IM 11-5895-724-15

INSTRUCTION MANUAL

FOR

NACOM II COMMUNICATION FACILITY

MAYNARD, MASSACHUSSETTS

U. S. ARMY ELECTRONICS COMMAND

MAINTENANCE ENGINEERING DIRECTORATE

FORT MONMOUTH, NEW JERSEY

MAY 1971

This publication is NOT available through AG publications channels

*IM 11-5895-724-15

TECHNICAL MANUAL) U. S. ARMY ELECTRONICS COMMAND

) DEPARTMENT OF THE ARMY

NO. 11-5895-724-15) FORT MONMOUTH, NEW JERSEY 07703, 1971

STATION INSTRUCTION MANUAL FOR NACOM II COMMUNICATION FACILITY

LIST OF ILLUSTRATIONS

WARNING

HIGH VOLTAGE

High radio-frequency (RF) voltages exist at the output connections of the radio transmitters and at the connections to the RF dummy loads and RF switching matrix. Turn off transmitter high-voltage supplies when working at these points. Observe extreme caution when working in these areas.

Operator and maintenance personnel should be familiar with the requirements of TB SIG 291 before attempting installation or operation of the equipment covered in this manual. Failure to follow requirements of TB SIG 291 could result in injury or DEATH.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

This manual provides instructions for the operation and maintenance of the National Communications (NACOM) II facility located at Maynard, Massachussetts. This facility is an HF (high-frequency) radio transmitting and receiving station. The manual presents a description of the technical characteristics of the station. It gives a functional description of the station equipment and a detailed discussion of the equipment application in the system. Preliminary operating procedures to prepare the equipment for operation are included as well as procedures for actual operations. The manual sets forth specific preventive maintenance routines along with procedures for the operator to follow in performing the maintenance. For corrective maintenance, troubleshooting procedures are included to enable the operator to trace failures down to the functional units.

1-2. Index of Publications

Refer to the latest issue of DA PAM 310-4 to determine whether there are new editions, changes, or additional publications pertaining to the equipment. Department of the Army Pamphlet No. 310-4 is an index of current technical manuals, technical bulletins, supply manuals (types 4, 6, 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the individual parts (-10, -20, -35P, et) and the latest changes to and revisions of each equipment publications.

1-3. Forms and Records

a. Reports of maintenance and unsatisfactory equipment. Use equipment forms and records in accordance with instructions in TM 38-750.

b. Report of damaged or improper shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700-58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71-4 (Air Force).

c. Reporting of station manual improvements. The direct reporting of errors, omissions, and recommendations for improving this station manual by the individual user, is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed using pencil, pen, or typewriter. DA Form 2028 will be completed by the individaul using the manual and forwarded direct to Headquarters, United States Army Electronics Command, AMSEL-ME-NMP-CT, Fort Monmouth, New Jersey 07703.

Section II. DESCRIPTION AND DATA

1-4. Purpose and Use

The purpose of the NACOM II facility is to provide long-distance voice and teletype communications. The facility contains HF radio communications equipment and all the ancillary equipment needed to constitute a complete operating station. The equipment is so arranged that it can be operated from a central location in the station.

1-5. Technical Characteristics

The facility is divided into two rooms. One houses high-power HF transmitting equipment and the associated receiving equipment. The other room contains other HF radio equipment, voice and teletype terminal equipment and the Communications Control Console. The equipment layout in the two rooms is shown in Figure 1.

The high-power HF transmitting equipment is the AN/URT-37(V)1. This is a dual, 10-kW transmitter which operates in the 2- to 30-MHz frequency band. Because of the antenna/transmission line matching devices used at this station, the equipment is limited to 5 kW average power output. Each section of the dual exciter part of the transmitter provides four ISB (independent sideband) voice channels by FDM (frequency-division multiplexing). Thus, the high-power transmitting equipment has a total capacity of eight voice channels.

The receiving equipment associated with the high-power transmitting equipment is the AN/FRR-85(V)1. Each receiving set is a dual receiver to provide for diversity reception. The receivers can operate in the following modes:

SSB (single sideband)

2- and 4-channel ISB

CW (continuous wave)

MCW (modulated continuous wave)

AM (amplitude modulation)

FSK* (frequency-shift keyed telegraph)

FAX* (facsimile)

DATA*

*with appropriate terminal equipment.

The three radio receiving sets included in the facility provide a maximum capacity of 12 dual-diversity voice channels.

Both Radio Transmitter AN/URT-37(V)1 and Radio Receiving Set AN/FRR-85(V)1 are equipped for remote operation, which in this facility is performed at the Communications Control Console.

The other HF radio equipment consists of two KWT-6 Transceivers. These are manually controlled transmitter-receiver sets. They operate in the 2- to 30-MHz band. The transmitter output is 500 W PEP (peak envelope power). The mode of operation can be SSB, AM, CW or FSK. The two sets provide a total of two transmit and receive voice channels.

A VLF (very low frequency) Receiver/Comparator, Type 207-4, combined with a Distribution Amplifier, Type 203A, receives and distributes the National Bureau of Standards frequency standard (broadcast by station WWVB) to the HF radio equipment for use by the frequency synthesizers.

In addition to the HF radio equipment, there are four R-390/URR general purpose radio receivers. These are connected into the system only on the audio side. They are not connected to antennas.

RF Switching Matrix AN/URA-65(V)1 enables the operator to change antenna assignments among Radio Transmitter AN/URT-37(V)1, Radio Receiving Sets AN/FRR-85(V)1 and Transceivers KWT-6 Type 8. Remote Control Group AN/URA-63 permits operation of Radio Transmitter AN/URT-37(V)1 and Radio Receiving Sets AN/FRR-85(V)1 from the Communications Control Console.

Receiver Filter System SYM-4200 protects the Radio Receiving Sets AN/FRR-85(V)1 from overloading by transmissions from collocated antennas and reduces interference effects from local transmitters. It is equipped for remote control from the Communications Control Console.

Voice conditioning equipment is available at a patch panel for application to the system as required to provide proper audio frequency power levels, to convert between two-wire and four-wire telephone circuits, and to enable the setting up of four-way voice conferences. Voice-frequency telegraph (VFTG) equipment enables up to 16 teletype channels to be transmitted over a single voice channel, and to be received in dual diversity over two other voice channels from separate receivers. A VFTG interface unit provides the proper levels for interconnecting the VFTG equipment and the teletypewriters.

Some of the equipment contained in this system is covered by instruction manuals utilizing the commercial equipment nomenclature. This station manual uses military nomenclature where available. Table 1-1 gives the military and commercial nomenclature of all station equipment to which they apply.

Table 1-1. EQUIPMENT NOMENCLATURE LIST

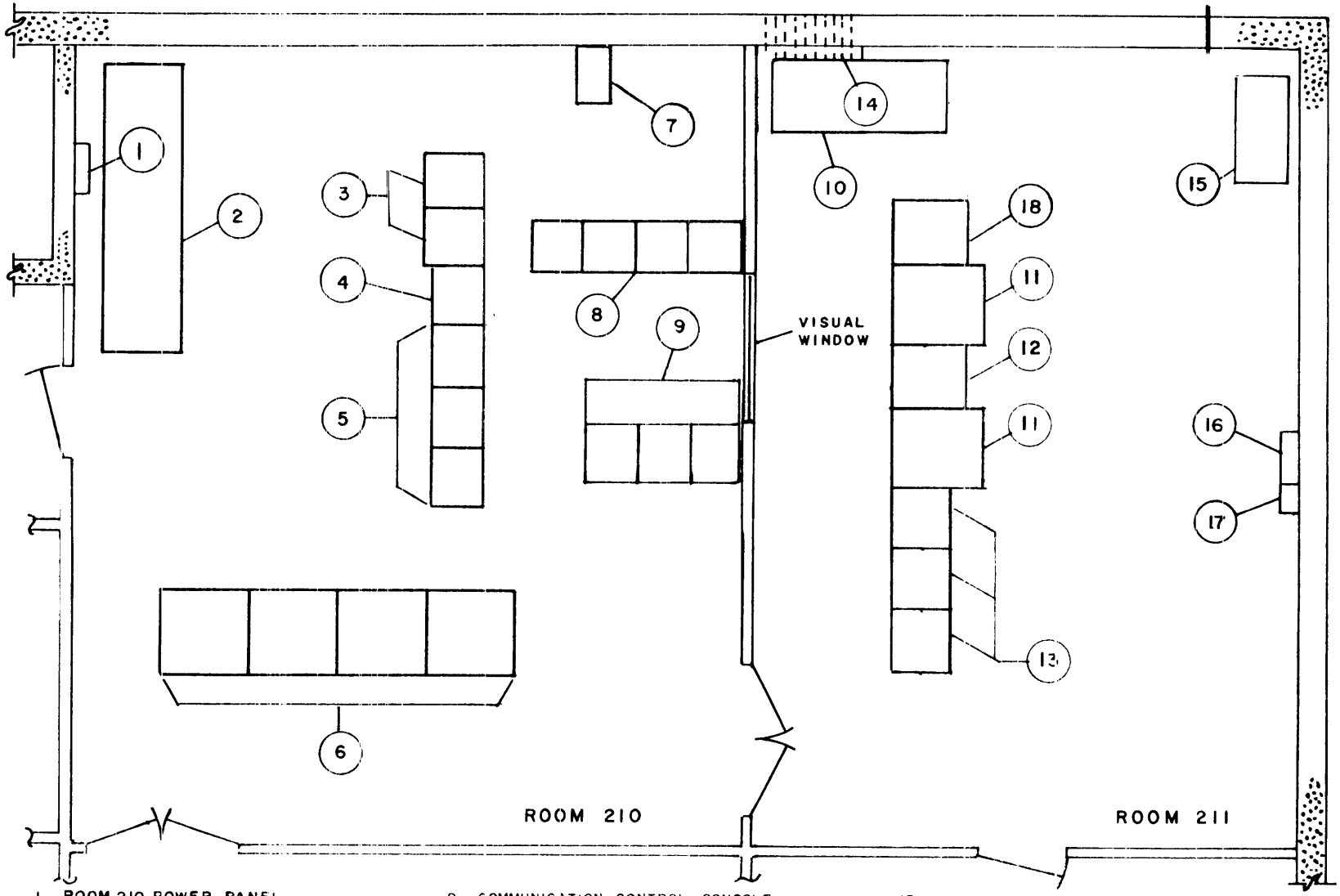
Equipment	Military Nomenclature	Commercial Nomenclature
Radio Transmitter, c/o	AN/URT-37(V)1	GPTR-10KYA
Signal Data Converter-Storer	CV-2520(V)/URC	RTMU-41A
Electronic Frequency Converter	CV-2644/URT	CHGR-4
Electronic Frequency Converter	CV-2645/URT	CMRA-4
Command Signals Decoder	DY-675/URT	RTTD-5A
Test Key Unit	----	AX-5903
Power Distribution Panel	----	APP-17
RF Linear Amplifier	AM-6226/URT-37(V)	PALA-10K
Radio Receiving Set, c/o	AN/FRR-85(V)1	DDRR-10N2
Radio Frequency Tuner	TN-525/FRR	HFRR-5
Demultiplexer	TD-696/FRR	MSAR
Reference Signal Generator	0-1510/URR	HFSR-4
Decoder	KY-661/URR	RTTD-4
T/R Relay Assembly	----	AX-5104
Receiver Filter System	----	SYM-4200
Remote Control Set, c/o	AN/URA-63	----
Receiver Remote Control Group	----	COPB-1
Transmitter Remote Control Group	----	COPC-1
Transceiver, c/o	KWT-6 Type 8	----
Power Amplifier	367A-3	----
Frequency Generator	786E-1	----
Sideband Generator	786F-1	----
Audio and Control Unit	159B-1	----
High Voltage Power Supply	428B-1	----
Low Voltage Power Supply	429B-1	----
Blower	199G-3	----
Handset Adapter	----	----
Frequency Comparator	54Q-1	----

Table 1-1. EQUIPMENT NOMENCLATURE LIST (Cont.)

Equipment	Military Nomenclature	Commercial Nomenclature
Transceiver (cont'd)		
CW and FSK Unit	----	----
Dummy Antenna	172J-1	----
Antenna Network	180U-2	----
RF Switching Matrix, incl.	AN/URA-65(V)1	
Input Module	PL-1001/URA-65	----
Output Module	PL-1002/URA-65	----
Push-button Module	PL-1003/URA-65	----
Matrix Wiring Module	----	----
Power Supply	PP-101/URA-65	----
Matrix Lockout Interlock	----	----
Antenna Coupler	CU-1897/URT	TRC-5000
Electrical Dummy Load	DA-550/U	TER-18K-A-50U
VLF Receiver/Comparator	----	207-4
Distribution Amplifier	----	203A
Telegraph Terminal	AN/FGC-61A	----
VFTG Interface Unit	----	GS1A-1
Teletypewriter	AN/FGC-58	
Communications Control Console, c/o	----	----
Loudspeaker	LS-452/U	LSP-4
DC Patch Group	----	----
Power Supply	----	PSP-101
DC IDF	----	----
VU Meter Panel	----	----
Voice Conditioning Equipment, c/o	----	----
Telephone Termination Set	----	7304
Four-Wire, Four-Way Conference Bridge	----	7314A

Table 1-1. EQUIPMENT NOMENCLATURE LIST (Cont.)

Equipment	Military Nomenclature	Commercial Nomenclature
Communications Control Console		
Voice Conditioning Equipment (cont'd)		
Amplifier	----	456B
Bridging-Monitor Amplifier	----	----
Compression Amplifier	----	460B
Audio Amplifier	AM-3905/URT	SPU-2
Audio Patch Group	----	----



1. ROOM 210 POWER PANEL
2. AMATEUR RADIO STATION EQUIPMENT
3. AN/FGC-61
4. VLFC EQUIPMENT
5. R-390/URR RECEIVING SETS
6. AN/FGC-58 TELETYPE EQUIPMENT
7. ANTENNA MANUAL PATCH PANEL
8. KWT-6 TRANSCEIVERS (2)
9. COMMUNICATION CONTROL CONSOLE
10. AN/URA-65(V) RF SWITCHING MATRIX
11. AM-6226/URT-37(V) RADIO FREQ. AMPLIFIER NO. 1 AND NO. 2 PARTS OF AN/URT-37(V) TRANSMITTING SET
12. (2) SBG-4(V) EXCITERS, PART OF AN/URT-37(V)
13. AN/FRR-85(V)1 RECEIVING SETS
14. RF TRANSMISSION LINE ENTRANCE
15. DA-550/U ELECTRICAL DUMMY LOAD
16. ROOM 211 POWER PANEL
17. RADIO TRANSMITTER POWER PANEL
18. RECEIVER FILTER SYSTEM SYM4200

FIGURE 1 NACOM II EQUIPMENT LAYOUT

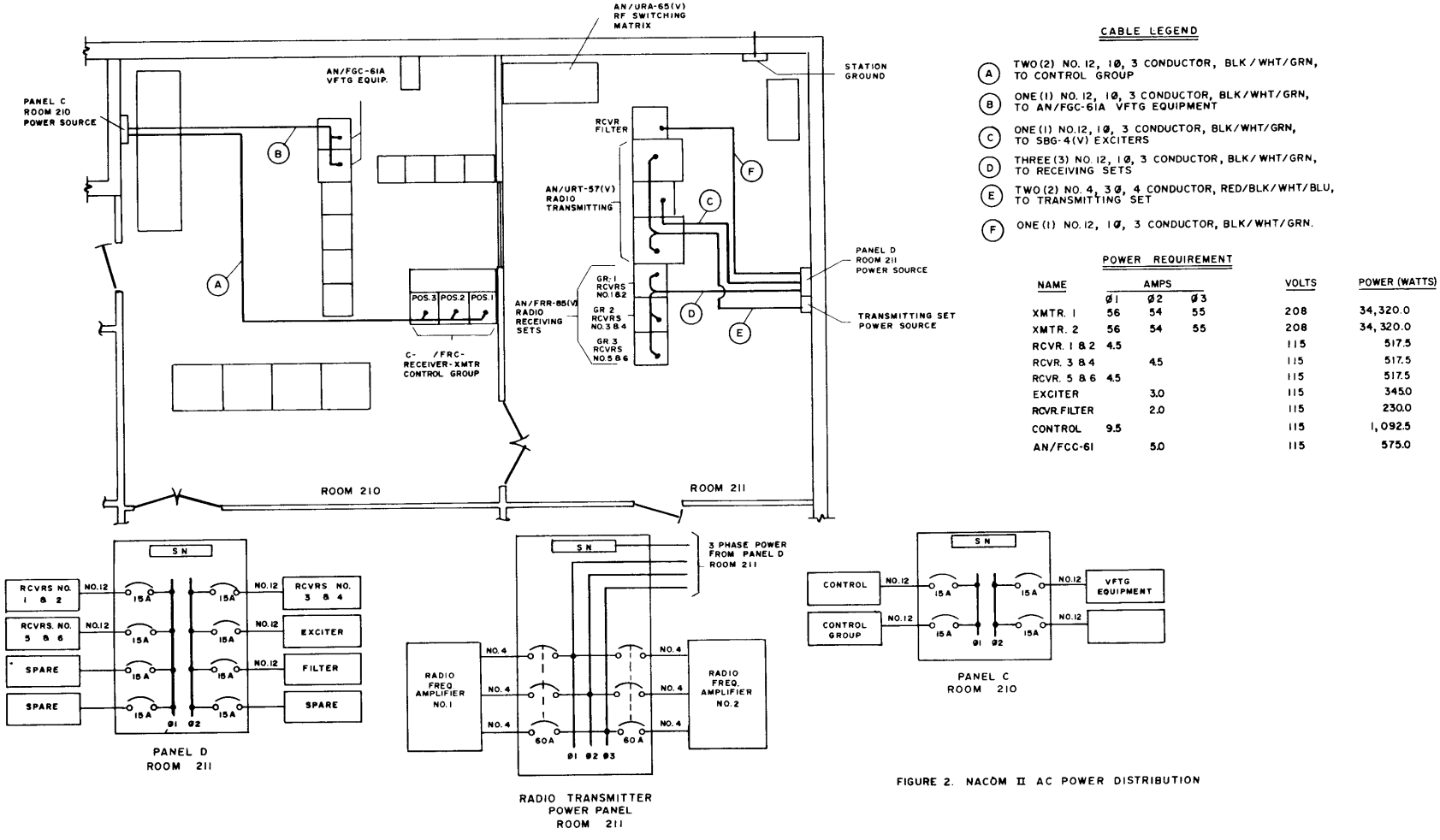


FIGURE 2. NACOM II AC POWER DISTRIBUTION

Figure 2. NACOM II Power Requirements

CHAPTER 2

STATION EQUIPMENT

Section I. FUNCTIONAL DESCRIPTIONS

2-1. Radio Transmitter AN/URT-37(V)1

Radio Transmitter AN/URT-37(V)1 is a dual, 10kW transmitter. (In the NACOM II system it operates at 5kW because of the power handling limitation of the antenna coupler.) The transmitter is tunable, in 100-Hz increments, in the range of 1.6 to 29.9999 MHz. It is capable of operation in the AM, SSB or ISB modes and each unit of the pair can transmit four, ISB, 3-kHz channels as shown in Figure 3. The transmitter is housed in three cabinets on a common base (Figure 4). It is made up of the following components:

1 Dual Exciter System c/o

- 1 Signal Data Converter-Storer CV-2520(V)/URC
- 2 Electronic Frequency Converters CV-2644/URT
- 2 Electronic Frequency Converters CV-2645/URT
- 2 Command Signals Decoders KY-675/URT
- 2 Test Key Units AX-5093
- 1 Power Distribution Panel APP-17 (AC Power Panel)

2 RF Linear Amplifiers AM-6226/URT-37(V)

Remote tuning control, readout and indicating units are also included. They are located in the Communications Control Console (Room 210). As shown in Figure 4, each of the outside cabinets is a 10kW RF amplifier containing a power supply, servo amplifier, driver and power amplifier.

a. Electronic Frequency Converter CV-2645/URT. The CV-2645/URT provides the primary stage of frequency conversion. When used in the four-channel ISB mode, it also provides frequency-division multiplexing. The converter produces a composite signal centered at 1.75 MHz. Carrier suppression and mode selection are controlled by coded information from the Communications Control Console. Channel power level and carrier insertion must be controlled at the converter panel.

b. Electronic Frequency Converter CV-2644/URT. The next stage of frequency translation takes place in the CV-2644/URT. Here, the 1.75 MHz composite signal from the CV-2645/URT is translated to the desired RF output frequency. The frequency selection is accomplished by coded information from the Communications Control Console.

c. Signal Data Converter-Storer CV-2520(V)/URC. The CV-2520(V)/URC receives the coded tuning information from the Communications Control Console. It stores the entire tuning "message" until it receives the end-of-message signal. This signal triggers the unit to relay the message to the appropriate Decoder KY-675/URT. One signal data converter-storer serves both transmitters of the AN/URT-37(V)1 pair, and all six receivers of the three AN/FRR-85(V)1 pairs.

d. Decoder KY-675/URT. The KY-675/URT receives the coded tuning message from the Signal Data Converter-Storer CV-2520(V)/URC. The decoder converts the coded message into signals which operate the tuning controls in the transmitters. Special circuitry in the decoder operates on signals from the transmitter to achieve proper sequencing in the tuning process. The decoder also receives certain status information from the transmitter. It electronically scans

this information, encodes it and transmits it to the Communications Control Console. Each decoder serves a single transmitter.

e. Test Key Unit AX-5093. The AX-5093 provides for the application of an external audio test signal to any of the ISB channels. It also has a jack for monitoring exciter operation, and a test key to complete the Electronic Frequency Converter CV-2645/URT circuit in CW operation.

f. Power Distribution Panel APP-17. The APP-17 provides two, front panel, 115-volt AC outlets. (Exciter Rack, SBG-4(V), Figure 4)

g. RF Linear Amplifier AM-6226/URT-37(V). The AM-6226/URT-37(V) accepts the 100-milliwatt output of Frequency Converter CV-2644/URT and amplifies it to 5 kilowatts. (The amplifier has a 10-kW capability which is not used in this station.) The amplifier can be tuned from the Communications Control Console.

2-2. Radio Receiving Set AN/FRR-85(V)1

Radio Receiving Set AN/FRR-85(V)1 is a set of two receivers for dual diversity reception of signals in the 2- to 32-MHz frequency band. The receivers are tunable throughout the band by remote control from the Communications Control Console. They can receive SSB, ISB, AM, CW and MCW signals. They contain demultiplexers for four-channel ISB reception (refer to Figure 3). They can also receive a 2.5- or 6.0-kHz channel symmetrical about the carrier, as shown in Figure 5. This MACOM II station has three complete receiving sets, installed as shown in the rack elevation diagram, Figure 6.

Radio Receiving Set AN/FRR-85(V)1 is made up of the following components:

Radio Frequency Tuner TN-525/FRR

Demultiplexer TD-969/FRR

Reference Signal Generator 0-1510/URR

Decoder KY-661/URR

T/R Relay Assembly AX-5104

a. Radio Frequency Tuner TN-525/FRR. The TN-525/FRR tunes through the 2- to 32-MHz range in four bands. It displays the selected frequency in 100-kHz increments on a digital indicator. The tuner includes AFC (automatic frequency control) circuitry. It also supplies a carrier injection frequency to the Demultiplexer TD-969/FRR.

b. Demultiplexer TD-969/FRR. In four-channel ISB operation, the TD-969/FRR demultiplexes the composite received signal into four separate channels. It utilizes the carrier injection frequency from the Radio Frequency Tuner TN-525/FRR for sideband product detection.

c. Reference Signal Generator 0-1510/URR. The 0-1510/URR provides a stabilized frequency in the 0.2- to 3.2-MHz band to the Radio Frequency Tuner TN-525/FRR for servo-controlled tuning in synthesized frequency-control operation. The frequency is stabilized with respect to a 1-MHz frequency standard generated in the 0-1510/URR. The 1-MHz frequency standard is also supplied to the tuner. The 0-1510/URR contains automatic switching circuitry and a phase comparator meter for checking phase differences between the internal and an external frequency standard.

d. Decoder KY-661/URR. The KY-661/URR acts on data received from the Signal Data Converter-Storer CV-2520(V)/URC (described in paragraph 2-1, c) to operate the servo-controlled tuning mechanism in the associated receiver

in Receiving Set AN/FRR-85(V)1. It also relays certain status information from the receiver to the Communications Control Console.

e. T/R Relay Assembly AX-5104. The AX-5104 shown in Figure 31 provides coaxial switching between Radio Transmitter AN/URT-37(V)1 and Radio Receiving Set AN/FRR-85(V)1 for "push-to-talk" operation. The antenna is normally connected, through its coaxial transmission line, to its permanently assigned receiver. When the voice operated (VOX) relay in Electronic Frequency Converter CV-2645/URT is keyed by pressing the push-to-talk button on the handset or microphone, the T/R relay assembly switches the antenna to the transmitter. When the push-to-talk button is released, the VOX relay contacts break and the antenna is returned to the receiver. Capacitors in the T/R relay assembly provide a half-second delay, which allows the transmitter linear amplifier circuits to discharge before the antenna is switched off the transmitter. The T/R relay assembly provides positive protection against the possibility of operating the transmitter without it being connected to an antenna or dummy load. The T/R relay assemblies are mounted on top of RF Switching Matrix AN/URA-65.

2-3. Receiver Filter System SYM 4200

Receiver Filter System SYM 4200 consists of 36 tunable bandpass-filter modules and a remote control panel. It is associated with an RF and DC patch panel. Each bandpass-filter module (hereafter referred to as a filter module) is called an LPFB-2. Six LPFB-2 filter modules form a Drawer LPFB-2(6). Thus, a drawer contains six filter channels. There are six drawers in the receiver filter system, one drawer being assigned to each of the six Radio Receiving Sets AN/FRR-85(V)1. The six drawers of filter modules are in a rack adjacent to

Radio Transmitter AN/URT-37(V)1 (see Figure 1). Remote Control Panel RCP-6 is located in the Communications Control Console, Position 1 (see Figure 17). The associated RF and DC patch panel is located at the top of the same rack which contains the filter module drawers.

The purpose of the receiver filter system is to prevent burn-out of the radio receiving set RF stages due to overloading from nearby transmitting antennas (in particular the rotatable log-periodic antenna when it is used for transmitting and is pointed at a receiving antenna) and to reduce cross-modulation, blocking and intermodulation from the same source. It prevents burn-out due to overloading by electrically removing the receiving antenna from its associated receiver and grounding it when the RF input from the antenna exceeds a pre-set level. The characteristics of the filters in the filter modules discriminate against emanations at frequencies other than those in the bandpass of the filters.

Figure 7 is a front panel elevation drawing of the cabinet containing the filter module drawers and associated patch panel. Figure 8 shows the front panel of a filter module drawer. The front of Remote Control Panel RCP-6 is shown in Figure 9. Appendix III contains schematic and wiring diagrams and a maintenance parts list for the receiver filter system.

Specifications for Receiver Filter System SYM 4200 are as follows:

Tunable frequency range:	2 to 32 MHz
Bandpass:	Not less than $\pm$7 kHz from nominal frequency, at -2 db points
Insertion loss:	3 db nominal at center frequency
Frequency rejection:	25 db at 10% frequency separation; 30 db at 15% frequency separation

Input and output impedances:	50 ohms, unbalanced
Automatic protection overload voltage:	5 volts RMS
Input power requirement:	25 watts; 115 volts AC, 50 or 60 Hz.
Dimensions:	Filter module drawer rack: 69" high 24-5/8" wide 29-15/16" deep Remote control panel mounting space: 19" wide 5-1/4" high

The RF and DC patch panel associated with Receiver Filter System SYM-4200 is designated as Patch Panel SPP-PA-132. It enables coaxial patching between antenna transmission lines and receiver filter modules as shown in Figure 10. It also provides RF patching for the two T/R Relay Assemblies AX-5104 and control voltage patching between the T/R relay assemblies and the receiver muting controls.

2-4. Remote Control Set AN/URA-63

Remote Control Set AN/URA-63 provides remote control and monitoring facilities for Radio Transmitter AN/URT-37(V)1 and Radio Receiving Set AN/FRR-85(V)1. It is located in the Communications Control Console. The AN/URA-63 is made up of two groups: Transmitter Remote Control Group COPC-1, and Receiver Remote Control Group COPB-1. The COPC-1 utilizes a five-level binary code, generated by its pushbutton keyboard, to tune the transmitters. It

transmits the coded tuning instructions to Signal Data Converter-Storer CV-2520 (V)/URC. It receives transmitter status information signals from Decoder KY-675/URT and displays the information on digital indicators and a projection screen. The COPB-1 operates similarly in connection with the receivers.

2-5. Transceiver KWT-6 Type 8

The KWT-6 Type 8 is a radio communications transceiver (transmitter-receiver combination) which operates in the 2- to 30-MHz frequency range. The transmitter delivers a peak-envelope-power (PEP) output of 500 watts. The transceiver is designed to operate primarily in the SSB mode. It provides for transmission and reception of upper or lower sideband, or two independent sidebands, with separate audio and i-f (intermediate-frequency) for each sideband. In addition to SSB operation, the design enables compatible AM (carrier reinserted), CW or FSK operation. The operating frequency can be selected in 1-kHz increments on a direct-reading frequency counter. Frequency accuracy and stability are provided by a self-contained frequency standard. An external standard may also be used. The rack elevation of the KWT-6, Type 8 is shown in Figure 11. The transceiver consists of the following:

Power Amplifier 367A-3

Frequency Generator 786E-1

Sideband Generator 786F-1

Audio and Control Unit 159B-1

High Voltage Power Supply 428B-1

Low Voltage Power Supply 429B-1

Air Duct Kit

Blower 199G-3

Cable Kit

Handset Adapter

Junction Box, 153H-3

Frequency Comparator 54Q-1

CW and FSK Unit

Dummy Antenna 172J-1

Antenna Network 180U-2

a. Power Amplifier 367A-3. The 367A-3 amplifies the 0.15-watt, PEP, signal from Frequency Generator 786E-1 to a nominal output power of 500 watts, PEP.

b. Frequency Generator 786E-1. Frequency Generator 786E-1 is an i-f to r-f translator for transmitting and an r-f to i-f translator for receiving. In addition, it supplies a 100-kHz and a 1-kHz output for operation of Sideband Generator 786F-1 and Frequency Comparator 54Q-1. For transmitting, the 300-kHz i-f signal from Sideband Generator 786F-1 is translated to any desired 1-kHz frequency point in the range of 2.0 to 30.0 MHz and amplified to approximately 0.15 watts PEP for delivery of power amplifier 367A-3. For receiving, any desired 1-kHz frequency point in the range of 2.0 to 30.0 MHz is translated to a 300-kHz i-f signal and delivered to Sideband Generator 786F-1 for demodulation.

c. Sideband Generator 786F-1. Sideband Generator 786F-1 consists of a sideband generator chassis and the following plug-in modules: modulator, USB (upper sideband) i-f/a-f amplifier, LSB (lower sideband) i-f/a-f (audio frequency) amplifier, AM i-f/a-f amplifier, TGC (Transmitter Gain Control), and carrier generator. In transmitting, the audio inputs from Audio and Control Unit 159B-1

are fed to the modulator module which contains two 300-kHz balanced modulators. One modulator is followed with an upper-sideband filter and the other, with a lower-sideband filter. The two output signals are fed to a TGC module where the amplitude of the output signal is controlled by a TGC voltage from Power Amplifier 367A-3. The 300-kHz i-f output of the TGC module is fed to Frequency Generator 786E-1. In receiving, the 300-kHz i-f signal from Frequency Generator 786E-1 is fed to the i-f/a-f amplifier where it is amplified, filtered, and detected to obtain audio outputs which are fed to the Audio and Control Unit 159B-1. In all modes of operation, except FSK, receive a 100-kHz signal from the CW and FSK unit is multiplied to 300-kHz by the carrier generator module and supplied as injection signal to the modulator module and the USB and LSB i-f/a-f amplifier modules. The 300-kHz output of the carrier generator module is also used for carrier reinsertion in tuning and AM transmit operation. In FSK receive operation, the CW and FSK unit supplies a variable bfo (beat-frequency oscillator) signal, centered at 300.550 kHz, to the carrier generator module. This signal is amplified by the carrier generator and applied to the USB i-f/a-f amplifier module.

d. Audio and Control Unit 159B-1. Audio and Control Unit 159B-1 is a dual-channel audio amplifier. For transmitting, the audio signal from the handset adapter is fed to the 600-ohm unbalanced input of Audio and Control Unit 159B-1. This input is applied to the USB line amplifier or the LSB line amplifier by the Sideband Selector switch. The output of the LSB and USB line amplifiers are fed to the balanced modulator module of Sideband Generator 786F-1. In receive operation, the Sideband Selector switch selects the USB or LSB output

of Sideband Generator 786F-1. This is fed to the speaker amplifier module of the audio and control unit. The output is fed to the Handset Adapter or to a local speaker.

e. High Voltage Power Supply 428B-1. High Voltage Power Supply 428B-1 supplies 2000 volts d-c at 500 ma, and 400 volts d-c at 80 ma for Power Amplifier 367A-3. With the proper connections on the primary of its power transformer, the 428B-1 can be used on a 115- or 230-volt, 60-Hz, single-phase, power source.

f. Low Voltage Power Supply 429B-1. Low Voltage Power Supply 429B-1 supplies the following voltages for operation of transceiver KWT-6, Type 8:

+250 volts d-c,	37 ma (filtered)
+130 volts d-c,	315 ma (filtered)
+28 volts d-c,	1.5 amp
+28 volts d-c,	580 ma (filtered)
+28 volts d-c,	180 ma, regulated
-90 volts d-c,	6 ma (filtered)
12.6 volts a-c	(center tap) 5.2 amp
35 volts a-c	(center tap) at 500 ma

With the proper connections on the primary of its power transformer, the 429B-1 can be used on a 115- or 230-volt, 60-Hz, single-phase, power source.

g. Blower 199G-3. Blower 199G-3 is a centrifugal blower capable of delivering 125 cfm of air at a pressure equivalent to 1.83 inches of water. The blower is driven by a direct-coupled, 115/230-volt, single-phase induction motor. The air input to the blower is through an air filter located on the front of the 199G-3. The 199G-3 includes an interlock switch is operated by air pressure. The contacts of this switch close when the pressure in the output chamber of the

blower is equivalent to 1. 3 inches of water and remain closed until the pressure drops below 0. 85 inches of water. These contacts are used as interlocks in the primary power to the system.

h. Handset Adapter. The Handset Adapter permits local operation of Transceiver KWT-6 Type 8 using a dynamic handset or remote operation using a Radio Set Remote Control Unit AM-3905/URT and the Dynamic Handset. Local or remote operation is selected by a front panel handset control. A handset control on the front panel connects the audio input, the audio output, and the transmit key line to either local or remote operating positions. The Handset Adapter contains the 12 volt d-c supply and microphone transformer necessary for operation of the Dynamic Handset.

i. Frequency Comparator 54Q-1. Frequency Comparator 54Q-1 compares a reference oscillator signal with an external frequency standard. Two comparison methods are provided. The first compares a 100-kHz reference oscillator frequency with a 100-kHz external standard without interrupting normal operation. The second compares a 1-kHz output from the frequency standard with a received signal (heterodyned to 1-kHz) from a netting station or any other transmitted frequency standard such as WWV. This method results in interruption of service. A front panel meter oscillates at the frequency difference rate between the signals being compared. By counting the number of oscillations during a period of time, the frequency difference can be determined. When the 1-kHz standard is compared with a transmitter frequency standard, the output from the 54Q-1 can be supplied to an accessary speaker. This permits frequency differences which are too great to be indicated on the meter to be heard as a beat note.

j. CW and FSK Unit. The GW and FSK Unit enables the KWT-6 Type 8 to be operated in the CW mode using a CW key or FSK from a neutral teletype-writer loop. For transmitting, the unit provides audio tone outputs to the USB balanced modulator of Sideband Generator 786F-1. On CW operation, the unit provides a choice of a keyed audio tone of 1-Hz or a keyed audio tone of 1. 5-kHz. In FSK transmitting operation, the unit provides audio tones of 1575 Hz on space (0 ma), and 2425 Hz on mark (positive pulse). In FSK receiving, the unit supplies a bfo signal to the USB i-f/a-f amplifier module of Sideband Generator 786F-1. This bfo signal replaces the normal 300-kHz injection to this module and is centered at 300. 550 kHz and may be varied approximately 1. 0 kHz each side of this center frequency. The bfo injection is necessary to provide the 2125-Hz (space) and 2975-Hz (mark) audio tone outputs for operating the FSK converter. The CW and FSK Unit also has a metering circuit for monitoring the receive and transmit audio outputs of Audio and Control Unit 159B-1 in addition to monitoring the output of the CW and FSK Unit.

k. Dummy Antenna 172J-1. Dummy Antenna 172J-1 is a 50-ohm unbalanced, 500-watt, nonradiating load. The 172J-1 is mounted on the KWT-6 Type 8 air duct and receives cooling air through a hole in the mounting surface. The unit is connected to the dummy load output of the antenna tuning control unit. A switch on the antenna tuning control enables the operator to select Dummy Antenna 172J-1 for transmitter tuning and testing purposes The 172J-1 has a removable cover for cleaning and inspection.

l. Antenna Network 180U-2. Antenna Network 180U-2 matches a 50-ohm output from an RF amplifier to a 50 ohm transmission line having a standard-

wave ratio up to 2 to 1. The operating frequency of the unit is between 2 and 30 MHz. Antenna Network 180U-2 contains a transfer relay, a directional coupler with an r-f wattmeter, and a reversible L-network for impedance matching. A 4-ohm loudspeaker is provided as well as a terminating load which is switched to the audio input when the speaker is not in use.

2-6. Radio Receiver R-390/URR

Radio Receiver R-390/URR provides for the reception of SSB, CW and FSK signals. It is continuously tunable, by mechanical means, over the range of 0.5 to 32 MHz.

2-7. RF Switching Matrix AN/URA-65(V)1

RF Switching Matrix AN/URA-65(V)1 is a crossbar coaxial switching system for making connections between transmitters and antennas. The inputs to the matrix come from the two AN/URT-37(V)1 transmitters and the two KWT-6 transceivers. (See Figure 12) The outputs from the matrix go to the rotatable log-periodic antenna, four folded dipole antennas, a dummy load and the manual RF patch panel associated with the R-390/URR receivers. The matrix is so arranged that all five antennas are normally connected to five of the AN/FRR-85(V)1 receivers. It is controlled from a special control panel in the Communications Control Console.

a. RF matrix. The RF matrix is made up of vacuum coaxial relays, coaxial tee and elbow assemblies, coaxial adaptor sections, and an electro-mechanical control system. The physical arrangement of the matrix is shown in Figure 13. The actuating mechansisms for the coaxial relays are of the two-position latching type. While a power pulse is required to activate the relay,

no power is required to maintain a connection. The relays can be operated manually if the control system fails. Two Form-C microswitch interlocks on each relay prevent the transmittters from being turned on until a proper path through the matrix to the antenna has been established.

b. Control system. The control system is made up of the following modules:

Input Control Module PL-1001/URA-65: one per input line

Output Control Module PL-1002/URA-65: one per output line

Push-button Control Module PL-1003/URA-65: one per input/output combination plus one per input line

Matrix Wiring Modules - (one per input/output combination)

Power Supply PP-101/URA-65

Matrix Lockout Interlocks

Status Display Panel

Figure 14 shows the arrangment of the control system modules in the Communications Control Console relay rack. Figure 15 is a diagram of the interconnecting cabling for the modules.

(1) Push-button Control Module PL-1003/URA-65. This module is a multi-circuit latching device. Its circuits energize the input and output modules. It is used to initiate "select" and "cancel" control sequences. Status lights in the push-button glow white when a select or cancel sequence is successfully completed, and red if a select command is unsuccessfully, i.e. erroneous.

(2) Input Control Module PL-1001/URA-65. The input module receives its "command" from the push-button module. It then establishes the input line circuit to be energized in the RF matrix. It also sends a command

through the push-button module to the output module to establish the output line circuit. Next, the input module commands the power supply to energize the established input and output lines in the matrix. Then, the cross-point of the matrix lines is energized by the pulse of energy from the power supply capacitor discharge, causing the corresponding coaxial vacuum relays to operate. This establishes the RF path through the matrix. The input module then de-energizes the input and output line circuits, leaving the relays in their new condition. The input module checks through the interlock circuit in the matrix and, if the circuit is complete, closes the interlock associated with the input device (transmitter). This permits the input device to be turned on. Successful closure of this last interlock completes a circuit which causes the white "select" push-button light to glow. If closure is unsuccessful, a circuit is completed which causes the red push-button light to glow. It also causes the "cancel" push-button light to glow red, indicating the input device is off.

(3) Output Control Module PL-1002/URA-65: The output module receives from the push-button module the command originated in the input module. It then establishes the output line circuit to be energized in the RF matrix. A key switch on each output module can be used to disable the interlock circuits, thereby preventing use of specific RF outputs.

(4) Matrix Wiring Modules. These modules distribute the input and output line circuits to the RF vacuum relays. They are located in the RF matrix. They can be seen in the photographs on pages 4 and 19 of the manufacturer's manual for the AN/URA-65A(V)1. All matrix wiring modules in an input row are selected simultaneously by an input module. Similarly, an output module selects all matrix wiring modules in an output row simultaneously. Where the selected

input and output rows intersect becomes the selected crosspoint. Interlock wiring in the matrix wiring modules interconnects the crosspoint interlocks, and the input and output control modules to enable verification of the matrix status.

(5) Power Supply PP-101/URA-65. The power supply provides 26.5 volts DC for control circuit operation and matrix status indication. It also provides a voltage pulse, from a capacitor discharge circuit, to operate the vacuum coaxial relays. This voltage can be adjusted from 0 to 120 volts. The power supply operates from 115-volts AC, 24-volt DC (battery) or both simultaneously. The input power requirement is 100 watts. When the power supply is operating simultaneously from AC and battery, it serves as the charging source for the battery. If the AC power fails, the power supply continues to function, without interruption, from the battery. The drain on the battery is 4 amperes. A relay in the power supply enables remote and local indication of the power input status.

(6) Matrix Lockout Interlocks. There is an additional interlock circuit for each input (transmitter). They are located on the back of the input module shelf. These interlocks "lockout" all other inputs to an established input/output combination. They can be bypassed by jumpers between the proper terminals of Terminal Board TB-1. The proper terminals for each input are listed in Table 2-1.

Table 2-1. Lockout Interlock Terminals

TB-1 Terminals	Input Device
1 and 2	Transmitter No. 1
3 and 4	Transmitter No. 2
5 and 6	Transmitter No. 3
7 and 8	Transmitter No. 4

(7) The Status Display Panel at top of control unit indicates when an antenna is connected to a receiver input.

2-8. Antenna Coupler CU-1897/URT

The CU-1897/URT is a broad-band, transmitting, coupling transformer. It provides the necessary impedance match between the coaxial transmission line and its associated antenna with an insertion loss of less than 1 db. It has a power handling capability of 5 kW, average, or 10 kW, PEP. It includes spark gaps for protection against lightning discharge and static electricity on the antenna. It is located at the antenna.

2-9. Electrical Dummy Load DA-550/U

The DA-550/U is used for termination of the transmitter for "off-the-air" tuning. It can dissipate 18 kW, average, or 36 kW, PEP, over a frequency range of 0 to 30 MHz. It includes interlocks for connection to the transmitter as a safety precaution. It also provides forward and reflected power metering for use in VSWR computation.

2-10. VLF Receiver/Comparator Model 207

The basic 207 VLF Receiver/Comparator is a completely electronic phase tracking receiver. A 1.1-kHz signal derived from the local frequency standard is phase corrected to a 1.1-kHz signal derived from the received VLF or LF transmission signal by means of an electronic phase shifter. If the local frequency standard is at exactly the right frequency, there will be a constant phase shift. However, if the local frequency standard is high or low in frequency, the phase shift produced by the electronic phase shifter will change with time. This

changing phase shift is used to produce a time-interval error which is recorded on a strip chart recorder. In addition, a cumulative total of the error to the nearest tenth of a microsecond is maintained on a counter called the digital error accumulator. The fractional error of the local frequency standard is calculated by dividing the time-interval error by the observation period.

The basic VLF 207 Receiver/Comparator has been modified to become a 207-4 by incorporating a 1-MHz frequency standard within the receiver which is intended for use as a local primary standard where one is not already available or an additional primary standard when desired. The receiver thus provides a frequency source that is referenced to the VLF standard frequency broadcasts. The internal standard is a 1-MHz quartz crystal oscillator that offers moderately high stability to synthesized receivers and transmitters. The crystal is housed in a proportionately controlled oven with all solid-state electronic circuitry. The output frequency may be adjusted by a front panel control with the output being available at a rear panel BNC connector.

2-11. Model 203A Distribution Amplifier

The Model 203A Distribution Amplifier accepts the 1-MHz output frequency from the VLF Frequency/Comparator receiver and provides 8 output signals. Eight of these output signals are connected to the AN/FRR-85(V)1 receivers and the AN/URT-37(V)1 transmitters through BNC connectors and RG-58/U coaxial cables.

2-12. Telegraph Terminal AN/FGC-61A

The AN/FGC-61A is a multi-channel, frequency-shift terminal for the transmission and reception of telegraph signals. It can transmit 16 telegraph

channels in one 3-kHz voice channel. It can receive 16 telegraph channels in each of two 3-kHz voice channels for diversity operation. Figure 16 shows the rack elevation of a complete AN/FGC-61A terminal.

The tone keyers in the terminal convert DC telegraph keying into FSK tones for transmission. The tone converters translate received FSK tones into DC keying pulses. Diversity combiners in the terminal interconnect tone converters receiving the two channels of a diversity reception pair and select the stronger of the two signals for use as the telegraph channel output.

2-13. Voice Frequency Telegraph (VFTG) Interface Unit

The VFTG Interface Unit converts DC signal levels for circuit interfaces between Voice Frequency Telegraph Terminal AN/FGC-61A and Teletypewriter AN/FGC-58. It converts the high level DC output of the VFTG terminal to the low level DC input required by the teletypewriter. In the reverse direction it converts the low level DC keying output of the teletypewriter to the high level input required by the VFTG terminal. Each of the two VFTG Interface Units provides level conversion for 16 full duplex telegraph channels. The units are mounted at the top of Telegraph Terminal AN/FGC-61A (see Figure 16).

2-14. Teletypewriter AN/FGC-58

The AN/FGC-58 is an automatic send and receive (ASR) teletypewriter. It originates messages for transmission by manual operation of a keyboard or reading perforated paper tape. It provides facilities for recording messages, whether originated locally or remotely, by perforating them in tape and printing them on page-width copy paper. The ASR teletypewriter may be used in the following ways:

a. To transmit messages from the keyboard while making a printed page copy, with or without perforating tape.

b. To receive messages from line and print them on page copy, with or without perforating tape.

c. To locally perforate messages in tape from keyboard for later transmission while making a printed page copy.

d. To transmit messages from tape while making a page copy with or without perforating tape.

The tape punch and tape reader are mounted on the left side of the ASR. The tape feeds forward from a roll into the tape punch, where it is perforated. It can then be fed into the tape reader for transmission. Controls are provided for the tape punch and tape reader. A removable metallic chad container collects the paper (chad) punched out of the perforations in the tape.

2-15. Communication Control Console

The Communication Control Console is built in three sections (see Figure 17). As viewed from the front, the sections are numbered from left to right, Positions 1 through 3. The following paragraphs describe each position and the equipment they contain.

a. Position 1. Position 1 of the Control Console contains the Receiver Remote Control Group COPC-1 of Remote Control Set AN/URA-63. This group is comprised of Electronic Command Signal Programmer C-775/UR, Channel/Frequency Indicator ID-1600/UR and Indicator Panel SB-3230/UR. Position 1 also has a panel for loudspeakers LS-452/U, the DC patch panels (Patch Group), Power Supply PSP101, and the DC cross-connect and interconnect terminals blocks.

Description of the AN/URA-63 Remote Control Set is contained in paragraph 2-4. The other components comprising Position 1 are described below.

(1) Loudspeaker LS-452/U. The LS-452/U is designed as a communications monitor. It has been modified to permit manual volume control. One of these loudspeakers is mounted in Position 1 and one in Position 3.

(2) DC Patch Group. The DC Patch Group is comprised of three jack panels (see Figure 18). The two top panels contain 48 sets (3 rows) of jacks each. The left side of the two top panels are labeled 1 through 48 SEND and the right sides, 1 through 48 RECEIVE. The third panel contains 24 single jacks on the left side, and a mounting panel for an additional 24 jacks on the right side. The jacks are the tip-ring-and-sleeve type with only the tip and ring used.

Each set of jacks in the two top panels consists of a monitor, line and equipment jack. The monitor jack is paralleled with the line jack. This allows monitoring of the line without breaking into it. Line jacks 1 through 32, SEND and RECEIVE, are connected to the associated signal pair of the inputs and outputs of the VFTG interface units. Line jacks 33 through 48, SEND and RECEIVE are spares. ASR teletypewriters are connected to equipment jacks 1 through 5, SEND and RECEIVE. Equipment jacks 6 through 48 are spares. All circuits connected to the jacks on these two panels are for low level keying (6VDC).

The left side of the bottom (miscellaneous) panel contains 2 sets of 6 parallel jacks: jacks 1 through 6 and 7 through 12. These jacks are paralleled on the panel and are not extended to the IDF. Jacks 13, 14, 15, and 16 are labeled FSK 2, 3, and 4. They are terminated on the IDF and provide the capability of future cross-connecting to the inputs of FSK equipment. Jacks

17 through 24 are spares. The right side of the panel is for expansion and contains mounting positions for jacks 25 through 48.

(3) Power Supply PSP-101. Power Supply PSP-101 provides 26 volts DC for operation of the miscellaneous voice conditioning equipment located in Position 2 of the Communications Control Console and the panel indicator lights in Position 3. The PSP-101 consists of two Acopion Model 24U300 AC-to-DC plug-in power supplies, connected in parallel. (See Figure 19) A blocking diode used in the output of the two plug-in supplies is filtered using a choke input two-stage filter which furnishes a DC voltage with total ripple of less than .01 volts. Each of the Acopian Model 24U300 plug-in units have sufficient capacity to furnish all the required DC voltage for the Communications Control Console. With this configuration the failure of one plug-in unit will not effect the DC output. Power Supply PSP-101 has an output voltage of 26 volts DC at 3 amperes. Input to the PSP-101 is 105-115 volts AC, single-phase, through a three-conductor cable.

(4) DC Intermediate Distribution Frame (IDF) "A" Blocks. The DC IDF is located in the lower rear of position 1 and consists of 2 horizontal rows of 4 vertically mounted 6 x 26 telephone terminal blocks (see Figure 20). Terminated on the frame are the 32 outputs and inputs of the VFTG Interface Unit, 5 send and 5 receive teletypewriter circuits and all the jacks of the DC patch field except the monitor jacks. Terminations of the circuits of the VFTG Interface Unit and teletypewriters are cross-connected to a corresponding number of jack terminations. Access to the IDF is by removing the rear cover of the cabinet. An incandescent light with a manually controlled switch is located in the cabinet just above the IDF. The frame has been installed to permit rapid

changes in cross-connects and/or additional cable terminations. (See Figure 21) The frame has a 50% expansion capability. The cable wiring and cross-connect information for the DC IDF is contained in Appendix II.

b. Position 2. Position 2 of the Communications Control Console contains the VU meter panel, voice conditioning equipment, audio patch group, control for one rotating, log-periodic antenna (RLPA), space for future RLPA, VF cross-connect and interconnect terminal blocks, and a utility AC receptacle panel. The components comprising position 2 are described in the following paragraphs.

(1) VU Meter Panel. The VU Meter Panel, for use in measuring signal levels in audio frequency circuits, consists of a Simpson Model 1247 VU Meter ("A" scale) and circuitry to extend its range. The extended range is -16 to +15 VU. When the switch is in the normal (middle) position, the range is -16 to +7 VU. Zero deflection corresponds to +4 VU. When the switch is in the right position, zero deflections corresponds to +12 VU.

(2) Voice Conditioning Equipment. This equipment consists of various audio amplifiers, hybrid termination units and a conference bridging unit. These units are installed in shelves in Position 2 (see Figure 17) as indicated in Table 2-2.

(a) ALTEC 7304 Telephone Termination Set. The telephone termination set converts the audio-frequency circuit from a two-wire telephone instrument to a four-wire audio-frequency circuit for the transmission equipment in one direction, and converts from four-wire to two-wire in the other direction. The set consists of certain standard plug-in units and a mounting panel which

Table 2-2. Voice Conditioning Equipment Shelves

Shelf	No. of Shelves	Equipment	Quantity of Equipment
2/4-wire Hybrid	2	ALTEC 7304 Telephone Termination Set	1 per shelf
Conference Bridge	1	ALTEC 7314A Four-Wire, Four-Way Conference Bridge	1
Amplifier Shelf	1	ALTEC 456B Amplifier	4
		Bridging-Monitor Amplifier c/o	
		ALTEC 480A Bridging Amplifier	1
		ALTEC 456B Amplifier	1
		ALTEC 463A Monitor Amplifier	1
		ALTEC 460B Compression Amplifier	1
Audio Amplifier	1	Audio Amplifier AM-3905/URT	1

contains the sockets for the plug-in units, interconnecting wiring and test jacks. The standard plug-in units are:

Two ALTEC 15189 Transformers

One ALTEC 13530A Compromise Network

Two ALTEC 14477A Attenuators

The physical configuration of the telephone terminating set is shown in Figure 22. Figure 23 is a schematic diagram of the set.

The two ALTEC 15189 Transformers are used in combination to form a hybrid for two- to four-wire and four- to two-wire conversion. Sockets J19 and J20 are wired to utilize the 600-ohm transformer taps on the two-wire side. (Other two-wire impedances are available by using different taps.) The four-wire impedance is always 600 ohms.

The ALTEC 13530 Compromise Network functions as a balancing network for the hybrid. It also contains circuitry which enables a signaling circuit to be derived in the hybrid. The network balancing function is provided by a 400- to 1450-ohm variable resistor (R1 in Figure 23) and a 2-microfarad capacitor (C1). Terminal K is strapped to Terminals C and D to provide two microfarads for the signaling circuit.

The ALTEC 14477A Attenuators introduce the required amount of attenuation into the transmit and receive legs of the four-wire transmission circuit. Each attenuator provides from 1 to 35 db of attenuation, adjustable in 1-db increments by strapping the appropriate terminals on the attenuator. (See Table 2-3 and Figure 24.) In the transmit direction, the incoming level from the two-wire line has a nominal value of -5 dbm. The insertion loss of the ALTEC 15189 Transformer is 3.7 db. Thus, the level at the output of the transformer

is -8.7 db. The level at the input to the transmission equipment should be -16 dbm. Therefore, the attenuator must be strapped to provide 7 db of attenuation. (The attenuator can only be strapped in increments of 1 db.) In the receive direction, the output of the transmission equipment is 7 dbm. The transformer insertion loss, again, is 3.7 db. The required two-wire line input level is 0 dbm. Therefore, the pad is strapped to provide 3 db of attenuation.

(b) ALTEC 7314A Four-Wire, Four-Way Conference Bridge. The ALTEC 7314A provides a four-way conferencing capability among four-wire circuits. It is made up of certain standard plug-in units and a mounting panel which contains sockets for the plug-in units, interconnecting wiring and test jacks. The plug-in units, shown in Figure 25 are:

One ALTEC 40431A Resistance Bridge

Four ALTEC 456B Amplifiers

Four ALTEC 14477A Attenuators

Figure 26 is a block diagram of the 7314A conference bridge.

The ALTEC 40431A Resistance Bridge is a combining network of the resistive type. It provides inputs and outputs for four four-wire channels. The ALTEC 14477A Attenuators provide the right input levels for the resistance bridge, while the ALTEC 456B Amplifiers are used at the outputs of the bridge to compensate for the 15-db insertion loss of the bridge.

(c) ALTEC 456B Amplifier. Four ALTEC 456B Amplifiers are provided on the Amplifier Shelf of Position 2 of the Communications Control Console. Inputs and outputs corresponding to these amplifiers are availabe as jacks on the MISC (miscellaneous) Panel of the Audio Patch Group (described in

Paragraph 2-15, b, (3)). The gain provided by these amplifiers is adjustable from -2 db to 39 db. They will accept a maximum power input of -22 dbm, providing a maximum power output of 17 dbm. They are available for patching into 600-ohm audio circuits requiring amplification.

(d) Bridging-Monitor Amplifier. The bridging-monitor amplifier is available at Position 2 of the Communications Control Console for monitoring circuits without degrading or interrupting them due to amplifier loading. The bridging-monitor amplifier is made up of:

One ALTEC 480A Repeater Amplifier

One ALTEC 456B Amplifier

One ALTEC 463A Amplifier

One ADC Products Model 122F Impedance-Matching Transformer

Figure 27 is a block diagram of the bridging-monitor amplifier.

ALTEC 480A Repeater Amplifier provides a high-impedance (24,000 ohms) input impedance for bridging active audio circuits. Its maximum power input capability from a 600-ohm line is -5.5 dbm. It will provide a maximum power output with the gain control set for maximum gain of 17 dbm. ALTEC 456B Amplifier was described in Paragraph 2-15, b, (3). ALTEC 463A Amplifier provides sufficient output power for distribution of the audio signal to several locations by way of the Audio Patch Group described in Paragraph 2-15, b, (3).

(e) ALTEC 460B Compression Amplifier. The ALTEC 460B provides a relatively constant audio output signal over a wide range of input signals levels. It is available, through jacks in the MISC (miscellaneous) Panel of the Audio Patch Group described in Paragraph 2-15, b, (3).

(f) Audio Amplifier AM-3905/URT. This is a constant level audio amplifier with a dynamic range of 40 db. It is used in the NACOM II system as a microphone amplifier and as an amplifier for the voice-operated (VOX) relay included in Radio Transmitter AN/URT-37(V)1 for push-to-talk operation, and for the VOX relay in the tape recording system. It is available through jacks in the MISC (miscellaneous) Panel of the Audio Patch Group described in Paragraph 2-15, b, (5). When used in transmitting, the operator can switch in a self-contained speech-clipper and pre-emphasis circuit to help provide a uniform power density. SQUELCH, VOX GAIN and VOX RELEASE controls permit adjustment of the VOX circuit to compensate for ambient noise, voice input level and VOX decay rate.

(3) Audio Patch Group. The Audio Patch Group consists of three 48-jack panels. Each panel has three rows of 16 jacks. In the top two panels, the three rows are labelled LINE, EQUIP (Equipment) and MON (Monitor). All three rows in the bottom panel are labelled MISC (Miscellaneous). Jacks are of the tip, ring and sleeve type, with only the tip and ring being used. The monitor jacks on the two top panels are paralleled with the equipment jacks on their respective panels. Equipment jack terminations are as follows (see Figure 28):

TOP PANEL

(a) Jacks 1 through 24 are the demultiplexed channels of the AN/FRR-85(V)1 Receivers. These appear as channels B2, B1, A1 and A2, in that order, for each of the six receivers.

(b) Jacks 25 through 32 are the inputs to the two multiplexers of the AN/URT-37(V)1. These are GPT-10K No. 1 and 2; B2, B1, A1, A2.

(c) Jacks 41 and 42 are KWT-6 No. 1, SEND USB and LSB respectively. KWT-6 No. 2 SEND USB and LSB are on Jack 43 and 44.

(d) Jacks 33, 34, 35, 36, 45 and 46 are spares.

(e) Jack positions 37, 38, 39, 40, 47 and 48 are for future expansion.

MIDDLE PANEL

(a) Jacks 1 through 12, 17, 18, 29, 30, 35, 36, and 41 through 48 are spares.

(b) Jacks 13 and 14 are KWT-6 No. 1, RECEIVE USB and LSB and 15 and 16 are KWT-6 No. 2 RECEIVE USB and LSB.

(c) Jacks 19, 20, 21, and 22 are the audio outputs of the four R-390 receivers.

(d) Jacks 25 and 26 are the two VF (voice-frequency) inputs (RECEIVE) to VFTG No. 1 and 27 and 28 are the two inputs to VFTG No. 2.

(e) Jacks 31 and 32 are VFTG 1 and 2 outputs.

(f) Jack positions 35 through 40 are blank plugs.

BOTTOM PANEL

(a) Jacks 1 through 6 are for six 2-wire telephone lines.

(b) Jacks 7, 8, 9, 16, 17, 18, 29, 30, 43, 46, 57 through 60, 69 through 72, 90 through 96, 103, 104 and 105 are spares.

(c) Jacks 10 through 15 are for the two two-wire/four-wire hybrid units. Jacks 10 and 13 are the two-wire sides and jacks 11, 12, 14 and 15 are the four-wire sides.

(d) Jack 19 is a 24,000 ohm bridging input to the monitor amplifier.

(e) Jack 20 is a 4-ohm impedance matching output jack, 21 is an 8-ohm impedance matching output, jack 22 is a 250-ohm impedance matching output and jack 23 is a 500-ohm impedance matching output, all from the bridging amplifier.

(f) Jack 24 is the input to the VU meter.

(g) Jack 25 is the input to speaker 1 in position 1 and jack 26 is the input to speaker 2 in position 2.

(h) Jack 27 is the input to the speech processing unit and jack 28 is the output.

(i) Jacks 31 through 42 are the jacks and controls for the two tape recorders. Jack 31 and 37 are inputs to the recorder. Positions 32 and 38 are lamps that illuminate when the recorders are recording. Positions 33 and 39 are the control switches (push to record, pull to stop). Jacks 34 and 40 are tape recorder playback outputs. Positions 35 and 41 are lamps that illuminate during playback Positions 36 and 42 are control switches for the playback functions.

(j) Positions 43 through 48 are spare jacks, switches and lamps for tape recorder control.

(k) Jacks 49 through 56 are the inputs and outputs of the four line amplifiers.

(l) Jacks 57 through 60, 69 through 72 and 91 through 96 are spares.

(m) Jacks 61 through 68 are the inputs and outputs of the conference bridges.

(n) Jacks 73 through 76 provide 600 ohm terminations.

(o) Jacks 77 and 78 are the input and output of the constant level amplifier.

(p) Jacks 79 through 90 are terminations for six four-wire telephone circuits.

CAUTION

Jacks 111 and 112 designated 10K No. 1 and No. 2 have an applied 26-volt dc control voltage for the push-to-talk circuitry. If this dc voltage were to be inadvertently patched into the voice conditioning equipment or other equipment terminated on the Audio Patch Group, serious damage to the equipment could result.

(q) Jacks 97 through 102 are the push-to-talk (PTT) switch circuits of the six four-wire telephones.

(r) Jacks 103, 104, 105, 109, 110, 113 and 117 are spares and positions 106, 114, 118, 119, 120, 125 and 126 are blanks.

(s) Jacks 107 and 108 are the input and output for the PTT feature of AM-3905/URT.

(t) Jacks 111 and 112 are the inputs of the PTT control circuitry to the AN/URT-37(V)1 transmitters and are designated 10K No. 1 and No. 2. There are 26 volts on these jacks.

(u) Jacks 115 and 116 are the inputs to the control circuitry to the KWT-6 transceivers.

(v) Jacks 121 through 124 are paralleled.

(w) Jacks 127 through 138 are the transmit over-ride controls for the six four-wire telephones. Each control consists of a switch (cut-key) and a lamp which illuminates when the switch is operated.

(x) Jacks 139 through 144 are indicating lamps and switches for three additional control circuits.

(4) Rotating Log-Periodic Antenna (RLPA) Control. The RLPA Control panel contains the azimuth selection switch, a pilot lamp and an ON/OFF switch. The azimuth selection switch provides 12 different azimuths at 30 degree intervals. The pilot light will illuminate when the antenna is turning. When the antenna is at its new azimuth, the light will go out.

(5) Voice Frequency (VF) IDF "B" Blocks. The VF IDF is located in the lower rear of Position 2 and like the DC IDF consists of 2 horizontal rows of 4 vertically mounted 6 x 26 telephone terminal blocks. (See Figure 20) Terminated on the frame are the audio outputs from the Radio Receiving Sets AN/FRR-85(V)1, Receivers R-390, audio inputs to the Transmitter AN/URT-37(V), audio inputs and outputs of the Transceivers KWT-6, audio inputs and outputs of the VFTG Terminals AN/FGC-61A, two-wire and four-wire telephones, inputs and outputs of the ALTEC 7304 Telephone Termination Sets, the ALTEC 7314A Conference Bridge, the ALTEC 456B Line Amplifiers, the Bridging-Monitor Amplifier, the Audio Amplifier AM-3905/URT, the record and playback circuits of the

tape recorders, the push-to-talk and over-ride circuitry, and all the jacks of the Audio Patch Group except the MON (monitor) jacks.

The operator gains access to the frame by removing the rear cover of the cabinet. An incandescent light with a manually controlled switch is located in the cabinet just above the IDF. The frame has been installed to permit changes in cross-connects or additional terminations. The frame has a 50% expansion capability. Cable wiring and cross-connect information for the VF IDF is contained in Appendix II.

c. Position 3. Position 3 of the Communications Control Console contains a Loudspeaker LS-452/U, Transmitter Remote Control Group COPC-1 of Remote Control Set AN/URA-63, RF Switching Matrix AN/URA-65, and a Control Circuit IDF.

The Control Circuit IDF is located in the lower rear of Position 3 and consists of 2 horizontal rows of 4 vertically mounted 6 x 26 telephone terminal blocks. Terminated on this frame are the control circuits of the RF switching matrix, the transmitter and receiver remote control groups, the control lines to the remote controlled equipment, and the cross-connects. The operator gains access to the control circuit IDF by removing the rear cover of the cabinet. An incandescent light with a manually controlled switch is located in the cabinet just above the frame. Cable termination and cross-connect information are contained in Appendix II.

Section II. EQUIPMENT APPLICATION

2-16. System Configuration

The system at this NACOM II station can be configured to meet specific communications requirements. The Communications Control Console provides the means for setting up different system configurations. Through its DC and audio patch groups and remote control facilities, it enables the operator to arrange various combinations of communications equipment. To satisfy a long-distance teletype requirement, for example, the operator would form an appropriate combination of teletypewriters, voice-frequency telegraph (VFTG) equipment, high powered radio transmitting and sensitive radio receiving equipment, and an antenna oriented in the desired direction. Or, for a medium-distance voice requirement, he would combine microphone and loudspeaker, or telephone equipment, voice conditioning equipment, medium powered radio equipment and the proper antenna. Numerous combinations can be formed to satisfy requirements for conferencing, tape recording, monitoring and testing.

The basic equipment arrangements which provide this flexibility in system configuration are shown in Figures 29 and 30. There is a logical, functional division between the transmitting and receiving system equipment even though both utilize the Communications Control Console and certain other common equipment.

a. Transmitting System. The transmitting system transmits both voice and teletype information. Voice transmissions originate in telephone instruments or microphones. There are six two-wire telephone circuits and six four-wire telephone circuits connected to the VF IDF (voice-frequency intermediate

distribution frame). Each two-wire telephone circuit must be patched, at the Audio Patch Group panel, through an ALTEC 7304 Telephone Termination Set, for conversion to a four-wire circuit for transmission. Since there are two Telephone Termination Sets, two two-wire telephone circuits can be accomodated simultaneously. Up to four four-wire telephone circuits can be combined in a conference network by patching through the Conference Bridge. There are four ALTEC 456B Amplifiers to increase voice-frequency levels on lines where they are too low (less than -22 dbm). An ALTEC 460B Compression Amplifier provides a constant input level to the transmitter when level variations on an incoming telephone line are severe enough to cause speech-clipping. Audio Amplifier AM-3905/URT performs the same function for microphone inputs to the system. It also operated the VOX (voice-operated) relay in Radio Transmitter AN/URT-37(V)1 in the push-to-talk mode. The Bridging-Monitor permits the operator to bridge any voice-frequency circuit for monitoring purposes. The Audio Patch Group provides access for all incoming lines to these conversion, conditioning and monitoring units.

The Teletypewriters AN/FGC-58 originate the teletype transmissions by sending out low-level (6-volt) DC keying pulses. These low-level pulses must be converted to high-level (130-volt) DC pulses for input to Telegraph Terminal AN/FGC-61A. This conversion takes place in the VFTG Interface Unit, which is wired directly to the telegraph terminal. The low-level keying circuits are patched to the interface unit through the DC Patch Group. The telegraph terminal converts the DC keying pulses into FSK (frequency-shift keying) tones. Each of the two telegraph terminals accomodates 16 teletype channels simultaneously.

The composite VF outputs of the telegraph terminals are patched to the desired transmitters at the Audio Patch Group.

The DC IDF (intermediate distribution frame) provides the cross-connects for the teletypewriters, the VFTG interface unit and the audio patch group. The VF IDF provides the cross-connects for the telegraph terminals, the two-wire and four-wire telephone circuits, the telephone termination sets, the conference bridge, the 456B amplifiers, the compression amplifier, the bridging amplifier, the audio amplifier (AM-3905/URT) and the audio patch group. The VF IDF is interconnected with the CDF (combined distribution frame), which provides the cross-connects for the transceivers and the high-powered transmitters.

Remote Control Set AN/URA-63 enables the operator to control and monitor Radio Transmitter AN/URT-37(V)1 from the Communications Control Console. The VLF Receiver/Comparator and Distribution Amplifier provide a 1-MHz frequency standard to the transmitter. This frequency standard is derived from the National Bureau of Standards frequency standard broadcast over station WWV and received by the VLF Receiver/Comparator.

The RF outputs of the two Transceivers KWT-6 Type 8 and Radio Transmitter AN/URT-37(V)1 (a dual transmitter) go to RF Switching Matrix AN/URA-65 where they are connected to the desired antenna or Dummy Load DA-550/U. The RF switching matrix is operated from the Communications Control Console. One rotating log-periodic and four folded dipoles comprise the available antennas.

b. Receiving System. The antennas just mentioned as available to the transmitting system are normally connected to specific receivers in the

receiving system through RF Switching Matrix AN/URA-65. The specific receivers are five of the six Radio Receiving Sets AN/FRR-85(V)1. The operator can transfer an antenna to the Manual RF Patch Panel to make it available to a Radio Receiver R-390/URR. This transfer is accomplished through the RF switching matrix, the control system of which is in the Communications Control Console.

The operator controls and monitors Radio Receiving Set AN/FRR-85(V)1 by Remote Control Set AN/URA-63, also located in the Communications Control Console. The VLF Receiver/Comparator and Distribution Amplifier provide a 1-MHz frequency standard to the receiving set.

The voice-frequency outputs of the receivers go the CDF, where they are cross-connected to the VF IDF. At the VF IDF, they are cross-connected to the Audio Patch Group.

At the Audio Patch Group, the operator can patch the VF circuits to the desired termination. If the VF circuits carry voice, he can route them to a four-wire telephone receiver, a loudspeaker, the conference bridge or to a two-wire telephone circuit through a telephone termination set. If a VF level is too low, he can route the circuit through one of the four amplifiers available for this purpose. He can patch in the bridging-monitor to test a circuit without interrupting or degrading it. Or, he can patch in Audio Amplifier AM-3905/URT to operate the VOX relay in the tape recording system.

If the circuits carry voice-frequency telegraph, they are routed to Telegraph Terminal AN/FGC-61A. This unit converts the FSK tones into high-level (120-volt) DC keying pulses. The keying circuit passes through the VFTG

Interface Unit for conversion of the pulses to low-level (6-volt) pulses. The low-level keying circuits are cross-connected at the DC IDF to the DC Patch Group, where they are available for patching to the Teletypewriters AN/FGC-58.

2-17. Signal Flow

Signal Flow through the station can be demonstrated by three typical system configurations. Although the operator can set up many more configurations, the three typical configurations illustrate the principles involved.

a. DC and VF Signal Flow for Teletype Circuit. Figure 31 diagrams the signal flow in send and receive directions in a typical system configuration for a full duplex teletype circuit. Teletypewriter AN/FGC-58 originates DC keying pulses. The DC loops that carry the keying pulses from the teletypewriters are cross-connected at the IDF with EQUIP jacks on the panels of the DC Patch Group. Assuming the signal originates in No. 1 teletypewriter, it flows through the EQUIP and LINE jack circuits, through an IDF cross-connection, to the Channel 1 input terminals of the VFTG Interface Unit without patching. (The EQUIP and LINE jacks are normal-through jacks. The operator can patch a teletypewriter to a different channel input than the one to which it is assigned by patching from the corresponding ASR SND (EQUIP) jack to the desired VFTG-SEND CHAN (LINE) jack.) The VFTG Interface Unit converts the 6-volt output of Teletypewriter AN/FGC-58 to 130 volts, neutral. This is sent directly to Keyer Input 1 of Telegraph Terminal AN/FGC-61A, No. 1.

The AN/FGC-61A converts the DC keying pulses into frequency-shift keying (FSK) tones. The lines carrying these tones are cross-connected at the IDF with the VFTG 1 OUT (EQUIP) jack on a panel of the Audio Patch Group.

The typical system configuration shows the channel patched to Radio Transmitter AN/URT-37(V)1 No. 1 via the GPT-10K B2 (EQUIP) jack, an IDF cross-connection and a CDF interconnection. The designation B2 indicates one of the four independent sideband (ISB) channels.

The output of the radio transmitter goes through the T/R Relay Assembly, AX5104 to the RF Switching Matrix AN/URA-65 for channeling to the desired antenna transmission line. In the example, transmission utilizes Antenna No. 3. Dual diversity reception utilizes Antennas No. 1 and No. 2. The RF switching matrix routes the received signals for the full duplex circuit to Receivers No. 1 and No. 2 of Radio Receiving Set AN/FRR-85(V)1 No. 1.

The received channels pass through the CDF interconnection and the IDF cross-connection to the Audio Patch Group. ISB Channel B2 of the two receivers appears at the GPI-R1 B2 (EQUIP) and GPI-R2 (EQUIP) jacks of the Audio Patch Group. From there, the channels are patched to the VFTG 1 IN 1 an and VFTG 1 IN 2 jacks, respectively. They are cross-connected to the Converter Input 1-1 and 1-2 terminals of Telegraph Terminal AN/FGC-61A at the IDF. The telegraph terminal demodulates the received signals (FSK tones), combines them into a single channel, and converts them to 120-volt DC, neutral keying pulses. The VFTG Interface Unit accepts these pulses and changes them to 6-volt pulses for input to Teletypewriter AN/FGC-58.

The outputs of the VFTG Interface Unit are cross-connected at the IDF to the DC Patch Group. The Channel 1 output appears at the VFTG - RECEIVE CHAN 1 (LINE) jack. It passes, without patching, to the ASR REC 1 jack and the IDF cross-connect which takes it to the input terminals of the teletypewriter.

b. VF Signal Flow for Typical Voice Push-to-Talk Simplex Operation. In simplex operation, a single antenna is used for both transmit and receive, one at a time. In the push-to-talk mode, the user causes the antenna to switch from receiving to transmitting by pressing the push-to-talk switch on his handset or microphone. In the example illustrated in Figure 31, the user instrument is a four-wire push-to-talk telephone handset. The control signal goes through the IDF cross-connection to the 4 WIRE TEL PTT 1 (MISC) jack in the Audio Patch Group. Here, it is connected through (without patching) to the 10K PTT 1 jack. From there it goes through an IDF cross-connection and a CDF interconnection to T/R Relay Assembly AX-5104 where it activates the relay which switches the transmission line between the transmitter and receiver.

The send circuit from the telephone handset is interconnected at the IDF to the 4 WIRE TELEPHONE 1T (MISC) jack in the Audio Patch Group. It is then patched to the CONST AMP IN jack for cross-connection at the IDF to the ALTEC 460B Compression Amplifier. The amplifier provides a constant-level VF signal output, through the IDF cross-connection to the CONST AMP OUT jack. From there, it is patched to the GPT-10K No. 1 B2 jack. The signal level at this point is -16 dbr (db relative level).

From the GPT-10K No. 1 B2 jack the signal passes through the IDF cross-connection and a CDF interconnection to Radio Transmitter AN/URT-37(V)1. The transmitter output signal goes through T/R Relay Assembly AX-5104 and RF Switching Matrix AN/URA-65 to the selected antenna. In the receive direction, the signal from the antenna goes through the RF switching matrix and the T/R relay assembly to Receiver No. 1 of Radio Receiving Set AN/FRR-85(V)1. The

Channel B2 output of the receiver is at a level of +7 dbr. It goes through the CDF interconnection and IDF cross-connection to the GPI-R1 B2 jack in the Audio Patch Group.

A patch from the GPI-R1 B2 jack to the 4 WIRE TELEPHONE 1R jack takes the circuit to the IDF where it is cross-connected to the telephone handset.

c. VF Signal Flow for Typical Four-Way Conferencing on a Simplex Circuit. This example, Figure 33, shows four different circuit types interconnected in the Conference Bridge. It also shows a monitoring arrangement on one of the circuits. The four circuit types are:

(1) A local four-wire telephone circuit.

(2) A four-wire telephone circuit with a high loss, as would be encountered in a long cable connection without repeaters.

(3) A two-wire telephone circuit.

(4) A simple, VOX (voice-operated) relay radio circuit.

The local four-wire telephone circuit originates in the handset of a four-wire telephone instrument. It is cross-connected at the IDF to the Audio Patch Group where it has send and receive appearances at the 4 WIRE TELEPHONE 1T and 1R jacks, respectively. The send pair is patched to INPUT 4W/4W 1 for IDF cross-connection to the Conference Bridge. The Channel 1 receive output from the Conference Bridge is cross-connected to the OUTPUT 4W/4W jack where it is patched to the 4 WIRE TELEPHONE 1R jack.

The high loss, four-wire telephone circuit is cross-connected at the IDF to the 4 WIRE TELEPHONE 2T and 2R jacks in the Audio Patch Group. The send pair from the 2T jack goes through a patch to the LINE AMP INPUT 1 jack for cross-connection to an ALTEC 456B Amplifier. The amplifier raises the

signal to a level suitable for insertion into the Conference Bridge. (The actual level required depends on the attenuator strapping at the input to the bridge. Conversely, the attenuator can be strapped to accept any level within a 35-db range.) The amplified signal appears at LINE AMP OUTPUT 1 in the Audio Patch Group. A patch takes it to INPUT 4W/4W 2 where it is cross-connected to the Conference Bridge.

In the receive direction, the Channel 2 output of the Conference Bridge goes through the IDF cross-connection to the OUTPUT 4W/4W 2 jack for patching to LINE AMP INPUT 2 and the cross-connection to a second ALTEC 456B Amplifier. The amplifier raises the signal level to offset the cable loss on the telephone circuit. The amplified signal appears at the LINE AMP OUTPUT 2 jack. It is patched to the 4 WIRE TELEPHONE 2R jack for cross-connection to the telephone circuit.

The two-wire telephone circuit must be converted to four-wire for radio transmission and reception. This takes place in the hybrid transformer of the ALTEC 7304 Telephone Termination Set. The two-wire circuit comes into the IDF where it is cross-connected to the 2 WIRE TELEPHONE 1 jack. A patch to the 2W/4W HYBRID 2W IN jack takes it to the IDF for cross-connection to the telephone termination set. In the send direction, the output of the telephone termination set is cross-connected at the IDF and appears at the 2W/4W HYBRID T jack. From there, it is patched to the Conference Bridge by way of INPUT 2W/4W 3 jack. In the receive direction, the output of the bridge appears at the OUTPUT 4W/4W 3 jack and is patched to the 2W/4W HYBRID R jack. From there, it goes through an IDF cross-connection to the telephone terminations set where it is converted back to two-wire form.

The example shows the Bridging-Monitor patched into the radio receiver output circuit at the GPI-R1 B1 MON jack. The patch goes to the MON AMP IN jack to provide a high-impedance bridging of the circuit. The Bridging-Monitor output appears at the MON AMP OUT jack where it is patched to the LSP-4 jack for cross-connection to Loudspeaker LSP-4.

TABLE 2-3. ALTEC 14477A ATTENUATOR STRAPPING

Attenuation (db)	Strap A to -	Strap B to -	Strap C to -	Strap D to -	Strap E to -	Strap F to -	Strap G to -	Strap H to -	Also Strap
1	1	2	3	4	G	H			
2	5	6	7	8	G	H			
3	1	2	7	8	G	H			3 to 5, 4 to 6
4	5	6	11	12	G	H			7 to 9, 8 to 10
5	C	D			13	14	15	16	
6	1	2	3	4	13	14	15	16	
7	5	6	7	8	13	14	15	16	
8	1	2	7	8	13	14	15	16	3 to 5, 4 to 6
9	5	6	11	12	13	14	15	16	7 to 9, 8 to 10
10	C	D			17	18	19	20	
11	1	2	3	4	17	18	19	20	
12	5	6	7	8	17	18	19	20	
13	1	2	7	8	17	18	19	20	3 to 5, 4 to 6
14	5	6	11	12	17	18	19	20	7 to 9, 8 to 10
15	C	D			21	22	23	24	
16	1	2	3	4	21	22	23	24	
17	5	6	7	8	21	22	23	24	
18	1	2	7	8	21	22	23	24	3 to 5, 4 to 6
19	5	6	11	12	21	22	23	24	7 to 9, 8 to 10
20	C	D			13	14	23	24	15 to 21, 16 to 22
21	1	2	3	4	13	14	23	24	15 to 21, 16 to 22

TABLE 2-3. ALTEC 14477A ATTENUATOR STRAPPING (Cont.)

Attenuation (db)	Strap A to -	Strap B to -	Strap C to -	Strap D to -	Strap E to -	Strap F to -	Strap G to -	Strap H to -	Also Strap
22	5	6	7	8	13	14	23	24	15 to 21, 16 to 22
23	1	2	7	8	13	14	23	24	3 to 5, 4 to 6, 15 to 21, 16 to 22
24	5	6	11	12	13	14	23	24	7 to 9, 8 to 10, 15 to 21, 16 to 22
25	C	D			17	18	23	24	19 to 21, 20 to 22
26	1	2	3	4	17	18	23	24	19 to 21, 20 to 22
27	5	6	7	8	17	18	23	24	19 to 21, 20 to 22
28	1	2	7	8	17	18	23	24	3 to 5, 4 to 6, 19 to 21, 20 to 22
29	5	6	11	12	17	18	23	24	7 to 9, 8 to 10, 19 to 21, 20 to 22
30	C	D			13	14	23	24	15 to 17, 16 to 18, 19 to 21, 20 to 22
31	1	2	3	4	13	14	23	24	15 to 17, 16 to 18 19 to 21, 20 to 22
32	5	6	7	8	13	14	23	24	15 to 17, 16 to 18, 19 to 21, 20 to 22

TABLE 2-3. ALTEC 14477A ATTENUATOR STRAPPING (Cont.)

Attenuation (db)	Strap A to -	Strap B to -	Strap C to -	Strap D to -	Strap E to -	Strap F to -	Strap G to -	Strap H to -	Also Strap
33	1	2	7	8	13	14	23	24	3 to 5, 4 to 6, 15 to 17, 16 to 18, 19 to 21, 20 to 22
34	5	6	11	12	13	14	23	24	7 to 9, 8 to 10, 15 to 17, 16 to 18, 19 to 21, 20 to 22
35	1	2	11	12	13	14	23	24	3 to 5, 4 to 6, 7 to 9, 8 to 10, 15 to 17, 16 to 18, 19 to 21, 20 to 22

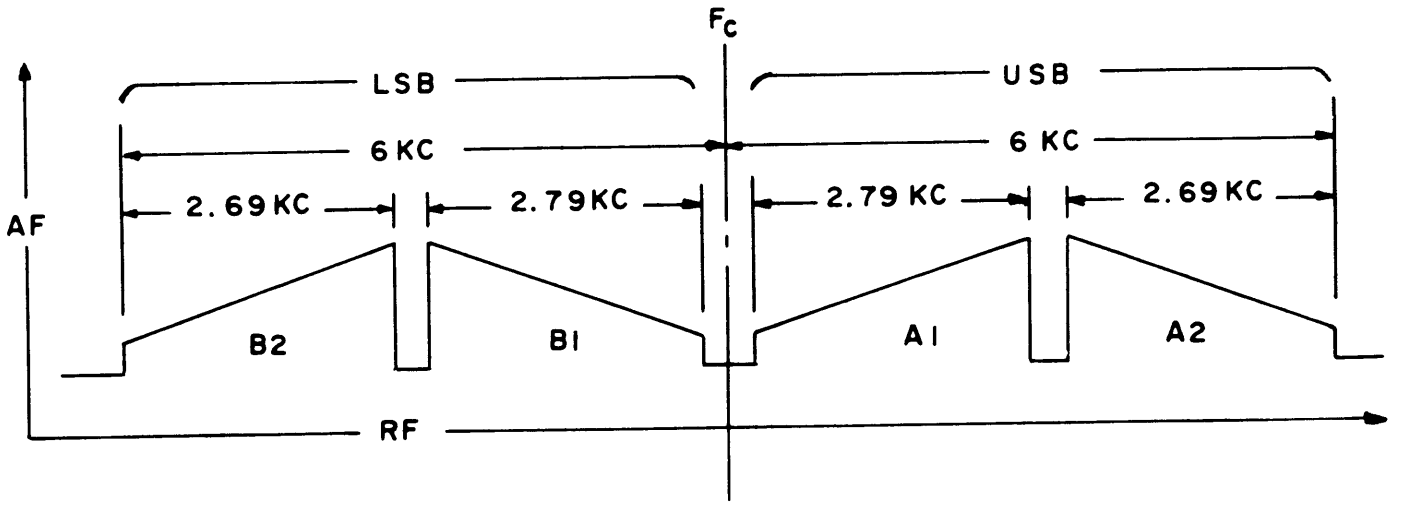


FIGURE 3, FREQUENCY SPECTRUM, FOUR CHANNEL ISB

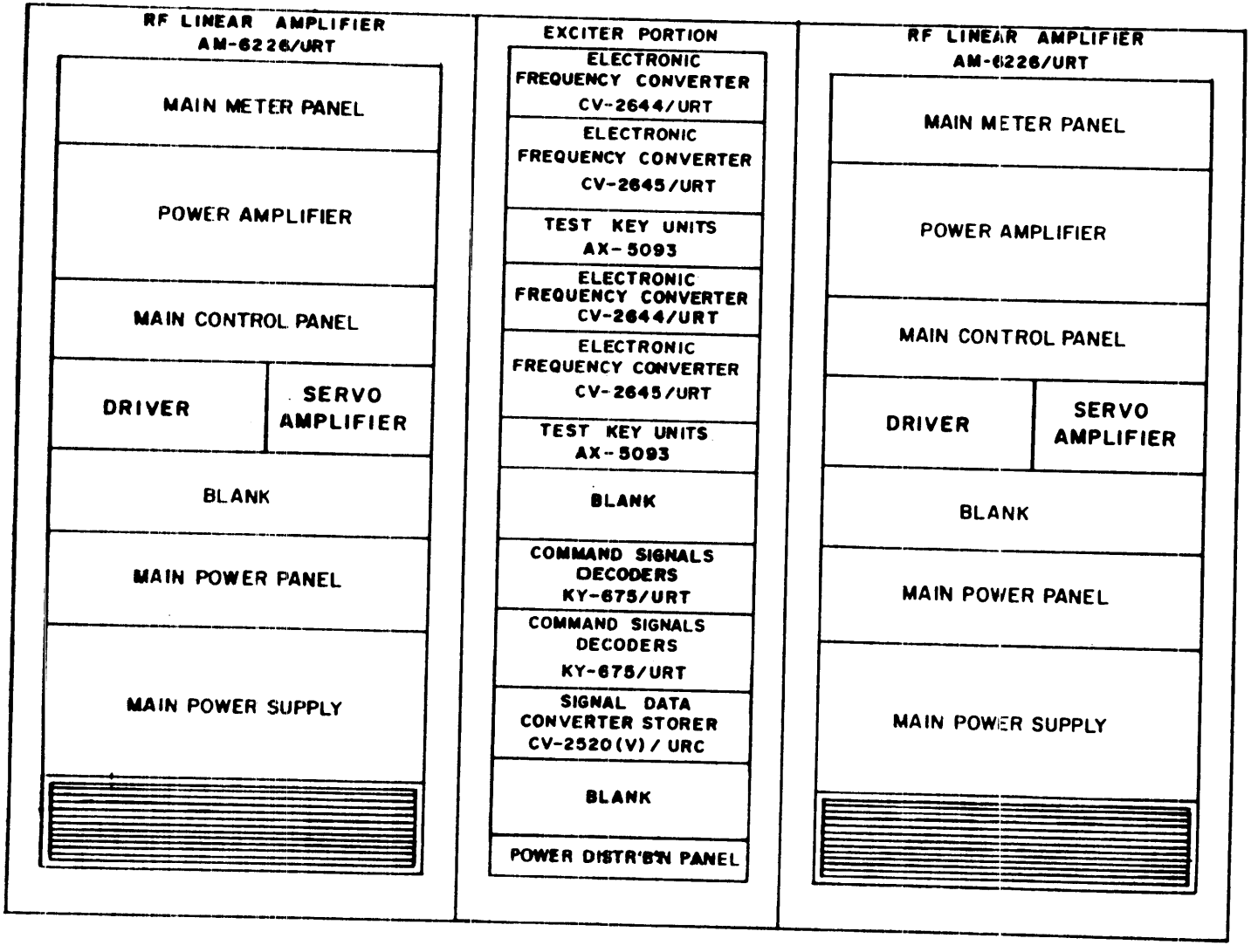


FIGURE 4. AN/URT-37(V) RADIO TRANSMITTING SET, FRONT ELEVATION

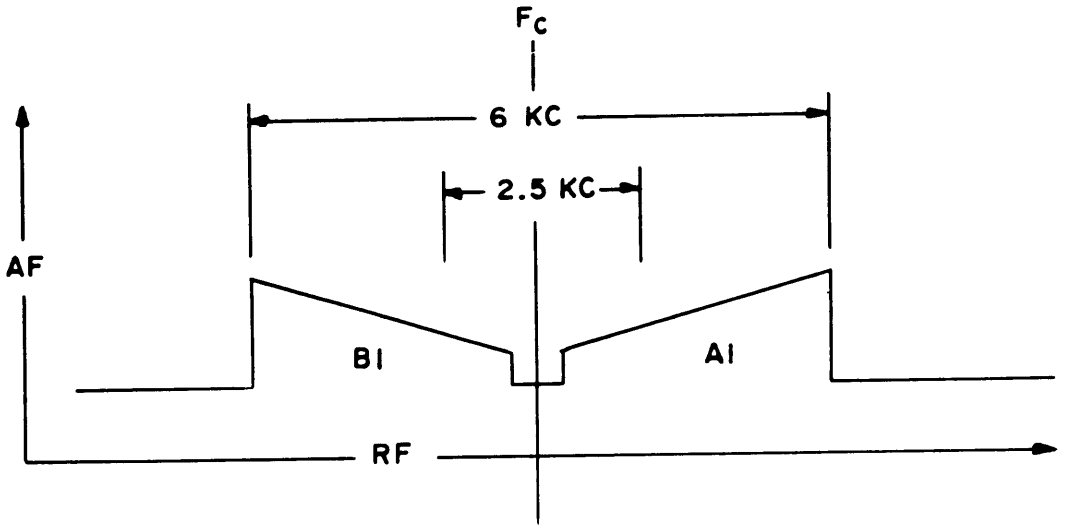


FIGURE 5, FREQUENCY SPECTRUM, SYMMETRICAL CHANNEL

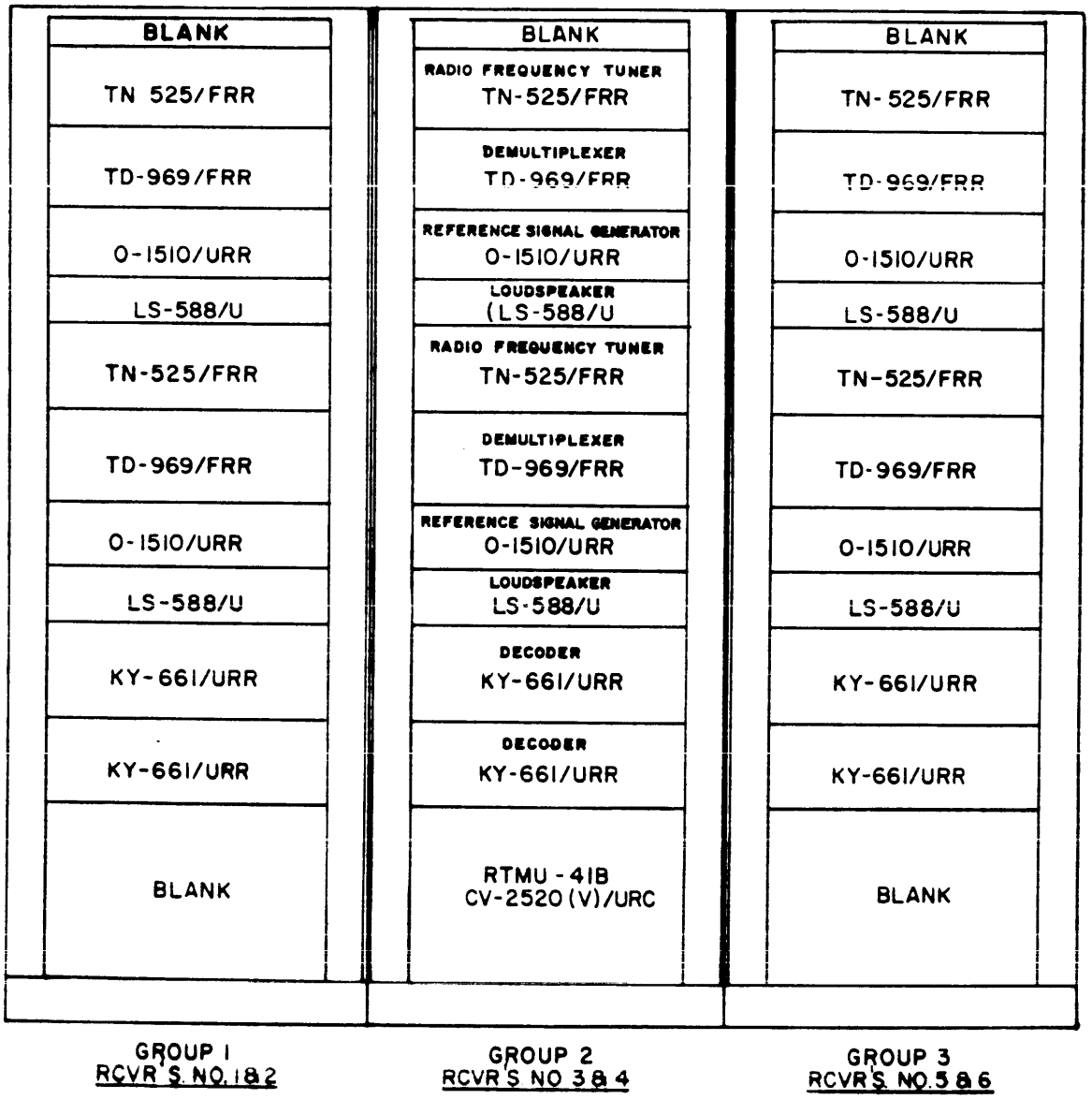


FIGURE 6. RADIO RECEIVING SET AN/FRR-85(V)1, FRONT ELEVATION

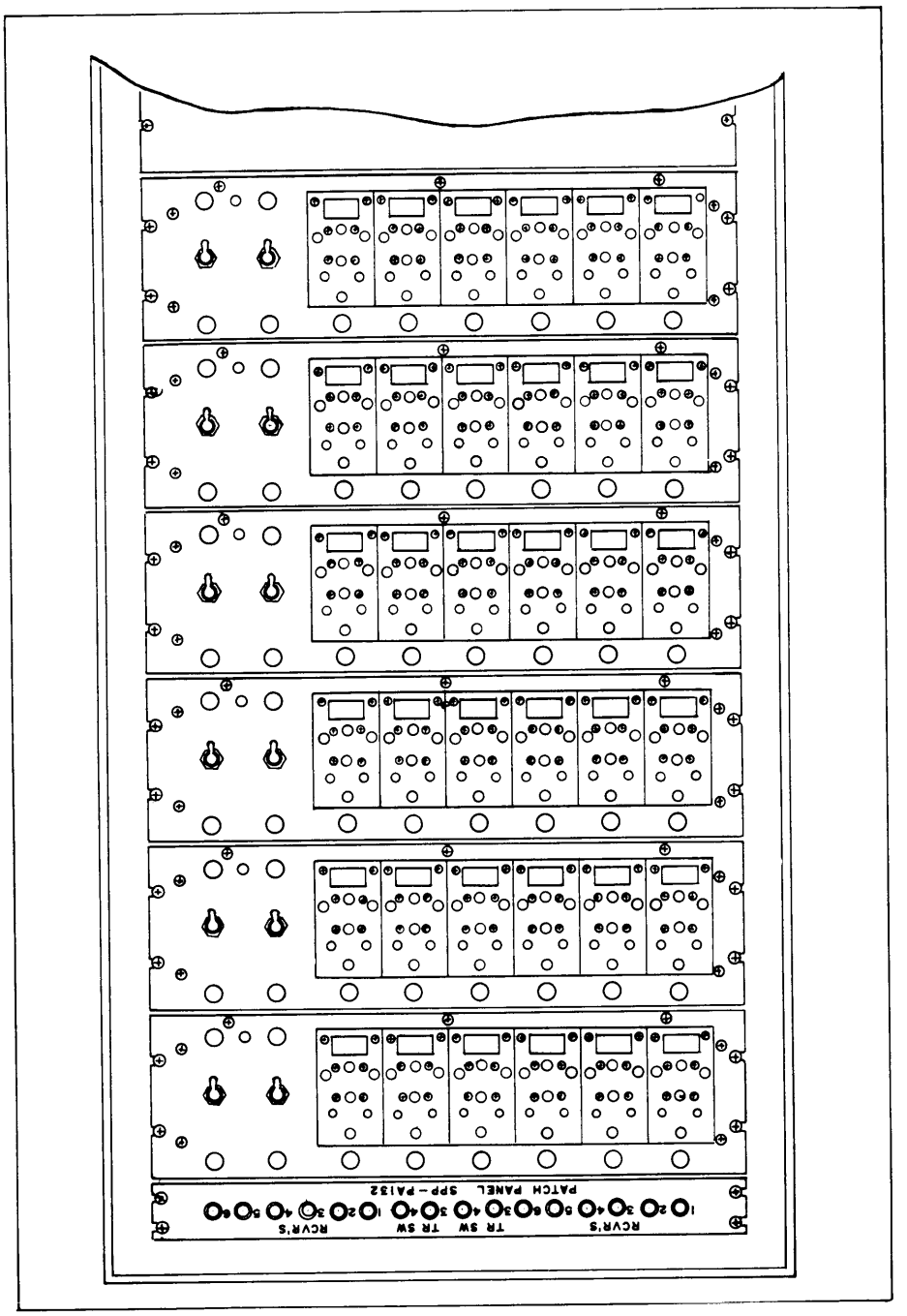


Figure 7. Receiver Filter System SYM 4200, Front Elevation

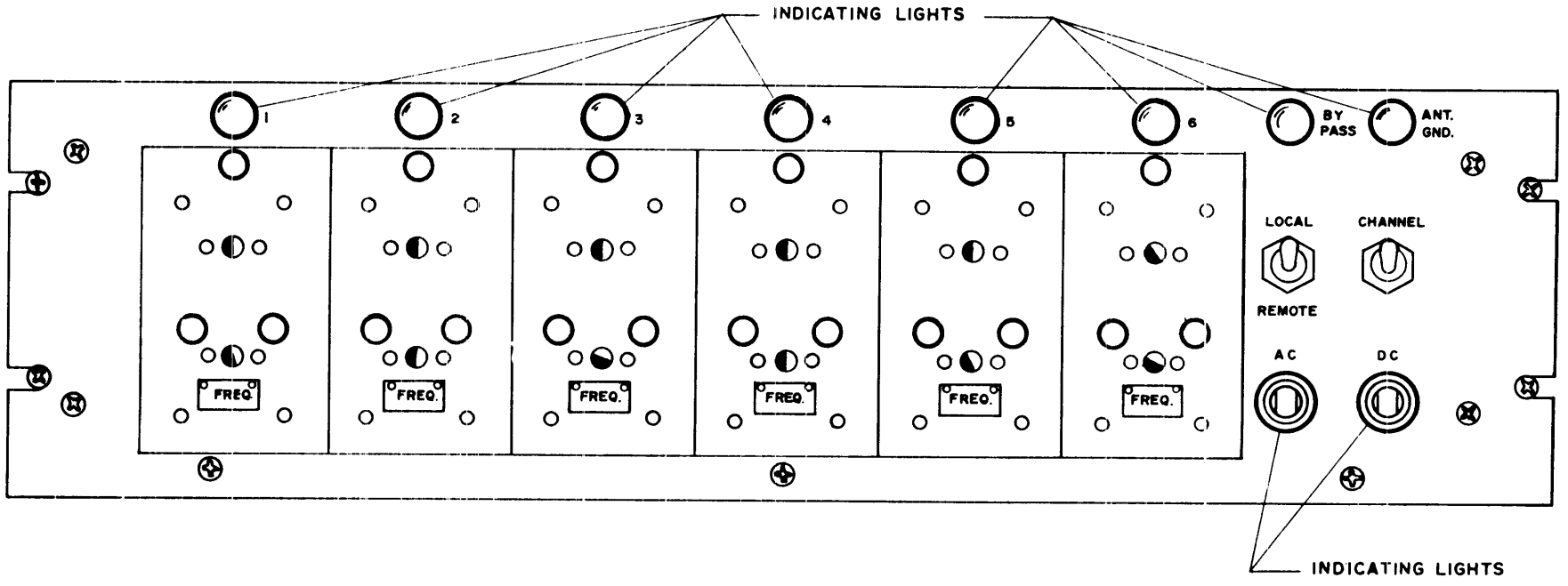


Figure 8. Filter Module Drawer LPFB-2(6), Front Panel

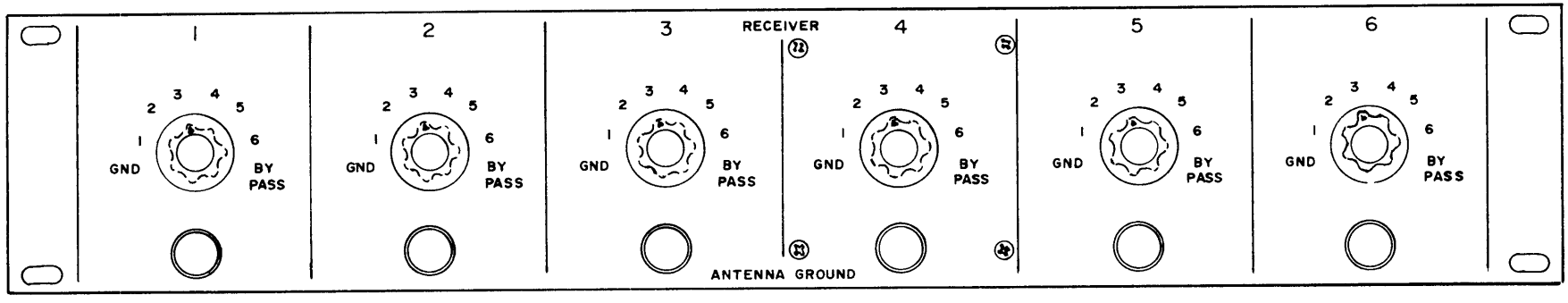


Figure 9. Remote Control Panel RCP-6

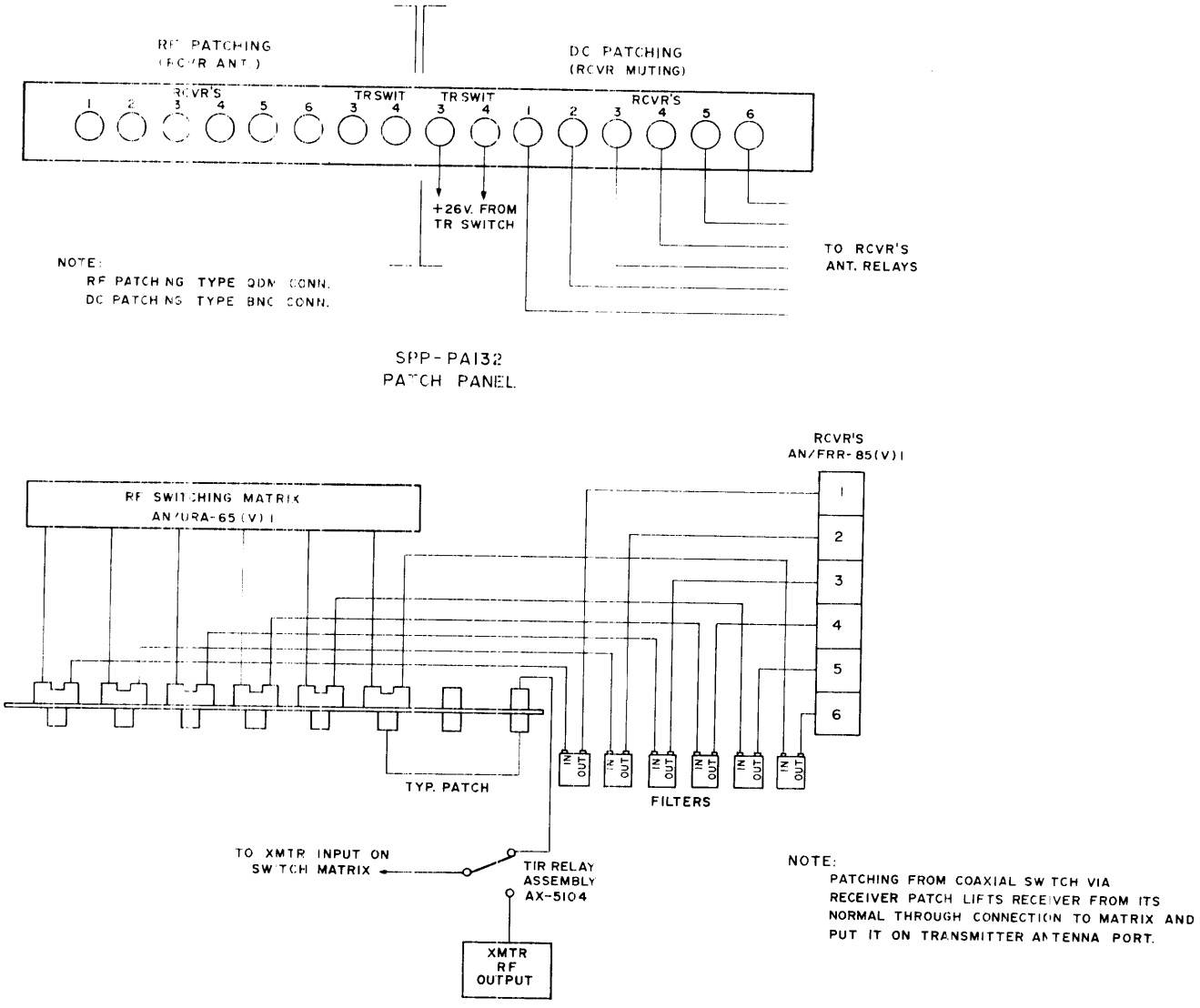


Figure 10. Patch Panel SPP-PA132, Patching Schematic

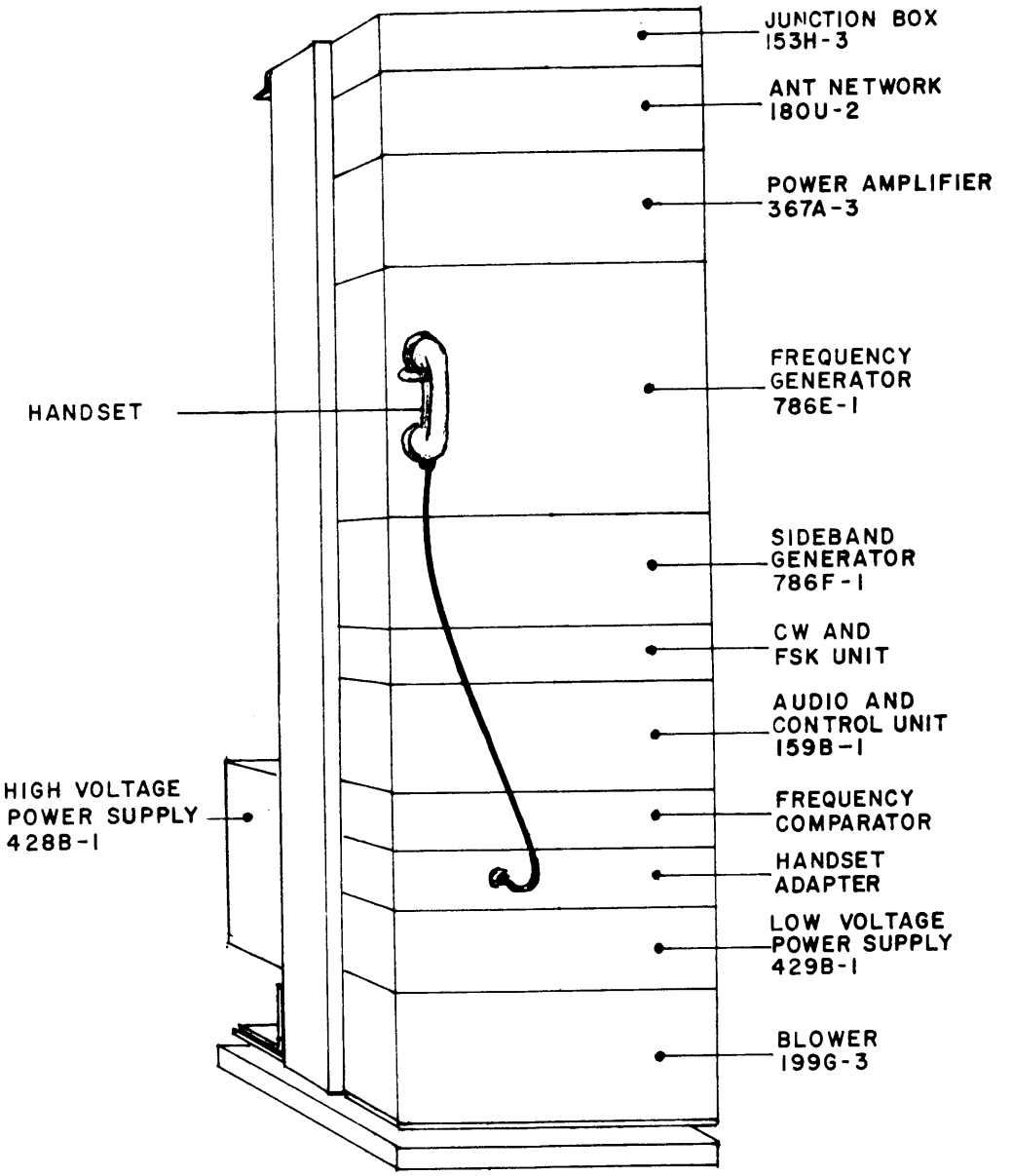
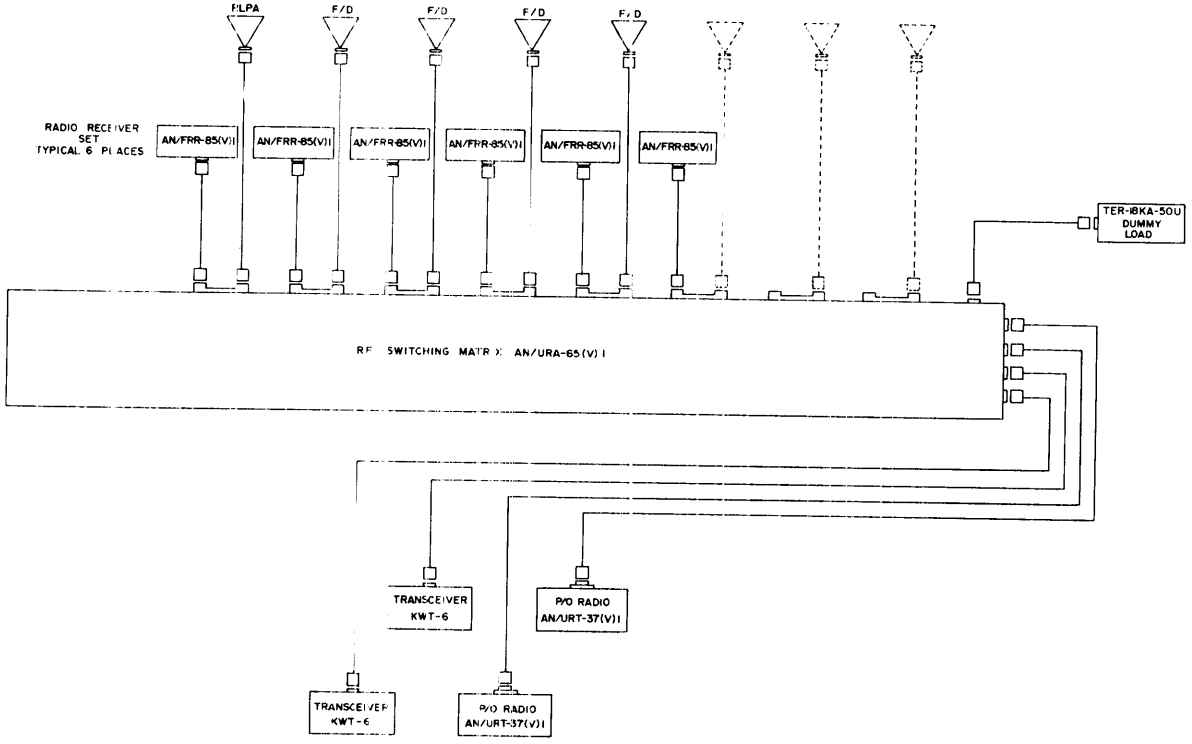


FIGURE 11, TRANSCEIVER KWT-6 TYPE 8



NOTES:
1. DOTTED LINES INDICATE FUTURE INSTALLATION.
2. RLPA ROTATABLE LCG PERIODIC ANTENNA.
3. F/D FAN DOUBLET.

Figure 12. RF Switching Matrix Inputs and Outputs

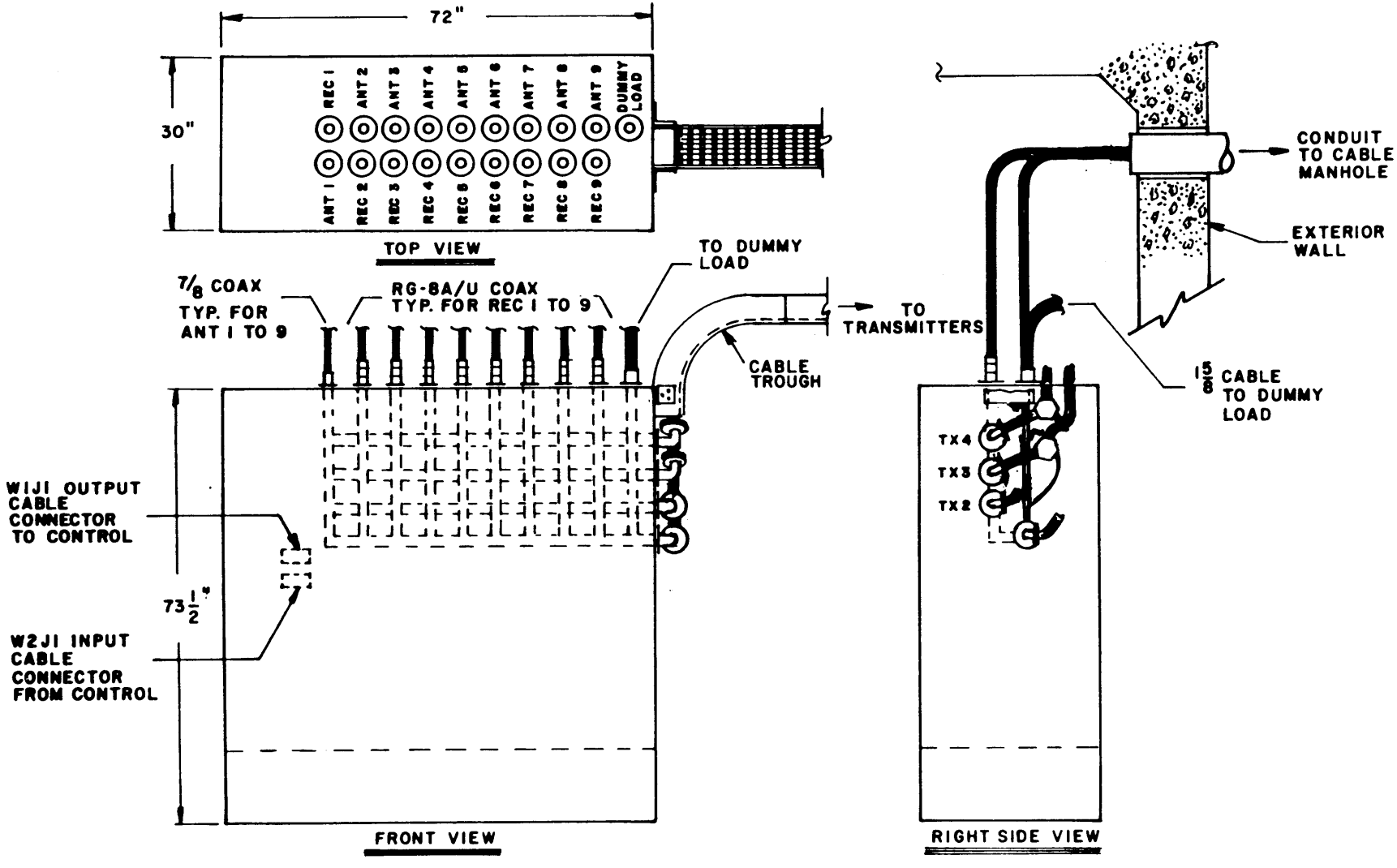


FIGURE 13. RF SWITCHING MATRIX AN/URA-65(V), PHYSICAL ARRANGEMENT

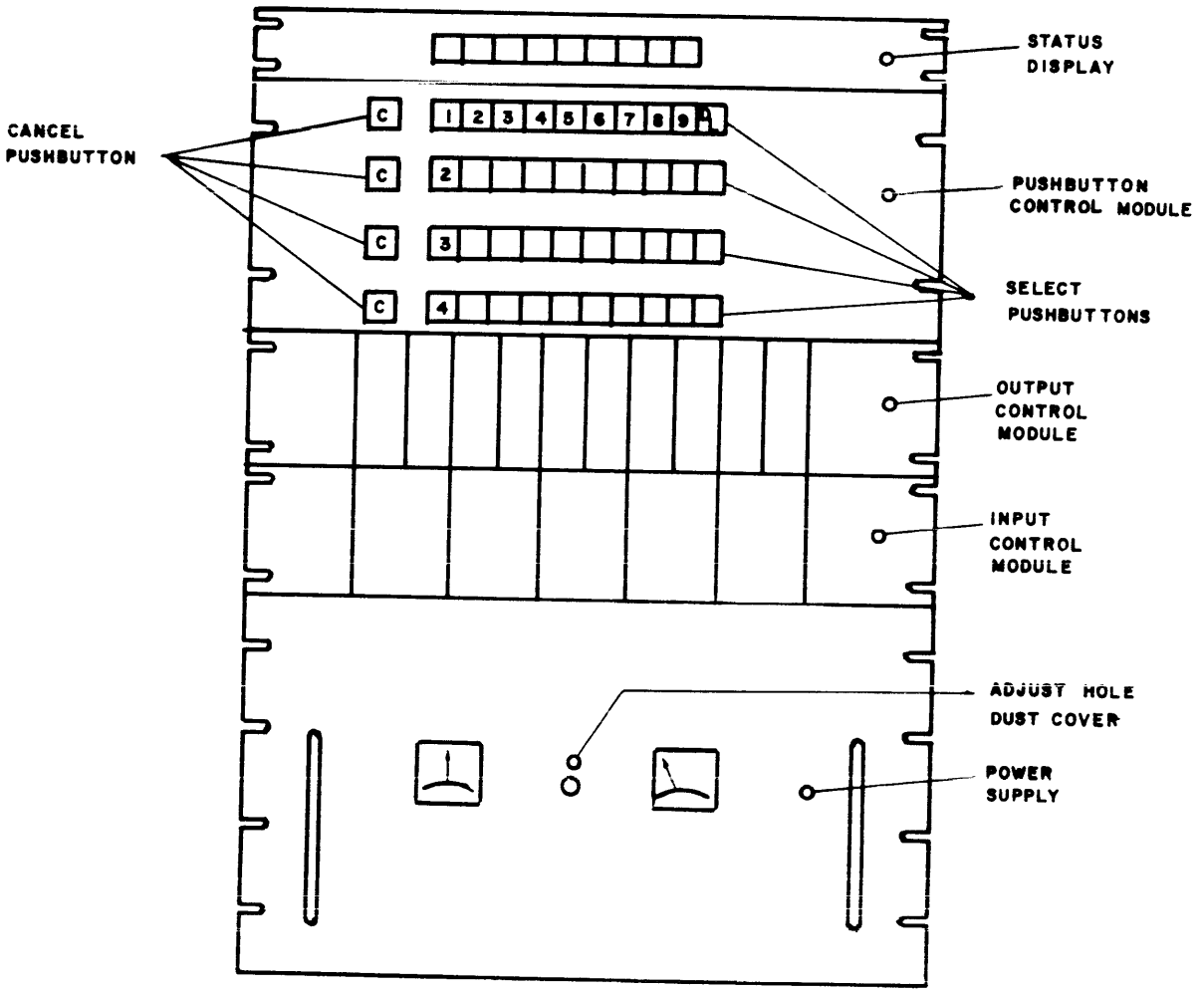


FIGURE 14, RF SWITCHING MATRIX AN/URA-65(V) 1, CONTROL PANEL

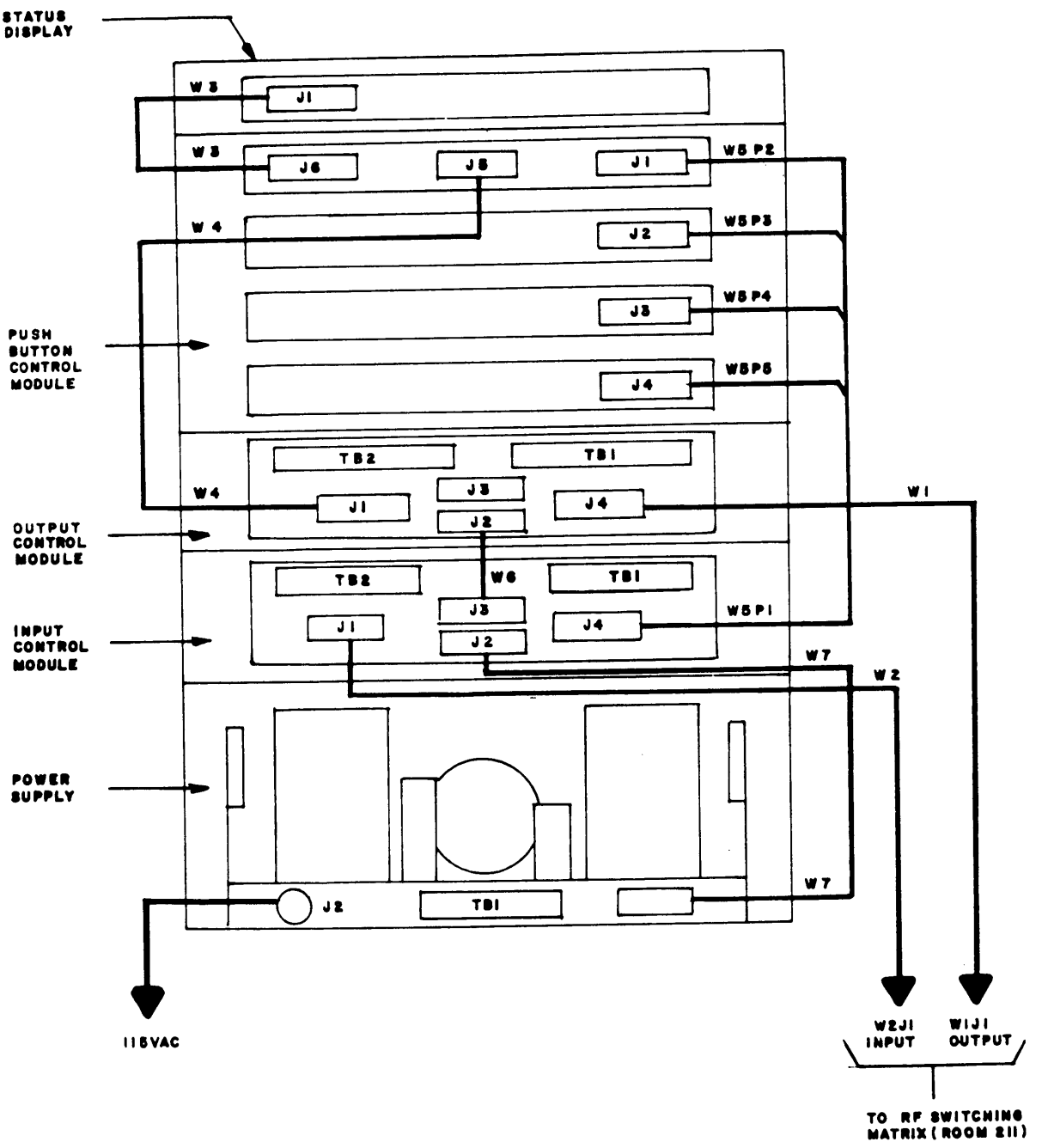


FIGURE 15, RF SWITCHING MATRIX CONTROL PANEL INTERCONNECTING WIRING

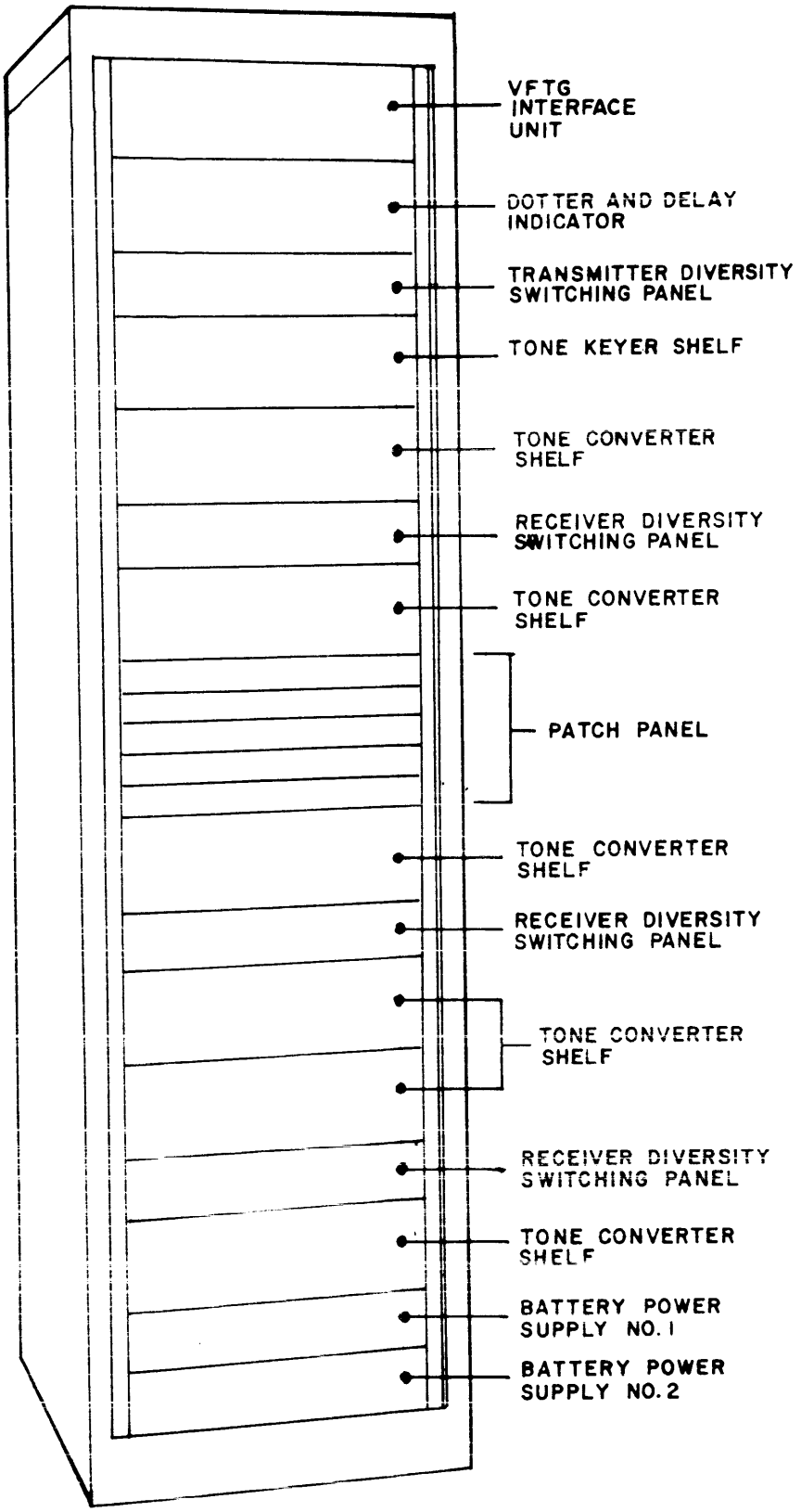
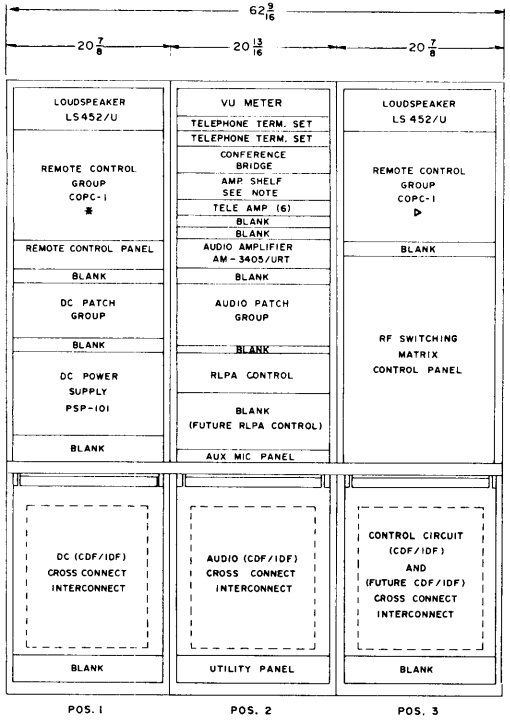
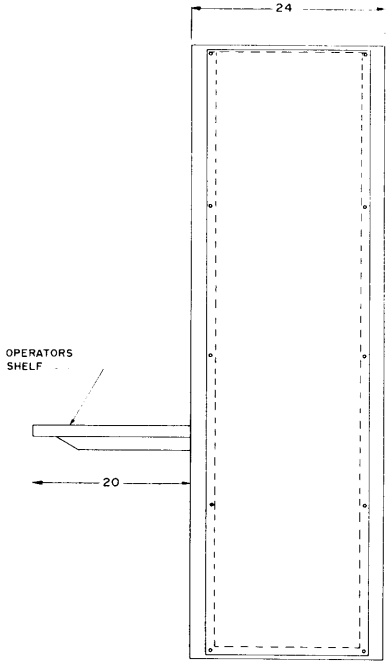


FIGURE 16, TELEGRAPH TERMINAL AN/FGC-61A





NOTES:

* 1. RECEIVER REMOTE CONTROL
▷ 2. TRANSMITTER REMOTE CONTROL
3. AMPLIFIER SHELF CONTAINS:
FOUR (4) LINE AMPLIFIERS - 456B BRIDGING-MONITOR AMP CONSISTING OF 480A, 456B AND 463A CONSTANT LEVEL AMP - 460B

REFERENCE DWG'S:

S630-002• NACOM II, FLOOR PLAN
S630-003• NACOM II, POWER DISTRIBUTION
S630-004• NACOM II, SIGNAL CABLE DISTRIBUTION
S630-005• NACOM II, DC PATCH PANEL
S630-009• NACOM II, AUDIO PATCH PANEL
S630-010• NACOM II, ACTIVE AUDIO CIRCUIT DIAGRAM
S630-001• NACOM II, TYPICAL SIGNAL FLOW DIAGRAM

Figure 17. Communications Control Console

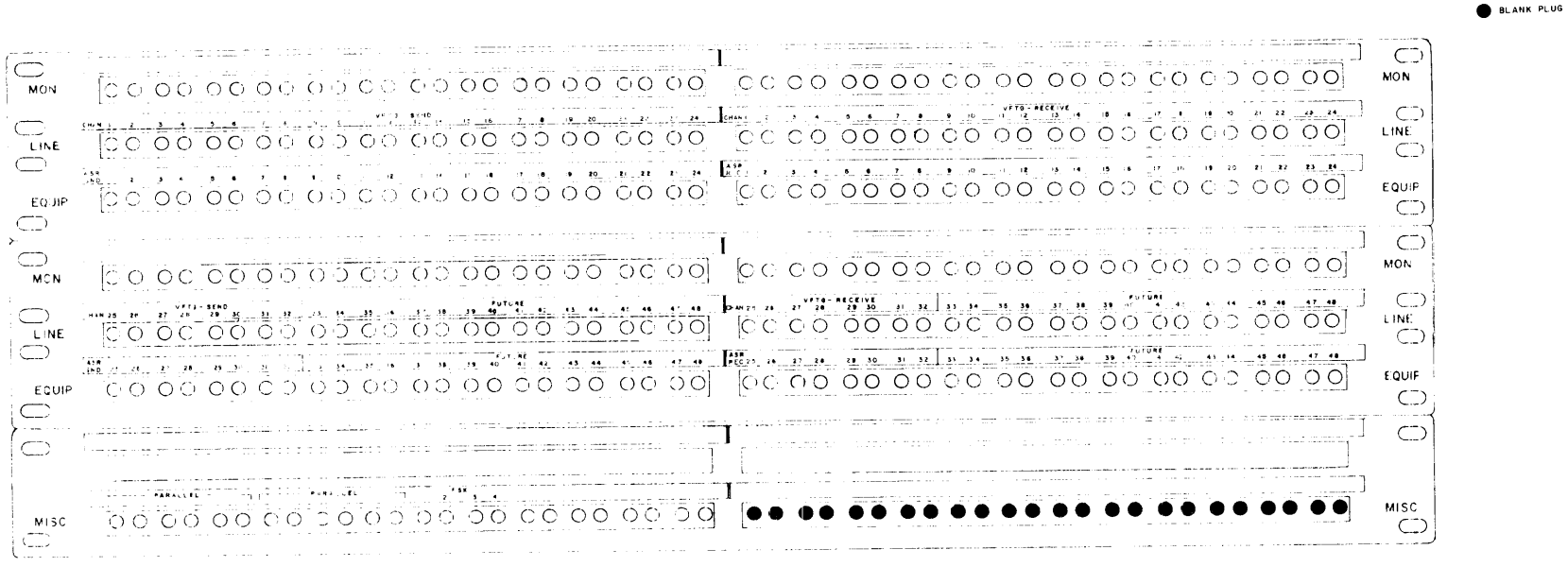


Figure 18. DC Patch Group

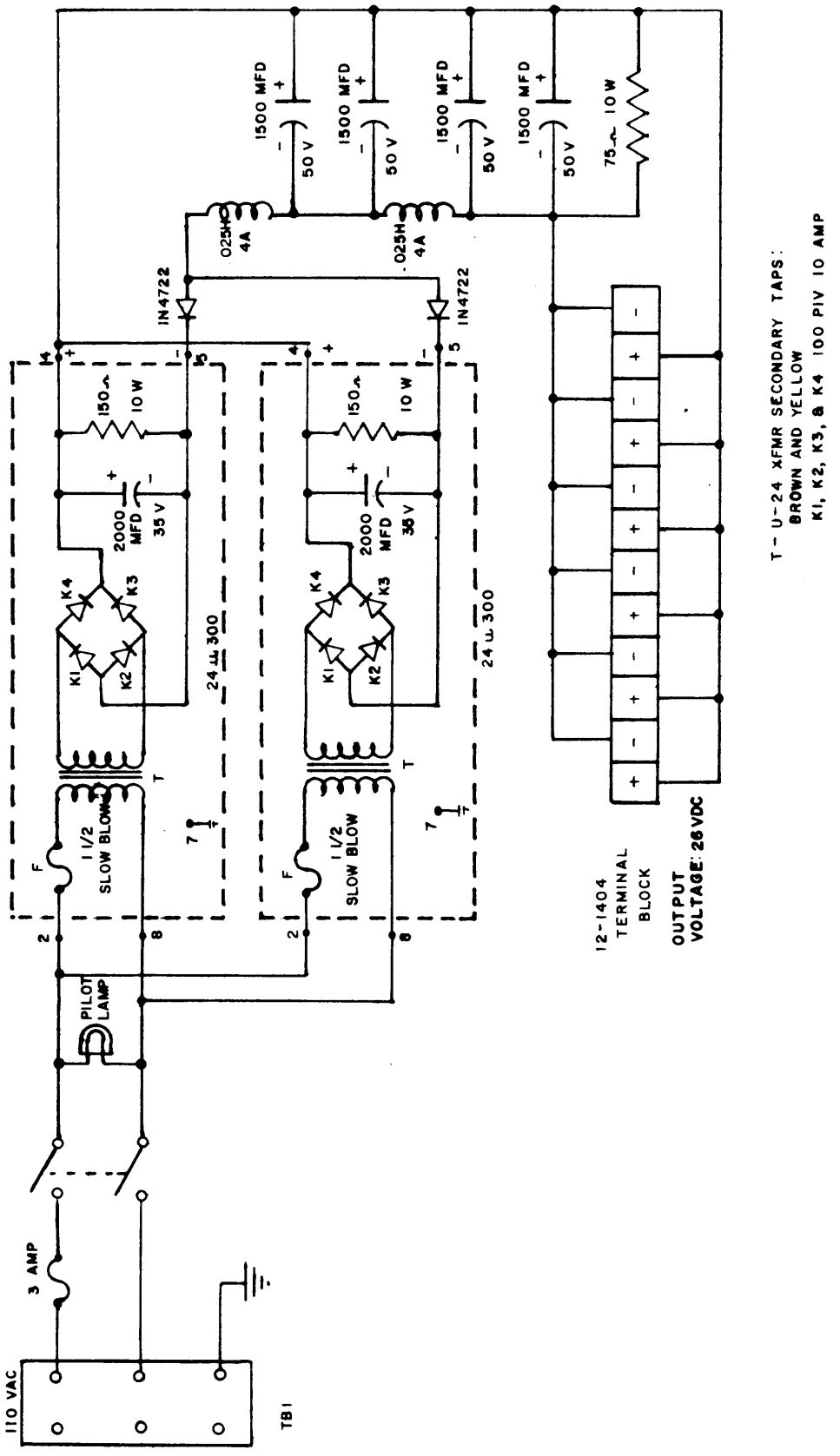
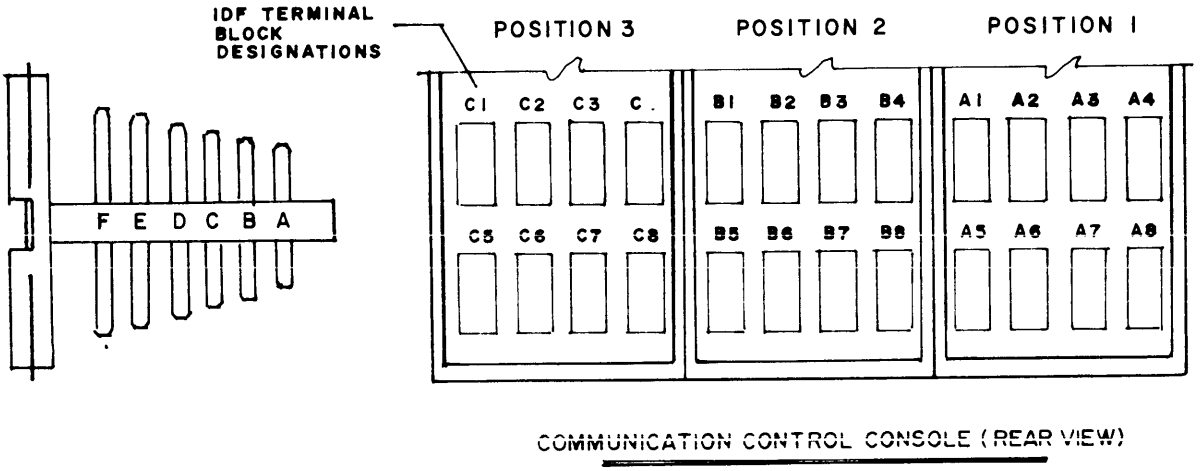


FIGURE 19. DC POWER SUPPLY, PSP-101



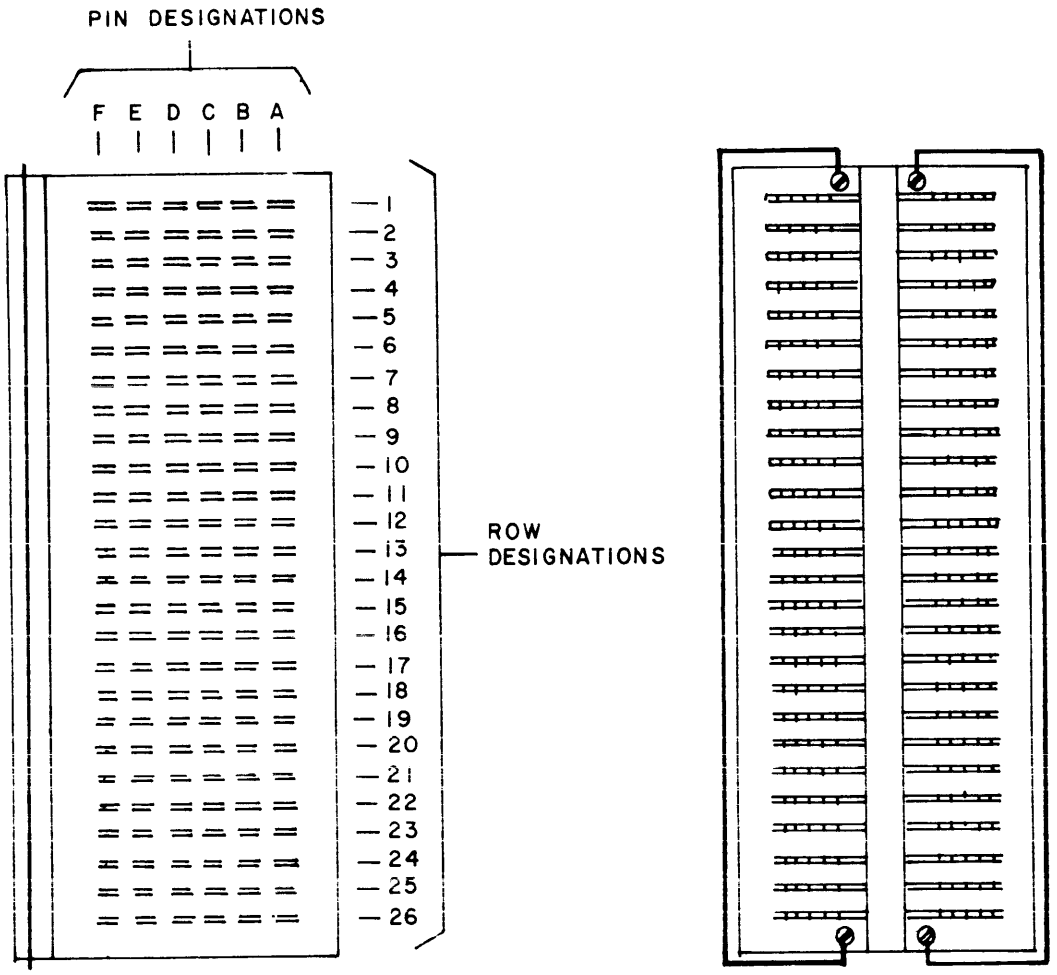
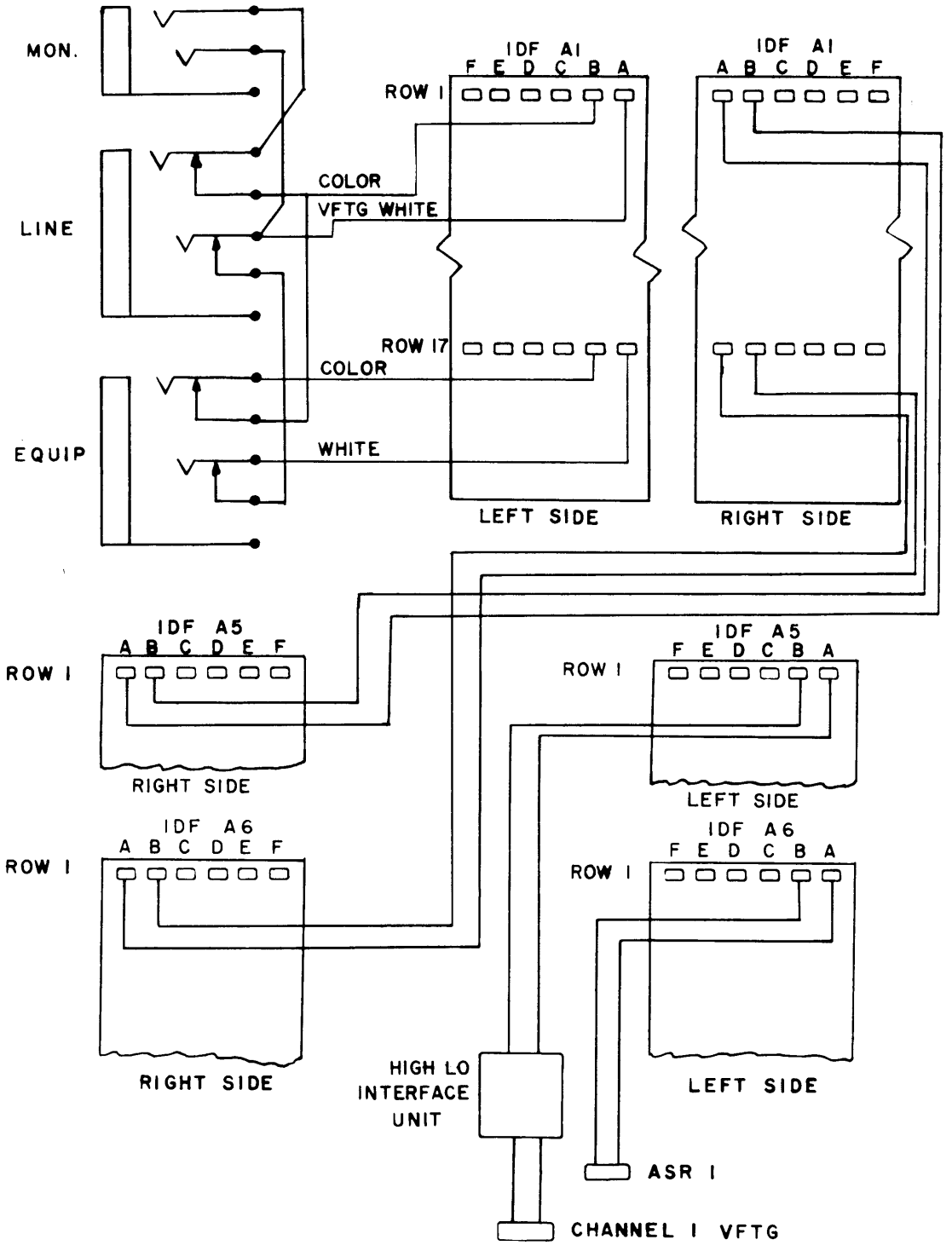
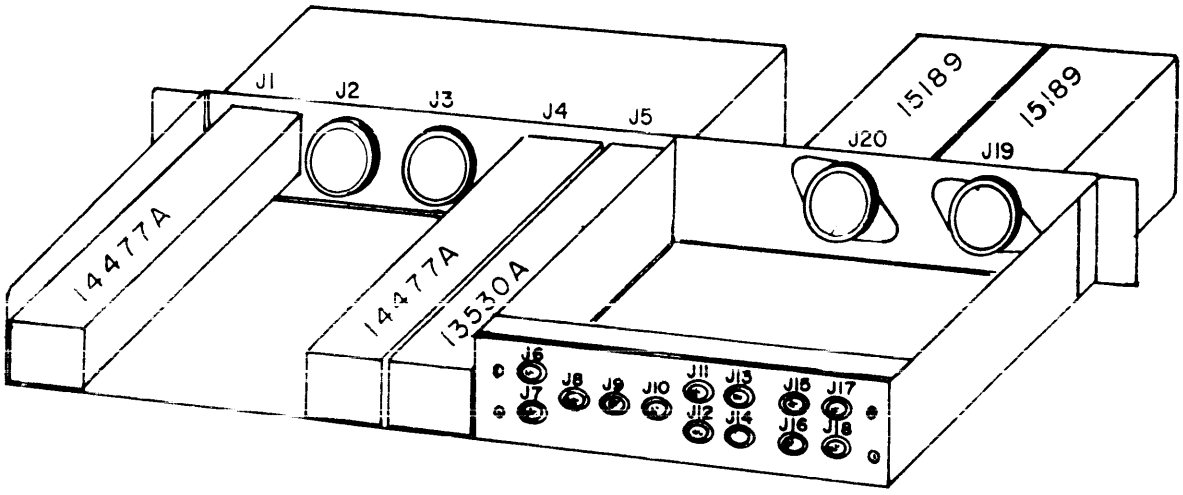


FIGURE 20. TYPICAL IDF TERMINAL BLOCK



NOTE: CABLES TERMINATED LEFT SIDE OF BLOCK CROSS CONNECT RIGHT SIDE OF BLOCK.

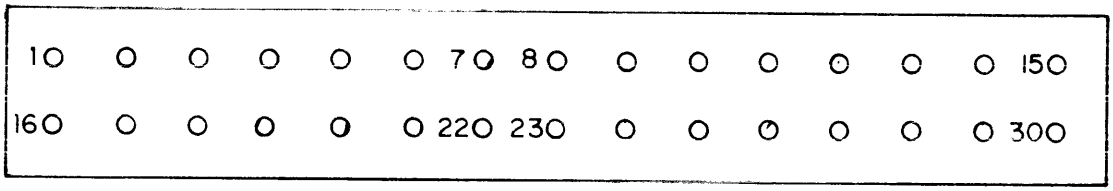
FIGURE 21. TYPICAL DC CIRCUIT



SOCKET ALLOCATIONS FOR PLUG-IN COMPONENTS

SOCKET	ALTEC COMPONENT	QUANTITY
J1 AND J4	ATTENUATOR 14477A	2
J2 AND J3	NOT USED	-
J5	COMPROMISE NETWORK 1353A	1
J19 AND J20	TRANSFORMER 15189	2

NOTE: ON SOCKETS J2 AND J3, STRAP PIN 1 TO 3 AND PIN 2 TO 4



TB1 REAR VIEW

FIGURE 22. ALTEC 7304 TELEPHONE TERMINATION SET, PHYSICAL CONFIGURATION

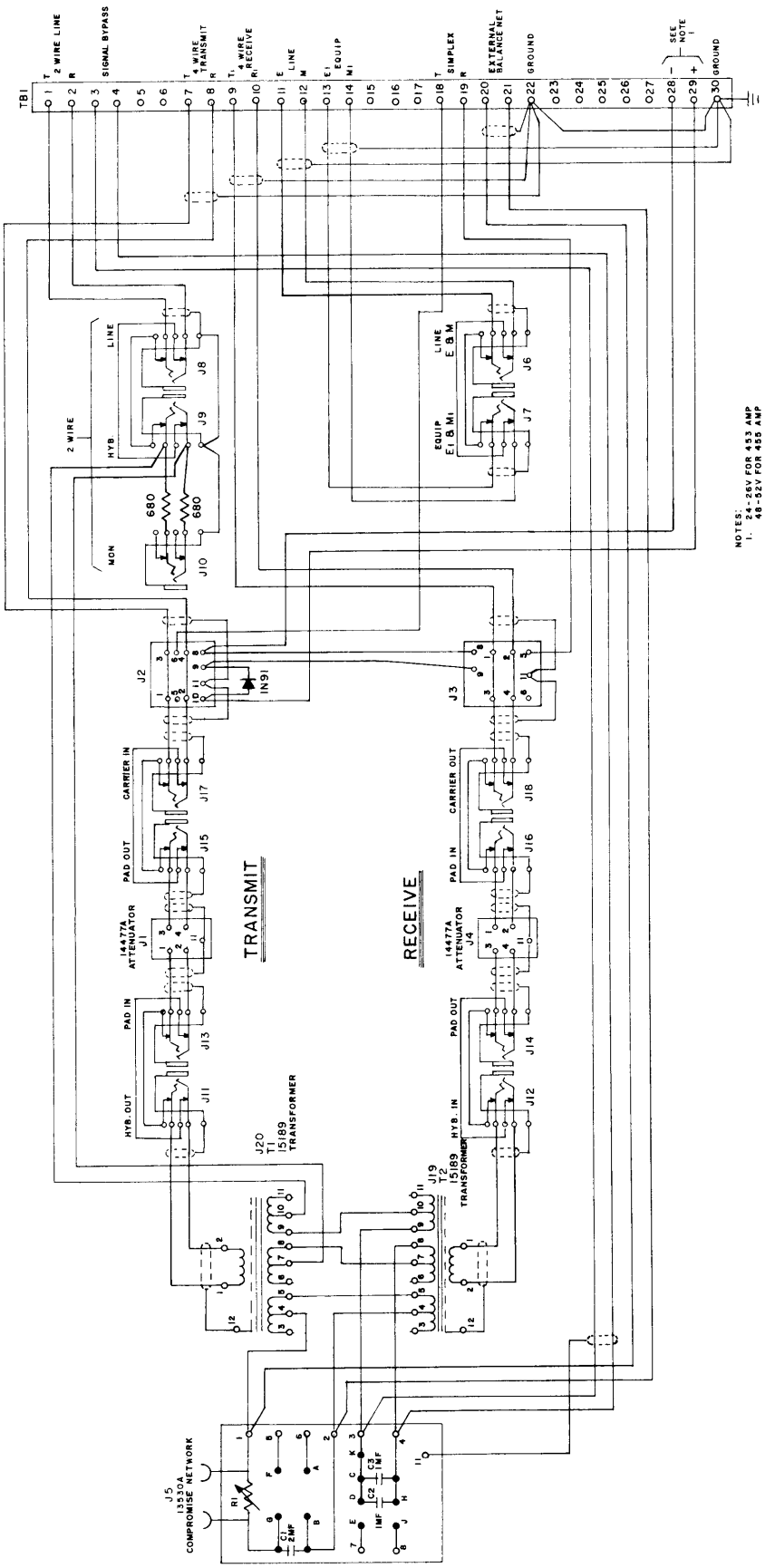
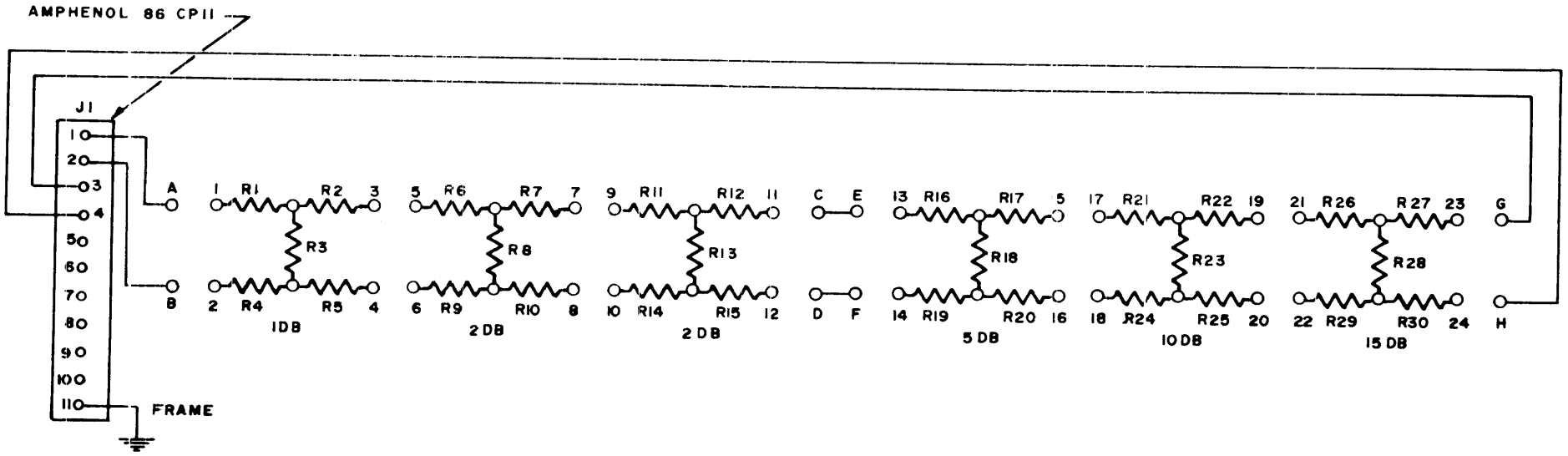
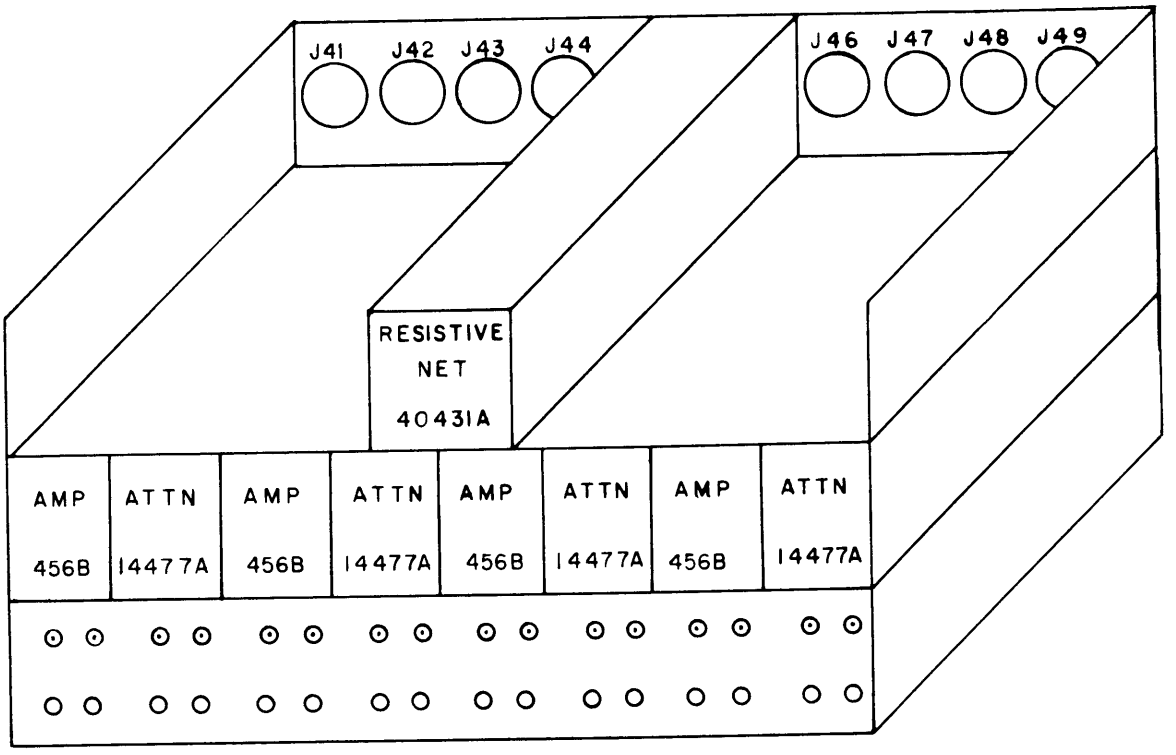


Figure 23. ALTEC 7304 Telephone Termination Set, Schematic Diagram



RESISTORS 1/4W ±1%	OHMS
R1, R2, R4, R5	17
R3	5200
R6, R7, R9, R10, R11, R12, R14, R15	34
R8, R13	2580
R16, R17, R19, R20	84
R18	983
R21, R22, R24, R25	155
R23	421
R26, R27, R29, R30	211
R28	220

Figure 24. ALTEC 14477A Attenuator, Schematic Diagram



SOCKET ALLOCATIONS FOR PLUG-IN COMPONENT

SOCKET	ALTEC COMPONENT
J33, J35, J37, J39	456B AMPLIFIER
J34, J36, J38, J40	14477A ATTENUATOR
J41, J43, J46, J48 J42, J44, J47, J49	NOT USED, STRAPPED
J45	40431A RESISTANCE BRIDGE

NOTE: SOCKETS J41, J43, J46, & J48 SHOULD BE STRAPPED FROM PINS 1 TO 3, 2 TO 4, 5 TO 7, AND 6 TO 10.

SOCKETS J42, J44, J47 & J49 SHOULD STRAPPED FROM PINS 1 TO 3, AND FROM 2 TO 4.

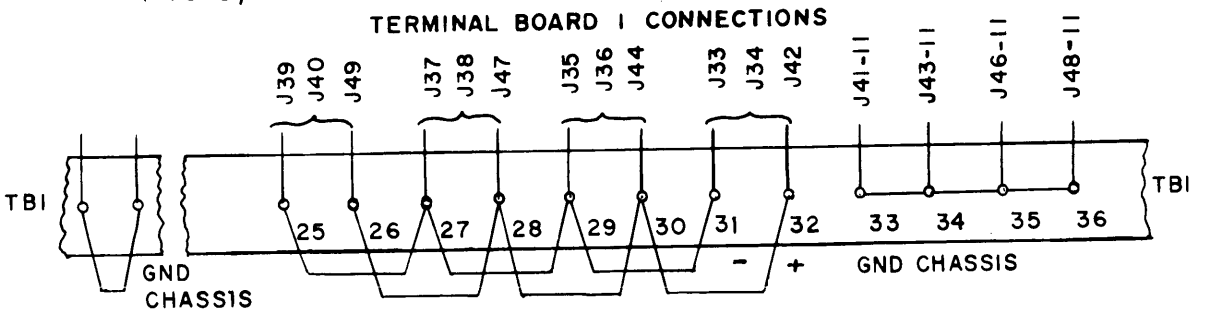
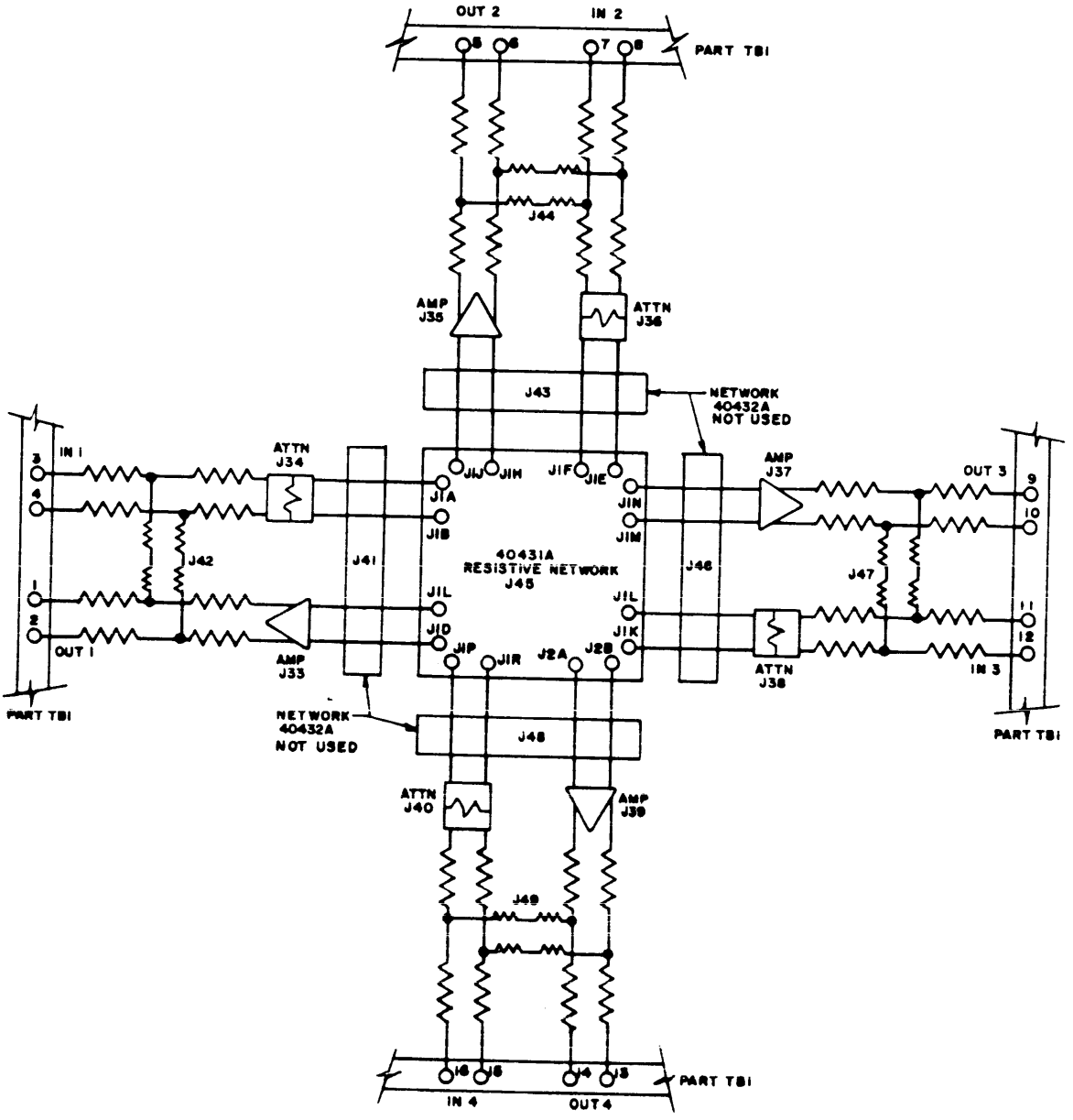


FIGURE 25, ALTEC 7314A FOUR WIRE, FOUR WAY PHYSICAL CONFIGURATION



1. SIDETONE NETWORK SOCKETS J41, J43, J46 AND J48 ARE BYPASSED WITH STRAPS.
2. SIDETONE AMPLIFIER SOCKETS J42, J44, J47 AND J49 ARE BYPASSED WITH STRAPS.

FIGURE 26, ALTEC 7314A FOUR WIRE, FOUR WAY CONFERENCE BRIDGE, BLOCK DIAGRAM

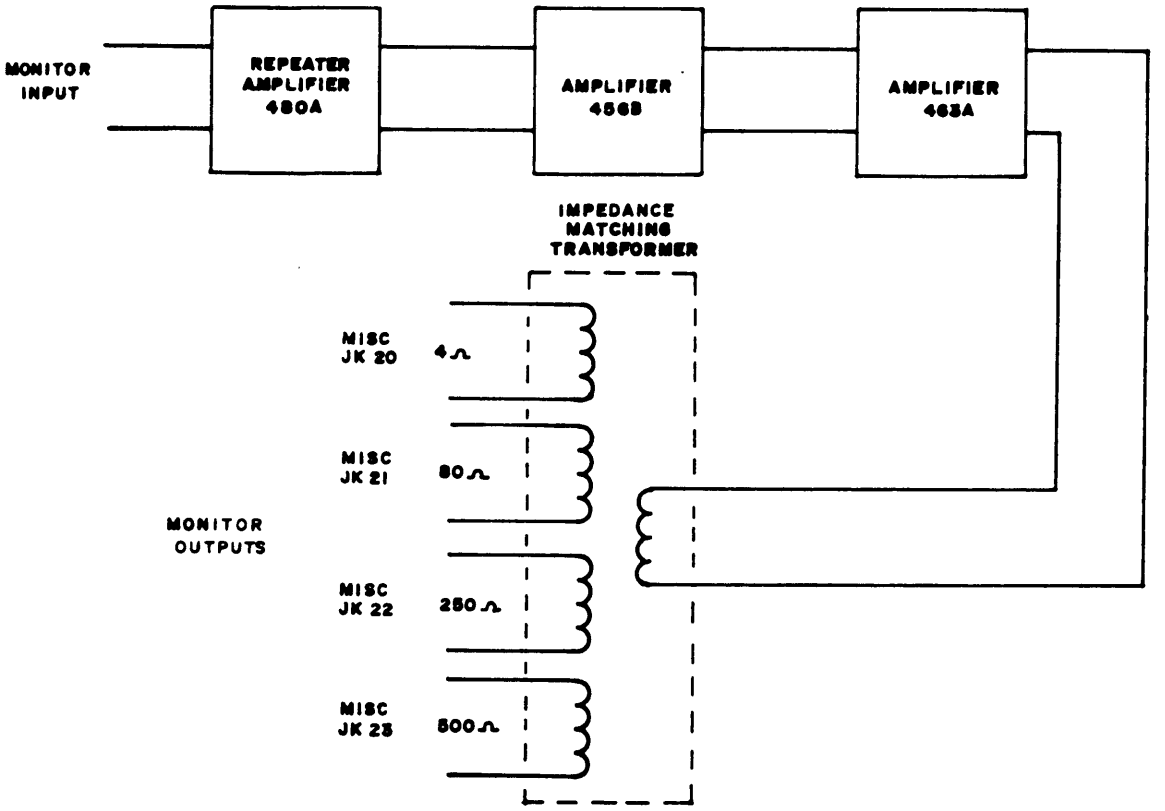


FIGURE 27, BRIDGING-MONITOR, BLOCK DIAGRAM

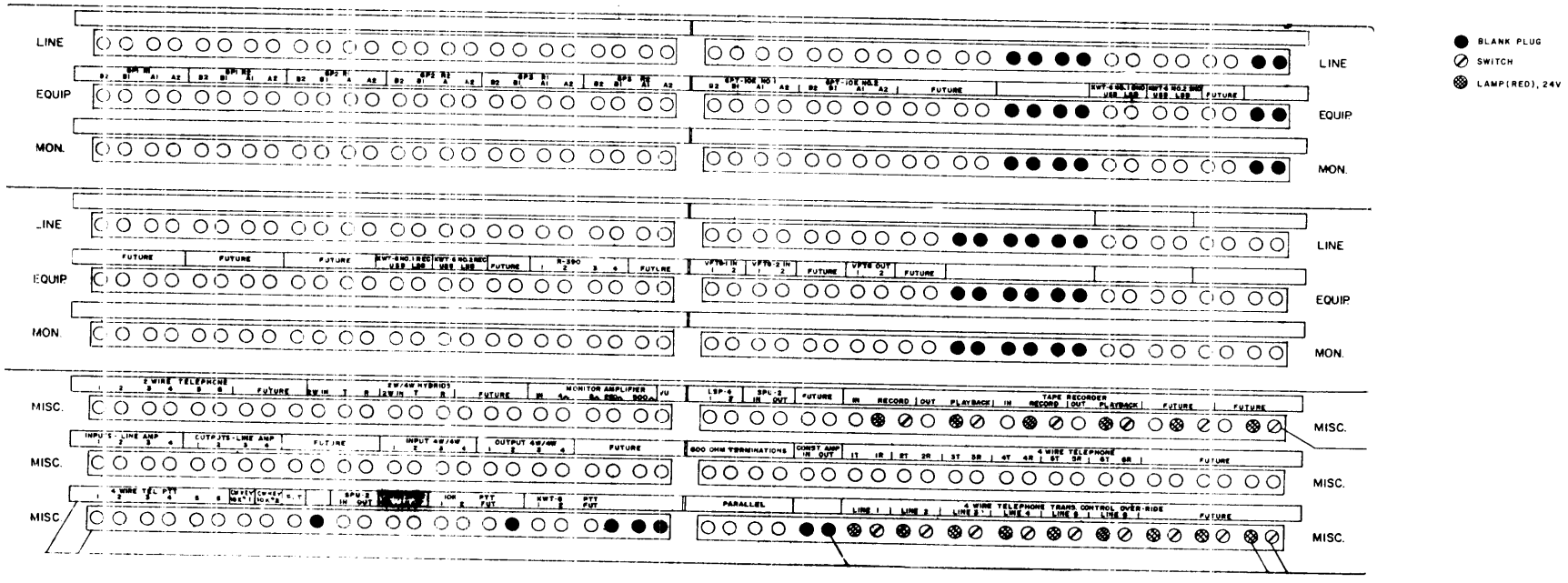


Figure 28. Audio Patch Group

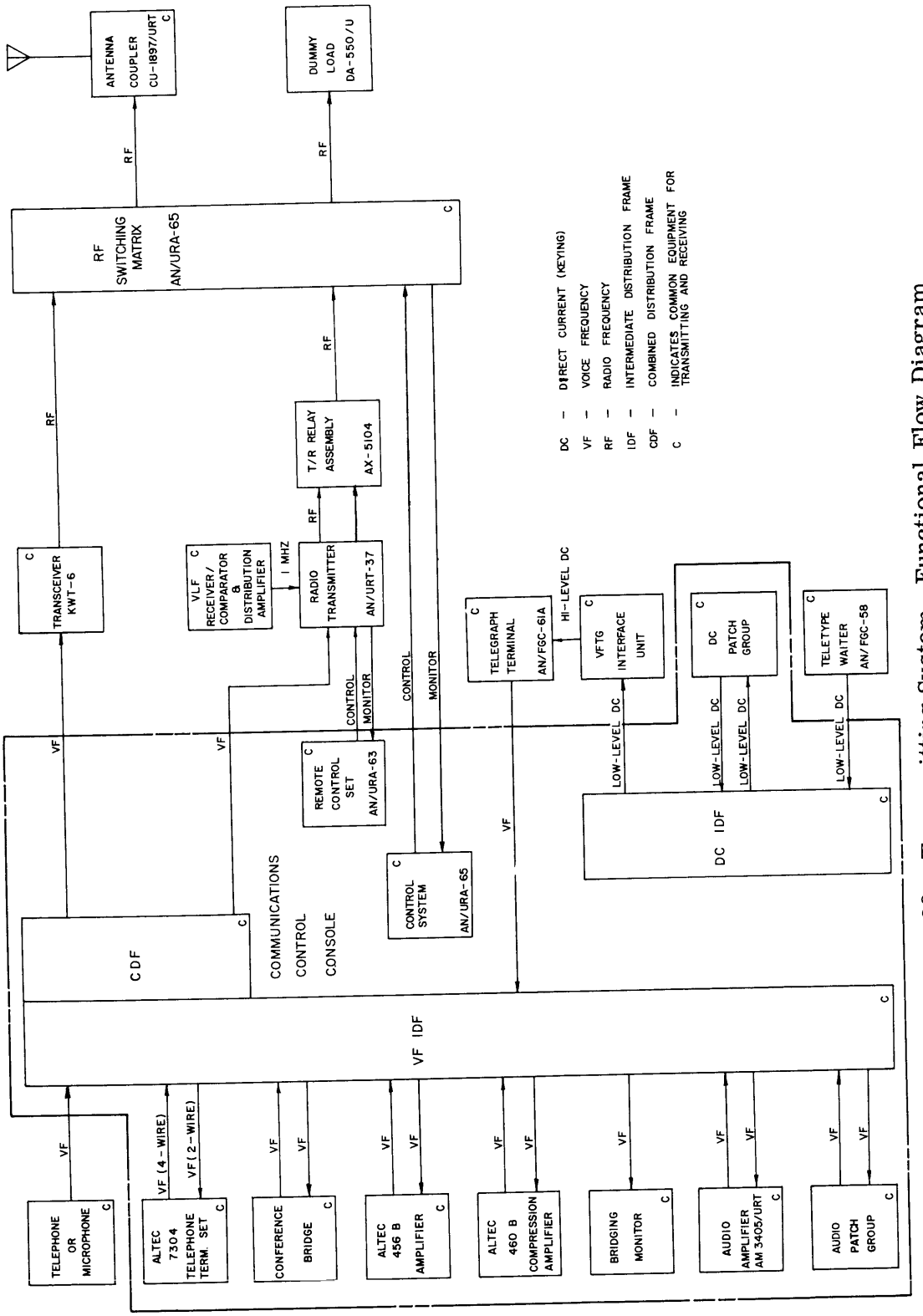


Figure 29. Transmitting System, Functional Flow Diagram

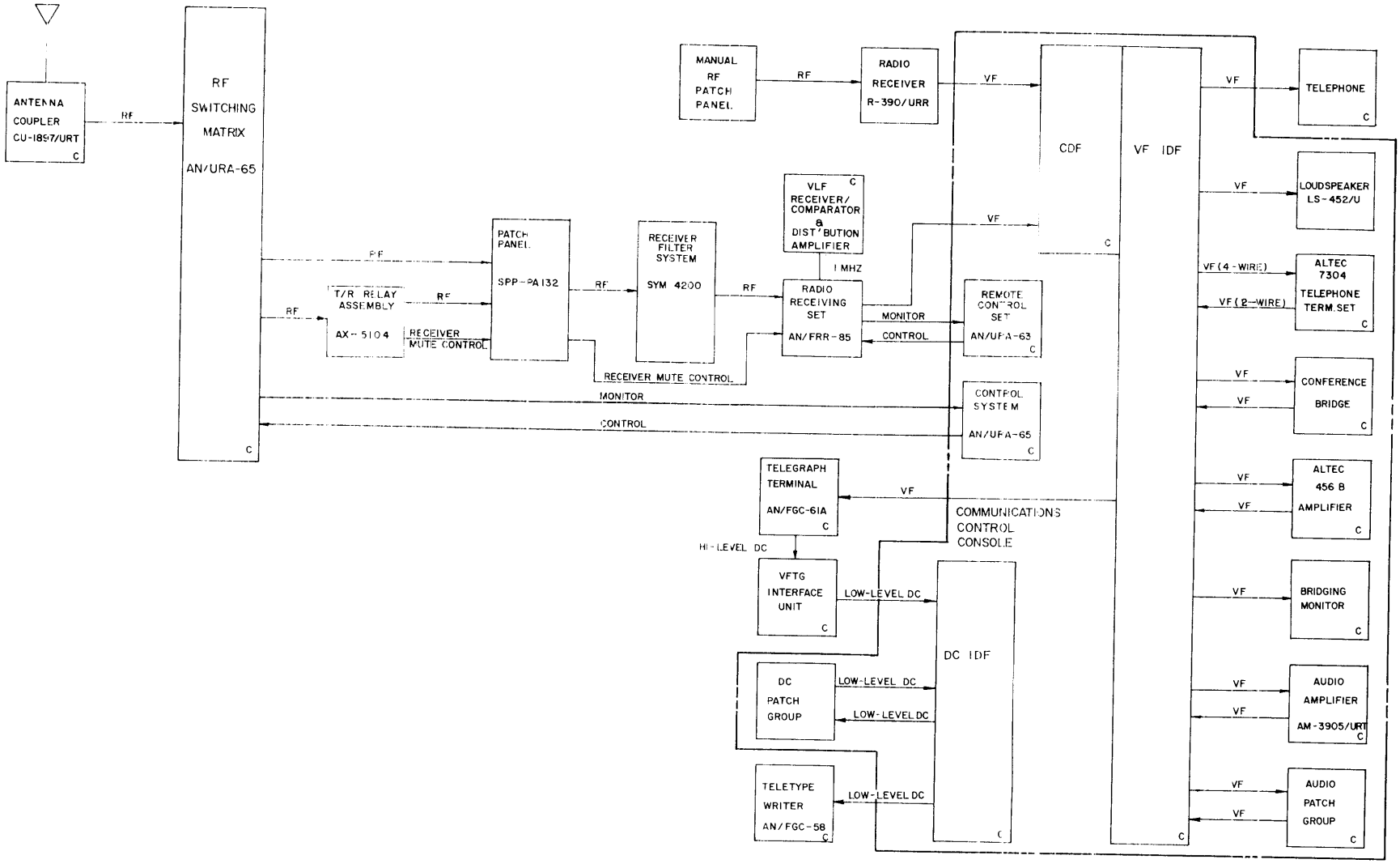


Figure 30. Receiving System, Functional Flow Diagram

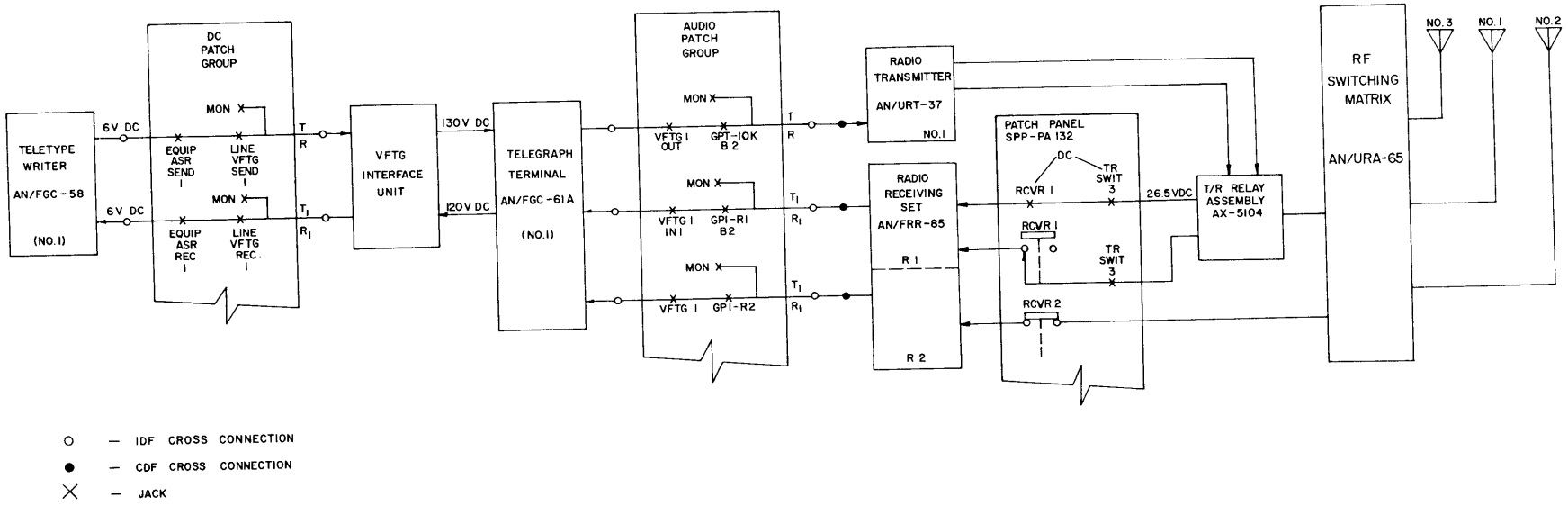


Figure 31. DC and VF Signal Flow in Typical System Configuration for Teletype Circuit

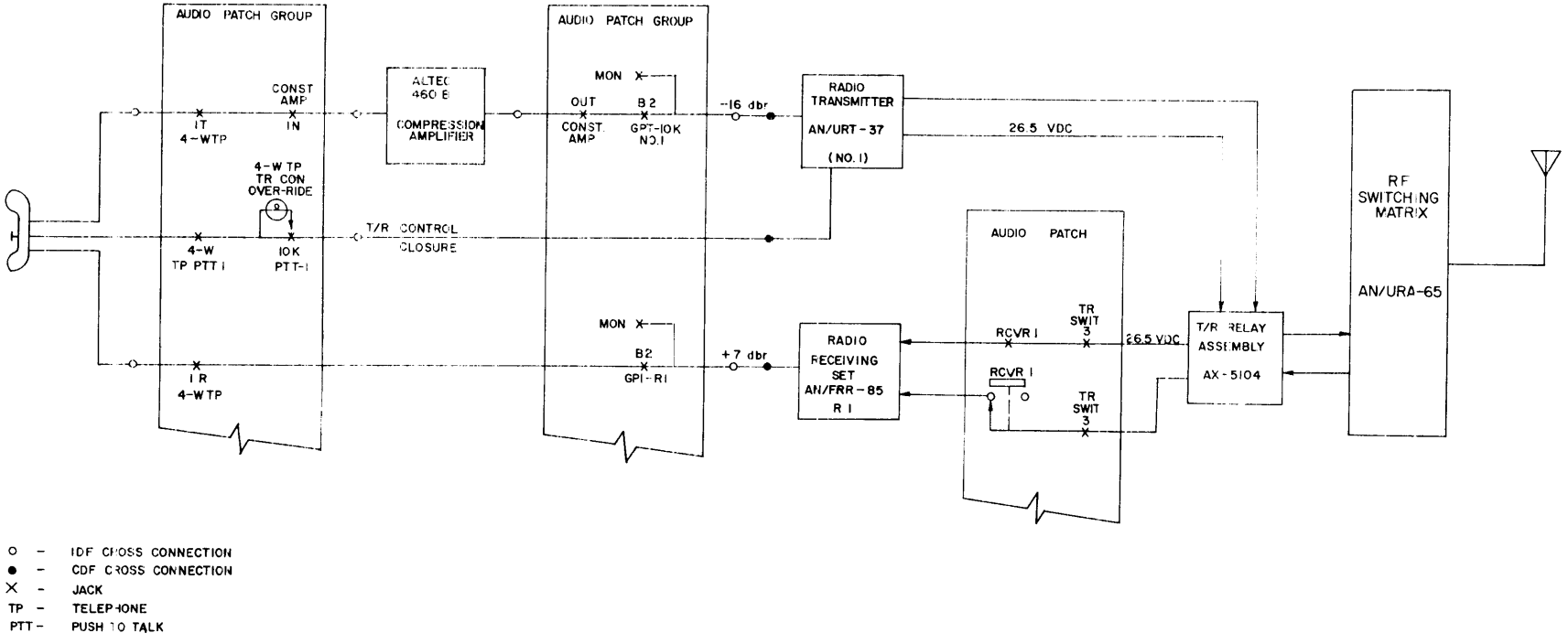


Figure 32. VF Signal Flow in Typical System Configuration for Voice Push-to-Talk

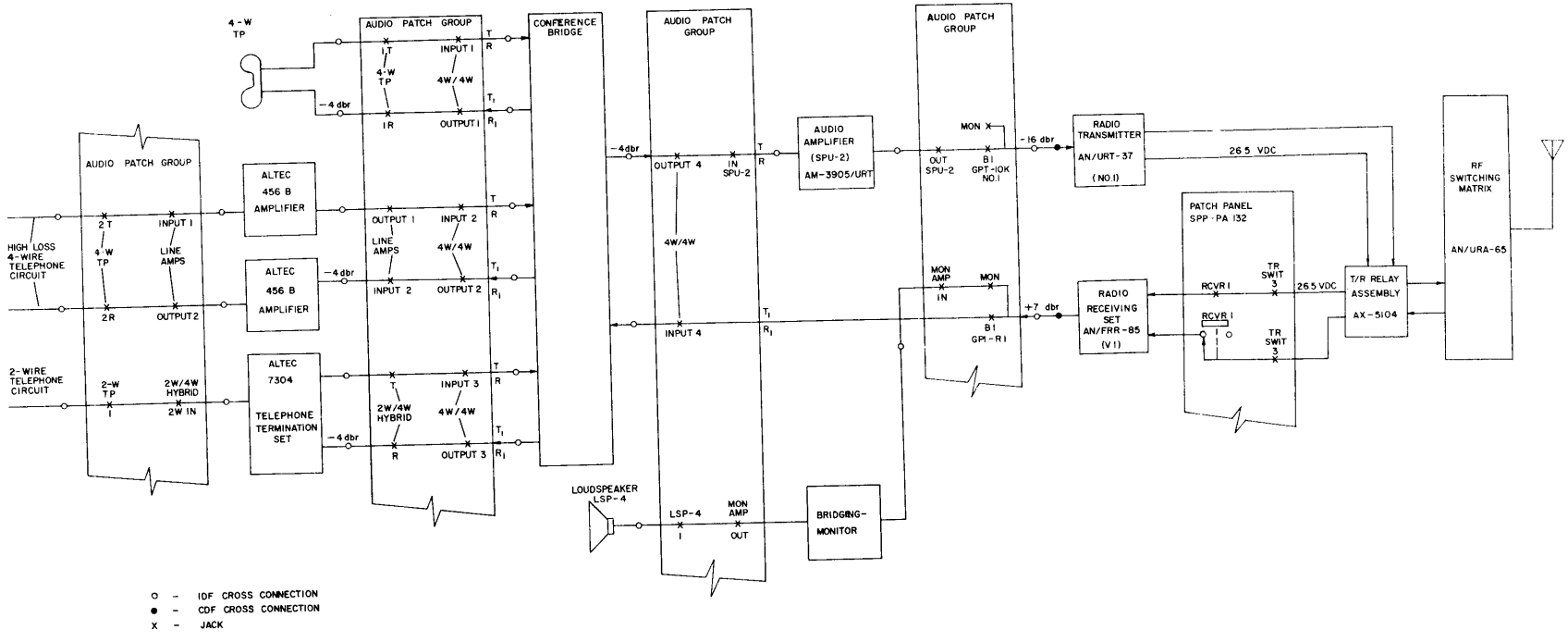


Figure 33. VF Signal Flow in Typical System Configuration for Voice Conferencing

WARNING

Before operating this equipment make certain all requirements of TB SIG 291 are met. Injury or DEATH could result from improper or careless operation.

CHAPTER 3

OPERATION

Section I. PRELIMINARY OPERATING PROCEDURES

3-1. General

Operation of the NACOM II station consists basically of circuit-patching and equipment operation. Circuit-patching establishes specific system configurations to meet operational requirements. Equipment operation includes the pre-setting of controls and pre-operational checks, starting up procedures, operating procedures, and stopping procedures. This section in covering the preliminary operating procedures includes circuit-patching, the pre-setting of controls and pre-operational checks. Since the station is capable of a wide variety of system configurations to meet various needs, the circuit-patching instructions are necessarily based on typical requirements. These examples are such that they cover the principals involved in setting up any configuration. The examples have been selected to illustrate the configurations for operating in the four primary HF radio modes of which this station is capable: AM, AME, SSB and ISB.

3-2. HF Radio Operating Modes

All of the HF radio equipment in this station is capable of operating in the AM mode. Figure 34 is a block diagram of the basic system configuration for this mode utilizing a Radio Transmitter AN/URT-37(V)1 and a Radio Receiving Set AN/FRR-85(V)1. Since the input to the transmitter is through the multiplexer which provides four channels in the ISB mode, the two channels first on either side of the carrier, Channels A1 and B1 (see Figure 5), are used to provide the

required upper and lower sidebands of the AM mode. As shown in the diagram, the single voice input from the microphone amplifier is applied to the two channels by means of the PARALLEL jacks in the Audio Patch Group. Receiving in this mode is also on a symmetrical channel basis, although only one of the channels provides the audio output. (Note that the microphone-monitor-speaker combination in this configuration is typical of order-wire operation in any mode.)

a. Amplitude Modulation Equivalent (AME). AME is sometimes referred to as compatible AM because it is actually SSB with the carrier reinserted to be compatible with normal AM reception equipment. Since it only requires one sideband, a single channel of the transmitter multiplexer is all that is needed, as shown in Figure 35. Thus, the audio input from the microphone amplifier is patched directly to the input of one of the transmitter channels. Otherwise, the configuration is the same as for AM.

b. Single Sideband (SSB) and Independent Sideband (ISB). As shown in Figure 36, the same basic setup is used for both SSB and ISB. In SSB only one transmitter and one receiver channel are used, while in ISB up to four channels may be used. Each channel in ISB operation can carry separate intelligence. This intelligence can be either voice or teletype FSK tones. Up to 16 teletype channels can be accommodated on a single voice channel.

3-3. Controls for Establishing System Configurations

a. RF Switching Matrix AN/URA-65(V)1. The RF switching matrix is controlled from the pushbutton control panel of the group located in the Communications Control Console, Position 3. The main bank of pushbuttons (see Figure 37) selects the transmitter/antenna combinations. The vertical row of buttons

to the left of the main band cancels the selecti on in the corresponding horizontal rows. Cancelling a selection prepares the matrix for the next selection in that row. When a selection is made and the circuit completed, the "select" push-button glows white. If the circuit is not completed, it glows red. The "cancel" pushbutton also glows red to indicate that the associated transmitter is not turned on.

b. Audio Patch Group. The Audio Patch Group provides equipment, line and monitor jacks for patching between equipments at audio frequency. The audio portions of system configurations are "built-up" on the panels of this group by inserting patch cords into the appropriate jacks. Cut-key switches and indicator lamps provide for control and monitoring of tape recorders and the transmitter push-to-talk control over-ride circuitry. Figure 28 shows the face (front panels) of the Audio Patch Group.

c. DC Patch Group. The DC Patch Group (Figure 18) provides the jacks for setting up the DC (telegraph) portions of system configurations. Normal-through jacks provide internal connections between teletypewriters and the respective channels in the telegraph terminals. Different channel arrangements are made by patching between the EQUIP and LINE jacks.

3-4. Procedures for Establishing Typical System Configurations

a. AM Voice Operation.

(1) Transmitting.

(a) On the pushbutton control panel for the RF switching matrix, push the button corresponding to the desired transmitter/

antenna combination. After about two seconds, the pushbutton should glow white, indicating the connection has been made.

(b) Insert one end of a patch cord into the GPT-10K No. 1 A1 jack and the other end into one of the PARALLEL jacks. (Both jacks are in the Audio Patch Group.)

(c) Insert one end of another patch cord into the GPT-10K No. 1 B1 jack and the other end into another PARALLEL jack.

(d) Insert one end of a third patch cord into a third PARALLEL jack and the other end into the SPU-2 OUT (Audio Amplifier AM-3905/URT) jack.

(e) Insert a microphone plug into the SPU-2 IN jack. This completes the transmitting direction hook-up.

(2) Receiving.

(a) The Radio Receiving Set AN/FRR-85(V)1 is normally connected to its assigned antenna. As long as this assignment holds, no further action is required for the antenna/receiver connection.

(b) Insert one end of a patch cord into the GPI-R1 B2 jack in the Audio Patch Group. Insert the other end into the MONITOR AMPLIFIER (Bridging-Monitor) IN jack.

(c) Insert one end of another patch cord into the MONITOR AMPLIFIER 4Ω jack and the other end into the LSP-4 1 jack. This completes the receiving direction hook-up.

b. AME Voice Operation.

(1) Transmitting.

(a) Select a transmitter/antenna combination as for AM voice operation in 3-4, a, (1), (a), above.

(b) Insert one end of a patch cord into the GPT-10K No. 1 A1 jack in the Audio Patch Group and the other end into the SPU-2 OUT (Audio Amplifier AM-3905/URT) jack.

(c) Insert a microphone plug into the SPU-2 IN jack. This completes the transmitting direction hook-up.

(2) Receiving.

(a) As in 3-4, a, (2), (a), above, Radio Receiving Set AN/FRR-85(V)1 is normally connected to its antenna and no further action is required for the antenna/receiver connection.

(b) Insert one end of a patch cord into the GPI-R1 B2 jack in the Audio Patch Group. Insert the other end into the MONITOR AMPLIFIER (Bridging-Monitor) IN jack.

(c) Insert one end of another patch cord into the MONITOR AMPLIFIER 4Ω jack and the other end into the LSP-4 jack. This completes the receiving direction hook-up.

c. ISB and Teletype Operation.

(1) Transmitting.

(a) Select a transmitter/antenna combination as in 3-4, a, (1), (a), above.

(b) For the voice channel, insert one end of a patch cord into the GPT-10K No. 1 A1 jack in the Audio Patch Group and the other end into a 2W/4W HYBRID (ALTEC 7304 Telephone Termination Set) T jack.

(c) Insert one end of another patch cord into the 2W IN jack of the same 2W/4W HYBRID group. Insert the other end into the 2 WIRE TELEPHONE 1 jack. This completes the transmitting direction hook-up for a two-wire telephone termination.

(d) For the teletype channel, insert one end of a patch cord into GPT-10K No. 1 B1 jack and the other end into the VFTG OUT 1 jack.

(e) In the DC Patch Group, the VFTG - SEND 1 jack is internally wired to the ASR SND 1 jack. This connects a Teletypewriter AN/FGC-58 to Channel 1 of the Telegraph Terminal AN/FGC-61A. No further patching is necessary to complete the transmitting direction teletype circuit.

(2) Receiving.

(a) As in 3-4, a, (2), (a), above, Radio Receiving Set AN/FRR-85(V)1 is normally connected to its antenna and no further action is required for the antenna/receiver connection.

(b) For reception of the voice channel, insert one end of a patch cord into the GPI-R1 A1 jack in the Audio Patch Group. Insert the other end into 2W/4W HYBRID (ALTEC 7304 Telephone Termination Set) R jack.

(c) The patch made in 3-4, c, (1), (c), above, between the 2W/4W HYBRID 2W **IN** jack and 2 WIRE TELEPHONE 1 jack serves for both transmitting and receiving directions; hence, no

further action is required to complete the voice circuit in the receiving direction.

(d) For the teletype channel, insert one end of a patch cord into the GPI-R1 B1 jack in the Audio Patch Group and the other end into a VFTG IN 1 jack. (If diversity reception is being used, as will normally be the case in teletype operation, patch also from GPI-R2 to the VFTG IN 1.)

(e) In the DC Patch Group, the VFTG - RECEIVE 1 jack is internally wired to the ASR REC 1 jack. This provides the Channel 1 receiving connection to the same Teletypewriter AN/FGC-58 in 3-4, c, (1), (e), above. No further action is necessary to complete the receiving teletype circuit.

3-5. Equipment Preliminary Operating Procedures

a. RF Switching Matrix AN/URA-65(V)1. Follow the instructions given in the instruction manual for the AN/URA-65(V)1 for turning on the RF switching matrix power supply, adjusting the control voltage, pre-setting the matrix and checking operation of the pushbuttons.

b. Radio Transmitter AN/URT-37(V)1.

(1) Pre-set controls in exciter portion of the radio transmitter. This portion consists of:

Signal Data Converter-Storer CV-2520(V)/URC

Electronic Frequency Converter CV-2644/URT

Electronic Frequency Converter CV-2645/URT

Command Signals Converter KY-675/URT

Instructions for pre-setting the exciter controls are given in the instruction manual for Radio Transmitter AN/URT-37(V)1. The manual is entitled Technical Manual for Radio Transmitter Model GPTR-10KYA. (This is the manufacturer's terminology for the radio transmitter.) The specific instructions consist of Steps 1 through 4, paragraph 3-5, a, page 3-6 of the section entitled System Manual for Exciter System Model SBGR-4YA.

(2) Check that the antenna or dummy load connection to the radio transmitter have been properly made. (Refer to paragraph 3-5, a of this section concerning pre-setting of matrix.)

c. Radio Receiving Set AN/FRR-85(V)1. Pre-set controls of the radio receiving set in accordance with Table 3-4, page 3-10 of the manufacturer's Technical Manual for Radio Receiving Set AN/FRR-85(V)1.

d. Remote Control Group AN/URA-63. No preliminary operating procedures are required for Remote Control Group AN/URA-63.

e. Receiver Filter System SYM-4200. Place LOCAL-REMOTE switches on filter module drawers (Figure 8) in REMOTE position.

f. Electrical Dummy Load DA-550/U. No preliminary operating procedures are required for Electrical Dummy Load DA-550/U.

g. Antenna Coupler CU-1897/URT. Antenna Coupler CU-1897/URT is a passive device. Therefore, no operating procedures are required.

h. Transceiver KWT-6 Type 8. Pre-set controls in accordance with paragraph 3.2.1, TM 11-5820-555-15.

i. Radio Receiver R-390/URR. The Radio Receivers R-390/URR are not used in this system, although their audio outputs are connected to the Audio Patch Group and appear at labelled jacks. If these radio receivers are used at a later date, refer to TM 11-5820-357-35 for operating instructions.

j. VLF Receiver/Comparator Model 207-4. No preliminary operating procedures are required for VLF Receiver/Comparator Model 207-4.

k. Distribution Amplifier 203A. No preliminary operating procedures are required for Distribution Amplifier 203A.

l. Audio Amplifier AM-3905/URT. Set controls for type of operation in accordance with Table 3-2, page 3-2, Technical Manual for Speech Processing Unit SPU-2 (manufacturer's designation for Audio Amplifier AM-3905/URT).

m. Voice Conditioning Equipment. No preliminary operating procedures are required for the Voice Conditioning Equipment.

n. Telegraph Terminal AN/FGC-61A. Carry out preliminary starting procedures given in paragraph 19, page 30, TM 11-5805-325-12.

o. VFTG Interface Unit. No preliminary operating procedures are required for the VFTG Interface Unit.

p. Teletypewriter AN/FGC-58. Refer to instruction manual on Teletypewriter AN/FGC-58 for preliminary operating procedures.

q. RLPA Control Panel. Refer to instruction manual on RLPA Control Panel for preliminary operating procedures.

3-6. Coordination Between Stations

In setting up and operating HF radio circuits, coordination is required between transmitting and receiving radio stations. This NACOM II station is

both a transmitting and receiving station. As a transmitting station, it must notify all associated receiving stations of transmitting schedules, frequency assignments and frequency changes. It must also disseminate information on the type and mode of transmission, e.g. four-channel ISB with voice on Channels A1, A2 and B2, and FSK teletype on Channel B1. The transmitting and the receiving stations work together to establish a radio circuit, checking voice level and quality, and teletype operation. The communications required in carrying out this coordination are provided by an order-wire channel over a prearranged HF radio circuit. The order-wire channel is set up by appropriate patching at the Audio Patch Group, as shown in the example given in Figure 34.

Section II. STARTING UP PROCEDURES

3-7. General

The starting up procedures apply specifically to the individual items of equipment. The procedures for each equipment are given in the instruction manual pertaining to the equipment. This section presents the sequence in which the equipment should be started.

3-8. Starting Sequence

a. RF Switching Matrix AN/URA-65(V)1. Start up the RF switching matrix first to enable connection of the transmitters to antennas or the dummy load. The starting up procedure for the RF switching matrix is the same as the preliminary operating procedure given in 3-5, a of this section.

b. Radio Transmitter AN/URT-37(V)1.

(1) Start up exciter (refer to Preliminary Operating Procedures, paragraph 3-5, b, (1) for definition of exciter) in accordance with Steps 5 and 6 , paragraph 3-5, a, page 3-6 of the System Manual for Exciter System Model SBGR-4YA (part of Technical Manual for Radio Transmitter Model GPTR-10KYA).

(2) Tune and load the radio transmitter on a carrier frequency. This may be done manually at the radio transmitter or by remote control from the Communications Control Console. For manual tuning and loading on a carrier frequency, refer to paragraph 3-4, page 3-3, Technical Manual for Linear Power Amplifier Model PALA-10K (part of Technical Manual for Radio Transmitter Model

GPTR-10KYA). For remote tuning and loading refer to paragraph 3-5, page 3-5 of the same manual and to Section III, page 3-1 of the Technical Manual for Remote Control Group Model COPC-1.

c. Radio Receiving Set AN/FRR-85(V)1. Start up Radio Receiving Set AN/FRR-85(V)1 by following the last two steps in Table 3-4, page 3-10 of the Technical Manual for Radio Receiving Set AN/FRR-85(V)1.

d. Remote Control Group AN/URA-63. No start-up procedures are required for Remote Control Group AN/URA-63. (The COPC-1 portion of Remote Control Group AN/URA-63 is used in Step 3-8, b, (2) of this section for remote tuning and loading of Radio Transmitter AN/URT-37(V)1.)

e. Receiver Filter System SYM-4200. Observe that AC and DC indicator lights on filter module drawers (Figure 8) are on.

f. Electrical Dummy Load DA-550/U. No start-up procedure is required for Electrical Dummy Load DA-550/U.

g. Antenna Coupler CU-1897/URT. Antenna Coupler CU-1897/URT is a passive device. Therefore, no operating procedures are required.

h. Transceiver KWT-6 Type 8. Follow instructions for turning on equipment given in paragraph 3.2.2, page 1-28, TM 11-5820-555-15.

i. Radio Receiver R-390/URR. If the Radio Receivers R-390/URR are fully connected into the system at a later date, refer to TM 11-5820-357-35 for operating instructions.

j. VLF Receiver/Comparator Model 207-4. Refer to instruction manual on VLF Receiver/Comparator Model 207-4 for starting up instructions.

k. Distribution Amplifier 203A. Start up Distribution Amplifier by following the instructions in Section II of the manufacturer's Instruction Manual.

l. Audio Amplifier AM-3905/URT. To turn on Audio Amplifier AM-3905/URT, follow Step 10, Table 3-2, page 3-2, Technical Manual for Speech Processing Unit SPU-2.

m. Voice Conditioning Equipment. The active units, i.e. amplifiers, in the Voice Conditioning Equipment are on when station power is on; hence, no starting up procedures are required.

n. Telegraph Terminal AN/FGC-61A. Start up Telegraph Terminal AN/FGC-61A as directed in paragraph 20, page 30, TM 11-5805-325-12.

o. VFTG Interface Unit. The VFTG Interface Unit is on when the station power is on. Therefore, no starting up procedures are required.

p. Teletypewriter AN/FGC-58. Refer to instruction manual on Teletypewriter AN/FGC-58 for starting up instructions.

q. RLPA Control Panel. Refer to instruction manual on RLPA Control Panel for preliminary operating procedures.

Section III. OPERATING PROCEDURES

3-9. General

Station operation consists of setting up system configurations and establishing radio contacts in response to operational requirements, changing configurations in response to changing requirements, changing frequencies in accordance with schedules and directives or as required by propagation conditions, and monitoring of radio circuits to assure proper operation. The operator sets up or changes system configurations by circuit patching at the DC and Audio Patch Groups and by antenna switching through the RF switching matrix. He makes the necessary changes in type or mode of operation by remote control of the transmitters and receivers from the Communications Control Console. He handles frequency changes the same way. The Communications Control Console provides the operator with the bridging-monitor, loudspeakers and level measuring equipment he requires for monitoring the quality of the radio circuits without interrupting traffic over the circuits.

Section I of this chapter gave procedures for setting up system configurations. The same principles apply to changing configurations. This section presents the procedures involved in operating the equipment in the processes of setting up or changing configurations, changing frequencies and monitoring circuits.

3-10. Equipment Operating Procedures

a. Radio Transmitter AN/URT-37(V)1.

(1) Before making any changes in the transmitter/antenna combinations, it is necessary to turn off the radio transmitter high

voltage, as in Step 21, paragraph 3-4, page 3-5, Technical Manual for Linear Power Amplifier Model PALA-10K.

(2) Change operating frequency and mode, carrier suppression and output power as described in paragraph 3-5, pages 3-6 through 3-9 of the System Manual for Exciter System Model SBGR-4YA, and Section III of the Technical Manual for Remote Control Group Model COPC-1.

b. RF Switching Matrix AN/URA-65(V)1. Operate the RF switching matrix from the control panel located in the Communications Control Console. Follow the procedure given in the equipment instruction manual.

c. Radio Receiving Set AN/FRR-85(V)1.

(1) Make changes in operating mode as described in Table 3-4 (on control pre-setting), page 3-10 of the Technical Manual for Radio Receiving Set AN/FRR-85(V)1.

(2) Tune the radio receiving set to required frequencies following the procedure in Table 3-5, page 3-12 of the same manual.

(3) Also refer to the Technical Manual for Remote Control Group COPB-1 (part of AN/URA-63) for instructions on performing these two steps from the Communications Control Console.

d. Remote Control Group AN/URA-63. Operation of the two parts of this remote control group, COPB-1 and COPC-1, has been covered in paragraph 3-10 a and c, above, in connection with Radio Transmitter AN/URT-37(V)1 and Radio Receiving Set AN/FRR-85(V)1.

e. Receiver Filter System SYM 4200. The six receiver filter modules for each Radio Receiving Set AN/FRR-85(V)1 are pre-tuned to assigned frequencies.

(Instructions for re-tuning to new frequencies are given in Appendix III.) Operation consists of selecting the appropriate filter module and switching it into the circuit.

(1) Operation at the receiver filter system cabinet (local).

(a) Place the LOCAL-REMOTE switch in LOCAL. (See Figure 8.)

(b) Observe AC and DC panel lights to note presence of electrical power.

(c) Push CHANNEL switch down. The CHANNEL switch is a spring-loaded, two-directional switch which is normally in center position. It controls a 12-position stepping switch. Pushing the CHANNEL switch down causes the stepping switch to step through its positions. The stepping switch has 12 positions, the first 8 of which are active. The other four are not used, although the switch is required to step through them to complete its cycle. Step positions 1 through 6 are the six filter modules associated with the stepping switch. Step 7 is the BYPASS position which routes the RF circuit directly between antenna and receiver, bypassing the filter modules. Step 8 is the ANT. GND (antenna ground) position. Indicator lights along the top of the filter module drawer show which position the stepping switch is in at any moment. Therefore, hold down the CHANNEL switch until the desired filter module or other stepping switch position is reached. There

are no lights to indicate positions 9 through 12. Hold the CHANNEL switch down until the stepping switch has stepped through these positions to arrive at the first filter module position.

(d) When the CHANNEL switch was pushed down it automatically grounded the associated antenna. To remove the ground, push the CHANNEL switch up. This connects the antenna to the selected filter module.

(2) Operation at Remote Control Panel RCP-6 (in Communications Control Console).

(a) At filter module drawer in receiver filter system cabinet, place the LOCAL-REMOTE switch on REMOTE.

(b) Turn knob-switch corresponding to specific receiver to desired filter module or stepping switch position. (See Figure 9.)

(c) Push re-set button to remove antenna ground and complete connection.

f. Electrical Dummy Load DA-550/U. No operating procedure is required for Electrical Dummy Load DA-550/U. It dissipates transmitter RF power when connected to a transmitter through RF Switching Matrix AN/URA-65(V)1.

g. Antenna Coupler CU-1897/URT. Antenna Coupler CU-1897/URT is a passive device. Therefore, no operating procedure is required.

h. Transceiver KWT-6 Type 8.

(1) To change frequency, follow the instructions in paragraph 3.2.3, page 1-29, TM 11-5820-555-15.

(2) To adjust audio levels, refer to paragraph 3.2.4, page 1-32 of the same manual.

(3) To operate in the push-to-talk mode, follow instructions given in paragraph 3.2.5, page 1-32 of the same manual.

(4) For operation of the thermal relay receiver input protector, refer to paragraph 3.2.6, page 1-33 of the same manual.

i. Radio Receiver R-390/URR. If the Radio Receivers R-390/URR are fully connected into the system at a later date, refer to TM 11-5820-357-35 for operating instructions.

j. VLF Receiver/Comparator Model 207-4. Refer to the instruction manual on the equipment for the procedure for bringing in Station WWVB.

k. Distribution Amplifier 203A. Refer to Section II of the manufacturer's instruction manual for instructions on operating Distribution Amplifier 203A.

l. Audio Amplifier AM-3905/URT. To operate Audio Amplifier AM-3905/URT, follow the procedure given in Table 3-2, page 3-2, Technical Manual for Speech Processing Unit SPU-2.

m. Voice Conditioning Equipment. Operation of the Voice Conditioning Equipment consists simply of patching it into circuits at the Audio Patch Group.

n. Telegraph Terminal AN/FGC-61A. The only operating procedure required for Telegraph Terminal AN/FGC-61A is for the selection of diversity. Proceed as directed in paragraph 21, page 30, TM 11-5805-325-12.

o. VFTG Interface Unit. No operating procedure is required for the VFTG Interface Unit.

p. Teletypewriter AN/FGC-58. Refer to instruction manual on Teletypewriter AN/FGC-58 for operating instructions.

q. RLPA Control Panel. Refer to instruction manual on RLPA Control Panel for preliminary operating procedures.

Section IV. STOPPING PROCEDURES

3-11. Stopping to Standby Condition of Station

a. Turn off high voltage on Radio Transmitter AN/URT-37(V)1. Follow Step 21, paragraph 3-4, page 3-5, Technical Manual for Linear Power Amplifier Model PALA-10K.

b. Turn off high voltage on Transceiver KWT-6 Type 8 transmitter section. Follow Step a, paragraph 3.2.7, page 1-33, TM 11-5820-555-15.

c. Leave all other equipment on and patch panels in DC Patch Group and Audio Patch Group arranged for required system configurations.

3-12. Emergency Shutdown of Station

Emergency shutdown of the station is accomplished by throwing the main circuit breaker for the station to the OFF position. This breaker is located in another room and is not under the control of the radio operator. No action is required on the part of the operator at the Communications Control Console.

3-13. Normal Shutdown of Station

a. Radio Transmitter AN/URT-37(V)1.

(1) Turn off high voltage as described in 3-11, a, above.

(2) Turn off all other transmitter power. Refer to Technical Manual for Radio Transmitter Model GPTR-10KYA.

b. Transceiver KWT-6 Type 8.

(1) Turn off high voltage as described in 3-11, b, above.

(2) Turn off all other transceiver power as in Steps b and c, paragraph 3.2.7, page 1-33, TM 11-5820-555-15.

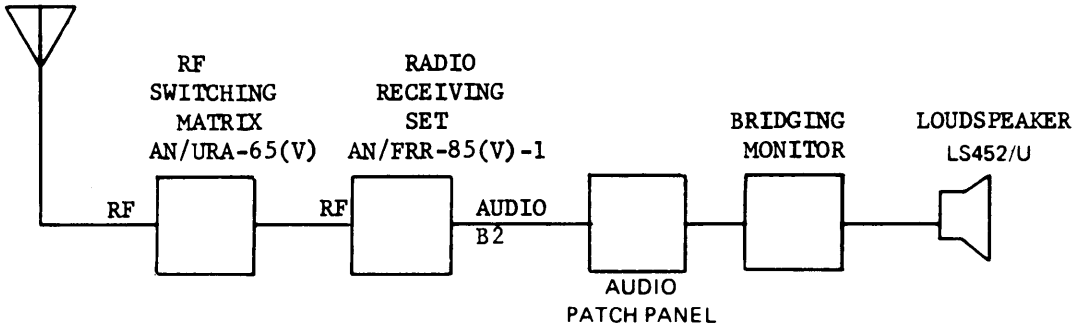
c. Radio Receiving Set AN/FRR-85(V)1. Turn off the radio receiving set by reversing the last two steps of Table 3-4, page 3-10 of the Technical Manual on the equipment.

d. Circuit Breaker Panels.

(1) Throw circuit breakers in Transmitter Circuit Breaker (Power) Panel to OFF position. This panel is Item 17, Room 211, in Figure 1.

(2) Throw circuit breakers in Panel D (Item 18, Room 211, Figure 1) to OFF position.

(3) Throw circuit breakers in Panel C (Item 1, Room 210, Figure 1) to OFF position.



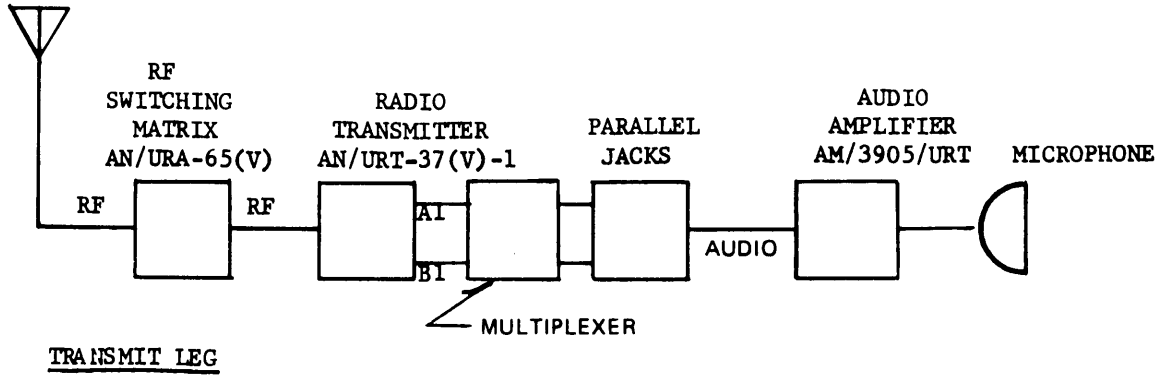
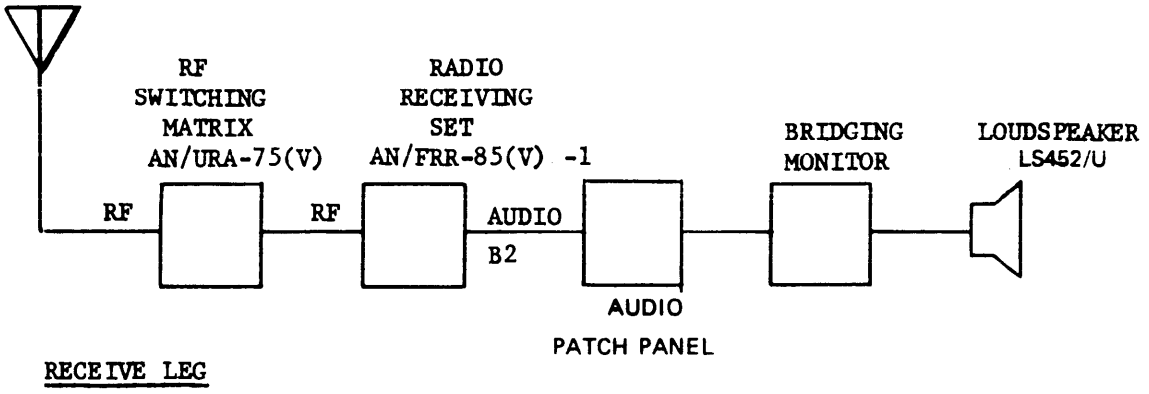


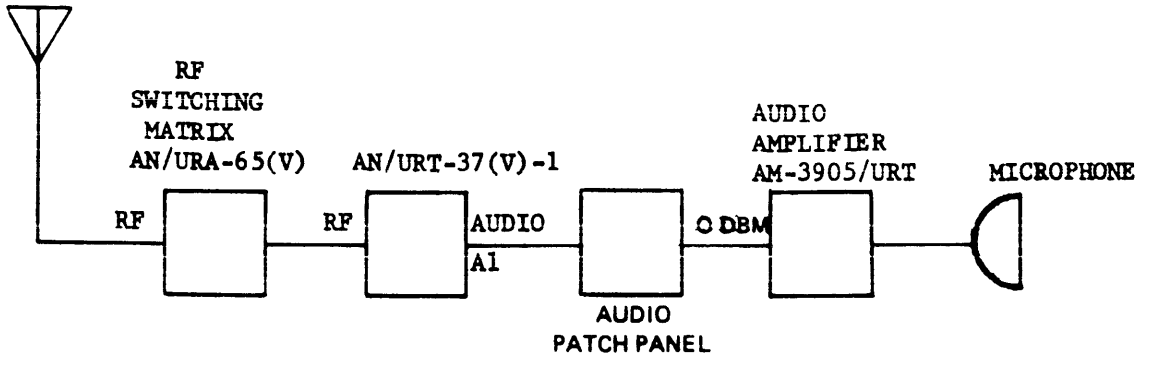
Figure 34

AM OPERATION

TYPICAL SYSTEM CONFIGURATION



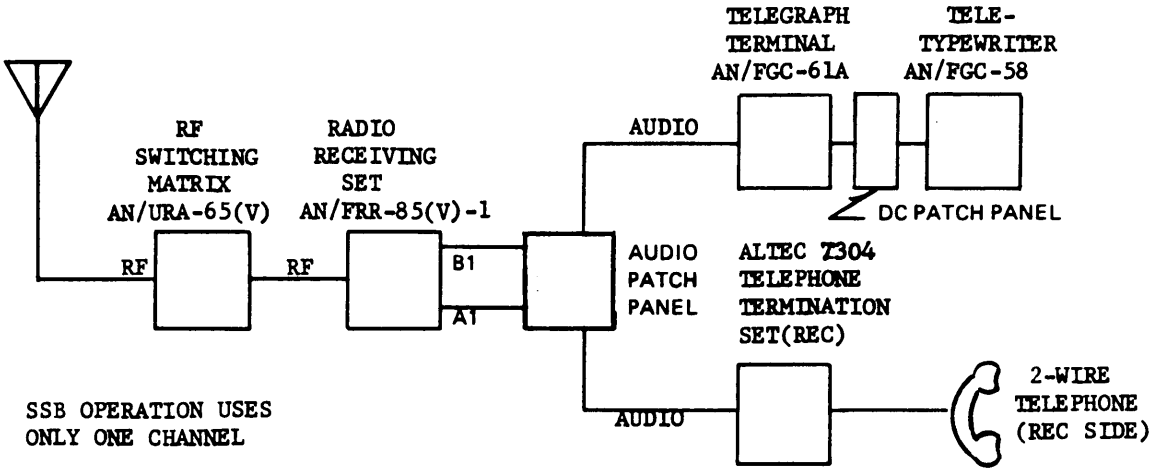
RECEIVE LEG



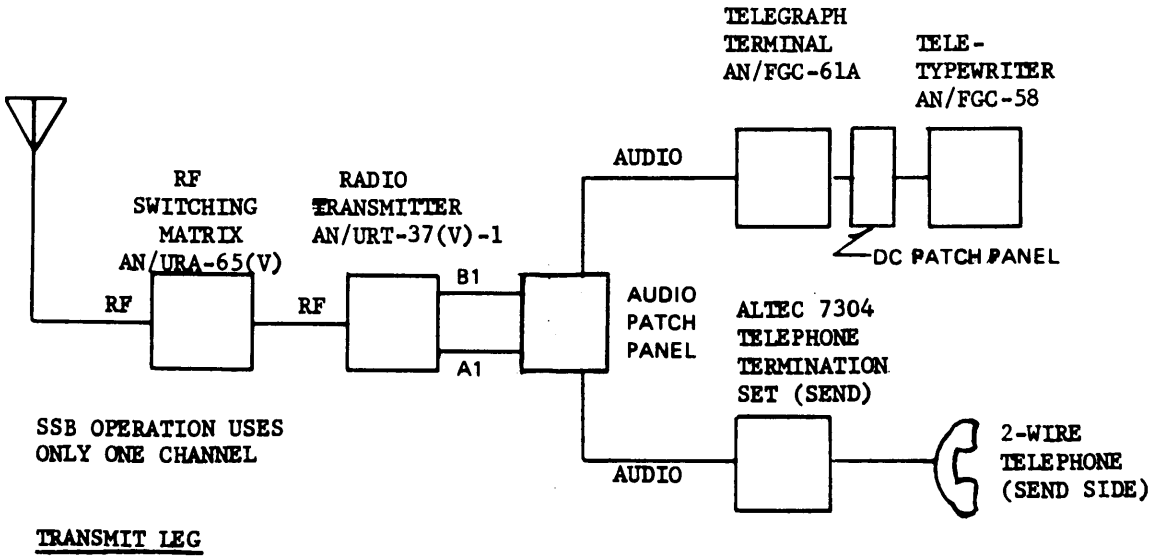
TRANSMIT LEG

Figure 35

AME OPERATION
TYPICAL SYSTEM CONFIGURATION



RECEIVE LEG



TRANSMIT LEG

Figure 36

SSB AND ISB OPERATION
TYPICAL SYSTEM CONFIGURATION

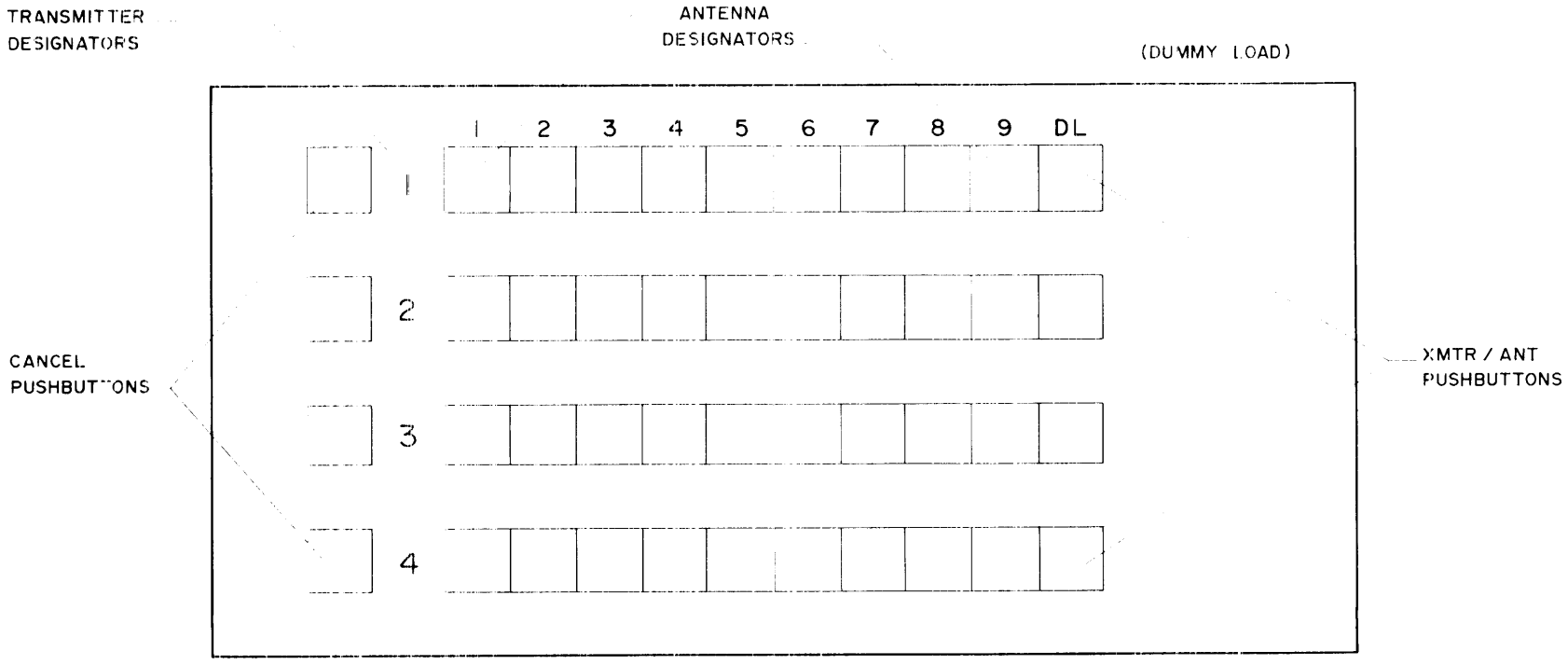
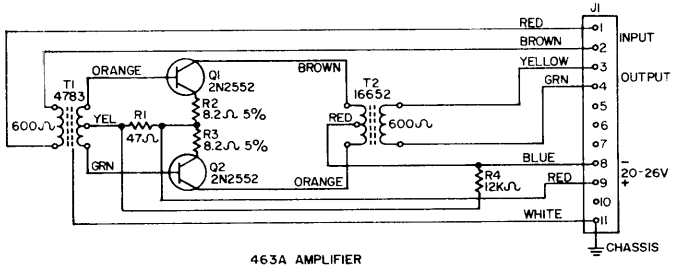
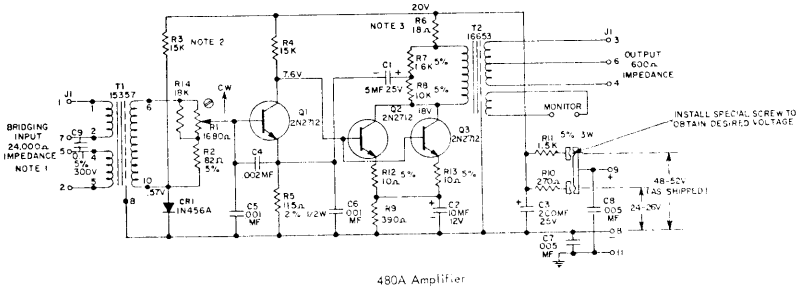


FIGURE 37 PUSHBUTTON CONTROL PANEL FOR RF SWITCHING MATRIX AN/URA-65.

Figure 37. Pushbutton Control Panel for RF Switching Matrix AN/URA-65



463A AMPLIFIER



480A Amplifier

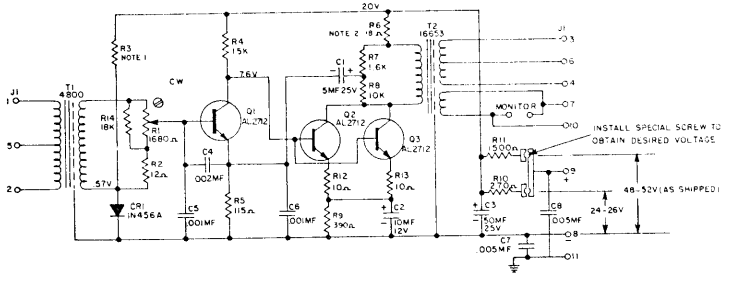


Figure 38. ALTEC Amplifiers; 456B, 463A, 480A, Schematic Diagrams

WARNING

During removal, disassembly, erection, assembly, or repair of the tower conform to all safety requirements of TB SIG 291. Injury or DEATH could result from failure to comply with safe practices.

CHAPTER 4

MAINTENANCE AND TROUBLESHOOTING

Section I. MAINTENANCE

4-1. Preventive Maintenance Checks and Services Periods

The procedures presented in this section are those required for preventive maintenance on a periodic basis. They consist of general condition checks and services to be performed daily, and operational checks and services to be performed weekly. These checks and services do not replace the maintenance procedures given in the various equipment manuals, which must also be performed. They supplement, and in some cases provide a schedule for, the routines given in the manual.

In addition to periodic preventive maintenance during normal, continuous station operation, the daily and weekly checks and services should be performed each time the station is to be re-activated after a period in the standby or shutdown condition.

4-2. Operator's Daily Preventive Maintenance Checks and Services

Caution: Do not disturb any control settings of equipment in use.

Sequence No.	Item	Procedure	Reference
1	Station inventory	Check for completeness and general condition of all equipment in Rooms 210 and 211.	Chapter 1 and Figure 1.
2	Equipment racks, cabinets and patch panels	Clean dirt and moisture from microphones, telephones, keys, jacks, plugs, equipment panels.	Figure 1.
3	Equipment controls	Check for normal operation when using to set up circuits. Do not disturb established circuits in traffic.	Equipment instruction manuals.
4	Equipment	Check for normal operation when carrying traffic by bridging circuits with bridging-monitor. Listen for quality of voice traffic and examine teletype messages for errors.	None.
5	Rooms 210 and 211	Provide safe operating environment by maintaining rooms in clean, orderly condition.	None.

4-3. Operator's Weekly Preventive Maintenance Checks and Services

Caution: Do not disturb any control settings of equipment in use.

Sequence No.	Item	Procedure	Reference
1	RF Switching Matrix AN/URA-65(V)1	a. Ascertain that no traffic is being passed and that all transmitter high-voltages are off. b. Check matrix clamps and coaxial connectors for tightness. c. Check wires and cables for signs of wear. d. Check control voltage. e. Check matrix operation by pushbuttons.	Equipment Instruction Manual for AN/URA-65(V)1.
2	Radio Transmitter AN/URT-37(V)1	a. Ascertain that no traffic is being passed by the transmitter. Turn off high-voltage. b. Using the RF switching matrix, switch transmitter to dummy load. c. Observe transmitter operation while carrying out the steps in the manual and automatic carrier-frequency tuning procedures.	Para. 3-4 and 3-5 of Technical Manual of Radio Transmitter Model GPTR-10KYA.
3	Radio Receiving Set AN/FRR-85(V)1	a. Ascertain that no traffic is being passed by the receiving set. b. Observe receiving set operation while carrying out the manual tuning procedure. c. Repeat tuning procedure from the Communications Control Console.	Table 3-5, Technical Manuals for Radio Receiving Set AN/FRR-85(V)1 and Remote Control Group Model COPB-1.

4-3. Operator's Weekly Preventive Maintenance Checks and Services (Continued)

Sequence No.	Item	Procedure	Reference
4	Remote Control Group AN/URA-63	In Sequence No. 's 2 and 3 , above, observe operation of COPC-1 and COPB-1 which make up AN/URA-63.	Technical Manuals for Remote Control Groups Models COPB-1 and COPC-1.
5	Receiver Filter System SYM-4200	a. Check coaxial cable connections for tightness. b. Check operation of stepping switch.	Para. 3-10, e, (1) of this manual.
6	Electrical Dummy Load DA-550/U	a. Ascertain that no transmitter is operating into the dummy load and check coaxial cable connections for tightness. b. Clean all electrical contacts.	Technical Manual for Transmitting Antenna Dissipator and Dummy Load Model TER-18K-A-50U.
7	Antenna Coupler CU-1897/URT	Observe physical appearance of all antenna couplers. Look for cracks in Mykroy insulator bowls.	Technical Manual for Transmitting Antenna Coupler Model TRC-5000.
8	Transceiver KWT-6 Type 8	a. Ascertain that no traffic is being passed by the transceiver and that the transmitter part high-voltage is off. b. Carry out the referenced operating procedures and operator checks.	Para. 3.2 and 3.3, TM 11-5820-555-15
9	VLF Receiver/Comparator 207-4	a. Check for presence of received WWVB frequency standard. b. Check for presence of 1-MHz output to distribution amplifier.	Technical Manual on VLF Receiver/Comparator 207-4.

4-3. Operator's Weekly Preventive Maintenance Checks and Services (Continued)

Sequence No.	Item	Procedure	Reference
10	Distribution Amplifier 203A	Check output levels using LEVEL CHECK switch and meter on front panel of equipment.	Section II, Instruction Manual for Distribution Amplifier 203A.
11	Audio Amplifier AM-3905/URT	Check output level using controls and meter on front panel of equipment.	Table 3-2, Technical Manual for Speech Processing Unit Model SPU-2.
12	Voice Conditioning Equipment	Using a 1000-Hz test-tone, check output levels at jacks in Audio Patch Group.	Figure 23 and pertinent equipment descriptions in Section II of this manual.
13	Telegraph Terminal AN/FGC-61A	Carry out steps in referenced equipment performance checklist.	Para. 26, c, TM 11-5805-325-12.
14	VFTG Interface Unit	Using test keys and meters on front panel of unit, check condition of each teletypewriter circuit.	Chapter 3, Technical Manual for VFTG Interface Unit.
15	Teletypewriter AN/FGC-58	Carry out cleaning and adjustment procedures given in reference manual.	Technical Manual on on Teletypewriter AN/FGC-58.

Section II. TROUBLESHOOTING

4-4. Isolation of Functional Units at Fault

Station troubleshooting consists of tracing circuit outages and failures to the functional units of equipment at fault. It is a straightforward process of fault isolation. It can be performed for the most part at the Communications Control Console, using the various remote control devices, patch groups, and monitoring and level-measuring equipment. When the failure has been traced to a particular functional unit, refer to the pertinent equipment instruction manual for equipment troubleshooting procedures.

4-5. Troubleshooting Chart

Item No.	Symptom	Procedure	Possible Fault and Verification
1	Interruption in voice reception over circuit utilizing Radio Receiving Set AN/FRR-85(V)1.	a. Set up monitor by patching LSP-4 1 or 2 to MONITOR AMPLIFIER 4 Ω in the Audio Patch Group. b. Patch monitor into GPI R1 or R2 MON jack for interrupted channel and check for presence of audio signal. c. If no audio signal present, check for received RF signal by observing RF/AFC LEVEL meter on front panel of RF Tuner TN-525/FRR, p/o AN/FRR-85(V)1.	a. If no RF signal observed: (1) Distant transmitter off-the-air. Check via order-wire. (2) Break in antenna transmission line. Inspect. (3) Erroneous operation of RF switching matrix, disconnecting receiver from transmission line. Check matrix control panel. (4) Disconnect at receiver filter coaxial patch panel. Inspect patch panel. (5) Erroneous operation of receiver filter system. Observe filter module indicator lights for proper selection. b. If RF signal received at satisfactory level, Radio Receiving Set AN/FRR-85(V)1 is at fault.
		d. If audio signal present at GPI R1 or R2 channel MON jack, patch into output jack for any voice conditioning equipment included in circuit.	c. If audio signal not present at new jack, voice conditioning equipment is at fault. d. If audio signal is present, terminating instrument (telephone or loudspeaker) is at fault.
2	Interruption in teletype reception over circuit utilizing Radio Receiving Set AN/FRR-85(V)1.	a. Proceed as in 1, a, b and c, above, but check for presence of VFTG tones.	a. Same as in 1, a and b, above.
		b. If audio signal present at GPI R1 or R2 channel MON jack, patch DC voltmeter,	b. If pulses are present, fault is in teletypewriter.

4-5. Troubleshooting Chart (Continued)

Item No.	Symptom	Procedure	Possible Fault and Verification
		equipped with proper plug, into MON jack for interrupted channel in the DC Patch Group. Check for 6-volt DC keying pulses.	c. If no pulses fault is in Telegraph Terminal AN/FGC-61A or VFTG Interface Unit. Check voltages at equipment to isolate faulty unit.
3	Interruption in voice reception over circuit utilizing Transceiver KWT-6 Type 8.	Proceed as in 1, a-d, but read RF signal level on meter in front panel of Sideband Generator 786F-1, p/o Transceiver KWT-6 Type 8.	Same as in Item 1.
4	Interruption in teletype reception over circuit utilizing Transceiver KWT-6 Type 8.	Proceed as in Item 2.	Same as in Item 2.
5	Distant receiving station reports transmission from Radio Transmitter AN/URT-37(V)1 has stopped.	Observe indicators on Remote Control Group COPC-1 panels (refer to Technical Manual on COPC-1).	Transmitter malfunctions. (Refer to Technical Manual on COPC-1 for correlation of indications with malfunctions.)
6	Distant receiving station reports transmission from Transceiver KWT-6 Type 8 has stopped.	Observe indications on front panels of transceiver.	Fault in transmit circuitry of transceiver. (Refer to TM 11-5820-555-15 for correlation of indications with faults.)

4-5. Troubleshooting Chart (Continued)

Item No.	Symptom	Procedure	Possible Fault and Verification
7	Voice levels too high or too low.	a. If faulty circuit is still carrying traffic, use monitor set-up from 1, a, above, to bridge circuit at test points: (1) Receiver output jacks. (2) Voice conditioning equipment input and output jacks. (3) Terminating instrument output jacks. b. If faulty circuit is out of traffic, patch 1-kHz test-tone from audio oscillator into voice conditioning equipment input jacks and measure levels at output jacks, using VU meter in Communications Control Console.	a. Faults corresponding to abnormal results from test points: (1) Receiver malfunction. (2) Faulty voice conditioning equipment. (3) Faulty termination equipment. b. Faulty voice conditioning equipment.
8	Erratic teletype operation	a. Check received RF signal level (1) On RF/AFC LEVEL meter for AN/FRR-85(V)1, (2) On RF signal level meter on 786F-1, p/o KWT-6 Type 8. b. Use monitor set-up in 1, a, above, to bridge receiver output and listen for presence of VFTG tones. (Receiver outputs for AN/FRR-85(V)1 are at GPI R1 and R2 jacks for channel involved, A1, A2, B1, or B2. Receiver outputs for KWT-6 are at KWT-6 No. 1 and No. 2 REC USB or LSB jacks.)	a. If signal level varies widely, failure is due to propagation fading. b. If RF signal is steady but tones sound erratic, receiver is at fault.

4-5. Troubleshooting Chart (Continued)

Item No.	Symptom	Procedure	Possible Fault and Verification
		c. With DC voltmeter check for 6-volt DC keying pulses at VFTG REC jacks.	c. If voltages are missing or improper, check same at outputs of VFTG Interface Unit and at outputs of Telegraph Terminal AN/FGC-61A. (The DC at the latter should be at 130 volts.) This will isolate the fault to either the VFTG Interface Unit or the AN/FGC-61A.
		d. If a, b, and c checks reveal no faults, use a distortion analyzer (Radiation, Inc. DAS-10 or equivalent) to measure distortion. (Refer to distortion analyzer instruction manual for procedures.)	d. Bias distortion occurs when receiving system does not adequately compensate for amplitude variations in transmission level. Receiver fault. Characteristic distortion occurs when pulses of different lengths are transmitted. Distant transmitter fault. Fortuitous distortion is caused by impulse noise. Check for radio noise sources.

APPENDIX I

REMOTE CONTROL TUNING

AND READBACK CODES

1.1 GENERAL

Appendix I contains the teletype tuning codes employed in the remote tuning of the AN/URT-37(V)1 Transmitting Set, and the AN/FRR-85(V)1 Receiving Sets. These codes are broken down into the following tables:

Table A - Transmitter Tuning Code

Table B - Transmitter Readback Code

Table C - Receiver Tuning Code

Table D - Receiver Readback Code

APPENDIX I

TABLE A - TRANSMITTER TUNING CODES

Pushbutton (C-8335/URT)	5-Bit Code 12345	Equivalent CCITT TTY Character
FAULT:		
RESET	01000	Line Feed
H.V.:		
ON	01000	Line Feed
OFF	00100	Space
OUTPUT PWR:		
1	01000	Line Feed
2	00100	Space
3	01100	I
4	00010	Carriage Return
CARRIER SUPPRESSION:		
0 db	01000	Line Feed
3 db	00100	Space
6 db	01100	I
20 db	00010	Carriage Return
30 db	01010	R
FULL	00110	N
MODE:		
CW	01000	Line Feed
PUSH-TO-TALK	00100	Space
VOX	01100	I
NORM	00010	Carriage Return

TABLE A - TRANSMITTER TUNING CODES (Cont'd)

Pushbutton (C-8335/URT)	5-Bit Code 12345	Equivalent CCITT TTY Character
FREQUENCY:		
0	01000	Line Feed
1	00100	Space
2	01100	I
3	00010	Carriage Return
4	01010	R
5	00110	N
6	01110	C
7	00001	T
8	01001	L
9	00101	H
TUNE	10000	E
CLEAR	01111	V
FUNCTION:		
10 MHz	11000	A
1 MHz	10100	S
100 KHz	11100	U
10 KHz	10010	D
1 KHz	11010	J
.1 KHz	10110	F
MODE	11110	K
CARR SUPP	10001	Z
OUT PWR	11001	W
HV	10101	Y
FAULT RESET	11101	Q

TABLE A - TRANSMITTER TUNING CODES (Cont'd)

Pushbutton C-8335/URT)	5-Bit Code 12345	Equivalent CCITT TTY Character
EQUIPMENT SELECTION:		
A	10101	Y
B	10110	F
C	11010	J
D	11001	W
E	10011	B
1	00010	Carriage Return
2	01010	R
3	01100	I
4	01000	Line Feed
5	00100	Space
6	01101	P
7	00101	H
8	00011	O
9	00111	M
10	01011	G

APPENDIX I

TABLE B - TRANSMITTER READBACK CODES

Character Reception Order	Display	Indication	Code Bits 1 2345
1	Resets indicator for new cycle		1 0000
2	ID-1678/URT FREQUENCY/ MEGAHERTZ 10-MHz digit	0	1111
		1	0111
		2	1011
		3	0011
	ID-1678/URT TRANSMITTER READY/TUNING/FAULT lamps	See note*	
3	ID-1678/URT FREQUENCY/ MEGAHERTZ 1-MHz digit	0	1111
		1	0111
		2	1011
		3	0011
		4	1101
		5	0101
		6	1001
		7	0001
		8	1110
		9	0110
	ID-1678/URT FREQUENCY/ READY/TUNING/FAULT lamps	See note*	

*Readback for READY/TUNING/FAULT lamps is contained in bit #1 of codes #2 and #3 combined:

	Bit #1	
Code #2	Code #3	Lamp
1	0	READY
0	1	TUNING
1	1	FAULT

TABLE B - TRANSMITTER READBACK CODES (Cont'd)

Character Reception Order	Display	Indication	Code Bits 1 2345
4	ID-1678/URT FREQUENCY/MEGAHERTZ 100-KHz digit	0-9, same as for 1-MHz digit	
	ID-1678/URT EQUIPMENT SELECTED lamp	on out	1 0
5	ID-1678/URT FREQUENCY MEGAHERTZ 10-KHz digit	0-9, same as for 1-MHz digit	
	ID-1678/URT DECODER POWER lamp	on out	1 0
6	ID-1678/URT FREQUENCY/MEGAHERTZ 1-KHz digit	0-9, same as for 1-MHz digit	
	ID-1678/URT LOCAL lamp	on out	1 0
7	ID-1678/URT FREQUENCY/MEGAHERTZ .1-KHz digit	0-9, same as for 1-MHz digit	
	ID-1678/URT VSWR & XMTR OVERLOAD lamps		*
8 (Function 1)	ID-1678/URT HIGH VOLTAGE lamp	on out	1 1000 0 1000
9 (Function 2)	ID-1678/URT VSWR & XMTR OVERLOAD lamps		* 1000
10 (Function 3)	ID-1677/URT XMTR OVERLOAD lamp #1	on out	1 1000 0 1000

* Readback for VSWR and XMTR OVERLOAD lamps is contained in Bit #1 of codes #7 and #9 combined:

Bit #1	Code #7	Code #9	Lamp
	1	1	OVERLOAD/VSWR
		1	OVERLOAD/XMTR

TABLE B - TRANSMITTER READBACK CODES (Cont'd)

Character Reception Order	Display	Indication	Code Bits 1 2345
11 (Function 4)	ID-1677/URT XMTR OVERLOAD lamp #2	on	1
		out	0
	ID-1678/URT MODE indicator	CW	1111
		PUSH-TO-TALK	0111
		VOX	1011
		NORM	0011
12 (Function 5)	ID-1677/URT XMTR OVERLOAD lamp #3	on	1
		out	0
	ID-1678/URT CARR SUPP indicator	0 db	1111
		3 db	0111
		6 db	1011
	ID-1678/URT CARR SUPP indicator	20 db	0011
		30 db	1101
		FULL	0101
13 (Function 6)	ID-1677/URT XMTR OVERLOAD lamp #4	on	1
		out	0
	ID-1678/URT OUTPUT POWER LEVEL indicator	MAIN PWR OFF	1111
		1	0111
		2	1011
		3	0011
		4	1101
14 (Function 7)	ID-1677/URT XMTR OVERLOAD lamp #5	on	1 1000
		out	0 1000
15 (Function 8)	ID-1677/URT XMTR OVERLOAD lamp #6	on	1 1000
		out	0 1000
16 (Function 9)	Not used		

TABLE B - TRANSMITTER READBACK CODES (Cont'd)

Character Reception Order	Display	Indication	Code Bits 1 2345
17 (Function 10)	ID-1677/URT XMTR SELECTED lamps #1 through #6	1	0 1110
		2	0 0110
		3	0 1010
		4	0 0010
		5	0 1100
		6	0 0100

APPENDIX I

TABLE C - RECEIVER TUNING CODES

Pushbutton (C-7775/UR)	5-Bit Code 12345	Equivalent CCITT TTY Character
FUNCTION:		
SYNTH	01000	Line Feed
APC	00100	Space
AGC TIME CONSTANT:		
SLOW	01000	Line Feed
MEDIUM	00100	Space
FAST	01100	I
MODE:		
AM 2.5 KHz	01000	Line Feed
AM 6 KHz	00100	Space
CW 2.5 KHz	01100	I
CW 6 KHz	00010	Carriage Return
ISB	01010	R
FREQUENCY:		
0	01000	Line Feed
1	00100	Space
2	01100	I
3	00010	Carriage Return
4	01010	R
5	00110	N
6	01110	C
7	00001	T
8	01001	L

TABLE C - RECEIVER TUNING CODES (Cont'd)

Pushbutton (C-7775/UR)	5-Bit Code 12345	Equivalent CCITT TTY Character
FREQUENCY (Cont'd)		
9	00101	H
TUNE	10000	E
CLEAR	01111	V
FUNCTION:		
10 MHz	11000	A
1 MHz	10100	S
100 KHz	11100	U
10 KHz	10010	D
1 KHz	11010	J
.1 KHz	10110	F
MODE	11110	K
SYM/B2	10001	Z
B1	11001	W
A1	10101	Y
A2	11101	Q
FUNC	10011	B
EQUIPMENT SELECTION:		
A	10101	Y
B	10110	F
C	11010	J
D	11001	W

TABLE C - RECEIVER TUNING CODES (Cont'd)

Pushbutton (C-7775/UR)	5-Bit Code 12345	Equivalent CCITT TTY Character
EQUIPMENT SELECTION (Cont'd)		
E	10011	B
1	00010	Carriage Return
2	01010	H
3	01100	I
4	01000	Line Feed
5	00100	Space
6	01101	P
7	00101	H
8	00011	O
9	00111	M
10	01011	G

APPENDIX I

TABLE D - RECEIVER READBACK CODES

Character Reception Order	Display (ID-1600/UR)	Indication	Code Bits 1 2345
1	Resets indicator for new cycle		1 0000
2	FREQUENCY/MEGAHERTZ 10-MHz digit	0	1111
		1	0111
		2	1011
		3	0011
	Receiver READY/TUNING FAULT lamps	See Note*	
3	FREQUENCY/MEGAHERTZ 1-MHz digit	0	1111
		1	0111
		2	1011
		3	0011
		4	1101
		5	0101
		6	1001
		7	0001
		8	1110
		9	0110
	Receiver READY/TUNING FAULT lamps	See Note*	

* Readback for READY/TUNING/FAULT lamps is contained in Bit #1 of codes #2 and #3 combined:

Bit #1		
Code #2	Code #3	Lamp
1	0	READY
0	1	TUNING
1	1	FAULT

TABLE D - RECEIVER READBACK CODES (Cont'd)

Character Reception Order	Display (ID-1600/UR)	Indication	Code Bits 1 2345
4	FREQUENCY/MEGAHERTZ 100-KHz digit	0-9, same as for 1-MHz digit	
	EQUIPMENT SELECTED lamp	on	1
		out	0
5	FREQUENCY/MEGAHERTZ 10-KHz digit	0-9, same as for 1-MHz digit	
	DECODER POWER lamp	on	1
		out	0
6	FREQUENCY/MEGAHERTZ 1-KHz digit	0-9, same as for 1-MHz digit	
	NON-AUTOMATIC lamp	on	1
		out	0
7	FREQUENCY/MEGAHERTZ	0-9, same as for 1-MHz digit	
	AFC ALARM lamp	on	1
		out	0
8	SYNTH/FUNCTION	on	1 1000
		out	0 1000
9	AFC/FUNCTION lamp	on	1 1000
		out	0 1000
10	MODE display	2.5 KHz AM	0 1111
		6 KHz AM	0 0111
		2.5 KHz CW	0 1011
		6 KHz CW	0 0011
		ISB	0 1101
11	AGC TIME CONSTANT display, SYM B2 and B1	SLOW and SLOW	0 1111
		SLOW and MED	0 1101
		SLOW and FAST	0 1110
		MED and SLOW	0 0111
		MED and MED	0 0101
		MED and FAST	0 0110

TABLE D - RECEIVER READBACK CODES (Cont'd)

Character Reception Order	Display (ID-1600/UR)	Indication	Code Bits 1 2345
11 (Cont'd)	AGC TIME CONSTANT display, SYM B2 and B1	FAST and SLOW	0 1011
		FAST and MED	0 1001
		FAST and FAST	0 1010
12	AGC TIME CONSTANT display, A2 and A1	SLOW and SLOW	0 1111
		SLOW and MED	0 1101
		SLOW and FAST	0 1110
		MED and SLOW	0 0111
		MED and MED	0 0101
		MED and FAST	0 0110
		FAST and SLOW	0 1011
		FAST and MED	0 1001
		FAST and FAST	0 1010
	Display (SB-3230/UR)		
13	1-10 lamps (Readback receiver identification)	1	0 1111
		2	0 0111
		3	0 1011
		4	0 0011
		5	0 1101
		6	0 0101
		7	0 1001
		8	0 0001
		9	0 1110
		10	0 0110

APPENDIX II

WIRE RUNNING LIST

1.1 GENERAL

Appendix II contains the wire running lists for the Control Console wiring and interconnect cables. This wire running list was correct at the time of installation. If all changes, additions or deletions to the wiring are entered promptly, this Appendix can be a valuable aid to repair and troubleshooting. This wire running list has been broken down into the following sections.

A. DC Equipment to IDF

B. Audio Equipment to IDF

C. DC Patch to IDF

D. Audio Patch to IDF

E. Cross Connects

F. DC Control Circuits

1.2 WIRING COLOR CODE

The following tables list the wiring color codes used for both DC and Audio cables. Table 1 lists color code of TMC 12-pair cable used between Jack Fields and IDF, Table 2 lists the color code for Belden 11-pair cable, Table 3 for Belden 6-pair cable and Table 4 for Belden 3-pair cable.

TABLE 1 - 12 pair Cable

1.	White - Brown	7.	White - Violet
2.	White - Red	8.	White - Slate
3.	White - Orange	9.	Black - Brown
4.	White - Yellow	10.	Black - Red
5.	White - Green	11.	Black - Orange
6.	White - Blue	12.	Black - Yellow

TABLE 2 - 11 pair Cable

1.	Red - Blue	7.	Black - Red
2.	Red - Green	8.	Black - Orange
3.	Red - Yellow	9.	Black - Brown
4.	Black - Blue	10.	Red - White
5.	Black - Green	11.	Black - White
6.	Black - Yellow		

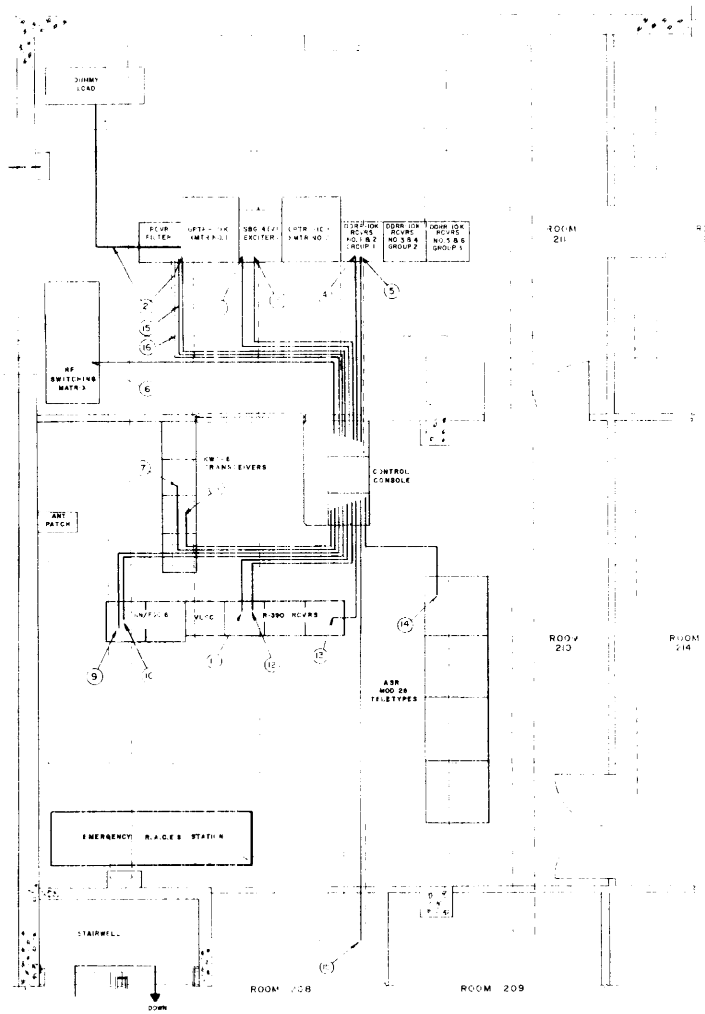
TABLE 3 - 6 pair Cable

1.	Black - Blue	4.	Black - Red
2.	Black - Green	5.	Black - Brown
3.	Black - Yellow	6.	Black - White

TABLE 4 - 3 pair Cable

1. Black - Green
2. Black - Red
3. Black - White

In addition Appendix II contains Signal Cable Distribution Drawing, Figure II-I, showing the interconnection cable runs between the equipments and the Communication Control Console.



LEGEND

1	TRANSMIT AUDIO	TWO(2) RUNS, SIX(6) PAIR, NO. 22, INDIVIDUALLY SHIELDED. (BELDEN NO. 8768)
2	INTERLOCKS	SIX (6) PAIR, NO. 22 INDIVIDUALLY SHIELDED (BELDEN NO 8768)
3	TRANSMITTER CONTROL	" " " " "
4	RECEIVER CONTROL	" " " " "
5	RCVR AUDIO OUT	SIX (6) RUNS, SIX(6) PAIR, NO. 22, INDIVIDUALLY SHIELDED. (BELDEN NO. 8768)
6	MATRIX CONTROL	CABLE SUPPLIED BY ITT JENNINGS TO BE RUN OVERHEAD IN CONDUIT. TERMINATES DIRECTLY ON EQUIP. IN MS TYPE CONNECTORS.
7	AUDIO (FROM KWT-6 XCVR'S)	SIX(6) PAIR, NO. 22 INDIVIDUALLY SHIELDED (BELDEN NO 8768)
8	AUDIO (TO KWT-6 XCVR'S)	" " " " "
9	DC	SIX(6) RUNS, ELEVEN(11) PAIR, NO. 22, INDIVIDUALLY SHIELDED. (BELDEN NO. 8765)
10	AUDIO	ELEVEN(11) PAIR, NO 22, INDIVIDUALLY SHIELDED. (BELDEN NO. 8765)
11	DC (TAPE/REC CONTROL)	TWO(2) RUNS, THREE(3) PAIR, NO 22 INDIVIDUALLY SHIELDED (BELDEN NO. 876[illegible])
12	AUDIO (TO TAPE RECORDER)	FOUR(4) RUNS, THREE(3) PAIR NO. 22 INDIVIDUALLY SHIELDED. (BELDEN NO. 8767)
13	FROM R-390 RCVR'S	ELEVEN(11) PAIR, NO. 22, INDIVIDUALLY SHIELDED. (BELDEN NO. 8765)
14	TO ASR MOD. 28 TELETYPES	ELEVEN(11) PAIR, NO. 22 INDIVIDUALLY SHIELDED. (BELDEN NO. 8765)
15	TO TELEPHONES	FIVE(5) RUNS, THREE(3) PAIR, NO 22, INDIVIDUALLY SHIELDED. (BELDEN NO. 8765)
16	CONTROL CABLES FOR FILTERS 24 PAIR SHIELDED	

NOTES
1. AUDIO, DC AND CONTROL CIRCUITS TO BE ISOLATED IN COMPUTER FLOOR DUCT

Figure II-1. Signal Cable Distribution

APPENDIX II

WIRE RUNNING LIST A

DC EQUIPMENT TO IDF

Cable DCS-1

Pair	From	To	Block	Row	Pin
1	VFTG CHAN 1 Send	IDF	A5	1	A-B
2	VFTG CHAN 2 Send	IDF	A5	1	C-D
3	VFTG CHAN 3 Send	IDF	A5	1	E-F
4	VFTG CHAN 4 Send	IDF	A5	2	A-B
5	VFTG CHAN 5 Send	IDF	A5	2	C-D
6	VFTG CHAN 6 Send	IDF	A5	2	E-F
7	VFTG CHAN 7 Send	IDF	A5	3	A-B
8	VFTG CHAN 8 Send	IDF	A5	3	C-D
9	VFTG CHAN 9 Send	IDF	A5	3	E-F
10	VFTG CHAN 10 Send	IDF	A5	4	A-B
11	VFTG CHAN 11 Send	IDF	A5	4	C-D

Cable DCS-2

1	VFTG CHAN 12 Send	IDF	A5	4	E-F
2	VFTG CHAN 13 Send	IDF	A5	5	A-B
3	VFTG CHAN 14 Send	IDF	A5	5	C-D
4	VFTG CHAN 15 Send	IDF	A5	5	E-F
5	VFTG CHAN 16 Send	IDF	A5	6	A-B
6	VFTG CHAN 1 Receive	IDF	A5	6	C-D
7	VFTG CHAN 2 Receive	IDF	A5	6	E-F
8	VFTG CHAN 3 Receive	IDF	A5	7	A-B

Cable DCS-2 (Cont'd)

Pair	From	To	Block	Row	Pin
9	VFTG CHAN 4 Receive	IDF	A5	7	C-D
10	VFTG CHAN 5 Receive	IDF	A5	7	E-F
11	VFTG CHAN 6 Receive	IDF	A5	8	A-B
Cable DCS-3					
1	VFTG CHAN 7 Receive	IDF	A5	8	C-D
2	VFTG CHAN 8 Receive	IDF	A5	8	E-F
3	VFTG CHAN 9 Receive	IDF	A5	9	A-B
4	VFTG CHAN 10 Receive	IDF	A5	9	C-D
5	VFTG CHAN 11 Receive	IDF	A5	9	E-F
6	VFTG CHAN 12 Receive	IDF	A5	10	A-B
7	VFTG CHAN 13 Receive	IDF	A5	10	C-D
8	VFTG CHAN 14 Receive	IDF	A5	10	E-F
9	VFTG CHAN 15 Receive	IDF	A5	11	A-B
10	VFTG CHAN 16 Receive	IDF	A5	11	C-D
11	Spare	IDF	A5	11	E-F
Cable DCS-4					
1	VFTG CHAN 17 Send	IDF	A5	13	A-B
2	VFTG CHAN 18 Send	IDF	A5	13	C-D
3	VFTG CHAN 19 Send	IDF	A5	13	E-F
4	VFTG CHAN 20 Send	IDF	A5	14	A-B
5	VFTG CHAN 21 Send	IDF	A5	14	C-D
6	VFTG CHAN 22 Send	IDF	A5	14	E-F

Cable DCS-4 (Cont'd)

Pair	From	To	Block	Row	Pin
7	VFTG CHAN 23 Send	IDF	A5	15	A-B
8	VFTG CHAN 24 Send	IDF	A5	15	C-D
9	VFTG CHAN 25 Send	IDF	A5	15	E-F
10	VFTG CHAN 26 Send	IDF	A5	16	A-B
11	VFTG CHAN 27 Send	IDF	A5	16	C-D

Cable DCS-5

1	VFTG CHAN 28 Send	IDF	A5	16	E-F
2	VFTG CHAN 29 Send	IDF	A5	17	A-B
3	VFTG CHAN 30 Send	IDF	A5	17	C-D
4	VFTG CHAN 31 Send	IDF	A5	17	E-F
5	VFTG CHAN 32 Send	IDF	A5	18	A-B
6	VFTG CHAN 17 Receive	IDF	A5	18	C-D
7	VFTG CHAN 18 Receive	IDF	A5	18	E-F
8	VFTG CHAN 19 Receive	IDF	A5	19	A-B
9	VFTG CHAN 20 Receive	IDF	A5	19	C-D
10	VFTG CHAN 21 Receive	IDF	A5	19	E-F
11	VFTG CHAN 22 Receive	IDF	A5	20	A-B

Cable DCS-6

1	VFTG CHAN 23 Receive	IDF	A5	20	C-D
2	VFTG CHAN 24 Receive	IDF	A5	20	E-F
3	VFTG CHAN 25 Receive	IDF	A5	21	A-B
4	VFTG CHAN 26 Receive	IDF	A5	21	C-D

Cable DCS-6 (Cont'd)

Pair	From	To	Block	Row	Pin
5	VFTG CHAN 27 Receive	IDF	A5	21	E-F
6	VFTG CHAN 28 Receive	IDF	A5	22	A-B
7	VFTG CHAN 29 Receive	IDF	A5	22	C-D
8	VFTG CHAN 30 Receive	IDF	A5	22	E-F
9	VFTG CHAN 31 Receive	IDF	A5	23	A-B
10	VFTG CHAN 32 Receive	IDF	A5	23	C-D
11	Spare	IDF	A5	23	E-F

Cable DCS-7

1	ASR - #1 Send	IDF	A6	1	A-B
2	ASR - #1 Receive	IDF	A6	1	C-D
3	ASR - #2 Send	IDF	A6	1	E-F
4	ASR - #2 Receive	IDF	A6	2	A-B
5	ASR - #3 Send	IDF	A6	2	C-D
6	ASR - #3 Receive	IDF	A6	2	E-F
7	ASR - #4 Send	IDF	A6	3	A-B
8	ASR - #4 Receive	IDF	A6	3	C-D
9	Spare	IDF	A6	3	E-F
10	Spare	IDF	A6	4	A-B
11	Spare	IDF	A6	4	C-D

APPENDIX II

WIRE RUNNING LIST B

AUDIO EQUIPMENT TO IDF

Aud - 1

Pair	From	To	Block	Row	Pin
1	AN/FRR-85(V)RCVR 1 -B2	IDF	B5	1	A-B
2	AN/FRR-85(V)RCVR 1 -B1	IDF	B5	1	C-D
3	AN/FRR-85(V)RCVR 1 -A1	IDF	B5	1	E-F
4	AN/FRR-85(V)RCVR 1 -A2	IDF	B5	2	A-B
5	Spare	IDF	B5	2	C-D
6	Spare	IDF	B5	2	E-F

Aud - 2

1	AN/FRR-85(V)RCVR 2 -B2	IDF	B5	3	A-B
2	AN/FRR-85(V)RCVR 2 -B1	IDF	B5	3	C-D
3	AN/FRR-85(V)RCVR 2 -A1	IDF	B5	3	E-F
4	AN/FRR-85(V)RCVR 2 -A2	IDF	B5	4	A-B
5	Spare	IDF	B5	4	C-D
6	Spare	IDF	B5	4	E-F

Aud - 3

1	AN/FRR-85(V)RCVR 3 - B2	IDF	B5	5	A-B
2	AN/FRR-85(V)RCVR 3 - B1	IDF	B5	5	C-D
3	AN/FRR-85(V)RCVR 3 - A1	IDF	B5	5	E-F

Aud - 3 (Cont'd)

Pair	From	To	Block	Row	Pin
4	AN/FRR-85(V)RCVR 3 -A2	IDF	B5	6	A-B
5	Spare	IDF	B5	6	C-D
6	Spare	IDF	B5	6	E-F
Aud - 4					
1	AN/FRR-85(V)RCVR 4-B2	IDF	B5	7	A-B
2	AN/FRR-85(V)RCVR 4-B1	IDF	B5	7	C-D
3	AN/FRR-85(V)RCVR 4-A1	IDF	B5	7	E-F
4	AN/FRR-85(V)RCVR 4-A2	IDF	B5	8	A-B
5	Spare	IDF	B5	8	C-D
6	Spare	IDF	B5	8	E-F
Aud - 5					
1	AN/FRR-85(V)RCVR 5-B2	IDF	B5	9	A-B
2	AN/FRR-85(V)RCVR 5-B1	IDF	B5	9	C-D
3	AN/FRR-85(V)RCVR 5-A1	IDF	B5	9	E-F
4	AN/FRR-85(V)RCVR 5-A2	IDF	B5	10	A-B
5	Spare	IDF	B5	10	C-D
6	Spare	IDF	B5	10	E-F
Aud - 6					
1	AN/FRR-85(V)RCVR 6-B2	IDF	B5	11	A-B
2	AN/FRR-85(V)RCVR 6-B1	IDF	B5	11	C-D
3	AN/FRR-85(V)RCVR 6-A1	IDF	B5	11	E-F
4	AN/FRR-85(V)RCVR 6-A2	IDF	B5	12	A-B
5	Spare	IDF	B5	12	C-D
6	Spare	IDF	B5	12	E-F

Aud - 7

Pair	From	To	Block	Row	Pin
1	AN/URT-37 # 1 - B2	IDF	B5	13	A-B
2	AN/URT-37 # 1 - B1	IDF	B5	13	C-D
3	AN/URT-37 # 1 - A1	IDF	B5	13	E-F
4	AN/URT-37 # 1 - A2	IDF	B5	14	A-B
5	Spare	IDF	B5	14	C-D
6	Spare	IDF	B5	14	E-F

Aud - 8

1	AN/URT-37 # 2 - B2	IDF	B5	15	A-B
2	AN/URT-37 # 2 - B1	IDF	B5	15	C-D
3	AN/URT-37 # 2 - A1	IDF	B5	15	E-F
4	AN/URT-37 # 2 - A2	IDF	B5	16	A-B
5	Spare	IDF	B5	16	C-D
6	Spare	IDF	B5	16	E-F

Aud - 9

1	KWT-6 #1 Receive USB	IDF	B5	17	A-B
2	KWT-6 #1 Receive LSB	IDF	B5	17	C-D
3	KWT-6 #1 Send USB	IDF	B5	17	E-F
4	KWT-6 #1 Send LSB	IDF	B5	18	A-B
5	Spare	IDF	B5	18	C-D
6	Spare	IDF	B5	18	E-F

Aud - 10

Pair	From	To	Block	Row	Pin
1	KWT-6 #2 Receive USB	IDF	B5	24	A-B
2	KWT-6 #2 Receive LSB	IDF	B5	24	C-D
3	KWT-6 #2 Send USB	IDF	B5	24	E-F
4	KWT-6 #2 Send LSB	IDF	B5	25	A-B
5	Spare	IDF	B5	25	C-D
6	Spare	IDF	B5	25	E-F

Aud - 11

1	R-390 #1 Audio Out	IDF	B6	1	A-B
2	R-390 #2 Audio Out	IDF	B6	1	C-D
3	R-390 #3 Audio Out	IDF	B6	1	E-F
4	R-390 #4 Audio Out	IDF	B6	2	A-B
5	Future	IDF	B6	2	C-D
6	Future	IDF	B6	2	E-F
7	Spare				
8	Spare				
9	Spare				
10	Spare				
11	Spare				

Aud - 12

1	VFTG -1 In #1	IDF	B6	3	A-B
2	VFTG -1 In #2	IDF	B6	3	C-D
3	VFTG -2 In #1	IDF	B6	3	E-F

Aud - 12 (Cont'd)

Pair	From	To	Block	Row	Pin
4	VFTG-2 In #2	IDF	B6	4	A-B
5	Future	IDF	B6	4	C-D
6	Future	IDF	B6	4	E-F
7	VFTG-1 Out	IDF	B6	5	A-B
8	VFTG-2 Out	IDF	B6	5	C-D
9	Future	IDF	B6	5	E-F
10	Future	IDF	B6	6	A-B
11	Spare				

Aud - 13

1	4W/W Bridge In #1	IDF	B7	15	A-B
2	4W/W Bridge In #2	IDF	B7	15	C-D
3	4W/W Bridge In #3	IDF	B7	15	E-F
4	4W/W Bridge In #4	IDF	B7	16	A-B
5	4W/W Bridge Out #1	IDF	B7	16	C-D
6	4W/W Bridge Out #2	IDF	B7	16	E-F
7	4W/W Bridge Out #3	IDF	B7	17	A-B
8	4W/W Bridge Out #4	IDF	B7	17	C-D
9	Future	IDF	B7	17	E-F
10	Future	IDF	B7	18	A-B
11	Future	IDF	B7	18	C-D
12	Future	IDF	B7	18	E-F

Aud - 14

Pair	From	To	Block	Row	Pin
1	Tel Term - 2 wire	IDF	B7	19	A-B
2	Tel Term - 2 wire	IDF	B7	19	C-D
3	Tel Term - 2 wire	IDF	B7	19	E-F
4	Tel Term - 2 wire	IDF	B7	20	A-B
5	Tel Term - 2 wire	IDF	B7	20	C-D
6	Tel Term - 2 wire	IDF	B7	20	E-F
7	Future	IDF	B7	21	A-B
8	Future	IDF	B7	21	C-D
9	Future	IDF	B7	21	E-F
10	Spare				
11	Spare				

Aud - 15

1	2W/4W Hybrid #1- 2-wire In	IDF	B7	22	A-B
2	2W/4W Hybrid #1- XMIT Out	IDF	B7	22	C-D
3	2W/4W Hybrid #1- Receive Out	IDF	B7	22	E-F
4	2W/4W Hybrid #2- 2-Wire In	IDF	B7	23	A-B
5	2W/4W Hybrid #2- XMIT Out	IDF	B7	23	C-D
6	2W/4W Hybrid #2- Receive Out	IDF	B7	23	E-F
7	Future	IDF	B7	24	A-B

Aud - 15 (Cont'd)

Pair	From	To	Block	Row	Pin
8	Future	IDF	B7	24	C-D
9	Future	IDF	B7	24	E-F
10	Spare				
11	Spare				
Aud - 16					
1	Mon Ampl In	IDF	B7	25	A-B
2	Mon Ampl 4 ohms	IDF	B7	25	C-D
3	Mon Ampl 8 ohms	IDF	B7	25	E-F
4	Mon Ampl 250 ohms	IDF	B7	26	A-B
5	Mon Ampl 500 ohms	IDF	B7	26	C-D
6	Spare				
Aud - 17					
1	VU Meter - VU In	IDF	B7	26	E-F
Aud - 18					
1	LSP-4 Speaker	IDF	B8	1	A-B
Aud - 19					
1	LSP-4 Speaker	IDF	B8	1	C-D
Aud - 20					
1	SPU-2 In	IDF	B8	1	E-F
2	SPU-2 Out	IDF	B8	2	A-B

Aud - 20 (Cont'd)

Pair	From	To	Block	Row	Pin
3	Future	IDF	B8	2	C-D
4	Future	IDF	B8	2	E-F
5	Spare				
6	Spare				
Aud - 21					
1	Tape Recorder - In	IDF	B8	3	A-B
2	Tape Recorder - Record	IDF	B8	3	C-D
3	Tape Recorder - Out	IDF	B8	3	E-F
Aud - 22					
1	Tape Recorder-Playback	IDF	B8	4	A-B
2	Tape Recorder, In	IDF	B8	4	C-D
3	Tape Recorder, Record	IDF	B8	4	E-F
Aud - 23					
1	Tape Recorder - Out	IDF	B8	5	A-B
2	Tape Recorder-Playback	IDF	B8	5	C-D
3	Future	IDF	B8	5	E-F
Aud - 24					
1	Future	IDF	B8	6	A-B
2	Future	IDF	B8	6	C-D
3	Future	IDF	B8	6	E-F

Aud - 25

Pair	From	To	Block	Row	Pin
1	Line Ampl - Amp In	IDF	B8	7	A-B
2	Line Ampl - Amp In	IDF	B8	7	C-D
3	Line Ampl - Amp In	IDF	B8	7	E-F
4	Line Ampl - Amp In	IDF	B8	8	A-B
5	Future	IDF	B8	8	C-D
6	Future	IDF	B8	8	E-F
7	Line Ampl - Amp Out	IDF	B8	9	A-B
8	Line Ampl - Amp Out	IDF	B8	9	C-D
9	Line Ampl - Amp Out	IDF	B8	9	E-F
10	Line Ampl - Amp Out	IDF	B8	10	A-B
11	Future	IDF	B8	10	C-D
12	Future	IDF	B8	10	E-F

Aud - 28

1	4-Wire Tel - Xmit #1	IDF	B8	15	A-B
2	4-Wire Tel - Receive #1	IDF	B8	15	C-D
3	4-Wire Tel - Xmit #2	IDF	B8	15	E-F
4	4-Wire Tel - Receive #2	IDF	B8	16	A-B
5	4-Wire Tel - Xmit #3	IDF	B8	16	C-D
6	4-Wire Tel - Receive #3	IDF	B8	16	E-F
7	4-Wire Tel - Xmit #4	IDF	B8	17	A-B
8	4-Wire Tel - Receive #4	IDF	B8	17	C-D
9	4-Wire Tel - Xmit #5	IDF	B8	17	E-F
10	4-Wire Tel - Receive #5	IDF	B8	18	A-B

Aud - 28 (Cont'd)

Pair	From	To	Block	Row	Pin
11	4-Wire Tel - Xmit #6	IDF	B8	18	C-D
12	4-Wire Tel - Receive #6	IDF	B8	18	E-F

Aud - 30 and 31

1	Comparator Ampl-Amp In	IDF	B8	14	A-B
1	Comparator Ampl-Amp Out	IDF	B8	14	C-D

Aud - 32 and 33

1	Bridge Ampl - Amp In	IDF	B8	19	A-B
1	Bridge Ampl - Amp Out	IDF	B8	19	C-D

APPENDIX II

WIRE RUNNING LIST C

DC PATCH TO IDF

GRD-1-1

Pair	From	To	Block	Row	Pin
1	Line Jack 1	IDF	A1	1	A-B
2	Line Jack 2	IDF	A1	1	C-D
3	Line Jack 3	IDF	A1	1	E-F
4	Line Jack 4	IDF	A1	2	A-B
5	Line Jack 5	IDF	A1	2	C-D
6	Line Jack 6	IDF	A1	2	E-F
7	Line Jack 7	IDF	A1	3	A-B
8	Line Jack 8	IDF	A1	3	C-D
9	Line Jack 9	IDF	A1	3	E-F
10	Line Jack 10	IDF	A1	4	A-B
11	Line Jack 11	IDF	A1	4	C-D
12	Line Jack 12	IDF	A1	4	E-F
GRD-1-2					
1	Line Jack 13	IDF	A1	5	A-B
2	Line Jack 14	IDF	A1	5	C-D
3	Line Jack 15	IDF	A1	5	E-F
4	Line Jack 16	IDF	A1	6	A-B
5	Line Jack 17	IDF	A1	6	C-D
6	Line Jack 18	IDF	A1	6	E-F

GRD-1-2 (Cont'd)

Pair	From	To	Block	Row	Pin
7	Line Jack 19	IDF	A1	7	A-B
8	Line Jack 20	IDF	A1	7	C-D
9	Line Jack 21	IDF	A1	7	E-F
10	Line Jack 22	IDF	A1	8	A-B
11	Line Jack 23	IDF	A1	8	C-D
12	Line Jack 24	IDF	A1	8	E-F
GRD-1-3					
1	Line Jack 25	IDF	A1	9	A-B
2	Line Jack 26	IDF	A1	9	C-D
3	Line Jack 27	IDF	A1	9	E-F
4	Line Jack 28	IDF	A1	10	A-B
5	Line Jack 29	IDF	A1	10	C-D
6	Line Jack 30	IDF	A1	10	E-F
7	Line Jack 31	IDF	A1	11	A-B
8	Line Jack 32	IDF	A1	11	C-D
9	Line Jack 33	IDF	A1	11	E-F
10	Line Jack 34	IDF	A1	12	A-B
11	Line Jack 35	IDF	A1	12	C-D
12	Line Jack 36	IDF	A1	12	E-F
GRD-1-4					
1	Line Jack 37	IDF	A1	13	A-B
2	Line Jack 38	IDF	A1	13	C-D

GRD-1-4 (Cont'd)

Pair	From	To	Block	Row	Pin
3	Line Jack 39	IDF	A1	13	E-F
4	Line Jack 40	IDF	A1	14	A-B
5	Line Jack 41	IDF	A1	14	C-D
6	Line Jack 42	IDF	A1	14	E-F
7	Line Jack 43	IDF	A1	15	A-B
8	Line Jack 44	IDF	A1	15	C-D
9	Line Jack 45	IDF	A1	15	E-F
10	Line Jack 46	IDF	A1	16	A-B
11	Line Jack 47	IDF	A1	16	C-D
12	Line Jack 48	IDF	A1	16	E-F

GRD-1-5

1	Equip Jack 1	IDF	A1	17	A-B
2	Equip Jack 2	IDF	A1	17	C-D
3	Equip Jack 3	IDF	A1	17	E-F
4	Equip Jack 4	IDF	A1	18	A-B
5	Equip Jack 5	IDF	A1	18	C-D
6	Equip Jack 6	IDF	A1	18	E-F
7	Equip Jack 7	IDF	A1	19	A-B
8	Equip Jack 8	IDF	A1	19	C-D
9	Equip Jack 9	IDF	A1	19	E-F
10	Equip Jack 10	IDF	A1	20	A-B
11	Equip Jack 11	IDF	A1	20	C-D
12	Equip Jack 12	IDF	A1	20	E-F

GRD-1-6

Pair	From	To	Block	Row	Pin
1	Equip Jack 13	IDF	A1	21	A-B
2	Equip Jack 14	IDF	A1	21	C-D
3	Equip Jack 15	IDF	A1	21	E-F
4	Equip Jack 16	IDF	A1	22	A-B
5	Equip Jack 17	IDF	A1	22	C-D
6	Equip Jack 18	IDF	A1	22	E-F
7	Equip Jack 19	IDF	A1	23	A-B
8	Equip Jack 20	IDF	A1	23	C-D
9	Equip Jack 21	IDF	A1	23	E-F
10	Equip Jack 22	IDF	A1	24	A-B
11	Equip Jack 23	IDF	A1	24	C-D
12	Equip Jack 24	IDF	A1	24	E-F

GRD-1-7

1	Equip Jack 25	IDF	A2	1	A-B
2	Equip Jack 26	IDF	A2	1	C-D
3	Equip Jack 27	IDF	A2	1	E-F
4	Equip Jack 28	IDF	A2	2	A-B
5	Equip Jack 29	IDF	A2	2	C-D
6	Equip Jack 30	IDF	A2	2	E-F
7	Equip Jack 31	IDF	A2	3	A-B
8	Equip Jack 32	IDF	A2	3	C-D
9	Equip Jack 33	IDF	A2	3	E-F

GRD-1-7 (Cont'd)

Pair	From	To	Block	Row	Pin
10	Equip Jack 34	IDF	A2	4	A-B
11	Equip Jack 35	IDF	A2	4	C-D
12	Equip Jack 36	IDF	A2	4	E-F
GRD-1-8					
1	Equip Jack 37	IDF	A2	5	A-B
2	Equip Jack 38	IDF	A2	5	C-D
3	Equip Jack 39	IDF	A2	5	E-F
4	Equip Jack 40	IDF	A2	6	A-B
5	Equip Jack 41	IDF	A2	6	C-D
6	Equip Jack 42	IDF	A2	6	E-F
7	Equip Jack 43	IDF	A2	7	A-B
8	Equip Jack 44	IDF	A2	7	C-D
9	Equip Jack 45	IDF	A2	7	E-F
10	Equip Jack 46	IDF	A2	8	A-B
11	Equip Jack 47	IDF	A2	8	C-D
12	Equip Jack 48	IDF	A2	8	E-F
GRD-2-1					
1	Line Jack 1	IDF	A2	9	A-B
2	Line Jack 2	IDF	A2	9	C-D
3	Line Jack 3	IDF	A2	9	E-F
4	Line Jack 4	IDF	A2	10	A-B
5	Line Jack 5	IDF	A2	10	C-D
6	Line Jack 6	IDF	A2	10	E-F

GRD-2-1 (Cont'd)

Pair	From	To	Block	Row	Pin
7	Line Jack 7	IDF	A2	11	A-B
8	Line Jack 8	IDF	A2	11	C-D
9	Line Jack 9	IDF	A2	11	E-F
10	Line Jack 10	IDF	A2	12	A-B
11	Line Jack 11	IDF	A2	12	C-D
12	Line Jack 12	IDF	A2	12	E-F

GRD-2-2

1	Line Jack 13	IDF	A2	13	A-B
2	Line Jack 14	IDF	A2	13	C-D
3	Line Jack 15	IDF	A2	13	E-F
4	Line Jack 16	IDF	A2	14	A-B
5	Line Jack 17	IDF	A2	14	C-D
6	Line Jack 18	IDF	A2	14	E-F
7	Line Jack 19	IDF	A2	15	A-B
8	Line Jack 20	IDF	A2	15	C-D
9	Line Jack 21	IDF	A2	15	E-F
10	Line Jack 22	IDF	A2	16	A-B
11	Line Jack 23	IDF	A2	16	C-D
12	Line Jack 24	IDF	A2	16	E-F

GRD-2-3

Pair	From	To	Block	Row	Pin
1	Line Jack 25	IDF	A2	17	A-B
2	Line Jack 26	IDF	A2	17	C-D
3	Line Jack 27	IDF	A2	17	E-F
4	Line Jack 28	IDF	A2	18	A-B
5	Line Jack 29	IDF	A2	18	C-D
6	Line Jack 30	IDF	A2	18	E-F
7	Line Jack 31	IDF	A2	19	A-B
8	Line Jack 32	IDF	A2	19	C-D
9	Line Jack 33	IDF	A2	19	E-F
10	Line Jack 34	IDF	A2	20	A-B
11	Line Jack 35	IDF	A2	20	C-D
12	Line Jack 36	IDF	A2	20	E-F

GRD-2-4

1	Line Jack 37	IDF	A2	21	A-B
2	Line Jack 38	IDF	A2	21	C-D
3	Line Jack 39	IDF	A2	21	E-F
4	Line Jack 40	IDF	A2	22	A-B
5	Line Jack 41	IDF	A2	22	C-D
6	Line Jack 42	IDF	A2	22	E-F
7	Line Jack 43	IDF	A2	23	A-B
8	Line Jack 44	IDF	A2	23	C-D
9	Line Jack 45	IDF	A2	23	E-F

GRD-2-4 (Cont'd)

Pair	From	To	Block	Row	Pin
10	Line Jack 46	IDF	A2	24	A-B
11	Line Jack 47	IDF	A2	24	C-D
12	Line Jack 48	IDF	A2	24	E-F
GRD-2-5					
1	Equip Jack 1	IDF	A3	1	A-B
2	Equip Jack 2	IDF	A3	1	C-D
3	Equip Jack 3	IDF	A3	1	E-F
4	Equip Jack 4	IDF	A3	2	A-B
5	Equip Jack 5	IDF	A3	2	C-D
6	Equip Jack 6	IDF	A3	2	E-F
7	Equip Jack 7	IDF	A3	3	A-B
8	Equip Jack 8	IDF	A3	3	C-D
9	Equip Jack 9	IDF	A3	3	E-F
10	Equip Jack 10	IDF	A3	4	A-B
11	Equip Jack 11	IDF	A3	4	C-D
12	Equip Jack 12	IDF	A3	4	E-F
GRD-2-6					
1	Equip Jack 13	IDF	A3	5	A-B
2	Equip Jack 14	IDF	A3	5	C-D
3	Equip Jack 15	IDF	A3	5	E-F
4	Equip Jack 16	IDF	A3	6	A-B
5	Equip Jack 17	IDF	A3	6	C-D

GRD-2-6 (Cont'd)

Pair	From	To	Block	Row	Pin
6	Equip Jack 18	IDF	A3	6	E-F
7	Equip Jack 19	IDF	A3	7	A-B
8	Equip Jack 20	IDF	A3	7	C-D
9	Equip Jack 21	IDF	A3	7	E-F
10	Equip Jack 22	IDF	A3	8	A-B
11	Equip Jack 23	IDF	A3	8	C-D
12	Equip Jack 24	IDF	A3	8	E-F
GRD-2-7					
1	Equip Jack 25	IDF	A3	9	A-B
2	Equip Jack 26	IDF	A3	9	C-D
3	Equip Jack 27	IDF	A3	9	E-F
4	Equip Jack 28	IDF	A3	10	A-B
5	Equip Jack 29	IDF	A3	10	C-D
6	Equip Jack 30	IDF	A3	10	E-F
7	Equip Jack 31	IDF	A3	11	A-B
8	Equip Jack 32	IDF	A3	11	C-D
9	Equip Jack 33	IDF	A3	11	E-F
10	Equip Jack 34	IDF	A3	12	A-B
11	Equip Jack 35	IDF	A3	12	C-D
12	Equip Jack 36	IDF	A3	12	E-F

GRD-2-8

Pair	From	To	Block	Row	Pin
1	Equip Jack 37	IDF	A3	13	A-B
2	Equip Jack 38	IDF	A3	13	C-D
3	Equip Jack 39	IDF	A3	13	E-F
4	Equip Jack 40	IDF	A3	14	A-B
5	Equip Jack 41	IDF	A3	14	C-D
6	Equip Jack 42	IDF	A3	14	E-F
7	Equip Jack 43	IDF	A3	15	A-B
8	Equip Jack 44	IDF	A3	15	C-D
9	Equip Jack 45	IDF	A3	15	E-F
10	Equip Jack 46	IDF	A3	16	A-B
11	Equip Jack 47	IDF	A3	16	C-D
12	Equip Jack 48	IDF	A3	16	E-F

GRD-3-1

1	Misc Jack 1	IDF	A3	17	A-B
2	Misc Jack 2	IDF	A3	17	C-D
3	Misc Jack 3	IDF	A3	17	E-F
4	Misc Jack 4	IDF	A3	18	A-B
5	Misc Jack 5	IDF	A3	18	C-D
6	Misc Jack 6	IDF	A3	18	E-F
7	Misc Jack 7	IDF	A3	19	A-B
8	Misc Jack 8	IDF	A3	19	C-D
9	Misc Jack 9	IDF	A3	19	E-F

GRD-3-1 (Cont'd)

Pair	From	To	Block	Row	Pin
10	Misc Jack 10	IDF	A3	20	A-B
11	Misc Jack 11	IDF	A3	20	C-D
12	Misc Jack 12	IDF	A3	20	E-F

GRD-3-2

1	Misc Jack 13	IDF	A3	21	A-B
2	Misc Jack 14	IDF	A3	21	C-D
3	Misc Jack 15	IDF	A3	21	E-F
4	Misc Jack 16	IDF	A3	22	A-B
5	Misc Jack 17	IDF	A3	22	C-D
6	Misc Jack 18	IDF	A3	22	E-F
7	Misc Jack 19	IDF	A3	23	A-B
8	Misc Jack 20	IDF	A3	23	C-D
9	Misc Jack 21	IDF	A3	23	E-F
10	Misc Jack 22	IDF	A3	24	A-B
11	Misc Jack 23	IDF	A3	24	C-D
12	Misc Jack 24	IDF	A3	24	E-F

APPENDIX II

WIRE RUNNING LIST D

AUDIO PATCH TO IDF

GRA-1-1

Pair	From	To	Block	Row	Pin
1	Line Jack 1	IDF	B1	1	A-B
2	Line Jack 2	IDF	B1	1	C-D
3	Line Jack 3	IDF	B1	1	E-F
4	Line Jack 4	IDF	B1	2	A-B
5	Line Jack 5	IDF	B1	2	C-D
6	Line Jack 6	IDF	B1	2	E-F
7	Line Jack 7	IDF	B1	3	A-B
8	Line Jack 8	IDF	B1	3	C-D
9	Line Jack 9	IDF	B1	3	E-F
10	Line Jack 10	IDF	B1	4	A-B
11	Line Jack 11	IDF	B1	4	C-D
12	Line Jack 12	IDF	B1	4	E-F

GRA-1-2

1	Line Jack 13	IDF	B1	5	A-B
2	Line Jack 14	IDF	B1	5	C-D
3	Line Jack 15	IDF	B1	5	E-F
4	Line Jack 16	IDF	B1	6	A-B

GRA-1-2 (Cont'd)

Pair	From	To	Block	Row	Pin
5	Line Jack 17	IDF	B1	6	C-D
6	Line Jack 18	IDF	B1	6	E-F
7	Line Jack 19	IDF	B1	7	A-B
8	Line Jack 20	IDF	B1	7	C-D
9	Line Jack 21	IDF	B1	7	E-F
10	Line Jack 22	IDF	B1	8	A-B
11	Line Jack 23	IDF	B1	8	C-D
12	Line Jack 24	IDF	B1	8	E-F

GRA-1-3

1	Line Jack 25	IDF	B1	9	A-B
2	Line Jack 26	IDF	B1	9	C-D
3	Line Jack 27	IDF	B1	9	E-F
4	Line Jack 28	IDF	B1	10	A-B
5	Line Jack 29	IDF	B1	10	C-D
6	Line Jack 30	IDF	B1	10	E-F
7	Line Jack 31	IDF	B1	11	A-B
8	Line Jack 32	IDF	B1	11	C-D
9	Line Jack 33	IDF	B1	11	E-F
10	Line Jack 34	IDF	B1	12	A-B
11	Line Jack 35	IDF	B1	12	C-D
12	Line Jack 36	IDF	B1	12	E-F

GRA-1-4

Pair	From	To	Block	Row	Pin
1	Line Jack 37	IDF	B1	13	A-B*
2	Line Jack 38	IDF	B1	13	C-D*
3	Line Jack 39	IDF	B1	13	E-F*
4	Line Jack 40	IDF	B1	14	A-B*
5	Line Jack 41	IDF	B1	14	C-D
6	Line Jack 42	IDF	B1	14	E-F
7	Line Jack 43	IDF	B1	15	A-B
8	Line Jack 44	IDF	B1	15	C-D
9	Line Jack 45	IDF	B1	15	E-F
10	Line Jack 46	IDF	B1	16	A-B
11	Line Jack 47	IDF	B1	16	C-D*
12	Line Jack 48	IDF	B1	16	E-F*

* Tied back at Jackfield.

GRA-1-5

Pair	From	To	Block	Row	Pin
1	Equip Jack 1 Rcvr 1 B2	IDF	B1	18	A-B
2	Equip Jack 2 Rcvr 1 B1	IDF	B1	18	C-D
3	Equip Jack 3 Rcvr 1 A1	IDF	B1	18	E-F
4	Equip Jack 4 Rcvr 1 A2	IDF	B1	19	A-B
5	Equip Jack 5 Rcvr 2 B2	IDF	B1	19	C-D
6	Equip Jack 6 Rcvr 2 B1	IDF	B1	19	E-F
7	Equip Jack 7 Rcvr 2 A1	IDF	B1	20	A-B
8	Equip Jack 8 Rcvr 2 A2	IDF	B1	20	C-D
9	Equip Jack 9 Rcvr 3 B2	IDF	B1	20	E-F
10	Equip Jack 10 Rcvr 3 B1	IDF	B1	21	A-B
11	Equip Jack 11 Rcvr 3 A1	IDF	B1	21	C-D
12	Equip Jack 12 Rcvr 3 A2	IDF	B1	21	E-F

GRA-1-6

1	Equip Jack 13 Rcvr 4 B2	IDF	B1	22	A-B
2	Equip Jack 14 Rcvr 4 B1	IDF	B1	22	C-D
3	Equip Jack 15 Rcvr 4 A1	IDF	B1	22	E-F
4	Equip Jack 16 Rcvr 4 A2	IDF	B1	23	A-B
5	Equip Jack 17 Rcvr 5 B2	IDF	B1	23	C-D
6	Equip Jack 18 Rcvr 5 B1	IDF	B1	23	E-F
7	Equip Jack 19 Rcvr 5 A1	IDF	B1	24	A-B
8	Equip Jack 20 Rcvr 5 A2	IDF	B1	24	C-D
9	Equip Jack 21 Rcvr 6 B2	IDF	B1	24	E-F

GRA-1-6 (Cont'd)

Pair	From	To	Block	Row	Pin
10	Equip Jack 22 Rcvr 6 B1	IDF	B1	25	A-B
11	Equip Jack 23 Rcvr 6 A1	IDF	B1	25	C-D
12	Equip Jack 24 Rcvr 6 A2	IDF	B1	25	E-F
GRA-1-7					
1	Equip Jack 25 GPT-10K 1 B2	IDF	B2	1	A-B
2	Equip Jack 26 GPT-10K 1 B1	IDF	B2	1	C-D
3	Equip Jack 27 GPT-10K 1 A1	IDF	B2	1	E-F
4	Equip Jack 28 GPT-10K 1 A2	IDF	B2	2	A-B
5	Equip Jack 29 GPT-10K 2 B2	IDF	B2	2	C-D
6	Equip Jack 30 GPT-10K 2 B1	IDF	B2	2	E-F
7	Equip Jack 31 GPT-10K 2 A1	IDF	B2	3	A-B
8	Equip Jack 32 GPT-10K 2 A2	IDF	B2	3	C-D
9	Equip Jack 33 Spare	IDF	B2	3	E-F
10	Equip Jack 34 Spare	IDF	B2	4	A-B
11	Equip Jack 35 Spare	IDF	B2	4	C-D
12	Equip Jack 36 Spare	IDF	B2	4	E-F
GRA-1-8					
1	Equip Jack 37	IDF	B2	5	A-B*
2	Equip Jack 38	IDF	B2	5	C-D*
3	Equip Jack 39	IDF	B2	5	E-F*
4	Equip Jack 40	IDF	B2	6	A-B*

*Tied back at Jack

GRA-1-8

Pair	From	To	Block	Row	Pin
5	Equip Jack 41 KWT6 1 Send USB	IDF	B2	6	C-D
6	Equip Jack 42 KWT6 1 Send LSB	IDF	B2	6	E-F
7	Equip Jack 43 KWT6 2 Send USB	IDF	B2	7	A-B
8	Equip Jack 44 KWT6 2 Send LSB	IDF	B2	7	C-D
9	Equip Jack 45 Spare	IDF	B2	7	E-F
10	Equip Jack 46 Spare	IDF	B2	8	A-B
11	Equip Jack 47	IDF	B2	8	C-D*
12	Equip Jack 48	IDF	B2	8	E-F*

GRA-2-1

1	Line Jack 1	IDF	B2	10	A-B
2	Line Jack 2	IDF	B2	10	C-D
3	Line Jack 3	IDF	B2	10	E-F
4	Line Jack 4	IDF	B2	11	A-B
5	Line Jack 5	IDF	B2	11	C-D
6	Line Jack 6	IDF	B2	11	E-F
7	Line Jack 7	IDF	B2	12	A-B
8	Line Jack 8	IDF	B2	12	C-D
9	Line Jack 9	IDF	B2	12	E-F
10	Line Jack 10	IDF	B2	13	A-B
11	Line Jack 11	IDF	B2	13	C-D
12	Line Jack 12	IDF	B2	13	E-F

* Tied back at Jack

GRA-2-5 (Cont'd)

Pair	From	To	Block	Row	Pin
4	Equip Jack 4 Spare	IDF	B3	2	A-B
5	Equip Jack 5 Spare	IDF	B3	2	C-D
6	Equip Jack 6 Spare	IDF	B3	2	E-F
7	Equip Jack 7 Spare	IDF	B3	3	A-B
8	Equip Jack 8 Spare	IDF	B3	3	C-D
9	Equip Jack 9 Spare	IDF	B3	3	E-F
10	Equip Jack 10 Spare	IDF	B3	4	A-B
11	Equip Jack 11 Spare	IDF	B3	4	C-D
12	Equip Jack 12 Spare	IDF	B3	4	E-F

GRA-2-6

1	Equip Jack 13 KWT6 1 Rcv USB	IDF	B3	5	A-B
2	Equip Jack 14 KWT6 1 Rcv LSB	IDF	B3	5	C-D
3	Equip Jack 15 KWT6 2 Rcv USB	IDF	B3	5	E-F
4	Equip Jack 16 KWT6 2 Rcv LSB	IDF	B3	6	A-B
5	Equip Jack 17 Spare	IDF	B3	6	C-D
6	Equip Jack 18 Spare	IDF	B3	6	E-F
7	Equip Jack 19 R390-1	IDF	B3	7	A-B
8	Equip Jack 20 R390-2	IDF	B3	7	C-D
9	Equip Jack 21 R390-3	IDF	B3	7	E-F
10	Equip Jack 22 R390-4	IDF	B3	8	A-B
11	Equip Jack 23 Spare	IDF	B3	8	C-D
12	Equip Jack 24 Spare	IDF	B3	8	E-F

GRA-2-7

Pair	From		To	Block	Row	Pin
1	Equip Jack 25	VFTG 1 In #1	IDF	B3	9	A-B
2	Equip Jack 26	VFTG 1 In #2	IDF	B3	9	C-D
3	Equip Jack 27	VFTG 2 In #1	IDF	B3	9	E-F
4	Equip Jack 28	VFTG 2 In #2	IDF	B3	10	A-B
5	Equip Jack 29	Spare	IDF	B3	10	C-D
6	Equip Jack 30	Spare	IDF	B3	10	E-F
7	Equip Jack 31	VFTG Out #1	IDF	B3	11	A-B
8	Equip Jack 32	VFTG Out #2	IDF	B3	11	C-D
9	Equip Jack 33	Spare	IDF	B3	11	E-F
10	Equip Jack 34	Spare	IDF	B3	12	A-B
11	Equip Jack 35		IDF	B3	12	C-D*
12	Equip Jack 36		IDF	B3	12	E-F*

GRA-2-8

1	Equip Jack 37		IDF	B3	13	A-B*
2	Equip Jack 38		IDF	B3	13	C-D*
3	Equip Jack 39		IDF	B3	13	E-F*
4	Equip Jack 40		IDF	B3	14	A-B*
5	Equip Jack 41	Spare	IDF	B3	14	C-D
6	Equip Jack 42	Spare	IDF	B3	14	E-F

*Tied back at Jack

GRA-2-2

Pair	From	To	Block	Row	Pin
1	Line Jack 13	IDF	B2	14	A-B
2	Line Jack 14	IDF	B2	14	C-D
3	Line Jack 15	IDF	B2	14	E-F
4	Line Jack 16	IDF	B2	15	A-B
5	Line Jack 17	IDF	B2	15	C-D
6	Line Jack 18	IDF	B2	15	E-F
7	Line Jack 19	IDF	B2	16	A-B
8	Line Jack 20	IDF	B2	16	C-D
9	Line Jack 21	IDF	B2	16	E-F
10	Line Jack 22	IDF	B2	17	A-B
11	Line Jack 23	IDF	B2	17	C-D
12	Line Jack 24	IDF	B2	17	E-F

GRA-2-3

1	Line Jack 25	IDF	B2	18	A-B
2	Line Jack 26	IDF	B2	18	C-D
3	Line Jack 27	IDF	B2	18	E-F
4	Line Jack 28	IDF	B2	19	A-B
5	Line Jack 29	IDF	B2	19	C-D
6	Line Jack 30	IDF	B2	19	E-F
7	Line Jack 31	IDF	B2	20	A-B
8	Line Jack 32	IDF	B2	20	C-D
9	Line Jack 33	IDF	B2	20	E-F

GRA-2-3 (Cont'd)

Pair	From	To	Block	Row	Pin
10	Line Jack 34	IDF	B2	21	A-B
11	Line Jack 35	IDF	B2	21	C-D*
12	Line Jack 36	IDF	B2	21	E-F*
GRA-2-4					
1	Line Jack 37	IDF	B2	22	A-B*
2	Line Jack 38	IDF	B2	22	C-D*
3	Line Jack 39	IDF	B2	22	E-F*
4	Line Jack 40	IDF	B2	23	A-B*
5	Line Jack 41	IDF	B2	23	C-D
6	Line Jack 42	IDF	B2	23	E-F
7	Line Jack 43	IDF	B2	24	A-B
8	Line Jack 44	IDF	B2	24	C-D
9	Line Jack 45	IDF	B2	24	E-F
10	Line Jack 46	IDF	B2	25	A-B
11	Line Jack 47	IDF	B2	25	C-D
12	Line Jack 48	IDF	B2	25	E-F
GRA-2-5					
1	Equip Jack 1 Spare	IDF	B3	1	A-B
2	Equip Jack 2 Spare	IDF	B3	1	C-D
3	Equip Jack 3 Spare	IDF	B3	1	E-F

*Tied back at Jack

GRA-2-8 (Cont'd)

Pair	From	To	Block	Row	Pin
7	Equip Jack 43 Spare	IDF	B3	15	A-B
8	Equip Jack 44 Spare	IDF	B3	15	C-D
9	Equip Jack 45 Spare	IDF	B3	15	E-F
10	Equip Jack 46 Spare	IDF	B3	16	A-B
11	Equip Jack 47 Spare	IDF	B3	16	C-D
12	Equip Jack 48 Spare	IDF	B3	16	E-F

GRA-3-1

1	Misc Jack 1 2W Tele 1	IDF	B3	18	A-B
2	Misc Jack 2 2W Tele 2	IDF	B3	18	C-D
3	Misc Jack 3 2W Tele 3	IDF	B3	18	E-F
4	Misc Jack 4 2W Tele 4	IDF	B3	19	A-B
5	Misc Jack 5 2W Tele 5	IDF	B3	19	C-D
6	Misc Jack 6 2W Tele 6	IDF	B3	19	E-F
7	Misc Jack 7 Spare	IDF	B3	20	A-B
8	Misc Jack 8 Spare	IDF	B3	20	C-D
9	Misc Jack 9 Spare	IDF	B3	20	E-F
10	Misc Jack 10 Hyb 2 Wire In	IDF	B3	21	A-B
11	Misc Jack 11 Hyb 4 Wire T	IDF	B3	21	C-D
12	Misc Jack 12 Hyb 4 Wire R	IDF	B3	21	E-F

GRA-3-2

Pair	From	To	Block	Row	Pin
1	Misc Jack 13 Hyb 2 Wire In	IDF	B3	22	A-B
2	Misc Jack 14 Hyb 4 Wire T	IDF	B3	22	C-D
3	Misc Jack 15 Hyb 4 Wire R	IDF	B3	22	E-F
4	Misc Jack 16 Spare	IDF	B3	23	A-B
5	Misc Jack 17 Spare	IDF	B3	23	C-D
6	Misc Jack 18 Spare	IDF	B3	23	E-F
7	Misc Jack 19 Mon Amp In	IDF	B3	24	A-B
8	Misc Jack 20 Mon Amp 4 Ohm	IDF	B3	24	C-D
9	Misc Jack 21 Mon Amp 8 Ohm	IDF	B3	24	E-F
10	Misc Jack 22 Mon Amp 250 Ohm	IDF	B3	25	A-B
11	Misc Jack 23 Mon Amp 500 Ohm	IDF	B3	25	C-D
12	Misc Jack 24 VU Meter	IDF	B3	25	E-F

GRA-3-3

1	Misc Jack 25 LSP 1	IDF	B4	1	A-B
2	Misc Jack 26 LSP 2	IDF	B4	1	C-D
3	Misc Jack 27 SPU 2 In	IDF	B4	1	E-F
4	Misc Jack 28 SPU 2 Out	IDF	B4	2	A-B
5	Misc Jack 29 Spare	IDF	B4	2	C-D
6	Misc Jack 30 Spare	IDF	B4	2	E-F
7	Misc Jack 31 Tape Rcdr 1 In	IDF	B4	3	A-B
8	Misc Jack 33 Tape Rcdr 1 Rcd Cut Key	IDF	B4	3	C-D

GRA-3-3 (Cont'd)

Pair	From	To	Block	Row	Pin
9	Misc Jack 34 Tape Rcdr 1 Out	IDF	B4	3	E-F
10	Misc Jack 36 Tape Rcdr 1 Play Back Cut Key	IDF	B4	4	A-B
11	Misc Jack 37 Tape Rcdr 2 In	IDF	B4	4	C-D
12	Misc Jack 39 Tape Rcdr 2 Rcd Cut Key	IDF	B4	4	E-F

GRA-3-4

1	Misc Jack 40 Tape Rcdr 2 Out	IDF	B4	5	A-B
2	Misc Jack 42 Tape Rcdr 2 Play Back Cut Key	IDF	B4	5	C-D
3	Misc Jack 43 Spare	IDF	B4	5	E-F
4	Misc Jack 45 Spare	IDF	B4	6	A-B
5	Misc Jack 46 Spare	IDF	B4	6	C-D
6	Misc Jack 48 Spare	IDF	B4	6	E-F
7	Spare	IDF			*
8	Spare	IDF			*
9	Spare	IDF			*
10	Spare	IDF			*
11	Spare	IDF			*
12	Spare	IDF			*

*Tied back at Jack

GRA-3-5

Pair	From		To	Block	Row	Pin
1	Misc Jack 49	Line Amp 1 In	IDF	B4	7	A-B
2	Misc Jack 50	Line Amp 2 In	IDF	B4	7	C-D
3	Misc Jack 51	Line Amp 3 In	IDF	B4	7	E-F
4	Misc Jack 52	Line Amp 4 In	IDF	B4	8	A-B
5	Misc Jack 53	Line Amp 1 Out	IDF	B4	8	C-D
6	Misc Jack 54	Line Amp 2 Out	IDF	B4	8	E-F
7	Misc Jack 55	Line Amp 3 Out	IDF	B4	9	A-B
8	Misc Jack 56	Line Amp 4 Out	IDF	B4	9	C-D
9	Misc Jack 57	Spare	IDF	B4	9	E-F
10	Misc Jack 58	Spare	IDF	B4	10	A-B
11	Misc Jack 59	Spare	IDF	B4	10	C-D
12	Misc Jack 60	Spare	IDF	B4	10	E-F

GRA-3-6

1	Misc Jack 61	4W/4W Brdg 1 In	IDF	B4	11	A-B
2	Misc Jack 62	4W/4W Brdg 2 In	IDF	B4	11	C-D
3	Misc Jack 63	4W/4W Brdg 3 In	IDF	B4	11	E-F
4	Misc Jack 64	4W/4W Brdg 4 In	IDF	B4	12	A-B
5	Misc Jack 65	4W/4W Brdg 1 Out	IDF	B4	12	C-D
6	Misc Jack 66	4W/4W Brdg 2 Out	IDF	B4	12	E-F
7	Misc Jack 67	4W/4W Brdg 3 Out	IDF	B4	13	A-B
8	Misc Jack 68	4W/4W Brdg 4 Out	IDF	B4	13	C-D
9	Misc Jack 69	Spare	IDF	B4	13	E-F

GRA-3-6 (Cont'd)

Pair	From	To	Block	Row	Pin
10	Misc Jack 70 Spare	IDF	B4	14	A-B
11	Misc Jack 71 Spare	IDF	B4	14	C-D
12	Misc Jack 72 Spare	IDF	B4	14	E-F
GRA-3-7					
1	Spare *				
2	Spare *				
3	Spare *				
4	Spare *				
5	Misc Jack 77 Const Amp In	IDF	B4	15	A-B
6	Misc Jack 78 Const Amp Out	IDF	B4	15	C-D
7	Misc Jack 79 4 Wire Tele 1T	IDF	B4	15	E-F
8	Misc Jack 80 4 Wire Tele 1R	IDF	B4	16	A-B
9	Misc Jack 81 4 Wire Tele 2T	IDF	B4	16	C-D
10	Misc Jack 82 4 Wire Tele 2R	IDF	B4	16	E-F
11	Misc Jack 83 4 Wire Tele 3T	IDF	B4	17	A-B
12	Misc Jack 84 4 Wire Tele 3R	IDF	B4	17	C-D
GRA-3-8					
1	Misc Jack 85 4 Wire Tele 4T	IDF	B4	18	A-B
2	Misc Jack 86 4 Wire Tele 4R	IDF	B4	18	C-D
3	Misc Jack 87 4 Wire Tele 5T	IDF	B4	18	E-F

* Tied back at Jack and IDF

GRA-3-8 (Cont'd)

Pair	From	To	Block	Row	Pin
4	Misc Jack 88 4 Wire Tele 5R	IDF	B4	19	A-B
5	Misc Jack 89 4 Wire Tele 6T	IDF	B4	19	C-D
6	Misc Jack 90 4 Wire Tele 6R	IDF	B4	19	E-F
7	Misc Jack 91 Spare	IDF	B4	20	A-B
8	Misc Jack 92 Spare	IDF	B4	20	C-D
9	Misc Jack 93 Spare	IDF	B4	20	E-F
10	Misc Jack 94 Spare	IDF	B4	21	A-B
11	Misc Jack 95 Spare	IDF	B4	21	C-D
12	Misc Jack 96 Spare	IDF	B4	21	E-F

APPENDIX II

WIRE RUNNING LIST E

CROSS CONNECTS

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
A1	1	A-B	Jackfield	A5	1	A-B	AN/FGC-61A
A1	1	C-D	Jackfield	A5	1	C-D	AN/FGC-61A
A1	1	E-F	Jackfield	A5	1	E-F	AN/FGC-61A
A1	2	A-B	Jackfield	A5	2	A-B	AN/FGC-61A
A1	2	C-D	Jackfield	A5	2	C-D	AN/FGC-61A
A1	2	E-F	Jackfield	A5	2	E-F	AN/FGC-61A
A1	3	A-B	Jackfield	A5	3	A-B	AN/FGC-61A
A1	3	C-D	Jackfield	A5	3	C-D	AN/FGC-61A
A1	3	E-F	Jackfield	A5	3	E-F	AN/FGC-61A
A1	4	A-B	Jackfield	A5	4	A-B	AN/FGC-61A
A1	4	C-D	Jackfield	A5	4	C-D	AN/FGC-61A
A1	4	E-F	Jackfield	A5	4	E-F	AN/FGC-61A
A1	5	A-B	Jackfield	A5	5	A-B	AN/FGC-61A
A1	5	C-D	Jackfield	A5	5	C-D	AN/FGC-61A
A1	5	E-F	Jackfield	A5	5	E-F	AN/FGC-61A
A1	6	A-B	Jackfield	A5	6	A-B	AN/FGC-61A
A1	6	C-D	Jackfield	A5	13	A-B	AN/FGC-61A
A1	6	E-F	Jackfield	A5	13	C-D	AN/FGC-61A
A1	7	A-B	Jackfield	A5	13	E-F	AN/FGC-61A
A1	7	C-D	Jackfield	A5	14	A-B	AN/FGC-61A

Block	Row	Pin	Description	Block	Row	Pin	Description
A1	7	E-F	Jackfield	A5	14	C-D	AN/FGC-61A
A1	8	A-B	Jackfield	A5	14	E-F	AN/FGC-61A
A1	8	C-D	Jackfield	A5	15	A-B	AN/FGC-61A
A1	8	E-F	Jackfield	A5	15	C-D	AN/FGC-61A
A1	9	A-B	Jackfield	A5	6	C-D	AN/FGC-61A
A1	9	C-D	Jackfield	A5	6	E-F	AN/FGC-61A
A1	9	E-F	Jackfield	A5	7	A-B	AN/FGC-61A
A1	10	A-B	Jackfield	A5	7	C-D	AN/FGC-61A
A1	10	C-D	Jackfield	A5	7	E-F	AN/FGC-61A
A1	10	E-F	Jackfield	A5	8	A-B	AN/FGC-61A
A1	11	A-B	Jackfield	A5	8	C-D	AN/FGC-61A
A1	11	C-D	Jackfield	A5	8	E-F	AN/FGC-61A
A1	11	E-F	Jackfield	A5	9	A-B	AN/FGC-61A
A1	12	A-B	Jackfield	A5	9	C-D	AN/FGC-61A
A1	12	C-D	Jackfield	A5	9	E-F	AN/FGC-61A
A1	12	E-F	Jackfield	A5	10	A-B	AN/FGC-61A
A1	13	A-B	Jackfield	A5	10	C-D	AN/FGC-61A
A1	13	C-D	Jackfield	A5	10	E-F	AN/FGC-61A
A1	13	E-F	Jackfield	A5	11	A-B	AN/FGC-61A
A1	14	A-B	Jackfield	A5	11	C-D	AN/FGC-61A
A1	14	C-D	Jackfield	A5	18	C-D	AN/FGC-61A
A1	14	E-F	Jackfield	A5	18	E-F	AN/FGC-61A
A1	15	A-B	Jackfield	A5	19	A-B	AN/FGC-61A
A1	15	C-D	Jackfield	A5	19	C-D	AN/FGC-61A

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
A1	15	E-F	Jackfield	A5	19	E-F	AN/FGC-61A
A1	16	A-B	Jackfield	A5	20	A-B	AN/FGC-61A
A1	16	C-D	Jackfield	A5	20	C-D	AN/FGC-61A
A1	16	E-F	Jackfield	A5	20	E-F	AN/FGC-61A
A2	17	A-B	Jackfield	A5	21	A-B	AN/FGC-61A
A2	17	C-D	Jackfield	A5	21	C-D	AN/FGC-61A
A2	17	E-F	Jackfield	A5	21	E-F	AN/FGC-61A
A2	18	A-B	Jackfield	A5	22	A-B	AN/FGC-61A
A2	18	C-D	Jackfield	A5	22	C-D	AN/FGC-61A
A2	18	E-F	Jackfield	A5	22	E-F	AN/FGC-61A
A2	19	A-B	Jackfield	A5	23	A-B	AN/FGC-61A
A2	19	C-D	Jackfield	A5	23	C-D	AN/FGC-61A
A3	1	A-B	Jackfield	A5	15	E-F	AN/FGC-61A
A3	1	C-D	Jackfield	A5	16	A-B	AN/FGC-61A
A3	1	E-F	Jackfield	A5	16	C-D	AN/FGC-61A
A3	2	A-B	Jackfield	A5	16	E-F	AN/FGC-61A
A3	2	C-D	Jackfield	A5	17	A-B	AN/FGC-61A
A3	2	E-F	Jackfield	A5	17	C-D	AN/FGC-61A
A3	3	A-B	Jackfield	A5	17	E-F	AN/FGC-61A
A3	3	C-D	Jackfield	A5	18	A-B	AN/FGC-61A

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
A1	17	A-B	Jackfield	A6	1	A-B	ASR 1
A1	17	C-D	Jackfield	A6	1	E-F	ASR 2
A1	17	E-F	Jackfield	A6	2	C-D	ASR 3
A1	18	A-B	Jackfield	A6	3	A-B	ASR 4
A2	1	A-B	Jackfield	A6	1	C-D	ASR 1
A2	1	C-D	Jackfield	A6	2	A-B	ASR 2
A2	1	E-F	Jackfield	A6	2	E-F	ASR 3
A2	2	A-B	Jackfield	A6	3	C-D	ASR 4
B1	18	A-B	Jackfield	B5	1	A-B	Equip
B1	18	C-D	Jackfield	B5	1	C-D	Equip
B1	18	E-F	Jackfield	B5	1	E-F	Equip
B1	19	A-B	Jackfield	B5	2	A-B	Equip
B1	19	C-D	Jackfield	B5	3	A-B	Equip
B1	19	E-F	Jackfield	B5	3	C-D	Equip
B1	20	A-B	Jackfield	B5	3	E-F	Equip
B1	20	C-D	Jackfield	B5	4	A-B	Equip
B1	20	E-F	Jackfield	B5	5	A-B	Equip
B1	21	A-B	Jackfield	B5	5	C-D	Equip
B1	21	C-D	Jackfield	B5	5	E-F	Equip
B1	21	E-F	Jackfield	B5	6	A-B	Equip
B1	22	A-B	Jackfield	B5	7	A-B	Equip

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
B1	22	C-D	Jackfield	B5	7	C-D	Equip
B1	22	E-F	Jackfield	B5	7	E-F	Equip
B1	23	A-B	Jackfield	B5	8	A-B	Equip
B1	23	C-D	Jackfield	B5	9	A-B	Equip
B1	23	E-F	Jackfield	B5	9	C-D	Equip
B1	24	A-B	Jackfield	B5	9	E-F	Equip
B1	24	C-D	Jackfield	B5	10	A-B	Equip
B1	24	E-F	Jackfield	B5	11	A-B	Equip
B1	25	A-B	Jackfield	B5	11	C-D	Equip
B1	25	C-D	Jackfield	B5	11	E-F	Equip
B1	25	E-F	Jackfield	B5	12	A-B	Equip
B2	1	A-B	Jackfield	B5	13	A-B	Equip
B2	1	C-D	Jackfield	B5	13	C-D	Equip
B2	1	E-F	Jackfield	B5	13	E-F	Equip
B2	2	A-B	Jackfield	B5	14	A-B	Equip
B2	2	C-D	Jackfield	B5	15	A-B	Equip
B2	2	E-F	Jackfield	B5	15	C-D	Equip
B2	3	A-B	Jackfield	B5	15	E-F	Equip
B2	3	C-D	Jackfield	B5	16	A-B	Equip
B2	6	C-D	Jackfield	B5	17	E-F	Equip
B2	6	E-F	Jackfield	B5	18	A-B	Equip
B2	7	A-B	Jackfield	B5	24	E-F	Equip
B2	7	C-D	Jackfield	B5	25	A-B	Equip

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
B3	5	A-B	Jackfield	B5	17	A-B	Equip
B3	5	C-D	Jackfield	B5	17	C-D	Equip
B3	5	E-F	Jackfield	B5	24	A-B	Equip
B3	6	A-B	Jackfield	B5	24	C-D	Equip
B3	7	A-B	Jackfield	B6	1	A-B	Equip
B3	7	C-D	Jackfield	B6	1	C-D	Equip
B3	7	E-F	Jackfield	B6	1	E-F	Equip
B3	8	A-B	Jackfield	B6	2	A-B	Equip
B3	9	A-B	Jackfield	B6	3	A-B	Equip
B3	9	C-D	Jackfield	B6	3	C-D	Equip
B3	9	E-F	Jackfield	B6	3	E-F	Equip
B3	10	A-B	Jackfield	B6	4	A-B	Equip
B3	11	A-B	Jackfield	B6	5	A-B	Equip
B3	11	C-D	Jackfield	B6	5	C-D	Equip
B3	18	A-B	Jackfield	B7	19	A-B	Equip
B3	18	C-D	Jackfield	B7	19	C-D	Equip
B3	18	E-F	Jackfield	B7	19	E-F	Equip
B3	19	A-B	Jackfield	B7	20	A-B	Equip
B3	19	C-D	Jackfield	B7	20	C-D	Equip
B3	19	E-F	Jackfield	B7	20	E-F	Equip
B3	21	A-B	Jackfield	B7	22	A-B	Equip
B3	21	C-D	Jackfield	B7	22	C-D	Equip
B3	21	E-F	Jackfield	B7	22	E-F	Equip
B3	22	A-B	Jackfield	B7	23	A-B	Equip

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
B3	22	C-D	Jackfield	B7	23	C-D	Equip
B3	22	E-F	Jackfield	B7	23	E-F	Equip
B3	24	A-B	Jackfield	B7	25	A-B	Equip
B3	24	C-D	Jackfield	B7	25	C-D	Equip
B3	24	E-F	Jackfield	B7	25	E-F	Equip
B3	25	A-B	Jackfield	B7	26	A-B	Equip
B3	25	C-D	Jackfield	B7	26	C-D	Equip
B3	25	E-F	Jackfield	B7	26	E-F	Equip
B4	1	A-B	Jackfield	B8	1	A-B	Equip
B4	1	C-D	Jackfield	B8	1	C-D	Equip
B4	1	E-F	Jackfield	B8	1	E-F	Equip
B4	2	A-B	Jackfield	B8	2	A-B	Equip
B4	3	A-B	Jackfield	B8	3	A-B	Equip
B4	3	C-D	Jackfield	B8	3	C-D	Equip
B4	3	E-F	Jackfield	B8	3	E-F	Equip
B4	4	A-B	Jackfield	B8	4	A-B	Equip
B4	4	C-D	Jackfield	B8	4	C-D	Equip
B4	4	E-F	Jackfield	B8	4	E-F	Equip
B4	5	A-B	Jackfield	B8	5	A-B	Equip
B4	5	C-D	Jackfield	B8	5	C-D	Equip
B4	7	A-B	Jackfield	B8	7	A-B	Equip
B4	7	C-D	Jackfield	B8	7	C-D	Equip

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
B4	7	E-F	Jackfield	B8	7	E-F	Equip
B4	8	A-B	Jackfield	B8	8	A-B	Equip
B4	8	C-D	Jackfield	B8	9	A-B	Equip
B4	8	E-F	Jackfield	B8	9	C-D	Equip
B4	9	A-B	Jackfield	B8	9	E-F	Equip
B4	9	C-D	Jackfield	B8	10	A-B	Equip
B4	11	A-B	Jackfield	B7	19	A-B	Equip
B4	11	C-D	Jackfield	B7	15	C-D	Equip
B4	11	E-F	Jackfield	B7	15	E-F	Equip
B4	12	A-B	Jackfield	B7	16	A-B	Equip
B4	12	C-D	Jackfield	B7	16	C-D	Equip
B4	12	E-F	Jackfield	B7	16	E-F	Equip
B4	13	A-B	Jackfield	B7	17	A-B	Equip
B4	13	C-D	Jackfield	B7	17	C-D	Equip
B4	15	A-B	Jackfield	B8	14	A-B	Equip
B4	15	C-D	Jackfield	B8	14	C-D	Equip
B4	15	E-F	Jackfield	B8	15	A-B	Equip
B4	16	A-B	Jackfield	B8	15	C-D	Equip
B4	16	C-D	Jackfield	B8	15	E-F	Equip
B4	16	E-F	Jackfield	B8	16	A-B	Equip
B4	17	A-B	Jackfield	B8	16	C-D	Equip
B4	17	C-D	Jackfield	B8	16	E-F	Equip
B4	18	A-B	Jackfield	B8	17	A-B	Equip
B4	18	C-D	Jackfield	B8	17	C-D	Equip

FROM				TO			
Block	Row	Pin	Description	Block	Row	Pin	Description
B4	18	E-F	Jackfield	B8	17	E-F	Equip
B4	19	A-B	Jackfield	B8	18	A-B	Equip
B4	19	C-D	Jackfield	B8	18	C-D	Equip
C1	1	A-B	Exciter 1	C5	1	A-B	Remote Control
C1	1	C-D	Exciter 1	C5	1	C-D	Readback
C1	1	E-F	Exciter 1	C5	1	E-F	Spare
C1	2	A-B	Exciter 2	C5	2	A-B	Interlock 1
C1	2	C-D	Exciter 2	C5	2	C-D	Interlock 2
C1	2	E-F	Exciter 2	C5	2	E-F	Spare
C1	3	A-B	Rcvr Rack 2	C5	3	A-B	Remote Control
C1	3	C-D	Rcvr Rack 2	C5	3	C-D	Readback
C1	3	E-F	Rcvr Rack 2	C5	3	E-F	Spare

APPENDIX II

WIRE RUNNING LIST F

DC CONTROL CIRCUITS

DCC-1

Pair	From	To	Block	Row	Pin
1	Exciter Rack - Remote Cont	IDF	C1	1	A-B
2	Exciter Rack - Readback	IDF	C1	1	C-D
3	Exciter Rack - Spare	IDF	C1	1	E-F
DCC-2					
1	Recv Rack #2 - Remote Cont	IDF	C1	3	A-B
2	Recv Rack #2 - Readback	IDF	C1	3	C-D
3	Recv Rack #2 - Spare	IDF	C1	3	E-F
DCC-3					
1	Exciter Rack - Interlocks	IDF	C1	2	A-B
2	Exciter Rack - Interlocks	IDF	C1	2	C-D
3	Exciter Rack - Spare	IDF	C1	2	E-F

APPENDIX III

RECEIVER FILTER SYSTEM SYM-4200 RE-TUNING

PROCEDURE AND MAINTENANCE

PARTS LIST

III-1. General

The wiring diagram of the LPFB-2(6) filter module drawers in their cabinet is given in Figure III-1. Figure III-2 is a schematic diagram of a single filter module drawer. Figure III-3 is a schematic diagram of Remote Control Panel RCP-6, and Figure III-4 is a schematic diagram of a Filter Module LPFB-2.

III-2. Re-Tuning Procedure

NOTE: This procedure applies to the individual Filter Module LPFB-2. Refer to Figure III-4.

a. Remove the covers from the filter module.

b. Connect the lead from the J1 input to the desired tap on L1 or L2:

(1) 2 to 4 MHz: 6T on L1

(2) 4 to 8 MHz: 2.5T on L1

(3) 8 to 32 MHz: 2T on L2

c. Connect the output of L1 or L2 to C3 as follows:

(1) 2 to 4 MHz: Orange on L1 (71T)

(2) 4 to 8 MHz: Yellow on L1 (26T)

(3) 8 to 16 MHz: Brown on L2 (21T)

(4) 16 to 32 MHz: Gray on L2 and ground 1T

d. Referring to the chart on Figure III-3, connect the appropriate capacitor across C1.

e. Repeat steps b through d for the strapping of L3 and L4.

f. Connect the 50-ohm output of an HF signal generator (Hewlett-Packard 606B or equivalent) to a Tee connector. Connect one output of the Tee connector to the filter module J1 input. Connect a frequency counter to the other output of the Tee connector. Tune the signal generator to the desired frequency. Measure the signal generator output frequency. Disconnect the frequency counter from the Tee connector.

g. Connnect a 50-ohm non-inductive resistor between the J2 output and ground.

h. Connect an RF oscilloscope or an RF vacuum-tube voltmeter to the 50-ohm resistor (load).

i. Adjust C1 and C2 for maximum indication.

j. Adjust R2 on A1 (Figure III-2) so that the output is grounded by K1 when the RF voltage reaches 5 volts RMS.

III-3. MAINTENANCE PARTS LIST

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
A1	BD, ASSY, PC	A-4857
C1	CAP, FXD, ELEC	CE105-20-100
C2	CAP, FXD, CER	CC-100-16
CR1	SCOND DEV, DIO	DD130-100-1.5
CR2	SCOND DEV, DIO	1N547
CR3	SAME AS CR2	
CR4	SCOND DEV, DIO	1N2986B
DS1 THRU DS8	LAMP, INCAND	BI110-7
F1	FUSE, CTG	FU102-.750
F2	FUSE, CTG	FU102-1.5
J1	CONN, RECEP, AC	JJ175
J2	CONN, RECEP, FML 14/C	MS3102A20-27S
J3	CONN, RECEP, BNC	JJ172
J4	SAME AS J3	
R1	RES, FXD, WW 10W	RW109-1
R2	RES, FXD, WW 25W	RW111-11
R3	RES, FXD, COMP	RC42GF182J
R4	RES, FXD, WW 25W	RW111-7
S1	SW, TOGGLE	ST103-24-62
S2	SW, TOGGLE	ST40-G
S3	SW, ROT SOL	SW403
T1	XTMR, SD	TF222
XDS1	LIGHT, IND	TS153-3
XDS2 THRU XDS6	SAME AS XDS1	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
XDS7	LIGHT, IND	TS153-1
XDS8	LIGHT, IND	TS153-5
XF1	FUSE HOLDER	FH104-3
XF2	FUSE HOLDER	FH104-11

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAP, VAR, AIR	CT100-3
C2	SAME AS C1	
C3	CAP, FXD, CER	CM111E020D5S
C4	CAP, FXD, CER	CM111E240J5S
C5	CAP, FXD, CER	CM111C470K5S
C6	CAP, FXD, CER	CM111E101J5S
C7	SAME AS C4	
C8	SAME AS C5	
C9	SAME AS C6	
J1	JACK, TIP	JJ114-2
J2	SAME AS J1	
L1	COIL, RF	CL464
L2	COIL, RF	CL465
L3	SAME AS L1	
L4	SAME AS L2	

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
C1	CAP, FXD, CER	CM111C050D5S
C2	CAP, FXD, CER	CM111C120J5S
C3	CAP, FXD, CER	CC100-16
CR1	SCOND DEV, DIO	1N3070
CR2	SCOND DEV, DIO	1N2484
CR3	SAME AS CR2	
CR4	SCOND DEV, DIO	1N270
CR5	SAME AS CR4	
K1	REL, ARM, 4PDT	RL156-10
Q1	TSTR	2N1595
R1	RES, FXD, COMP	RC20GF472J
R2	RES, VAR, COMP	RV111U502A
R3	RES, FXD, COMP	RC20GF391J
XK1	SOC, REL	TS171-4

REF SYMBOL	DESCRIPTION	TMC PART NUMBER
DS1 THRU DS6	LAMP, INCAND	BI110-7
J1	CONN, RECEP, ML 52K	MS3102A32-414P
S1 THRU S6	SW, PUSHBUTTON	SW503-3B
S7 THRU S12	SW, ROT	SW397
W1	WRG HARN, BRCHD	CA1591

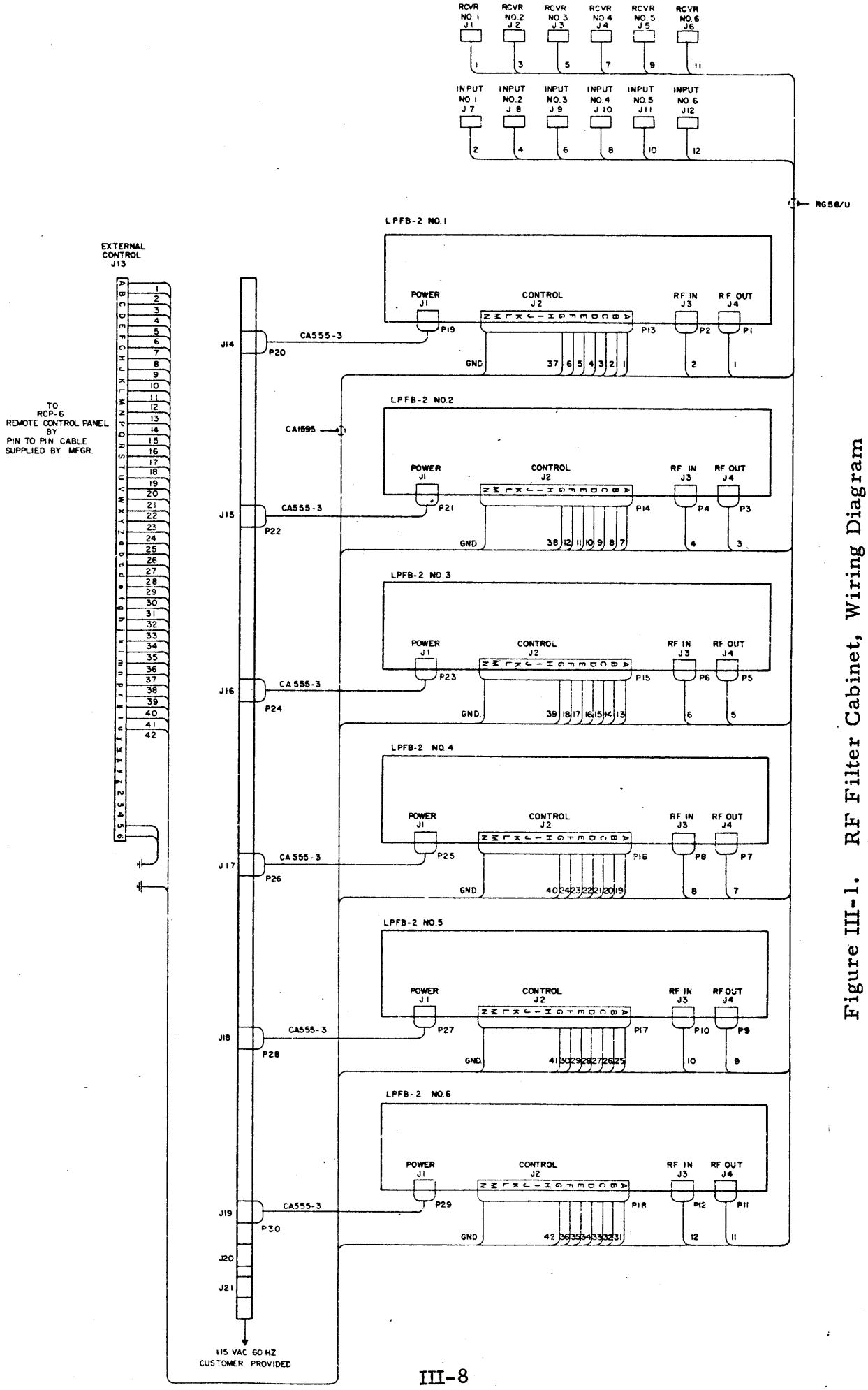
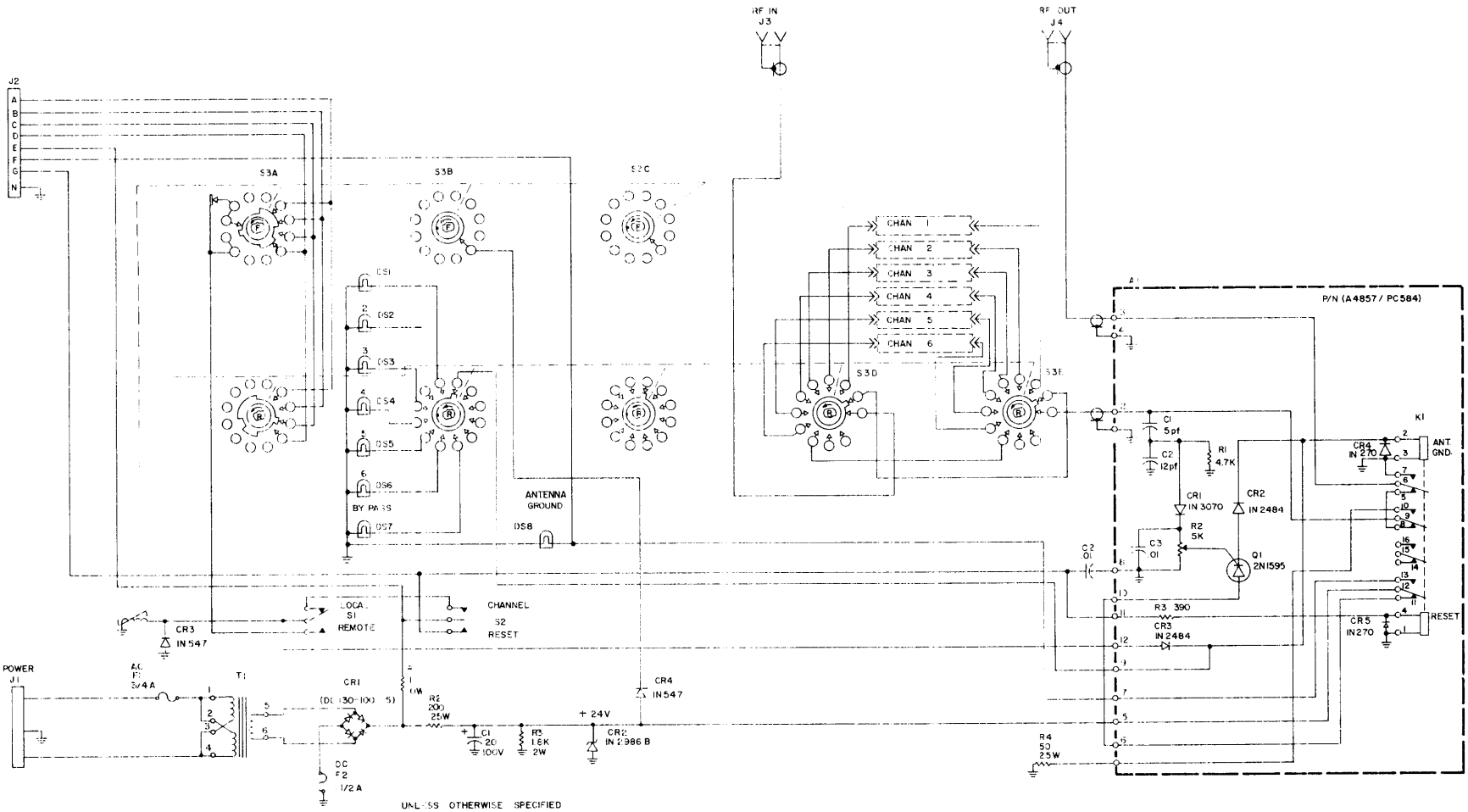


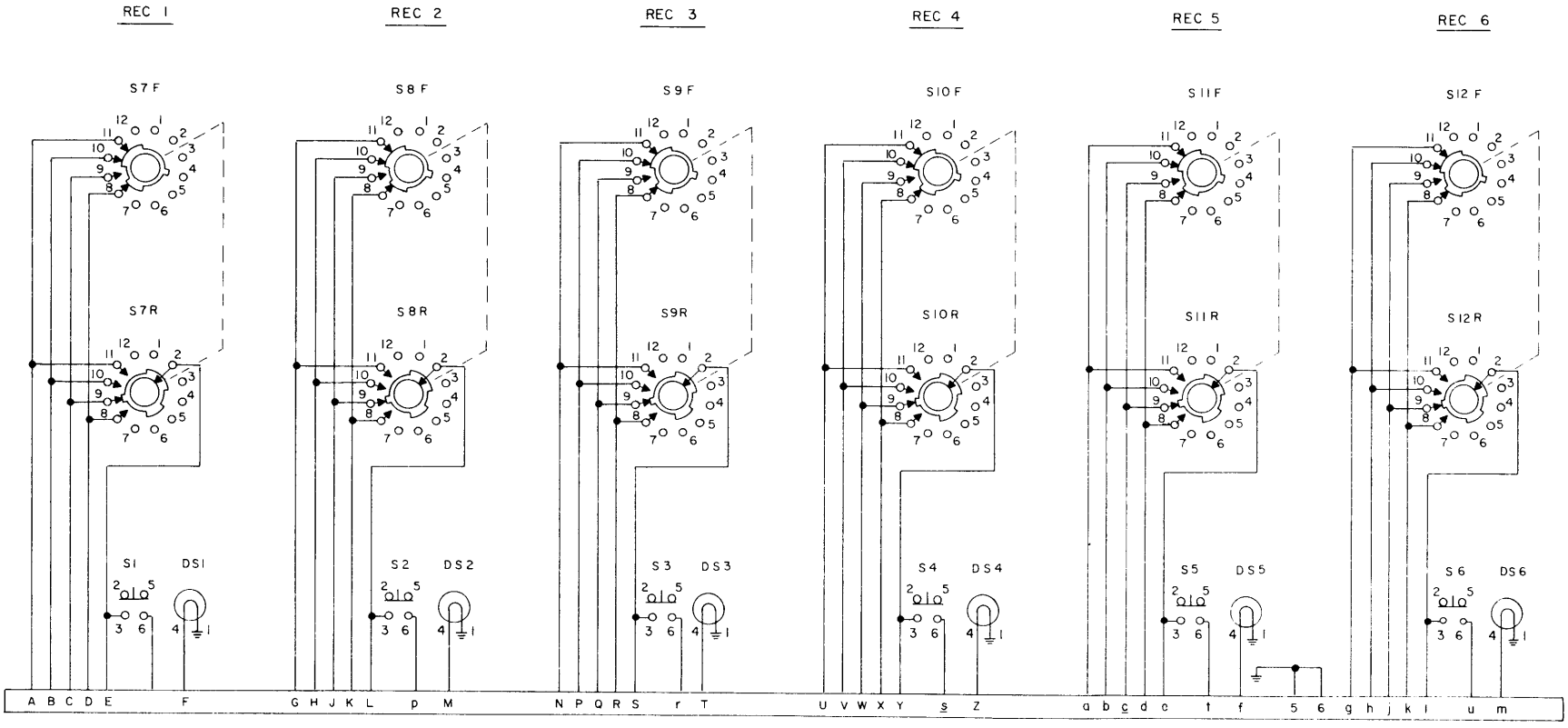
Figure III-1. RF Filter Cabinet, Wiring Diagram



UNLESS OTHERWISE SPECIFIED

1. ALL RESISTANCES IN OHMS
2. ALL RESISTANCES ARE 1/2 W
3. ALL CAPACITANCES IN MFD
4. SWITCH SHOWN FROM SOLENOID END
5. PARTIAL REFERENCE DESIGNATIONS ARE SHOWN. PREFIX REFERENCE DESIGNATION WITH SUB-ASSY DESIGNATION

Figure III-2. Filter Module Drawer, Schematic Diagram



SWITCHES SHOWN IN POS. 1 FROM FRONT.

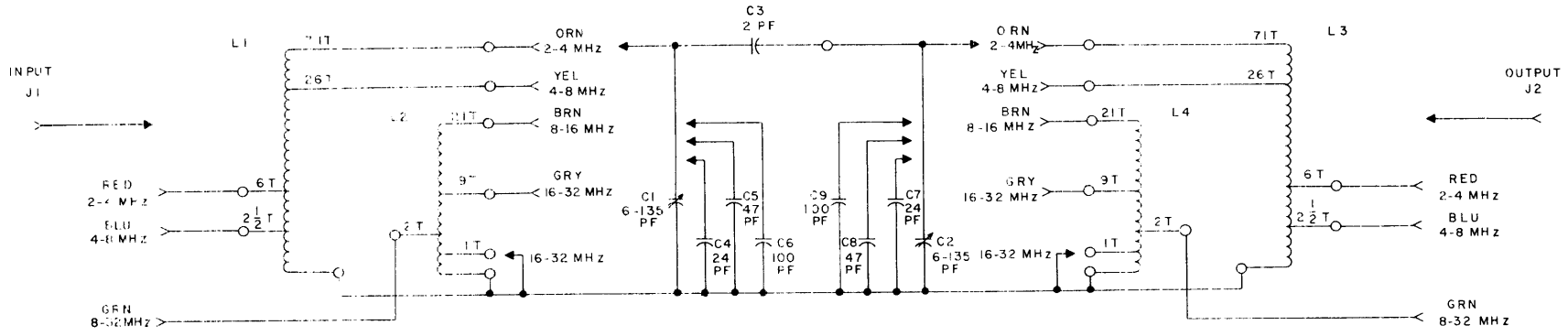
POS	FUNTION
1	ANTENNA GROUND
2	FILTER 1
3	FILTER 2
4	FILTER 3
5	FILTER 4
6	FILTER 5
7	FILTER 6
8	BY - PASS

S1 THRU S6 - FILTER RESET

S7 THRU S12 - FILTER CONTROL

DS1 THRU DS6 - ANTENNA GND. IND.

Figure III-3. Remote Control Panel, Schematic Diagram



MHz BAND	PF SHUNT CAP
2-2.5	100 + 47
2.5-4.0	24
4.0-5.0	100
5.0-32.0	NONE

JUMP COILS AS SHOWN

Figure III-4. Filter Module, Schematic Diagram