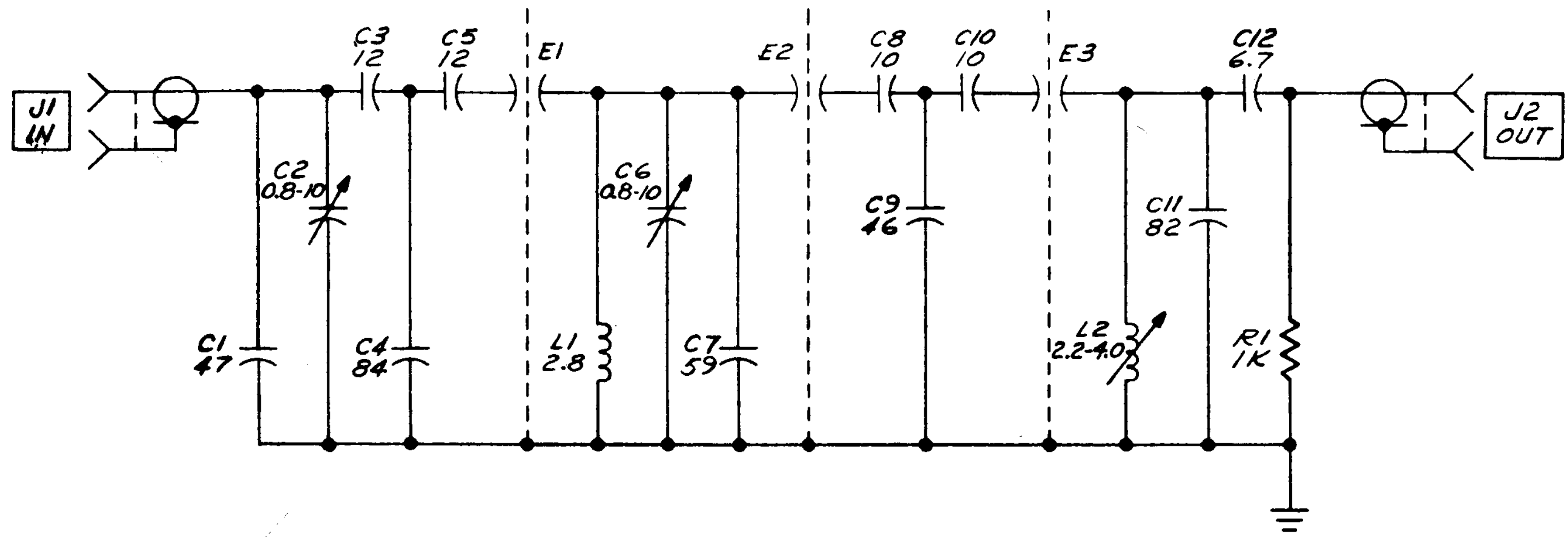
200-KC BANDPASS FILTER
NUS 5967-6

DESCRIPTION

The 200-kc bandpass filter (9.8 mc) increases the signal-to-noise ratio of a receiver by restricting the if. bandwidth. The filter operates on a 3 db bandwidth of 200 kc at a center frequency of 9.8 mc, and can be used for one-or two-channel operation.

CIRCUIT DESCRIPTION (Figures 1 and 2)

The filter receives the 9.8 mc if. signal together with broadband noise at connector J1. Since the bandwidth of the filter is much narrower than the if. passband, the noise is substantially reduced while the 9.8 mc signal remains virtually unaffected. In this manner, the signal-to-noise ratio is greatly improved. The output of the filter appear at connector J2. The filter is mounted in the if. and baseband drawer where it is secured by captive screws.



NOTES:
1. UNLESS OTHERWISE SPECIFIED.,
ALL CAPACITANCE VALUES ARE IN PF.
ALL INDUCTANCE VALUES ARE IN UH.
ALL RESISTANCE VALUES ARE IN OHMS, ½ WATT.

TD 64-501-1

Figure 1. 200-Kc Bandpass Filter NUS 5967-6, Schematic Diagram.

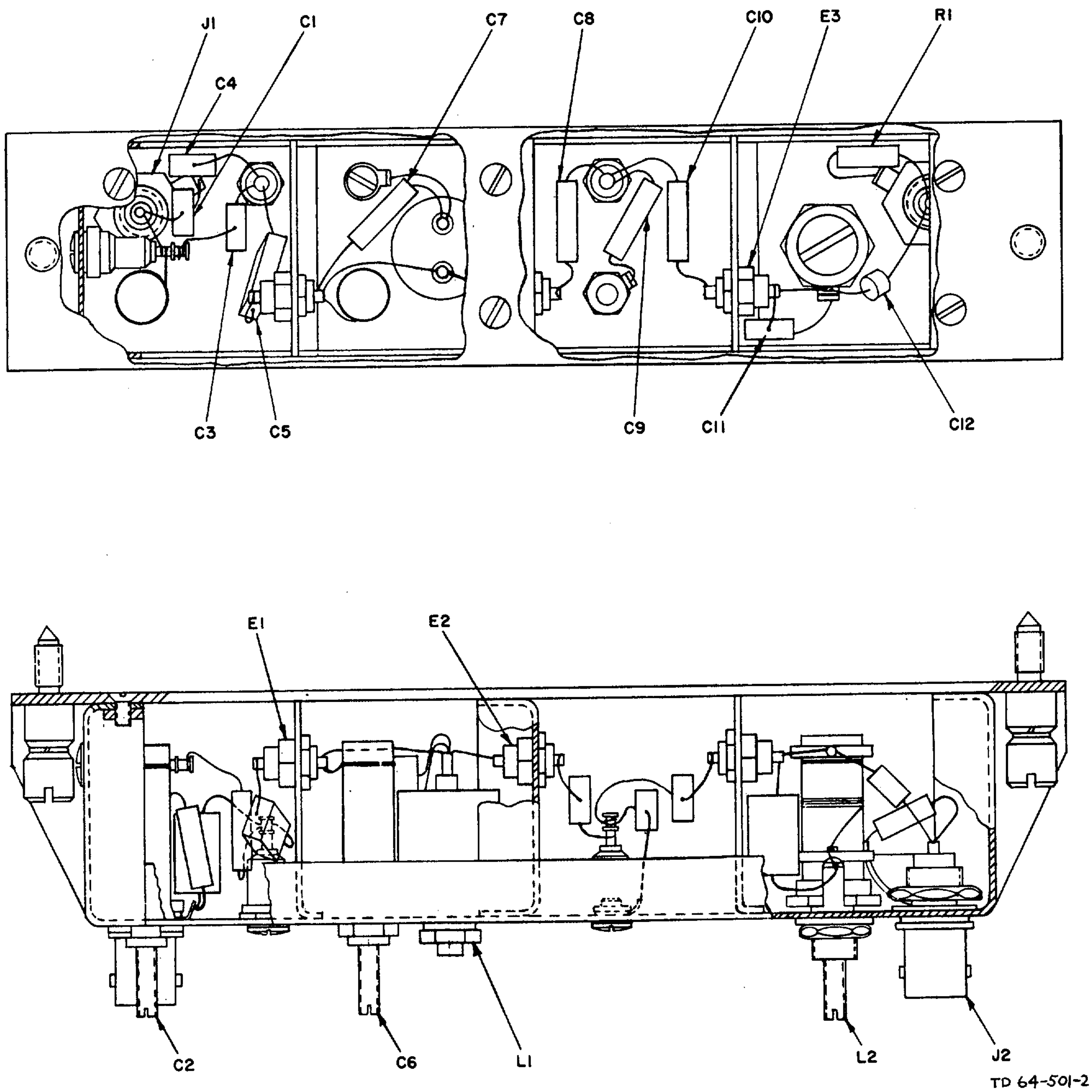


Figure 2. 200-Kc Bandpass Filter NUS 5967-6, Parts Location

POWER SUPPLY AND FAN ASSEMBLY
NUS 5968-1, NUS 5968-3, and NUS 5968-4

DESCRIPTION

The power supply and fan assembly consists of a maximum of three power supplies, a cooling fan, and primary power control circuits. The 150-165 volt power supply (NUS 5974 or NUS 8798) is used in all configurations of the power supply and fan assembly. Depending on the equipment to be supplied with operating voltages, a 5 volt power supply (NUS 5975-1 or NUS 8797G4), or 15 volt power supply (NUS 5975-31 or NUS 8797G5) can also be incorporated. In addition, a 30 volt power supply (NUS 5975-41 or NUS 8797G3) can also be incorporated. The pertinent specifications of the power supply and fan assembly are as follows:

Input:

Voltage	115 volts ac
Frequency	47-63 cps
Current	5 amperes

Outputs:

Voltages	Load Current
150 volts dc	1 ampere
165 volts dc	300 ma
5 volts dc*	1 ampere
15 volts dc*	1 ampere
30 volts dc*	700 ma
6.3 volts ac	15 amperes

*Optional

CIRCUIT DESCRIPTION (Figures 1 and 2)

The 115 volt ac input to the power supply and fan assembly is available at convenience outlet J5, through fuse F2. When main power switch CB1 is placed to the on position, 115 volt ac power is applied to the three power supply modules and to the blower fan B1. The fan is protected by fuse F1. The 150-165 volt power supply produces 150, and 165 volts dc, and 6.3 volts ac. In addition, 5 or 15 volts dc, depending upon the module used, is available at pin 12. If the third power supply module is used, 30 volts dc is available at pin 15 interlock switch S1 removes the input voltage to the fan when the power supply and fan assembly is removed from position in the cabinet.

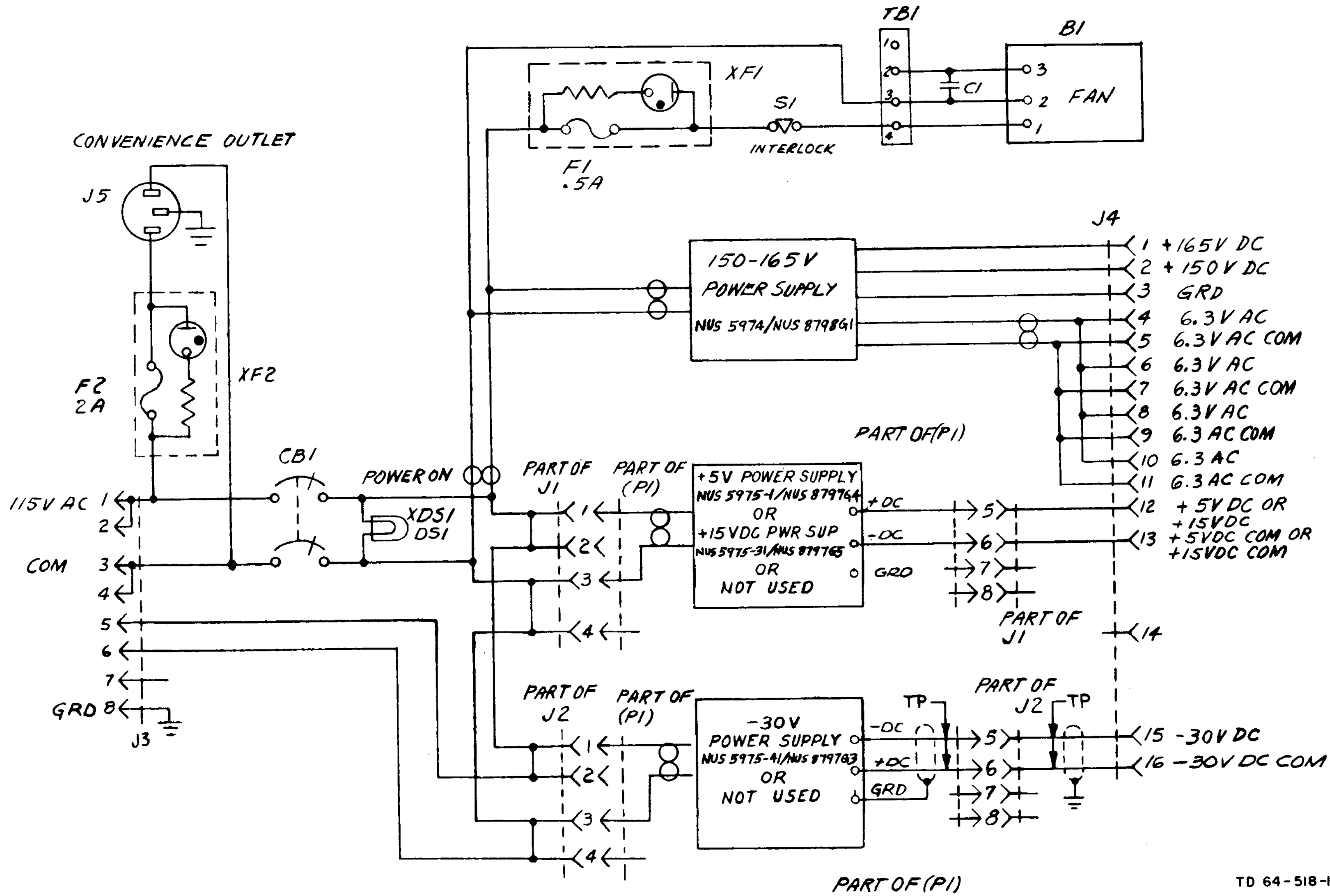
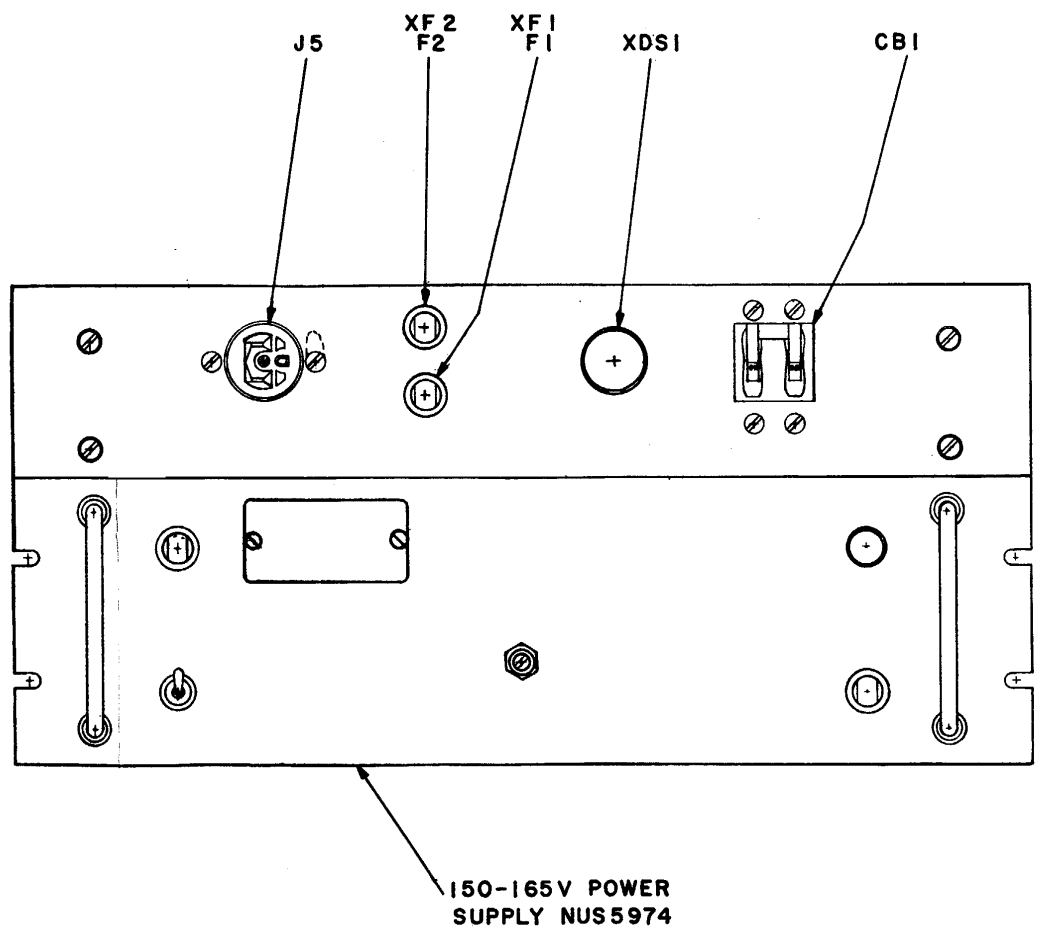


Figure 1. Power Supply and Fan Assembly NUS 5968-1, NUS 5968-3, and NUS 5968-4, Schematic Diagram



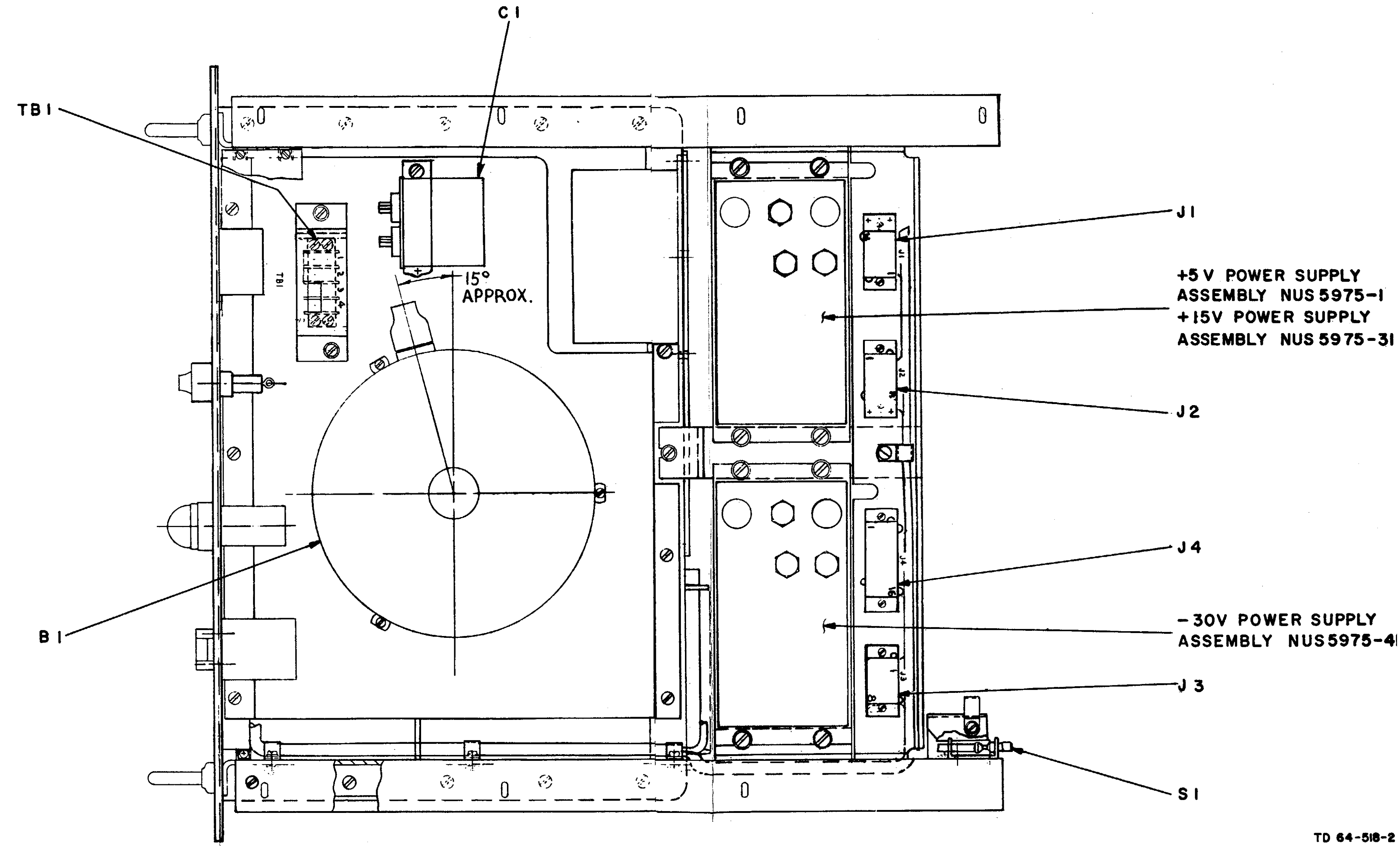


Figure 2. Power Supply and Fan Assembly
NUS 5968-1, NUS 5968-3, and
NUS 5968-4, Parts Location

9.8-MC AGC AMPLIFIER
NUS 5969-1

DESCRIPTION

The agc amplifier is associated with a dual receiver and provides a gain-control voltage which may be manually preset by means of an adjustment potentiometer, or may be automatically controlled by the level of the sum of two if. input signals. Facilities for dual-quadruple diversity switching are also provided. All parts of the agc amplifier are mounted on a chassis which is secured in a drawer by captive screws. Power requirements and input and output signal characteristics are as follows:

Input power requirements	+5 volts dc
	-5 volts dc
If. input signal frequency	9.8 mc
If. input signal level	0.65 volt rms
Gain-control output signal	0.60 volt dc

CIRCUIT DESCRIPTION (Figures 1 and 2)

Automatic Gain-Control Circuit. If. input signals at 9. 8 mc are applied to input jacks J1 and J5, and are coupled through capacitor C1 to the resonant circuit consisting of inductor ½ L1 in parallel with inductor L2 and the stray capacitance of the circuit. The if. voltage developed across the resonant circuit is coupled through emitter-follower Q1, whose high input impedance prevents loading of the if. circuits, to the output level detector consisting of diode CR1, diode CR2 and resistor R5. Potentiometer R9 sets the quiescent (no signal) current of emitter-follower Q2. The rectified if. voltage produced by the output is added across resistor R4 and potentiometer R9. The output of the level detector is coupled through emitter-follower Q2, isolating resistor R14, and AUTO-MANUAL switch S2 to pins 9 and 10 of plug 1 for transmission to the gain-controlled stages of the associated dual receiver.

Manual Gain-Control Circuit. When AUTO-MANUAL switch S2 is set to MANUAL, pins 9 and 10 of plug P1 are disconnected from the automatic gain-control circuit, and are connected instead to a voltage divider consisting of resistors R11, R12, and R13, and potentiometer R10. The agc voltage applied to plug P1 may be set by adjusting potentiometer R10.

Diversity Selection. Diversity selection is performed by DUAL-QUAD switch S1. When switch S1 is set to QUAD, one pole connects the agc amplifier emitter output line to the associated point in the other dual receiver, and the other pole connects the collectors of the agc amplifiers in the if. amplifier modules to the associated point in the other dual receiver. The cross connections insure that all if. amplifiers are operating at equal gain.

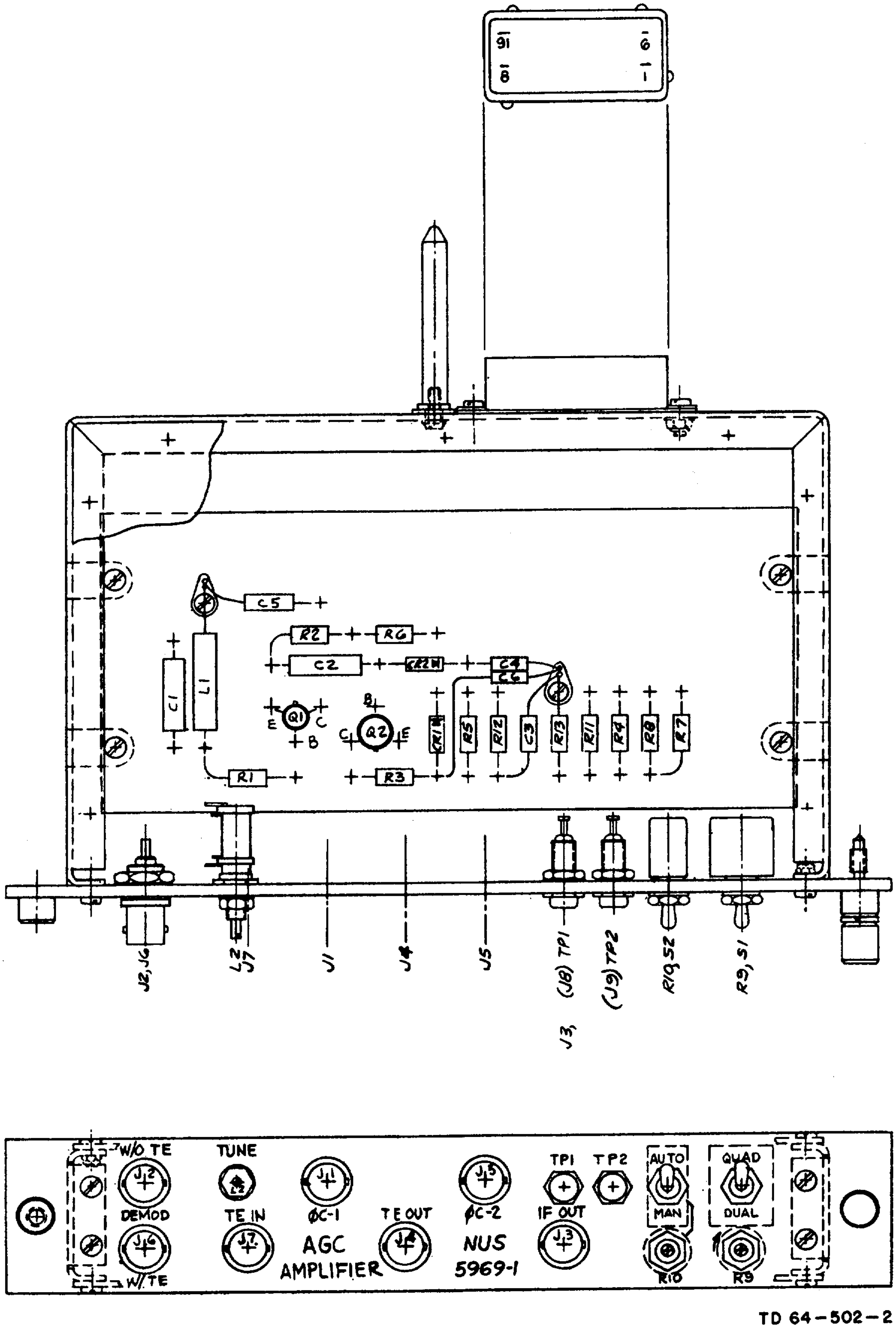


Figure 1. 9.8-Mc AGC Amplifier NUS 5969-1, Parts Location

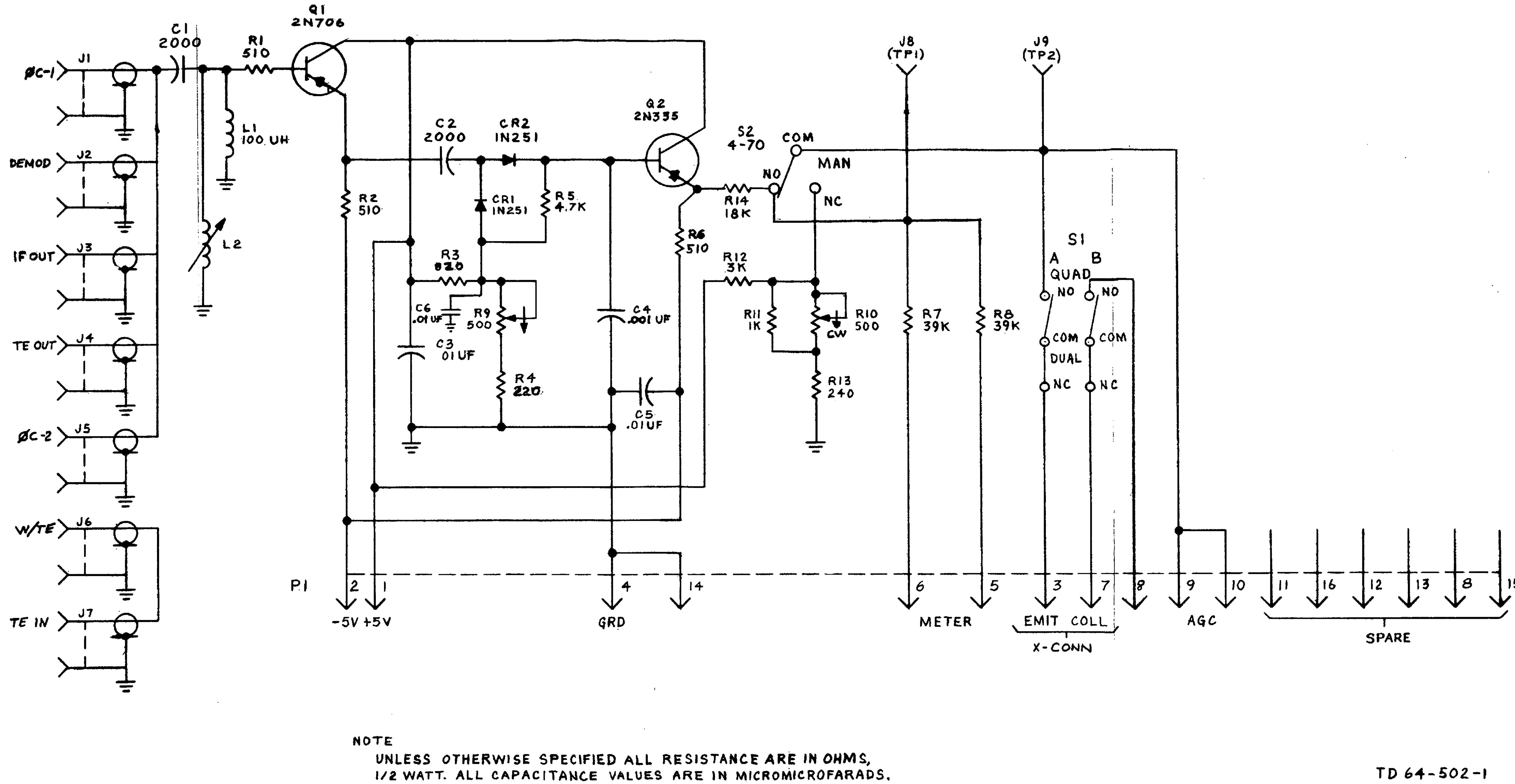


Figure 2. 9.8-Mc AGC Amplifier NUS 5969-1, Schematic Diagram

70-MC AGC AMPLIFIER
NUS 5969-4

DESCRIPTION

The 70-mc agc amplifier is used in dual and quadruple diversity, single conversion receivers, for which it provides automatic or manual gain control voltages. The 70-mc age amplifier also serves as the addition point for the phase combiner if. outputs and provides a common if. output. All detail parts of the 70-mc age amplifier are mounted on a chassis which is secured in the associated drawer by captive screws. The pertinent characteristics of this module are as follows:

Power input	+15 volts dc
If. input levels	1 volt rms (max)
If. output level	0.6 volt rms (max)
∅C-1 and ∅C-2 output levels	0.25 volt rms (nom)
Demod-TE output	0.28 volt rms (min)
ANCL DWR output	0.28 volt rms (min)
Man. agc output	0.58 volt de (nom)
Auto. agc output	0.65 volt de (nom)

CIRCUIT DESCRIPTION (Figures 1 through 3)

If. Distribution Circuits. The if. distribution circuits include two input amplifiers Q1 and Q2, and Q3 and Q4, and emitter-followers Q5 through Q7. The phase combiner if. outputs are applied to their respective input amplifiers through 0C-1 and 0C-2 connectors J1 and J2. The if. outputs of both amplifiers are applied to the base of Q5 and combined. The combined if. output appears at the emitter of Q5 and is applied to if. OUT connector J3, 0C-2 output connector J4, and 0C-1 output connector J5. The rectified amplifier inputs can be monitored at test points TP1 and TP2. The rectified combined if. output can be monitored at test point TP4 (J11). The combined if. output of Q5 is also applied to emitter follower Q6. The output of Q6 is applied to DEMOD-TE connector J6 and ANCL DWR connector J7 through emitter-follower Q7 and to the if. level detector in the age voltage circuits.

Age Voltage Circuits. The age voltage circuits include the if. level detector (diodes CR2 and CR4) and emitter-follower Q8. The combined if. output is applied to the if. level detector through capacitor C16. Potentiometer R15 is used to set the level of a delay voltage. The detector produces a de voltage which is applied to switch S2 through emitter-follower Q8. With switch S2 in the AUTO position, the dc voltage is applied to terminals P1-9 and Pi-10 as the age voltage. The age voltage can be monitored through test point TP3 (J10). The emitter of Q8 can be monitored through test point TP5 (J12).

Manual Gain-Control Voltage Circuit. The manual gain control voltage is developed at the arm of potentiometer R8. This variable de voltage is applied to terminals P1-9 and P1-10 when switch S2 is set to the MAN position.

Diversity Selection. Diversity selection is performed by DUAL-QUAD switch S1. When switch S1 is set to QUAD, one pole connects the agc amplifier emitter output line to the associated point in the other dual receiver, and the other pole connects the collectors of the agc amplifiers in the if. amplifier modules to the associated point in the other dual receiver. The cross connections insure that all if. amplifiers are operating at equal gain.

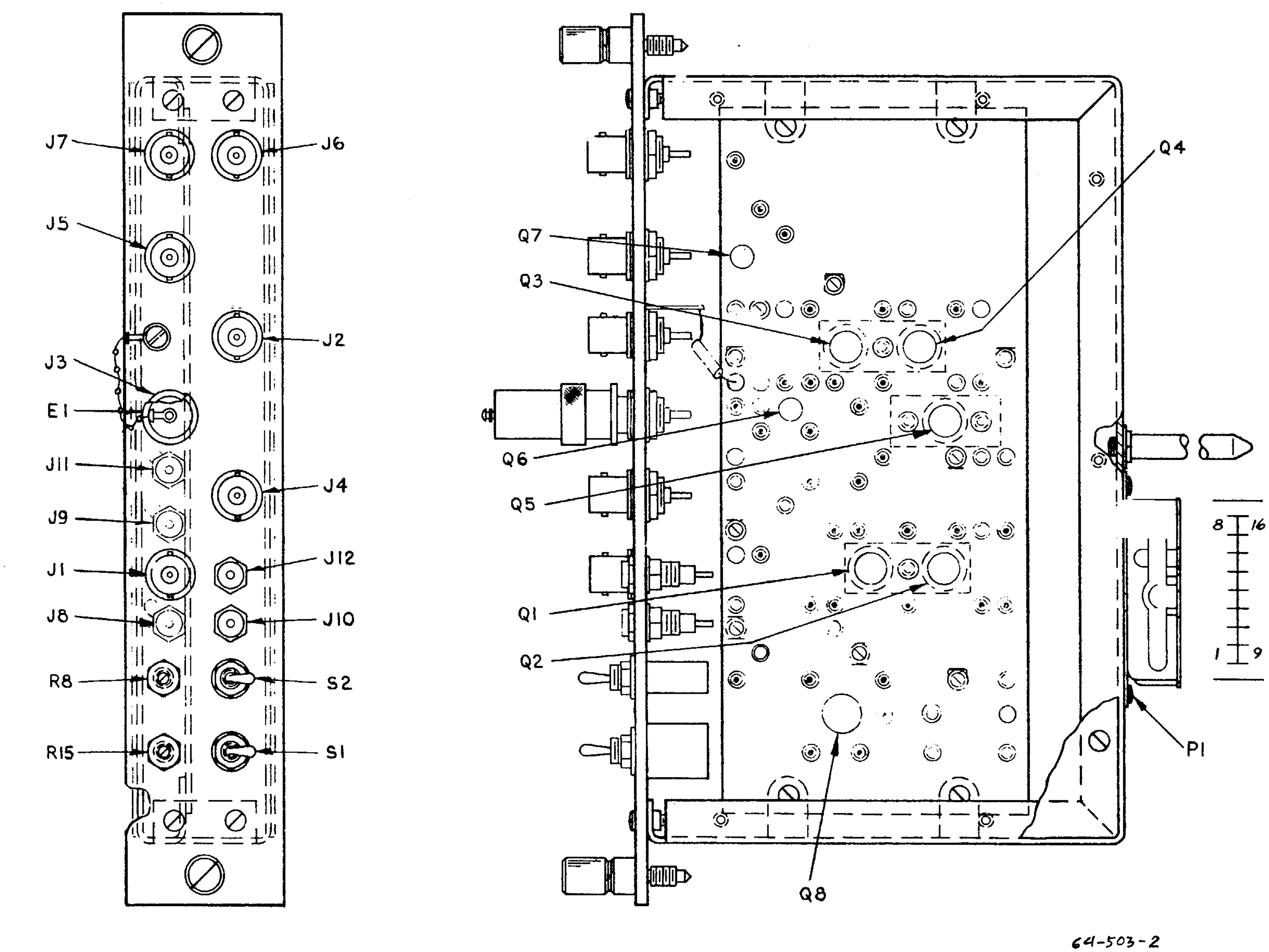


Figure 1. 70-Mc AGC Amplifier NUS 5969-4, Parts Location

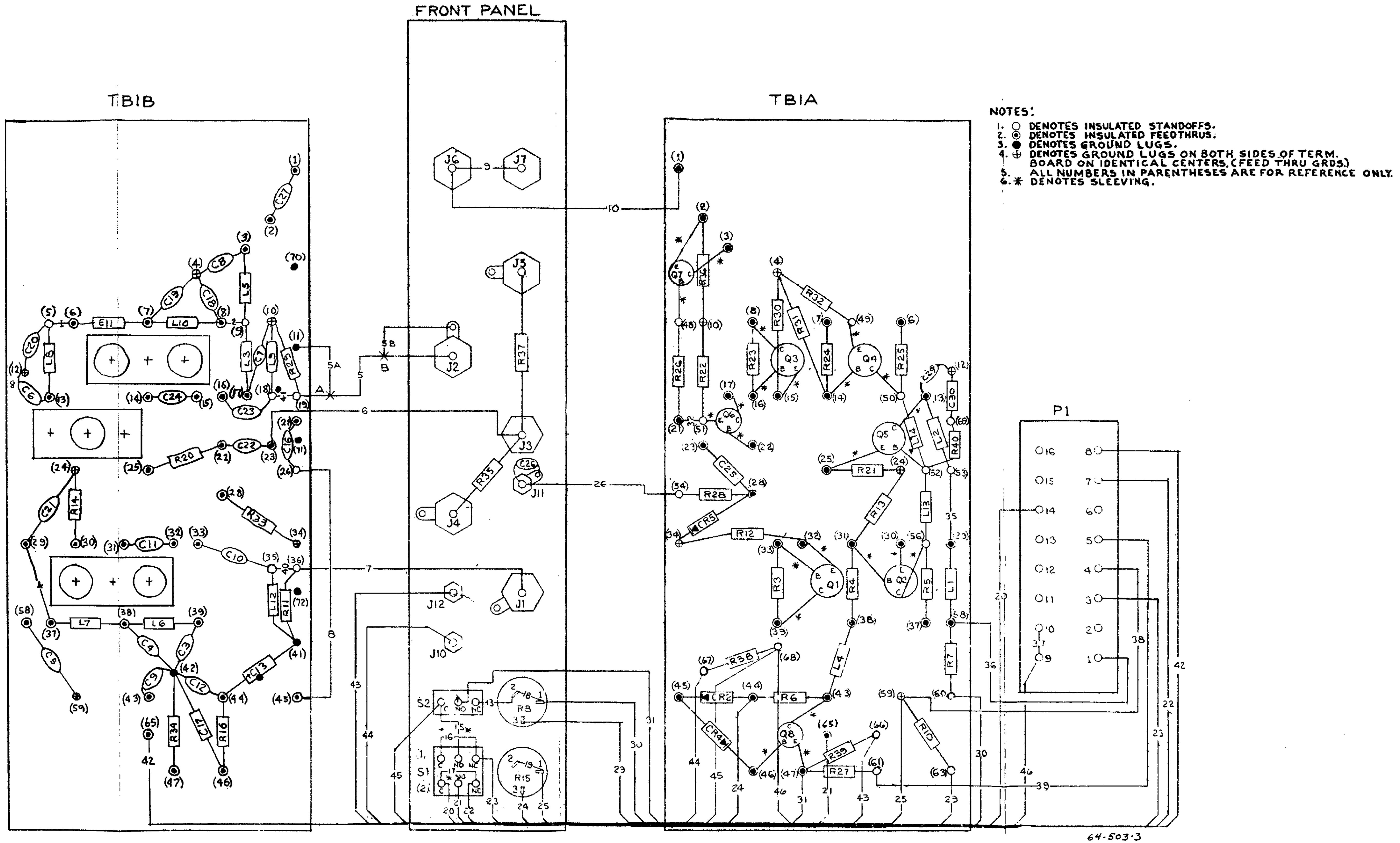


Figure 2. 70-Mc AGC Amplifier NUS 5969-4, Wiring Diagram

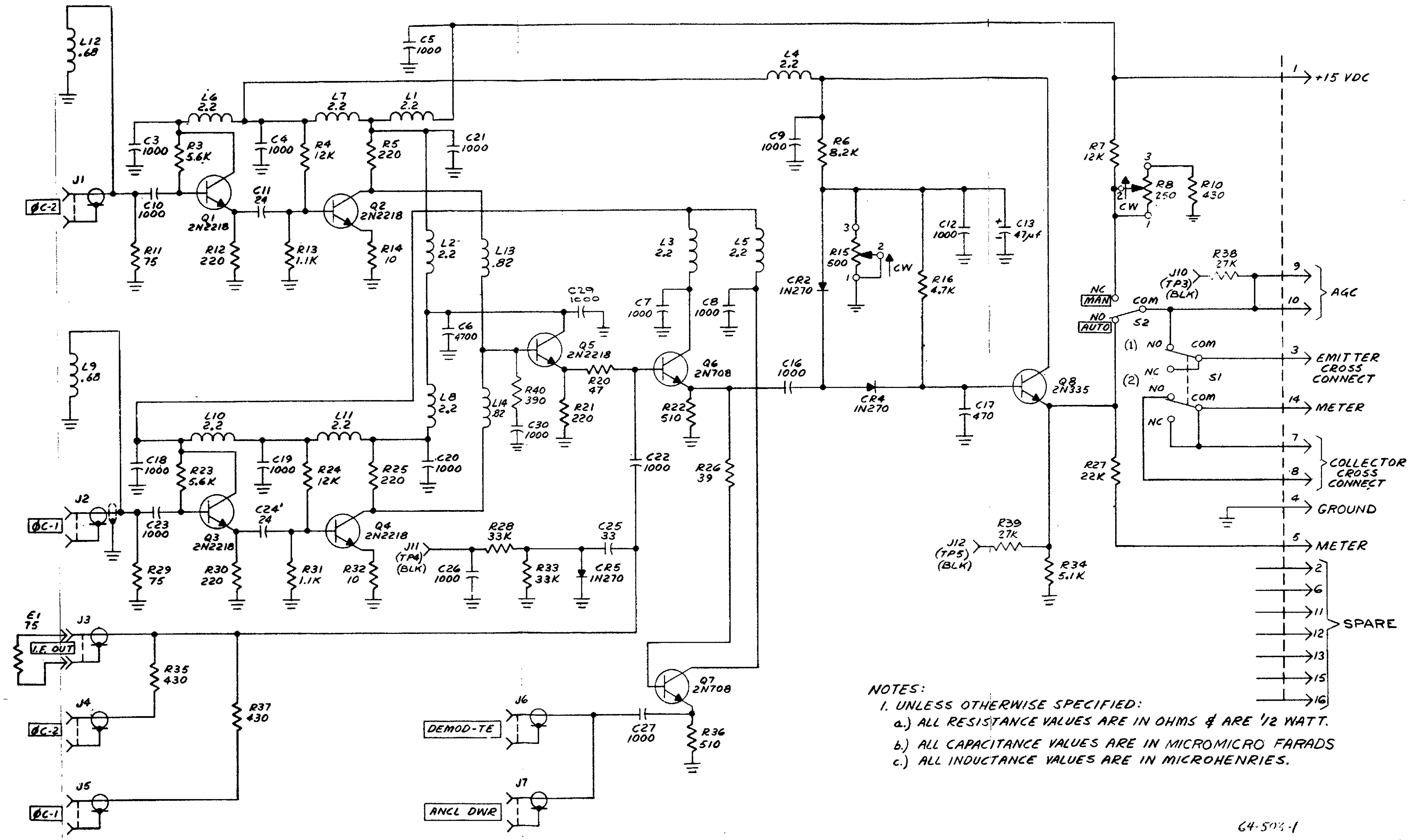


Figure 3. 70-Mc AGC Amplifier
NUS 5969-4, Schematic
Diagram

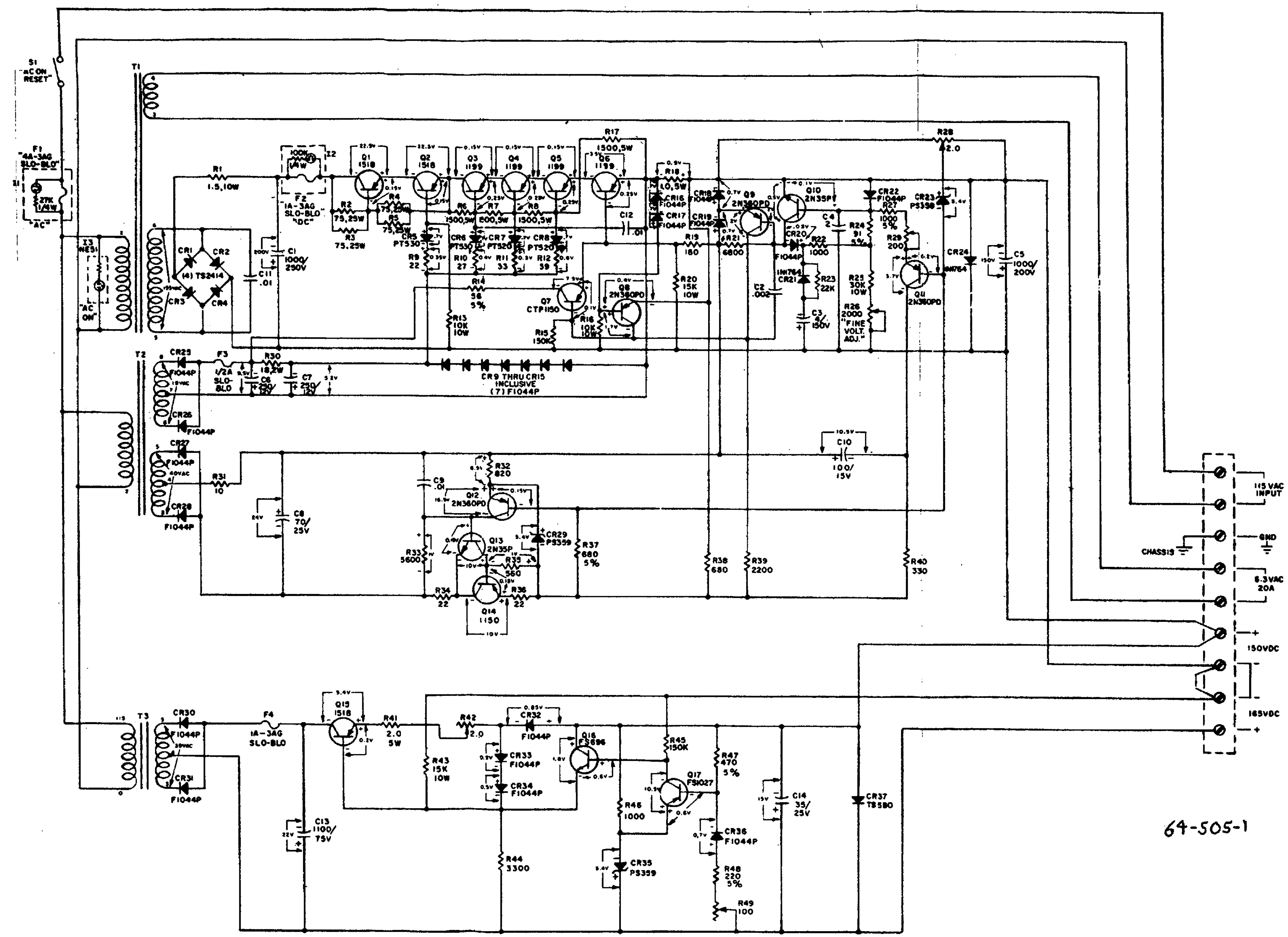


Figure 2. 150/165-VDC Power Supply
NUS 5974-1, Schematic
Diagram

BASEBAND AMPLIFIER
NUS 5970-3

DESCRIPTION

The baseband amplifier is used in both the transmitter and receiver equipments of the radio set to amplify the baseband signal. The module is mounted on the modulator-exciter drawer in the transmitter and in the if and baseband drawer in the receiver. Pertinent characteristics of the module are as follows:

Power required	-30 vdc at 125 ma
Gain	32 db
Input impedance	150 ohms
Output impedance	75 ohms
Noise power ratio	68 db
Noise figure	18 db nominal
Bandwidth	300 cps to 3 mc, ± 1 db

CIRCUIT DESCRIPTION (Figures 1 and 2)

The baseband amplifier provides three direct-coupled amplifier stages, utilizing negative feedback for stabilization. The baseband input is coupled through dc blocking capacitor C1 to the base of transistor Q1. Transistors Q1 and Q2 are common-emitter amplifiers. Resistor R9 provides degeneration to stabilize the gain of Q2. Emitter follower Q3 supplies the output signal to output connector J4 through dc blocking capacitor C6. The feedback coupling impedance is the series combination of R16 and R7. The setting of R7 determines the amount of feedback which, in turn, determines the gain.

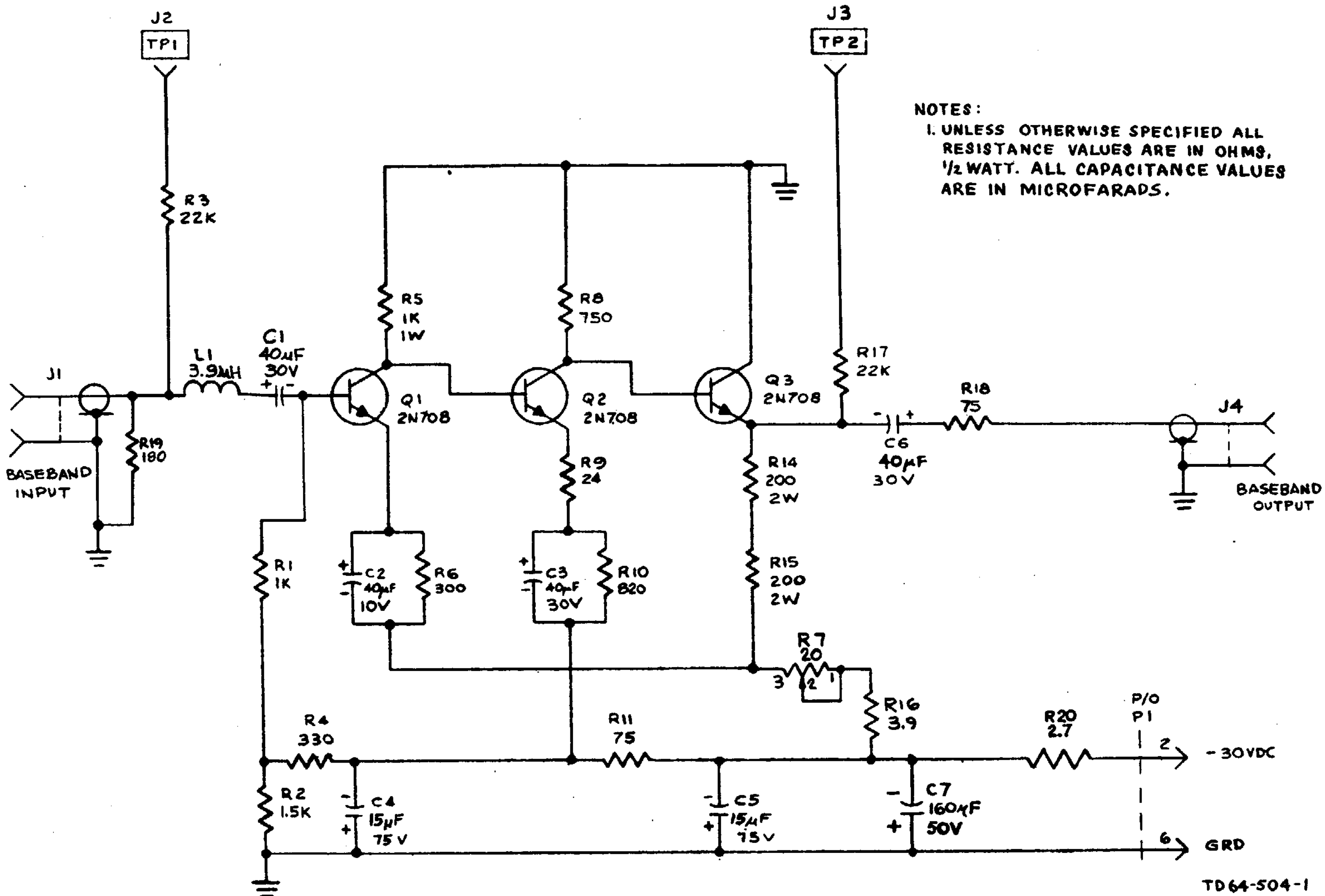


Figure 1. Baseband Amplifier NUS 5970-3, Schematic Diagram

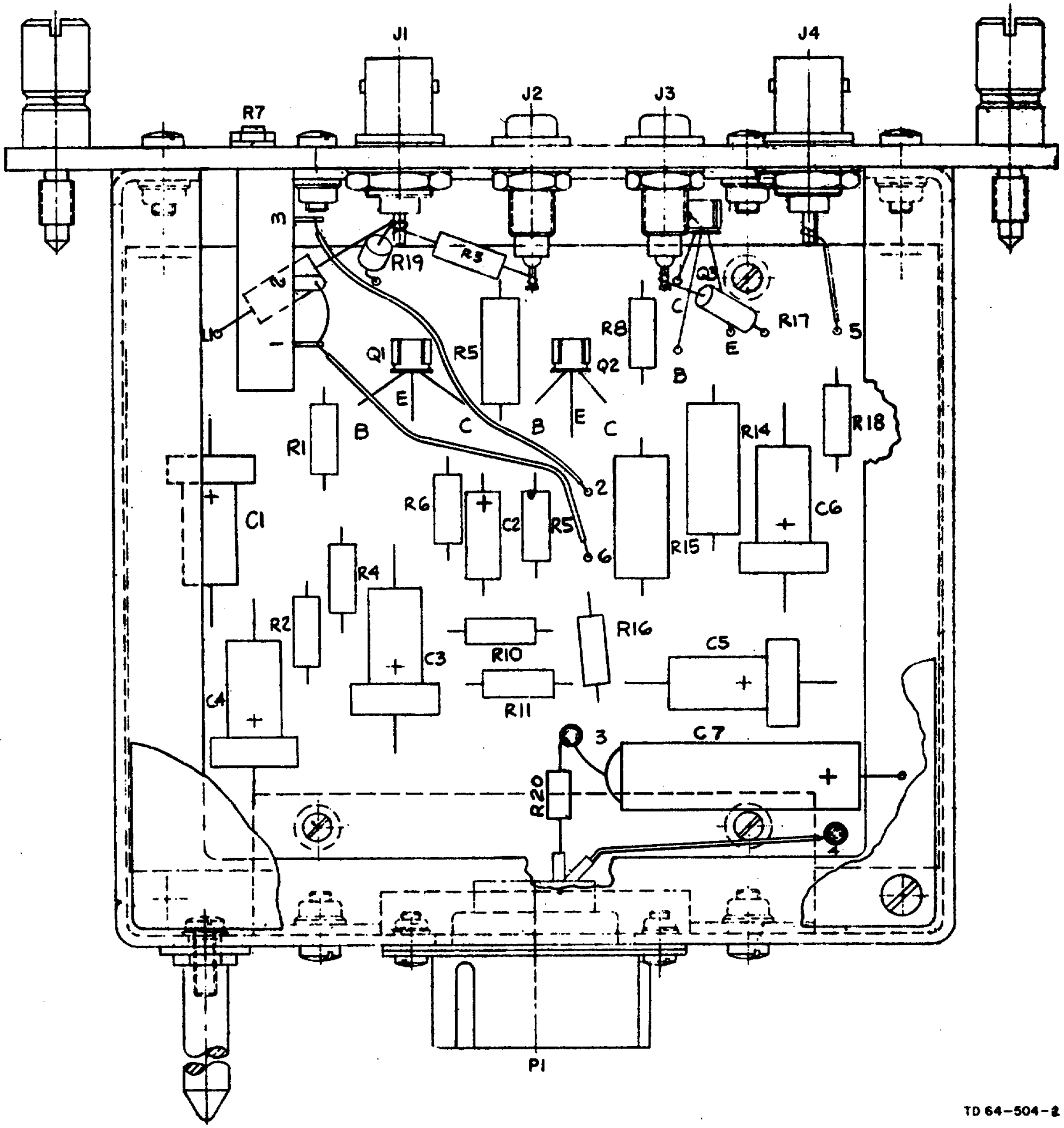


Figure 2. Baseband Amplifier NUS 5970-3, Parts Location

150/165-VDC POWER SUPPLY
NUS 5974-1

DESCRIPTION

The 150/165-vdc power supply is a transistorized, voltage regulated dc power source that provides outputs of 150 and 165 volts dc. A 6.3 volts ac output is also provided for vacuum tube heaters. Protective circuitry is employed to prevent damage to the power supply and to external load circuits. The protective circuit operates in 30 microseconds to cut off the dc output power until manually reset. If an external overload or short circuit exists, the power supply cannot be turned on.

A power dissipation control circuit is incorporated to reduce heat dissipation in the series power transistors of the regulator system under extreme line and load operating conditions. The circuit continuously monitors these transistors and automatically shifts current above the preset maximum value into an external load.

Line voltage transient absorbing circuitry is also provided. The circuit continuously monitors the voltage drop in the series power transistors. Voltages above a preset maximum are instantaneously absorbed, protecting these transistors against line voltage transients up to 200 per cent of rated line voltage. The specifications for the power supply are as follows:

Power input:	105 to 125 volts ac, 47 to 63 cps, single phase, 400 watts (at nominal voltage)
Power output:	150 volts dc at 700 milliamperes 165 volts dc at 300 milliamperes 6.3 volts ac at 20 amperes (unregulated)
DC voltage regulation:	± 0.1% for load or line variations within the operating range
Ripple voltage:	5 mv rms (max) at 150v dc 30 mv rms (max) at 165v dc
Ambient temperature range:	0 to 50°C, continuous duty at full load
Storage temperature range:	-40 to +85°C

NUS 5974-1

CIRCUIT DESCRIPTION (Figures 1 and 2)

150-Volts Dc Supply. The 150-volt dc supply comprises an unregulated dc source consisting of transformer T1, a full-wave bridge rectifier consisting of diodes CR1 through CR4, current limiting resistor R1, and input filter capacitor C1, followed by a transistorized series voltage regulator. The series voltage regulator functions by interposing a variable series resistance between the unregulated source and the load, and electronically altering the magnitude of the resistance to maintain a constant voltage across the load independent of load current and source voltage. At this point, the portion of output voltage developed across a voltage divider (potentiometer R26 and resistors R24, R25, R27, and R29) is applied to the base of transistor Q10. The reference voltage developed by zener diode CR23 is applied to base of transistor Q10 through emitter follower Q11. Transistor Q10 compares both voltages to produce and amplified differential voltage. This voltage controls the current flowing through series regulator transistors Q1 through Q6.

Auxiliary Constant Voltage Current Supply. Transistors Q14, Q13 and Q12 comprise a three-stage series regulator that provides operating potentials for the main dc regulator amplifier and functions as a constant current source for the zener voltage reference diode CR23. Q14 is the series pass transistor and Q13 a dc amplifier. Q12, a differential amplifier, compares the voltage drop of zener reference diode CR29 with that developed across resistor R37 and operates to maintain the voltage drop and the current through R37 constant. Since CR23 is effectively in series with R37, the main regulator zener voltage reference current is held constant and is independent of ac line or circuit variations. The regulator also functions as a constant voltage source for amplifiers Q7, Q8, and Q9, since the sum of the voltage drops across R37 and CR23 is also held constant. Diodes CR18 and CR19 are in series with the positive return lead of the auxiliary supply. These function as stabistors (forward-biased diodes with fixed voltage drop relatively independent of current) to provide stable operating potentials for amplifiers Q9 and Q10.

Regulator Amplifier. As described above, a portion of the dc output voltage is compared to the reference voltage developed by zener diode CR23. Since CR23 is reversed biased and the emitter of differential amplifier Q10 are connected to the negative buss of the supply, and the voltage drop across R27 and R29 is adjusted (for a given voltage) to be effectively equal to the zener reference voltage (Q10 is slightly forward biased to keep it in its operating region), any change in the output voltage will produce a corresponding change in the base-emitter voltage and current of QO1. This change is amplified by the regulator to change the series transistor impedance, to restore original operating conditions, and to maintain a constant out-put voltage. Diode CR22 is connected in reverse across the base-emitter junction of Q10 and operates only when an output short circuit occurs preventing the potential across C4 from appearing across this junction in reverse. This would result in avalanche breakdown and destruction of Q10. Capacitor C4 provides unattenuated ac feedback to Q10 for improved high frequency response and lower ripple content. R28 is a current feedback potentiometer connected across an output current-carrying lead in the supply. As the output current varies, a portion of the output lead voltage drop is introduced in series with zener reference CR23 to improve the regulation of the supply. Q9 functions as an amplifier for Q6, the series regulating transistor. Q1 through Q5 hold the voltage drop across Q6 constant, independent of input voltage, and function as a voltage pre-regulator.

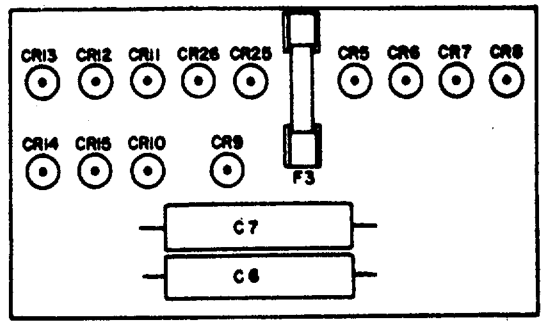
Transient Absorbing Circuits. Diodes CR9 through CR15 comprise a regulated source of 5.4 volts using stabistor diodes as the regulating elements. The positive terminal of this source is connected to the emitter of Q6. The negative terminal is connected through CR5, CR6, CR7, CR8, R9, R10, R11, and R12 to the bases of Q2, Q3, Q4, and Q5. As long as the collector-emitter voltage drop of Q6 is below 5.4 volts, a base current will flow in Q2, Q3, Q4, and Q5, predetermined by the choice of resistances R9, R10, R11, R12. To keep these transistors saturated (minimum collector-emitter voltage drop), Q1 is also held in a saturated condition by the proper choice of the resistance ratio R2, R3, R4, and R5. As the collector- emitter voltage of Q6 increases, the emitter voltage of Q2 increases and approaches that of the reference source CR9 through CR15. Since the base of Q2 is connected to the reference source, the emitter-base current will decrease, preventing Q2 from remaining in saturation. This condition occurs in Q2 since its emitter is closest to the reference potential (the sum of the collector-emitter drops of Q3, Q4, Q5, and Q6). As Q2 come s out of saturation and its collector-emitter voltage drop increases, Q1 will come out of saturation as well since its emitter is connected to the collector of Q2 and its base through a low resistance to the emitter of Q2. In effect, transistor Q1 will track the collector-emitter voltage drop of Q2. As the input voltage to the regulator system rises, the collector-emitter voltage drops across Q1 and Q2 will rise, and an increasing proportion of the output load current will be diverted through R2, R3, R4, and R5. The operating conditions of Q1 and Q2, and the resistance values of R2 through R5 are so chosen so that at minimum line voltage, Q1 and Q2 are saturated, and the major portion of the output current flows through these transistors. At high line voltage these transistors are cut off and all the current flows through the heat dissipating resistors. In this operating region, Q3, Q4 and Q5 remain saturated through the regulating action of Q1 and Q2. At higher line voltages and in the case of input voltage transients with Q1 and Q2 cut off, the voltage across Q6 will rise, pulling Q3 out of saturation and increasing its collector-emitter voltage drop, thus absorbing any transient voltage above 5.4 volts across Q6. Q4 and Q5 will always remain saturated except in the case of a short circuit across the supply. If this occurs Q4 and Q5 serve to prevent application of excessive collector voltages to the other series transistors.

Electronic Cutoff Circuitry. If an overload or short circuit at the output terminals of the power supply occurs, the series transistors in the regulator are driven to cutoff and the output voltage decreases to zero in an extremely short period of time by the action of diode CR20. The anode of CR20 is connected to the base of dc amplifier Q9, and the cathode through R22 to a tap on voltage divider R26, R25, R24, R27, etc., so that CR20 has a slight reverse bias and is nonconducting. If an overload or short circuit occurs, the output voltage of the supply decreases rapidly, making the cathode of R20 negative through R24, R27, R29, emitter follower Q11, and the auxiliary regulated supply. This provides an increased base-emitter current in Q9, increasing its collector current, decreasing the base current of driver transistor Q7, decreasing the base current of series transistor Q6, increasing its collector- emitter voltage drop, and decreasing the dc output voltage still further. This regenerative action continues until Q9 is saturated, Q7 and Q6 is cut off, and the output voltage is reduced to zero. Q9 remains saturated by the continued presence of base current from the regulated auxiliary source. Thus the supply can be restored to normal operation by simply disabling the auxiliary supply. Placing the AC ON RESET switch off and then on again will accomplish this function. If a continued overload or short circuit occurs the supply will remain inoperative since upon turn-on, the auxiliary supply will reach operating potential before the dc out- / put voltage can rise sufficiently to reverse bias CR20. R22 is employed to operate in series with the shunt capacitance of CR20 to provide an operational time constant. In its absence, the circuit operation is so fast that the cutoff circuit will operate with nanosecond load transients or radiated high frequency noise pulses. An electronic time delay in the operation of CR20, when the supply is first turned on, is provided to take care of capacitive or lamp loads. This function is performed by C3, CR21, and R23. When the supply is turned on, in the absence of overload or short circuit, the output voltage of the supply will rise, causing C3 to charge, CR21 will conduct and hold CR20 nonconducting as long as the output voltage continues to rise. As soon as the output voltage stabilizes at any point, C3 will stop charging, and if proper potentials are not present on CR20, the electronic cutoff circuit will operate. Proper choice of CR3 and other circuit constants permits delay of the cutoff circuit for a safe period. During this period, the output current of the supply is limited by Q8 to approximately 1.25 amperes.

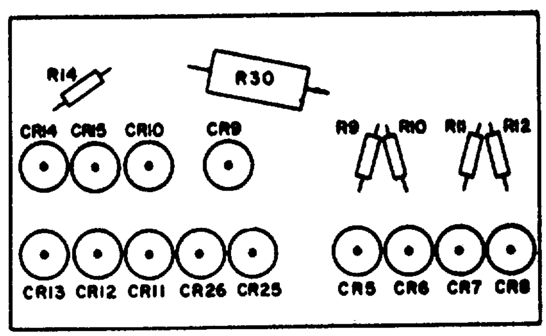
Output Current Limiter. To hold the output current of the supply cut off to a safe maxi- mum value and provide a sharp trip point for the circuitry, an output current limiting circuit is utilized. The voltage drop across R18 and the output current meter is compared with the reference voltage from stabistor diodes CR16 and CR17 by the base-emitter junction of Q8. As long as the voltage across R18 and the meter is less than a predetermined value, Q8 is reverse biased and no collector current will flow. With overload current, Q8 is forward biased and collector current will flow to limit the base current of Q7, thus limiting the base current of Q6 and the output current of the supply. This condition produces a drop in output voltage which trips the cutoff circuitry.

Operation of Series Transistors Q1 Through Q6 in Cutoff. In the event of operation of the cutoff circuitry with a short circuit at the output terminals of the supply, the entire unregulated and unloaded input voltage across C1 will appear across Q1through Q6. Since this voltage may be as high as 250 volts, it must be proportioned among these transistors to avoid avalanche breakdown or punch-through. This is accomplished by voltage divider R2, R3, R4, R5, R6, R7, R8 and R17. This voltage divider is connected effectively across C1 and the voltage drop across each transistor will be determined by the voltage drop across each portion of the divider. The bias supply provided by CR9 through CR15 will be inoperative since the voltage drop across Q1 through Q6 set by the divider will be sufficiently large to reverse bias CR5 through CR8, and effectively disconnect the base junctions of Q1 through Q5 from this source. Since the current of the voltage divider is approximately 40 milliamperes, Q3, Q4, Q5, and Q6 will have a collector-emitter drop of 60 volts each, and Q1 and Q2 a drop of 5 volts each, thus protecting these transistors.

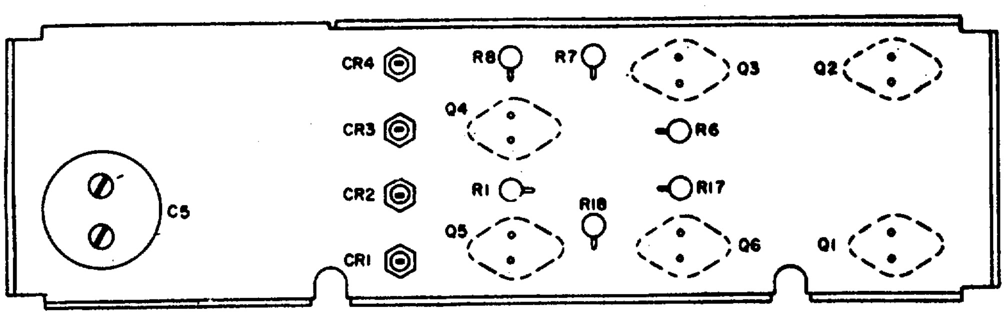
165-Volts DC Supply. The 165-volts dc consists of the 150-volts dc supply and a 15- volts dc supply connected in series with the 150-volts dc supply. The 15-volts dc supply consists of transformer T3, full-wave rectifiers CR30 and CR31, input filter capacitor C13, and a transistorized series voltage regulator. A change in the output voltage is detected by Q17 via voltage divider R47, CR36, R48, and R49. This voltage change is amplified by Q16 which controls series regulator Q15. Zener diode CR35 provides the reference voltage that is compared with a portion of the output voltage across the voltage divider. Diodes CR33 and CR34 provide protection for Q15 by limiting the voltage drop across R42, R41, and the base- emitter junction of Q15. Diode CR32 provides proper collector voltage for transistor Q16. Diode CR37 prevents power supply damage resulting from the application of reverse voltage to the output terminals.



RECTIFIER BOARD-FRONT VIEW



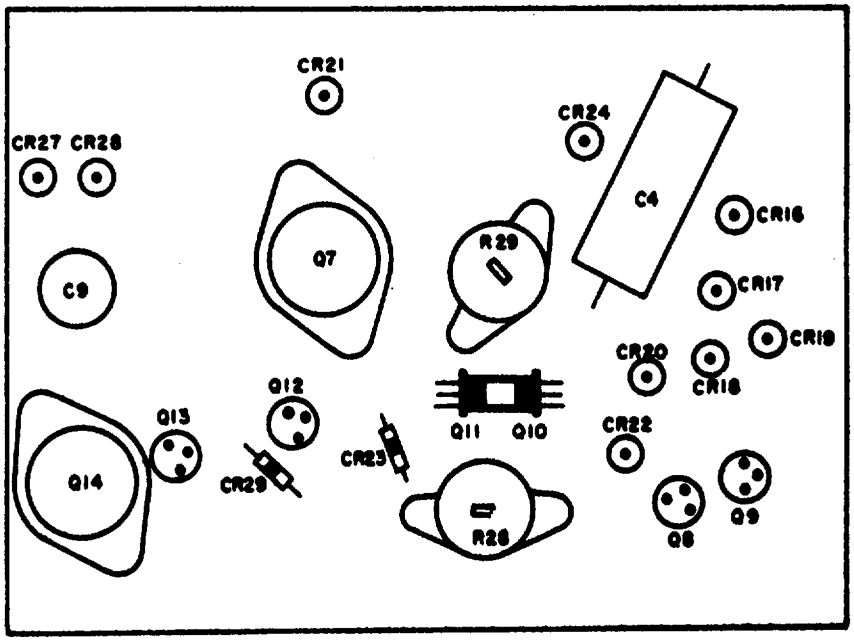
RECTIFIER BOARD-REAR VIEW



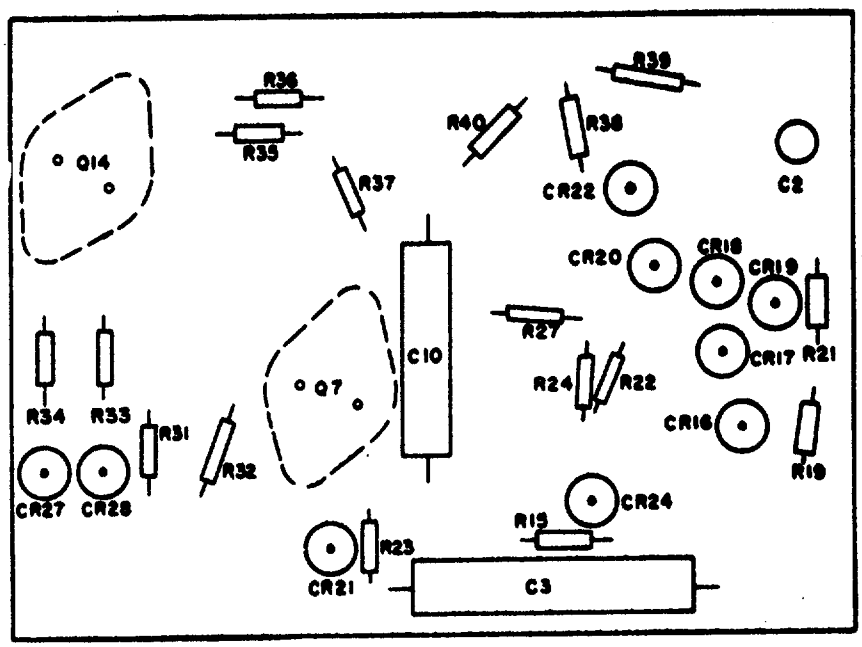
HEAT SINK

64-505-2-1

Figure 1. 150/165-VDC Power Supply NUS 5974-1, Parts Location (Sheet 1 of 3)



AMPLIFIER BOARD-TOP VIEW



AMPLIFIER BOARD—BOTTOM VIEW

64-505-2-2

Figure 1. 150/165-VDC Power Supply NUS 5974-1, Parts Location (Sheet 2 of 3)

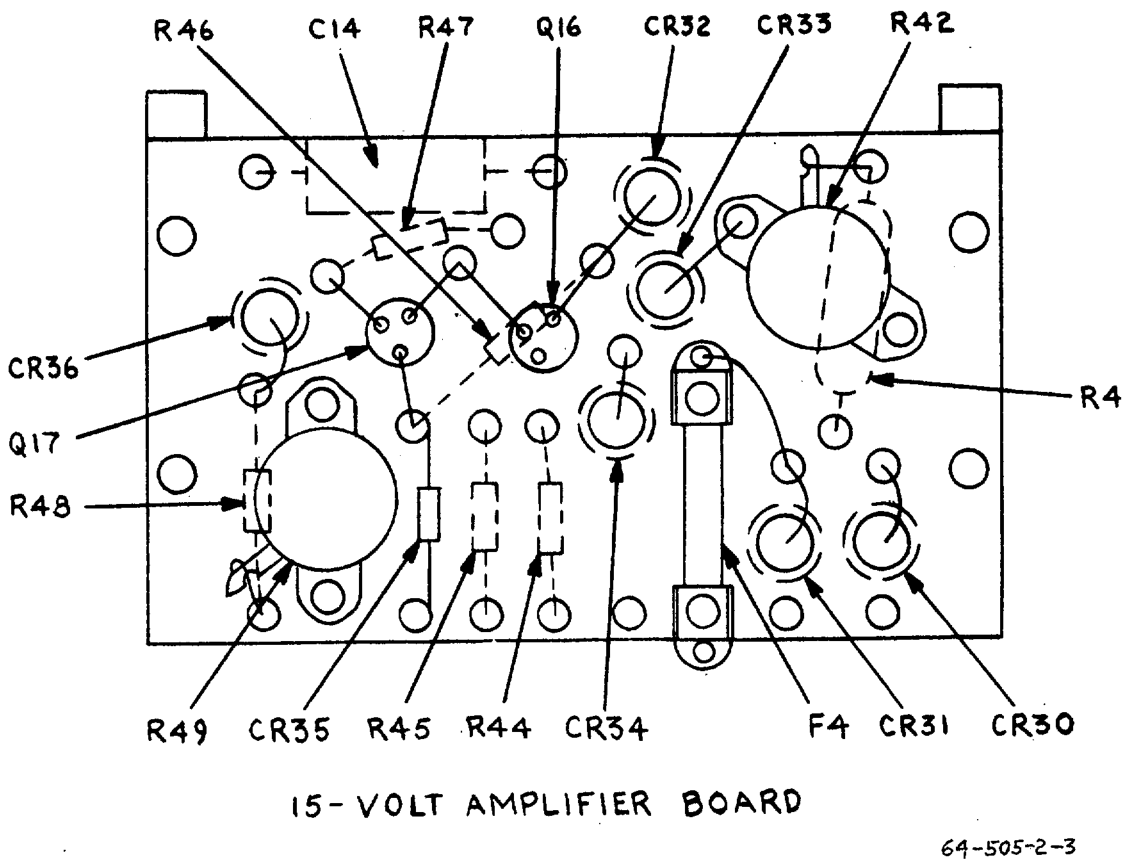


Figure 1. 150/165-VDC Power Supply NUS 5974-1, Parts Location (Sheet 3 of 3)

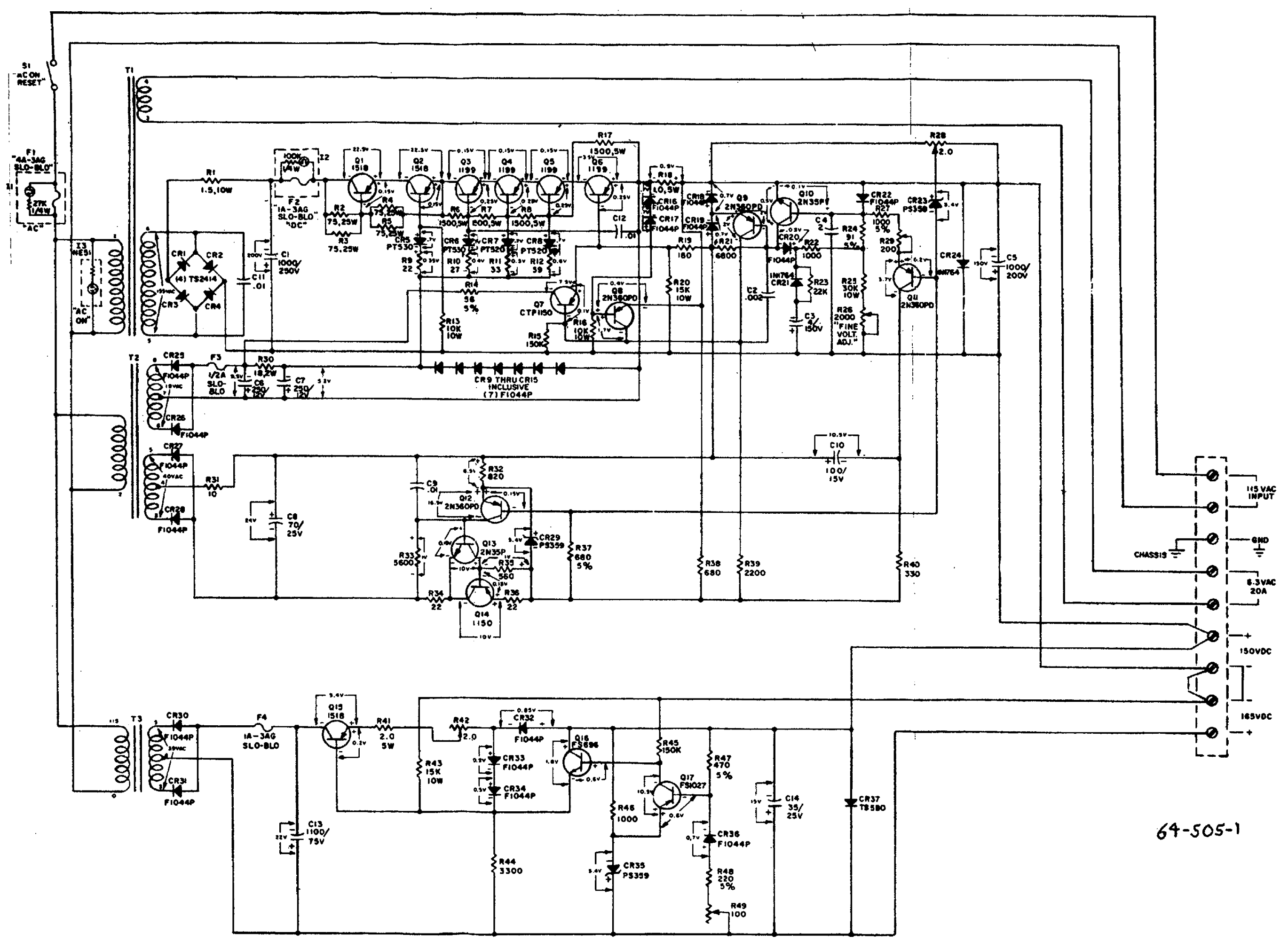


Figure 2. 150/165-VDC Power Supply
NUS 5974-1, Schematic
Diagram

Figure 2. 150/165-VDC Power Supply
NUS 5974-1, Schematic Diagram

LOW VOLTAGE POWER SUPPLY
NUS 5975-1, -3, -4, -31, and -41

DESCRIPTION

The low voltage power supply is the source of the +5-volt, +15-volt, and -30-volt dc power used by the dual diversity receiver, and the +15-volt and -30-volt dc power used by the transmitter. Five identical power supplies are used to provide these five voltages. The output voltage of each power supply is selected by input transformer taps and selection of resistors in the regulator control circuit. Power supplies NUS 5975-1, -31, and -41, which are located in the power supply drawer, provide the +5-, +15-, and -30-volt outputs, respectively, for the receiver. The +15- and -30-volt outputs for the transmitter are supplied by power sup- plies NUS 5975-3 and -4, respectively, located in the power distribution panel. The receiver power supplies are equipped with leads which connect to terminal boards inside the receiver cabinet. The power supplies used by the transmitter are equipped with connectors which mate with receptacles inside the transmitter cabinet. Pertinent characteristics of the low voltage power supplies are as follows:

Input power	115 ± 10 volts ac, 47 to 63 cps
Output power (regulated):	
NUS 5975-1	+5 volts dc, 1.0 amp
NUS 5975-3	+15 volts dc, 1.0 amp
NUS 5975-4	-30 volts dc, 1. 0 amp
NUS 5975-31	+15 volts dc, 1.0 amp
NUS 5975-41	-30 volts dc, 1.0 amp
Regulation	± 0.05 percent
Ripple 1 mv rms max	1 mv rms max
Operating temperature range	-20° C to +55° C

CIRCUIT DESCRIPTION (Figures 1 and 2)

Regulated DC Output. Primary power, 115 volts ac, is applied to the primary of transformer T1 through 3/4-amp fuse Fl. A center-tapped secondary, with taps adjustable for the output voltage desired, feeds a full-wave rectifier consisting of diodes CR1 and CR2. Capacitors C9 and C10 provide protection against reverse voltage breakdown to diodes CR1 and CR2, respectively. The rectified output of CR1 and CR2 is filtered by capacitor C1 and fed through thermostat S1 and transistor Q1 to the output of the power supply. Feedback from voltage-sensing transistor Q4, applied through Q2 to the base of Q1, increases or decreases the current through Q1 to provide the required regulation. Regulation occurs in the following manner:

1. A drop in output voltage will decrease current flowing through the voltage divider consisting of resistors R9, R10, and the selected tap resistor. The forward bias of Q5 increases, causing collector current to increase.

2. Increased collector current of Q5 causes the base current of Q4 to increase, producing a corresponding increase in the collector current.

3. Increased Q4 collector current is applied through diode CR6 to the base of transistor Q2, increasing forward bias of this transistor.

4. Increased forward bias applied to the base of Q2 permits a higher collector current through this transistor.

5. Increased Q2 collector current is applied to the base of transistor Q1, increasing the forward bias of this transistor.

6. Increased forward bias of Q1 permits a higher collector current through this transistor, restoring the power supply output to its proper level.

7. If the output voltage rises, the reverse of the processes described in steps 1 through 6 occurs.

Regulator Transistor Supply Voltages. Transistors Q6, Q7, and Q8 constitute a regulated dc supply for regulator transistors Q1 through Q5. This supply is powered by an additional center-tapped secondary on transformer T1. The voltage induced in the secondary rectified by the full-wave rectifier consisting of diodes CR3 and CR4, filtered by capacitor C6and applied through transistor Q6 to the regulator transistors. Feedback from voltage sensing transistor Q8, applied through Q7 to the base of Q6, increases or decreases the current through Q6 to provide the required regulation. Regulation occurs in the following manner:

1. A decrease in output voltage of the reference supply across capacitor C7 is impressed directly across resistors R20 and R21. This change decreases the base-emitter voltage of Q8, decreasing base-emitter current of this transistor.

2. The decreased forward bias of Q8 results in a lower collector current through the transistor.

3. The reduced Q8 collector current is transmitted to the base of transistor Q7, decreasing the forward bias of this transistor.

4. The reduced forward bias of Q7 results in a lower collector current through this transistor.

5. Since the current through resistor R18 is fixed by the voltage drop across diode CR9 and the base-emitter voltage drop of Q6, a decrease in the collector current of Q7 increases the base current of Q6.

6. The increase forward bias of Q6 permits a higher current through this transistor, restoring the regulator transistor supply potential to its proper level.

7. If the regulator transistor supply potential rises, the reverse of the processes described in steps 1 through 6 occurs.

Overload and Short Circuit Protection. If the load current increases, the voltage drop across resistor R3 increases, decreasing the collector-emitter voltage of Q4. If this voltage approaches zero, Q4 fails to operate as an amplifier. When this occurs, the change in the power supply output voltage is sensed by Q5. Transistor Q5 attempts to increase the collector current of Q4. Since Q4 is not operating as an amplifier. Q5 continues to conduct. The current that normally flows through diode CR7 and the base-emitter circuit of Q2 now flows through the base-emitter circuit of Q4 and collector-emitter circuit of Q5. When this occurs, the voltage drop developed across CR7 decreases to a potential which inhibits the conduction of Q1 and Q2. This condition persists when the overload or short is removed. To restore the power supply to normal operation, remove the overload or short circuit and turn the ac input off and on.

Overvoltage Protection. When the power supply is turned off, all normal operating bias voltages are removed from their associated circuits. Transistor Q3, however, continues to function, providing a constant reverse bias for Q1. This ensures that the leakage currents of Q1 and its associated circuits will not cause Q1 to conduct and pass the voltage across input capacitor C1 to the power supply output. Since the voltage across C1 exceeds the normal power supply output, damage to the load might result if this voltage were permitted to be applied across the output terminals. Diode CR5 operates in the forward direction to supply a constant reference voltage for Q3. This reference maintains a constant current through Q3 and resistor R2 regardless of input and output voltage variations.

NOTE: NUS 5975-4 and -41, the -30 volt supplies, include transistor Q9 and resistors R23, R24, and R25 to provide current limiting and operation up to 1.0 amperes. The operation of this circuit is similar to that previously described for control transistor Q4.

70-MC THRESHOLD EXTENSION MODULE
NUS 6455

DESCRIPTION

The threshold extension module is used in lowering the sensitivity threshold of the receiver by effectively narrowing the if. bandwith. The module consists of emitter followers Q6 and QS, amplifier Q7, a phase detector CR6 and CR7, a low-pass filter, a buffer amplifier Q9, a voltage controlled oscillator (VCO) Q1, Q2, and a 24/36 channel or 48/120 channel selection switch. The specifications for the threshold extension module are as follows:

Input:

Frequency	70 mc
Voltage	150 mv rms (min)
Impedance	75 ohms

Output:

Frequency	70 mc
VoUage	400 mv rms
Impedance	150 ohms
Power requirements	+ 15 volts dc - 5 volts dc

CIRCUIT DESCRIPTION (Figures 1 through 3)

General. The term threshold extension apples to methods applicable in fm receivers that produce a usable output from input signal levels which are at the normal receiver threshold. In effect, the threshold extension module compresses the received carrier wave deviation by means of fm feedback. The normal deviation of the 70 mc if. signal is reduced by the loop feedback factor of the VCO. For example, if the normal deviation is ±12 mc and if 6 db of feedback is used in the system, the deviation is reduced to ±6 mc. Using this same example, it follows that the bandwidth is reduced from 24 mc to 12 mc. The major stages of the 70-mc threshold extension module are explained in the following paragraphs.

Input Amplifier. Emitter followers Q6 and Q8 and the grounded base amplifier Q7 serve as the driving amplifier for the incoming if. signal to the phase detector. The if. input is fed into the base of stage Q6, which provides the proper input impedance for the coaxial cable feeding in the 70-mc signal. The output is then amplified by stage Q7 and fed into the base of stage Q8, an emitter follower. The output of stage Q8 is then applied to the primary of the phase detector transformer T1.

NUS 6455

Phase Detector. The secondary winding of transformer T1 is an integral part of the phase detector. Disregarding the effects of transformer T2 for the moment, the output of transformer T1 is detected by diodes CR6 and CR7, and filtered by capacitor C42. A balance control is made available to equalize the output voltages from pins 1 and 3 to the center tap of transformer T1, pin 2. The operation of tansformer T2 is to inject a locally generated signal into the center tap of transformer T1. This signal, at the same frequency as the incoming signal, upsets the balance of transformer T1, depending on the phase difference between the two 70-mc signals. This unbalance appears across capacitor C42 as a positive or negative dc voltage varying proportionally in magnitude as the phase varies. The error signal is fed into emitter follower Q9, keeping the impedance across capacitor C42 high, and then back to the voltage-controlled oscnilator (VCO) to correct the frequency of the oscillator so that the phase difference between the incoming if. signal and the VCO is minimum. Added filtering is utilized at the base of stage Q9, resistor R29 and capacitor C45, to limit the bandwidth of the error signal fed back to the VCO. This in turn eliminates some of the noise.

Voltage-Controlled Oscillator. The VCO incorporates grounded base amplifier Q1 and emitter follower Q2 as the driving element. Sufficient power gain is obtained at stage Q2 and fed back positively through resistors R3 and R6 to overcome circuit losses and sustain oscillations. The frequency of oscillation can be varied by changing the impedance from pin 1 of coil L5 to ground. This varying impedance is accomplished by varying the dc voltage across diode CR1, at the point where the phase detector output is applied. The output of the oscillator is then fed to a grounded base amplifier, whose collector is tuned to 70 mc. Two outputs are available, one fed through a buffer amplifier to the phase detector and the other a signal in phase with the input . signal but of lower bandwidth. The buffer amplifier consists of an emitter follower Q4 and a grounded base amplifier Q5 to drive the primary of transformer T2 in the phase detector circuit.

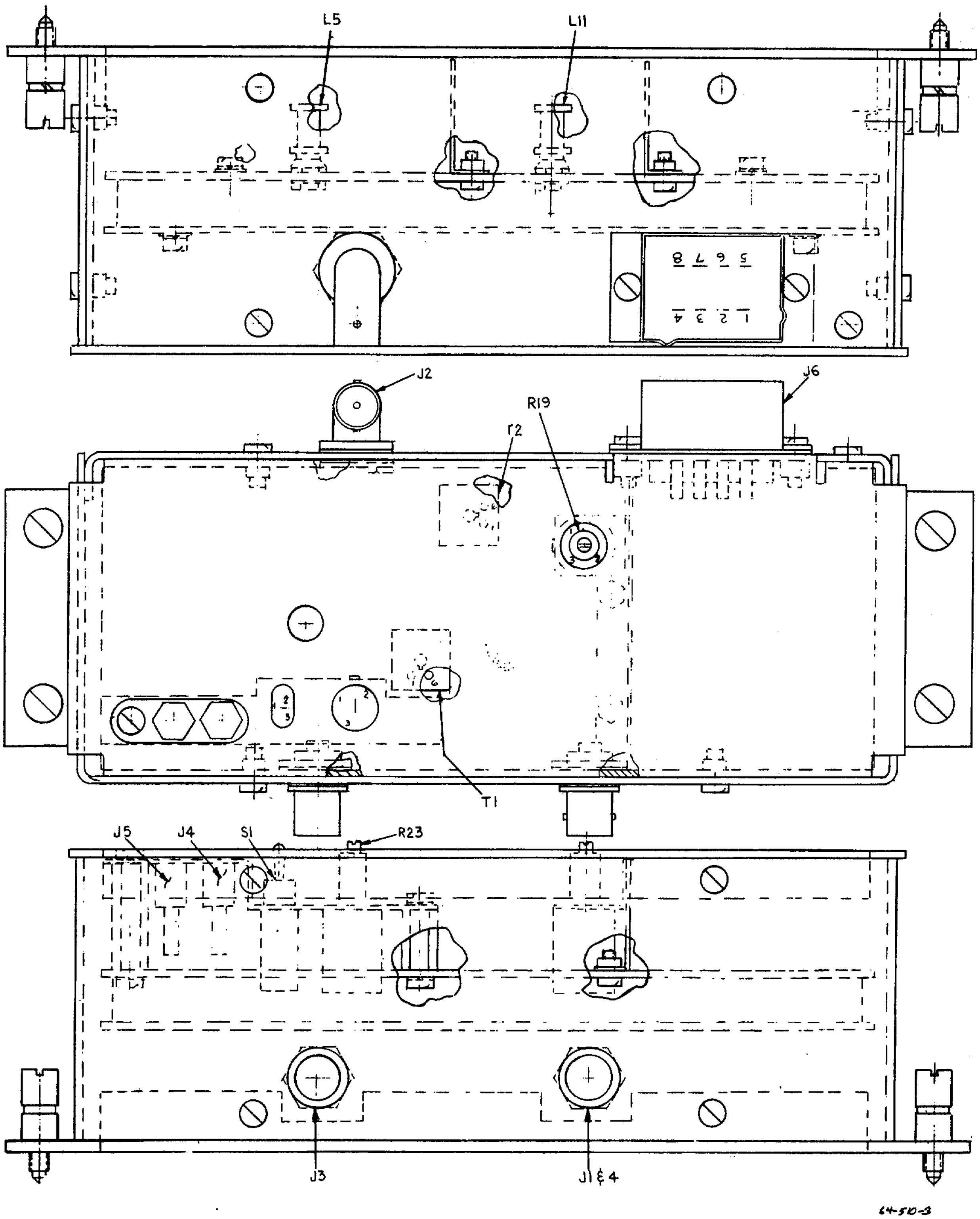


Figure 1. 70-Mc Threshold Extension Module NUS 6455, Parts Location

9. 8-MC THRESHOLD EXTENSION MODULE NUS 6579

DESCRIPTION

The threshold extension module is used t lower e sensitivity threshold of the receiver by effectively narrowing the if. bandwidth. The module consists of emitter followers Q1 and Q5, phase detector CR1 and CR2,voltage-controlled oscillator (VCO) Q2 and Q3, buffer amplifier Q4, and a low-pass filter. The specifications for the threshold extension module are as follows:

Input:

Frequency	9.8 mc
Voage	0. 2 volt rms (min)
Impedance	250 ohms

Output:

Frequency	9.8 mc
Votge	volt rms
Impedance	150 ohms
Power requirements:	+ 5 volts dc
	- 5 volts dc

CIRCUIT DESCRIPTION (Figures 1 and 2)

General. The threshold extension module lowers the noise threshold of a 9.8 mc if. signal by effectively narrowing the noise bandwidth. The term threshold extension applies to methods applicable in fm receivers that produce a usable output from input signal levels which are at tie normal receiver threshold. In effect, the threshold extension module compresses the received carrier wave bandwidth by means of fm feedback. The normal bandwidth of the 9. 8 mc if. signal is reduced by the loop feedback factor of a voltage-controlled oscillator (VCO). For example, if the normal bandwidth is i 1. 2 mc and if 6 db of feedback is used in the system, the deviation is reduced to t600 kc. Using this same example, it follows that the bandwidth is reduced from 2. 4 mc to 1. 2 mc.

Emitter Follower Q1. Emitter follower Q1 serves as the driver for the phase detector. The combined 9.8 mc if. output of the agc amplifier is applied to the base of Q1 through IF INPUT connector J1. The input level is adjusted by GAIN control R2. The bias for Q1 is developed across emitter resistor R4. The output d Q1 is applied to the phase detector.

Phase Detector. The if. output of Q1 is applied to the phase detector which consists of diodes CR1 and CR2 and associated parts. The phase detector compares the if. signal with a similar frequency generated by the VCO. The VCO signal is amplified by buffer amplifier Q4 and applied through emitter follower Q5 and transformer T2. The to Q1 is applied to the phase detector through transformer T1. When the phase angles of the if. and VCO signals differ, the phase detector produces a baseband signal which is applied to the VCO tuned circuits as a correction voltage. A low-pass filter (inductor L3 and capacitor C12) removes remaining if. signal components from the baseband error voltage. The dc error voltage may be monitored through test point TP2(JS) or BASEBAND TEST connector J2. The filter consisting of capacitor C11 and resistor R12 removes most of the baseband signal. BAL control R10 adjusts the initial phase detector balance.

Voltage-Controlled Oscillator. The voltage-controlled oscillator (VCO) incorporates grounded base amplifier Q2, emitter follower Q3, and the tuned circuit consisting of inductor L4, capacitors C14 and C16, and varicap diode CR4. oscillations are produced by coupling the output of Q3 back to its emitter through the tuned circuit and Q2. Sufficient feedback is provided through resistors R19 and R20 to overcome circuit losses and sustain oscillation. Frequency adjustment of the VCO is made by means of varicap diode CR4. Varicap diode CR4 is a device which exhibits the characteristics of a variable capacitor when i is reverse biased. The initial reverse bias condition, which corresponds to zero baseband error voltage from the phase detector, is established by the voltage divider consisting of resistors R17 and R22. When a baseband error voltage appears at the output of the phase detector, it changes the reverse bias condition for CR4 in accordance with the level and polarity. This action produces a corresponding capacitance change in the VCO tuned circuit, thereby changing its resonant frequency. The VCO output is amplified by buffer amplifier Q4 and applied to the phase detector through emitter follower QS.

Buffer Amplifier Q4 and Emitter Follower Q5. Buffer amplifier Q4 receives the 9. 8-mc signal from the VCO. The collector output of Q4 is applied to IF OUTPUT connector J3 for application to a demodulator and emitter follower QS5. The output of Q5 is applied to the phase detector through transformer T2. The rectified output of Q5 may be monitored through test point TP1 (J4).

70-MC PHASE COMBINER AND ALARM
NUS 8315-1

DESCRIPRION

The 70-mc phase combiner and alarm module receives a 70-mc input from its associated if amplifier. isolates this signal for processing and sends a signal to the agc amplifier, which combines the signal with inputs from one or more other if amplifiers in the same receiver (dual or quad). The combined signal is received from the agc by the combiner, amplified and compared in phase with its own if input signal.

The de output of the comparator and phase detector in the combiner is sent to the local oscillator associated with the combiner. t controls the oscillator frequency so that the if signal in the combiner channel is held in phase with the combined f signal.

If the local oscillator drifts, the dc control voltage changes due to a phase shift in the resultant if signal. A meter monitors the value of the dc voltage and if it reaches a preset limit away from zero, an alarm circuit in the combiner operates. The alarm circuit turns on a visual local alarm and also activates a relay for remote indication.

A secondary circuit is provided in the combiner to show when loss of signal level caused the phase to shift past the alarm limit. The level sensing circuit is manually switched. A loss of signal below a preset level triggers the alarm circuit.

The characteristics of the combiner are:

Input power requirement	Regulated +15 vdc
If input signal	
Frequency	70 mc
Amplitude	0.06 to 0.60 volts rms
reference (combined signal	
Frequency	70 mc
Amplitude	0.65 volts rms
Apc output signal	-0.70 vdc to +0.70 vdc
	0. 00 volts dc for in-phase condition
Phase alarm signals	1) visual on combiner 2) +15 volts dc at p 8 of plug P3 3) open circuit between pins 6 and 7 of P3

CIRCUIT DESCRIPTION (Figures 1 through 3)

The combiner contains an isolating emitter follower, liming amplifier, combined signal amplifier, apc detector, phase alarm detector, relay amplifier and noise cancellation amplifier.

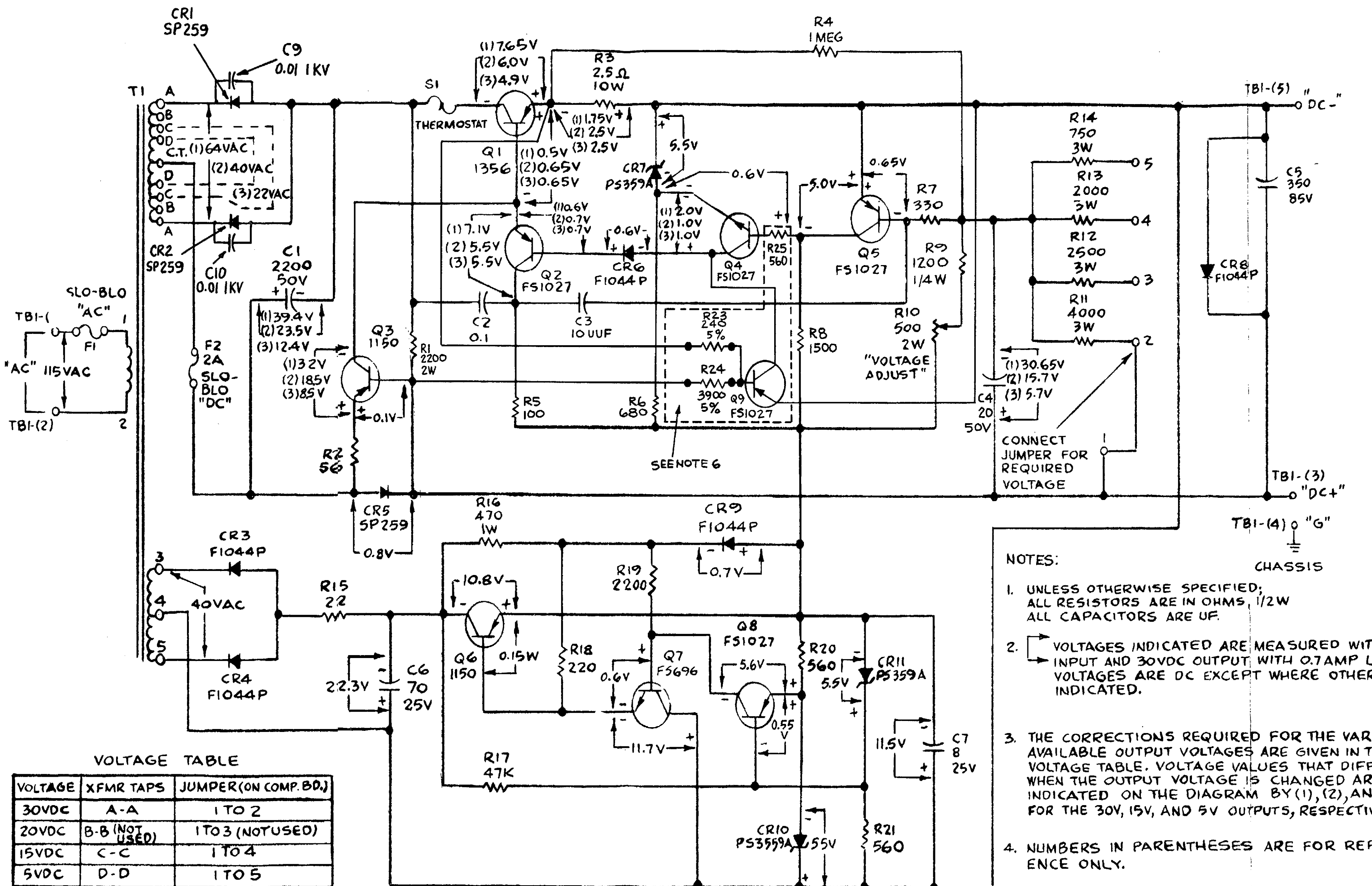
Emitter Follower. Emitter follower Q10 isolates the if input signal circuit (Pi) from any extraneous signals at P4 (OUT) when switch S2 (ALM TEST) is n position. When S2 is in L position, the output of Q10 is disconnected from P4 and loaded with 75 ohms (R47).

Limiting Amplifier. The limiting amplifier consists of transistors Q1, Q2, and Q3, connected as three cascaded, common-emitter amplifier stages. The ?0-mc i-f signal from one receiver, at an amplitude between 0.06 and 0. 60 volt rms, enters the module at IN plug P1 and is routed to OUT plug P4 through delay line DL1 and switch S2A. The signal is also applied to the base of transistor Q1; resistor R1 prevents the low input impedance of the transistor from loading the line excessively; capacitor C 1 isolates the base bias circuits from the line. Amplifier Q2 is similar to amplifier Q1, except that negative feedback is applied from collector to base by capacitor C45. Adjustment of this capacitor controls the width of the passband. Amplifier Q3 is generally similar to the first two stages but has an inductive load (inductor L4, broadly tuned by capacitor C9) instead of a resistive load. Adjustment of capacitor C9 determines the center frequency of the passband, but in order to make this adjustment the input signal must be reduced to a level at which neither of transistors Q2 and Q3 become saturated. Under normal conditions the limiting action of these transistors maintains an output signal amplitude between 1. 0 and 1. 5 volts for all input signal amplitudes exceeding 0. 05 volts rms. The output signal of the limiting amplifier is applied through capacitor C13 to the apc and alarm detector circuits and through capacitor C 12 to rectifier CR1.

The rectified signal is fed to a contact of S2 and is connected to the noise cancellation amplifier in the L position.

Combined Signal amplifier. The combined signal amplifier consists of amplifiers Q8 and Q9. The combined 70-mc H signals from two or more f channels, at an amplitude of approximately 0. 65 volt rms, enters the module at RETURN plug P2 and is applied to the resonant circuit consisting of inductor L13 and capacitor C38 0 ADJ; and to the base of transistor Q8 through capacitor C39. The first stage of the combined signal amplifier is connected in the commonemitter configuration; the second stage is an emitter follower which provides power gain and a low output impedance. The output signal is applied through capacitor C43 and delay line DL2 to the phase detector and to the quadrature circuits of the alarm detector. When 52 ALM TEST switch is in L (level) position, the amplifier is disabled by the cutoff of the collector supply voltage.

APC Detector. Transformer T1, diodes CR6 and CR?, and capacitors C26 and C27 constitute the APC phase detector. The output signal of the limiting amplifier is applied to one side of transformer T1, and a reference signal (the combined if signal) is applied to the junction of capacitors C26 and C27. circuit constants, line lengths, and delay line DL2 shift the reference signal by 90 degrees. This results in a zero output of the phase detector when the if and reference signals are in phase. R should be noted that the if and reference signals are 90 degrees apart at the phase detector for the in-phase condition and the rectified signals produced by diodes CR6 and CRY are equal and opposite, and the net voltage applied to the APC line is zero. I the phase angle of the if signal with respect to the reference signal is not 90 degrees, the rectified voltages become unequal, and then their sum is greater than zero. Switch S1 permits polarity reversal of the output signal. APC GAIN potentiometer R27 permits adjustment of the APC voltage forwarded to the receiver local oscillator. Phase Alarm Detector. Transformer T1, diodes CR4 and CR5, and capacitors C20 and C21 form a second phase detector which produces an alarm control signal. The if signal is coupled through capacitor C23 to diode CR4, for which inductor L6 provides the dc return. Similarly, an equal but 180 degree out-of-phase if signal is coupled through capacitor C25 to diode CR5. At this point, the application of a reference signal, which is 90 degrees out of phase

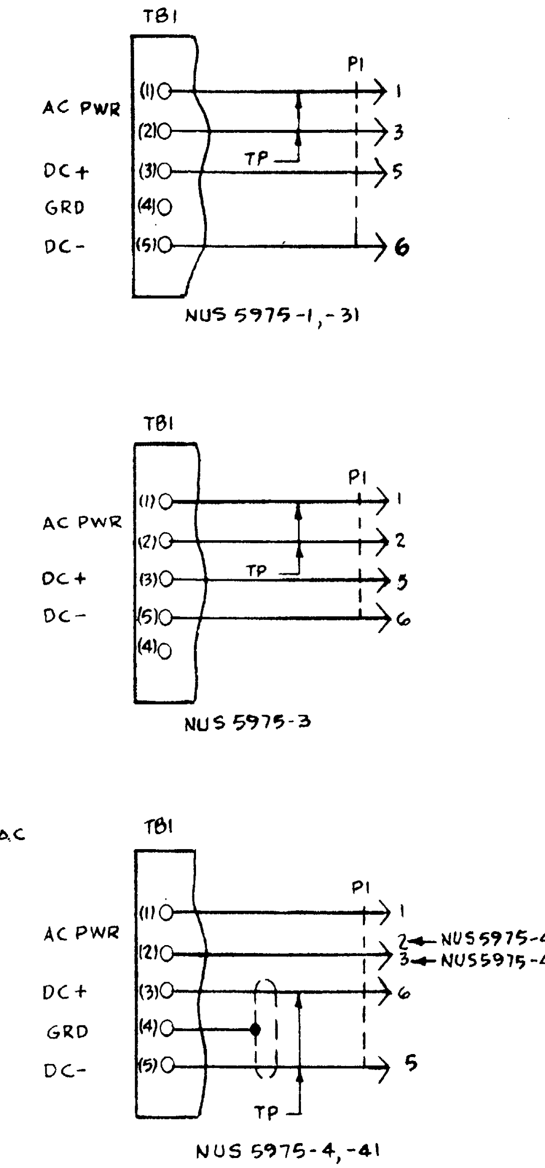


VOLTAGE TABLE

VOLTAGE	XFMR TAPS	JUMPER (ON COMP. BD.)
30VDC	A-A	1 TO 2
20VDC	B-B (NOT USED)	1 TO 3 (NOT USED)
15VDC	C-C	1 TO 4
5VDC	D-D	1 TO 5

NOTES:

1. UNLESS OTHERWISE SPECIFIED; ALL RESISTORS ARE IN OHMS, 1/2W ALL CAPACITORS ARE UF.
2. VOLTAGES INDICATED ARE MEASURED WITH 115VAC INPUT AND 30VDC OUTPUT WITH 0.7AMP LOAD. VOLTAGES ARE DC EXCEPT WHERE OTHERWISE INDICATED.
3. THE CORRECTIONS REQUIRED FOR THE VARIOUS AVAILABLE OUTPUT VOLTAGES ARE GIVEN IN THE VOLTAGE TABLE. VOLTAGE VALUES THAT DIFFER WHEN THE OUTPUT VOLTAGE IS CHANGED ARE INDICATED ON THE DIAGRAM BY (1), (2), AND (3) FOR THE 30V, 15V, AND 5V OUTPUTS, RESPECTIVELY
4. NUMBERS IN PARENTHESES ARE FOR REFERENCE ONLY.
5. INCORPORATES MODIFICATION 2388011.
6. INCORPORATES MODIFICATION 2388052. TRANSISTOR Q9 AND RESISTORS R23, R24, AND R25 APPLY ONLY TO NUS 5975-4, AND -41.



Changed September 1975

Figure 1. Low Voltage Power Supply NUS 5975-1, -3, -4, -31 and -41, Schematic Diagram

Figure 1. Low Voltage Power Supply NUS 5975-1,-3, -4, -31 and -41, Schematic Diagram.

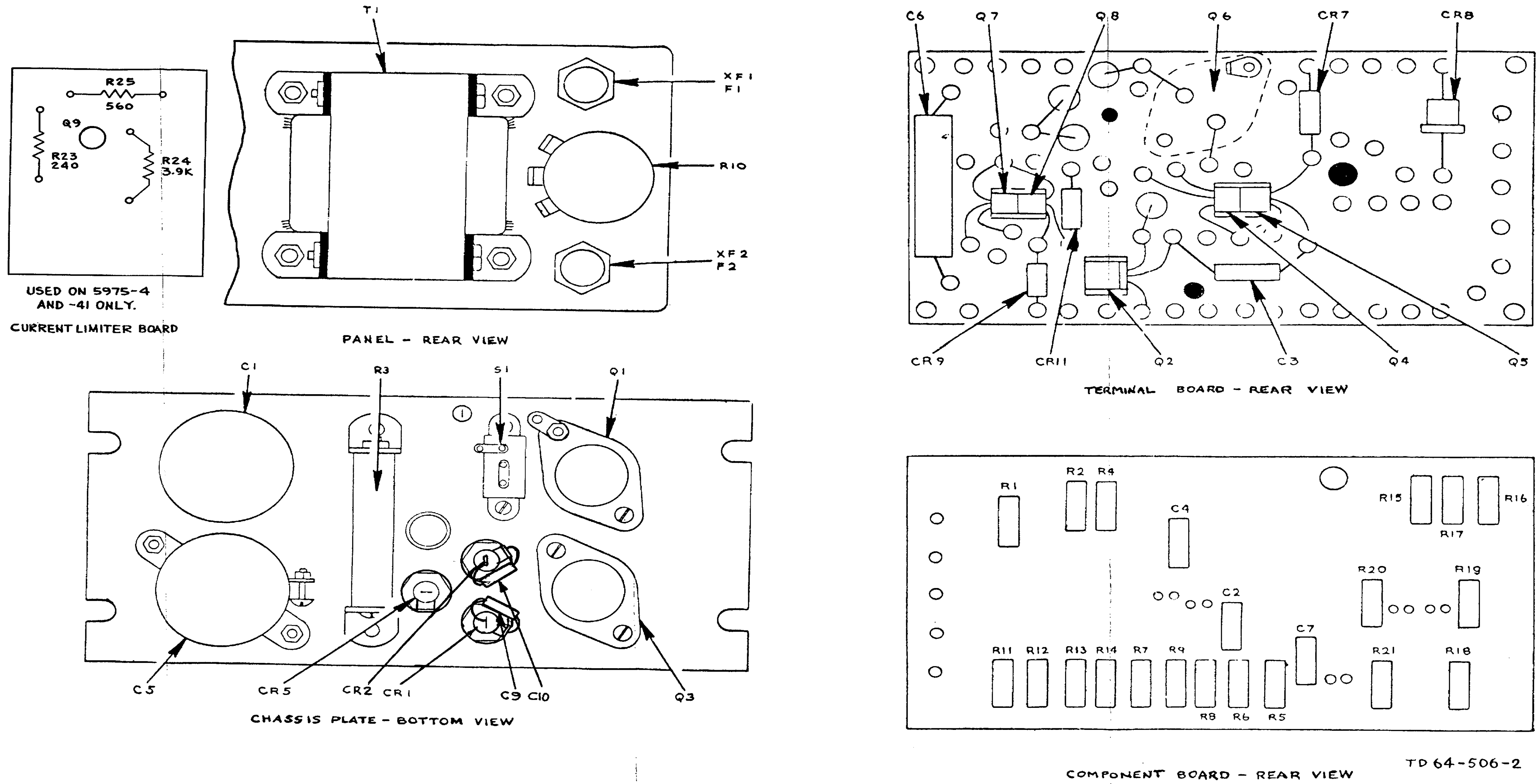
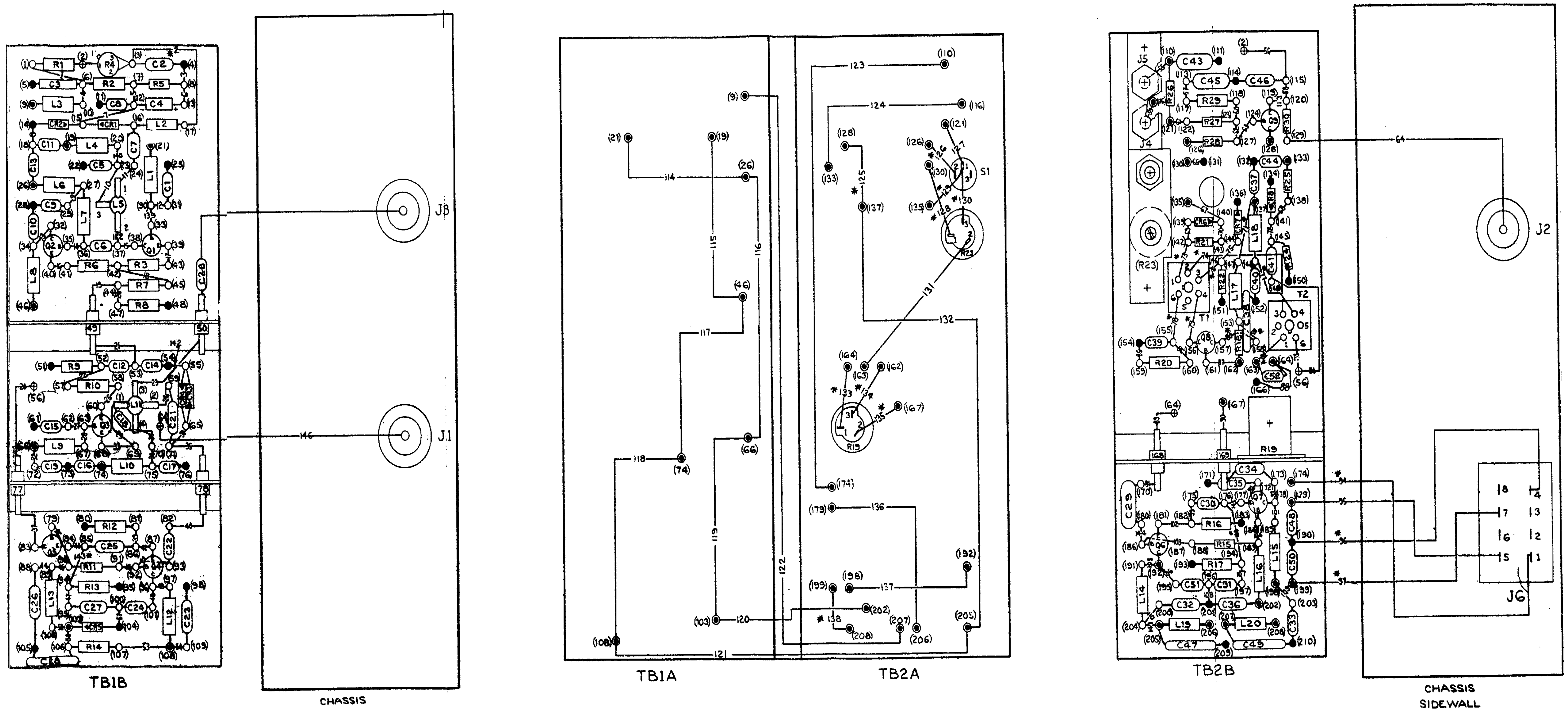


Figure 2. Low Voltage Power Supply NUS 5975-1, -3, -4, -31, and -41, Parts Location

Changed September 1975

Figure 2. Low Voltage Power Supply NUS 5975-1,-3, -4, -31 and -41, Parts Location
Changed September 1995



NOTES:
1. ○ DENOTES INSULATED STANDOFFS.
2. ◉ DENOTES INSULATED FEEDTHRUS (ONE BOARD).
3. ● DENOTES GROUND LUGS.
4. ⊕ DENOTES INSULATED FEEDTHRUS (TWO BOARDS).
5. ALL NUMBERS IN PARENTHESES ARE FOR REFERENCE ONLY.
6. * DENOTES SLEEVING.

Figure 2. 70-Mc Threshold Extension Module NUS 6455, Wiring Diagram

Figure 2. 70-Mc Threshold Extension Module NUS 6455, Wiring Diagram.

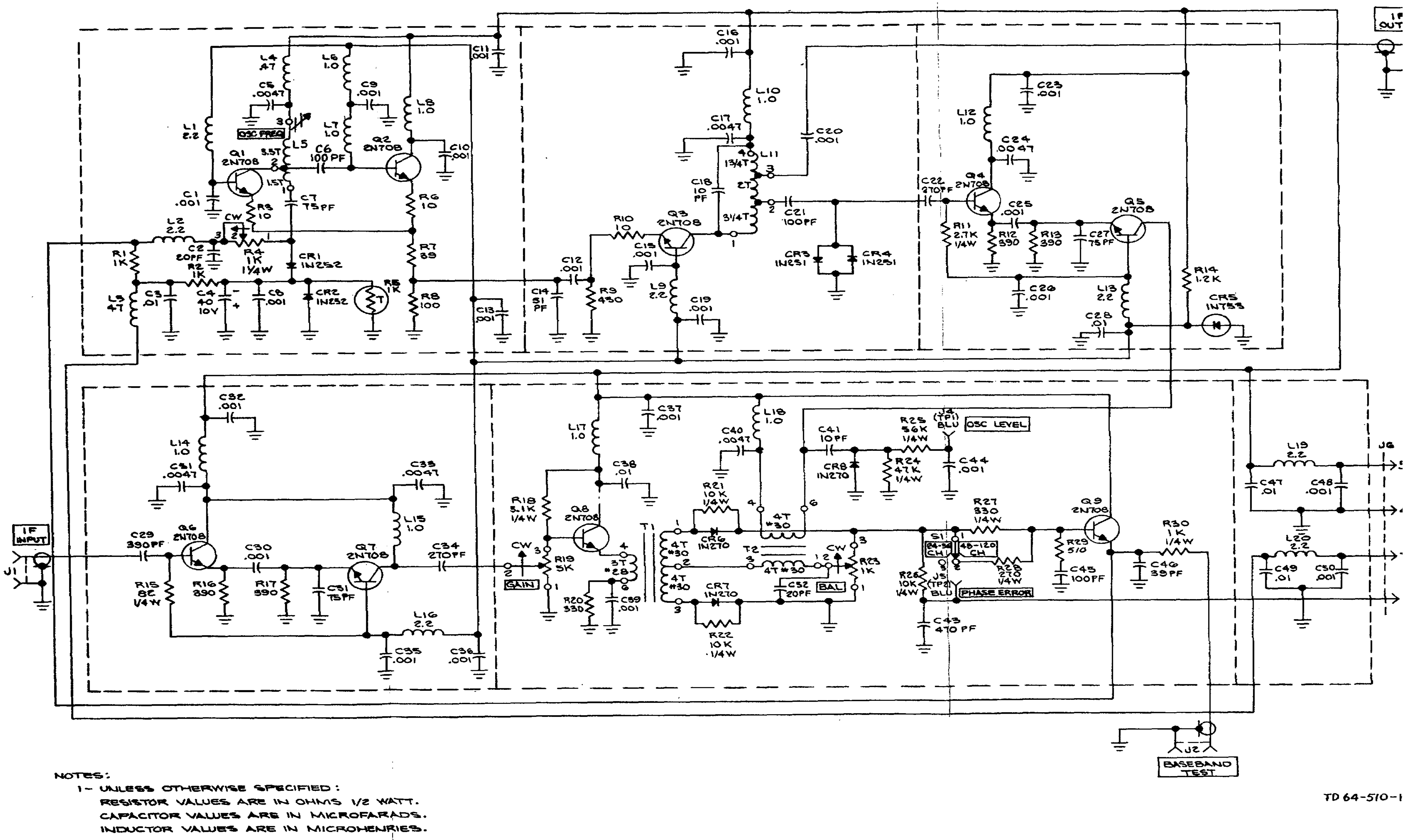


Figure 3. 70-Mc Threshold Extension Module NUS 6455, Schematic Diagram.

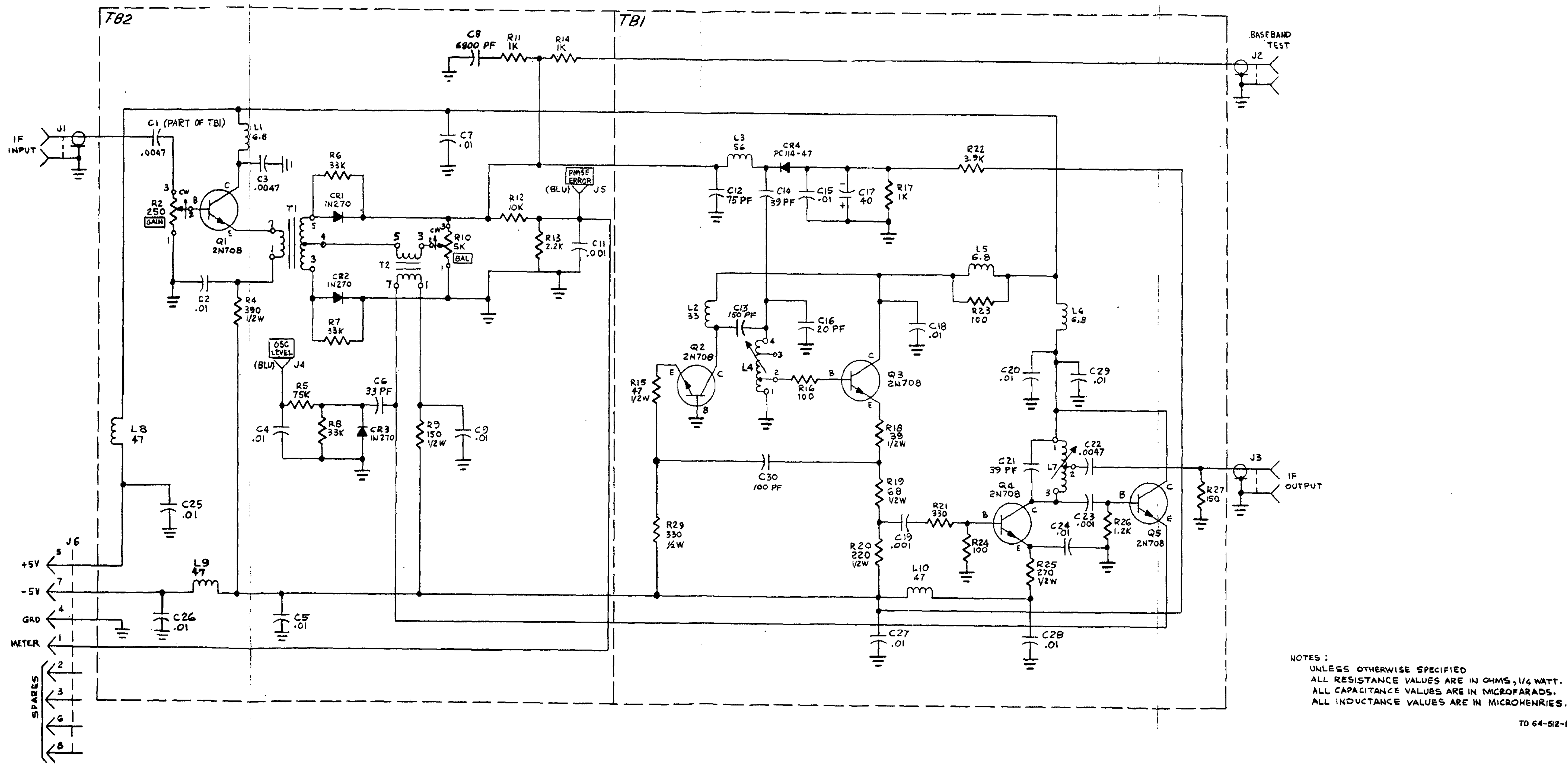


Figure 1. 9.8-Mc Threshold Extension Module NUS 6579, Schematic Diagram.

with the if signal to the junction of capacitors C20 and C21 produces a zero output from the detector. The reference signal is phase-shifted by 90 degrees in the quadrature circuits associated with emitter-follower QS, and 50 degrees by delay line DL2 before being applied to the junction of capacitors C20 and C21. Under normal conditions, therefore, when the if. input signal is exactly in phase with the reference (combined if) signal, the phase alarm detector produces maximum output (B, figure 2), which appears as a positive voltage across 0 ALM AD potentiometer R49 and resistor R48. Any deviation from the in-phase relationship between the if and reference signal, or any reduction of the if signal amplitude to an extent that drops below the limiting threshold of the limiting amplifier, causes the output of the phase alarm detector to be reduced. QUAD ADJ capacitor C30 permits precise adjustment of the phase angle of the reference signal applied to the phase alarm detector, in order to produce maximum amplitude of the alarm control signal for the locked-phase condition of if and combined if signals. Potentiometer R49 permits amplitude adjustment of the alarm control signal, which is then routed through switch S2B to relay amplifier Q7 and noise cancellation amplifier Q4.

Relay Amplifier. The relay amplifier consists of switching transistor Q7 and dual transistor Q8. Under normal locked-phase conditions, a positive alarm control signal from the phase alarm detector is applied through resistor R50 to the base of transistor Q7, causing the transistor to saturate. Under these condition, the collector of transistor Q7 and base no. 1 (pin 5) of transistor Q8 are near ground potential, and both sections of transistor Q6 ire cut off. Alarm relay K1 is then energized through resistor 133 and closes the remote alarm circuit between pins 6 and 7 of plug P3. At the same time, contacts 5 and ? of the relay open, thereby removing the 15-volt supply to ALM indicator lamp DS1 and pin 8 of plug P3. I the IN if signal is drastically reduced, or goes out of phase with the reference (combined if) signal, the output signal of the phase alarm detector is reduced and transistor Q7 cuts off. Capacitor C36 now begins to charge through resistor R38, and after an interval of between 5 and 10 seconds reaches a potential at which transistor Q6 conducts. DELAY switch S3 is provided to disable the delay circuit. Collector no. 2 (pin 1) and emitter no. 2 (pin 3) are connected directly across the alarm relay, and effectively short circuit the relay coil when the transistor conducts. The relay deenergizes, thereby opening the alarm circuit a pins 6 and 7 of plug P3 and applying 15 volts to ALM indictor lamp DS1 and pin 8 of plug P3.

Noise Cancellation Amplifier. The noise cancellation amplifier, Q4, is used in L (level) position only of switch S2. I the level of the if signal drops before the if amplifier, considerable noise is developed due to some increase in gain in the if amplifier. To prevent the alarm circuits from being held off by excess noise, Q4 is used as an inverter to cancel most of the noise before it reaches the relay amplifier. The dc signal from CR1 is taken from the output of the limiter amplifier through L5 and fed to one end of RS0. R is also fed to the base of Q4 through C15. Q4 amplifies the noise on the dc signal, inverts it and feeds it to rectifiers CR2 and CR3. The result an signal is fed through R20, which allows the inverted signal to be balanced against the signal at the end of RS0, thereby cancelling the noise.

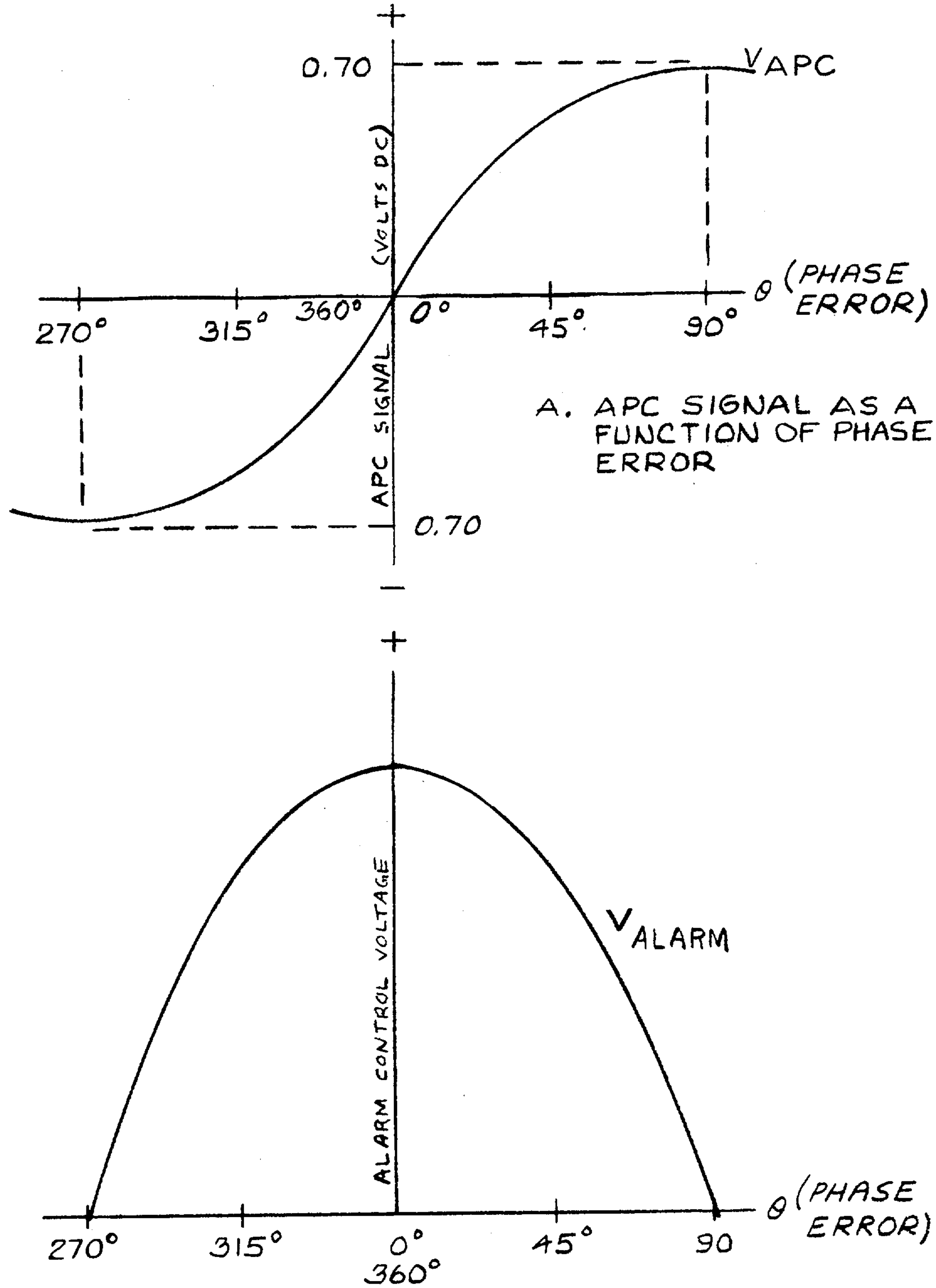


Figure 1. Relationship of APC and Alarm Controls Signals to Phase Error

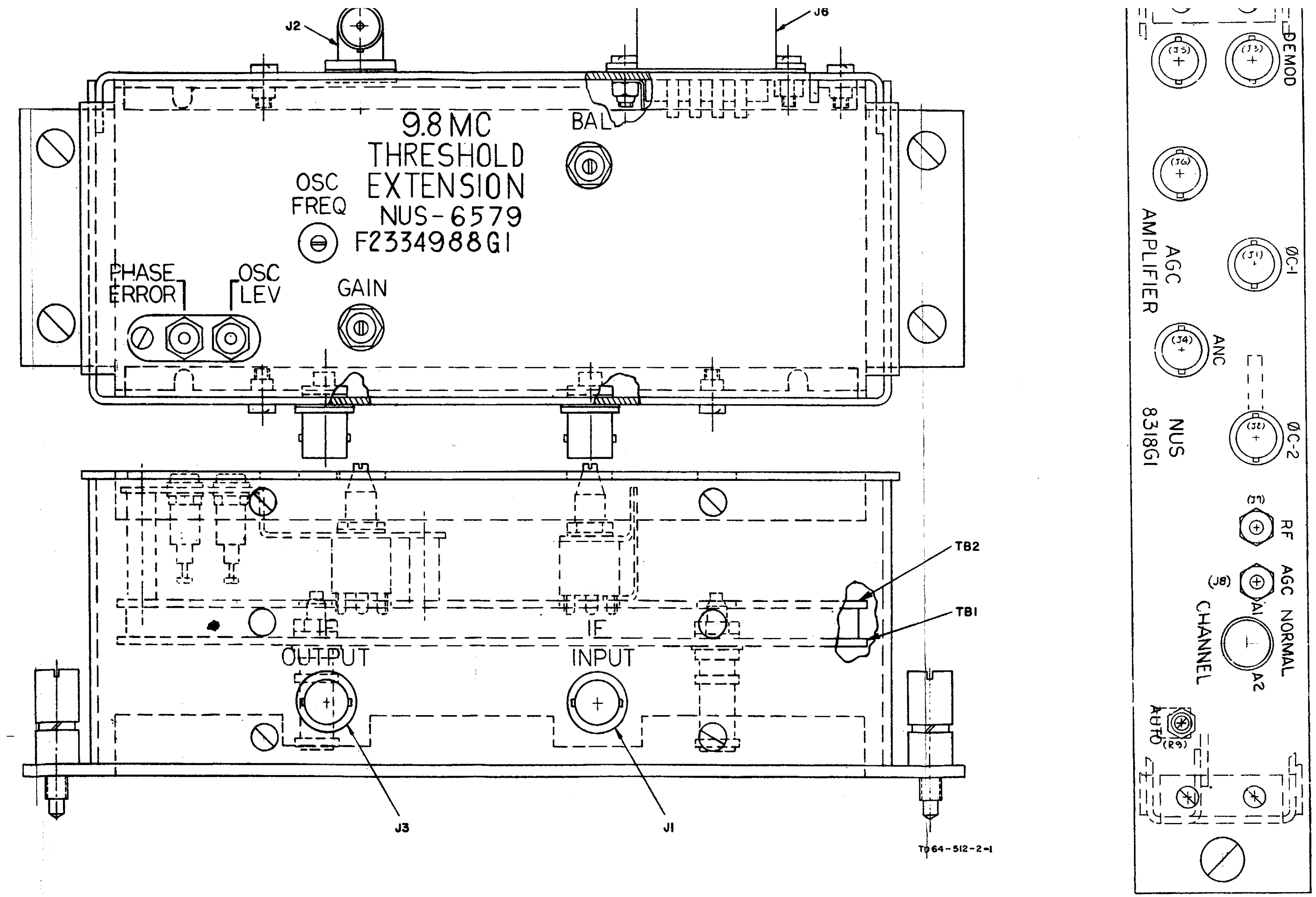
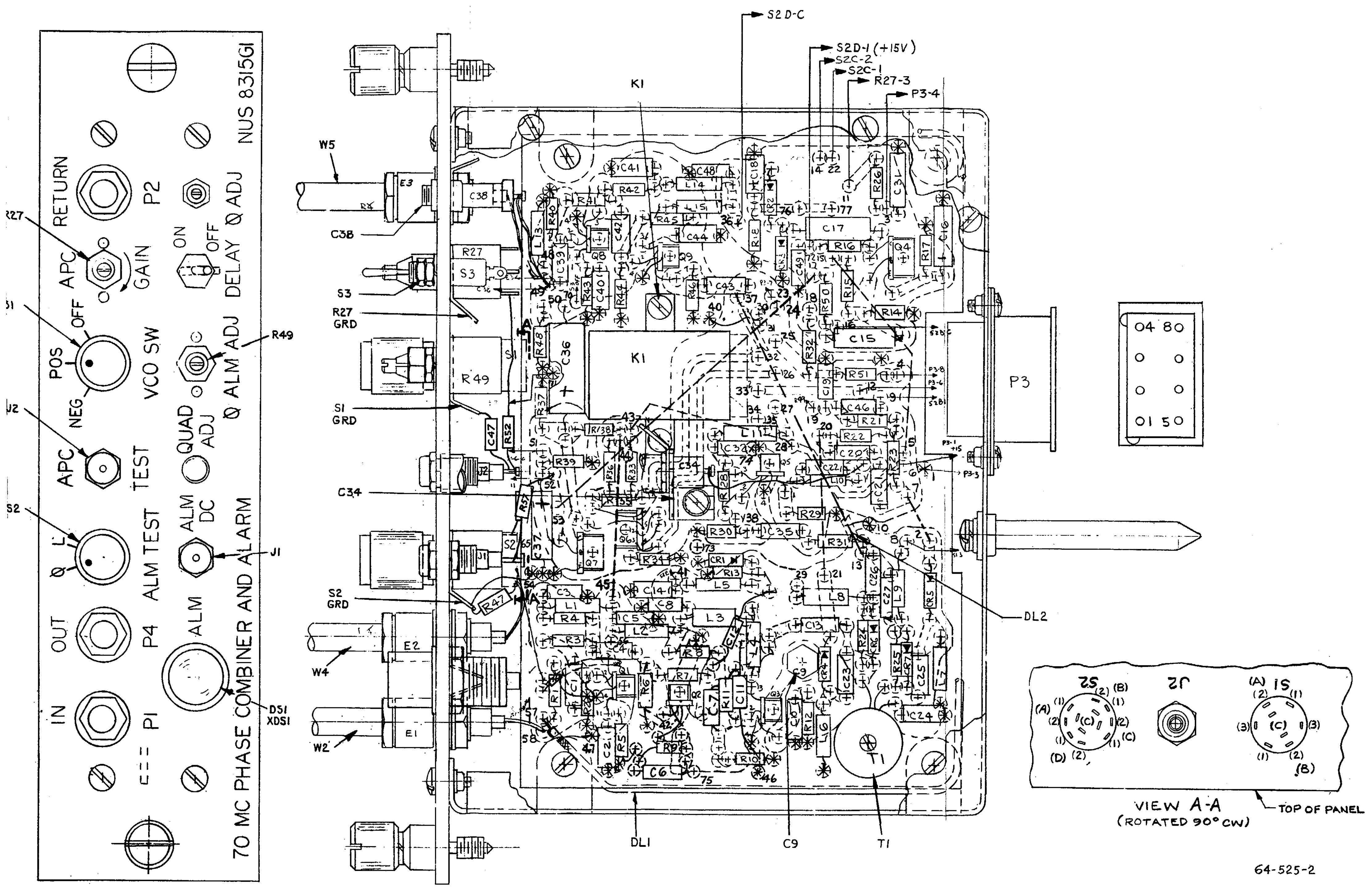
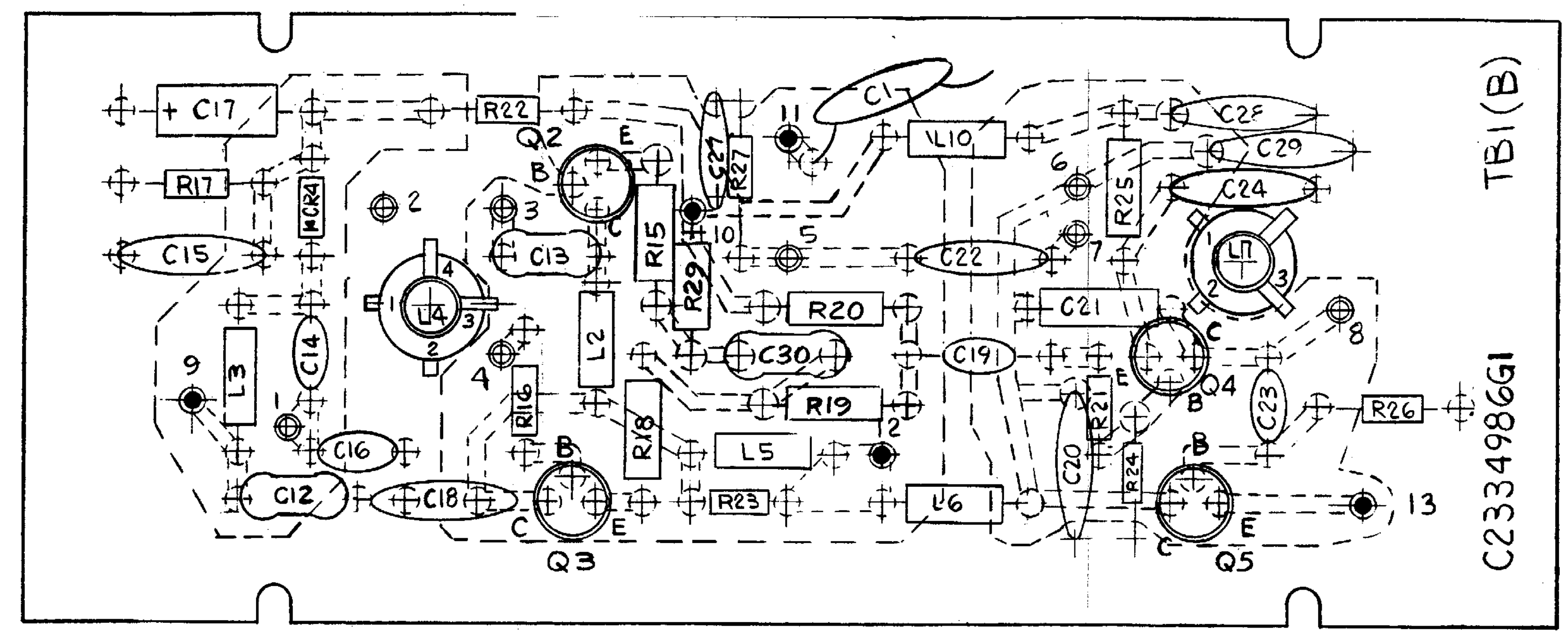


Figure 2. 9.8-Mc Threshold Extension Module NUS 6579, Parts Location (Sheet 1 of 3)

Figure 2. 9.8-Mc Threshold Extension Module NUS 6579, Parts Location (Sheet 1 of 3)


70 MC PHASE COMBINER AND ALARM
NUS 8315GI
RETURN
P2
APC
GAIN
ON
OFF
DELAY
Ø ADJ
VCO SW
POS
NEG
ALM ADJ
QUAD
ADJ
TEST
ALM
DC
ALM TEST
OUT
P4
IN
P1
K1
W5
C38
S3
R27
R27 GRD
R49
S1 GRD
C34
S2 GRD
W4
W2
E1
E2
DS1
XDS1
J1
S2 D-C
S2D-1 (+15V)
S2C-2
S2C-1
R27-3
P3-4
P3
DL1
DL2
C9
T1
VIEW A-A
(ROTATED 90° CW)
TOP OF PANEL
64-525-2



NOTE:
1. NUMBERS NEAR TERMINALS SHOWN BY ◉ APPEAR ON FAR SIDE.

C4-512-2-2

Figure 2.. 9.8 -Mc Phase Combiner and Module NUS 6579,, Parts Location (Sheet 3 of 3)

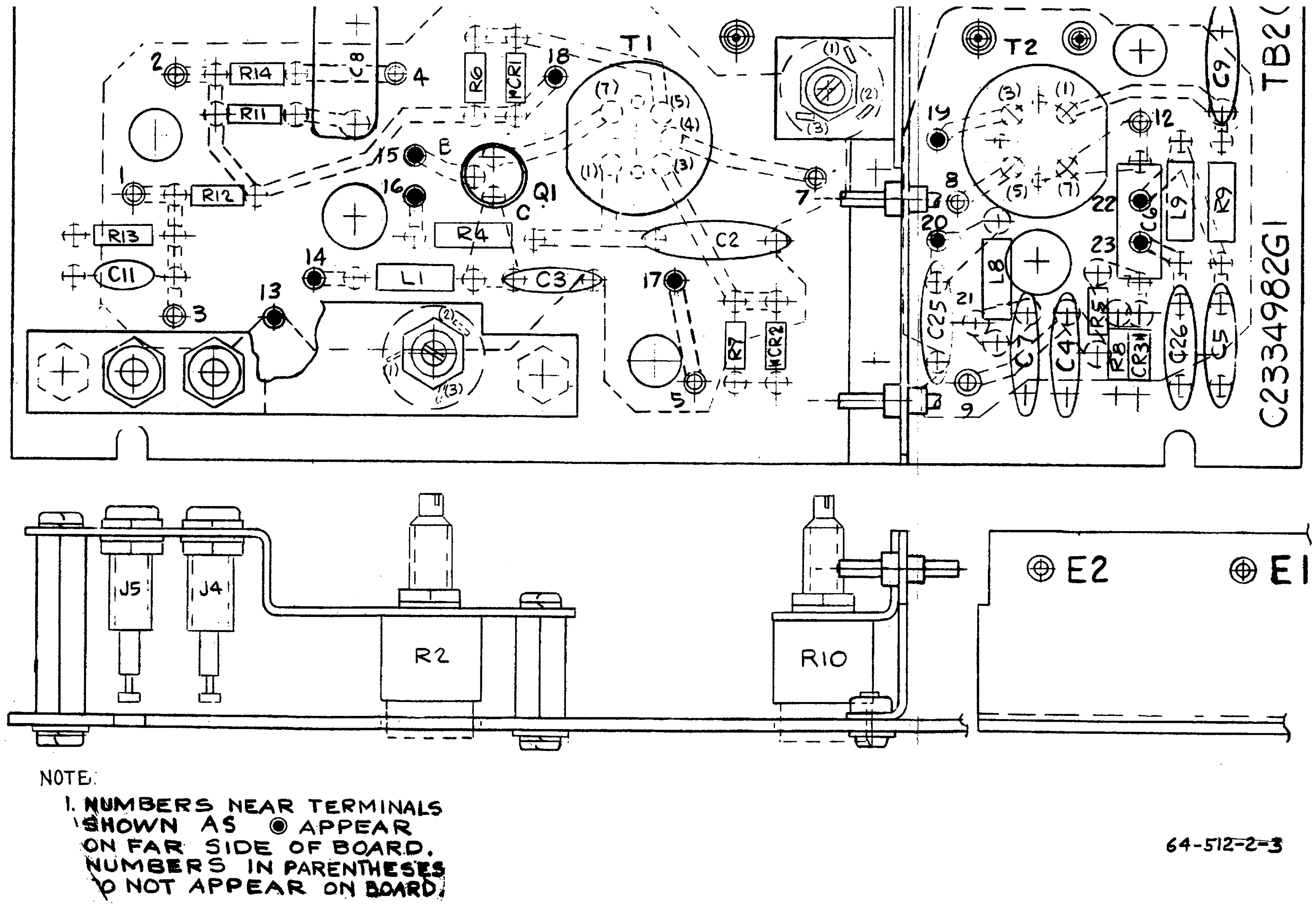


Figure 2. 9.8-Mc Threshold Extension Module NUS 6579, Parts Location (Sheet 3 of 3)

Figure 2. 9.8-Mc Threshold Extension Module NUS 6579, Parts Location (Sheet 3 of 3)

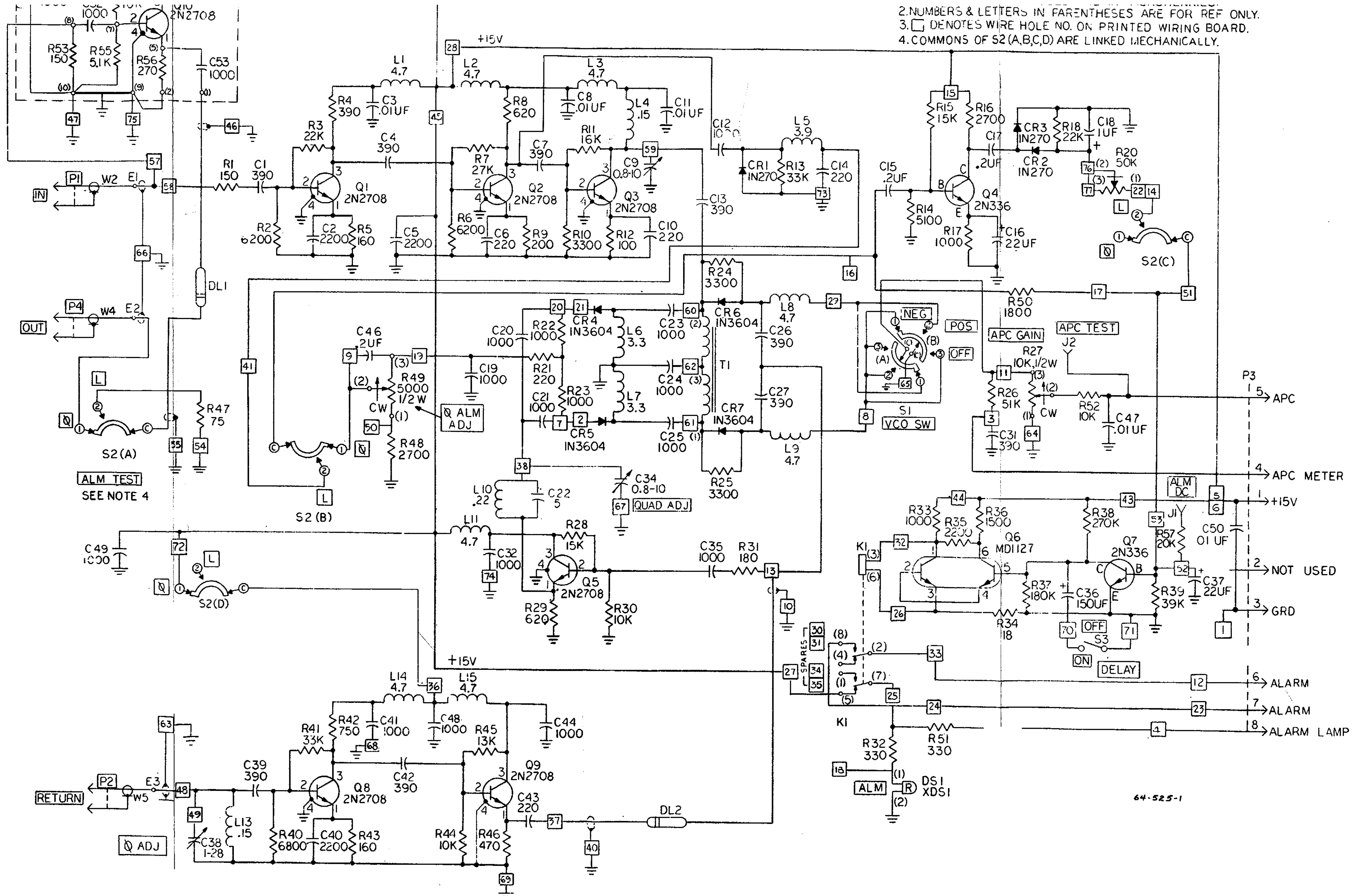


Figure 2. 70-Mc Phase Combiner and Alarm NUS 8315-1, Schematic Diagram

Figure 2. 70-Mc Phase Combiner and Alarm NUS 8315-1, Schematic Diagram

9.8-MI PHASE COMBINER AND ALARM
NUS 8316GI

DESCRIPTION

The 9.8-mc phase combiner and alarm module samples the if signal from its associated if amplifier, compares it with the combined if signal and produces an error signal whose polarity and amplitude are proportional to the phase difference between the two signals. Alarm circuits are utilized in the module to provide indications of large phase errors or loss of signal level.

The phase combiner circuits consists of a buffer amplifier, a limiter amplifier and a phase detector. The alarm circuits consist of alarm phase detector, an alarm amplifier and relay driver and a noise cancellation amplifier. When the if signal is in phase with the combined if signal, the automatic phase control (apc) voltage from the phase discriminator is zero.

CIRCUIT DESCRIPTION (Figures 1 through 3)

Buffer Amplifier. Q3 provides isolation between the if input signal and the combined if signal. The if signal enters the module at IN connector P1 and is coupled to an attenuator network, consisting of resistors R5 through R7 and inductor L3, via coupling capacitor C4. Switch S1 will be covered in another paragraph. The attenuator network reduces the amplitude of the if signal applied to the base of buffer amplifier Q3 to a level which will yield an overall gain of approximately unity. The output signal of the buffer amplifier is developed across inductor L5 and is coupled to OUT connector P2 via coupling capacitor C41. The signal present at the collector of buffer amplifier Q3 is the combined if signal from the AGC amplifier combine point which is applied to the phase detector and to the quadrature phase detector.

Limiter Amplifier. The limiter amplifier receives is input signal via coupling capacitor C3. The if signal is amplified by amplifier Q1, limited by diodes CR1 and CR2, and coupled to the phase shift network via coupling capacitor C7. The phase shift network, consisting of resistors R9 and R10, capacitors C9 and C14, and inductor L4, (PHASE), introduces a phase shift in the if signal which is necessary for proper phase discriminator operation. This phase- shifted signal is then processed through emitter follower Q2 and amplified by common base amplifier Q4. The output of amplifier Q4 is then impressed across the primary winding of transformer T1.

Phase Detector. The phase detector is basically a Quadrature Detector. The push-pull voltage required by diodes CR5 and CR6 is provided by the rf center tapped secondary of transformer T1. The combined if signal provides the reference voltage at the junction of capacitor C28 and C29. Resistor R27 provides the required load for diode CR6 and the network consisting of resistors R39, R40, R41, R43, and R45 and capacitor C42 provide the required load for diode CRS. The tuned circuit, consisting of the secondary of transformer T1 (FREQ) and capacitors C20 and C21, is tuned so that when the combined if signal and the f signal are in phase, current will flow through diode CR6 only. With no current flowing through diode CRS, no current will flow through the load network for the diode, and therefore, the apc voltage will be zero. The magnitude of the effect of the apc signal is adjusted by R45 (GAIN).

Alarm Phase Detector. The alarm phase detector consists of an emitter follower and amplifier combined in a single transistor (Q6). The input signal to the emitter follower is the same combined if signal that is used as the reference voltage in the phase detector. The combined if signal is processed through the emitter follower and applied to the base of the amplifier.

The output of the amplifier feeds transformer T2 which shifts the phase of the combined signal by 90 degrees. Fine phase shift adjustment is made by R58 (QD). The phase shifted signal feeds CR7 and CR8 and is compared with the shifted signal from the limiter amplifier.

When the combined if signal and the if signal are in phase, a positive voltage is developed across resistor R30. This voltage is then applied to PHASE/LEVEL switch S1 via ALM ADJ potentiometer R28.

Noise Amplifier-Detector. The noise amplifier-detector consists of detector CR3, CR4 and C17, amplifier QS, and detector CR9, CR10, and CR36. The output signal from amplifier Q4 is applied to the junction of diodes CR3 and CR4 which rectify the signal and produce a positive voltage across capacitor C17. Noise present in the if signal will cause the positive voltage across capacitor C17 to vary and be coupled to the base of amplifier Q5. Amplifier Q5 amplifies the noise level and couples it to the junction of diodes CR9 and CR10. At low noise levels the positive voltage developed across capacitor C17 and resistor R21 exceeds the negative voltage developed across capacitor C36 and resistor R37. When high noise levels are present in the if signal, the positive voltage developed across capacitor C17 will increase in the ratio of 1:1, however, the voltage developed cross capacitor C36 will increase negatively in proportion to the amplification factor of amplifier Q5. Therefore, when the minimum allowable noise level is exceeded, the output of the amplifier-detector will be negative.

Relay Driver. The relay driver consists of amplifier Q7, emitter follower Q8A, and amplifier Q8B. When there is no phase error or level error, a positive signal is applied to the base of amplifier Q7. This signal is amplified and inverted and applied to the base of amplifier Q8B, via emitter follower Q8A. This negative-going signal cuts off amplifier Q8B and the entire collector supply voltage is applied across relay K1. Relay K1 is thus energized and ALARM lamp DS1 is off. When an error exists, the positive signal applied to the base of amplifier Q7 decreases. This decrease produces a smaller negative signal at the base of amplifier Q8B and the amplifier is no longer held cutoff. The voltage across relay K1 decreases and the relay de-energizes. When relay K1 de-energizes ALARM lamp DS1 lights indicating that either a phase error or a noise error exists, depending upon the position of PHASE /LEVEL switch S1. Delay switch S2 is provided to place in the circuit a capacitor (C43) which prevents, by its long charging time (5 to 10 seconds*)* the operation of Q8 for momentary phase errors or loss of signal.

Phase-Level switch S1 (ø-L). Phase-level switch S1 has three decks. In the ø position, S(1) couples the if signal to the buffer amplifier Q3; S1(2) couples the output of the alarm phase detector to the noise amplifier-detector and S1(3) couples the alarm phase detector to the relay driver. In the L position at S1(1) the if signal is decoupled from the buffer amplifier and a compensating load (R59) is placed in the circuit; S1(2) disables the noise amplifier-detector by disconnecting the alarm detector input from Q5 and S1(3) disconnects the alarm detector from Q7 and connects the if signal input from Q1 to the relay driver amplifier Q7.

70-MC REDUNDANT AGC AMPLIFIER
NUS 8317-1

DESCRIPTION

The 70-mc redundant agc amplifier is used with the dual line-of-sight receiver. The module provides an automatic gain control voltage whose level is determined by the level of the received signals. The module contains two parallel and independent channels arranged so that if a malfunction occurs in one channel, normal operation is maintained by the other channel. Signal and power characteristics are as follows:

Input signal frequency	70 mc
Input signal level	0. 24 volt rms
Return signal level	0.15 volt rms
Gain control output signal	O to 0.7 volts dc
Input power requirement	+15 volts dc

CIRCUIT DESCRIPTION (Figures 1 and 2)

General. The 70-mc agc amplifier combines two if input signals in a reversed power divider and applies the combined signal to two independent agc channels. The combined input signals are also separated at a second power divider and appear at the signal output terminals at a level which is 3 to 4 db below the level of the input signals. The two identical agc channels rectify the combined if signal and produce two dc gain control signals. These two signals are combined and appear at the output terminals for routing to the gain-controlled receiver.

Power Dividers. The 70-megacycle if signals are applied through connectors J1 and J2 and delay lines DL1 and DL1 to power divider A1. At the input to the power divider, each signal is at a level of 0. 24 volt rms. The combined signal present at the output of power divider A1 is at a level of approximately 0. 27 volt rms. The combined signal is routed to isolation amplifiers Q1 and Q2, and to power divider A2. Two if signals, each at a level of 0. 15 volts rms, are available at the output of power divider A2 and are fed to output connectors J3 and J6. This arrangement of power dividers provides two output if signals from the module which are a little lower in level than the two output if signals because of the losses in the power dividers. Diode detector CR1 and its associated circuit detect and filter the input signal present at connector J1 so that the signal level can be monitored at test point J7. Similar detectors are available for monitoring the if input signal at connector J2 and the if output signals at connections J4 and J5.

Automatic Gain Control Circuits. The module contains two identical agc circuits parallel-fed from power divider A1. The first circuit, circuit 1, contains isolation amplifier Q1, diodes CR6 and CR7, and emitter follower Q3. The second circuit, circuit 2, contains transistor Q2, diodes CR8 and CR9, and transistor Q4. At this point, circuit description will be limited to the circuit consisting of transistors Q1 and Q3. The combined if output from power divider A1 is fed to isolation amplifier Q1. This signal is detected by diodes CR5 and CR12 and can be monitored at test point J11. The if signal appearing at the emitter of transistor Q1 is rectified by diodes CR6 and CR7. The resulting dc voltage is fed to the base of emitter follower Q2. An adjustable agc delay potential is developed by the voltage divider consisting of resistor R23 and potentiometer R21. The delay potential appearing at the junction of resistors R21 and R23 is fed through diodes CR7 and CR6 to the base of transistor Q3. The voltage developed across the potentiometer forward biases CR6 and

CR7, keeping the diodes conducting at low if signal levels. The dc output of CR6 is added to the bias voltage. At high signal levels, CR6 and CR7 act as a voltage doubler circuit, increasing the slope of the output-input characteristic curve. Capacitor C20 and resistor R23 form a network with a long time constant that allows the agc circuit to respond only to average signal level and not to instantaneous changes of the modulated signal. The dc voltage appearing at the base of transistor Q3 represents average if signal level. This agc voltage output is taken from the emitter of transistor Q3 if circuit 1 develops the greater agc voltage, or from the emitter of transistor Q4 if circuit 2 develops the greater agc voltage. A dc level of 0 to 0. volt is obtained, depending on the strength of the if signal. The combined agc signal is fed to pins 9 and 10 of connector P1.

Redundancy Check. Switch S1 provides a means for testing both agc amplifier circuits. Under normal operation, the channel A1 and A2 agc amplifiers are operating in parallel so that a failure of either amplifier, or a failure of either of the input DC supply voltages will not effect the agc output voltage. With S1 in the CHAN-A1 position the channel A2 agc amplifier is disconnected, and the channel A1 operation can be tested. Channel A2 can be tested by switching to channel A1.

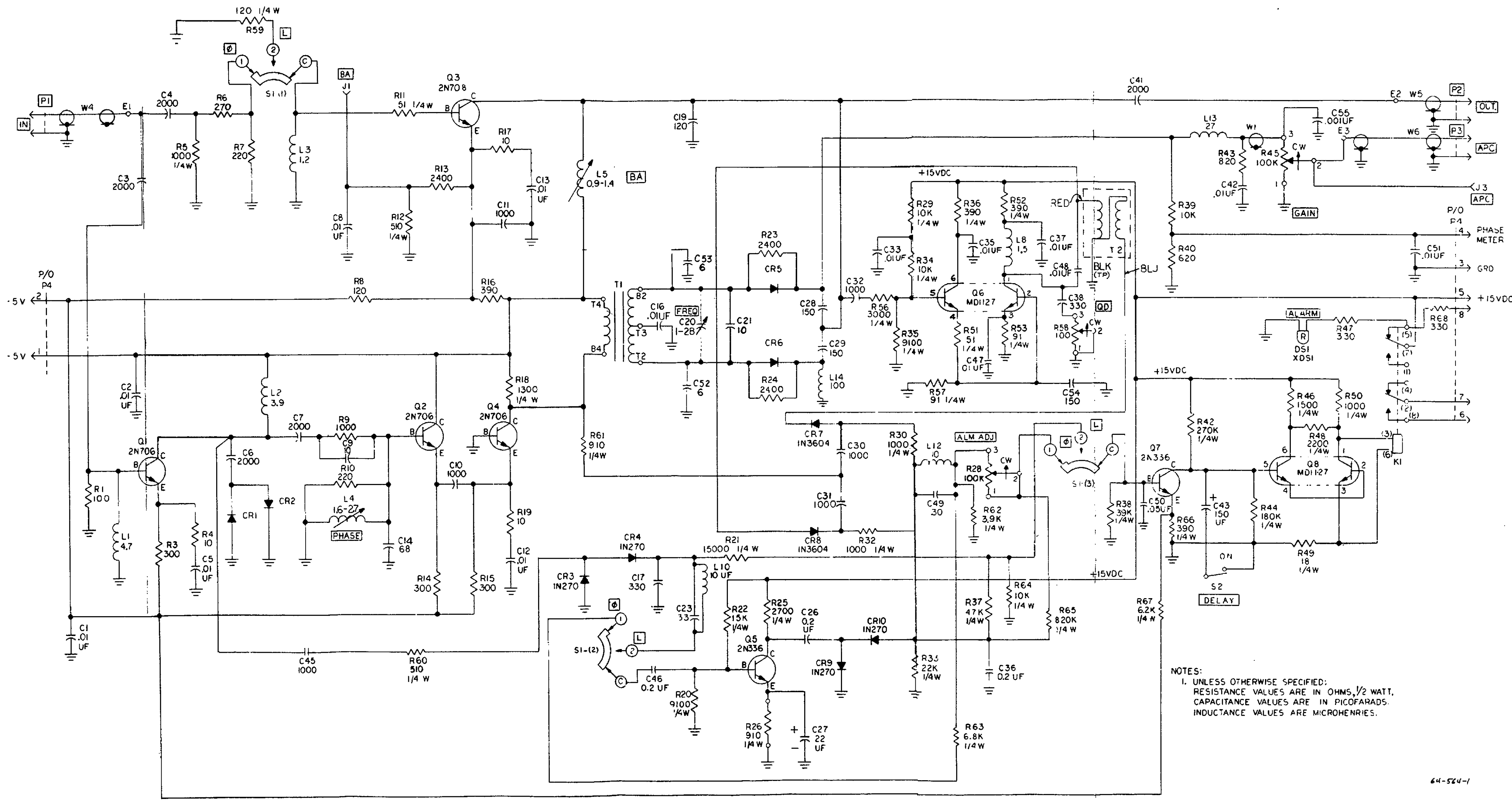


Figure 1. 9.8-Mc Phase Combiner and Alarm NUS 8316G1, Schematic Diagram

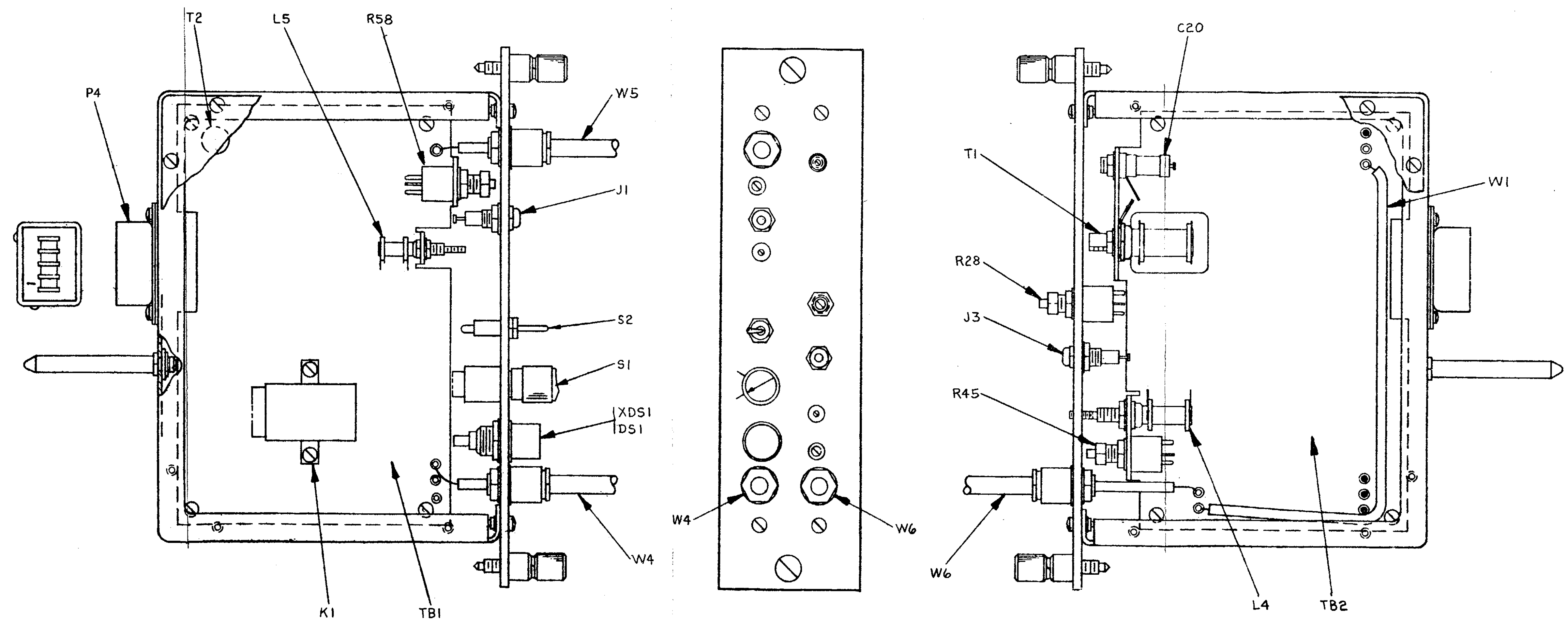


Figure 2. 9.8-Mc Phase Combiner and Alarm NUS 8316G1, Parts Location

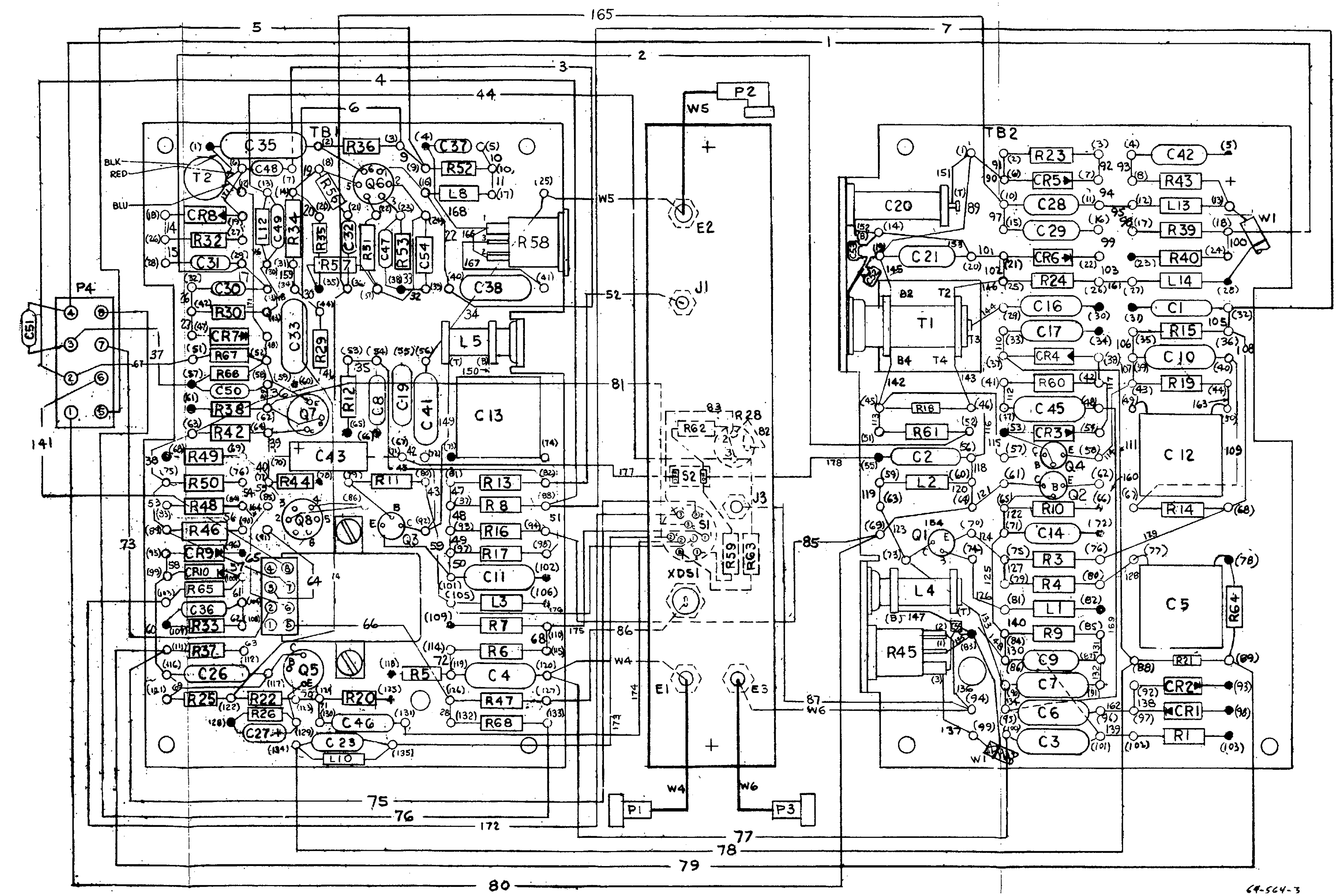


Figure 3. 9.8-Mc Phase Combiner and Alarm NUS 8316G1, Wiring Diagram

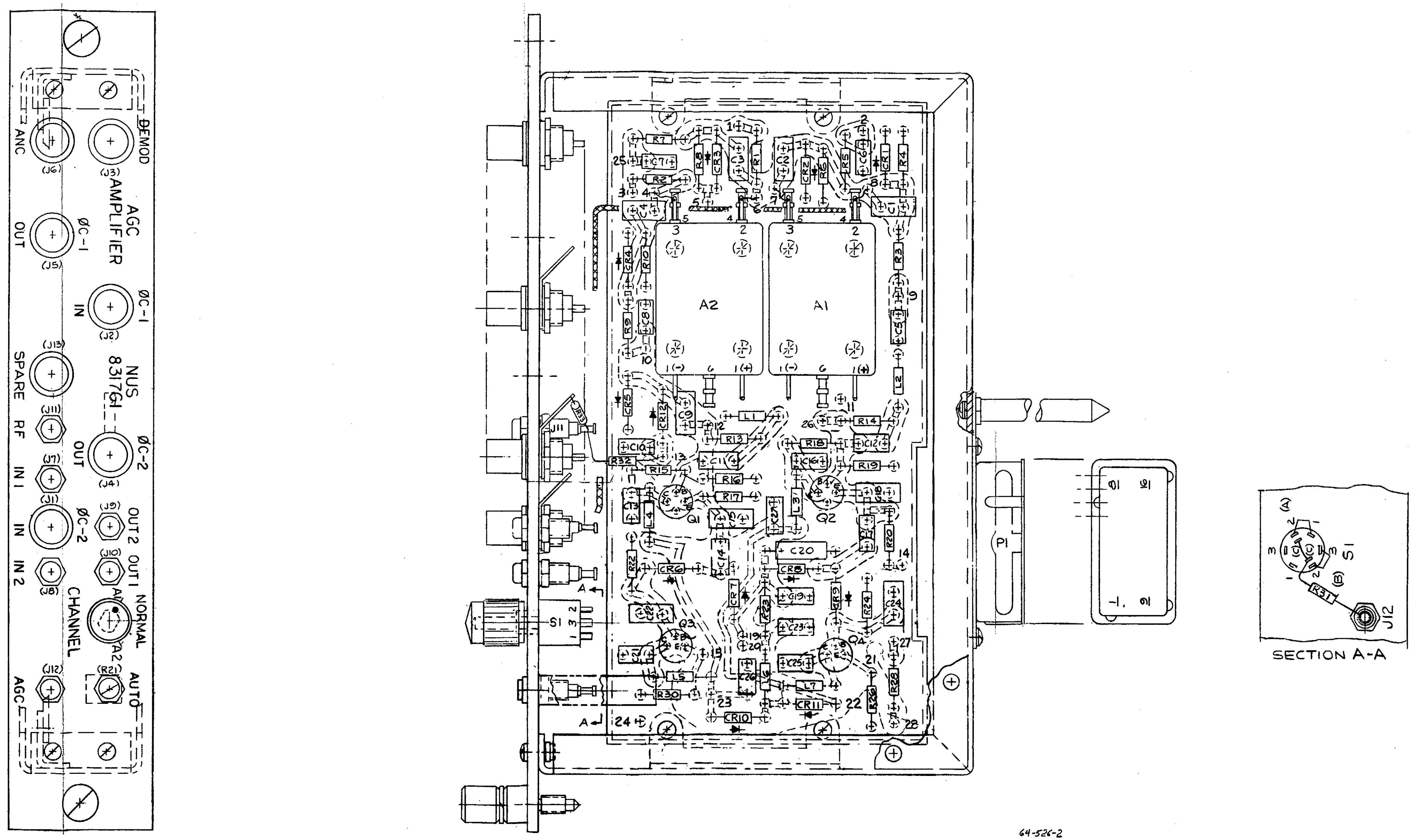


Figure 1. 70-Mc Redundant AGC Amplifier NUS 8317-1, Parts Location

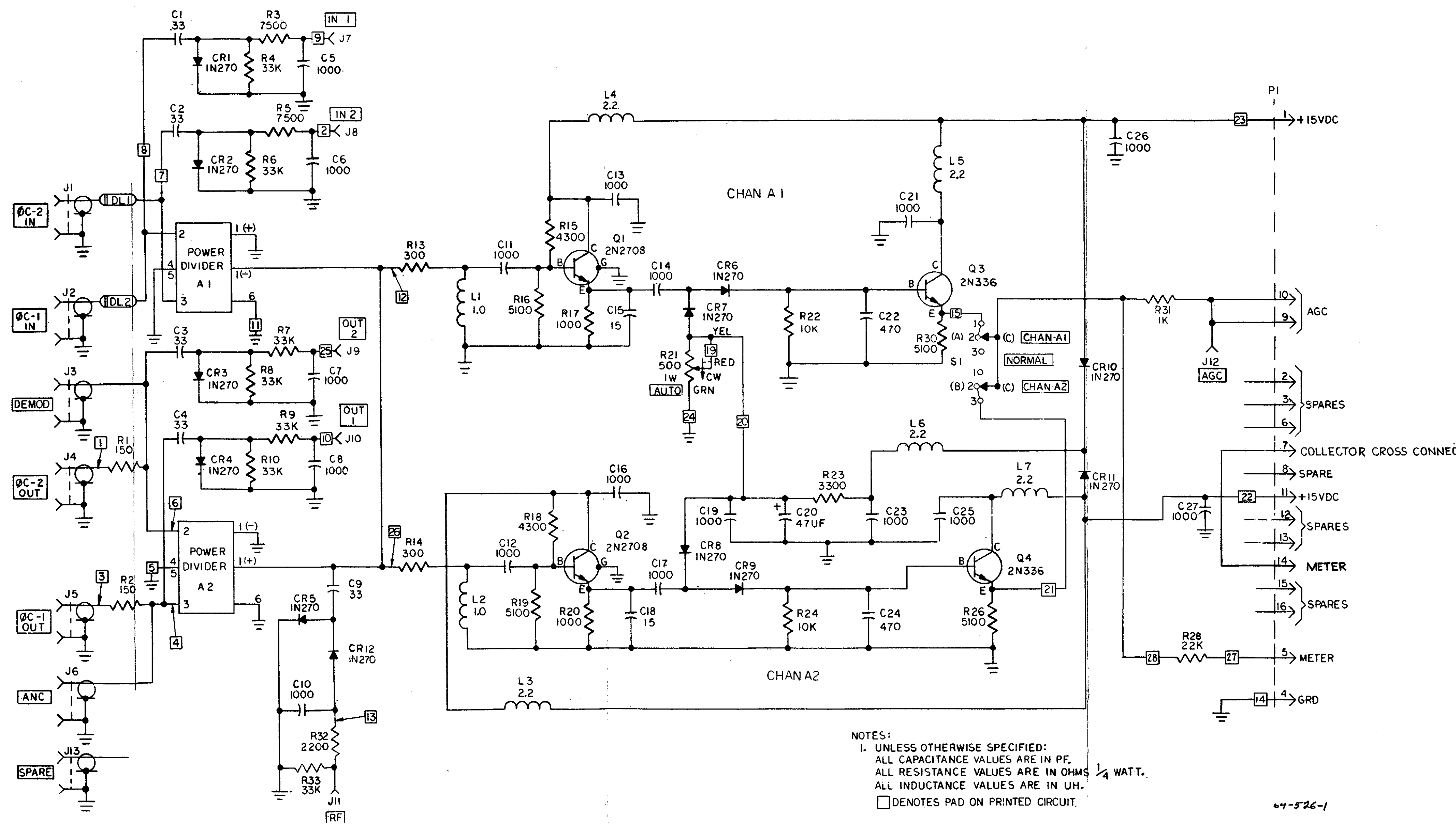


Figure 2. 70-Mc Redundant AGC Amplifier NUS 8317-1, Schematic Diagram

9.8-MC REDUNDANT AGC AMPLIFIER
NUS 8318-1

DESCRIPTION

The 9.8-mc redundant age amplifier is associated with a dual diversity receiver. It provides a gain-control voltage determined by the level of the combined if input signal. All parts of the redundant age amplifier are mounted on a module chassis which is secured in a drawer by captive screws. Power requirements and input and output characteristics are as follows:

Input power	+5 volts dc (two supplies)
-5 volts dc (two supplies)	
If input signal frequency	9.8 mc
I input signal level	0.65 volt rms
Gain-control output signal	0.60 volt dc

The 9.8-mc redundant age amplifier consists of two independent age amplifiers with common input, common age delay control and common output. Each amplifier is powered from separate power supplies. Monitoring points are provided.

The failure of any portion of either age amplifier or the loss of any of the power sources will not affect the operation of the remaining portion of the module.

CIRCUIT DESCRIPTION (Figures 1 and 2)

Automatic Gain Control Circuits. The module contains two identical age circuits fed from a common tie point at the input jacks. One circuit, CHAN A1, contains isolation amplifier Q1, diodes CR2 and CR3 and emitter follower Q2. The other circuit, CHAN A2, contains isolation amplifier QS3, diodes CR4 and CR5 and emitter follower Q4. The circuit description will cover CHAN Al (identical to A2). The if signal from jacks J1 and J2 is common at a tie point in the module. The signal is coupled to the base of transistor Q1. The output of Q1 is rectified by diodes CR2 and CR3. The resulting dc voltage is fed to the base of emitter follower Q2. An adjustable age delay potential is developed by the voltage divider R12, R10 and potentiometer R9. The delay potential present at the junction of R9 and R1 is fed through diodes CR2 and CR3 to the base of Q2. This voltage also keeps the diodes forward biased so that they continue to conduct at low signal levels. C7 removes the rf from the dc bias signal. R11I, CR6 and CR8 are protective devices in case of power supply shorts. The signal at the output of Q2 emitter is fed to switch S1 and then through R14 to pins 9 and 10 of P1.

Common Circuits. Since the age amplifier is redundant, input, monitoring, control and output circuits are common to both channels. The inputs are common at the tie points of J1, J2, J3 and J4 on the module. The monitoring point for the input if signal is at RF (J7), which is a dc voltage developed across rectifier CR1 and filtered by R7 and C6. The monitoring point for the age control dc voltage is at AGC (J8). The age delay potential developed across R9 and R10 feeds not only CR2 and CR3 in CHAN A1 but also feeds CR4 and CR5 in CHAN A2. In order to provide redundancy in case of a +5 volt power supply failure, one +5 supply is fed to CR6 in CHAN A1 and the other is fed to CR7 in CHAN A2. The two diodes are common at R12 which feeds the bias divider, thereby providing bias control at all times. The output circuits are common at R14 and J8 after going through the contacts of S1.

NUS 8318-1

Redundancy Check. Switch S1 provides a means for testing the amplifier operation. Under normal conditions, CHAN A1 and CHAN A2 are in parallel operation and a single failure in either amplifier or loss of any of the dc supply voltages will not affect the age output control voltage. Periodic checks require that the operation f each of the channels be tested separately. This is accomplished by switching S1 to CHAN A2 for checking the operation of CHAN A1 and switching to CHAN A1 for checking the operation of CHAN A2. The switch should be in NORMAL pos ion after checking each amplifier individually.

LOW VOLTAGE POWER SUPPLY
NUS 8797G1 through G5

DESCRIPTION

The low voltage power supply is the source of the +5 volt, +15 volt and -30 volt dc power used by the dual diversity receiver and the +15 volt and -30 volt dc power used by the transmitter. The output voltage of each power supply is selected by the connection made to the input transformer taps and output resistor taps. The power supplies are equipped with connectors which mate with receptacles inside the transmitter power distribution panel or the receiver power supply drawer. Pertinent characteristics of the low voltage power supplies are as follows:

Input	110 to 130 vac 47 to 63 cps
Output Voltage	+5 vdc, +15 vdc or -30 vdc (depending upon setup connections)
Output Current	1 amp
Ripple Voltage	1 mv rms max
Regulation	.05 percent max for line or load variation

CIRCUIT DESCRIPTION (Figure 1)

Primary power, 120 volts ac, is applied to the primary of transformer T1 through the 1. 5 amp fuse. Transformer T1 contains two secondary windings; a full wave bridge across one winding and three full wave rectifier across the other.

The three full wave bridge circuits CR1 and CR2, CR3 and CR6 and CR4 and CR5 provide operating voltages for the NPN transistor regulating circuits. The full wave bridge is connected to the tapped secondary according to the voltage required at its output terminals. The filtered dc output across capacitors C5 and C10 is applied to the collector of transistor Q3 which conducts feeding the voltage to the output terminals.

Regulation occurs when a change in current and voltage occurs at the output terminals of TB1. H a rise in voltage occurs due to a change in load the positive swing will be felt on the base of transistor Q6. Conduction of transistor Q6 will increase making the emitter junction of Q5 and Q6 more positive. With the emitter of Q5 more positive the transistor conducts less causing the collector voltage to rise. This positive change is also on the base of transistor Q1 which is tied directly to this point. Transistor Q1 conducts causing the base of transistor Q2 to become more negative which reduces its conduction allowing the base of transistor Q3 to become more negative. With the base of Q3 reducing the current flow in the transistor its impedance rises lowering the output voltage to the level set by potentiometer R19. Transistor Q6 also senses for a negative change in the output voltage which will create the opposite reaction on the regulating circuit. A negative change in the voltage will cause transistor Q3 to conduct more reducing its series impedance to the load. Overload sensing transistor Q4 is normally cut off by the bias set up by resistors R13, R14, and R15. When an overload occurs the Voltage drop across load sensing resistor R12 causes Q4 to conduct, lowers the voltage at the base of Q2 and increases the drop across the pass transistor Q3 to limit the load current.

150/165 - VDC POWER SUPPLY
NUS 8798

DESCRIPTION

The 150/165-vdc power supply is a transistorized, voltage regulated dc power source that provides two outputs of 150 and 165 volts dc. A 6. S3 volts ac output is also provided for vacuum tube heaters. The 150 volt supply provides the base for which the 165 volt output is built on and as a result any failure in the 150 volt power supply will effect the 165 volt output. The power supply is employed in any section of the system which contains vacuum tube modules. The pertinent characteristics of the power supply are as follows:

Input	110 to 130 volts ac 47 to 63 cps
output	150 volts dc at 700 ma.
	165 volts dc at 300 ma.
	6. 3 volts ac at 20 amps (unregulated)
DC voltage Regulation	0.1% at 150 Vdc and 0.3% at 165 Vdc for load or line variations within the operating range.
Ripple Voltage	5 mv RMS max at 150 Vdc
	30 mv RM max at 165 Vdc

CIRCUIT DESCRIPTION (Figure 1)

150 Volt Power Supply. Primary power, 115 Volts ac is applied to the primary of transformer T1 through switch S1 and the 4 amp slow blow fuse. The bridge circuit, CR8 through CRll1, filter capacitor C5 and resistor R21 complete the unregulated power supply section. The voltage is applied to the regulator circuit by the 3.3 ohm current limiting resistors and 1 amp slow blow fuse. Input series regulator Q7 functions when the output circuit is shorted or overloaded. R is normally biased on by Q8 which obtains its bias from the R18, R47 voltage divider and bias supply CR12 and C6. When an overload occurs the voltage across Q9 and Q10 increases. When the voltage increases to approximately 75 volts, the current through R47 cuts off Q8 cutting off Q? so that the supply voltage is shared by Q? and Q9 and Q10. The output voltage from the input series regulator is applied to the collectors of Q9 and Q10. The outputs of transistors Q9 + Q10 are applied to the 150 volt output terminal and also to the base of overload sensing transistor Q13. Load sensing transistors Q14 and Q15 detect changes in the output voltage. The voltage on the collector on the collector of Q15 will vary depending upon the base voltage of transistors Q14 and Q15. This voltage is applied to the base of Q12 and controls its conduction which controls transistor Q11. The emiter of transistor Q11 is connected to the base of Q8 and Q10 and any change in its conduction will change the base voltage of these two transistors. A change in base voltage will change the conduction of this series regulator circuit, change its impedance and compensate for the change at the output terminal.

Overload sensing transistor Q13 is normally biased off by the R45, R25, R34 bias resistors. When an overload occurs the increased drop across the load sensing resistors R28, R28A, R29 and R29A causes Q13 to conduct. This turns off Q12 and the series regulators turn off to limit the load current.

NUS 8798

165 Volt Power Supply. The 165 volt power supply is a 15 volt power supply which is referenced through component connections to the 150 volt power supply. A small amount of primary power is coupled to the two remaining secondary windings o T1. Diodes CR1 and CR2 along with capacitor C2 and resistor R1 provide the small dc voltage needed to raise the output a TB1-9 to 165 volts. Rectifiers CR3 and CR4 with associated circuitry provide a source voltage transistors Q4, Q2, Q3 and Q6.

The operation the 15 volt supply is very similar to the 150 volt supply. Because the lower voltage and current rating, the extra series regulators and parallel pass transistor are not needed. The circuit description for the operation o the pass transistor Q1, regulating transistor Q2 and Q3, overload sensing transistor Q4 and sensing transistors Q5 and Q6 is the same for both supplies. CR-7 provides a low impedance path across the 15 volt supply to protect it from reverse overvoltage in the event of a short to ground in the 165 volt output.

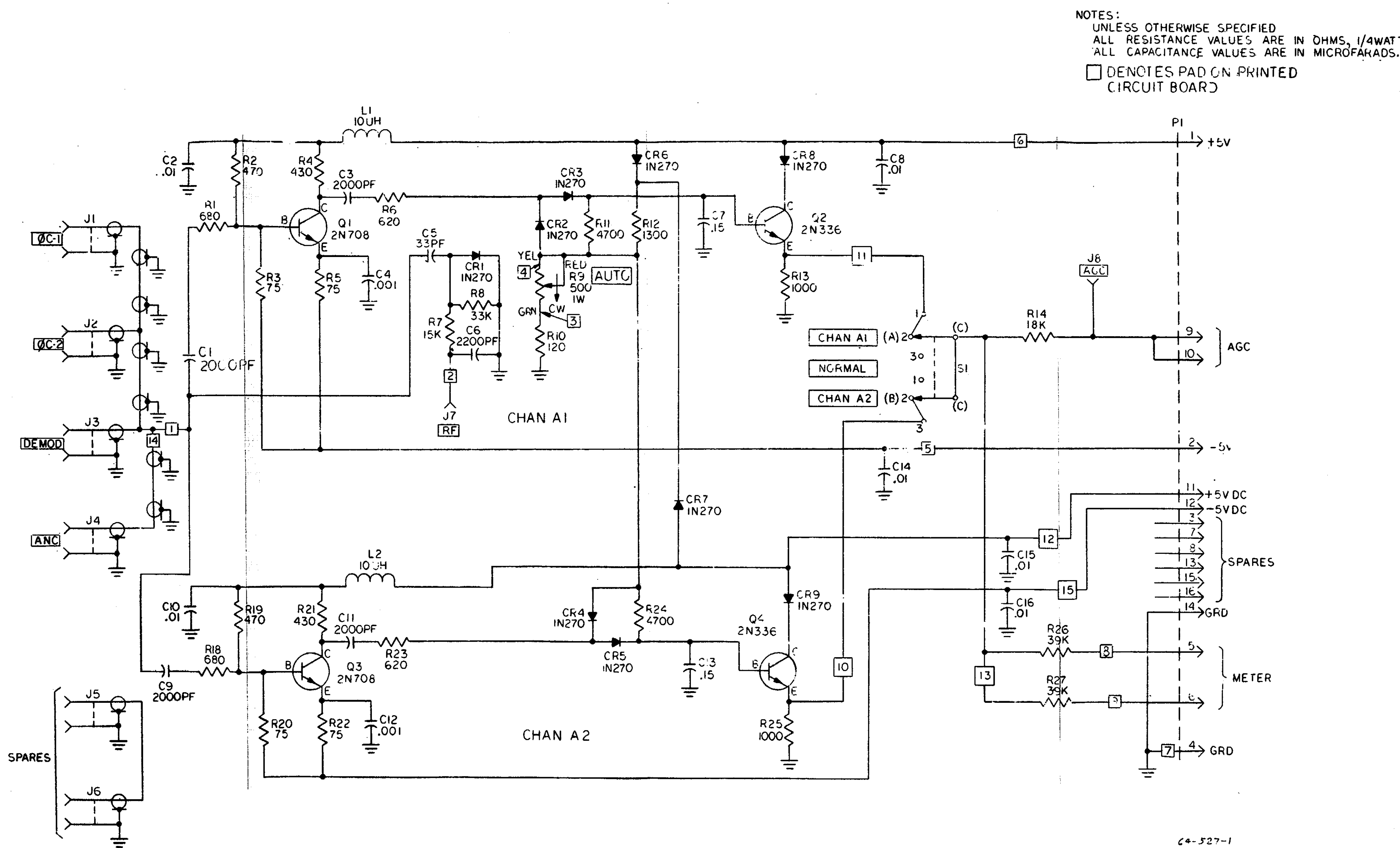


Figure 1. 9.8-Mc Redundant AGC AMPLIFIER NUS 8318-1, Schematic Diagram

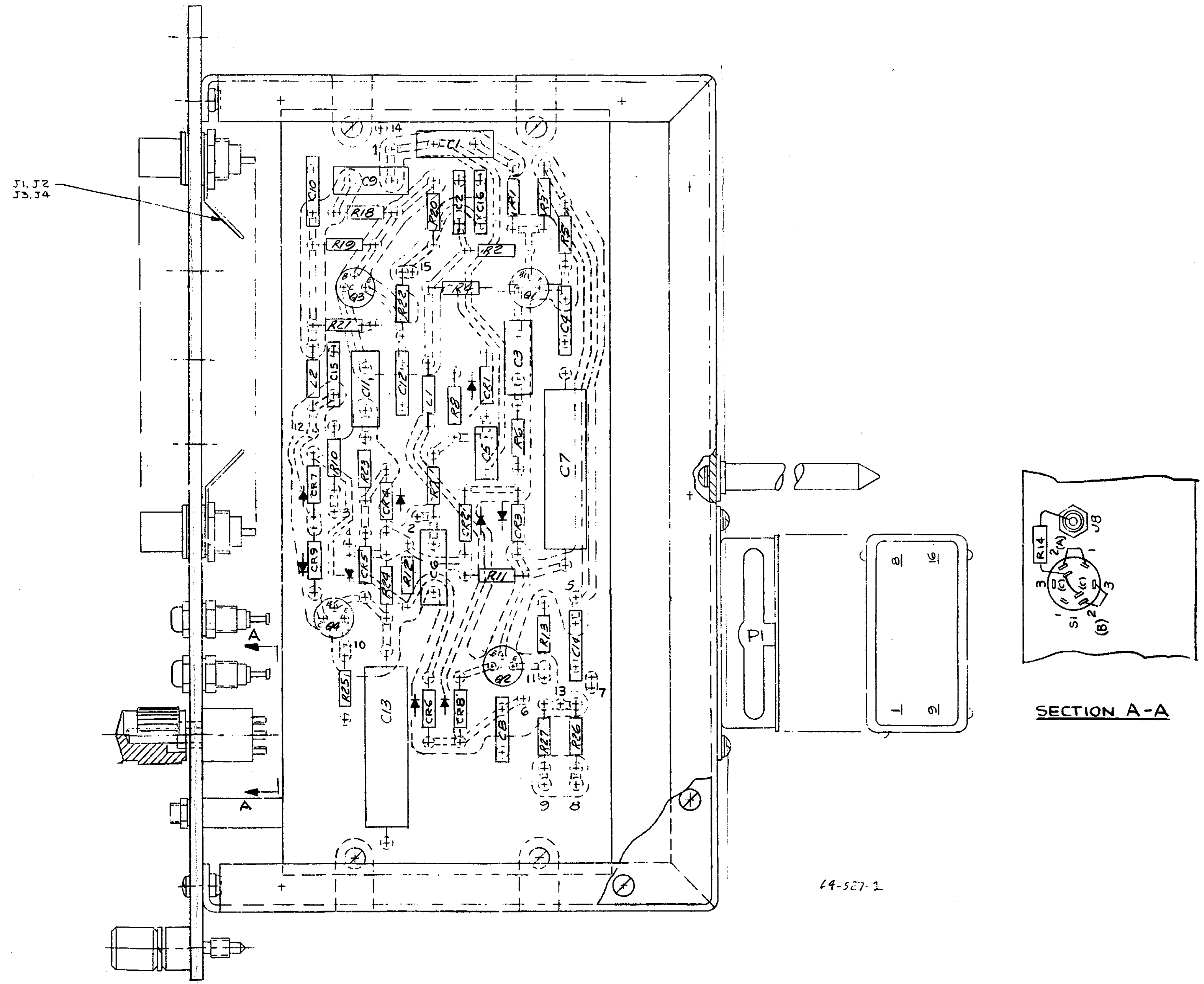
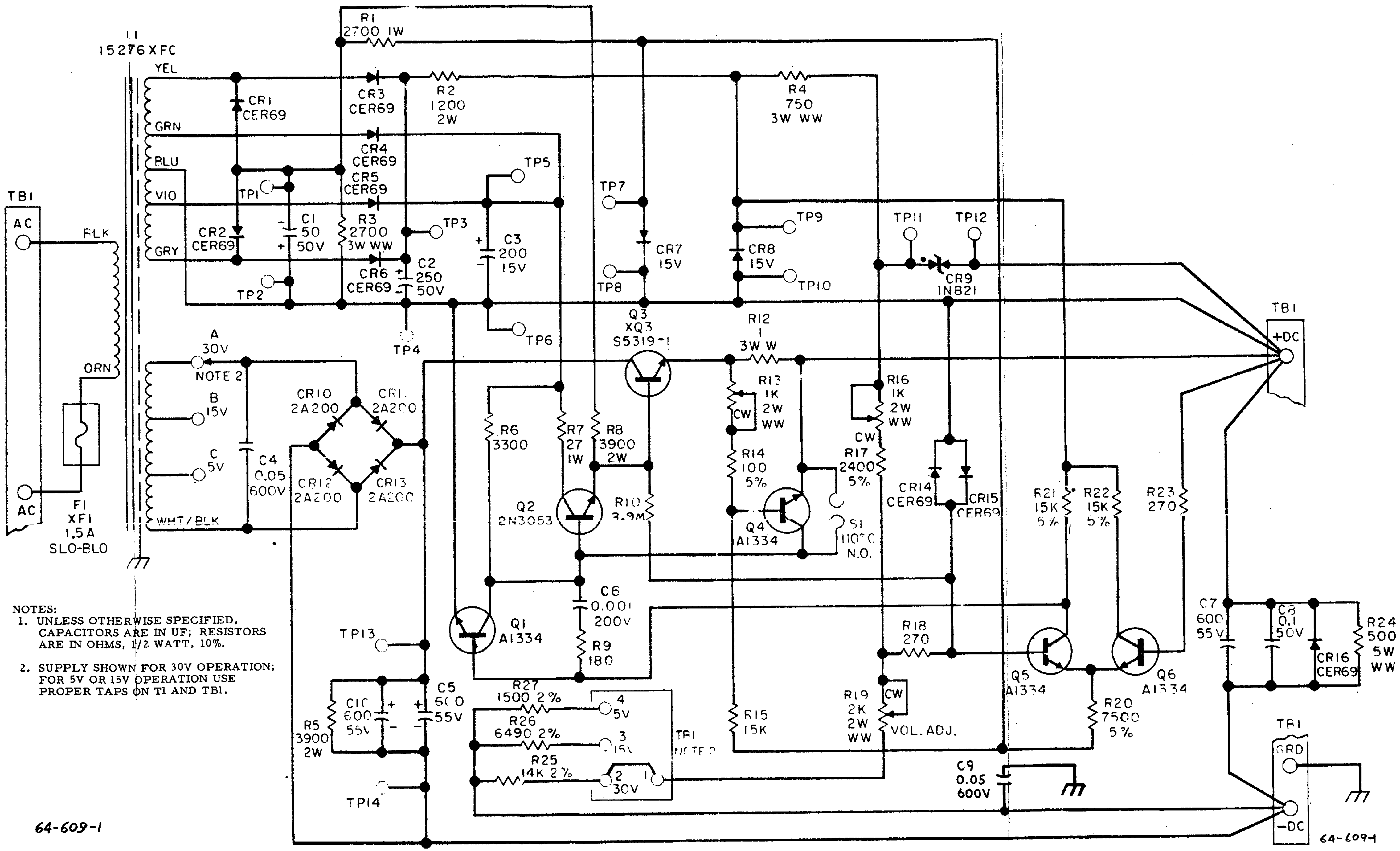


Figure 1. 9.8-Mc Redundant AGC AMPLIFIER NUS 8318-1 Parts Location



NOTES:
1. UNLESS OTHERWISE SPECIFIED, CAPACITORS ARE IN UF; RESISTORS ARE IN OHMS, 1/2 WATT, 10%.
2. SUPPLY SHOWN FOR 30V OPERATION; FOR 5V OR 15V OPERATION USE PROPER TAPS ON T1 AND TB1.

64-609-1

Figure 1. Low Voltage Power Supply NUS 8797G1 through G5, Schematic Diagram

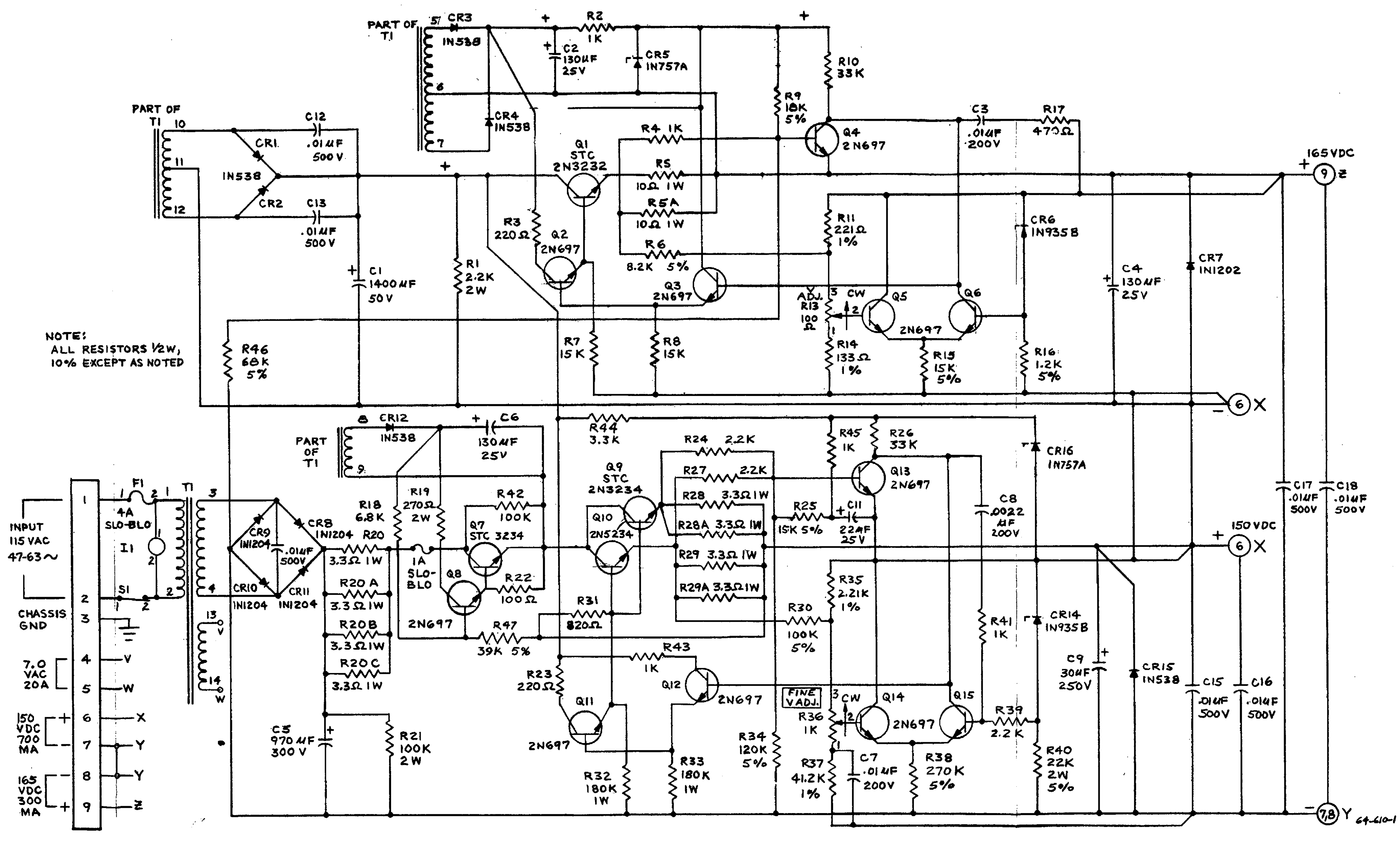
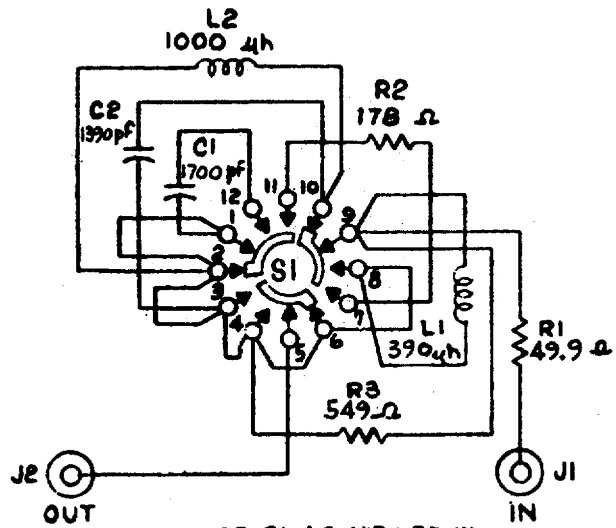
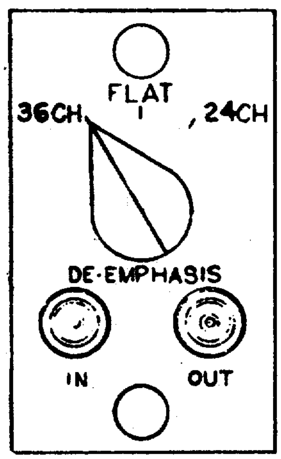
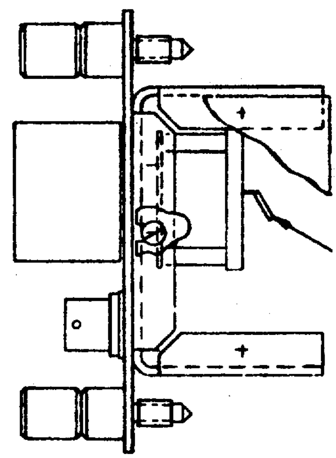


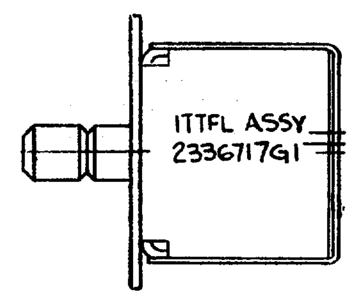
Figure 1. 150/165-VDC Power Supply NUS 8798, Schematic Diagram



WIRING OF S1 AS VIEWED IN FROM REAR(36 CH POSITION)







64-599-1

DE-EMPHASIS ASSEMBLY
C2336717, C2336719, C2336720, and C1260278

DESCRIPTION (Figures 1 through 3)

The de-emphasis assembly provides a frequency-shaping characteristic that attenuates the high-frequency components of the baseband signal in relation to the low-frequency components The de-emphasis assembly is associated with the receiver and is used in conjunction with a pre-emphasis assembly in the transmitter to provide a more uniform system signal-to-noise ratio over the entire frequency range of the baseband signal The assembly includes a three-position rotary switch that selects RLC components to produce the desired frequency-shaping characteristic. The source and load impedances of the de-emphasis assembly are 100 and 150 ohms, respectively. The types of de-emphasis assemblies and their channel capacities (width of baseband signal to be passed) are listed below:

De-Emphasis Assembly	Channel Capacity
C2336717	24/36
C2336719	48/60
C2336720	72/120
C1260278	180/240

CIRCUIT DESCRIPTION (Figures 1 through 8)

As the de-emphasis assemblies are similar, except for component values, only the 24/36 channel capacity assembly will be described.

With DE-EMPHASIS switch S1 set to 24 CH, the circuit shown in figure 5A is formed. The resonant frequency of the parallel resonant circuit formed by L1 and C1 is above the highest baseband frequency. Since the impedance of a parallel-resonant circuit is highest at resonance and decreases as the frequency moves away from resonance, the impedance of the network formed by C1, L1, and R3 is low at low baseband frequencies. Thus, the network attenuation at the low baseband frequency is low. As the baseband frequency Increases toward resonance the impedance of the network increases an thus, the network attenuation increases.

When DE-EMPHASIS switch S1 is set to FLAT, the circuit shown in figure 5B is formed. The attenuation of the voltage divider network is the flat loss across resistors R1 and R2. Since there are no reactive components in the divider, no de-emphasis takes place. The FLAT position is used only during testing and alignment of the system in which the assembly is used.

When Dg-EMPHASTS switch S1 is set to 36 CH, the circuit shown in figure 5 C is formed. The operation of this circuit is the same as that described above with DE-EMPHASIS switch S1 set to 24 CH, except that the bandwidth is greater in the 36 CH position because the capacitance and inductance values are smaller. This is required for the greater number of channels.

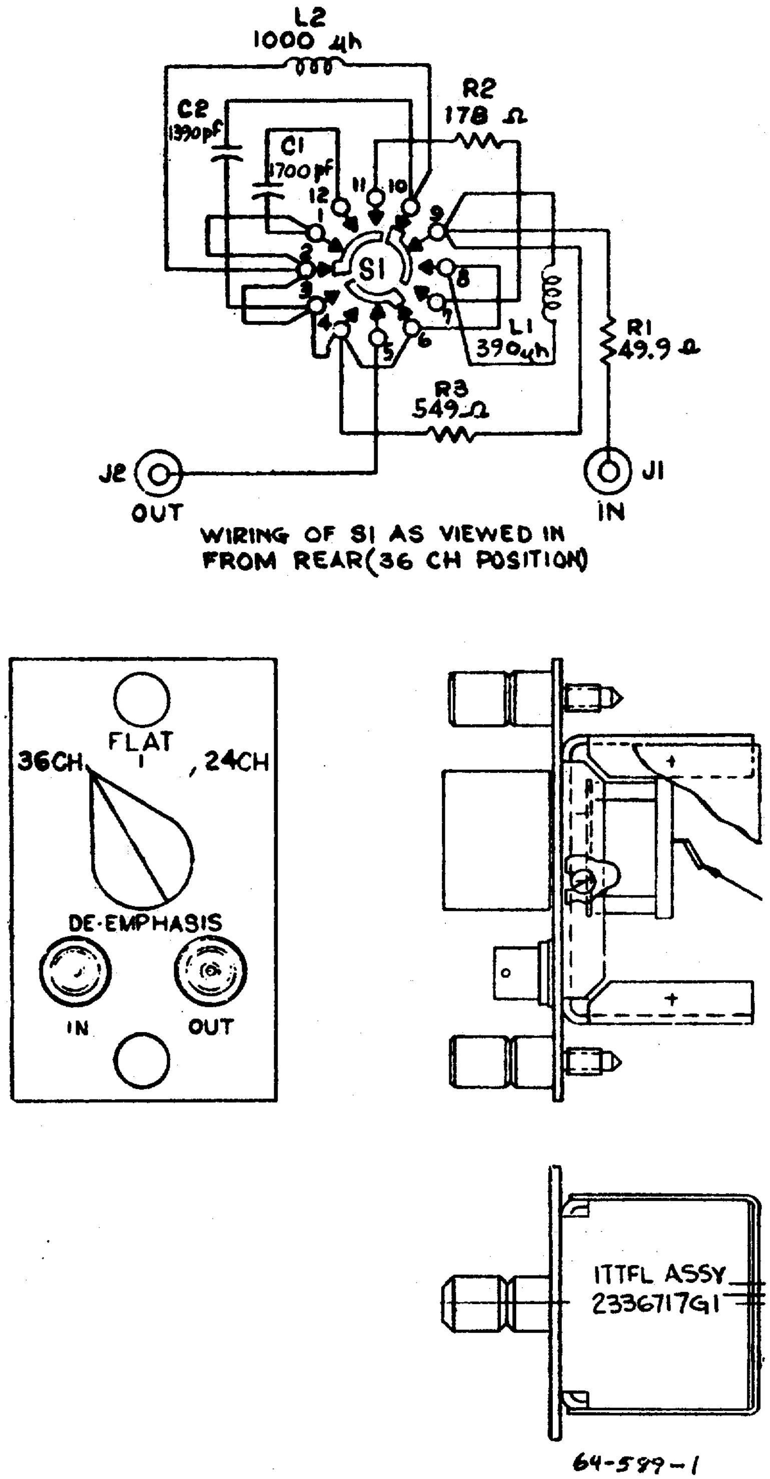


Figure 1. De-Emphasis Assembly C2336717, Parts Location

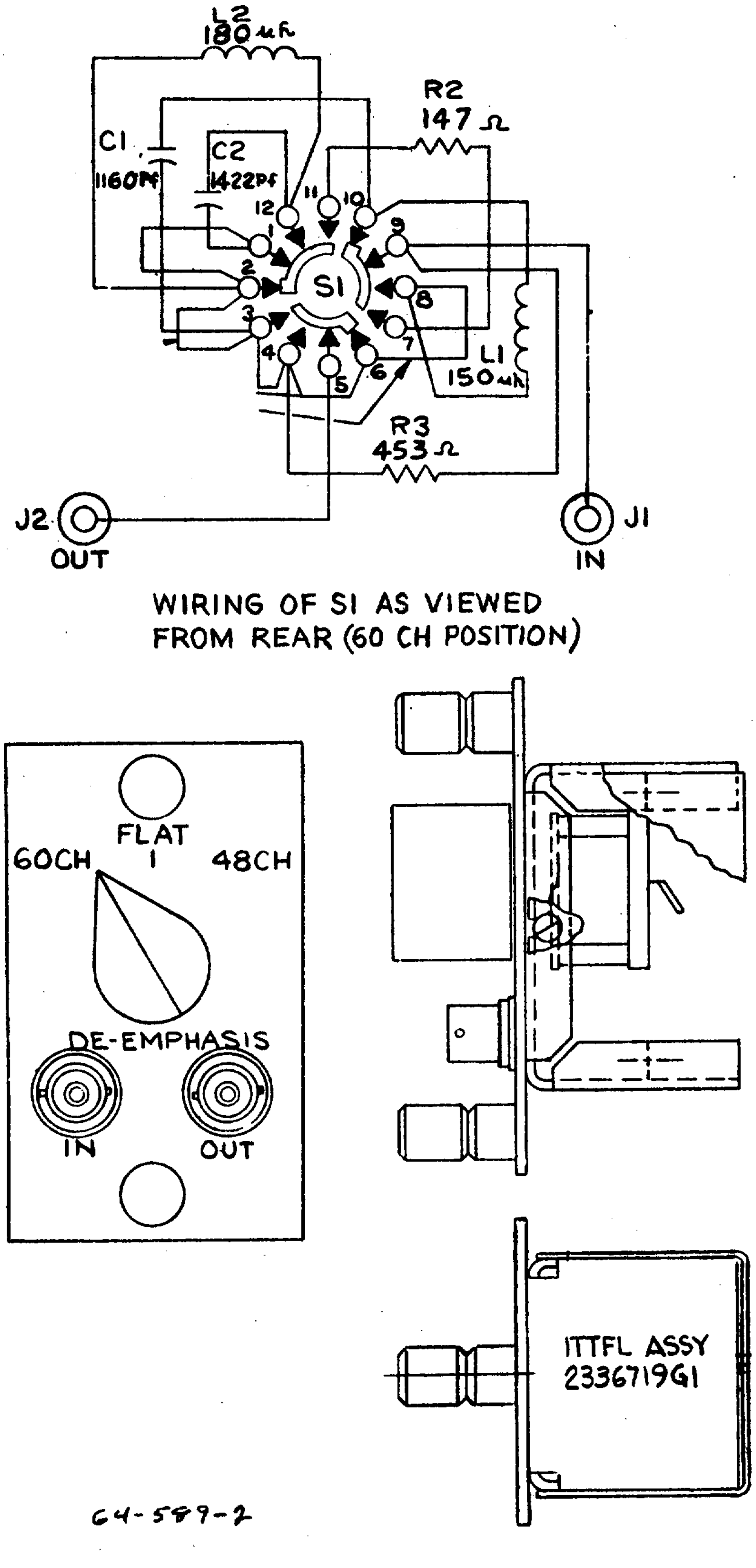


Figure 2. De-Emphasis Assembly C2336719, Parts Location

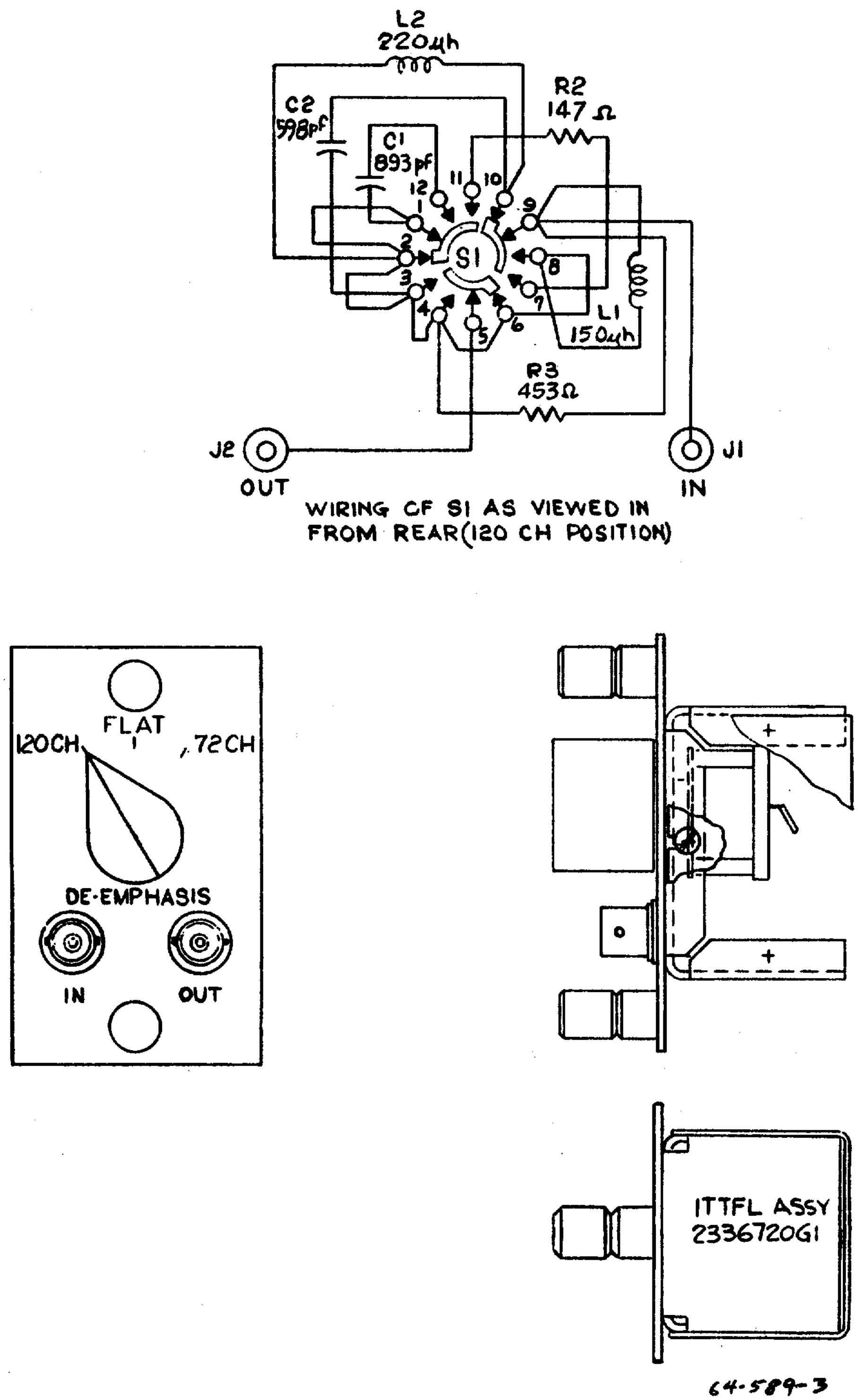


Figure 3. De-Emphasis Assembly C2336720, Parts Location

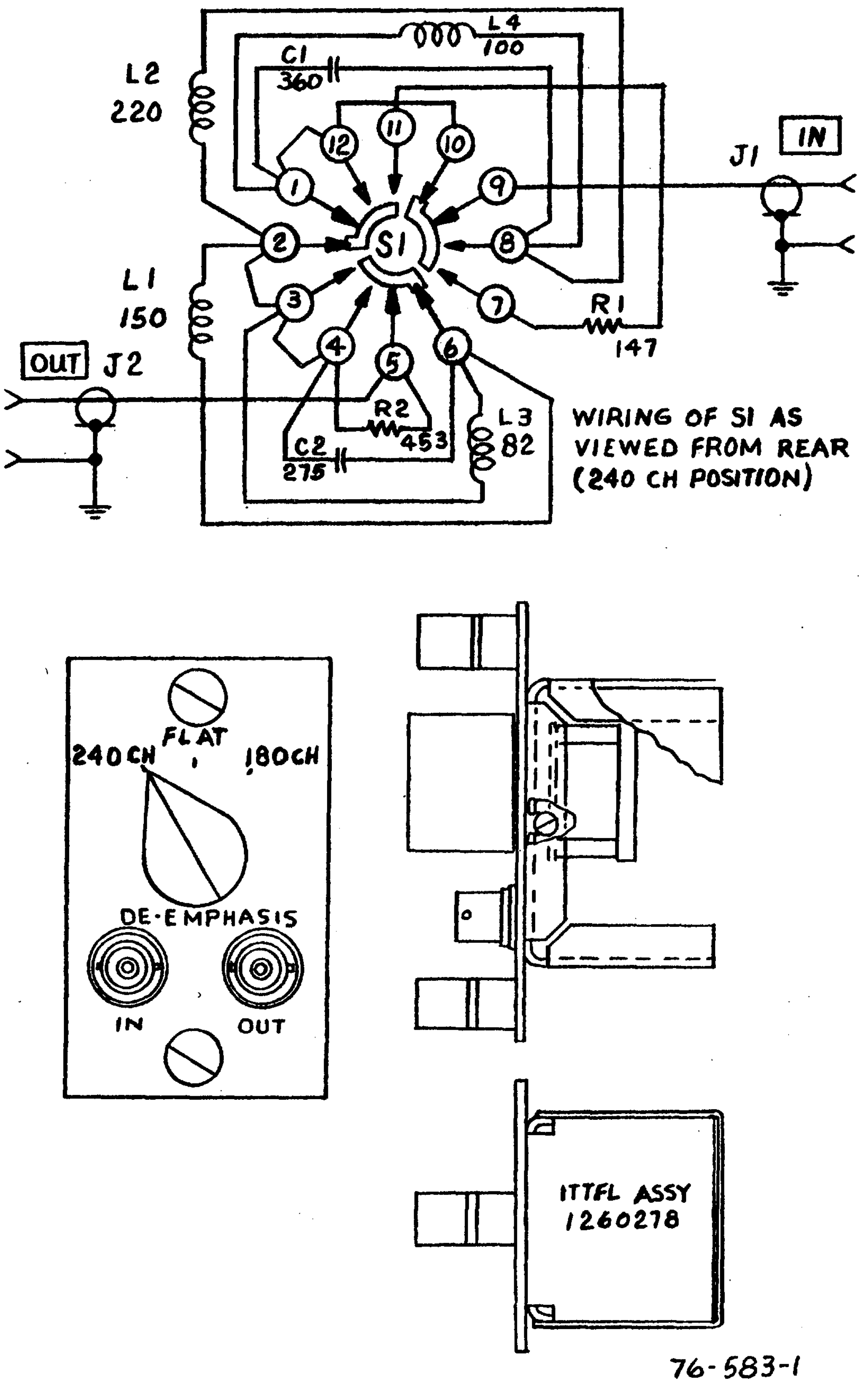


Figure 4. De-Emphasis Assembly C1260278, Parts Location

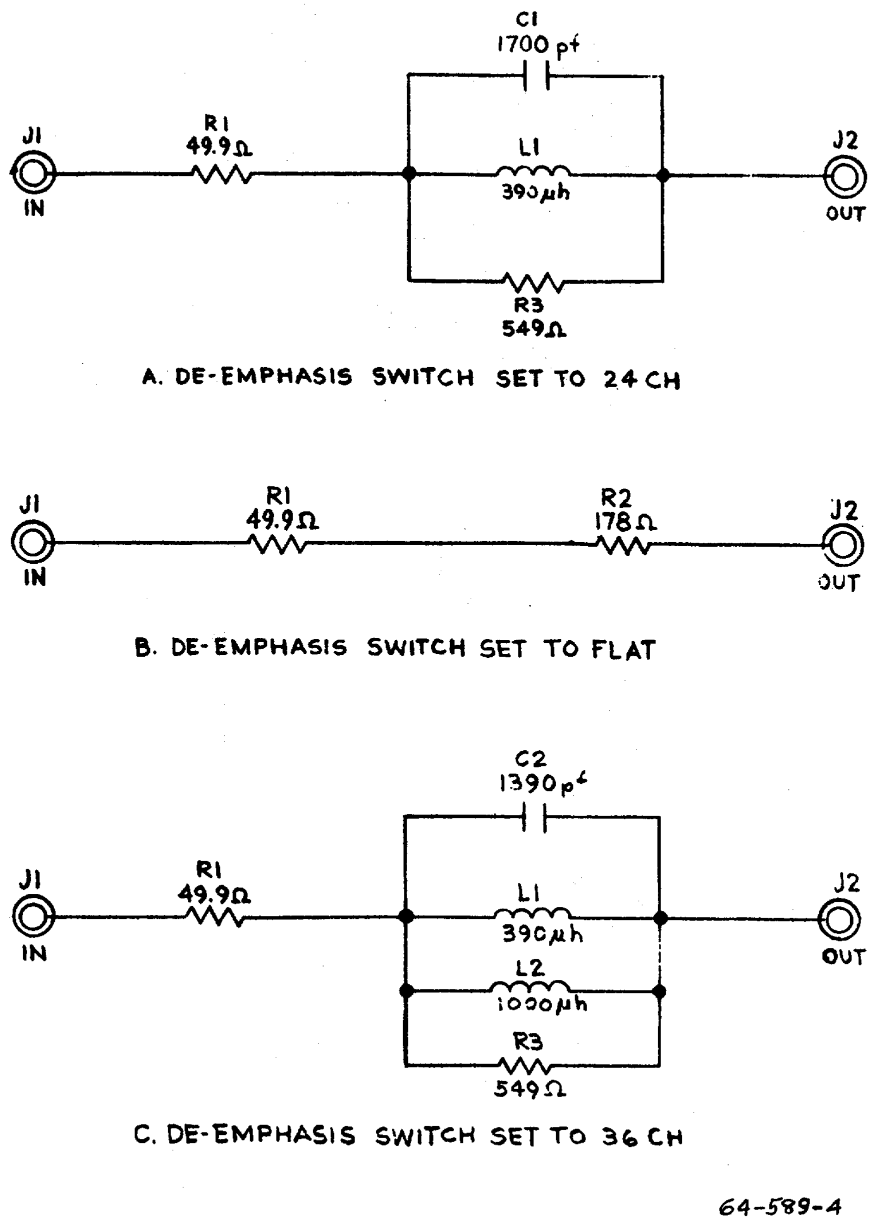


Figure 5. De-Emphasis Assembly C2336717, Simplified Schematic Diagram

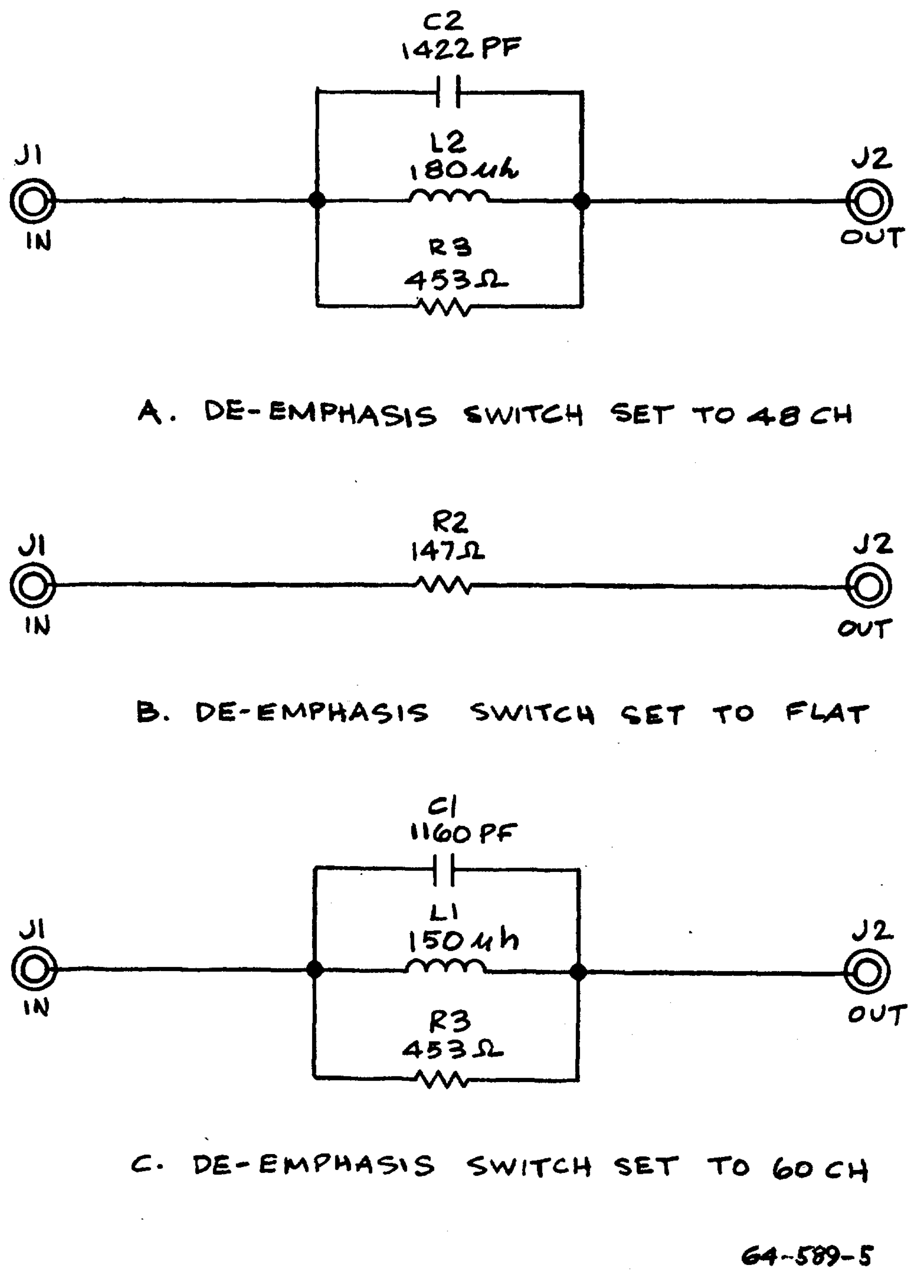


Figure 6. De-Emphasis Assembly C2336719, Simplified Schematic Diagram

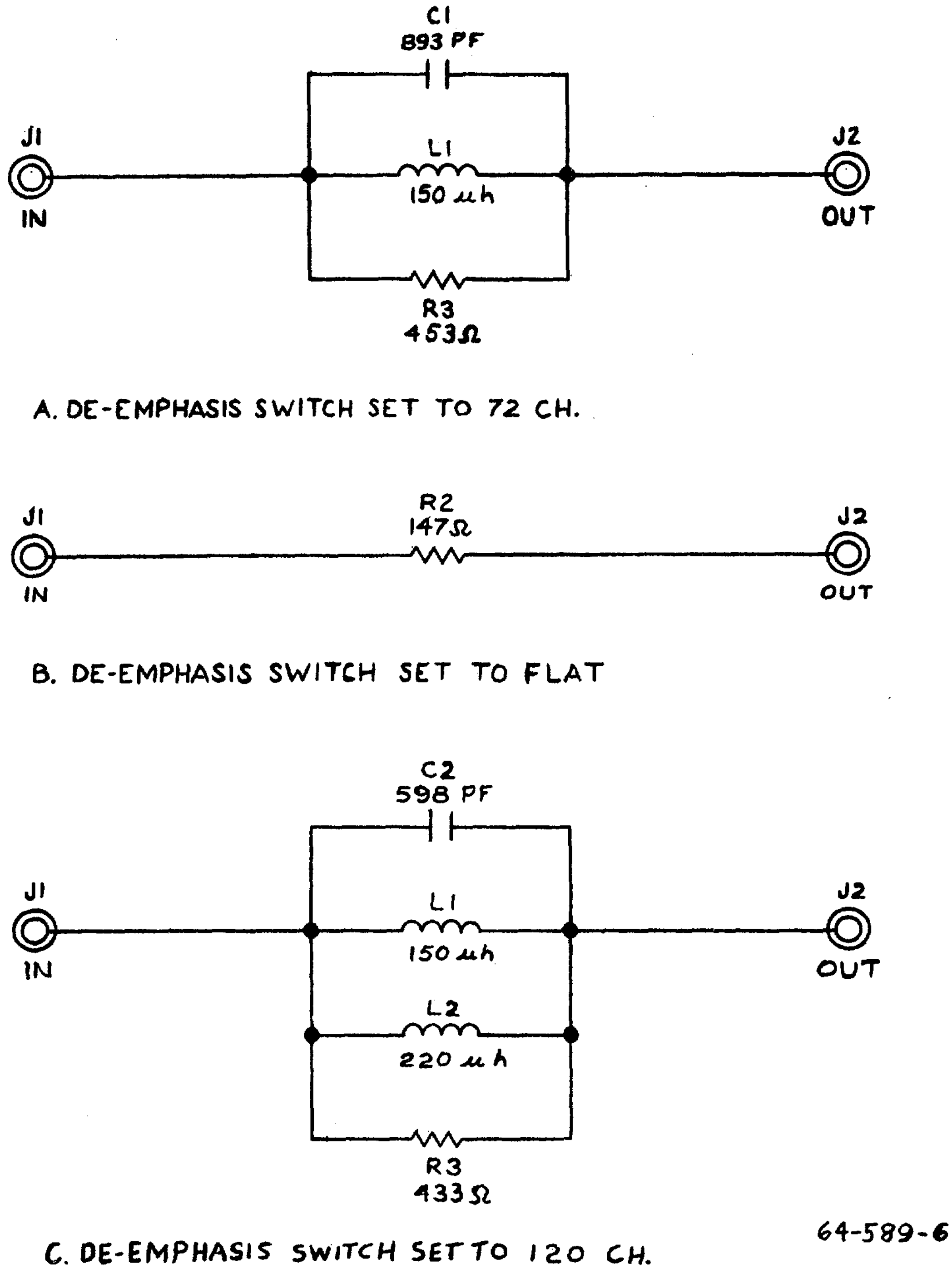


Figure 7. De-Emphasis Assembly C2336720, Simplified Schematic Diagram

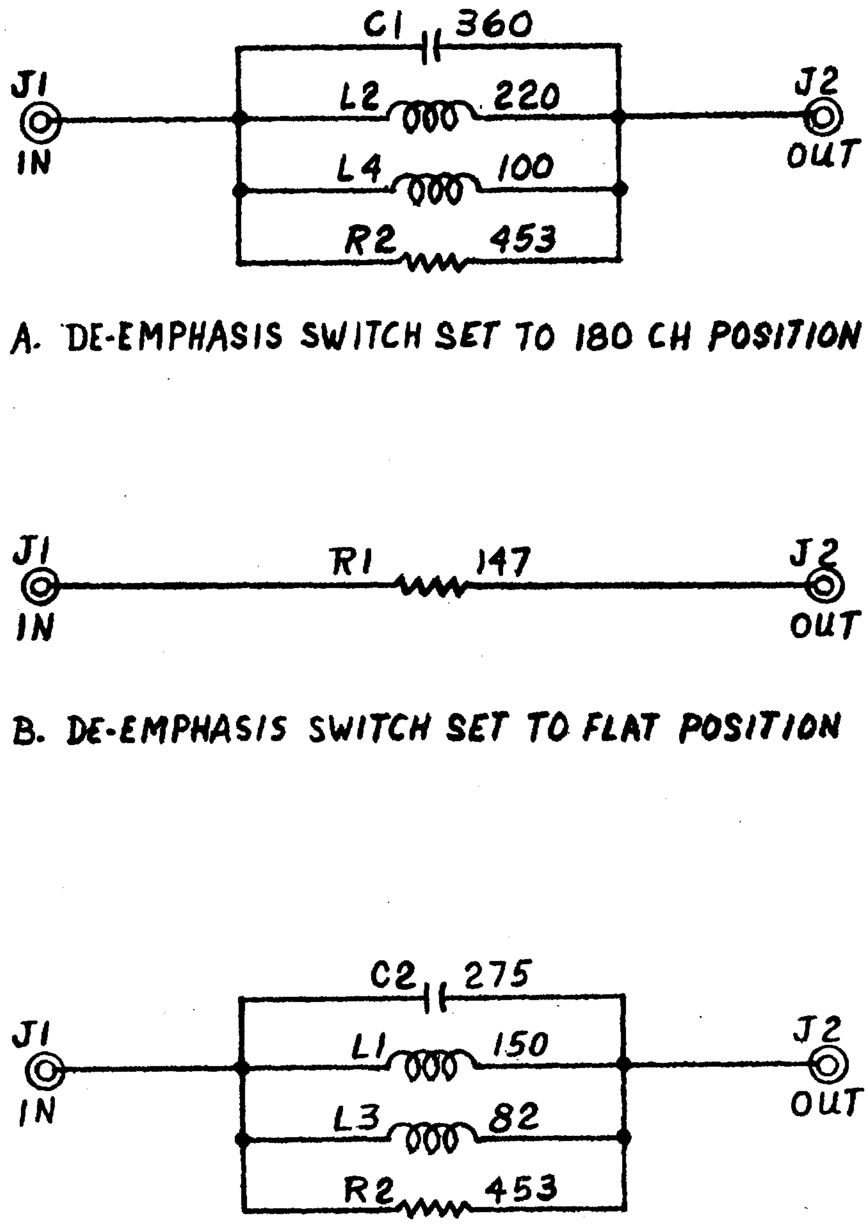


Figure 8. De-Emphasis Assembly C1260278, Simplified Schematic Diagram

4.4-MC BANDPASS FILTER
D2338037

DESCREPTION (Figures 1 and 2)

The 4.4-mc bandpass filter controls the if. bandwidth of the single conversion receiver in which is installed. The filter has an insertion loss of 7.4 db and an impedance of 75 ohms.

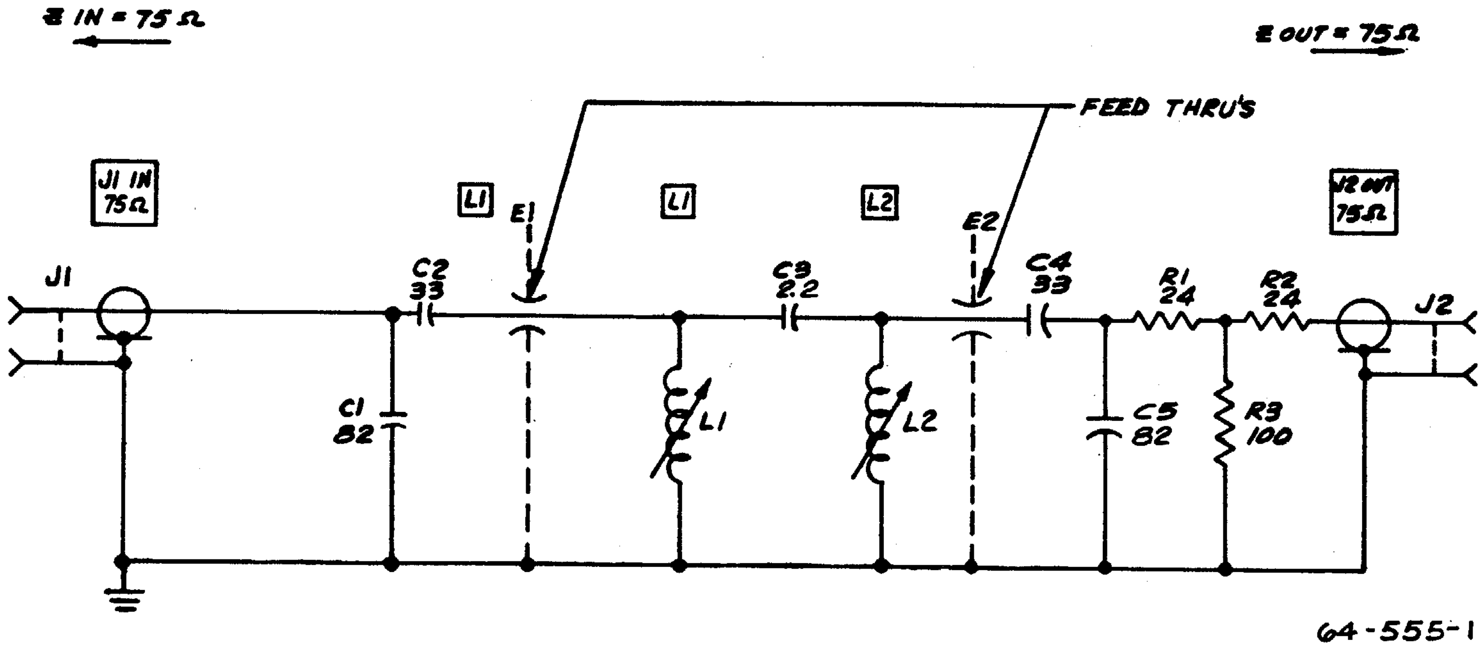


Figure 1. 4.4-Mc Bandpass Filter D2338037, Schematic Diagram

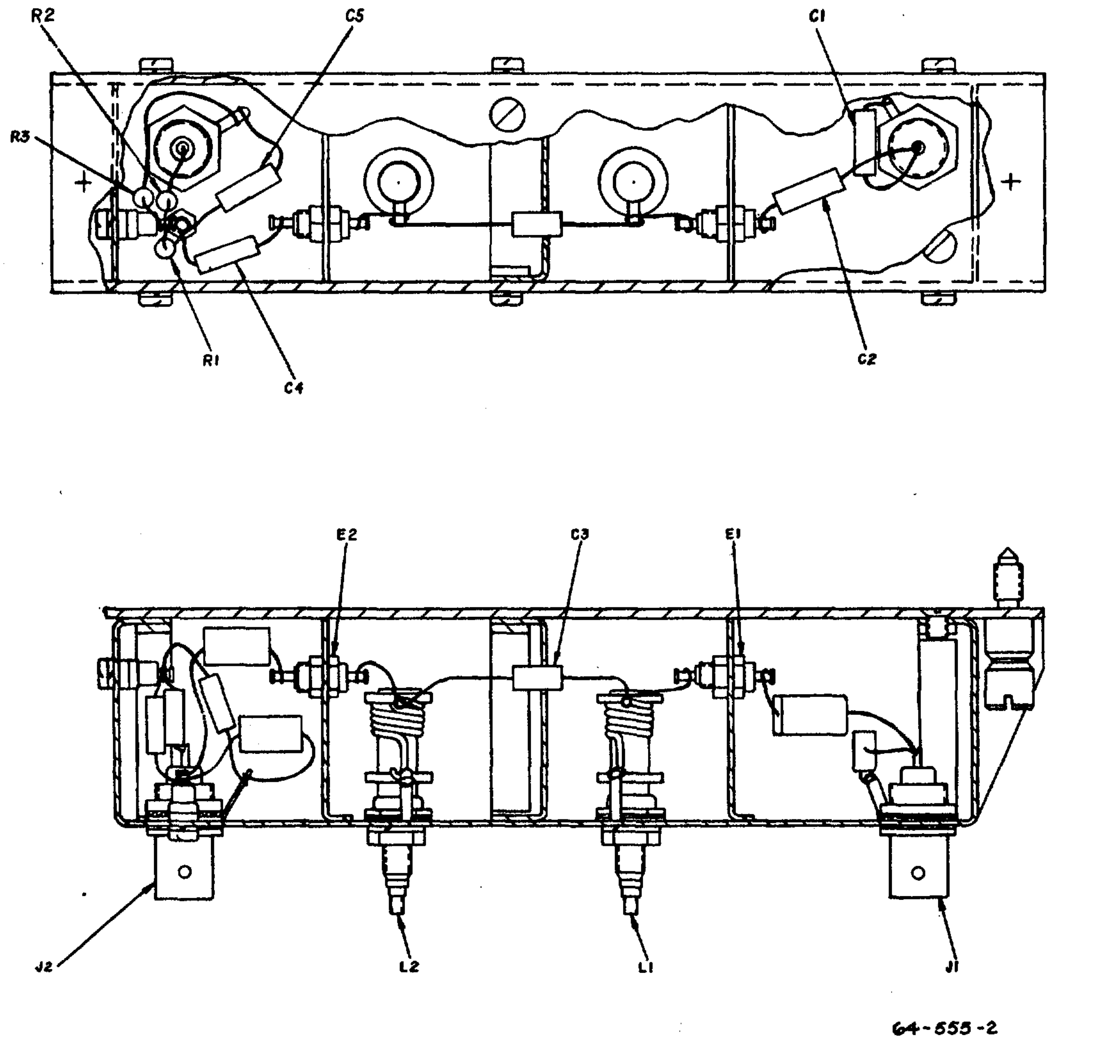


Figure 22. 4. 4- Mc Bandpass Filter D2338037, Parts Location

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USAICS (3)
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USARMIS (1)
Instl (2) except
Fort Gillem (10)
Fort Gordon (10)
Fort Huachuca (10)
Fort Carson (5)
Ft Richardson(ECOM) (2)
LBAD (14)
SAAD (30)
TOAD (14)
SHAD (3)
Sig FLDMS (1)
USAERDAA (1)
USAERDAW (1)

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 310-50.

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