
TECHNICAL MANUAL
OPERATOR'S, ORGANIZATIONAL, DIRECT SUPPORT,
AND GENERAL SUPPORT MAINTENANCE MANUAL

FOR

RADIO SET AN/ FRC-113(V)1	(NSN 5820-00-911-7991)
RADIO SET AN/ FRC-1 13(V)2	(NSN 5820-00-911-7998)
RADIO SET AN/ FRC-1 13(V)3	(NSN 5820-00-911-7997)
RADIO SET AN/ FRC-113(V)4	(NSN 5820-00-911-7996)
RADIO SET AN/ FRC-113(V)5	(NSN 5820-00-911-7995)
RADIO SET AN/ FRC-113(V)6	(NSN 5820-00-911-8003)
RADIO SET AN/ FRC-113(V)7	(NSN 5820-00-911-8004)
RADIO SET AN/ FRC-113(V)8	(NSN 5820-00-911-8005)
RADIO SET AN/ FRC-113(V)9	(NSN 5820-00-911-8006)
RADIO SET AN/ FRC-113(V)10	(NSN 5820-00-911-8007)
RADIO SET AN/ FRC-113(V)11	(NSN 5820-00-937-9221)

NUS 6060

HEADQUARTERS, DEPARTMENT OF THE ARMY

MAY 1976

WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

Be careful when working on the dc power supply circuits, or on the 208-volt ac line connections. Serious injury or death may result from contact with these points.

DON'T TAKE CHANCES!

EXTREMELY DANGEROUS VOLTAGES

EXIST IN THE FOLLOWING UNITS:

Power Amplifier	NUS 8013-2	7500 Volts
Transmitter	NUS 5951	800 Volts
Receiver	NUS 5961	1000 Volts

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RADIO SET AN/ FRC-113(V)3	(NSN 5820-00-911-7997)
RADIO SET AN/ FRC-113(V)4	(NSN 5820-00-911-7996)
RADIO SET AN/ FRC-113(V)5	(NSN 5820-00-911-7995)
RADIO SET AN/ FRC-113(V)6	(NSN 5820-00-911-8003)
RADIO SET AN/ FRC-113(V)7	(NSN 5820-00-911-8004)
RADIO SET AN/ FRC-113(V)8	(NSN 5820-00-911-8005)
RADIO SET AN / FRC-113(V)9	(NSN 5820-00-911-8006)
RADIO SET AN/ FRC-113(V)10	(NSN 5820-00-9118007)
RADIO SET AN/ FRC-113(V)11	(NSN 5820-00-937-9221)

**TABLE OF CONTENTS
 PART ONE**

CHAPTER Section		Paragraph	Page
1. INTRODUCTION			
I. General Information			
Scope	1	1	
Forms and records	2	1	
Definitions	3	1	
Related publications	4	3	
II. Characteristics and Data			
Purpose and use	5	4	
Shelter configurations.....	6	4	
Technical characteristics	7	4	
III. Description			
Shelter description	8	8	
Transmitting equipment.....	9	8	
Receiving equipment.....	10	15	
Central equipment.....	11	15	
Air conditioning	12	17	
Waveguide pressurizer dehydrator.....	13	17	

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

		Paragraph	Page
	Waveguide system.....	14	17
	Monitoring equipment.....	15	23
	Accessories.....	16	23
CHAPTER	2. INSTALLATION AND CHECKOUT		
Section	I. General Information		
	Shelter location	17	27
	Initial tests.....	18	27
	II. Checkout		
	General	19	28
	Test equipment required.....	20	28
	Physical and electrical checkout.....	21	30
	External waveguide connections	22	31
	Antenna deicer and tower light connections.....	23	31
	External signal cable connections.....	24	31
	Power turn-on and utility checks.....	25	34
	Initial central equipment adjustments	26	35
	Transmitter checkout and alignment.....	27	35
	Power amplifier checkout and alignment	28	37
	Receiver checkout and alignment.....	29	41
	Shelter alarm checkout.....	30	48
CHAPTER	3. OPERATING INSTRUCTIONS		
Section	I. General Information		
	Introduction.....	31	53
	Shelter controls	32	53
	II. Normal Operation		
	General	33	56
	Equipment turn-on	34	56
	Operating order wire facilities.....	35	56
	Equipment turn-off	36	57
	III. Operation Under Unusual Conditions		
	General.....	37	59
	Operation under adverse weather conditions.....	38	58
	Partial operation.....	39	58
CHAPTER	4. THEORY OF OPERATION		
	System application	40	61
	Block diagram description	41	61
CHAPTER	5. MAINTENANCE		
Section	I. Preventive Maintenance		
	Metering checks, daily.....	42	71
	Cleaning.....	43	71
	Air filter maintenance	44	71
	Alignment.....	45	71
	Inspection.....	46	72
	II. Troubleshooting		
	General Troubleshooting information.....	47	83
	Test equipment required.....	48	74
	Troubleshooting procedures	49	74

PART TWO

MODULES

De-icer control and alarm NUS 6064-1
 Recorder system NUS 6285
 VSWR monitor alarm module NUS 6464-1

APPENDIX

*Translation oscillator calibration for use in type 6060 radio shelters

LIST OF ILLUSTRATIONS

Figure No.	Title	
1	Typical 1 kw radio equipment shelter NUS 6060.....	9
2	Typical 1 watt radio equipment shelter.....	10
3	1 kw radio equipment shelter view through back door.....	11
4	Curbside view of typical radio shelter.....	12
5	Roadside view of typical radio shelter.....	13
6	Radio equipment shelter, location of major components.....	14
7	Waveguide system for 1 watt dual diversity shelter configurations.....	18
8	Waveguide system for 1 watt quadruple diversity shelter configurations.....	19
9	Waveguide system for 1 kw quadruple diversity shelter configurations.....	20
10	Waveguide system for 1 watt quadruple diversity, 10 kw driver shelter configuration....	21
11	Duplexer functional relationship, block diagram.....	22
12	Front inside wall, location drawing.....	24
13	Power distribution area, isometric view.....	25
14	Vswr alarm module, alignment setup.....	38
15	Power amplifier vswr alignment setup.....	39
16	Receiver threshold graphs typical.....	54
17	Radio shelter in typical radio link, block diagram.....	62
18	Receiver threshold test setup, multi-channel.....	75
19	Receiver threshold test setup, single channel.....	77
20	Shelter power distribution, circuit breaker designations.....	79
21	Shelter interconnection diagrams (5 parts).....	81
22	1 kw, quadruple diversity shelter configurations, block diagram.....	91
23	1 watt quadruple diversity shelter configuration, block diagram.....	93
24	1 watt dual diversity shelter configurations, block diagram.....	95
25	1 watt, 10 kw amplifier driver shelter configurations, block diagram.....	97
26	Radio equipment shelter schematic diagrams (4 parts).....	99

LIST OF TABLES

Table No		Page
I	Shelter configurations.....	5
II	Common shelter characteristics.....	6
III	Specific shelter characteristics	7
IV	Shelter dimensions and weights	8
V	Test equipment	28
VI	External waveguide connections	32
VII	Antenna deicer and tower light connections	33
VIII	Signal cable connections	33
IX	Shelter threshold levels	45
X	Shelter controls	53

PREFACE

This manual describes the radio equipment shelter used at mainline and tributary sites. It provides installation and checkout procedures, operating instructions, theory of operation, and maintenance information, on a system basis. Theory of operation is described at the system level for the various shelter configurations and emphasizes the interrelation of the radio equipment cabinets. Part Two of this manual provides a description of the ancillary items in the radio equipment shelter, and provides calibration procedures for the translation oscillator.

The radio equipment shelter conforms to a modular concept and is maintained to the direct support (3rd echelon) level. Maintenance to this level of support is concerned with localizing trouble to a particular module in the malfunctioning equipment. When the trouble is localized, replace the defective module. For maintenance information, refer to the manual for the applicable equipment, and refer to Instruction Manual for Test Facilities Kit MK-884/FRC-81 (), TM 11-6625-647-14/1 and -14/2 for maintenance information on the modules.

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

<i>Manual Title</i>	<i>Manual Number</i>
Maintenance Control Group AN/GSA-99(V)1 through AN/GSA-99(V)12 (NUS 6283)	11-5820-570-14
Operator's Manual for Center, Communications Operations AN/MSQ-76(V)1 through AN/MSQ-76(V)3 and AN/GSQ-106(V)1 through AN/GSQ-106(V)3 (Console Local Equipment)	11-5820-571-10
Radio Set AN/FRC-113(V)1 through AN/FRC-113(V)11 (NUS 6060)	11-5820-572-14
Multiplexer Set AN/FCC-40 through AN/FCC-54	11-5820-573-15
Nodal Point Receiver (NUS 8021/8024)	11-5820-574-14
Console, Communication Control OA-8149/MRC-114(V) through OA-8154/MRC-114(V) (NUS 5972-5, -6)	11-5820-575-14
Console Training Facility (NUS 8423)	11-5820-576-14
Switching Set, Communications AN/MSQ-74(V)1 through AN/MSQ-74(V)10 and AN/MSQ-74(V)12 (Console Remote Equipment) (NUS 7640)	11-5820-577-14
Center, Communications Operations AN/MSQ-76(V)1 through AN/MSQ-76(V)3 and AN/GSQ-106(V)1 through AN/GSQ-106(V)3 (Console Local Equipment)	11-5820-578-24
Communication Group OA-8319/MSM (NUS 6052-23G1)	11-5820-578-14-1
Power Amplifier Group AN/MRA-15 (NUS 7561)	11-5820-579-15
Electronic Tube Cooler, ET-A Type 15-27-32.5	11-5820-579-15-1
Amplifier-Power Supply AM-4832/FRC-113(V) (NUS 6061-3)	11-5820-580-14
Transmitter (NUS 5951)	11-5820-581-14
Console, Communication Control OA-7695/GRC and OA-7696/GRC (NUS 5972-3, -7)	11-5820-582-14
Dual Receiver (NUS 5961)	11-5820-583-14
Maintenance Control Group AN/GSA-100 (NUS 6284)	11-5820-585-14
Tributary Terminal Set AN/FSC-34 (NUS 7957)	11-5820-587-15
Amplifier-Power Supply AM-14419/GRC (NUS 8013-2)	11-5820-603-14
ET-A Mainline Site Manual	11-5895-376-14-1
ET-A Tributary Site Manual	11-5895-376-14-2
ET-A Site Equipment, Towers and Antennas	11-5895-376-14-3
Test Facilities Kit MK-884/FRC-81()	11-6625-647-14

PART ONE

CHAPTER 1

INTRODUCTION

Section I. GENERAL INFORMATION

1. Scope

This manual provides information on radio equipment shelters, type NUS 6060. It includes a description, installation and checkout procedure, operating instructions, theory and maintenance information.

2. 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 Packaging and Handling Deficiencies. Fill out and forward DD Form 6 (Packaging Improvement Report) as prescribed in AR 700-58/NAVSUPINST 4030.29/AFR 71-13/MCO P4030.29A, and DSAR 4145.8

c. You can help improve this manual by calling attention to errors and by recommending improvement and stating your reasons for the recommendations. Your letter or DA Form 2028 (Recommended Changes to Publications and Blank Forms) should be mailed direct to Commander, US Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, N. J. 07703. A reply will be furnished direct to you.

3. Definitions

Baseband	Information, including voice channel(s), orderwire channel, pilot tone and tele-type data that modulates a carrier for transmission.
Carrier	The rf output of a transmitter, which is capable of being modulated.
CEC	Central equipment cabinet.
Diversity reception	The reception of a radio signal by using two or more antennas, each of which feeds a receiver, and combining the signals in the receivers to provide a single output.
Diversity transmission	The transmission of radio signals using two or more transmitters, each driving a separate antenna feedhorn, all on the same frequency and all modulated with a common baseband.

Dual-diversity reception	The reception of a signal using one dual receiver and two antenna feedhorns.
Dual receiver	A receiver which contains two separate sets of signal processing circuits and a means of combining the signals.
ET-A	European Tropo-Army
LOS	Line-of-sight
Mod-switchover	The transfer of modulation function from one transmitter to the other in a transmitter pair. (See POMM11-5820-581-15)
Mainline	A station or site that is located so that it carries traffic between major points in the ET-A system. It may be an end-of-line station.
Nodal van	A van, located at a mainline site, that contains radio equipment for linking the mainline site with two to eight tributary sites.
Paramp	Parametric amplifier.
Pilot tone	A single frequency (4 kc) included in the baseband for monitoring purposes.
Polarization diversity	Diversity transmission or reception achieved by using antenna feedhorn polarized with respect to each other. The feedhorns can be on separate antennas or on one antenna.
Rf-switchover	The transfer of output drive from one transmitter to the other. (See POMM-11-5820-581-15.)
PSIG	Pounds per square inch, gage.
Quadruple diversity reception	The reception of signals using two dual receivers and four antenna feedhorns and combining the signals.
Signal channel	Designation of a channel carrying an rf or if signal.
TE	Threshold extension module
Tributary	A site located off the mainline that uses single voice channel equipment and links to a nodal van at a mainline site. Also may designate the link to or from the site.
Tty	Teletype (equipment or data)

Voice channel

Designation of a channel that is in the baseband and normally carries voice frequencies. Applies to multiplex channels if multiplex is used.

VSWR

Voltage standing wave ratio. Commonly used in connection with mismatching in rf waveguide.

4. Related Publications

a. Instruction Manuals. In addition to the system publications listed in the table on page vi which cover details of the radio transmitters, receivers, power amplifiers, CEC and shelter, vendor instruction manuals covering the following listed equipment are supplied with each shelter:

AirConditioner, Model MAC-3-S3
 Mfr. Airflow Company (Handbook 341)
 or
 AirConditioner, Model MAC 6V20
 Mfr. Trane Company (TM-5-4120-222-15)

Waveguide pressurizer, Model 2CD-AE0279-1
 Mfr. Trinity Equipment Corp. (Bulletin X-80)
 or
 Waveguide pressurizer, Model B1026
 Mfr. Howell Laboratories

b. Calibration Charts. Calibration charts are supplied for use with waveguide Tilters (preselectors) manufactured by:

Gombos Microwave Inc. Model 91440
 Gombos Microwave Inc. Model 4455
 Frequency Engineering Labs. Model 40D92700

Section II. CHARACTERISTICS AND DATA

5. Purpose and Use

a. The radio equipment shelter provides two-way, single - or multi-channel, line-of-sight or tropospheric scatter communication in the 4.4 to 5.0 GHz frequency range. The radio equipment shelter can be equipped to handle a maximum of 120 full-duplex voice frequency channels.

b. The radio equipment shelter is intended for use in an ETA Communication System radio link. Two shelters are required for a mainline radio link; one at each end of the link. One shelter is required at a tributary site and is normally linked to a nodal van at the mainline site.

6. Shelter Configurations

Due to radio link requirements and differences in distances and terrain characteristics between sites, a number of shelter configurations are used. The shelter configurations and their typical use in the ETA system are listed in table I.

7. Technical Characteristics and Data

a. Common Shelter Characteristics. Common shelter characteristics are listed in table II.

b. Specific Shelter Characteristics. Specific shelter characteristics are listed in table III.

c. Cross Reference Data. The Nutley Unit System (NUS) number and its associated type designation is listed below.

<u>NUS</u>	<u>Type Designation</u>
6060-1	AN/FRC-113(V)1
6060-4	AN/FRC-113(V)11
6060-5	AN/FRC-113(V)7
6060-6	AN/FRC-113(V) 8
6060-16	AN/FRC-113 (V)2
6060-17	AN/FRC-113(V)3
6060-18	AN/FRC-113(V)4
6060-19	AN/FRC-113 (V)5
6060-22	AN/FRC-113(V)6
6060-23	AN/FRC-113(V)9
6060-24	AN/FRC-113(V)10

TABLE I. SHELTER CONFIGURATIONS

Radio Equipment Shelter	Configuration	Typical use
NUS 6060-1	1-kw, multi-channel*, quadruple diversity with paramp and TE.	Long distance mainline tropospheric scatter links.
NUS 6060-4	1 watt, multi-channel*, quadruple diversity with paramp.	Medium-to-long distance mainline tropospheric scatter link.
NUS 6060-5	1 watt, multi-channel*, quadruple diversity.	Medium distance mainline tropospheric scatter link.
NUS 6060-6	1 watt, multi-channel*, dual diversity	Line-of-sight mainline link.
NUS 6060-16	1 kw, single channel**, quadruple diversity with paramp and TE.	Long distance tributary tropospheric scatter link.
NUS 6060-17	1 kw, single channel**, quadruple diversity with TE.	Long distance tributary tropospheric scatter link.
NUS 6060-18	1 kw, multi-channel*, quadruple diversity with paramp.	Long distance mainline tropospheric scatter link.
NUS 6060-19	1 kw, multi-channel*, quadruple diversity	Long distance mainline tropospheric scatter link.
NUS 6060-21	1 watt single channel**, quadruple diversity with paramp and TE.	Medium distance tributary tropospheric scatter link.
NUS 6060-22	1 watt single channel**, dual diversity	Line-of-sight tributary link.
NUS 6060-23	1 watt, single channel**, quadruple diversity with TE.	Medium distance tributary tropospheric scatter link.
NUS 6060-24	1 watt, multi-channel*, quadruple diversity with paramp and TE. for 10 KW amplifier in transmit direction.)	Long distance mainline tropospheric scatter link. (Driver
* 24/36/48/60/72/129/180/240 voice channel capacity **single or dual voice channel		

TABLE II. COMMON SHELTER CHARACTERISTICS

Frequency range	4.4 to 5.0 gc
Type of modulation	Frequency.
Frequency control	Crystal.
Monitoring pilot tone	4000 cps
Multiplex input level	-35 dbm
Carrier channel output level	-15 dbm
Remote order wire input level	-7 dbm
Remote order wire output level	-7 dbm
Order wire signaling frequency	1, 600 cps
External operating temperature	-25 to +450C
Maximum operating altitude	10, 000 ft.
Primary Power Requirements	
Voltage	120/208 vac, three-phase, four-wire.
Frequency	50 to 60 cps.
Power	
1 kw technical load	13.6 kw
1 kw utility load	13.0 kw
1 watt technical load	3.6 kw
1 watt utility load	8.0 kw

TABLE III. SPECIFIC SHELTER CHARACTERISTICS

Characteristic	Specification											
	Radio Equipment Shelter NUS 6060											
Rf input level (dbm threshold) -	-1	-4	-5	-6	-16	-17	-18	-19	-21	-22	-23	-24
2 or 12 to 60 channels	-100	-100	-90	-87.5	-113.5	-106.5	-97	-90	-113.5	-101	-106.5	-100
72 or 120 channels	-97	-97	-87	-84.5	-	-	-94	-87	-	-	-	-97
Rf output level, nominal (dbw)	30	0	0	0	30	30	30	30	0	0	0	-3

Section III. DESCRIPTION

8. Shelter Description

(fig. 1 through 6)

The shelter assembly is a military type S-141()/G shelter which has been modified for this application. It is transportable by truck or aircraft. Modifications to the shelter (required for mounting equipment, cable entry, waveguide entry, etc) have been made so as not to affect shelter mobility. The upper four corners of the shelter are equipped with combination lifting and tiedown eyes. A split door on the rear wall of the shelter provides access to the shelter interior. Primary power is applied to the shelter through the power entry panel to the left of the shelter door. The signal entry panels, mounted on the curbside and roadside walls near the front of the shelter, facilitate baseband and order wire cable and waveguide connections. In the shelter interior, position markings (RCVR A, RCVR B, etc.) designate the areas allocated for the various radio components. In shelters where certain equipments are not used, the designated areas are left vacant. A grounding bus (fig. 21), enclosed within the shelter power ducting provides common ground connection for the radio equipment cabinets. Lighting is provided by two rows of incandescent lamps which have swivel sockets and shade covers, permitting the concentration of light in particular areas. In addition to the radio components, the radio equipment shelter is equipped with one or two 18,000 BTU air conditioners (capable of providing heat when required), an exhaust fan (1000 cFm), a waveguide pressurizer, antenna deicer control and monitor module, vswr monitoring equipment, 2 fire extinguishers, a first aid kit, and an anti-skid floor. The air conditioner intake vents (fig. 1 and 2) are located to the right of the shelter door or on the curbside, and the outlet vents are on the same side of the shelter. Dimensions and weights for the shelter are listed in table IV.

TABLE IV. SHELTER DIMENSIONS AND WEIGHTS

Outside length, width, height	144 x 81 x 83 in.
Inside length, width, height	134 x 73-1/2 x 76 in.
Weight (empty)	1200 lbs (max.)
Weight (heaviest)	5000 lbs (max.)

9. Transmitting Equipment

a. Modulator-switchover Transmitters. In 1 watt shelters, both transmitters provide rf output to their respective antenna feedhorns at the same time. The baseband signal drives the modulators of both transmitters and the 70 mc modulator outputs are fed to a selector switch and power divider. Each arm of the divider drives the modulation circuit in the modulator-exciter drawer of a transmitter. One of the modulators is selected to carry traffic. If it should fail the circuit switches to the alternate modulator, a switchover indicator lights and an alarm signal is sent to the CEC. For complete information refer to TM 11-5820-581-14.

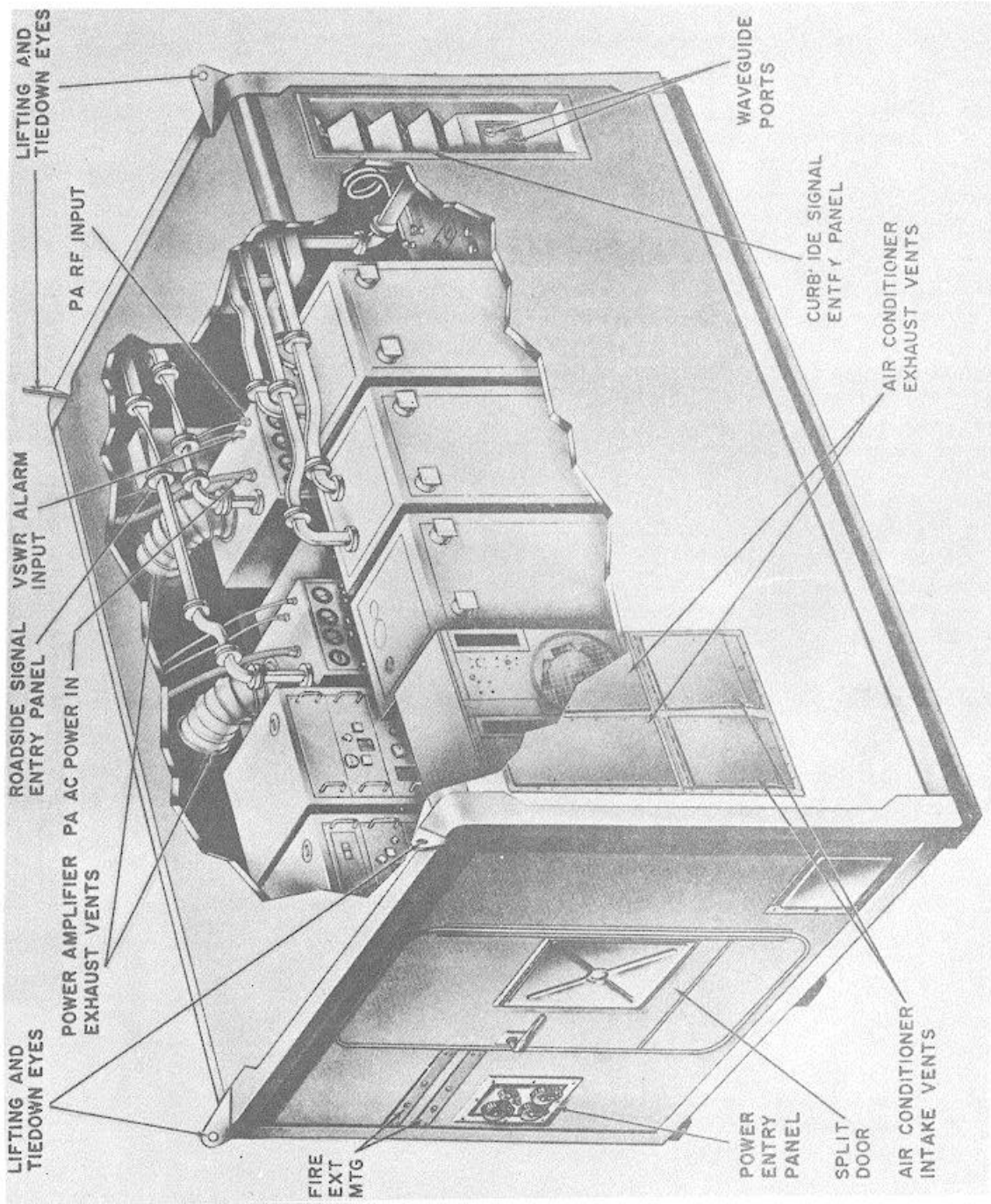


Figure 1. Typical 1 kw radio equipment shelter NUS 6060.

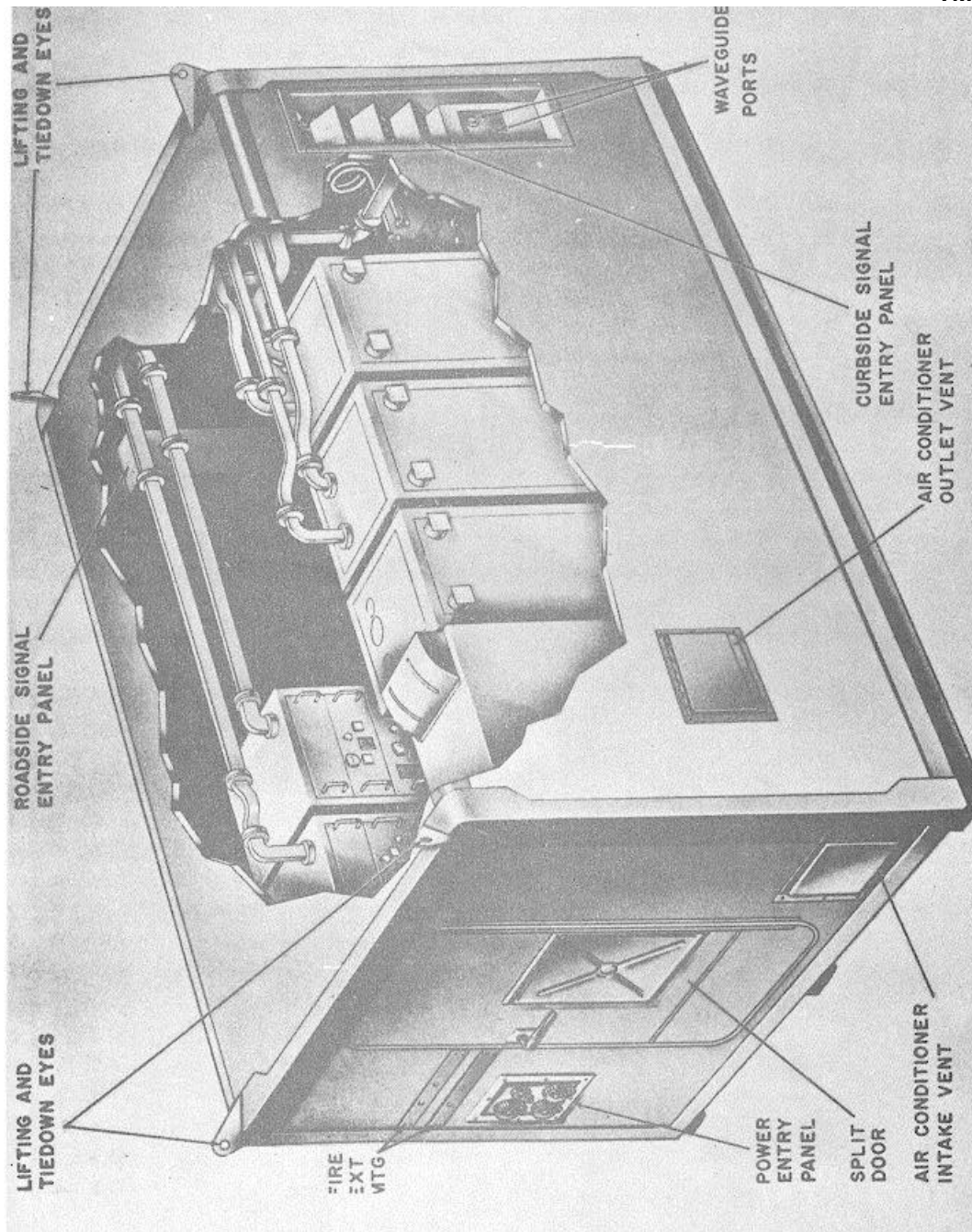


Figure 2. Typical 1 watt radio equipment shelter.

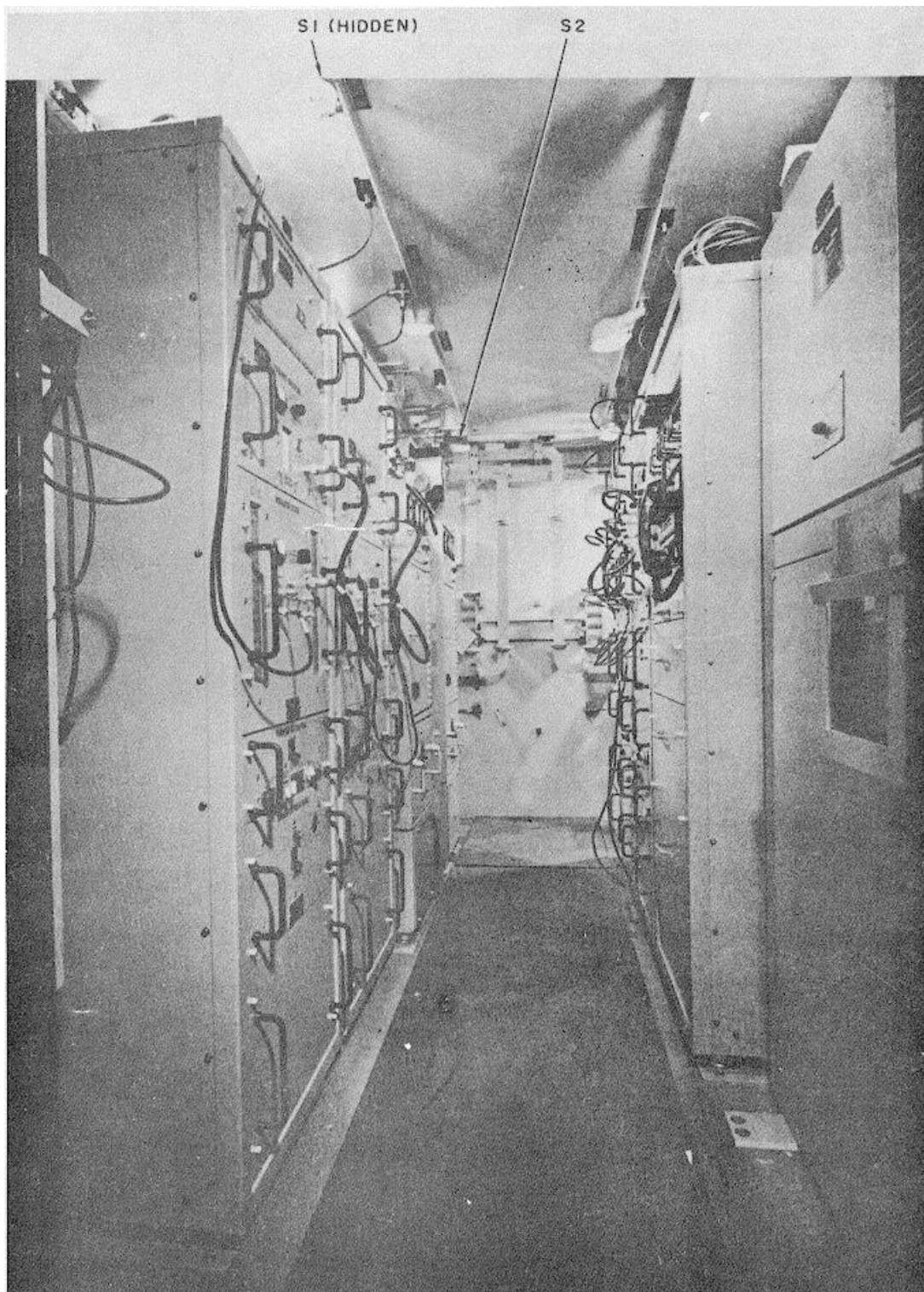


Figure 3. 1 kw radio equipment shelter view through back door.

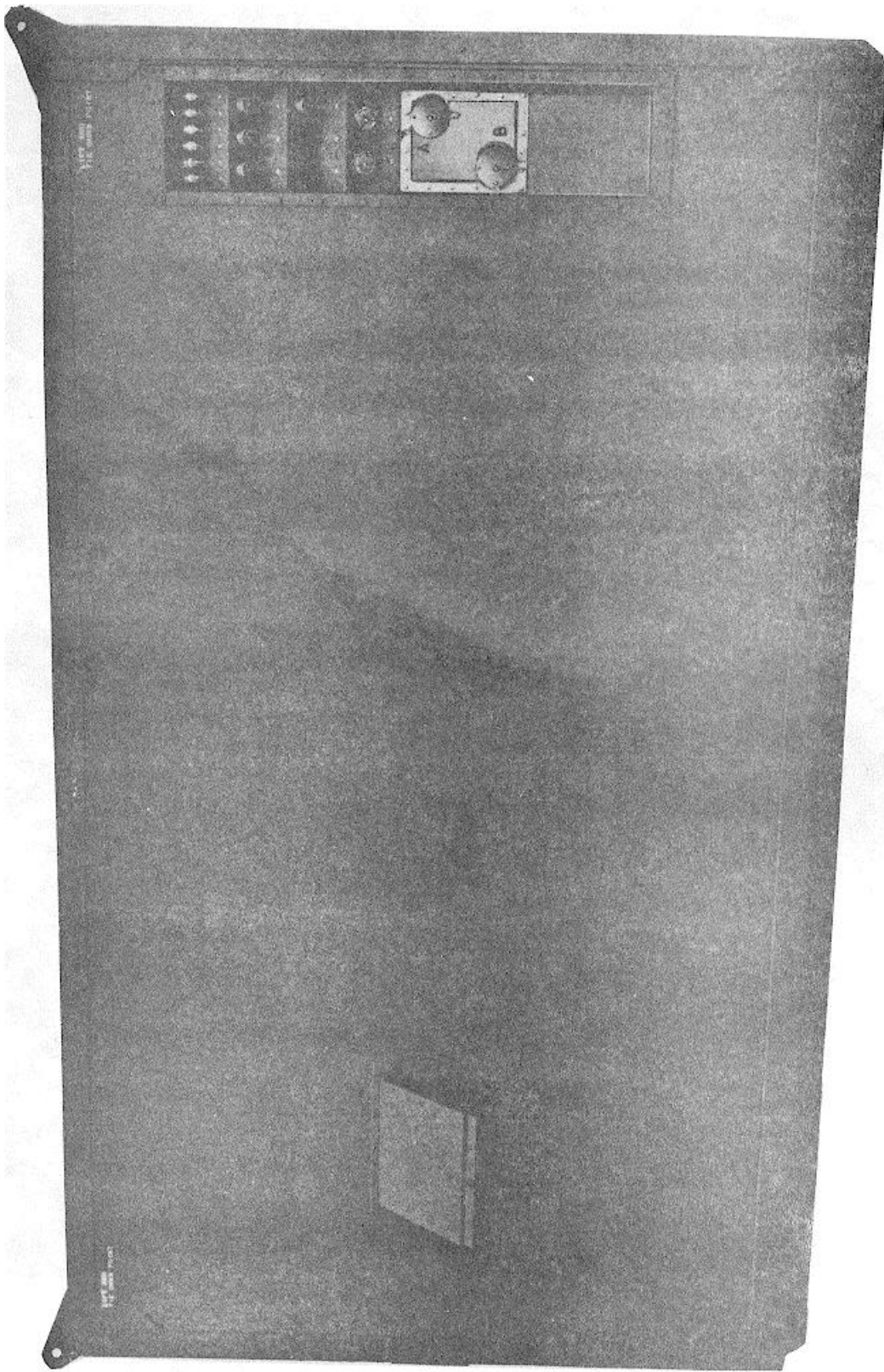


Figure 4. Curbside view of typical radio shelter.

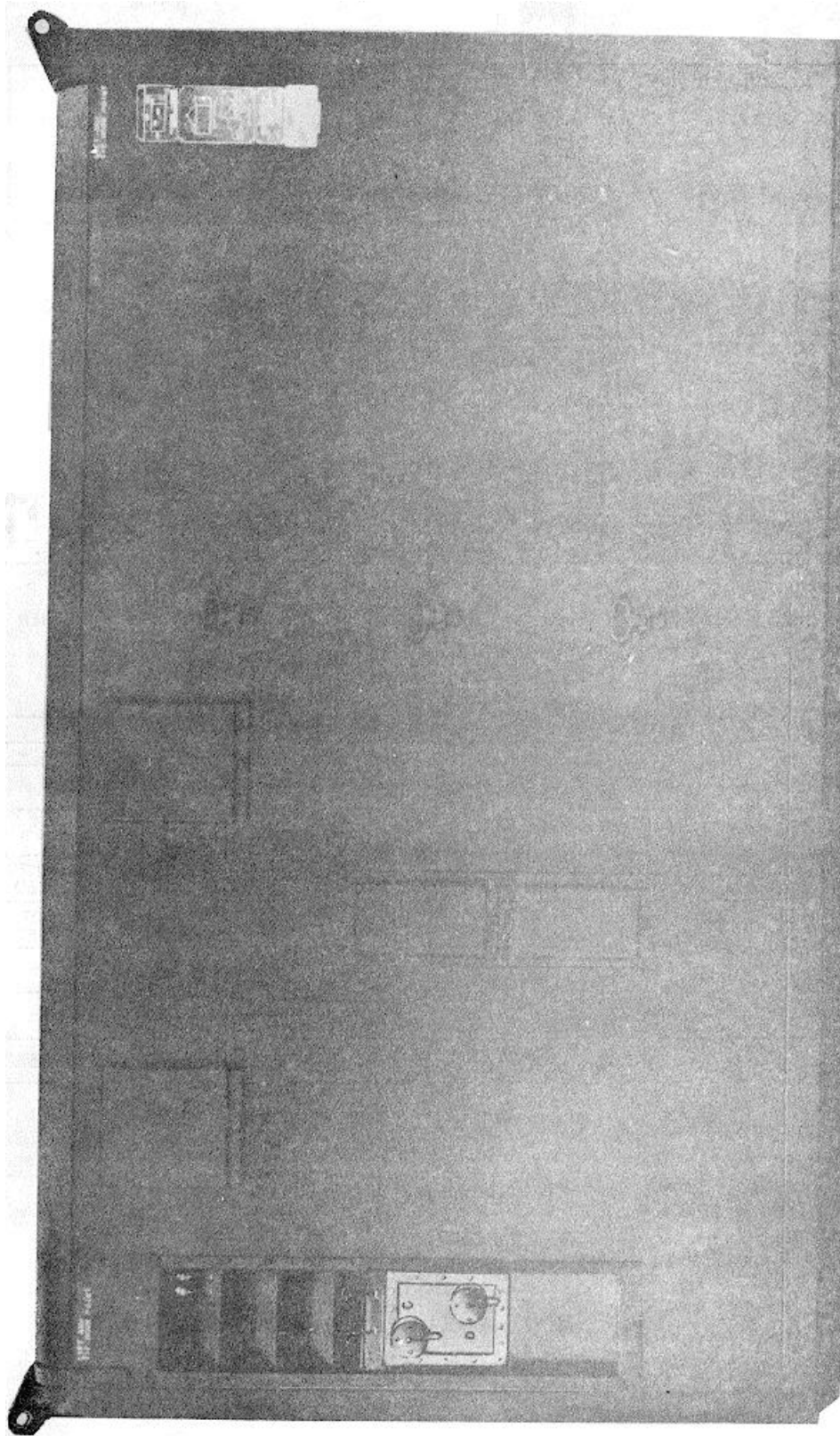
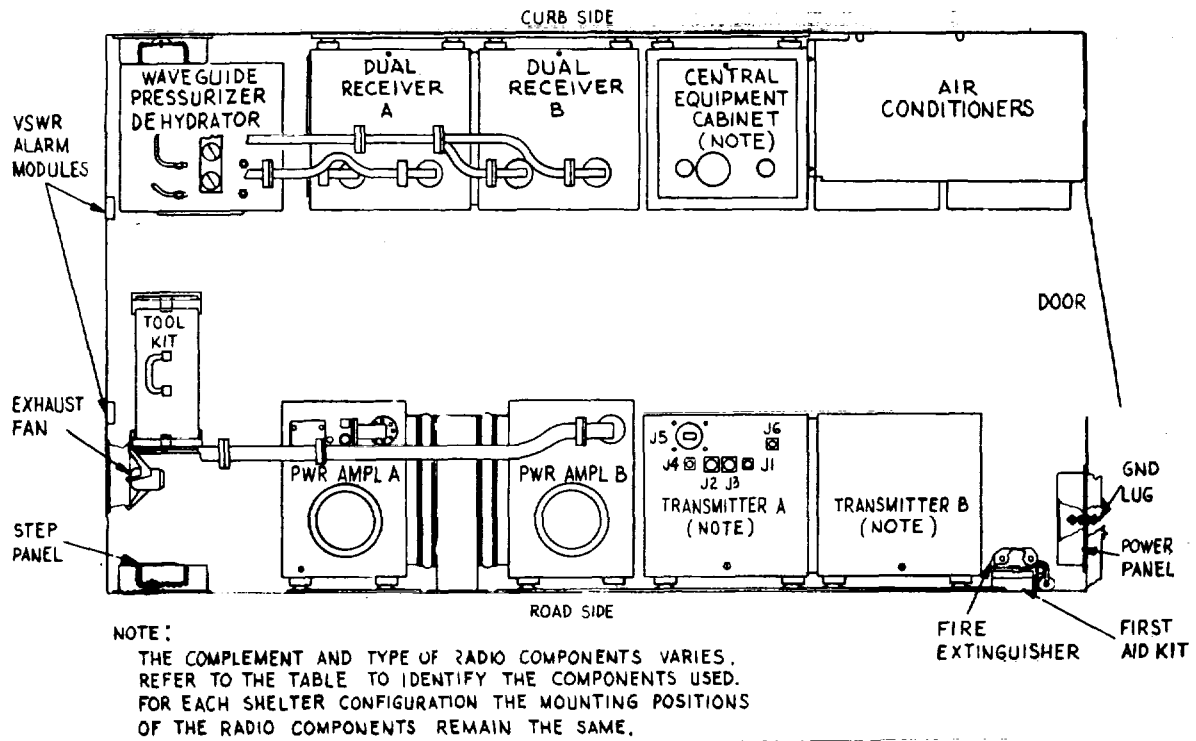


Figure 5. Roadside view of typical radio shelter.



RADIO COMPONENT	RADIO EQUIPMENT SHELTER NUS 6060											
	-1	-4	-5	-6	-16	-17	-18	-19	-21	-22	-23	-24
TRANSMITTER A (NUS 5951)	-11	-16	-16	-16	-3	-3	-11	-19	-21	-21	-21	-11
TRANSMITTER B (NUS 5951)	-12	-17	-17	-17	-17	-7	-12	-12	-25	-25	-25	-23
POWER AMPLIFIER A (NUS 6061-3 *OR 8013-2)	USED	NOT USED	NOT USED	NOT USED	USED	USED	USED	USED	NOT USED	NOT USED	NOT USED	NOT USED
POWER AMPLIFIER B (NUS 6061-3 *OR 8013-2)	USED	NOT USED	NOT USED	NOT USED	USED	USED	USED	USED	NOT USED	NOT USED	NOT USED	NOT USED
DUAL RECEIVER A (NUS 5961)	-15	-20	-16	-12	-9	-13	-20	-19	-9	-10	-13	-15
DUAL RECEIVER B (NUS 5961)	-15	-20	-16	NOT USED	-9	-13	-20	-19	-9	NOT USED	-13	-15
CENTRAL EQUIPMENT CABINET (NUS 5972)	-3	-3	-3	-3	-7	-7	-3	-3	-7	-7	-7	-3

*NUS 6061-13 IS SUPPLIED ONLY IN THE FOLLOWING RADIO EQUIPMENT SHELTERS:

- NUS 6060-1, SERIAL NUMBERS 1 AND 2
- NUS 6060-16, SERIAL NUMBERS 1 THROUGH 3
- NUS 6060-17, SERIAL NUMBERS 1 AND 2
- NUS 6060-18, SERIAL NUMBERS 1 THROUGH 12
- NUS 6060-19, SERIAL NUMBERS 1 THROUGH 8

NUS 8013-2 IS USED IN ALL OTHER IKW RADIO EQUIPMENT SHELTERS

Figure 6. Radio equipment shelter, location of major components.

b. Rf-switchover Transmitters. In 1 kw shelters and 10 kw driver shelters, the rf output of each transmitter goes to a coaxial selector switch. When the rf output of the switch is used to drive 1 kw amplifiers, a power divider is included in the switchover drawer and each arm of the divider is coupled by coaxial cable to an amplifier. The outputs of the amplifiers feed their respective antenna feedhorns. One of the transmitters is selected to drive the power amplifiers and if it fails, the circuit automatically switches to the alternate transmitter and provides indications of switchover and an alarm signal in the CEC. In the 10 kw driver usage, the power divider is not included in the radio shelter, but is provided in the 10 kw van, so that only a single waveguide coupling line is needed to drive the 10 kw van. Operation is otherwise the same as for 1 kw use. For further details see TM 11-5820-581-14.

c. 1 kw Power Amplifiers. In 1 kw shelters, two power amplifiers are included. They are driven by the power divider in the transmitter cabinet and each one feeds a separate antenna feedhorn. For complete details see TM 11-5820-603-14.

10. Receiving Equipment

a. Dual-Diversity Receivers. In line-of-sight shelters the receiver is dual-diversity. It is a single cabinet with two signal channels and combining circuits with complete redundancy in each baseband channel. For details see TM 11-5820-583-14.

b. Quadruple-Diversity Receivers. The receivers used in quadruple-diversity shelters consist of two cabinets, each containing a complete dual receiver, with combining circuits. The two dual receivers are combined in operation providing two redundant baseband channels. Details are given in TM 11-5820-583-14.

11. Central Equipment

Two basic types of central equipment are employed; one for main line links (NUS 5972-3) and the second for tributary links (NUS 5972-7). Both types are housed in identical cabinets but differ in the arrangement and complement of subassemblies and modules. Each central equipment provides order wire, alarm, switching and patching facilities. Refer to TM 11-5820-582-14 for details of the central equipment cabinets.

a. Order wire facility.

- (1) At main line links, the order wire facility is capable of providing voice communication between on-site shelters. This is accomplished through a switchboard at the maintenance control center. Voice communication between shelters at different sites is established in either of two ways. If an on-site shelter desires communication with a shelter at the other end of the associated link, communication is established directly. If the on-site shelter desires communication with a shelter on another link, communication is established through the maintenance control center switchboard.
- (2) At tributary links, the order wire facility provides voice communication with the maintenance control center and the associated rf nodal point van.

b. Alarm facilities. The alarm facilities at both main line and tributary links monitor the operation of the transmitting and receiving equipments, the antenna deicers, tower lights if connected and the waveguide pressurizer. Pilot tones are also monitored. In the event of an equipment malfunction or the absence of a pilot tone, an alarm indication (flashing lamp and ringing bell) is provided. A summary shelter alarm is also provided to alert personnel at the maintenance control center.

c. Switching facility. The switching unit in the main line and tributary central equipment cabinets provide automatic baseband switching. The absence of a pilot tone or excessive noise in a receiver baseband output causes the switchover to the redundant baseband output and lights a lamp to indicate that a switchover has occurred. After a switchover has occurred, the switching unit resets itself automatically when the trouble is cleared.

d. Patching facility. The video patch panel in the main line and tributary central equipment cabinets permits the performance of loop tests. It also permits the patching around defective equipment, the insertion of test signals, and the measurement of signal levels.

e. Recorder system. The recorder, which is supplied only in shelters used as mainline multichannel links, is intended to provide continuous data on the levels of received carriers before and after combining in the if system.

- (1) Receiver carrier levels prior to combining are measured by bridging a 70 mc logarithmic amplifier across any one of the if preamplifier outputs of a receiver, at which point the if carrier level is directly proportional to received carrier level. The amplified, logarithmic dc output of the carrier level amplifier is applied to one channel of a dual channel recorder and displayed on linear chart paper. Each one of 40 small divisions on the chart corresponds to a 1 db increment. The input level is the if carrier input to the if probe, which has an input impedance of about 1000 ohms. The input is also referenced to the rf carrier input level in dbm, assuming a typical receiver gain of 43 db in the rf and if preamplifier stages. By means of a pushbutton attenuator, the 40 db recorder range may be shifted in steps of 10 db to accommodate higher if input levels.
- (2) Receiver carrier levels after combining are obtained by measuring the receiver baseband out-of-band noise which is inversely proportional to combined carrier levels in fm systems. This out-of-band noise is measured by bridging a logarithmic baseband amplifier (with suitable filtering) across the receiver baseband output terminals. The detected output of this amplifier drives the second channel of the recorder to produce a logarithmic display of combined carrier levels on the same 40 division 1 db per division chart paper.
- (3) The use of the recording system permits quantitative analysis of voice channel signal-to-noise ratio and receiver diversity improvement.

- (a) The baseband noise recordings are a measure of baseband noise in a slot at a particular baseband frequency. Since this noise is related to the noise level in any voice channel by a fixed factor, the signal-to-noise ratio is readily obtained.
- (b) The data obtained by comparison of single and combined carrier levels is a measure of diversity improvement.
- (4) When the recorder time constant is made very long by the selection switch, it is very useful in making precise adjustments of the antenna systems.

12. Air Conditioning

The air conditioners provide both cooling and heating of the shelter. Initially supplied equipment included a single 18,000 BTU cooling and 12,000 BTU heating unit made by Airflow Company (fig. 2). Later issue equipment included one 18,000 BTU unit made by Trane Company for 1 watt shelters and two 18,000 BTU units of the Trane type for 1 kw shelters (fig. 1). The instruction manuals for the units are listed in paragraph 4.

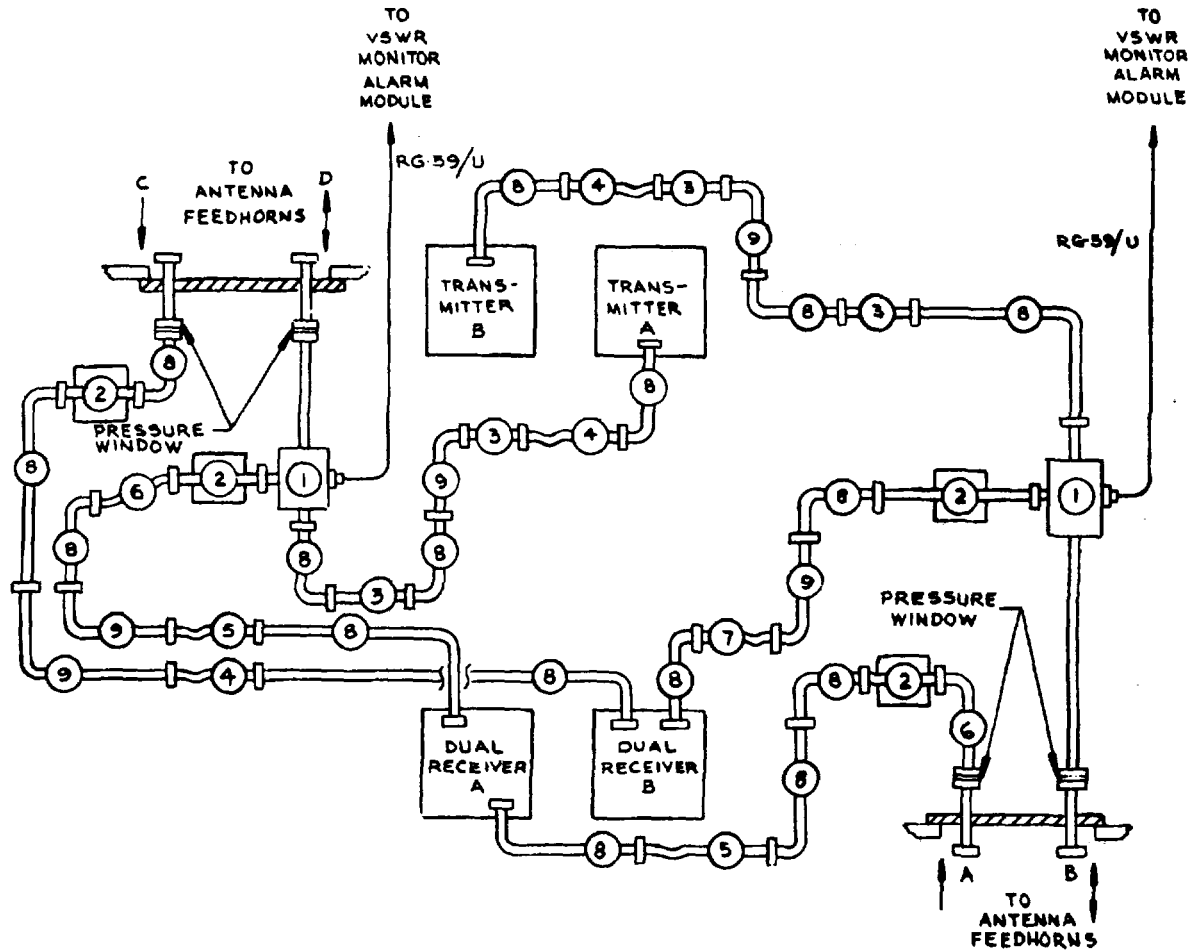
13. Waveguide Pressurizer Dehydrator

The waveguide pressurizer dehydrator maintains a steady flow of pressurized dry air to the external waveguide runs associated with each shelter. The pressure is kept above 0.5 psig and the dew point is maintained at -40 degrees F or lower, to avoid condensation in the waveguides. If the pressure drops too low or goes too high, an alarm sounds in the CEC. No alarm is provided for humidity and the color of the dessicant must be checked often. The equipment was manufactured by two suppliers, Trinity Equipment Corporation and Howell Labs. The instruction manuals are listed in paragraph 4.

14. Waveguide System (fig. 7 through 10).

The waveguide system is the rf conducting network that interconnects the transmitting and receiving equipment with feedlines to the antenna feedhorns or dual 10 kw amplifier van. It consists of two duplexers and both rigid and flexible waveguide sections.

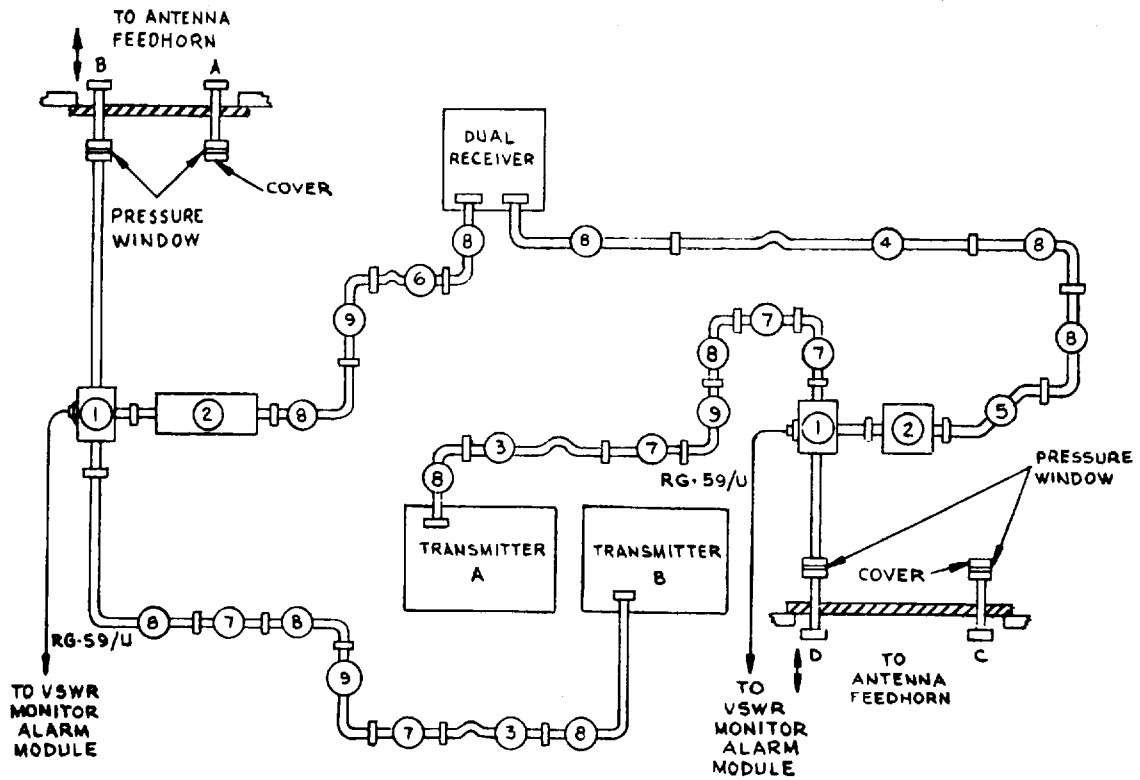
a. Duplexers (fig. 11). Each duplexer consists of a 4-port circulator. The duplexer is used with a waveguide filter. Sections of waveguide connect ports 1 and 2 of the circulator to the associated transmitter or power amplifier output and feedline to the antenna feedhorn, respectively. Port 3 feeds the associated receiver input through the waveguide filter. Port 4 is terminated in a dummy load which contains monitoring facilities to sample the power reflected back from the antenna feedhorn. It should be noted that the dummy load monitoring facilities are not provided in 1 watt shelter configurations serving as drivers for the dual 10 kw amplifier van, since these facilities are provided in the van.



LEGEND:

1. CIRCULATOR
2. WAVEGUIDE FILTER
3. STRASECTION
4. BOW SECTION (FLEXIBLE)
5. E-PLAIE OFFSET (FLEXIBLE)
6. E-PLANE OFFSET
7. H-PLANE OFFSET (FLEKISBLE)
8. 90 DEGREE H- PLANE SEND
9. 90 DEGREE E.-PLAWE BEUD
10. ↑ SINGLE ARROW OWE WAY SI1 PATH
 DOUBLE ARROW IN4DICATES 2 WAY SIG PATH
 □ A,B,C,D-WAVEGUIDE PORT DE51INATIOU OO
 OUTSIDE OF SHELTER.

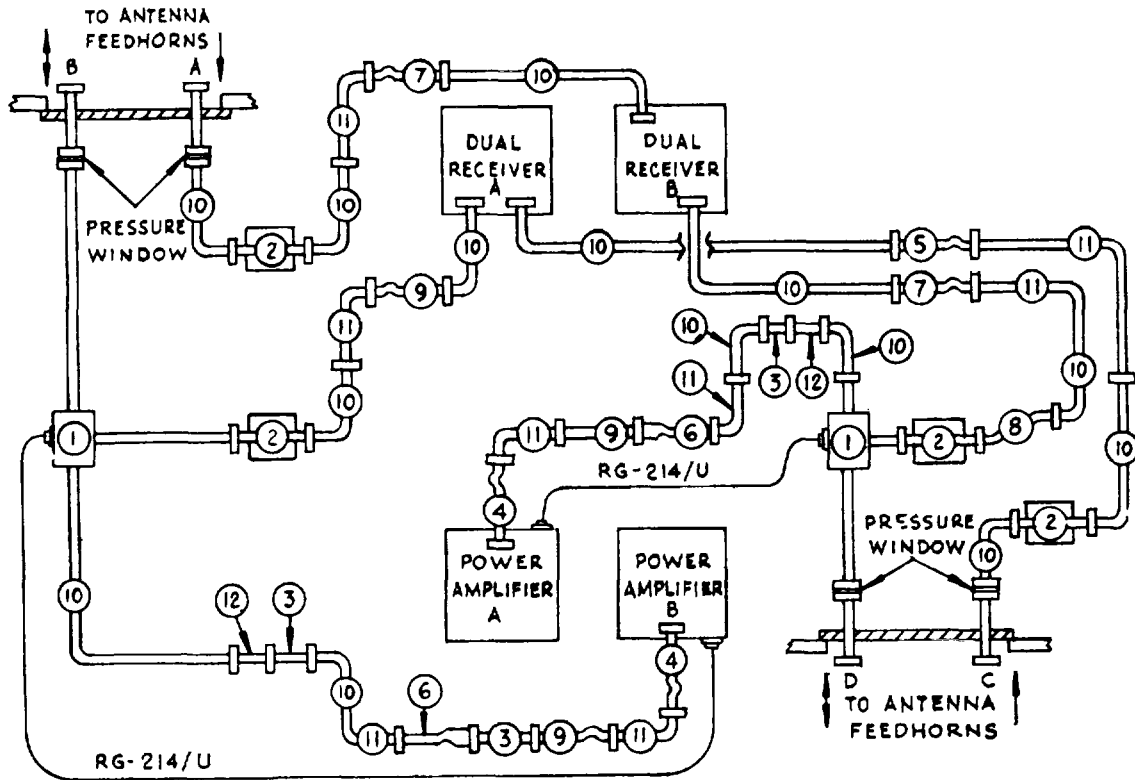
Figure 7. Waveguide system for 1 watt dual diversity shelter configurations.



LEGEND:

1. CIRCULATOR
2. WAVEGUIDE FILTER
3. BOW SECTION (FLEXI-LE)
4. E-PLANE OFFSET(FLEXIBLE)
5. E-PLANE OFFSET
6. H-PLAIE OFFSET (FLEXIBLE)
7. STRAIGHT SECTION
8. 90 DEGREE H-PLANE BEND
9. 90 DEGREE. E-PLANE BEND

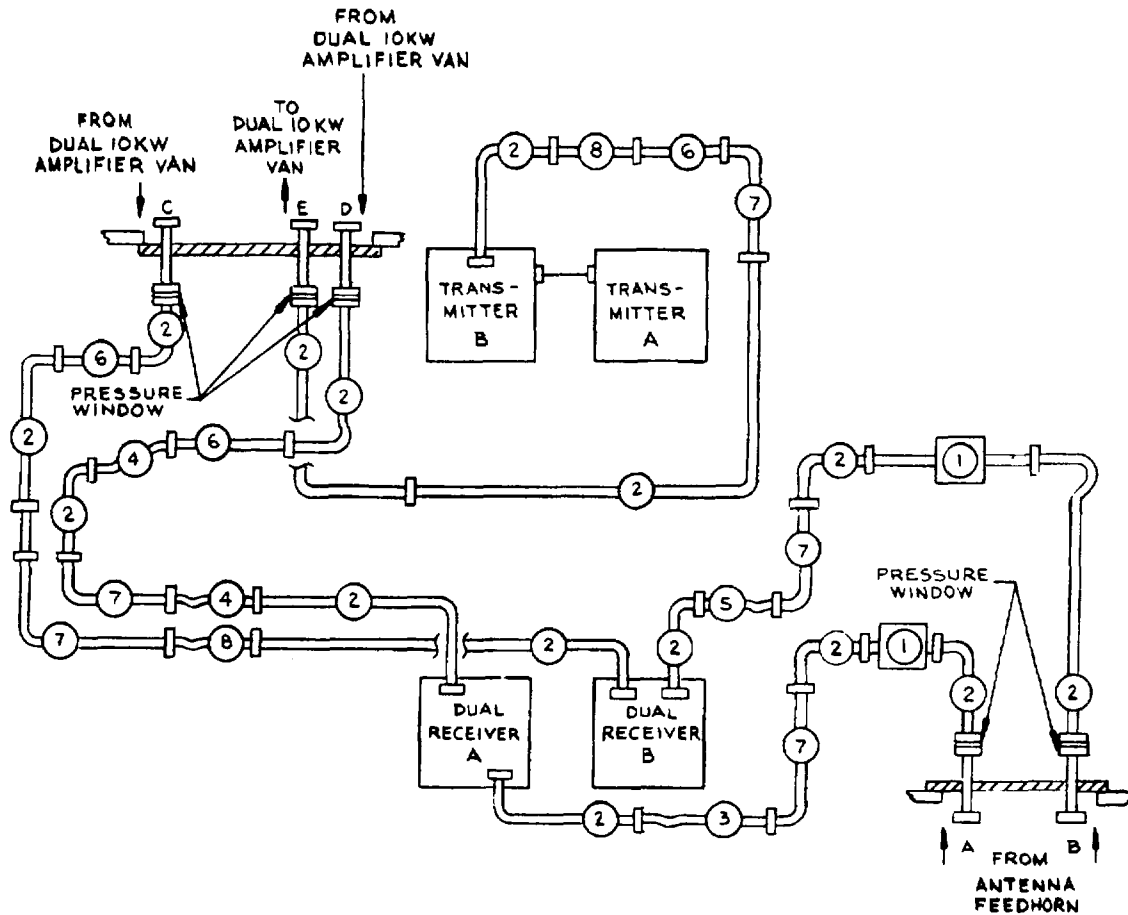
Figure 8. Waveguide system for 1 watt quadruple diversity shelter configurations.



LEGEND:

1. CIRCULATOR
2. WAVEGUIDE FILTER
3. STRAIGHT SECTION
4. STRAIGHT SECTION (FLEXIBLE)
5. 50W SECTION (FLEXIBLE)
6. 90 DEGREE TWIST
7. E-PLANE OFFSET (FLEXIBLE)
8. E-PLANE OFFSET
9. H-PLANE OFFSET (FLEXIBLE)
10. 90 DEGREE H-PLANE BEND
11. 90 DEGREE E - PLANE BEND
12. MICROWAVE FILTER

Figure 9. Waveguide system for 1 kw quadruple diversity shelter configurations.



LEGEND:

1. WAVEGUIDE FILTER
2. 90 DEGREE H-PLANE BEND
3. E-PLANE OFFSET (FLEXIBLE)
4. E-PLANE OFFSET
5. H-PLANE OFFSET (FLEXIBLE)
6. STRAIGHT SECTION
7. 90 DEGREE E-PLANE BEND
8. BOW SECTION (FLEXIBLE)

Figure 10. Waveguide system for 1 watt quadruple diversity, 10 kw driver shelter configuration.

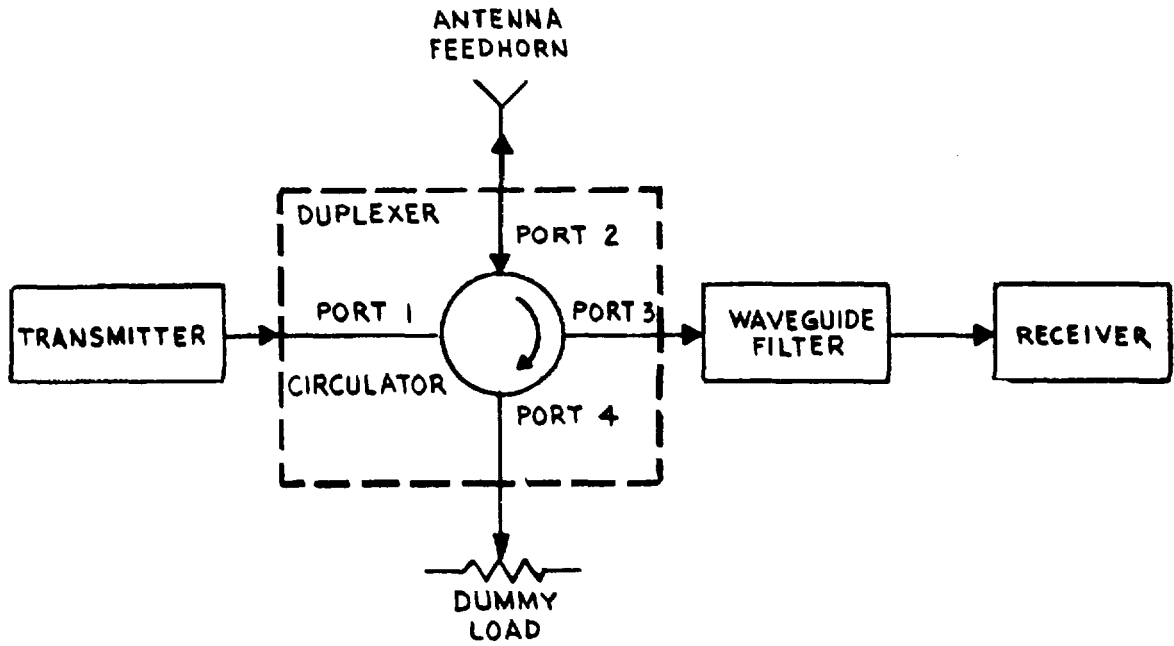


Figure 11. Duplexer functional relationship, block diagram.

b. Waveguide sections. The rigid waveguide sections are constructed from specially processed copper. The flexible waveguide sections are constructed from a silver-plated copper alloy and are covered with a neoprene jacket. All exposed waveguide surfaces are irradiated for maximum corrosion resistance. Flange connections are of the cover-to-choke type.

15. Monitoring Equipment

a. Vswr monitor alarm modules (fig. 12). Two vswr monitor alarm modules are provided in 1 watt shelter configurations. Each module continuously checks the output of an associated transmitter and actuates alarm circuits in the central equipment cabinet in the event of an excessive vswr. It should be noted that the vswr monitoring equipment for 1 kw shelter configurations is contained within the power amplifiers. It should also be noted that vswr alarm modules are not used in 1 watt shelter configurations serving as drivers for the dual 10 kw amplifier van, since the vswr monitoring equipment is contained within the van. Refer to part II of this manual for details of the vswr monitor alarm module.

b. Deicer control and alarm module (fig. 13). The deicer control and alarm module continuously monitors the operation of the antenna deicer heaters and actuates alarm circuits in the central equipment cabinet in the event of a heater failure. Refer to part II for details of the deicer control and alarm module.

16. Accessories

a. Safety.

- (1) First aid kit. The first aid kit is mounted in its bracket on the inside roadside wall adjacent to the power boxes (see fig. 13).
- (2) Fire extinguishers. Two fire extinguishers are supplied with each shelter. One sits inside the shelter in a quick-release cradle on the floor against the roadside wall adjacent to the power boxes (see fig. 13). One is supplied with a quick release hanger assembly and materials for mounting outside on the rear of the shelter. Two mounting plates are positioned over the power entry panel to the left of the door and support the fire extinguisher when mounted (fig. 1 and 2).
- (3) Lock and keys. The lock is chained to the closure handle on the door and provides protection against theft and tampering.

b. Maintenance.

(1) Instruction books. Instruction books covering the electronics equipment are listed in the table of system manuals on page vi. Those covering auxiliary equipment are listed in paragraph 4. Calibration charts for waveguide filters are supplied. Modules are covered in part II of this manual.

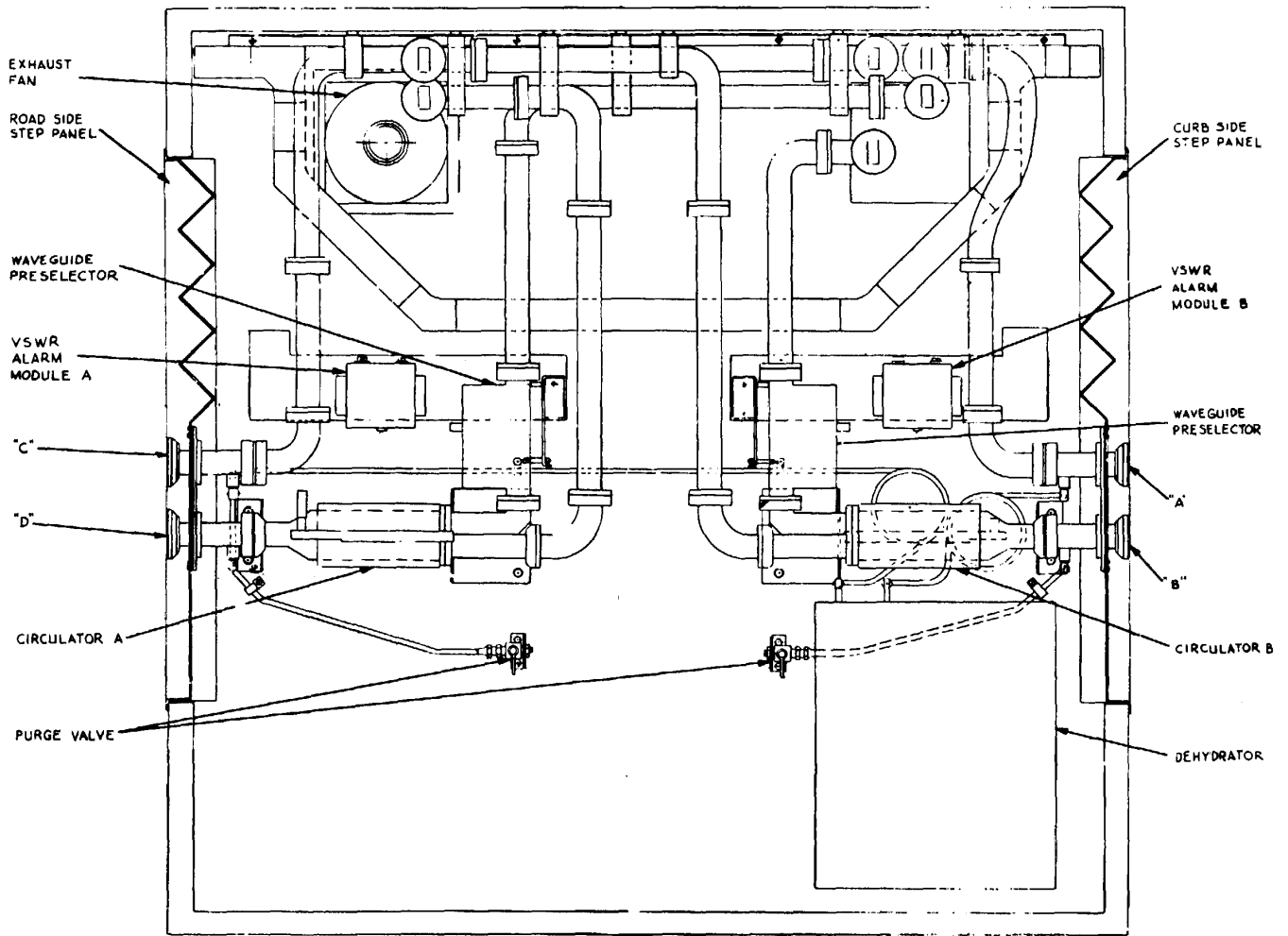


Figure 12. Front inside wall, location drawing.

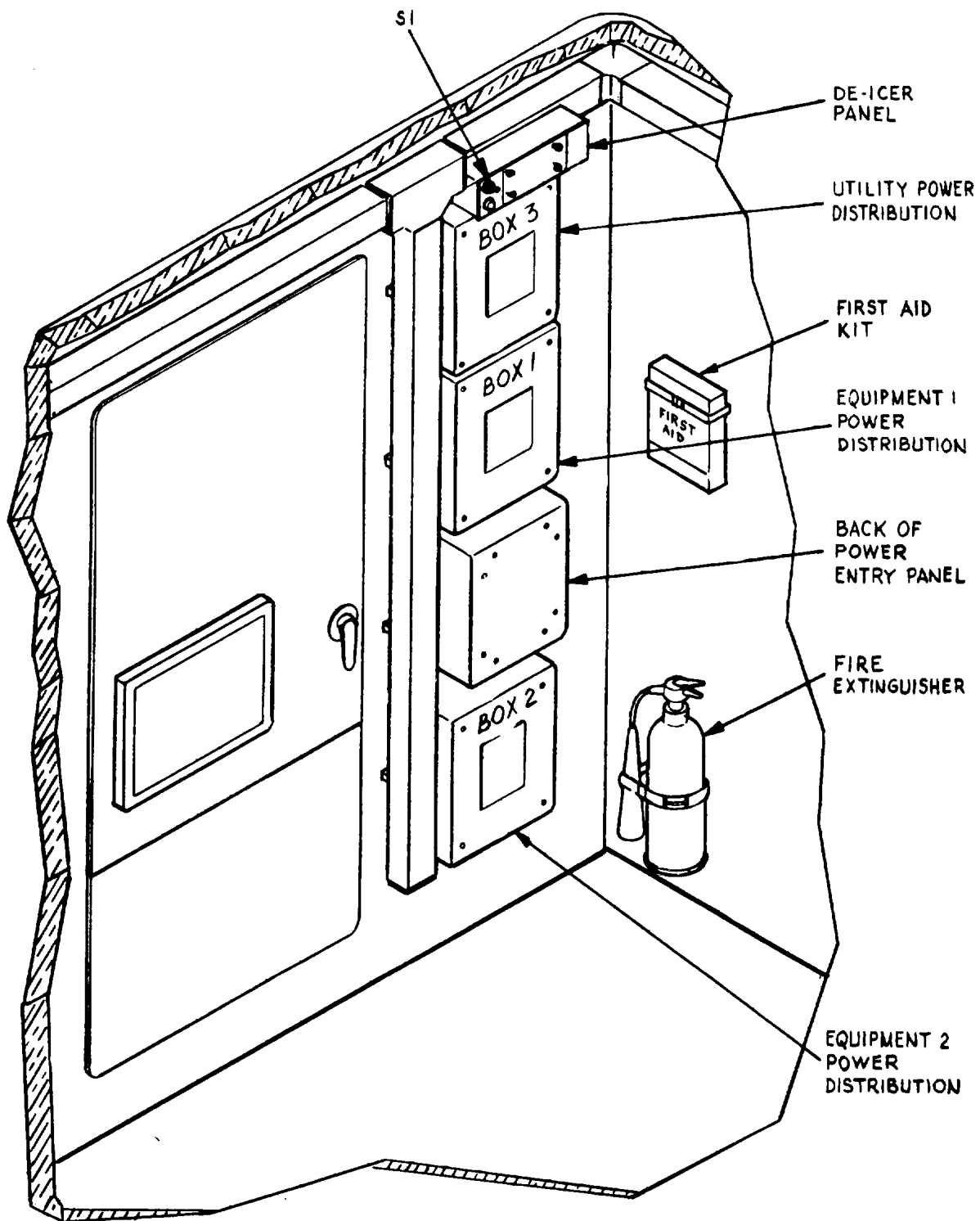


Figure 13. Power distribution area, isometric view.

- (2) Patch cord and test cable kit. The patch cord and test cable kit includes patch cords for use with the CEC, and test cables for use with the other electronic equipment in the shelter
- (3) Accessory kit. The accessory kit includes coaxial adapters and terminations used during maintenance.
- (4) Tool kit. The tool kit is held by belting in its bracket on the floor against the center of the front wall. It includes a large variety of hand tools for maintenance (see fig. 6).

c. Tie-down and sling assembly. The tie-down and sling assembly normally is used while the shelter is in transit to hold it down on the vehicle, and then is used to lift the shelter from the vehicle by a single hook crane using four corner lifting eyes.

CHAPTER 2 INSTALLATION AND CHECKOUT

Section I. GENERAL INFORMATION

17. Shelter Location

The site installation drawings cover the initial site layout, building and tower erection, cable and waveguide installation and placement of all shelters and vans.

18. Initial Tests

The Interim Test and Acceptance Plan (T and A) provides for the initial test and acceptance of each shelter (and other site equipment), and the recording of all data on T and A forms. A copy of this data becomes a part of the permanent record of shelter performance and may be found in the shelter. The T and A is performed at the time the using service accepts the shelter. After T and A the shelter is placed in operation on a 24 hour-a-day basis, or is assigned to float spares.

Section II. CHECKOUT

19. General

The checkout of the shelter is normally accomplished as a part of T and A. In order to provide for the situation that may arise if a shelter is replaced due to damage, or a shelter from float spares is added to a site to increase site capability, the following test information is supplied, to be performed if required.

20. Test Equipment Required

Table V lists the test equipment required for the initial checkout of shelters.

TABLE V. TEST EQUIPMENT

Description	Manufacturer	Model number	Quantity	Military equivalent
Signal Generator	Hewlett-Packard	650-A	1	AN/FPM-25
Vacuum Tube Voltmeter	Hewlett-Packard	400-D	1	ME-30/U
Freq. Sensitive Voltmeter	Sierra	125-B	1	ME-275/U
Multimeter	Simpson	260	1	TS-352
R-F Signal Generator	Hewlett-Packard	618-B	1	AN/URM-52A
Frequency Counter	Hewlett-Packard	524-D	1	AN/USM-26
Frequency Converter	Hewlett-Packard	525-A	1	MX-1637
Vacuum Tube Voltmeter	Hewlett-Packard	410-B	1	ME-26/U
Power Meter	Hewlett-Packard	430-C	1	AN/URM-98
Thermistor Mount	Hewlett-Packard	477-B	1	MX-2144 A/U
Noise Source	Hewlett-Packard	G347-A	1	SG-678/G
Noise Figure Meter	Hewlett-Packard	342-A	1	TS-2436/G
Oscilloscope	Tektronix	541-A	1	AN/USM-196
Pre-amplifier	Tektronix	CA	1	AM-1839/USM
Pre-amplifier	Tektronix	L	1	AM-1842/USM
Pre-amplifier	Tektronix	G	1	AM-3174/USM
Noise Generator	Marconi	TF1226B	1	
Noise Receiver	Marconi	TF1225A	1	
Filter Unit	Marconi	TM5774	1	
60 KC High Pass Filter	Marconi	TM5840	1	

TABLE V. TEST EQUIPMENT (cont)

Description	Manufacturer	Model number	Quantity	Military equivalent
204 KC Low Pass Filter	Marconi	TM5833/1	1	
70 KC Band Stop Filter	Marconi	TM5842	1	
105 KC Band Stop Filter	Marconi	TM5843	1	
185 KC Band Stop Filter	Marconi	TM5844	1	
Power Calorimeter-complete with Relay and Receptable Box B-2331407	Electronic Impulse Labs, Inc.	CPW-1500	1	
Deviation Meter	Marconi	TF791D	1	ME-57/U
Frequency Meter	FXR	H-410B	1	FR-177/G
Tunable Probe	FXR	B-200A	1	MX-3631
75-ohm Attenuator	Kay Electric	31-0	1	CN-1096/G
W/G Coax Adapter	Hewlett-Packard	G281-A	5	
Crystal Detector	Hewlett-Packard	420-A	1	MX-3671
W/G Termination	Hewlett-Packard	G910-A	1	CG-3216/G
Coax Attenuator	Microlab	AB-03N	1	
Coax Attenuator	Microlab	AB-06N	1	
Coax Attenuator	Microlab	AB-10N	1	
Coax Attenuator	Microlab	AB-20N	1	
Coax Attenuator	Microlab	AB-40N	1	
10 db W/G Attenuator	Waveline	B2330793G1	1	
Purge Meter	Trinity	W-127	1	
W/G Adapter	Microwave	MA-507	1	
W/G Adapter	Microwave	MA-510	1	
Preformed Flex W/G	Airtron	C2289852G1	1	CG-3215/G
Transmission Measuring Set	Daven	12-B	1	TS-2397/G
Radiation Monitor	Sperry	B86B1	1	
Isolator	Sperry	D-44C2-2	1	CU-1560/G
Translation Oscillator	ITTFL NUS 6633	H1090025G1	1	

TABLE V. TEST EQUIPMENT (cont)

Description	Manufacturer	Model number	Quantity	Military equivalent
Capacitive Decoupler Attenuator, Variable	ITTFL P.R.D. Electronics, Inc.	A2331266G1	1	CN-1095G
		G101	1	
Resistor, 75 ohm 1/2W			3	
Resistor, 82 ohm, 3 1/2W				
I-F Detector	ITTFL	C2334878G1	1	
Resistor 150 ohm 1/2 Watt			3	
Dual Reference Voltage Source	ITTFL	2385668	1	
Frequency Counter	CMC	2565A	1	
Capacitive Decoupler	ITTFL	B2386863	1	
Tee BNC Adapter		UG-274/U	4	
2nd Mixer LO Filter bypass	ITTFL	2386770	1	

21. Physical and Electrical Checkout

a. Check split door (fig. 1 and 2) and all air vents for freedom of movement and mechanical security. Leave all air vents open.

Note: Air vents are located on the door, to the right of door, on the curbside and roadside walls, and on the front wall.

b. Check that connectors and waveguide bulkhead fittings on power and signal entry panels have not been damaged or are otherwise defective.

c. Inspect to make certain that the shelter is GROUNDED. Turn all powerline circuit breakers, cabinet power switches, and utilities OFF. Connect the A Load, B Load, and Utility Load cables to the shelter.

d. Turn the main power switches in the Generator Room ON. With A Simpson 260 Voltmeter, measure between Neutral and the Line Terminal of all three primary powerline circuit breakers. Observe and record in station log that readings are 120 ± 10 volts a-c.

e. Untie shelter lighting fixtures. Make certain that incandescent lamps are securely tightened in their sockets.

Note: The shelter lighting fixtures are located on the curbside and roadside ceiling utility power ducts.

f. Turn the Utility and lighting circuit breakers CB1, CB3 and CB4 ON. Check all lighting, and all overhead convenience outlets for power. (See fig. 20.)

g. Check to determine that shelter is fully equipped in accordance with packing slip.

h. Remove drawer-securing hardware from transmitter, power amplifier if supplied, receiver and central equipment cabinets. Check that drawers slide smoothly and are secure in their cabinets. Also check cabinets for damage incurred in shipment and mechanical security to shelter walls and floor.

i. Check module complement of radio equipment cabinets by referring to applicable manuals.

j. Check mechanical security of exhaust fan, air conditioner, and waveguide pressurizer.

k. Determine NUS number of shelter. Record NUS number in station log.

l. Determine serial numbers of all radio equipment cabinets and other major components (air conditioner and waveguide pressurizer). Record serial numbers in station log.

22. External Waveguide Connections

The waveguide runs to the associated antennas (antennas A and B) or the dual 10 kw amplifier van are connected to the shelter through waveguide feedthrough fittings A, B, C, D, and E. Fittings A and B are located on the curbside signal entry panel; fittings C, D, and E are located on the roadside signal entry panel. The locations of the signal entry panels are shown in figures 4 and 5. Table VI lists the external waveguide connections for each specific shelter configuration.

23. Antenna Deicer and Tower Light Connections

Connect antenna deicer and tower light cables to the shelter as listed in table VII.

24. External Signal Cable Connections

Connect the external signal cables to the shelter as listed in table VIII. All signal cable connectors are located on the curbside signal entry panel.

TABLE VI. EXTERNAL WAVEGUIDE CONNECTIONS

Radio Equipment Shelter NUS 6060	Fitting A	Fitting B	Fitting C	Fitting D	Fitting E
-1, -4, -5, -16, -17, -18, -19, -21, and -23.	To horizontally polarized feed-horn on antenna A.	To vertically polarized feedhorn on antenna A.	To vertically polarized feedhorn on antenna B.	To horizontally polarized feedhorn on antenna B.	Not supplied.
-6 and -22.	Not used.	To horizontally polarized feedhorn on antenna A.	Not used.	To vertically polarized feedhorn on antenna B.	Not supplied.
-24.	To waveguide feedthrough fitting D on curbside wall of Dual 10 KW Amplifier Van NUS 7561.	To waveguide feedthrough fitting C on curbside wall of Dual 10 KW Amplifier Van NUS 7561.	To horizontally polarized feedhorn on antenna B.	To vertically polarized feedhorn on antenna B.	To waveguide bulkhead feed- through fitting E of Dual 10 KW Amplifier Van.

TABLE VII. ANTENNA DEICER AND TOWER LIGHT CONNECTIONS

Cable	From	Connector	
		Reference designation	Location
Deicer B	Antenna deicer assembly B.	J17	Curbside signal entry panel.
*Tower lights B	Antenna tower lights assembly B.	J18	Curbside signal entry panel.
Deicer A	Antenna deicer assembly A	J19	Roadside signal entry panel.
*Tower lights A	Antenna tower lights assembly A.	J20	Roadside signal entry panel.

*Used only for Radio Equipment Shelters having control of antenna tower lights (determined by specific site installation drawings).

TABLE VIII. SIGNAL CABLE CONNECTIONS

Cable	From	To connector
*Transmit multiplex baseband	Multiplex equipment shelter	J5
*Receive multiplex baseband	Multiplex equipment shelter	J6
*Order wire and summary alarm	Maintenance control center	J11
**Audio TTY and summary alarm	Maintenance control center and tributary terminal set	J12

* Used only at Radio Equipment Shelters NUS 6060-1, -4, -5, -6, -18, -19, and -24.

**Used only at Radio Equipment Shelters NUS 6060-16, -17, -21, -22, and -23.

25. Power Turn-On and Utility Checks

Perform the power turn-on and utilities test as follows:

a. Alternately set FAN EXHAUST switch S2 ON and OFF. Exhaust fan (on front wall of shelter) runs with S2 set to ON and is off with S2 set to OFF. Set S2 to ON. (See fig. 3.)

Note: Switch S2 is mounted in the roadside ceiling power duct, near the exhaust fan.

b. Alternately set circuit breaker CB4 OFF and ON. Power is removed from utility receptacles J21 through J26 (on roadside ceiling power duct) and J27 through J32 (on curbside ceiling power duct) and EXHAUST FAN with CB4 set to OFF. Power is applied to J21 through J32 and EXHAUST FAN with CB4 set to ON.

Note: Omit steps c and d if shelter does not have control over the antenna tower lights (site installation drawings determine light control connections).

c. If the shelter controls tower lights, alternately set circuit breaker CB6 ON and OFF. Power is applied to antenna tower lights circuit A connector J18 (on curbside signal entry panel) with CB6 set to ON. Power is removed from J18 with CB6 set to OFF. Reset to ON.

d. If shelter controls tower lights, alternately set circuit breaker CB7 ON and OFF. Power is applied to antenna tower lights circuit B connector J20 (on roadside signal entry panel) with CB7 set to ON. Power is removed from J20 with CB7 set to OFF. Reset to ON.

e. Alternately set circuit breaker CB8A ON and OFF. POWER is applied to external utility receptacle J4 (on power entry panel) with CB8A set to ON. Power is removed from J4 with CB8A set to OFF. Reset to ON.

f. On deicer module, set S1 on. Alternately set circuit breaker CB8B ON and OFF. POWER is applied to deicer connectors J17 and J19 (on roadside and curbside signal panels) with CB8B set to ON. Power is removed from J17 and J19 with CB8B set to OFF. Reset to ON. (See fig. 13.)

g. Turn the airconditioner circuit breaker CB2 in the distribution box ON. On the air conditioner, set the FUNCTION SWITCH to VENTILATE.

Note: Check direction of air flow at exhaust vent. If the blower rotation is reversed, turn CB2 OFF and interchange any two of the three leads feeding J3. Turn CB2 ON. Re-check for correct rotation.

h. Set air conditioner selector switch to COOLING. Cool air should be detected at output port after reasonable time period.

Note: A loud knocking noise may be heard. This noise should disappear after a few seconds of operation. If noise persists, set the air conditioner selector switch to OFF and inform site maintenance personnel of the trouble. Do not perform the remainder of this procedure until the source of the trouble has been eliminated.

i. Set air conditioner selector switch to HEATING. Warm air should be detected at output port after reasonable time period. Reset FUNCTION SWITCH to function desired. Turn off exhaust fan if air conditioner is used.

j. Turn shelter circuit breaker CB5 ON. Turn the power to the dehydrator ON according to the operating instructions. When the waveguide pressure stabilized, close the valves between the dehydrator and the waveguide and make a temporary record of the pressure reading. (Pressure should be 0.5 to 1.5 psig).

k. Observe the waveguide pressure at intervals until 60 to 70 minutes have elapsed. If any waveguide run shows a final pressure lower than 80 per cent of the original value, locate and repair the leak, and repeat the test. (See fig. 12.)

l. At the end of this test, open the purge valves partially to maintain a low pressure (approximately 0.6 PSIG) that will ensure a high duty-cycle of the dehydrator. Let the dehydrator run from 4 to 6 hours to certify proper operation and to dry out the system completely.

Note: To purge installations with only a single waveguide run to the antenna, the cover plate that seals the unused stub of the feed horn must be loosened enough to create a slow leak equivalent to a partially-open purge valve.

26. Initial Central Equipment Adjustments

Perform the initial CEC setup as follows:

a. Turn on shelter circuit breakers CB9, CB12, CB17, and CB20.

b. Check that POWER switches on all CEC power supply modules are set to ON. All central alarm panel indicators should be lit red or amber except those for the dehydrator, vswr monitors, deicer and all indicators marked SPARE.

Note: Refer to TM 11-5820-582-14 for the location of all central equipment cabinet controls and indicators.

c. Press each red lighted indicator. Each indicator should change color to amber as it is pressed. If the indicators for the dehydrator, or deicer is lit green, pressing the indicator should put out the light.

d. If BELL CUTOFF pushbutton on central alarm equipment module is not lit red, press pushbutton. Pushbutton should turn red.

e. Perform the alignment of the CEC if required. See Section II of the manual referred to in 26 b. above for alignment procedure.

27 Transmitter Checkout and Alignment

a. Turn on circuit breakers CB10 and CB18 in shelter power distribution boxes.

b. Ensure that proper crystal type (ITTF 2335659) of the correct frequency is in the holder in each transmitter. Mark the crystal frequency on the outside of the holder.

c. Refer to TM 11-5820-581-14 for the turn-on and alignment procedure to be used. Also refer to TABLE I herein to determine if the shelter uses single or multi-channel equipment. If it is single channel, peak tune the transmitters. If it is multi-channel, broadband the transmitters. After the alignment is complete, check on the CEC alarm panel that both transmitter indicators have turned to green. Acknowledge the change of status by depressing the indicators.

d. At the end of transmitter alignment, if 1 kw power amplifiers are used, perform the reduction in driving power to the transmitter doubler as follows:

- (1) On transmitter B, set the switchover module to MANUAL SELECT and select transmitter A.
- (2) Disconnect the coaxial cable on top of transmitter B that feeds power amplifier A. Acknowledge any alarms. Terminate the output of the transmitter with a 20 db coaxial attenuator, a test cable with a thermistor, and a power meter.
- (3) Adjust control J5 in the modulator-exciter drawer of transmitter A for a reading on the power meter of one milliwatt (100 milliwatts power output).
- (4) On transmitter A, set the frequency multiplier meter selector switch to position 2 RF PWR.
- (5) Adjust potentiometer R30 FWD in the frequency multiplier drawer for a meter reading of 50.
- (6) On the switchover module select transmitter B. Repeat step (3) through (5) on transmitter B.
- (7) Remove the test equipment and reconnect the cable removed in step (2). Acknowledge alarms.
- (8) In transmitter B, disconnect the coaxial cable from the rear of the frequency multiplier drawer. Terminate the drawer with a 3 db attenuator and a type N coaxial short.
- (9) On transmitter B, set the frequency multiplier meter selector switch to M REFL POWER. Adjust potentiometer R32 REFL in the frequency multiplier drawer for a reading of 50 on the meter (this corresponds to a vswr of 3.0:1 at the forward power corresponding to 100 milliwatts transmitter output from the switchover unit).
- (10) Disconnect the coaxial attenuator and short and reconnect the cable to the back of the drawer.
- (11) Select transmitter A. Repeat steps (8) through (10) on transmitter A.

e. At the end of transmitter alignment, if power amplifiers are not used, and the shelter is not used to drive a 10 kw van, perform the following to set up the vswr alarm levels:

- (1) With both transmitters set to standby, connect the equipment per figure 14.
- (2) In the shelter distribution boxes, turn on CB14 and CB22.
- (3) On each vswr alarm module (fig. 12) depress the reset buttons. The CEC VSWR MON A and B indicators should turn green. Depress each indicator to turn off the green light. Depress the BELL CUTOFF to activate the bell circuit.
- (4) On the circulators, (fig. 12), loosen the locking screw and withdraw each probe to its stop. Finger tighten the locks.
- (5) On vswr alarm module B disconnect the rf input cable from the circulator. Place transmitter B in normal condition. On circulator A loosen the probe lock and slowly insert the probe until VSWR MON A on the CEC lights red. Lock the probe. The CEC alarm bell should ring about five seconds after the VSWR MON A indicator lights. Depress VSWR MON A to stop the bell and change the indicator from red to amber.
- (6) Place transmitter B in standby. Depress vswr module A reset button. The VSWR MON A on the CEC should change to green and the bell should ring. Depress VSWR MON A on the CEC to put out the light and silence the bell. Reconnect the vswr module rf input cable.
- (7) Repeat steps (5) and (6) to set the level of vswr alarm for transmitter B, substituting A for B and vice versa where required. Press the BELL CUTOFF button. Disconnect test equipment and return connections to normal.

28. Power amplifier Checkout and Alignment

- a. Refer to TM 11-5820-603-14 (or TM 11-5820-580-14 for NUS 6061 power-amplifier) for location of controls of the power amplifier.
- b. Connect equipment per figure 15, turn the rf load power on, and perform the following steps to set up the vswr alarm protection circuits for the power amplifiers:
 - (1) On each power amplifier, turn the BEAM VOLTAGE adjust control fully counterclockwise.
 - (2) On each circulator (airtron type) loosen the vswr probe and decouple it as far as it will go by pulling gently until the stop is reached. Finger tighten the lock (Ferrotec circulators have fixed probes).
 - (3) Turn on CB13 and CB21 in the shelter power distribution boxes.
 - (4) On each power amplifier, turn on all circuit breakers.
 - (5) Depress each MAIN POWER SWITCH. It should be green when power is on.

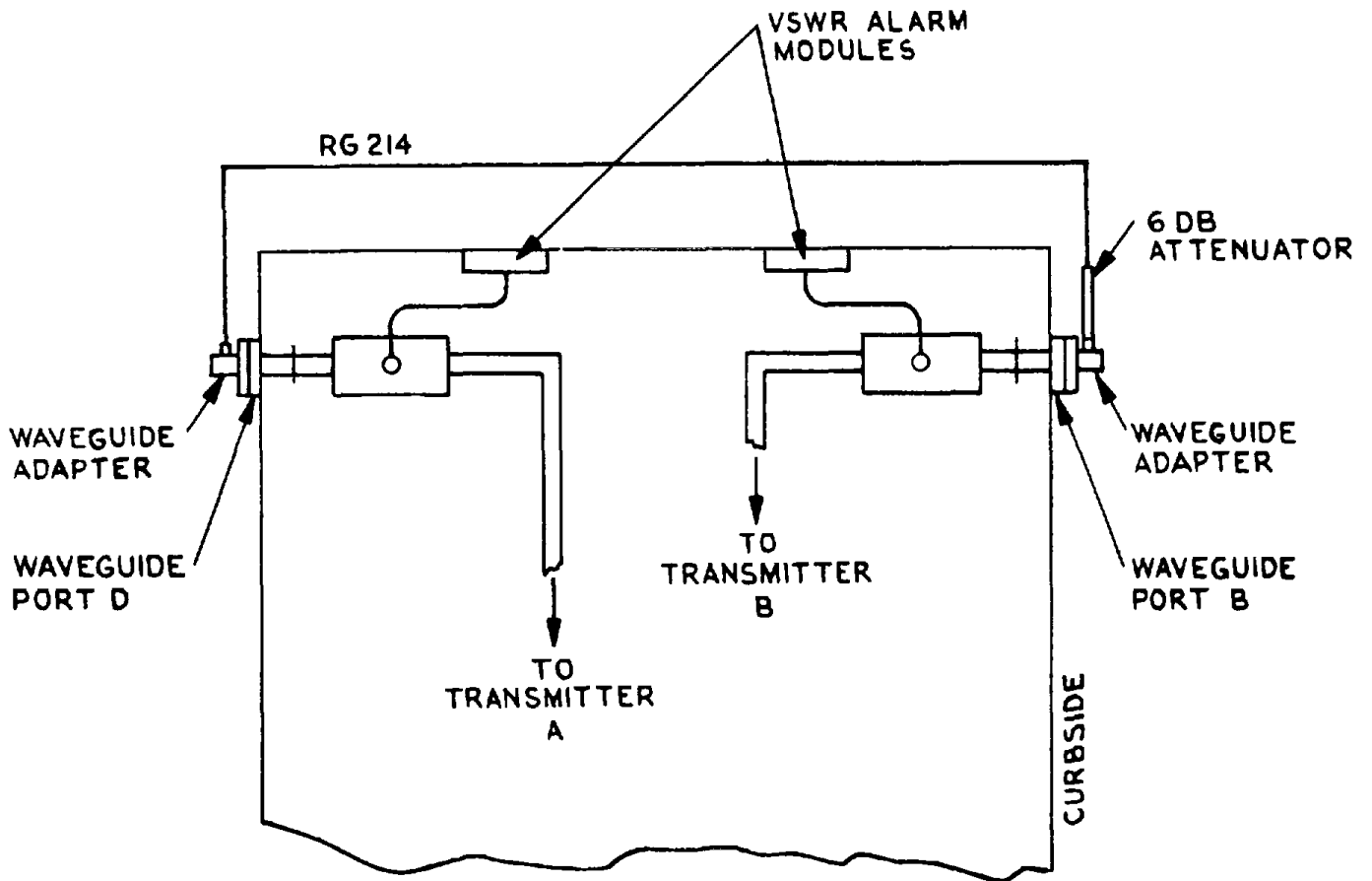


Figure 14. Vswr alarm module, alignment setup.

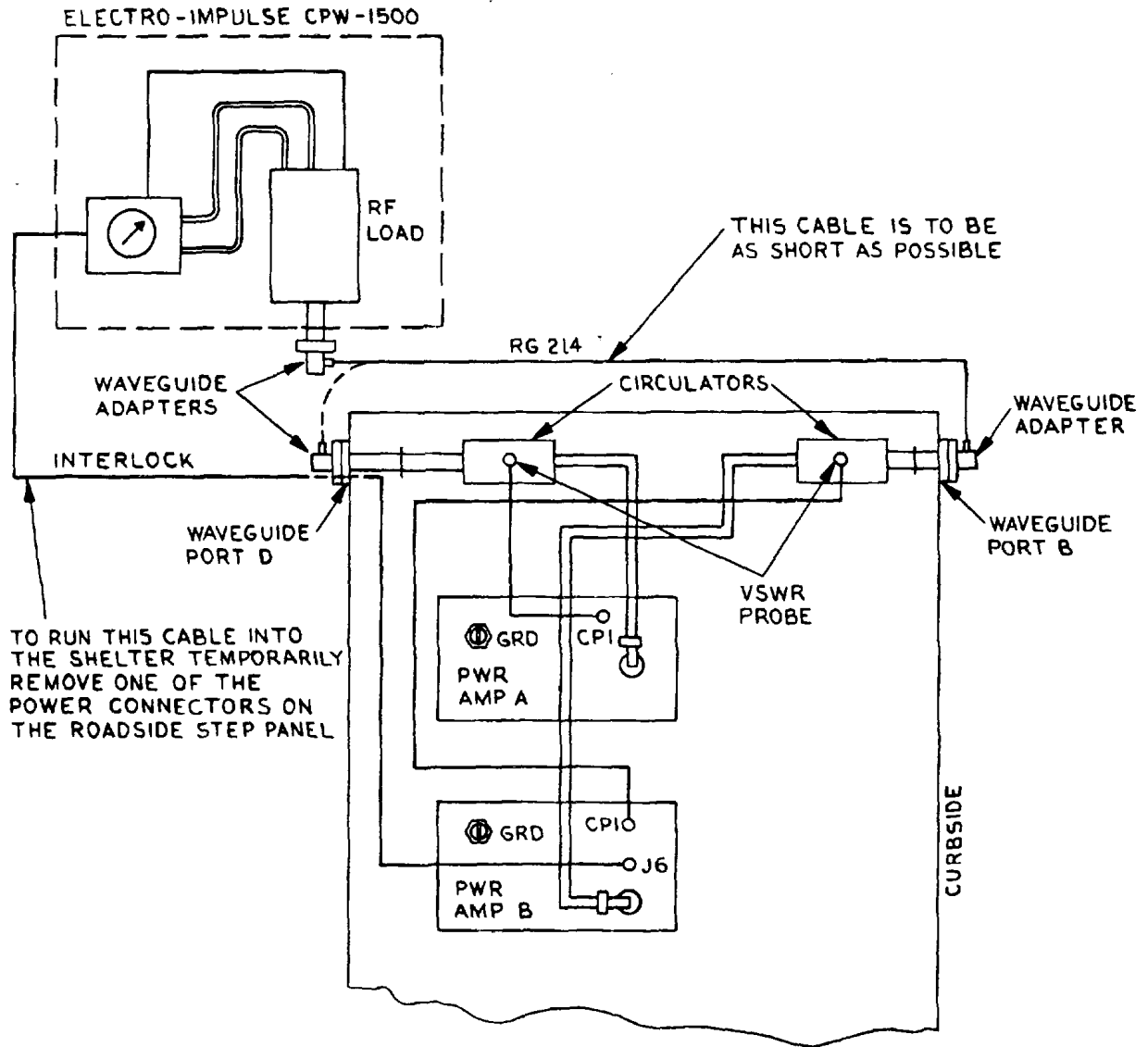


Figure 15. Power amplifier vswr alignment setup.

- (6) Make sure that each BEAM SWITCH is red. If not, depress it to make it red.
- (7) Both power amplifiers have warmed up when all indicators turn green except LOW RF, BEAM SWITCH, and BEAM. Depress the RESET button if necessary. When this has occurred, make sure that the test rf cable from port B is connected to the waveguide adapter of the rf load.
- (8) Depress BEAM SWITCH on power amplifier B. Turn the BEAM VOLTAGE adjust control clockwise in small steps, observing the calorimetric power meter and the BEAM VOLTAGE meter, until the power meter reads 100 watts or the beam voltage reads 5000 volts, whichever occurs first.

CAUTION: Do not allow the rf power to exceed 200 watts at this time.

- (9) If the rf power meter reads close to 100 watts, increase the beam voltage until the power is approximately 125 watts, then increase the attenuation in AT1 until the power meter reads 100 watts when stabilized. If the power meter did not read anything at 5000 volts beam voltage and the RF monitor meter on the power amplifier did not read either, carefully tune the input cavity of the klystron until a reading is obtained, making it as close to 125 watts as possible. Reduce the input at AT1 to stabilize the power meter at 100 watts. Calibrate the RF MONITOR meter on the front panel of the power amplifier, with the ANTENNA FORWARD WATTS X10 button depressed.
- (10) Depress the BEAM SWITCH to reduce the power amplifier power output to zero. Remove the end of the test cable from the calorimetric power meter and transfer it to the waveguide adapter on port D.
- (11) On the antenna mismatch control card in the power amplifier A drawer, turn the mismatch control fully counterclockwise.
- (12) Depress the BEAM SWITCH on power amplifier B. Observe the RF MONITOR meter. It should stabilize at 100 watts.
- (13) Depress the BEAM SWITCH on power amplifier A to activate the alarm circuit. The BEAM SWITCH and BEAM indicator should be green. On the antenna mismatch card turn the mismatch control slowly clockwise until the BEAM and ANT MISMATCH indicators turn red. If it is not possible to make them turn red by turning the control fully clockwise, set the control to three-quarters of its travel clockwise and lock it. Loosen the probe in circulator A and insert it very slowly until the BEAM and ANT MISMATCH indicators turn red. Lock the circulator probe. On power amplifier B, depress the BEAM SWITCH to turn off the beam voltage. On power amplifier A depress the RESET pushbutton to reset the alarm circuit.

- (14) On the CEC, depress POWER AMPL A switch indicator. It should change from amber to green. Depress it again to put it out. Depress the BELL CUTOFF pushbutton, turning the red light off and activating the bell circuit.
- (15) On power amplifier B, depress the BEAM SWITCH. The RF MONITOR meter should read 100 watts and on power amplifier A the ANTENNA MISMATCH and BEAM indicators should change from green to red and the POWER AMPL A switch indicator on the CEC should turn on red. After about five seconds the CEC alarm bell should ring. Depress the POWER AMPL A switch indicator to silence the bell and acknowledge the antenna mismatch. On power amplifier B depress the BEAM SWITCH to turn off the beam voltage and on power amplifier A depress the RESET button. On the CEC depress the BELL CUTOFF button.
- (16) Repeat steps (8) through (15) to set the alarm circuit of power amplifier B, substituting port B for port D and power amplifier A for B and vice versa.
- (17) Return all connections to normal and disconnect the test equipment.

c. Refer again to the instruction manual in a. above and perform the complete alignment of each power amplifier. Before the alignment is performed, refer to TABLE I to determine if the equipment in the shelter is multi-channel and broadbanding is required. When alignment is completed, place the power amplifiers in standby by depressing each BEAM SWITCH.

29. Receiver Checkout and Alignment

- a. Turn on circuit breakers CB11 and CB19 in shelter power distribution boxes.
- b. Using the calibration charts supplied by the manufacturer, set the preselector micrometers properly for the operating frequency.
- c. Ensure that the proper crystals (for single channel ITTFL 2335659, for multi-channel ITTFL 2287995) are in the holders in the receivers. Mark the crystal frequency on the outside of each holder.
- d. Refer to TM 11-5820-582-14 for the turn-on and alignment procedure for the receivers.
- e. For translation oscillator alignment and calibration, see the appendix to this manual. At the end of threshold extension alignment and calibration, for multi-channel receivers perform the threshold measurement as follows: (If receivers are single channel proceed to paragraph f.)
 - (1) Set up the equipment as shown in figure 18. A four-way coax power divider is available in the translation oscillator unit.
 - (2) Terminate leads nos. 2, 3, and 4 with 50-ohm terminations. For the number coding of the leads see figure 18.

- (3) Turn on the signal generator and the receivers and allow them to warmup for 30 minutes. Set the frequency control of the signal generator to the RF frequency of the single receiver under test.
- (4) Set the MOD SELECTOR switch of the signal generator to OFF. Adjust the ZERO SET control until the meter indicator is at the far left, ZERO SET position.
- (5) Set the MOD SELECTOR switch of the signal generator to CW. Adjust the ATTENUATOR control of the signal generator until a level of -6 dbm is read on the HP430C power meter.
- (6) Adjust the POWER SET control of the signal generator until the attenuator dial indicator is positioned over the number 6 (DECIBELS BELOW ONE MILLIWATT). The attenuator dial is now calibrated and gives the output level of lead no. 1 directly.
- (7) Measure the output level of lead no. 2 by removing the termination and connecting the lead to the power meter. Lead no. 1 must be terminated in 50 ohms before reading the power meter. The output level should be -6 dbm \pm 0.5 db if the coax divider is operating properly.
- (8) Repeat step (7) for lead nos. 3 and 4. Measure the output power of each one in turn (with the other three leads terminated). Now all four output levels should be very close to -6 dbm.
- (9) Set the ATTENUATOR control of the signal generator to 60 db. The output power level of leads nos. 1, 2, 3, and 4 should now be very close to -60 dbm.
- (10) Remove the termination from lead no. 1 and terminate lead no. 4 (leads nos. 2, 3, and 4 should now be terminated in 50 ohms). Connect lead no. 1 to RF INPUT 1 of receiver A (the input is located on the PRESELECTOR AND MIXER drawer of the dual receiver cabinet A).
- (11) Disconnect the cable from J16 of the lower IF AMPLIFIER module (located in the IF AND BASEBAND drawer) of receiver A. For a quad diversity shelter, also disconnect the cable from J16 on both upper and lower IF AMPLIFIER modules of receiver B.
- (12) Check that the Marconi noise receiver is connected to the REC MUX EQUIP jack of the central equipment cabinet video patch panel per figure 18. Set the BAND SELECTOR switch of the noise receiver to the 105-kc position (position 3). Set the NOISE POWER RATIO DB controls of the noise receiver to 20 and 10. Adjust the SENSITIVITY control to a mid-scale meter reading of 50.

Note: Steps (13), (14), (15), and (16) apply to quadruple diversity shelters. Steps (14) and (16) apply to dual diversity shelters only. Do only those steps which apply. Then continue to step (17).

- (13) For quad diversity shelter only, remove the plug from J7 of receiver A. Plug J7 is located behind the top panel of receiver A.
- (14) Connect terminal P1 of the test cable assembly (C2335875) to J7 of receiver A. See figure 18.
- (15) For quad diversity shelter only: connect the cable from J7 of receiver B to terminal P2 of the test cable assembly.
- (16) Connect the HP410B VTVM to P3 of the test cable assembly as show in figure 18.
- (17) Adjust the frequency of the signal generator slightly until a minimum AGC voltage is obtained on the HP410B VTVM.
- (18) Determine the RF input level to the receiver. The RF level (decibels below one milliwatt) may be read directly from the signal generator attenuator dial. Also determine the noise receiver NOISE POWER RATIO DB control setting necessary to make the meter read 50.

Note: Initially the input RF level will be -60 dbm (60 db below one milliwatt) and the Marconi NOISE POWER RATIO DB control setting will be 30 db.

- (19) Plot the point corresponding to the Marconi NOISE POWER RATIO DB control setting and the RF input level (as determined in step 14) on a graph similar to the example shown in figure 16A.
- (20) Increase the ATTENUATOR setting of the signal generator in increments of 3 db. Repeat steps 17, 18, and 19 after each 3 db change in attenuator setting. Go to step 17 after the attenuator reaches 99 db.
- (21) Determine the "breakpoint" as shown in figure 16A. The RF level corresponding to the breakpoint is the threshold level of the receiver. The threshold level should be as shown in table IX.
- (22) Return the signal generator ATTENUATOR control to 60 db.
- (23) The threshold level for receiver AI has been determined. Now reconnect the cable to J16 of the lower IF AMPLIFIER module of receiver A. Disconnect the cable to J16 of the upper IF AMPLIFIER module of receiver A.
- (24) Disconnect lead no. 1 from RF INPUT 1 of receiver A and connect it to RF INPUT 2 of receiver A.

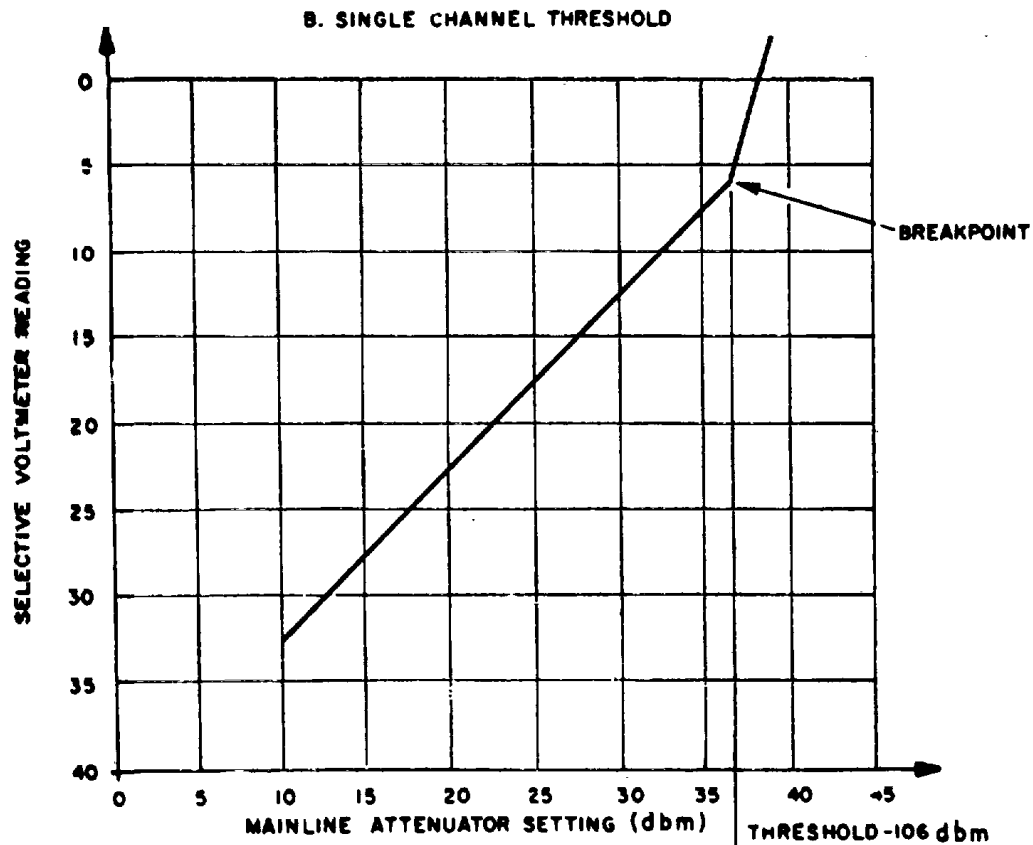
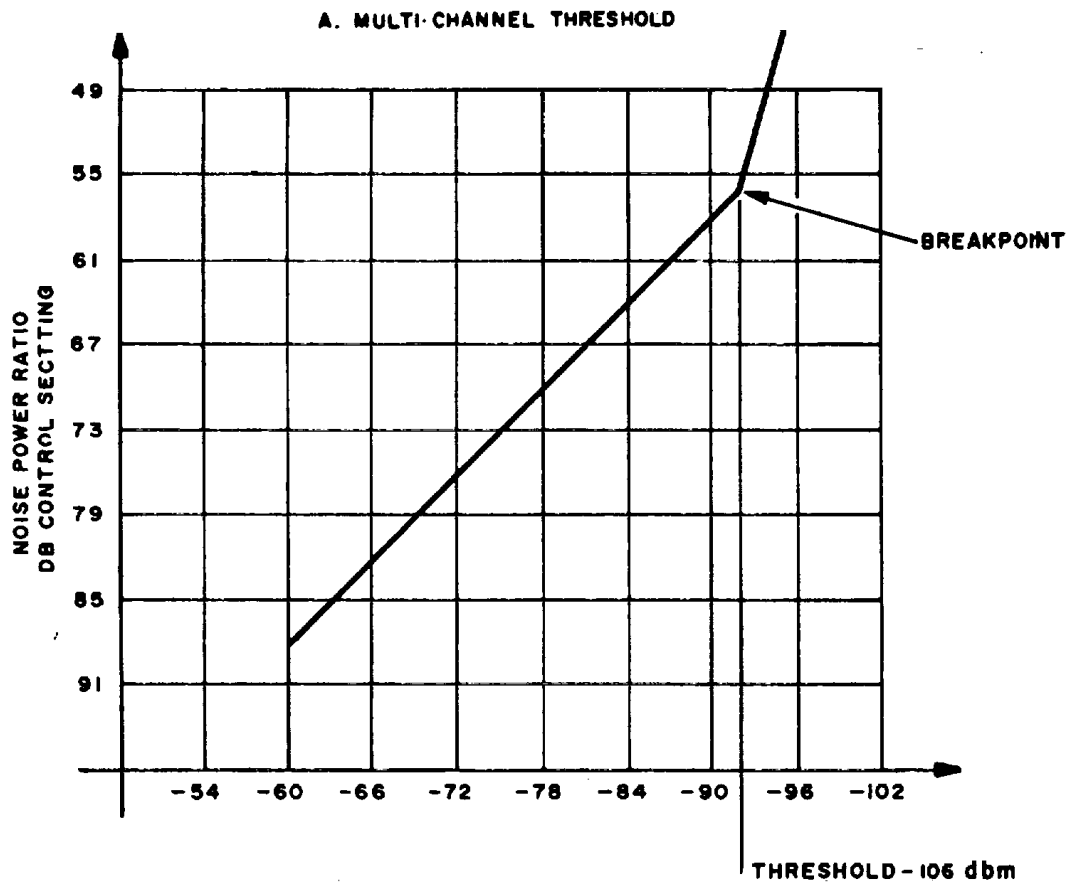


Figure 16. Receiver threshold graphs typical.

TABLE IX. SHELTER THRESHOLD LEVELS

Threshold characteristic (dbm)	Radio Equipment Shelter Number NUS 6060											
	1	4	5	6	16	17	18	19	21	22	23	24
Single Receiver												
2 or 12 to 60 channel	-93	-93	-83	-83	-106.5	-99.5	-90	-8	-106.5	-96.5	-99.5	-93
72 to 120channel	-90	-90	-80	-80	-	-	-87	-80	-	-	-90	
Dual Receiver												
2 or 12 to 60 channel	-	-	-	-85.5	-	-	-	-	-	-99	-	-
72 to 120 channel	-	-	-	-82.5	-	-	-	-	-	-	-	-
Quad Receiver												
2 or 12 to 60 channel	-98	-98	-88	-	-111.5	-104.5	-95	-88	-111.5	-	-104.5	-98
72 to 120 channel	-95	-95	-85	-	-	-	-92	-85	-	-	-	-95

(25) Repeat steps (17) through (22) to determine the threshold of receiver A2.

Note: For quad space diversity only perform steps (26) through (36).

(26) Reconnect the cable to J16 of the upper IF AMPLIFIER module of receiver B. Disconnect the cable to J16 of the lower IF AMPLIFIER module of receiver A.

(27) Disconnect lead no. 1 from RF INPUT 2 of receiver A and connect it to RF INPUT 1 of receiver B.

(28) Repeat steps (17) through (22) to determine the threshold of receiver B1.

(29) Reconnect the cable to J16 of the lower IF AMPLIFIER module of receiver B. Disconnect the cable to J16 of the upper IF AMPLIFIER module of receiver B.

(30) Disconnect lead no. 1 from RF INPUT 1 of receiver B and connect it to RF INPUT 2 of receiver B.

(31) Repeat steps (17) through (22) to determine the threshold level of receiver B2.

Note: To obtain the threshold level of the combined receiver perform steps (32) through (36).

(32) Reconnect all cables to their respective J16 jacks.

(33) Connect lead no. 1 to RF INPUT 1 of receiver A.

(34) Remove the 50-ohm terminations from leads nos. 2, 3, and 4.

(35) Connect lead no. 2 to RF INPUT 2 of receiver A; connect lead no. 3 to RF INPUT 2 of receiver B; and connect lead no. 4 to RF INPUT 2 of receiver B.

(36) Repeat steps (17) through (22) to determine the threshold level of the quad diversity receiver group. The threshold level should be as shown in table IX.

(37) Attach all graphs to the station log. Label the graphs according to the corresponding receiver serial number.

(38) Leave all test equipment on and connected for the radio equipment alarm tests in paragraph 30.

f. For single channel receiver threshold measurements, perform the following:

(1) If power amplifiers are used, turn them off by depressing the BEAM SWITCH and then the MAIN POWER SWITCH. Leave the circuit breakers on.

- (2) Turn off transmitter A and B by placing the 800 volt switch in the power drawer to STANDBY.
- (3) Set the equipment up per figure 19. (If the receiver is dual only connect a termination (50 ohms) to translation oscillator leads 3 and 4.)
- (4) Place transmitter A in normal operation by returning the 800 volt switch to NORMAL.
- (5) Measure the power from the transmitter at the input to the translation oscillator. Make a temporary record of this level.
- (6) Calculate the translation oscillator conversion gain from the calibration information obtained when the translation oscillator was calibrated. Select any particular receiver input level and from this subtract the numerical sum of the translation oscillator input level in dbm and the external waveguide attenuator setting used in calibration. For example, if a level of -75 dbm is selected, the power measured in (5) above is -20 dbm, and the chart prepared when calibrating the translation oscillator shows an attenuator reading of 20, then 20 plus 20 equals 40 and -75 minus 40 then equals -35. This is the conversion gain in dbm in the translation oscillator (always a negative figure).
- (7) Perform the following steps to establish the receiver threshold limit line on the graph (figure 16B).
 - (a) Record the value of attenuator "B" in series with the mainline attenuator (see figure 19).
 - (b) Record the translation oscillator conversion gain from (6).
 - (c) Record the translation oscillator rf input power measured in (5).
 - (d) Add the three numbers from (a), (b) and (c) algebraically and record the sum.
 - (e) Determine the difference between the number obtained in (d) and the single channel threshold for the shelter as shown in table IX. Draw a vertical line on the graph at a point corresponding to this value as shown for the mainline (waveguide) attenuator (see fig. 16B).

Example

- (7) (a) Attenuator "B" -15 db
- (b) T.O. conversion gain - 35 db
- (c) T.O. input power -20 db
- (d) Algebraic sum -70 db
- (e) Differential (NUS 6060-16 from table IX)
106.5 minus 70 =36.5

- (8) Calibrate the selective voltmeter. Set its frequency to a frequency between 13 and 19 kc but not at 12 or 16 kc (harmonics of the pilot tone). Set the bandwidth control to 250 cycles.
- (9) Ensure that the translation oscillator external attenuator is set to 0 db attenuation.
- (10) Perform steps e. (10) and (11).
- (11) Disconnect receiver A baseband output cable at J4 and connect the selective voltmeter to J4.
- (12) Using the translation oscillator external attenuator, determine the receiver threshold. Plot the attenuator reading against the selective voltmeter reading and take at least five readings at 3 db steps above and below the threshold limit line.
- (13) Perform step e. (23) and (24). Repeat step f. (12).
- (14) Perform steps e. (26) and (27). Repeat step f. (12).
- (15) Perform steps e. (29) and (30). Repeat step f. (12).
- (16) Reconnect all cables to their respective jacks J16 on the if amplifiers.
- (17) Repeat step f. (12) for the combined receiver threshold. Determine the required threshold limit line by repeating step (7) (e) and referring to table IX.
- (18) Draw on the graphs a straight line through the above threshold points and extend it through the threshold limit line (fig. 16B). The line should be at a 45 degree angle to the vertical lines on the graph.
- (19) Threshold requirements are met if the plotted curve is within plus or minus 2 db of the 45 degree line at the intersection of the threshold limit line.
- (20) At the end of combined threshold measurement leave the test equipment connected for the performance of alarm tests in paragraph 30.

30. Shelter Alarm Checkout

The following checks will determine that the alarm circuits are operating properly. On the CEC both RCVR A and RCVR B indicators should be amber as well as the RCVR PILOT indicator. If power amplifiers are used the POWERAMPL A and POWER AMPL B indicators should be amber. The BELL CUTOFF should be red. All other alarm indicators should be out.

a. Receiver alarm check.

- (1) On the CEC, press the BELL CUTOFF.

- (2) See figure 18 or 19. Connect the audio oscillator to the signal generator with a bnc tee. Connect the VTVM to the tee.
- (3) Set the signal generator control to 60.
- (4) Set the audio oscillator frequency to 4000 cycles per second. Set the audio oscillator level to 1.0 volt. The three receiver alarms on the CEC should turn from amber to green, showing the presence of if and pilot tone signals. (If the lights do not change color adjust the frequency of the audio oscillator by swinging it slowly above and below 4000 cps until the indicators change color). Acknowledge the change in alarm status by pressing the indicators to put out the indicator lights and silence the bell.
- (5) Disconnect the signal generator cable from RF INPUT 1 on receiver A. The RCVR A alarm indicator on the CEC should turn red and the bell should ring after a few seconds. Depressing the indicator should change its color to amber and silence the bell.
- (6) Reconnect the cable to RF INPUT 1. The RCVR A indicator should change to green and the bell should ring after a few seconds. Depressing the indicator should turn off its light and silence the bell.
- (7) Repeat steps (5) and (6) for receiver A RF INPUT 2.
- (8) Repeat steps (5) (6) and (7) on receiver cabinet B and its associated indicator.
- (9) On the CEC, make sure that the AUTO/MAN switch is set to AUTO and PRIORITY is set to A.
- (10) On receiver A, disconnect the inputs to RF INPUT 1 and 2. On the CEC the RCVR A indicator should light red and the bell should ring after a few seconds. Acknowledge the alarm by depressing the RCVR A indicator.
- (11) On receiver A, disconnect the quad crossconnect cable from the front panel. Open the if and baseband drawer and set the QUAD/DUAL switch on the AGC amplifier to DUAL. On the CEC, the A noise receiver should indicate red and the SWITCHOVER light should light.
- (12) On receiver A, reset the AGC QUAD/DUAL switch to QUAD and reconnect the quad crossconnect cable to the front panel. The SWITCH-OVER light on the CEC should go out and the A noise receiver light should go out.
- (13) On receiver A, reconnect the two cables to RF INPUT 1 and 2. On the CEC the RCVR A indicator should turn green and the bell should ring after a few seconds. Depressing the RCVR A indicator should turn off the green light and silence the bell.
- (14) On the CEC, set PRIORITY switch to receiver B. Repeat steps (10) through (13) on receiver B.

- (15) On the audio oscillator disconnect the output cable. On the CEC the RCVR A, RCVR B and RCVR PILOT should light red and the bell should ring after a few seconds. Depressing the RCVR A and B indicators should turn all three red lights to amber and silence the bell.
- (16) Reconnect the audio output cable to audio oscillator. The indicators for RCVR A and B and RCVR PILOT should change to green and the bell should ring. Depressing the indicators should turn put the green lights and silence the bell. (If the audio cable is reconnected after the alarm sounds the circuits will automatically reset themselves to normal.)
- (17) Disconnect all of the receiver test equipment and set the receivers for normal operation. Since no link signal is present, the RCVR A, RCVR B, RCVR PILOT and noise receivers will show alarm condition. Acknowledge all alarms to silence the bell.

b. Transmitter Alarms.

- (1) On front panel of transmitter A modulator exciter drawer, disconnect cable from BASEBAND IN connector. XMTR A switch-indicator (on central alarm panel) should light red and alarm bell should ring.
- (2) Press XMTR A switch-indicator. Switch-indicator should light amber and alarm bell should be silenced.
- (3) Reconnect cable disconnected in step (1). XMTR A switch-indicator should light green and alarm bell should ring.
- (4) Press XMTR A switch-indicator. Switch-indicator should go out and alarm bell should be silenced.
- (5) Disconnect cable from BASEBAND IN connector on front panel of transmitter B modulator exciter drawer. XMTR B switch-indicator should light red and alarm bell should ring.
- (6) Press XMTR B switch indicator. Switch-indicator should light amber and alarm bell should be silenced.
- (7) Reconnect cable disconnected in step (5). XMTR B switch indicator should light green and alarm bell should ring.
- (8) Press XMTR B switch-indicator. Switch-indicator should go out and alarm bell should stop ringing.
- (9) In transmitter A, open the power supply drawer and place 800 volt switch in STANDBY. On the CEC, XMTR A indicator should light red. Reset 800 volt switch to NORMAL. The CEC indicator should go out.
- (10) Repeat step (9) for transmitter B.

c. Power Amplifier Alarms. If power amplifiers are used, perform the following:

- (1) Ensure that all rf connections are properly made.
- (2) On power amplifier A, depress the BEAM SWITCH. The CEC POWER AMPL A indicator should turn green after the beam voltage comes to 7500 volts and LOW RF indicator on the power amplifier turns green. Depress the POWER AMPL A indicator to turn its green light out and silence the bell.
- (3) On power amplifier A disconnect the rf input cable from the top of the cabinet. The POWER AMPL A indicator on the CEC should turn red and the bell should ring. Reconnect the rf input cable to the power amplifier to silence the bell and turn out the red light. Depress the BEAM SWITCH to place the power amplifier in standby.
- (4) Repeat steps (2) and (3) for power amplifier B.

d. Auxiliary Alarms.

- (1) VSWR monitor alarms were checked during their alignment.
- (2) The dehydrator alarm may be checked by turning off circuit breaker CB5 in distribution box 3. The CEC indicator should turn red and should go out when CB5 is turned on.
- (3) The deicer module alarm may be checked by turning off CB8B in the distribution box. The CEC indicator should turn red and then should go out when CB8B is turned back on. When deicer switch S1 on the module is turned off no alarm should result. Reset S1 to ON.
- (4) Tower lights alarms may be checked by turning off the circuit breakers that control the lights if the shelter does control lights. The alarms should go off when the circuit breakers are turned back on.

**CHAPTER 3
OPERATING INSTRUCTIONS**

Section I. GENERAL INFORMATION

31. Introduction

This chapter is divided into three sections. Section I describes the controls not covered in the equipment manuals listed on page vi, in paragraph 4 and in part II of this manual. Section II provides procedures for turning on, operating, and turning off the shelter equipment. Section III provides instructions for maintaining operation under unusual conditions.

32. Shelter Controls

Table X lists the shelter controls. These controls consist of the circuit breakers in power distribution power boxes 1 through 3, SHELTER LIGHTS switch S1 and FAN EXHAUST switch S2. The locations of the circuit breakers are shown in figure 19. The switches are located in the roadside ceiling power duct.

TABLE X. SHELTER CONTROLS

Control	Function
Power distribution box 3 (utility power): (fig. 20)	
Circuit breaker CB1	Controls power applied to all circuit breakers in power distribution box 3.
Circuit breaker CB2	Controls power applied to air conditioner.
Circuit breaker CB3	Controls power applied to SHELTER LIGHTS switch S1 and FAN EXHAUST switch S2.
Circuit breaker CB4	Controls power applied to utility receptacles J21 through J26 (on roadside ceiling power duct) and J27 through J32 (on curbside ceiling power duct).
Circuit breaker CB5	Controls power applied to waveguide pressurizer.
Circuit breaker CB6	Controls power applied to antenna tower lights circuit A connector J18 (on curbside signal entry panel). Used as spare in shelters not having control over tower lights.

TABLE X. SHELTER CONTROLS (cont)

Control	Function
Circuit breaker CB	Controls power-applied to antenna tower lights circuit B connector J20 (on roadside signal entry panel). Used as spare in shelters not having control over tower lights.
Circuit breaker CB8	Controls power applied to external convenience receptacle J4.
Power distribution box 1 (equipment 1 power): (fig. 20)	
Circuit breaker CB9	Controls power applied to all circuit breakers in power distribution box 1.
Circuit breaker CB10	Controls power applied to transmitter A.
Circuit breaker CB11	Controls power applied to receiver A in quadruple diversity shelter configurations. Used as spare in dual diversity shelter configurations.
Circuit breaker CB12	Controls power applied to power supply circuit A of central equipment cabinet.
Circuit breaker CB13	Controls power applied to power amplifier A in 1 kw shelter configurations. Used as spare in 1 watt shelter configurations.
Circuit breaker CB14	Controls power applied to vswr monitor alarm module A. Used as spare in 1 kw shelter configurations.
Circuit breaker CB15	Spare.
Circuit breaker CB16	Spare.
Power distribution box 2 (equipment 2 power): (fig. 20)	
Circuit breaker CB17	Controls power applied to all circuit breakers in power distribution box 2.
Circuit breaker CB18	Controls power applied to transmitter B.

TABLE X. SHELTER CONTROLS (cont)

Control	Function
Circuit breaker CB19	Controls power applied to receiver B in quadruple diversity shelter configurations. In dual diversity shelter configurations, controls power applied to receiver A (only receiver used).
Circuit breaker CB20	Controls power applied to power supply circuit B of central equipment cabinet.
Circuit breaker CB21	Controls power applied to power amplifier B in quadruple diversity shelter configurations. Used as spare in 1 watt shelter configurations.
Circuit breaker CB22	Controls power applied to vswr monitor alarm module B in 1 watt shelter configurations. Used as spare in 1 kw shelter configurations.
Circuit breaker CB23	Spare.
Circuit breaker CB24	Spare.
Roadside ceiling	
power duct:	
SHELTER LIGHTS switch	
S1 (fig. 3)	Controls power applied to shelter lights.
FAN EXHAUST switch S2	
(fig. 3)	Controls power applied to exhaust fan.

Section II. NORMAL OPERATION**33. General**

This section provides procedures for completion of turn-on, operating, and turning off all shelter equipment. Since the shelter equipment is operated continuously after being turned on, the operating procedures are confined to the use of the order wire facilities.

34. Equipment Turn-On

The equipment is to be completely turned on when the requirements of initial installation (chapter 2) have been satisfied. At this point the equipment is on but in standby. To place the equipment in operation at the start of link operations, perform the following:

a. As soon as the link signal activates the alarm bell on the CEC, acknowledge the change in status of RCVR A, RCVR B and PILOT TONE by depressing each indicator. The receiver is now operating and link tests may be made in accordance with system procedures.

b. If power amplifiers are used, depress the BEAM SWITCH on each power amplifier. When the power has reached a level sufficient to turn off the LOW RF light on each power amplifier, acknowledge the change in status on the CEC by depressing the POWER AMPL A and B indicators.

35. Operating Order Wire Facilities

The radio equipment shelter order wire facilities are contained within the central equipment cabinet. A telephone handset on the 4-wire telephone unit permits voice communication between the shelter and the associated maintenance control center. Two operations are involved in the operation of the order wire facilities; initiating an outgoing call and acknowledging an incoming call. Procedures for performing these operations are given in a and b.

a. Initiating Outgoing Call. Initiate an outgoing call as follows:

- (1) Lift telephone handset from cradle on 4-wire telephone unit.
- (2) Press signaling pushbutton on telephone handset.

Note: Pressing the telephone handset signaling pushbutton actuates a buzzer at the maintenance control center, thereby signaling the attendant.

- (3) When the maintenance control center answers, proceed with message.
- (4) Return telephone handset to the cradle when the call is completed.

b. Answering Incoming Call. Answer an incoming call as follows:

- (1) When buzzer sounds, lift telephone handset from cradle. Do not press signaling pushbutton.

Note: The buzzer is located in the 1600 cps tone receiver module.

- (2) Identify yourself and proceed with conversation.
- (3) Return telephone handset to cradle when call is completed.

36. Equipment Turn-off

Except for extensive maintenance, the radio equipment shelter is kept in continuous operation. The turn-off procedure is as follows:

a. If power amplifiers are used, turn them off first.

- (1) Depress the BEAM SWITCH on each power amplifier.
- (2) Depress the MA.N POWER SWITCH on each power amplifier. The switch should change from green to white.
- (3) After two to three minutes the blowers should shut down. Rotate the BEAM VOLTAGE adj control fully counterclockwise.

b. If power amplifiers are not used, or after they are shut down if used, the shelter may be shut down by turning-off all of the circuit breakers in all three power boxes, commencing with the highest numbered breakers and ending with breaker CB1.

c. The shelter may be closed and locked if desired. Close all vents and secure them.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

37. General

a. The radio equipment shelter is capable of operating in extremely cold or hot climates. It provides complete protection from the elements for equipment and personnel, however, when the signal and power entry panels are exposed to adverse weather conditions, special precautionary measures are required. These measures are described in paragraph 38.

b. The radio equipment shelter is also capable of providing partial operation in the event of an equipment failure. Partial operation is described in paragraph 39.

38. Operation Under Adverse Weather Conditions

a. Cold Climates. Extreme cold causes cables and wiring to become hard, brittle, and difficult to handle. Use care when handling cables and wiring and when making connections to avoid kinks and unnecessary loops. Make certain that connectors, receptacles, and waveguide feed through fittings on the outside of the shelter are free of frost, snow, or ice by replacing the appropriate seals and covers on the connectors, receptacles, and feedthrough fittings when they are not in use. Also cover the signal and power entry panels when they are not in use. Replace connector, receptacle, and feedthrough fitting seals and covers as soon as they are disconnected. Never drag or place an open connector in the snow.

b. Hot Dry Climates. In hot, dry climates the connectors, receptacles, and feedthrough fittings are subject to damage from dirt and dust. Cover the signal and power entry panels when they are not in use and replace the seals and covers on the connectors, receptacles, and feedthrough fittings. Never drag an open connector on the ground.

c. Warm, Damp Climates. In warm, damp climates, the equipment is subject to damage from moisture and fungi. Wipe all moisture and fungi from the equipment with a lint-free cloth.

39. Partial Operation

a. Transmitting Equipment

(1) Transmitter malfunctions. In 1-watt radio equipment shelters, a malfunction in the modulator of one transmitter results in an automatic switchover to the modulator in the second transmitter. In 1 kw or driver for 10 kw radio equipment shelters, a malfunction in the modulator exciter or frequency multiplier drawer of one-transmitter, results in an automatic switchover to the second transmitter. In either case, communications are maintained until the defective unit is repaired and restored to normal operation.

(2) Power amplifier malfunctions. A failure in one power amplifier reduces transmission to single polarization. Communications can be maintained on this basis until the defective power amplifier is repaired and restored to normal operation.

b. Receiving Equipment

- (1) Radio Equipment Shelters NUS 6060-1, -4, -5, -16, -17, -18, -19, -2-1 and -24. Since the receiving equipment for these shelters consists of two complete dual-diversity receivers, a malfunction in one receiver reduces reception to a dual-diversity basis. Communications can be maintained on this basis until the defective receiver is repaired and restored to normal operation.
- (2) Radio Equipment Shelters NUS 6060-6 and -22. Since the receiving equipment for these shelters consists of a single, dual-diversity receiver, a malfunction in one receiver channel reduces reception to a non-diversity basis. Communications can be maintained on this basis until the defective channel is repaired and restored to normal operation.

c. Prime Power Failure. A failure of one of the prime power sources requires that immediate action be taken in the shelter if power amplifiers are used. Other equipment in the shelter is normally unaffected by power loss.

- (1) The normal sequence of shutdown of power amplifiers requires a cooling period of two to three minutes of forced air. If this cooling period is cut off by power failure, damage to the klystron may result.
- (2) Immediately after power failure, on the affected power amplifier, turn the BEAM SWITCH off and turn the BEAM VOLTAGE adjust control fully counterclockwise.
- (3) At the time that prime power returns, on the affected power amplifier, after normal warmup time, depress the BEAM SWITCH. Observing the BEAM VOLTAGE meter and the BEAM CURRENT meter, carefully and slowly turn the BEAM VOLTAGE adjust control clockwise. At a beam voltage of 2000 volts, wait five minutes, continue to raise the beam voltage until it reaches 4000 volts and wait five minutes. The beam current should be approximately 200 milliamperes. Continue to raise the beam voltage until it reaches 6000 volts. The beam current should not exceed 400 milliamperes at this time. Wait ten minutes and then raise the beam voltage to 7500 volts. The beam current should not exceed 500 milliamperes. If it does, shut down the power amplifier and call for maintenance personnel to check for klystron damage.

CHAPTER 4

THEORY OF OPERATION

40. System Application

a. The deployment of radio equipment shelters in a typical radio link is shown in figure 17. Signals originated by the subscribers at site A are applied to a multiplex shelter as individual voice frequency channels. The multiplex shelter combines these channels to produce a baseband level signal which is applied to the radio equipment shelter for transmission. In the radio equipment shelter, the baseband level signal modulates an rf carrier, producing a 4.4 to 5.0 gc fm signal. This signal is transmitted to radio equipment shelter 1 at site B using line-of-sight or tropospheric scatter propagation.

b. Using dual or quadruple diversity reception, site B radio equipment shelter 1 accepts the fm signal and provides the demodulation required to reproduce the baseband level signal. The baseband level signal is applied to the site B multiplex shelter where it is converted into its constituent voice frequency channels. Channels intended for the site B subscribers are separated and applied to the subscriber lines. Channels intended for subscribers at other sites are converted into a baseband level signal in the multiplex shelter and transmitted to site C through radio equipment shelter 2.

c. Voice frequency channels representing signals originated by the site B subscribers are converted into baseband level signals by the multiplex shelter. The baseband level signal containing the channels intended for the site A subscribers is transmitted to site A through radio equipment shelter 1. At site A, the multiplex shelter converts the baseband level signal into its constituent channels for application to the subscriber lines. The baseband level signal containing the channels intended for subscribers at other sites is transmitted to site C through radio equipment shelter 2.

41. Block Diagram Descriptions

a. 1 KW, Quadruple Diversity Shelter Configurations. The 1-kw, quadruple diversity shelter configurations (Radio Equipment Shelters NUS 6060-1, -16, -17,-18, and -19) are used for long and medium distance tropospheric scatter radio links. The basic signal paths are shown in figure 22 and described in (1) through (4), below.

(1) Received signal path.

(a) The 4.4 to 5.0 gc fm carrier signals received by the vertically polarized feedhorns of antennas A and B are applied to the B input of dual receiver A and the A input of dual receiver B, respectively. Fm carrier signals received by the horizontally polarized feedhorns of antennas A and B are applied to the A input of dual receiver A and the B input of dual receiver B, respectively. Duplexers A and B permit the dual receivers and power amplifiers A and B to share common feedhorns.

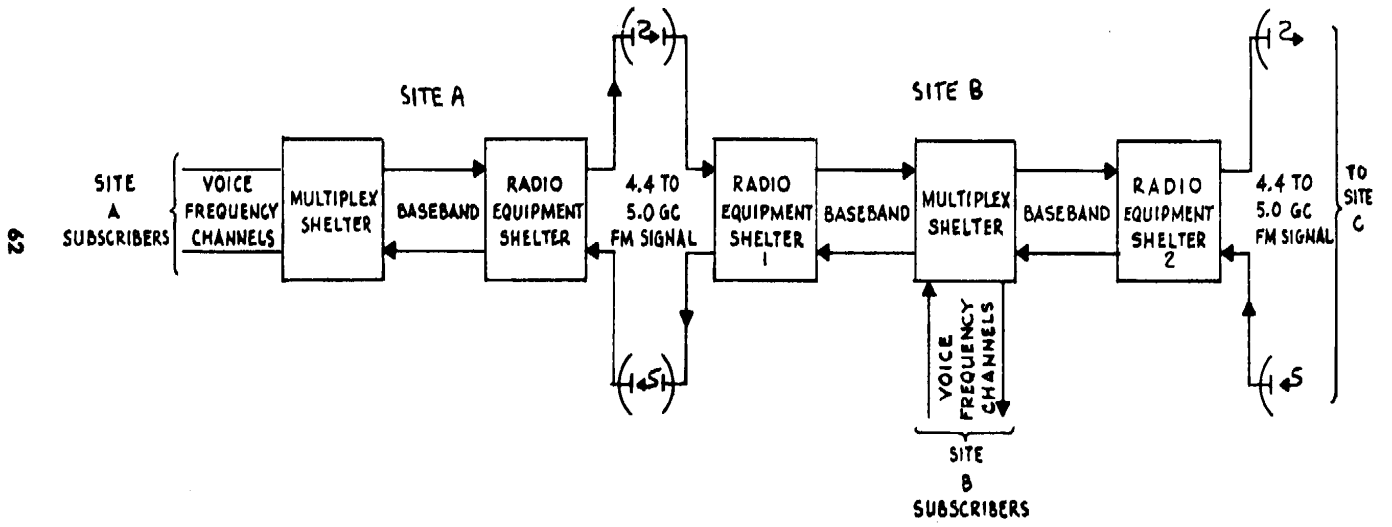


Figure 17. Radio shelter in typical radio link, block diagram.

- (b.) The fm carrier signal applied to each dual receiver input is converted to an intermediate frequency (70 mc for Radio Equipment Shelters NUS 6060-1, -18, and -19 or 70 and 9.8 mc for Radio Equipment Shelters 6060-16 and 17) and combined in a diversity combining circuit prior to demodulation. The combined if. outputs of both dual receivers are combined through the use of the quadruple diversity cross-connect cable and applied to the demodulator in each dual receiver, producing two redundant composite basebands outputs. The composite baseband outputs are applied to the central equipment cabinet.
- (c.) In the central equipment cabinet, both baseband outputs are applied to a switching unit which is manually set to select either baseband output for processing. The switching unit also operates under the control of two sets of 4 kc tone and noise receivers. Each set of 4 kc tone and noise receivers continuously monitors a baseband output for the presence of a 4 kc pilot tone and excessive noise, respectively. In the absence of the pilot tone or the presence of excessive noise, the appropriate receiver actuates the switching unit. The results in the automatic switchover to the second baseband output.
- (d.) In Radio Equipment Shelters NUS 6060-1, -18, and -19 (mainline sites) the baseband output selected by the switching unit is applied to a 12-kc separation filter which extracts the order wire and pilot tone signals. The order wire and pilot tone signals are applied to a 3.4-kc low-pass filter. This filter removes the pilot signals and passes the order wire signal to the maintenance control center. The remaining portion of the baseband is applied to the multiplex shelter where it is separated into its constituent voice frequency channels.
- (e.) In Radio Equipment Shelters NUS 6060-16 and -17 (tributary sites), the baseband output selected by the switching unit is applied to a line separation filter which provides bandpass and low-pass outputs. The bandpass output is the 7.0 to 9.7 kc carrier channel received from associated nodal site rf nodal point van. The carrier channel (ETA Console System audio channel A1), which contains the audio and tty signals transmitted by the console remote equipment van at the associated nodal site, is applied to carrier channel receive circuits. In these circuits, the carrier channel is mixed with a locally-generated 10 kc signal producing audio and tty signals in the 300 to 3000 cps audio channel which is applied to the central equipment cabinet 4-wire telephone unit, the tributary terminal set, and the maintenance control center. This channel is normally used as ETA Console System channel A2. When not being used for console system audio traffic between the console remote equipment van and the tributary terminal set, this channel may be used to handle order wire traffic between the rf nodal point van, the

maintenance control center, and the 4-wire telephone set. It should be noted that the console system has priority over the use of this channel.

(2) Transmitted signal path

- (a) In Radio Equipment Shelters NUS 6060-1, -18, and -19 (mainline sites), the order wire signal from the maintenance control center is applied to central equipment cabinet where it is combined with a locally-generated 4 kc pilot tone and the order wire signal from the 4-wire telephone handset. The combined order wire and pilot tone signals are applied to the low-pass input of a 12 kc separation filter. The baseband signal from the multiplex shelter is applied to the high-pass input of the separation filter, producing a composite baseband signal (combined baseband, order wire, and pilot tone signals) at the output of the filter. The composite baseband signal is applied to transmitters A and B.
- (b) In Radio Equipment Shelters NUS 6060-16 and -17 (tributary sites), the order wire signals from the maintenance control center and 4-wire telephone unit or the audio and tty signals from the tributary terminal set are combined with the locally-generated 4 kc pilot tone in the central equipment cabinet. The resulting composite baseband signal is applied to transmitters A and B through the line separation filter.
- (c) In both transmitters A and B, the composite baseband signal is applied to the modulator exciter drawer where it frequency-modulates a 70 mc subcarrier. The resulting 70 mc fm subcarrier is sampled for the presence of pilot tone, providing a 4kc pilot tone signal which is applied to a 4 kc tone receiver in the central equipment cabinet to inhibit the transmitter modulation failure alarm circuits. The absence of this 4 kc pilot tone signal produces a modulation failure alarm signal which is applied to the rf switchover and power divider drawer (in transmitter B). The operation of the rf switchover and power divider drawer is described in (e), below.
- (d) The 70 mc subcarrier is also mixed with a locally-generated 2.27 to 2.43 gc signal in the modulator exciter drawer to produce a 2.2 to 2.5 gc fm carrier. This carrier is applied to the frequency multiplier drawer for frequency doubling. The resulting 4.4 to 5.0 gc fm carrier is applied to the rf switchover and power divider drawer through a directional coupler (in the frequency multiplier drawer) which provides an rf monitoring signal. The rf monitoring signal is one of the signals controlling the operation of the rf switchover and power divider drawer.
- (e) The rf switchover and power divider drawer is manually set to select the 4.4 to 5.0 gc output of either transmitter for application to power amplifiers A and B. If the output of the selected transmitter fails, the resulting absence of the rf monitoring signal causes the rf switchover and power divider to switch to the

second transmitter. The rf switchover and power divider drawer also switches to the second transmitter upon receipt of a modulation failure alarm. The generation of the modulation failure alarm signal is described in (c), above.

- (f) The 4.4 to 5.0 fm carrier selected by the rf switchover and power divider drawer is applied to power amplifiers A and B. The 1 kw outputs of power amplifiers A and B are applied to the vertically polarized feedhorn on antenna A and the horizontally polarized feedhorn on antenna B, respectively. Duplexers A and B, connected between the associated power amplifiers and antenna feedhorns, permit the power amplifiers and dual receivers A and B to share common feedhorns. Each duplexer also contains facilities which monitor the power reflected by the associated antenna feedhorn and waveguide run. When the reflected power is excessive, each duplexer generates an antenna mismatch alarm signal which shuts down the associated power amplifier when the reflected power is excessive.
- (3) Radio equipment alarm signal paths. Each of the dual receivers, transmitters, and power amplifiers generates an alarm signal when it malfunctions. The receiver, transmitter, and power amplifier alarm signals are applied to the central equipment cabinet where they light the appropriate switch-indicators on the central alarm panel and actuate the alarm bell in the central alarm equipment module. The radio equipment alarm signals are summarized with the utility alarm signals ((4), below) producing a summary alarm signal. This signal is applied to the maintenance control center where it lights an indicator.
- (4) Utility equipment alarm signal paths. The waveguide pressurizer-dehydrator, tower lights, and antenna deicers also generate alarm signals when they malfunction. As with the radio equipment alarm signals ((3), above), the utility equipment alarm signals are applied to the central equipment cabinet where they light appropriate switch indicators and actuate the alarm bell. These signals are also summarized with all other alarm signals in the central equipment cabinet to produce the summary alarm signal which is applied to the maintenance control center.
- (a) The waveguide pressurizer-dehydrator alarm signal is generated by the waveguide pressurizer-dehydrator whenever the air pressure in the antenna waveguide runs cannot be maintained at 1.0 ± 0.5 psig.
- (b) A tower lights alarm signal is generated by the tower lights control box (on the antenna tower) whenever a tower lights lamp burns out or its associated circuit is defective. The tower lights control box contains a current sensing relay in each tower lights lamp circuit.

When a lamp burns out or the circuit is defective, the relay drops out, generating the tower lights alarm signal. It should be noted that the tower lights alarm signals are used only for shelters having control over the antenna tower lights.

- (c) A deicer alarm signal is produced by the deicer control and monitor module whenever an antenna deicer heater burns out or its associated circuit is defective. The deicer control and monitor module contains a current sensing relay in the deicer heater circuit. This relay drops out when the associated heater burns out or the circuit is defective, generating the deicer alarm signal.

b. 1 Watt, Quadruple Diversity Shelter Configurations. The 1 watt quadruple diversity shelter configurations (Radio Equipment Shelter NUS 6060-4, and -5 and -21 and -23) are used for tropospheric scatter radio links. The basic signal paths are shown in figure 23 and described in (1) through (4), below.

- (1) Received signal path. The basic flow of the received signal is identical to that described for the 1-kw, quadruple-diversity shelter configurations (a (1) (a) through a (1) (e), above). Substitute Radio Equipment Shelter NUS 9060-4, and -5 for Radio Equipment Shelters NUS 6060-1, -18, and -19 in a (1) (d) and Radio Equipment Shelter NUS 6060-21, and -23 for Radio Equipment Shelters NUS 6060-16, -17 in a (1) (e), respectively.

- (2) Transmitted signal path. Up to the output of the central equipment cabinet, the basic flow of the transmitted signal is identical to that described for the 1 kw, quadruple-diversity shelter configurations (a (2) (a) and a (2) (b), above). Substitute Radio Equipment Shelter NUS 6060-4 and -5 for Radio Equipment Shelters NUS 6060-1, -18, and -19 in a (2) (a) and Radio Equipment Shelter NUS 6060-21 and -23 for Radio Equipment Shelters NUS 6060-16 and -17 in a (2) (b), respectively. The basic signal flow from the output of the central equipment is described in (a) through (c), below.

- (a) The composite baseband output of the central equipment cabinet is applied to the modulator exciter drawers of both transmitters A and B. In each modulator exciter drawer, the composite baseband signal frequency-modulates a 70 mc fm subcarrier. The resulting 70 mc fm subcarrier is sampled for the presence of a pilot tone providing a 4 kc pilot tone signal which is applied to a 4 kc tone receiver in the central equipment cabinet. This signal inhibits the transmitter modulation failure alarm circuits. The absence of the 4 kc pilot tone signal results in the application of a modulation failure alarm signal to the modulator switchover and power divider drawer (in transmitter B).
- (b) The modulator switchover and power divider drawer is manually set to select the 70 mc fm subcarrier output of either modulator exciter drawer for application to mixing circuits in both transmitters. These circuits are located in the modulator exciter drawers. If the output of the selected modulator exciter

drawer fails due to the application of a modulation failure alarm signal or any other equipment malfunction, the modulator switchover and power divider drawer switches to the second modulator exciter drawer.

(c) The 70 mc subcarrier output selected by the modulator switchover and power drawer is applied to the mixing circuits in the modulator exciter drawers of both transmitters. In these circuits, the 70 mc subcarrier is mixed with a locally-generated 2.27 to 2.43 gc signal to produce a 2.2 to 2.5 gc fm carrier. The fm carrier produced in each modulator exciter drawer is applied to the associated frequency multiplier drawer for frequency doubling. The 1 watt, 4.4 to 5.0 gc fm carrier produced by the frequency multiplier drawer in transmitter A is applied to the vertically polarized feedhorn on antenna A; the fm carrier produced by the frequency multiplier drawer in transmitter B is applied to the horizontally polarized feedhorn on antenna B. The locally generated 2.27 to 2.43 gc signals of both transmitters are frequency locked by the local oscillator cross connect cable. Loss of lock is detected by the lock alarm detector in the transmitter and activates the alarm bell. Duplexer A and B, connected between the associated transmitters and antenna feedhorns, permit the transmitters and dual receivers A and B to share common feedhorns. Each duplexer also monitors the power reflected by the associated antenna feedhorn and produces a vswr alarm signal when the reflected power is excessive. The vswr alarm signal is applied to the central equipment where it lights the appropriate switch-indicator, actuates the alarm bell, and is summarized with all other alarm signals to produce the maintenance control center summary alarm signal.

(3) Radio equipment alarm signal paths. The basic flow of the radio equipment alarm signals is similar to that described for the 1 kw, quadruple-diversity shelter configurations (a (3), above). Omit the power amplifier alarm signals and add the vswr alarm signals.

(4) Utility equipment alarm signal paths. The basic flow of the utility equipment alarm signals is identical to that described for the 1 kw, quadruple-diversity shelter configurations (a (4), above).

c. 1 Watt Dual Diversity Shelter Configurations. The 1 watt, dual-diversity shelter configurations (Radio Equipment Shelters NUS 6060-6 and -22) are used only for line-of-sight links. The basic signal paths are shown in figure24 and described in (1) through (4), below.

(1) Received signal path.

(a) The 4.4 to 5.0 gc fm carrier signals received by the horizontally polarized feedhorn on antenna and the vertically polarized feedhorn on antenna B are applied to the A and B inputs of the dual receiver, respectively. Duplexers A and B permit the dual receiver and transmitters A and B to share common feedhorns.

- (b) The fm carrier signal applied to each dual receiver input is converted to an intermediate frequency (70 mc for Radio Equipment Shelter NUS 6060-6 or 70 and 9.8 mc for Radio Equipment Shelter NUS 6060-22) and combined in a diversity combining circuit prior to demodulation. The combined if. output is applied to two demodulators, producing two redundant composite baseband outputs. The composite baseband outputs are applied to the central equipment. At this point, the basic signal flow is identical to that described for the 1 kw, quadruple-diversity shelters (a (1) (c) through a (1) (e). above). Substitute Radio Equipment Shelter NU-6060-6 for Radio Equipment Shelters NUS 6060-1, -18, and -19 in a (1) (d) and Radio Equipment Shelter NUS 6060-22 for Radio Equipment Shelters NUS 6060-16 and -17 in a (1) (e), respectively.
- (2) Transmitted signal path. The basic flow of the transmitted signal is identical to that described for the 1 watt, quadruple-diversity shelters (b (2), above). Substitute Radio Equipment Shelters NUS 6060-6 and -2 for Radio Equipment Shelters NUS 6060-5 and -23, respectively.
- (3) Radio equipment alarm signal paths. The basic flow of the radio equipment alarm signals is similar to that described for the 1 kw, quadruple-diversity shelters (a (3), above). Omit the power amplifier alarm signals and add the vswr alarm signals.
- (4) Utility equipment alarm signal paths. The basic flow of the utility equipment alarm signal is identical to that described for the 1 kw, quadruple-diversity shelter configurations (a (4), above).
- d. 1 Watt, 10 KW Amplifier Driver Shelter Configuration. The 1 watt, 10 kw amplifier driver shelter configuration (Radio-Equipment Shelter NUS 6060-24) is used only at sites employing the dual 10 kw amplifier van. It provides the excitation for the dual 10 kw amplifier van. The basic signal paths are shown in figure 25 and described in (1) through (4), below.
- (1) Received signal path. The 4.4 to 5.0 gc fm carrier received by the horizontally and vertically polarized feedhorns of antenna A are applied to the B inputs of dual receivers A and B through the circulators in the dual 10 kw amplifier van. The fm carrier signals received by the horizontally and vertically polarized feedhorns of antenna B are applied to the A inputs of dual receivers A and B. At this point, the basic flow of the received signal is identical to that described for Radio Equipment Shelters NUS 6060-1, -18, and -19 (1 kw, quadruple diversity shelter configurations) in a (1) (b) through a (1) (d), above.
- (2) Transmitted signal path. Up to the output of the rf switchover drawer, the basic flow of the transmitted signals is identical to that described for Radio Equipment Shelters NUS 6060-1, -18, and 19 in a (2) (b) through a (2) (e), above except that no power division is made. The output selected by the rf switchover drawer is applied to the dual 10 kw amplifier van. The power divider is supplied in the 10 kw van.

- (3) Radio equipment alarm signal paths. The basic flow of the radio equipment alarm signals is similar to that described for the 1 kw, quadruple-diversity shelter configurations (a (3), above). Omit the power amplifier alarm signals.
- (4) Utility equipment alarm signal paths. The basic flow of the utility equipment alarm signals is identical to that described for the 1 kw, quadruple diversity shelter configurations (a (4), above).

**CHAPTER 5
MAINTENANCE**

Section I. PREVENTIVE MAINTENANCE

Preventive maintenance consists of a series of checks and adjustments that are performed at regular intervals to ensure that the radio equipment shelter will be operational at all times.

PREVENTIVE MAINTENANCE ROUTINES

Cycle	Routine
Daily When possible Monthly Quarterly	Metering checks Cleaning Air filter maintenance Alignment and inspection

42. Metering Checks, Daily

Perform the metering checks required by the preventive maintenance section of the instruction manual for each cabinet in the shelter. Record results in the station log.

43. Cleaning

The equipment should be cleaned whenever it is possible without impairing its traffic carrying ability. When alignment is performed, partial shutdown of the equipment will allow cleaning. The air conditioner and the dehydrator can be shut off for short periods of time without penalty.

44. Air Filter Maintenance

Air filter maintenance is the most important non-electronic routine that is required to assure continuous operation of the equipment. The lack of proper care (cleaning and replacement) of air filters can cause equipment breakdown due to excessive heating, or jamming of rotary controls as a result of dust accumulation. Replace all filters once monthly and the air conditioner filter more often if needed. Clean dirt filters with strong soap, detergent or solvent, dip in SAE 30 oil and drain for 24 hours before reuse.

45. Alignment

Alignment of the equipment in the shelter is performed at initial installation, after replacement of faulty modules and on a routine basis (recommended quarterly). The alignment procedures are covered in chapter 2.

46. Inspection

Inspection is performed on a routine basis and normally should coincide with alignment, as the equipment is partially shut down during alignment. Check mainly for frayed or worn cables, and loose cable connections, as well as for motor shafts that need cleaning or lubrication.

Section II. TROUBLESHOOTING

47. General Troubleshooting Information (fig. 21 through 26)

Radio equipment shelter malfunctions are generally caused by a primary power failure, a failure in the signal from an associated distant site, or an equipment failure within the shelter itself. The troubleshooting information given in a through e and the troubleshooting procedures given in paragraph 49 will assist maintenance personnel in isolating the trouble.

a. Alarm Indications. The radio equipment shelter incorporates an automatic selfcheck alarm system which continuously monitors the operational status of the equipment within the shelter, the antenna tower light and deicer equipment and the signals from associated distant sites. Alarm conditions are displayed on the central alarm panel in the central equipment cabinet. The central alarm panel contains a row of switch-indicators designated XMTR A, XMTR B, RCVR A, RCVR B, RCVR PILOT, DEHYDRATOR, DEICER, TOWER LTS, SPARE, etc. With the exception of those designated SPARE, all switch-indicators monitor the operation of their respective equipments and light red when an equipment malfunction occurs. For example; if the XMTR A switch-indicator lights red, a malfunction has occurred in transmitter A or its associated circuits. This could also indicate a defect in the cabling carrying the alarm information or the alarm circuit. In any case, an alarm condition is indicated by a red light on the applicable switch-indicator and the sounding of a bell after a five second delay. The five second delay inhibits unwarranted alarm conditions caused by transient electrical disturbances and signal path interruptions.

b. Visual Inspection. A careful visual inspection of the shelter may reveal abnormal conditions of the shelter equipment. Interconnecting cables should be inspected for loose connectors or broken connections. Cabinet drawers should remain closed, except for maintenance periods, to ensure proper operating temperatures, and to prevent dust and dirt from accumulating within the cabinets. Air filters should be inspected, cleaned and lubricated regularly to provide dust-free ventilation for operating equipment.

c. Meter Indications. The power amplifiers, transmitters, and receivers are equipped with built-in meters on the front panels and inside the drawers. These meters and their associated selector switches permit stage-by-stage monitoring.

d. Voltage Measurements. Power supply voltages are monitored by setting the front panel meter selector to the appropriate positions and observing the meter indications. Primary power applied to the transmitters and receivers can be monitored by connecting a multimeter to the front panel convenience outlets.

e. Intermittent Troubles. Malfunctions of an intermittent nature may be traced to loose connections, noisy tubes, defective parts, and loose mechanical assemblies. Connectors and wiring should be thoroughly checked for poorly soldered joints, frayed shield wires, or damaged plugs, or sockets. Lightly tapping or jarring tubes and associated circuits may reveal the source of an intermittent condition.

f. Operational Tests. Reference to the troubleshooting tables in the equipment manuals for both normal and abnormal indications will provide valuable troubleshooting assistance. The primary power to the shelter should be maintained within the operating voltages and load conditions specified in the primary power requirements.

48. Test Equipment Required

The test equipment required for troubleshooting is as follows:

Equipment	Type	Military equivalent	Quantity
Multimeter	Simpson 260	TS-352	1
Frequency sensitive voltmeter	Sierra 125-B	ME-275/U	1
Frequency counter	Hewlett-Packard 5243-L	AN/USM-26	1
Frequency counter	Hewlett-Packard 5251-A	MX-1637	1
VTVM	Hewlett-Packard	ME-26/U	1
115-volt, 75-watt incandescent lamp	---	---	1

49. Troubleshooting Procedures

a. Alarm Acknowledgment. When an equipment malfunction occurs, the applicable indicator-switch lights red and a bell sounds after a five second delay. The alarm is acknowledged by pressing the lighted indicator-switch. This action silences the alarm bell and causes the indicator-switch to light yellow. The yellow color indicates that the malfunction has been acknowledged. When the malfunction has been corrected, the indicator-switch lights green and the bell sounds after a five second delay. At this point, the bell is silenced by pressing the indicator-switch again. This action turns off the green indication and restores the alarm circuit to the original state.

b. Procedures

- (1) After the acknowledgment of an equipment malfunction, the maintenance technician is directed to the equipment indicated by the alarm. The first procedure to be performed is an analysis of the front panel alarm indicators on the malfunctioning equipment. A careful analysis of these indicators will expedite troubleshooting. For example; if the POWER OUTPUT FAILURE indicators on both the frequency multiplier and modulator exciter drawers of a transmitter are lit, the logical place to start troubleshooting is in the modulator exciter drawer. Since the frequency multiplier drawer is driven by the modulator exciter drawer, a failure at this point would result in a loss of power in the frequency multiplier drawer. Therefore, valuable time is saved by troubleshooting the modulator exciter drawer.
- (2) Following the isolation of trouble to an equipment drawer or similar functional area, stage-by-stage troubleshooting in accordance with the applicable cabinet instruction book troubleshooting section is initiated. This is accomplished through the use of the built-in meters and their associated selector switches. The performance of each stage is checked by setting the meter selector switch to the appropriate position and observing the meter indication. For example; if a filament of a tube in a stage is burned out, there is no indication of current for that stage. Reference to test data sheets and maintenance records may disclose the cause of the malfunction.

PART TWO

MODULES

GENERAL

This part contains a separate manual for the ancillary items contained in the radio equipment shelter. Each manual contains a general description, a circuit description, and schematic and parts location diagrams. For maintenance data, refer to TM 11-6825-647-14 /1 and 14/2.

This part also contains the appendix, which provides calibration procedures for the translation oscillator.

**DE-ICER CONTROL AND ALARM
NUS 6064-1**

DESCRIPTION

The de-icer control and alarm module NUS 6064-1 controls the application of power to two de-icer units. It also provides alarm circuits for the two de-icer units. It also provides alarm circuits for the two de-icer units. Pertinent characteristics of this module are as follows:

Power Requirement	115 vac, 60 cps
Output	Continuity or open circuit to external circuit
Monitored Deicer Heater Rating, nominal, each	50 watts

CIRCUIT DESCRIPTION (Figures 1 and 2)

The 115 vac, 60 cps input power is applied to TB1-1 and TB1-2 of the de-icer control and alarm module. TB1-2 is strapped to TB1-5 and TB1-8, which are connected to de-icer units A and B, respectively. When POWER switch S1 on the de-icer control and alarm module is placed in the ON position, the power circuits to the two de-icer units are completed. The power circuit for de-icer unit A is from TBI-1 through switch S1 and the primary of transformer T1 to TBI-4. The power circuit for de-icer unit B is from TBI-i through switch S1 and the primary of transformer T2 to TB1-7. Also, when switch S1 is in the ON position, POWER lamp DS1 and limiting resistor R1 are connected across the 115 vac power input causing DS1 to light. As long as power is applied and the de-icer units are operating properly, transformers T1 and T2 couple the voltage required to energize relays K2 and K1. When energized, the relays provide a normal indication to an external circuit. When power is removed or de-icer unit A and/or de-icer unit B are not operating properly the appropriate relay(s) deenergize and an alarm indication is provided.

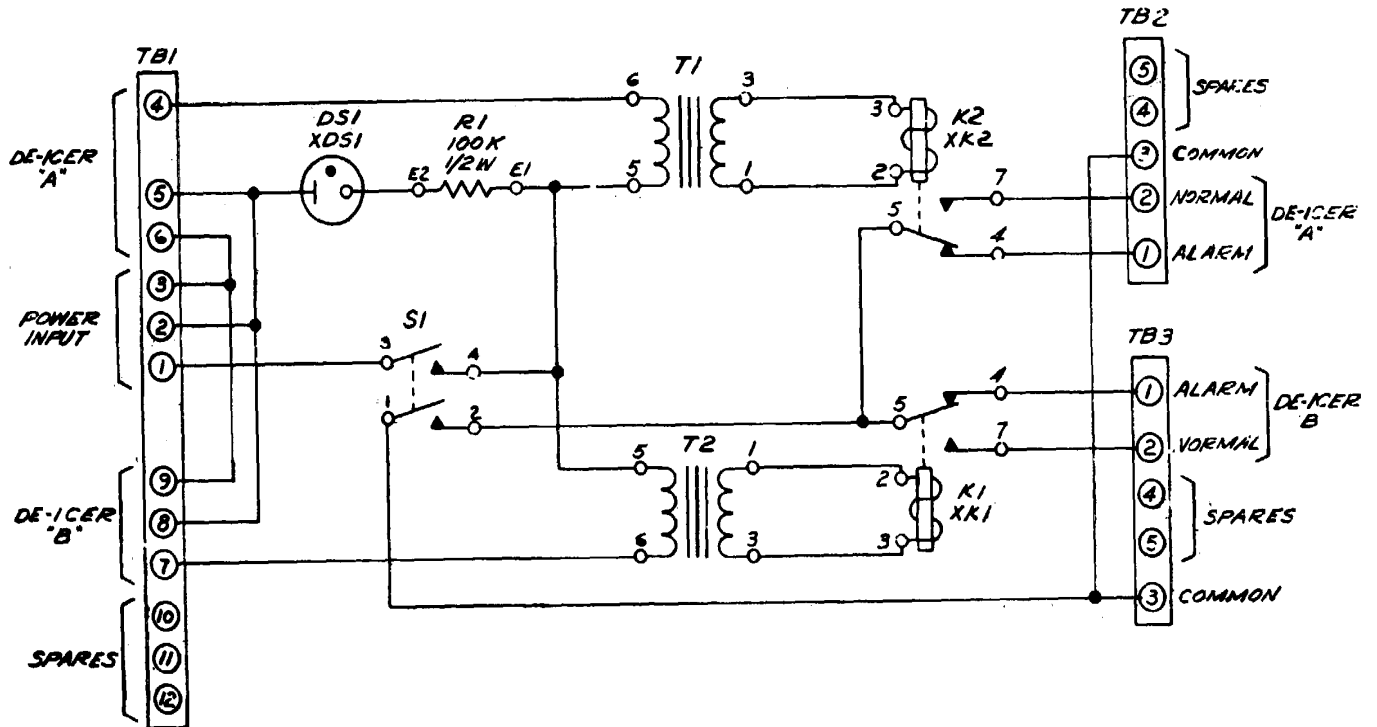


Figure 1. De-Icer Control and Alarm NUS 6064, Schematic Diagram

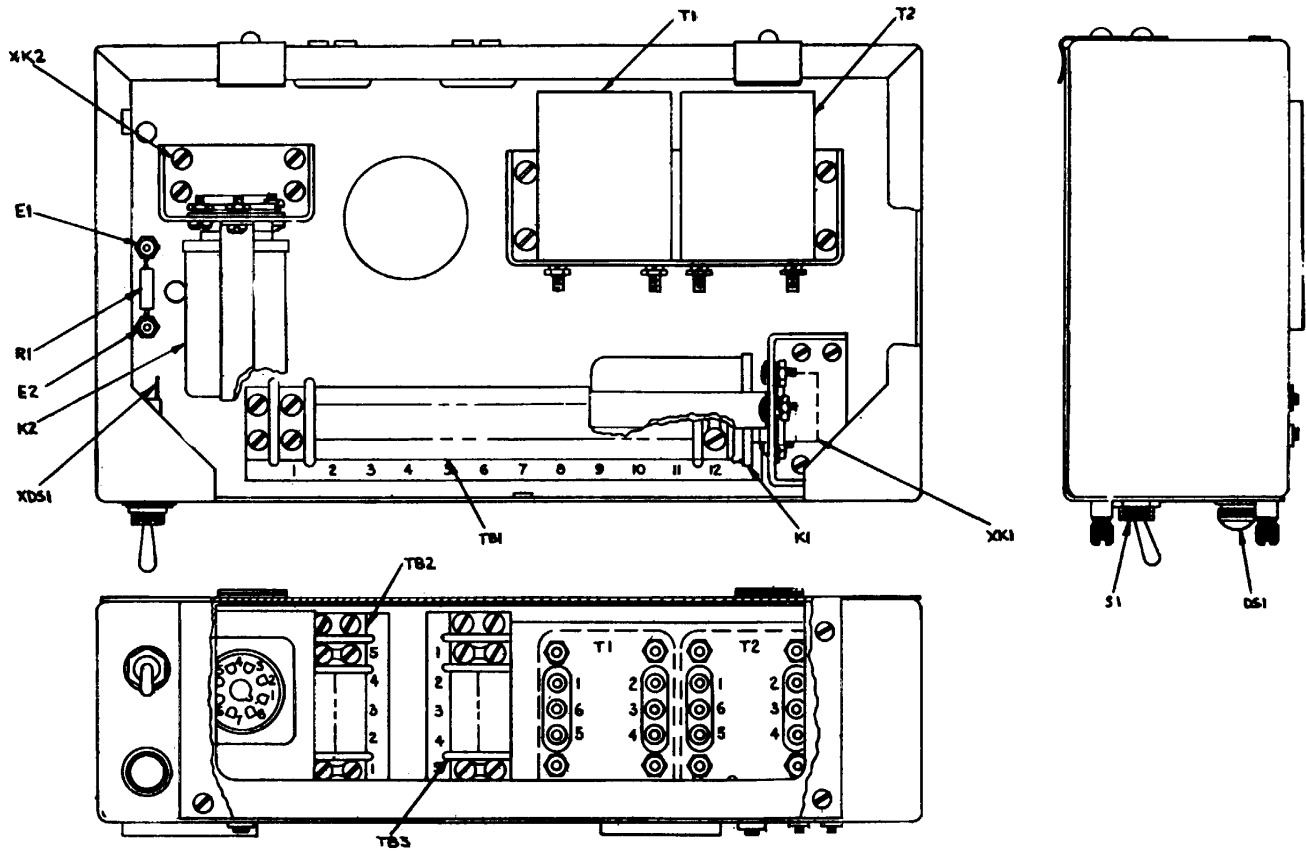


Figure 2. De-Icer Control and Alarm NUS 6064, Parts Location Drawing

RECORDER SYSTEM**NUS 6285****DESCRIPTION**

The recorder system is used in mainline multichannel links, with the NUS 5961 receiver, to provide continuous data on the levels of received carriers before and after combining in the if. system. The recorder system is mounted in a drawer of central equipment cabinet NUS 5972-3. It consists of an Esterline-Angus two-pen recorder 2383028, variable pushbutton attenuator 2383547, if. carrier amplifier NUS 6287, if. filter NUS 8325, baseband noise amplifier NUS 6288, baseband filter NUS 8327, and low voltage power supply 5975-3 (or NUS 8797G1).

CIRCUIT DESCRIPTION (Figures 1 through 4)

Two inputs are provided to the recorder:

1. The if. carrier level before combining is obtained from the output of any one of the if. preamplifiers of a receiver. The signal is attenuated, as required, in the pushbutton attenuator, variable in steps up to 70 db, and applied to the if. carrier amplifier through the if. filter. The if. filter is a 70 me bandpass filter with a bandwidth of 1. 0 mc. The amplified, logarithmic dc output of the 1J. carrier amplifier is applied to one channel of the recorder.

2. The combined carrier levels are obtained at the receiver baseband output, by measuring the receiver baseband out-of-band noise (which is inversely proportional to the combined carrier level). The signal is applied to the baseband noise amplifier through the baseband filter. The baseband filter is a 1050 kc bandpass filter with a bandwidth of 200 kc (950 to 1150 kc). The amplified, logarithmic output of the baseband noise amplifier is applied to the second channel of the recorder.

The recorder output for each channel is recorded on linear chart paper. Each of the 40 small divisions on the chart paper corresponds to a 1 db increment. Comparison of the two recorded outputs enables analysis of channel signal-to-noise ratio, and receiver diversity improvement.

The amplifiers and filters are described in detail in other parts of this section. Refer to the Esterline-Angus instruction manual for a detailed description of the recorder.

VSWR MONITOR ALARM MODULE**NUS 6464-1****DESCRIPTION**

The vswr alarm module continuously monitors the power reflected by an antenna feedhorn and the associated waveguide components. It provides a vswr alarm signal whenever the reflected power is excessive. The module contains two relays (K1 and K2 and a reset pushbutton (S1)).

CIRCUIT DESCRIPTION (Figures 1 and 2)

During normal operation, K1 is energized and K2 is deenergized. Relay K1 is energized by momentarily pressing S1. Relay K1 remains energized through the self-latching path provided by contacts K1-1 and K1-2. The power required to energize K1 is provided by diode CR1 which rectifies the ac voltage applied between contacts J3-A and J3-B. Relay K2 remains deenergized due to the absence of its energizing voltage.

When the associated radio equipment shelter duplexer detects a high vswr due to excessive reflected power, the voltage applied to connector J1 energizes K2 which closes normally-open contacts K2-1 and K2-7. The closure of K2-1 and K2-7 shorts the coil of K1. This action deenergizes K1, closing normally-open contacts K1-6 and K1-8. The closure of K1-6 and K1-8 provides the vswr alarm signal. When the excessive reflected power is no longer detected, switch S1 is pressed to restore the module to the normal operating condition.

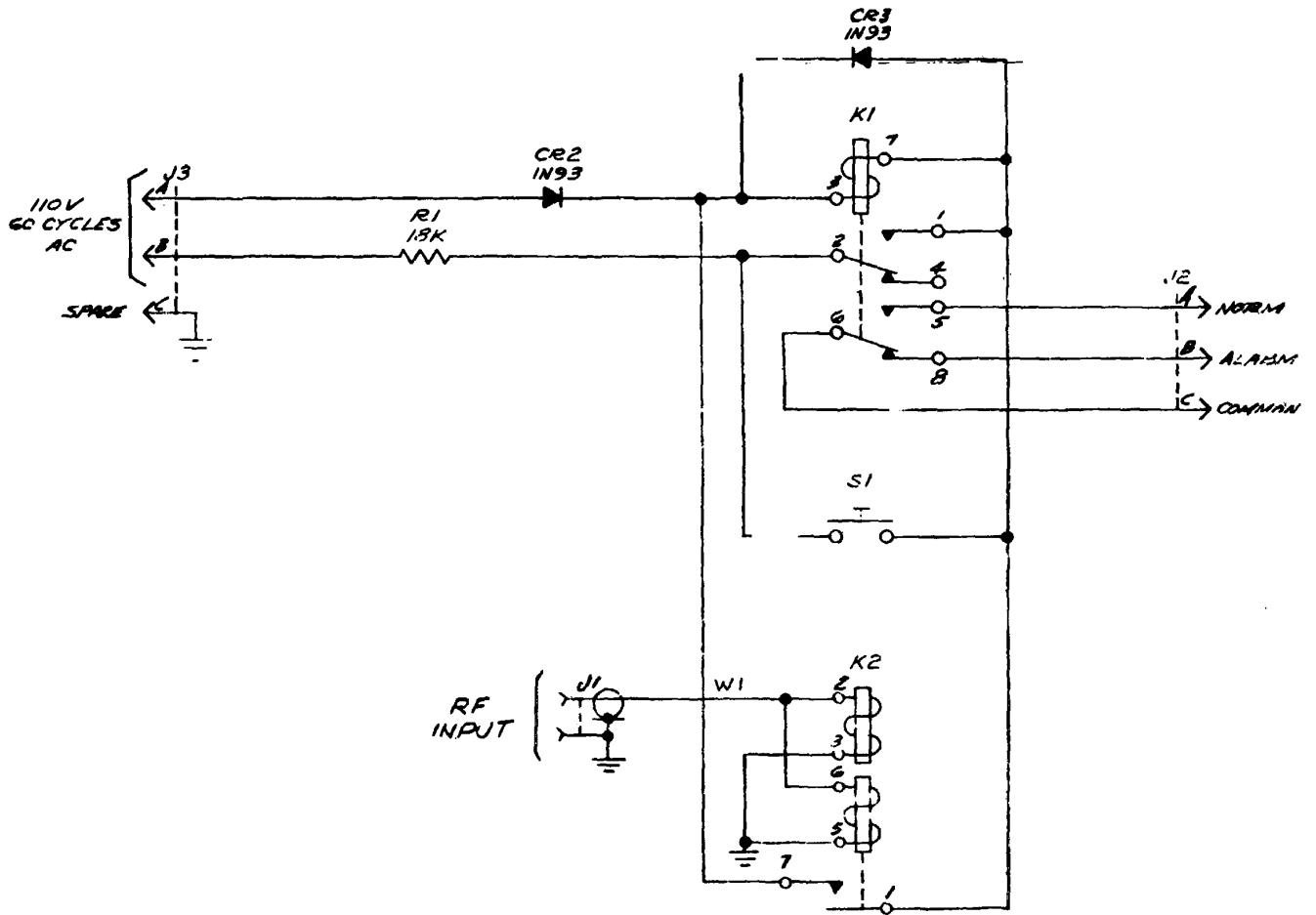


Figure 1. VSWR Monitor Alarm Unit NU8 6464, Schematic Diagram

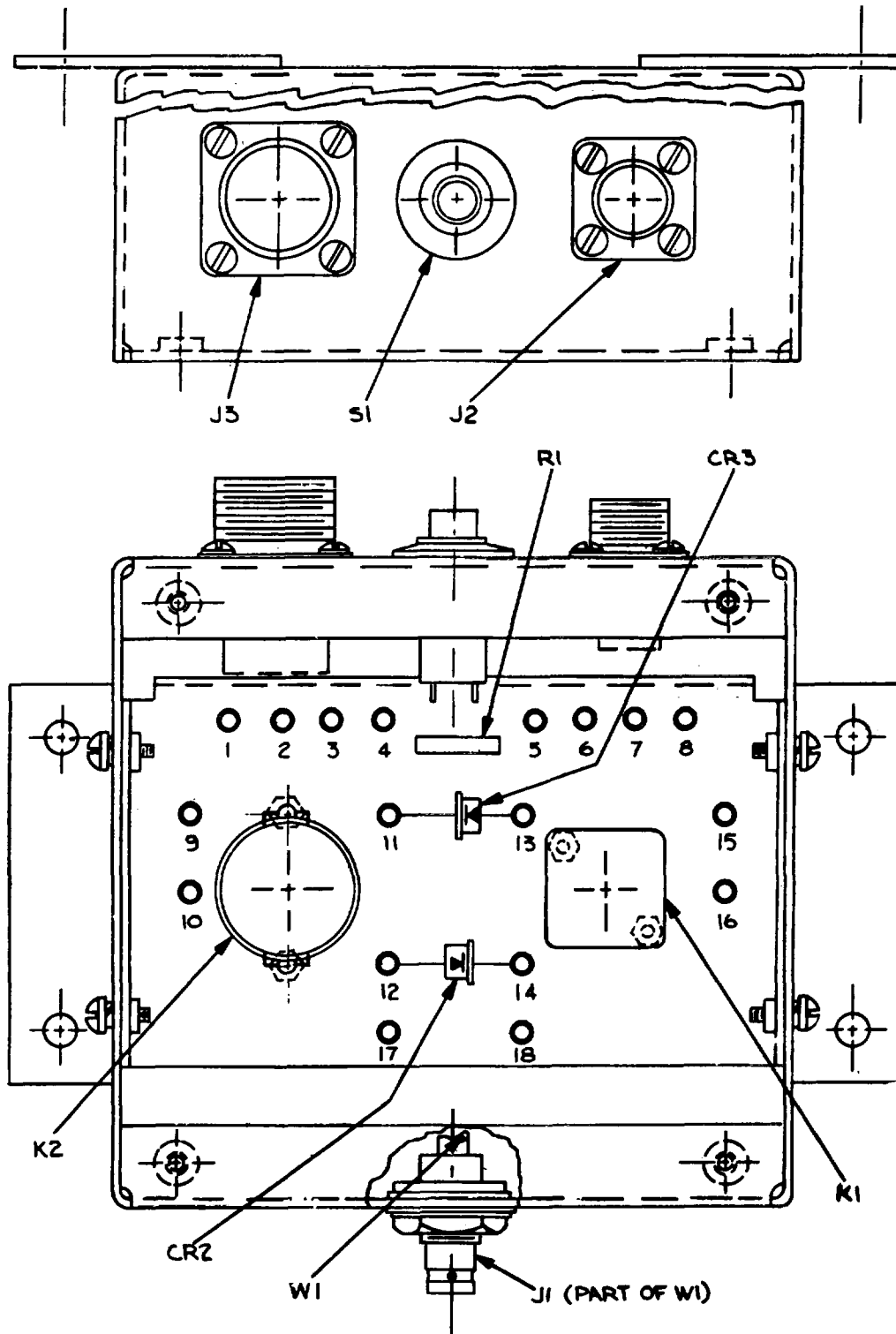


Figure 2. VSWR Monitor Alarm Unit NUB 6464, Parts Location Diagram

APPENDIX

**TRANSLATION OSCILLATOR
CALIBRATION FOR USE IN
TYPE 6060 RADIO SHELTERS**

ITTL D12 (N.) REV. 6/64

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A ORIGINAL ISSUE		REVISIONS	
LTR	DESCRIPTION	DATE	APPROVED
B	REZZANIN DUE TO LOST TRACING J.FAZIO / A.K.	3/25/66	J.P. Wise 6-6-66

SHEET NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
ISSUE LTR.	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B					

NEXT ASSEMBLY	G1	G	G	G	G
USED ON	N156200				

CONTRACT	
DWN W. LEHMAN	5/24/65
CKD W. ANDERSON	7/21/65
APPD. S. PAPANOU	7/26/65
T.R. WISE	7/26/65
760	J 5/6/66
ITTL	

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TRANSLATION OSCILLATOR CALIBRATION FOR USE IN TYPE CO-0 RADIO SHELTERS	
SIZE	CODE IDENT. NO.
A	90348
2385774	
SCALE	SHEET 1 OF 19

GOILVIE PRESS, INC., BROOKLYN 17, N. Y. REPROVAL NO. 4404

TEST EQUIPMENT REQUIREMENTS

TEST EQUIPMENT

QTY	PART NUMBER	DESCRIPTION
1	618B	SIGNAL GENERATOR, HEW-PACKARD
1	541A	OSCILLOSCOPE, TEKTRONIX
1	TYPE L	FAST RISE, HIGH GAIN UNIT, TEKTRONIX
1	430C	POWER METER, HEW-PACKARD
1	TF1225A	NOISE RECEIVER, MARCONI
1	2565A	FREQUENCY COUNTER, CMC
1	G101	ATTENUATOR, WAVEGUIDE, VARIABLE, PRO
1	NUS 6633	TRANSLATION OSCILLATOR, ITTFL

AUXILIARY EQUIPMENT

QTY	PART NUMBER	DESCRIPTION
3	G281A	ADAPTER, WAVEGUIDE TO COAX, HEW-PACKARD
1	UG-29B/U	ADAPTER, STRAIGHT, TYPE N, (F-F)
1	UG-914/U	ADAPTER, STRAIGHT, BNC, (F-F)
1	1699	ADAPTER, UHF TO BINDING POSTS, POMONA
1	AB-10N	ATTENUATOR, FIXED COAX, 10 DB, MICRO-LAB
1	AB-20N	ATTENUATOR, FIXED COAX, 20 DB, MICRO-LAB
2*	B2334876G1	RESISTOR TERMINATED BNC PLUG.(75 OHMS)
2*	B2334876G2	RESISTOR, TERMINATED, BNC PLUG (150 OHMS)
3	C2334895G1	50 OHMS, TERMINATED, TYPE N PLUG
1	477B	THERMISTOR MOUNT, HEW PACKARD
2	B2334494G1	TEST CABLE (RG218/U TYPE N PLUG ON BOTH ENDS)
3	B2334494G2	TEST CABLE (RG218/U, TYPE N PLUG ON BOTH ENDS)
1	B2334494G3	TEST CABLE (RG218/U, TYPE N PLUG ON BOTH ENDS)
1	B2336243G1	TEST CABLE (BNC PLUG-RG59B/U-BNC PLUG)
1	B2336245G1	TEST CABLE (RG59B/U, BNC PLUG ON BOTH ENDS)
2	B2336245G2	TEST CABLE (RG59B/U, BNC PLUG ON BOTH ENDS)
1**	B2386770G1	UNIT, 2ND MIXER LO FILTER BYPASS
1	UG-419 B/U	ADAPTER, STRAIGHT, BNC (M-M)

NOTES:

- * USE THE 75 OHM BNC PLUG FOR SINGLE CONVERSION RECEIVER, AND THE 150 OHM BNC PLUG FOR DOUBLE CONVERSION RECEIVERS.
- ** REQUIRED FOR DOUBLE CONVERSION RECEIVERS ONLY.

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PREPARED BY C. JOYCE	DATE 7/19/65	SIZE A	CODE IDENT. NO. 90348	2385774
CHECKED BY W. ANDERSON	DATE 7/27/65			SHEET 2B

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TRANSLATION OSCILLATOR CALIBRATION FOR USE IN TYPE C060 RADIO SHELTERS:

1.0 PRELIMINARY

1.1 THE RECEIVER CABINET, TRANSMITTER CABINET, TRANSLATION OSCILLATOR, HP618B SIGNAL GENERATOR, AND ASSOCIATED TEST EQUIPMENT SHALL HAVE BEEN IN OPERATION TWO HOURS PRIOR TO CONDUCTING TESTS.

1.2 PRIOR TO STARTING ANY CALIBRATION, CHECK AND MAKE SURE THAT THE RECEIVER CRYSTAL OSCILLATOR, THE RECEIVER SECOND MIXER LOCAL OSCILLATOR (FOR DOUBLE CONVERSION RECEIVERS ONLY), THE TRANSMITTER MODULATOR, THE TRANSMITTER CRYSTAL OSCILLATOR AND THE TRANSLATION OSCILLATOR CRYSTAL OSCILLATOR ARE SET TO THEIR SPECIFIED FREQUENCIES.

1.3 THE ETA SYSTEM SHELTER TRANSMITTER-RECEIVER FREQUENCY SEPARATION WILL VARY FROM 100 MC TO 120 MC. THEREFORE, THE SEPARATION IN A PARTICULAR SHELTER MUST BE DETERMINED, THE PROPER T.O. OSCILLATOR-TRIPLER CRYSTAL MUST BE OBTAINED, AND THE T.O. TUNED, PRIOR TO PROCEEDING WITH THE ALIGNMENT. THE CALIBRATION CURVES OBTAINED FROM THIS SPECIFICATION ARE VALID ONLY FOR THE PARTICULAR T.O. CRYSTAL USED IN CALIBRATION. THE T.O. MUST BE RECALIBRATED FOR EACH NEW CRYSTAL.

1.4 THE PROCEDURES OUTLINED BELOW UTILIZE RECEIVER A1 AS THE CALIBRATION CHANNEL. IF ANOTHER CHANNEL IS USED FOR CALIBRATION, APPROPRIATE CHANGES IN CONNECTIONS MUST BE MADE.

2.0 INITIAL SET-UP PROCEDURE

2.1 QUAD RECEIVER

2.1.1 ON THE CEC SWITCHING UNIT, SET THE AUTO/MAN SWITCH TO MAN AND THE SEL SWITCH TO THE "B" RECEIVER WHICH WILL CARRY TRAFFIC.

2.1.2 IN BOTH RECEIVER CABINETS, PLACE THE AGC DUAL/QUAD SWITCH TO DUAL.

2.1.3 DISCONNECT THE QUAD DIVERSITY CROSS-CONNECT CABLE BETWEEN THE TWO CABINETS AND TERMINATE THE CROSS-CONNECT JACKS WITH ONE OF THE FOLLOWING RESISTOR TERMINATED BNC PLUGS:

- B2334876G1 - 75 OHMS SINGLE CONVERSION RECEIVERS
- B2334876G2 - 150 OHMS DOUBLE CONVERSION RECEIVERS

2.2 DUAL RECEIVER

2.2.1 ON THE CEC SWITCHING UNIT, SET THE AUTO/MAN SWITCH TO MAN, AND THE SEL SWITCH TO "A" CHANNEL, WHICH IS TO BE USED FOR THE T.O. ALIGNMENT.

2.2.2 IN THE RECEIVER CABINET, DISCONNECT THE IF AMPLIFIER OUTPUT AT J16 OF THE "B" CHANNEL, WHICH WILL CARRY TRAFFIC, AND USING RG59 TEST CABLE B2336245G1 CONNECT J16 DIRECTLY TO ANCILLARY DRAWER INPUT J1.

2.2.3 SET THE CHANNEL "B" IF AGC SWITCH TO INTERNAL.

2.2.4 ON THE CEC SWITCHING UNIT, SET THE SEL SWITCH TO CHANNEL "B".

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3.0 SINGLE GENERATOR CALIBRATION

3.1 DISCONNECT THE RECEIVER AT WAVEGUIDE INPUT AT THE QUICK DISCONNECT FITTING LOCATED AT THE WAVEGUIDE BENDS ON THE TOP OF THE RECEIVER. CONNECT A WAVEGUIDE TO COAXIAL ADAPTER ON THE RECEIVER SIDE WAVEGUIDE.

3.2 FOR MULTICHANNEL RECEIVERS ONLY

PULL OUT THE PRESELECTOR AND MIXER DRAWER OF RECEIVER A. IF THERE ARE IF FILTERS PRESENT, BYPASS THE A1 RECEIVER IF FILTER BY USING A BNC UG-914/U ADAPTER.

3.3 FOR SINGLE CHANNEL RECEIVERS ONLY

PULL OUT THE IF AND BASEBAND DRAWER OF RECEIVER A. DISCONNECT THE A1 9.8 MC FILTER FROM THE 2ND MIXER LO, AND INSERT A 2ND MIXER LO FILTER BY-PASS UNIT 2386770 BETWEEN THE 2ND MIXER LO FILTER CABLES AS SHOWN IN FIGURE 9.

3.4 CONNECT THE RECEIVER A1 CHANNEL INPUT TO THE SIGNAL GENERATOR BY MEANS OF A B2334494G2 TEST CABLE AS SHOWN IN FIGURE 1.

3.5 CONNECT AN OSCILLOSCOPE TO THE BASEBAND OUT JACK OF RECEIVER "A", AS SHOWN IN FIGURE 2.

3.6 FOR QUAD RECEIVERS ONLY, DISCONNECT THE IF OUTPUT AT J16 OF IF AMPLIFIER A2.

3.7 ADJUST THE SIGNAL GENERATOR FOR AN OUTPUT OF APPROXIMATELY -75 DBM.

3.8 SLOWLY TUNE THE SIGNAL GENERATOR IN THE VICINITY OF THE OPERATING FREQUENCY TO OBTAIN BEST NOISE QUIETING, SUCH THAT MINIMUM NOISE IS OBSERVED ON THE OSCILLOSCOPE. CHECK THE SIGNAL GENERATOR FREQUENCY DIAL AND MAKE SURE THAT THIS IS NOT THE RECEIVER IMAGE FREQUENCY.

3.9 DISCONNECT THE SIGNAL GENERATOR OUTPUT CABLE FROM THE RECEIVER INPUT. CONNECT THE CABLE TO A POWER METER, AS SHOWN IN FIGURE 3.

3.10 TO CALIBRATE THE SIGNAL GENERATOR, SET "MOD SELECTOR" TO "OFF" AND ADJUST "ZERO SET" KNOB SO THAT "POWER SET" METER NEEDLE IS EXACTLY OVER THE "ZERO SET" INDEX LINE ON THE METER. PLACE "MOD SELECTOR" SWITCH TO THE "CW" POSITION AND ADJUST "POWER SET" METER TO 0 DBM POSITION BY MEANS OF THE "POWER SET" CONTROL.

3.11 SET THE SIGNAL GENERATOR "OUTPUT ATTENUATOR" FOR MINIMUM SIGNAL, APPROXIMATELY -125 DBM AND ADJUST THE POWER METER BIAS FOR ZERO ON THE 1 MW SCALE.

3.12 SET THE SIGNAL GENERATOR OUTPUT ATTENUATOR FOR 0 DBM ON THE POWER METER.

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SIZE A	CODE IDENT. NO. 90348
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NOTE: DUE TO AGING OR OUTPUT CABLE LENGTH, IT MAY NOT BE POSSIBLE TO GENERATE 0 DBM FROM THE SIGNAL GENERATOR. IN THIS CASE SOME OTHER LESSER VALUE MAY BE USED FOR CALIBRATION SUCH AS -3 DBM OR -5 DBM.

3.13 SIMULTANEOUSLY ADJUST "OUTPUT ATTEN" AND "POWER SET" ON THE SIGNAL GENERATOR, KEEPING 0 DBM ON THE ATTENUATOR DIAL UNDER THE INDEX MARK. ADJUST FOR A 0 DBM READING ON THE POWER METER.

3.14 STEPS 3.10 THROUGH 3.13 MAY HAVE TO BE REPEATED SEVERAL TIMES BECAUSE OF DRIFT IN THE POWER METER ZERO ADJUST.

3.15 RECORD THE SIGNAL GENERATOR POWER SET METER READING ON TABLE 3.

3.16 UPON COMPLETION OF THIS CALIBRATION, THE SIGNAL GENERATOR OUTPUT ATTENUATOR WILL INDICATE DIRECTLY IN -DBM SO LONG AS THE SAME OUTPUT CABLE IS USED AND THE POWER SET METER INDICATES THE SAME VALUE AS THAT RECORDED AT CALIBRATION.

4.0 RECEIVER CARRIER LEVEL DATA

NOTE: SEE STEP 1.2

4.1 SET THE SIGNAL GENERATOR ATTENUATOR FOR AN OUTPUT OF -40 DBM.

4.2 CONNECT THE SIGNAL GENERATOR OUTPUT CABLE TO THE RECEIVER AS SHOWN IN FIGURE 1.

4.3 DISCONNECT THE RG59 CABLE FROM THE IF OUTPUT 1 JACK ON THE PRE-SELECTOR-MIXER DRAWER FRONT PANEL AND CONNECT A FREQUENCY COUNTER TO THIS JACK AS SHOWN IN FIGURE 4.

4.4 VERY SLOWLY TUNE THE SIGNAL GENERATOR FREQUENCY TO OBTAIN 70 MC ± 10 KC AT THE IF OUTPUT 1 JACK. DISCONNECT THE FREQUENCY COUNTER FROM THE IF JACK.

4.5 RECONNECT THE RG59 CABLE DISCONNECTED IN STEP 4.3, TO THE IF OUTPUT 1 JACK ON THE PRESELECTOR-MIXER DRAWER.

4.6 SET THE SIGNAL GENERATOR FOR AN OUTPUT OF -85 DBM.

4.7 CONNECT A MARCONI NOISE RECEIVER TO THE RECEIVER BASEBAND OUT JACK, AS SHOWN IN FIGURE 5.

4.8 SET THE NOISE RECEIVER SLOT SELECTOR TO THE LOWEST BAND SLOT.

4.9 SET THE NOISE RECEIVER ATTENUATOR TO 60 DB, THAT IS, 40 DB ON THE 20 DB STEP CONTROL AND 20 DB ON THE 1 DB STEP CONTROL.

4.10 ADJUST THE NOISE RECEIVER SENSITIVITY FOR A MID-SCALE READING OF 50 ON THE NOISE RECEIVER METER. NOTE: THE SENSITIVITY ADJUSTMENT ON THE NOISE RECEIVER MUST NOT BE CHANGED UNTIL THE T.O. CALIBRATION HAS BEEN COMPLETED.

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- 4.11 RECORD THE SIGNAL GENERATOR OUTPUT OF STEP 4.6 AND NOISE RECEIVER ATTENUATOR SETTING OF STEP 4.9 ON TABLE 1.
- 4.12 ADJUST THE SIGNAL GENERATOR OUTPUT ATTENUATOR FOR A SIGNAL LEVEL OF -80 DBM.
- 4.13 ADJUST THE NOISE RECEIVER ATTENUATOR TO AGAIN OBTAIN A MIDSCALE READING OF 50 ON THE NOISE RECEIVER METER. RECORD NOISE RECEIVER ATTENUATOR READING IN SPACE PROVIDED ON TABLE 1.
- 4.14 REPEAT STEPS 4.12 THROUGH 4.13 FOR SIGNAL LEVELS OF -70 DBM, -60 DBM AND -55 DBM. RECORD RESULTS ON TABLE 1.
- 4.15 DISCONNECT THE SIGNAL GENERATOR CABLE FROM THE RECEIVER.
- 5.0 T.O. CALIBRATION
- NOTE: SEE STEP 1.2
- 5.1 CONNECT THE EQUIPMENT AS PER FIGURE 6
- 5.2 ADJUST WAVEGUIDE VARIABLE ATTENUATOR FOR 30 DB.
- 5.3 DISCONNECT THE RG59 CABLE FROM THE IF OUTPUT 1 JACK ON THE PRESELECTOR AND MIXER DRAWER OF RECEIVER A. CONNECT A FREQUENCY COUNTER TO THE IF OUTPUT 1 JACK OF THE PRESELECTOR-MIXER DRAWER AS SHOWN IN FIGURE 4, IT SHOULD READ 70 MC, ±10 KC. IF NOT, RE-CHECK ALL FREQUENCIES. NOTE: IT MAY BE NECESSARY TO BYPASS THE 10 DB FIXED ATTENUATOR AND/OR SET THE T.O. VARIABLE ATTENUATOR TO MINIMUM ATTENUATION IN ORDER TO HAVE A HIGH ENOUGH LEVEL TO DRIVE THE COUNTER.
- 5.4 DISCONNECT THE FREQUENCY COUNTER FROM THE IF JACK AND RE-CONNECT THE RG59 CABLE, DISCONNECTED IN STEP 5.3, TO THE IF OUTPUT 1 JACK ON THE PRESELECTOR-MIXER DRAWER.
- 5.5 ADJUST THE NOISE RECEIVER ATTENUATOR FOR 60 DB. (SEE STEPS 4.9 AND 4.10)
- 5.6 ADJUST THE T.O. INTERNAL COAXIAL ATTENUATOR TO OBTAIN A MID-SCALE READING OF 50 ON THE NOISE RECEIVER METER.
- 5.7 SET THE WAVEGUIDE VARIABLE ATTENUATOR FOR 25 DB.
- 5.8 ADJUST THE NOISE RECEIVER ATTENUATOR TO OBTAIN A MID-SCALE READING OF THE NOISE RECEIVER METER. THE ATTENUATION SHOULD BE THE SAME, ±0.5 DB, AS THAT OBTAINED IN STEP 4.13 FOR A CARRIER LEVEL OF -80 DBM. RECORD IN TABLE 2.

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5.9 REPEAT STEP 5.8 WITH THE WAVEGUIDE VARIABLE ATTENUATOR SET TO 15, 5 AND 0 DB. THE NOISE RECEIVER ATTENUATION SHOULD BE THE SAME WITHIN ± 0.5 DB, AS THAT OBTAINED IN STEP 4.14 FOR CARRIER LEVELS OF -70, -60, AND -55 DBM, RESPECTIVELY. RECORD IN TABLE 2.

5.10 IF REQUIRED, READJUST THE T.O. VARIABLE ATTENUATOR AND REPEAT THE CALIBRATION UNTIL THE READINGS ON THE NOISE RECEIVER ATTENUATOR MATCH THE SETTINGS IN STEPS 4.9, 4.13, AND 4.14 WITHIN ± 0.5 DB.

5.11 A CHART SHOULD NOW BE PLOTTED ON FIGURE 7 USING THE VALUES RECORDED IN TABLE 2. FIGURE 8 SHOWS A TYPICAL EXAMPLE OF CALIBRATION CURVE.

5.12 THE T.O. IS NOW CALIBRATED. DESIRED SIGNAL LEVELS MAY NOW BE GENERATED BY SETTING THE VARIABLE ATTENUATOR IN ACCORDANCE WITH THE CALIBRATION CHART, SHOWN IN FIGURE 10.

5.13 TO INSURE STABLE CONDITIONS, THE METER READINGS LISTED ON TABLE 3 SHOULD BE TAKEN AND RECORDED.

6.0 EQUIPMENT RESTORATION

6.1 DISCONNECT AND REMOVE ALL TEST EQUIPMENT.

6.2 RESTORE THE WAVEGUIDE CONNECTION WHICH WAS OPENED IN STEP 3.1.

6.3 IN MULTICHANNEL RECEIVERS, RESTORE THE IF FILTER WHICH WAS BYPASSED IN STEP 3.2

6.4 FOR SINGLE CHANNEL RECEIVERS, RESTORE THE 9.8 MC FILTER WHICH WAS BYPASSED IN STEP 3.3.

6.5 QUAD RECEIVER

6.5.1 RECONNECT THE IF OUTPUT AT J16 OF THE IF AMPLIFIER A2 WHICH WAS DISCONNECTED IN STEP 3.6.

6.5.2 REMOVE THE TWO TERMINATING RESISTORS AND RECONNECT THE IF CROSS-CONNECT CABLE BETWEEN THE TWO DRAWERS WHICH WAS DISCONNECTED IN STEP 2.1.3

6.5.3 IN BOTH RECEIVER CABINETS, RESET THE AGC DUAL/QUAD SWITCH TO "QUAD".

6.5.4 ON THE CEC SWITCHING UNIT FOR THE CALIBRATION CHANNEL, RESET THE SEL SWITCH TO THE "A" RECEIVER AND THE AUTO/MAN SWITCH TO AUTO.

6.6 DUAL RECEIVER

6.6.1 ON THE CEC, RESET THE SELECT SWITCH TO CHANNEL "A".

6.6.2 RESET CHANNEL "B" IF AGC SWITCH TO EXTERNAL.

6.6.3 DISCONNECT THE RG59 TEST CABLE B2336245G1 BETWEEN J16 & ANCILLARY DRAWER INPUT J1 WHICH WAS CONNECTED IN STEP 2.2.2. RECONNECT THE IF AMPLIFIER AT J16 OF THE "B" CHANNEL.

6.6.4 ON THE CEC SWITCHING UNIT, RESET THE AUTO/MAN SWITCH TO "AUTO" AND THE SEL SWITCH TO "A" CHANNEL.

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CHECKED BY W. ANDERSON	DATE 7/27/65			SHEET 7 B

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ADAPTER, WAVEGUIDE TO COAX, HP G281A

TEST CABLE
B2334494G2
(CAL STANDARD)

SIGNAL GENERATOR
HP 618B

RF OUTPUT

RF INPUT #1

RF INPUT #2

PRESELECTOR & MIXER

RF INPUT #1

RF INPUT #2

DUAL RCVR CABINET

FIGURE 1
SIGNAL GENERATOR HOOK-UP TO RECEIVER

PREPARED BY
C. JOYCE 7-19-65

CHECKED BY
W. ANDERSON 7-25-65

SIZE
A

CODE IDENT. NO.
90348

2385774

SHEET 8 8

ITEL DIS (N) - V REV 6 64

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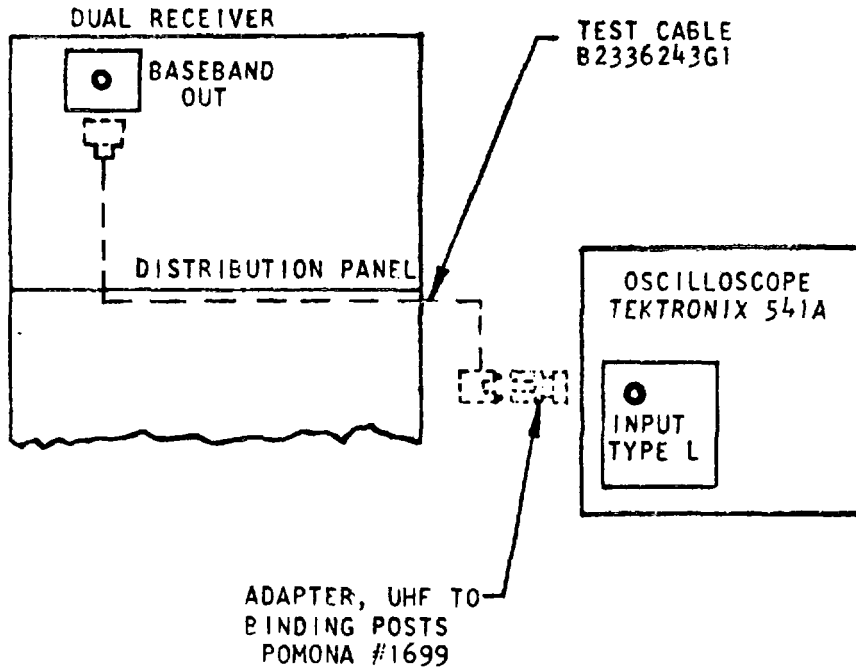


FIGURE 2
OSCILLOSCOPE HOOK-UP TO RECEIVER

PREPARED BY
W. LEHMAN 5-24-65

CHECKED BY
W. ANDERSON 7-27-65

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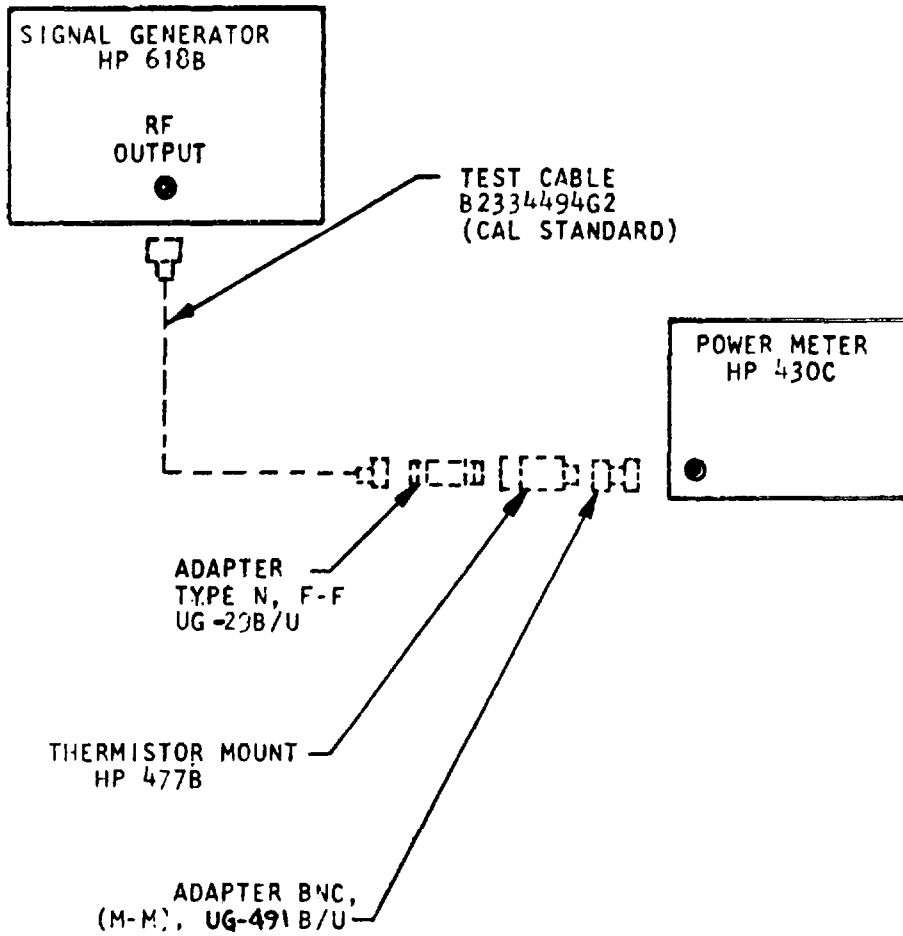


FIGURE 3
SIGNAL GENERATOR HOOK-UP TO POWER METER

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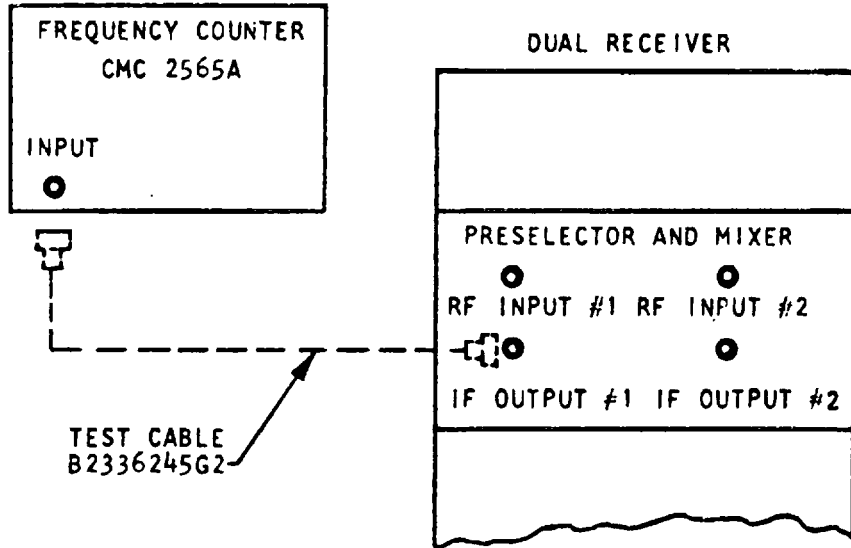


FIGURE 4
FREQUENCY COUNTER HOOK-UP TO RECEIVER

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CHECKED BY W. ANDERSON 7-27-65			SHEET 11B

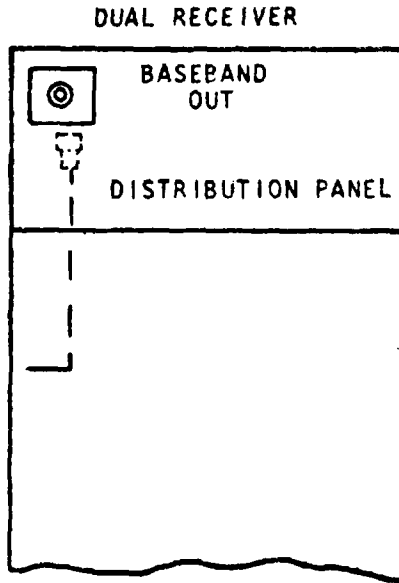
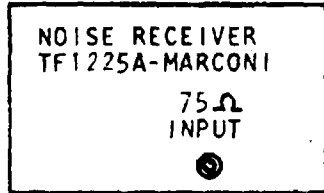
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TEST CABLE
B2336245G2



FIGURE 5

NOISE RECEIVER HOOK-UP TO RECEIVER

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CHECKED BY
W. ANDERSON 7/27/65

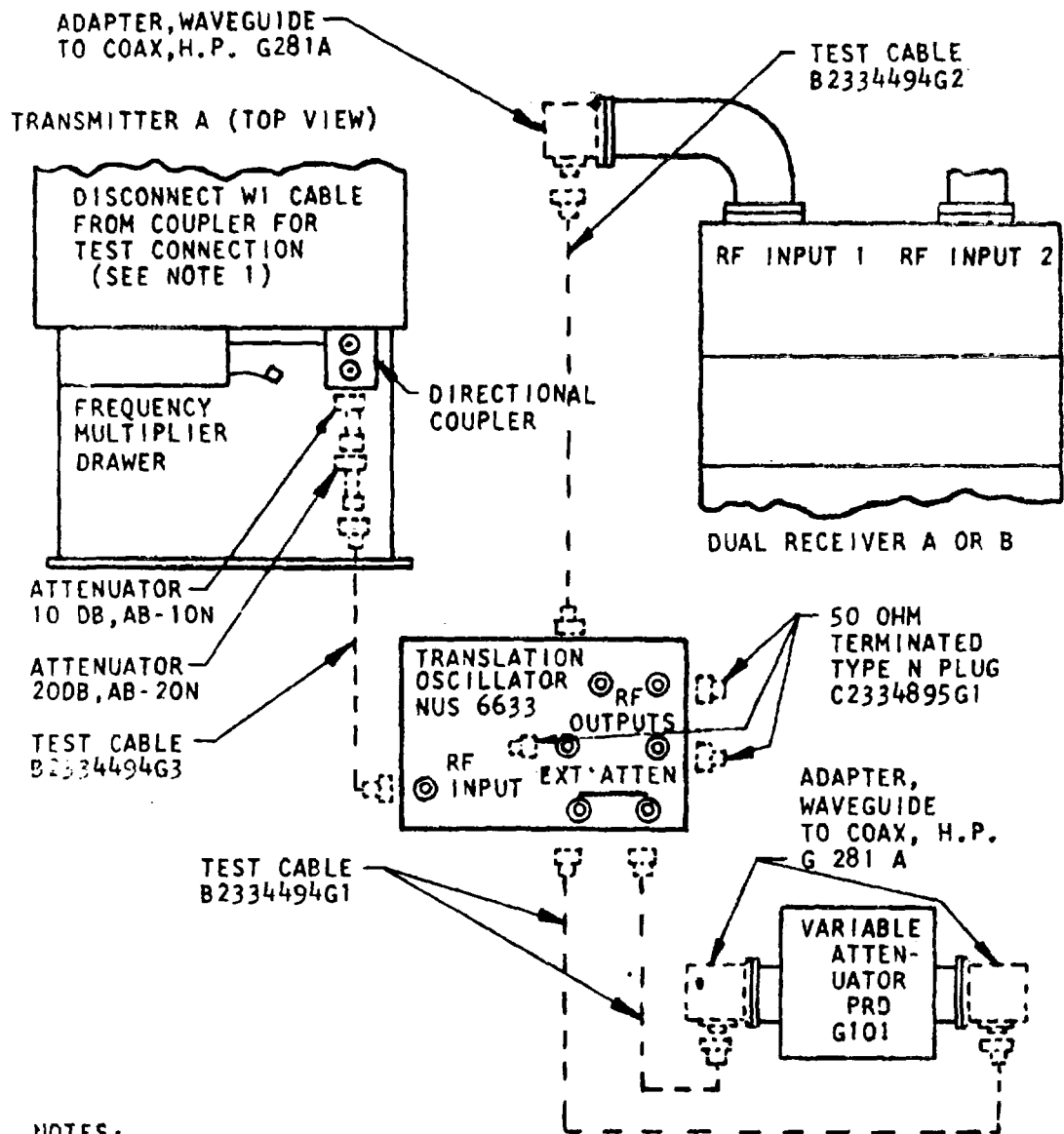
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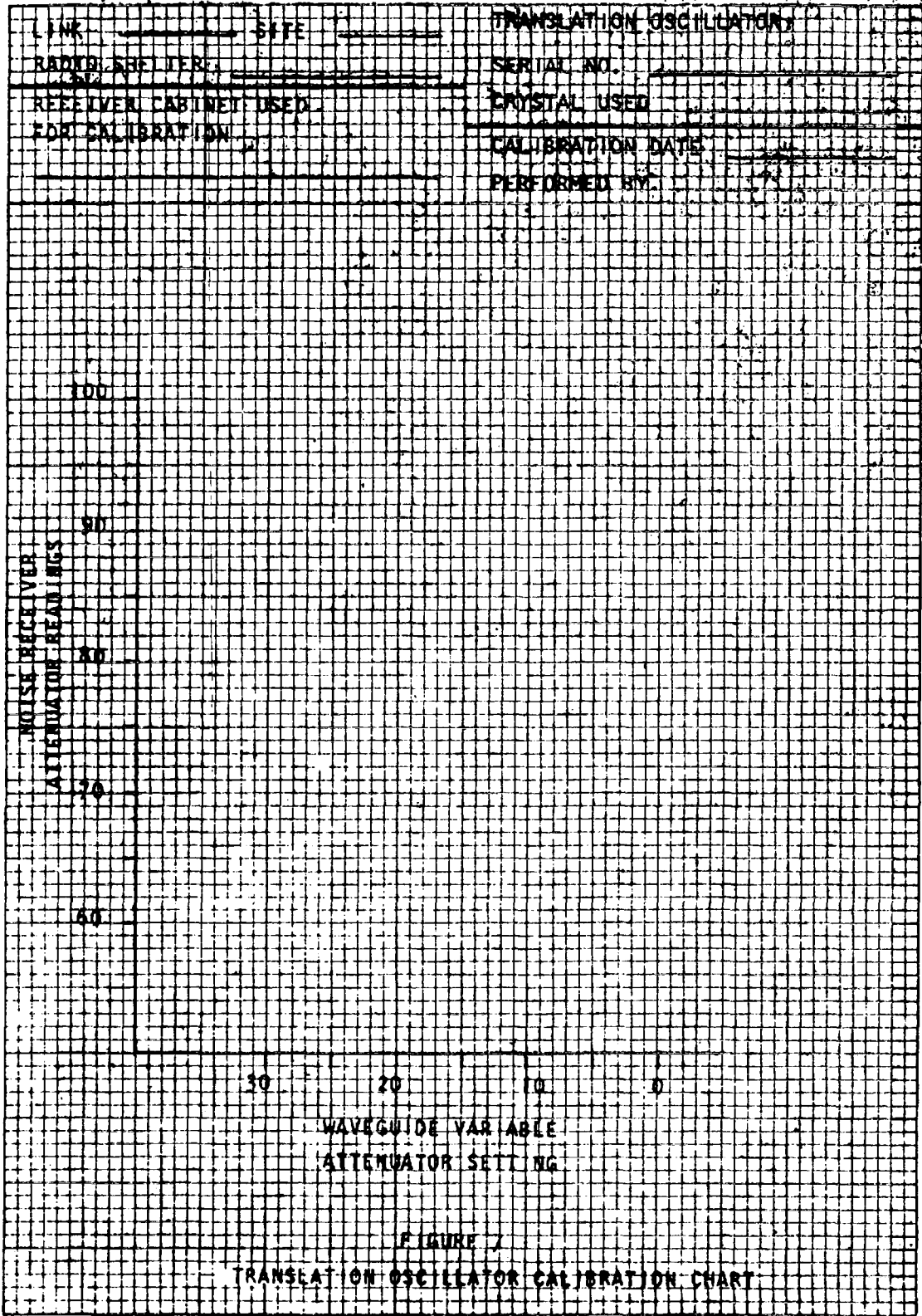


- NOTES:
1. DIRECTIONAL COUPLER IN TRANSMITTER FREQUENCY MULTIPLIER DRAWER MAY HAVE 3 PORTS. THEREFORE, USE 3RD. PORT FOR TEST CONNECTION AND DO NOT DISCONNECT CABLE W1

FIGURE 6
 TRANSLATION OSCILLATOR HOOK-UP TO RECEIVER

PREPARED BY E. JOYCE 7/19/65	SIZE A	CODE IDENT. NO. 90348	2385774
CHECKED BY W. ANDERSON 7/27/65			SHEET 13 B

A2385774



A2385774 SHEET 14 B

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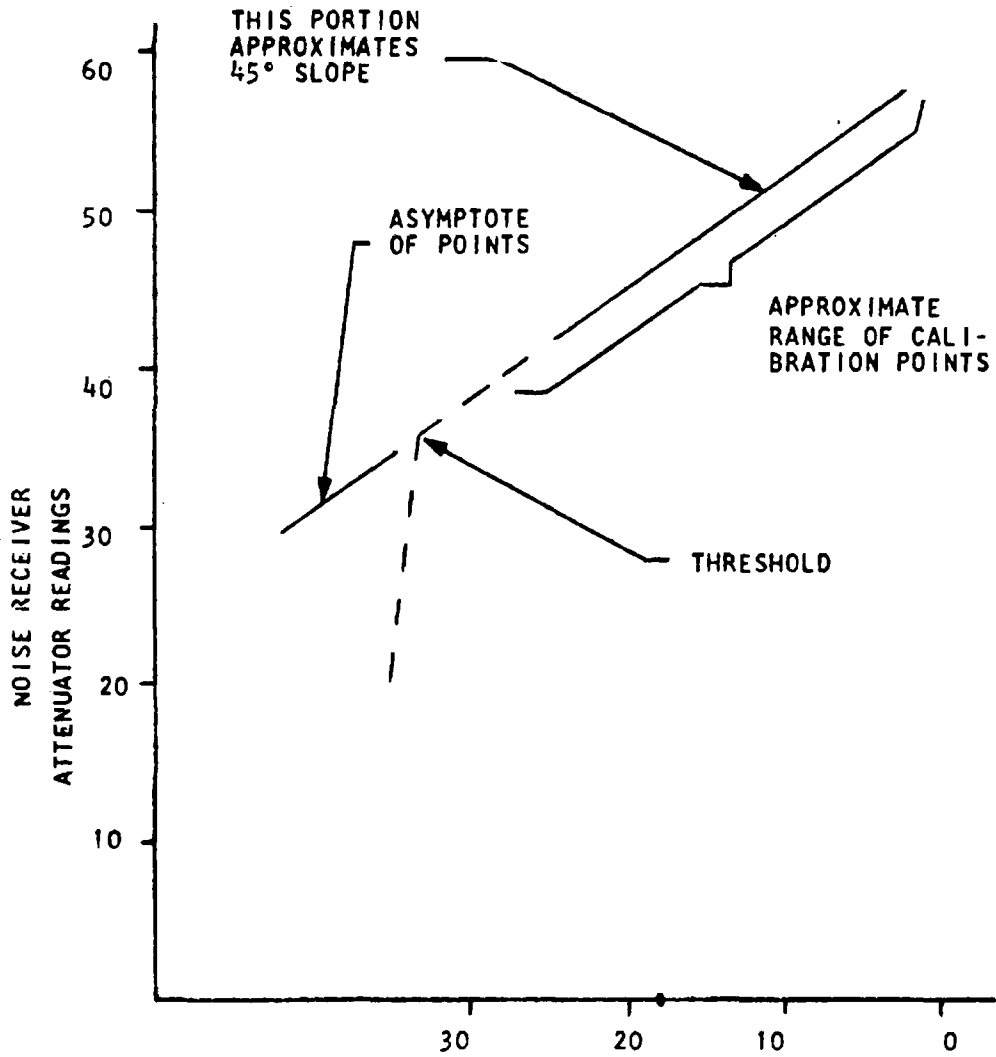


FIGURE 8

TYPICAL TRANSLATION OSCILLATOR CALIBRATION CURVE

PREPARED BY C. JOYCE 7/22/65	SIZE A	CODE IDENT. NO. 90348	2385774
CHECKED BY W. ANDERSON 7/27/65			

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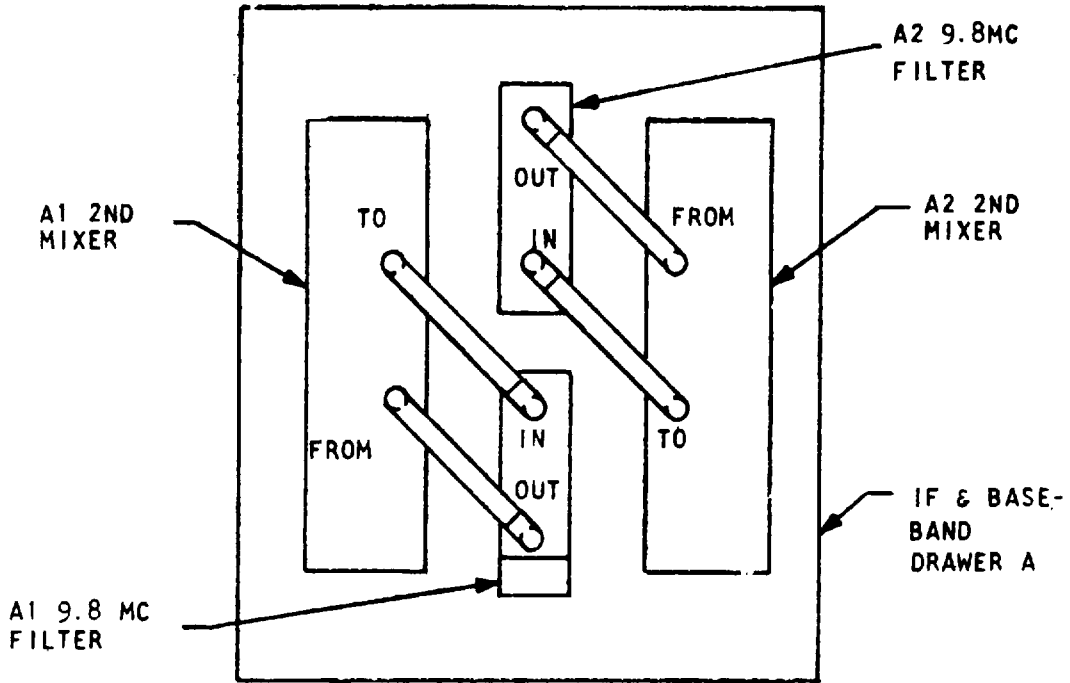


FIGURE 9A

IF & BASEBAND DRAWER LAYOUT

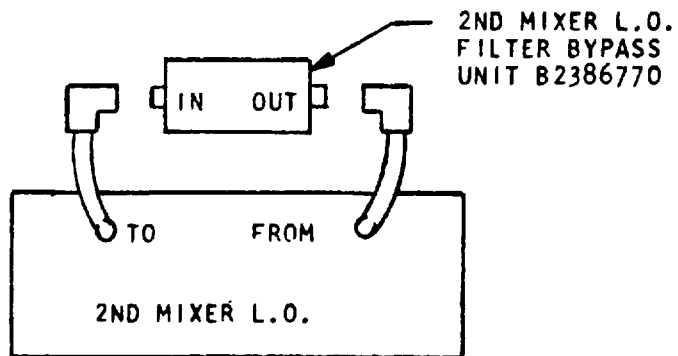


FIGURE 9B

2ND MIXER L.O. FILTER BYPASS CONNECTIONS

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 CHECKED BY
W. ANDERSON 7/27/65

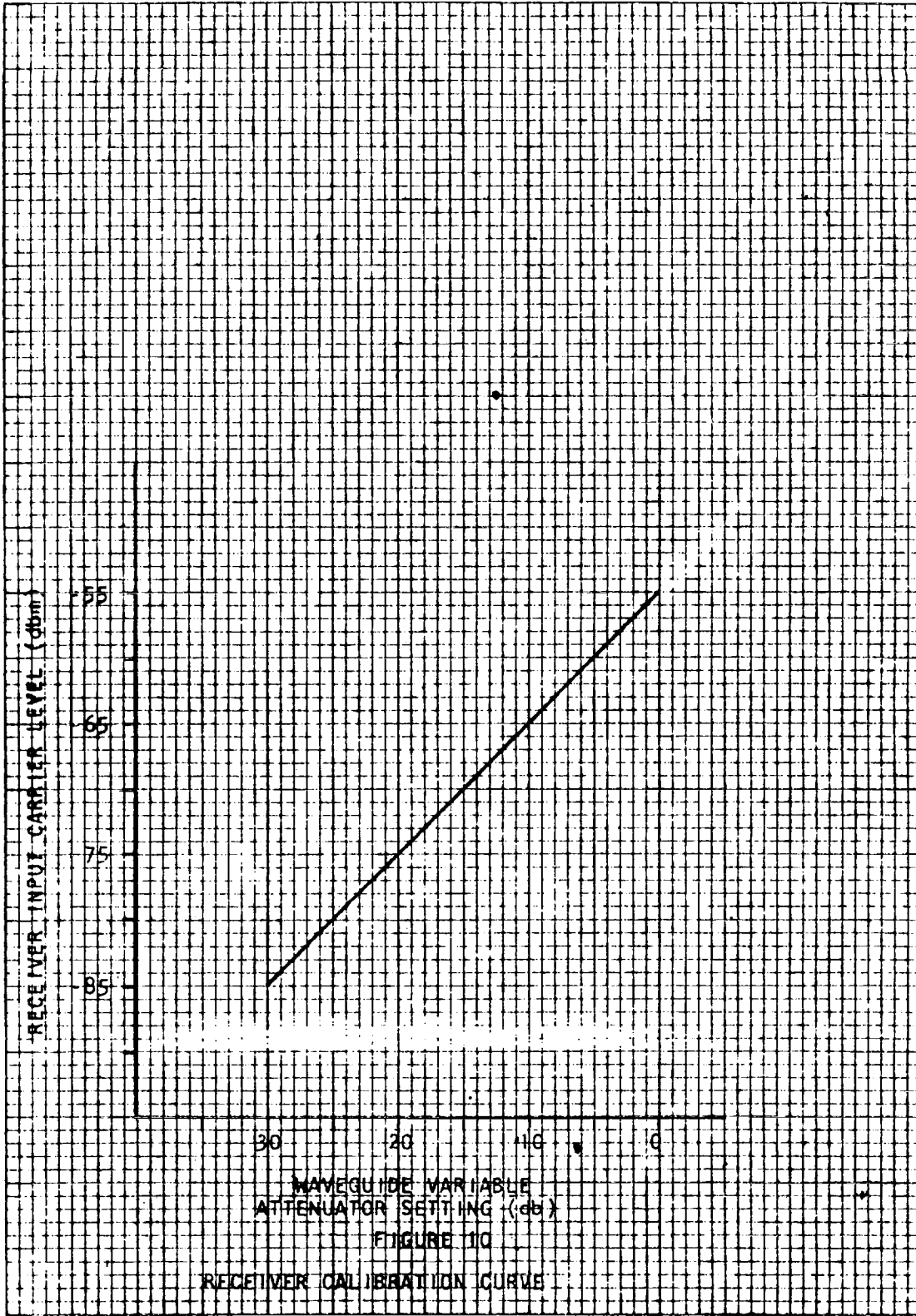
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TABLE 1

READINGS FOR STEPS 4.6 THROUGH 4.14	
CARRIER LEVEL (SIG GEN OUTPUT)	RELATIVE BASEBAND NOISE LEVEL (NOISE RCVR SETTING)
-55 DBM	
-60 DBM	
-70 DBM	
-80 DBM	
-85 DBM	60 DB

TABLE 2

READINGS FOR STEPS 5.6 THROUGH 5.9	
CARRIER LEVEL (WAVEGUIDE ATT SETTING)	RELATIVE BASEBAND NOISE LEVEL (NOISE RCVR SETTING)
0 DB	
5 DB	
15 DB	
25 DB	
30 DB	60 DB

PREPARED BY
C. JOYCE 7/19/65
CHECKED BY
W. ANDERSON 7/27/65

SIZE
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TABLE 3
METER READINGS

TRANSMITTER

POWER OUT _____
CATHODE CURRENT _____

RECEIVER

XTAL CURRENT G _____
XTAL CURRENT H _____

TRANSLATION OSCILLATOR

XTAL CURRENT 1 _____
XTAL CURRENT 2 _____

SIGNAL GENERATOR

POWER SET _____

DATE _____

BY _____

PREPARED BY
C. JOYCE 7/19/65

CHECKED BY
W. ANDERSON 7/27/65

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USACC (4)	USAIS (2)
MDW (1)	USAES (2)
Armies (2)	MAAG (1)
Corps (2)	USARMIS (1)
HISA (Ft Monmouth) (33)	USAERDAA (1)
Instl (2) except	USAERDAW (1)
Ft Gillem (10)	Sig FLDMS (1)
Ft. Gordon (10)	

ARNG & USAR: None.

For explanation of abbreviations used, see AR 310-50.

* U.S. GOVERNMENT PRINTING OFFICE: 1965 0 - 461-421

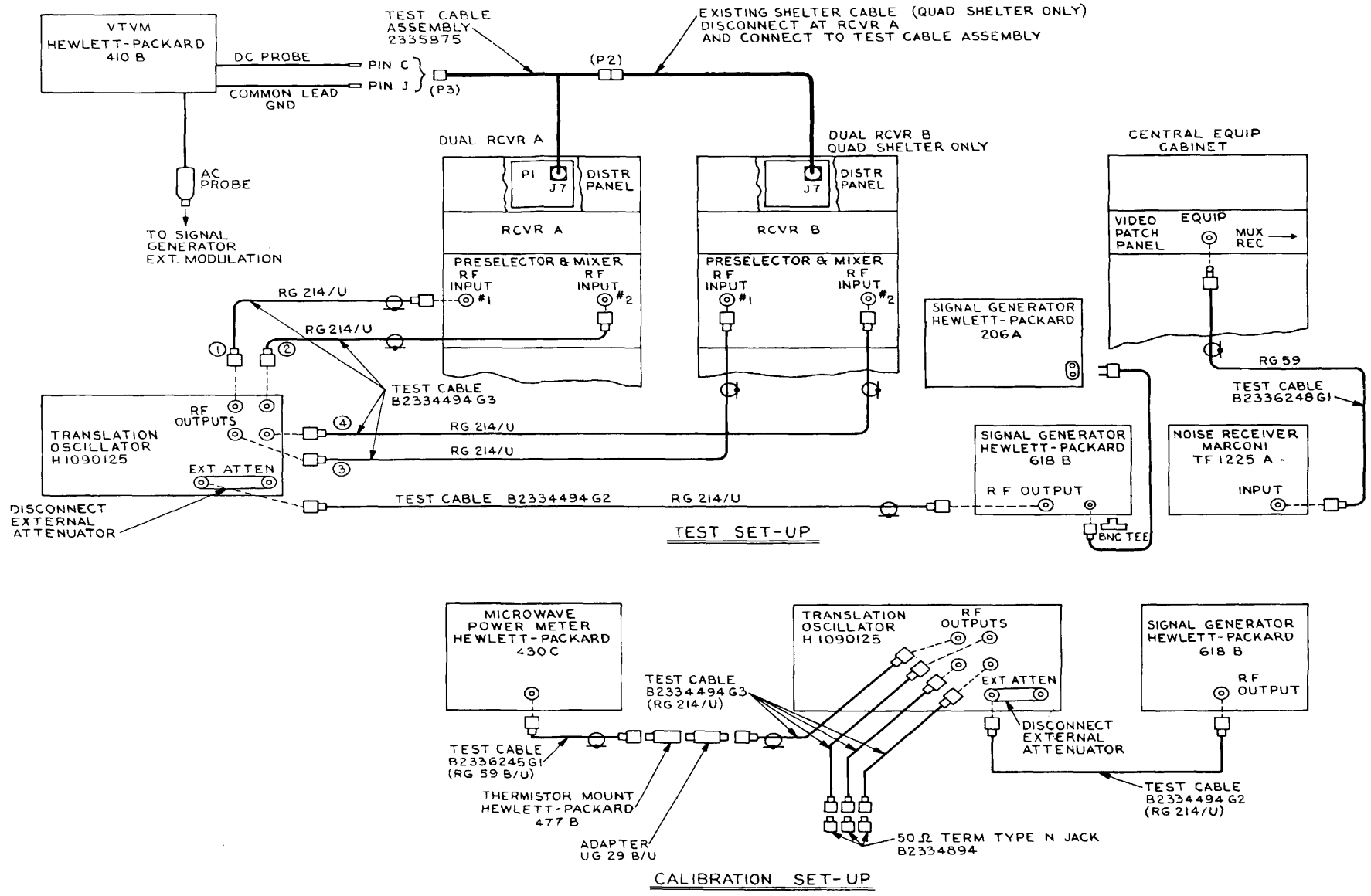
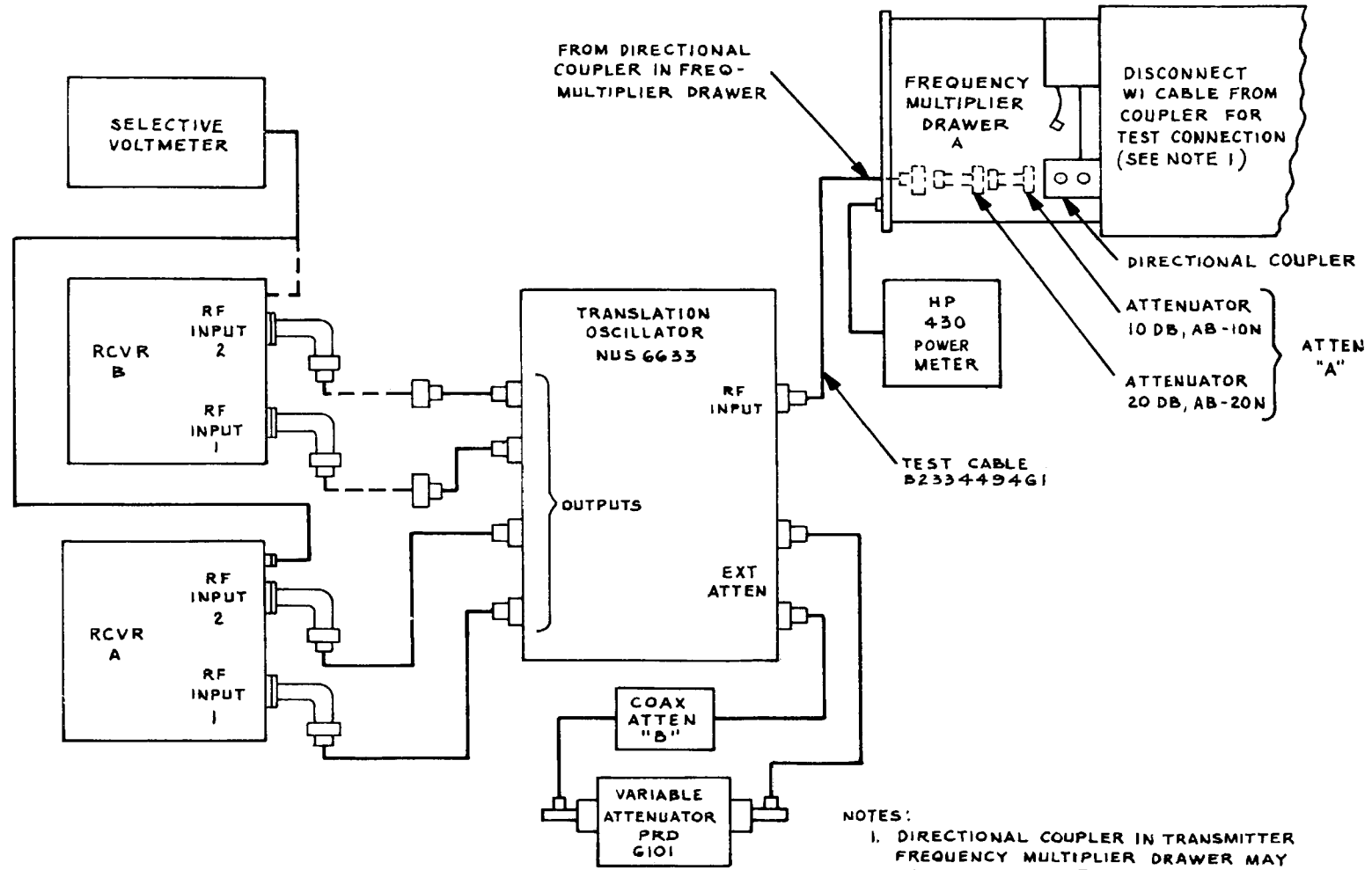


Figure 18. Receiver threshold test setup, multi-channel.



NOTES:
1. DIRECTIONAL COUPLER IN TRANSMITTER FREQUENCY MULTIPLIER DRAWER MAY HAVE 3 PORTS. THEREFORE, USE 3RD PORT FOR TEST CONNECTION AND DO NOT DISCONNECT CABLE W1 AND DETECTOR MOUNT.

Figure 19. Receiver threshold test setup, single channel.

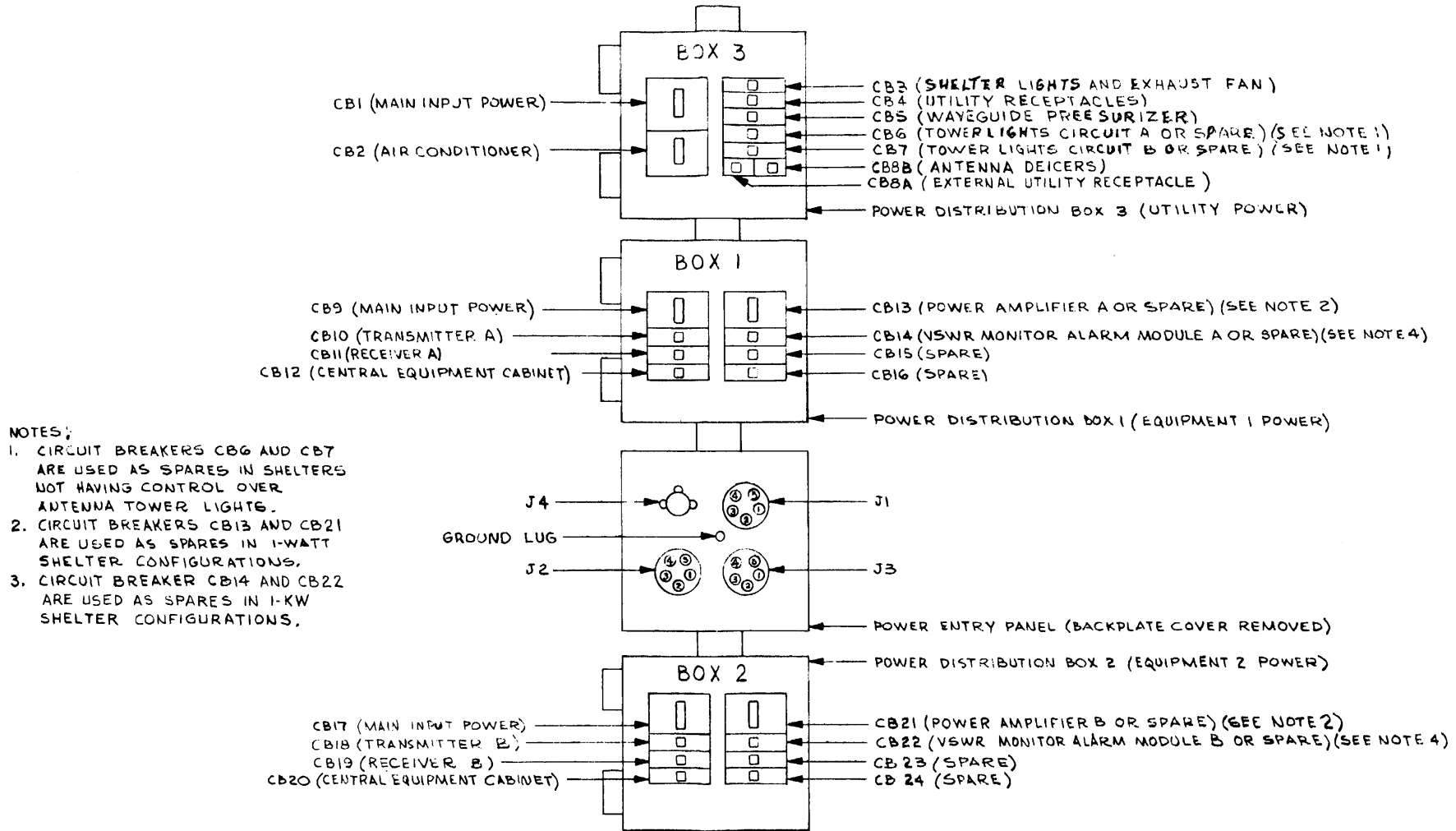


Figure 20. Shelter power distribution circuit breaker designations.

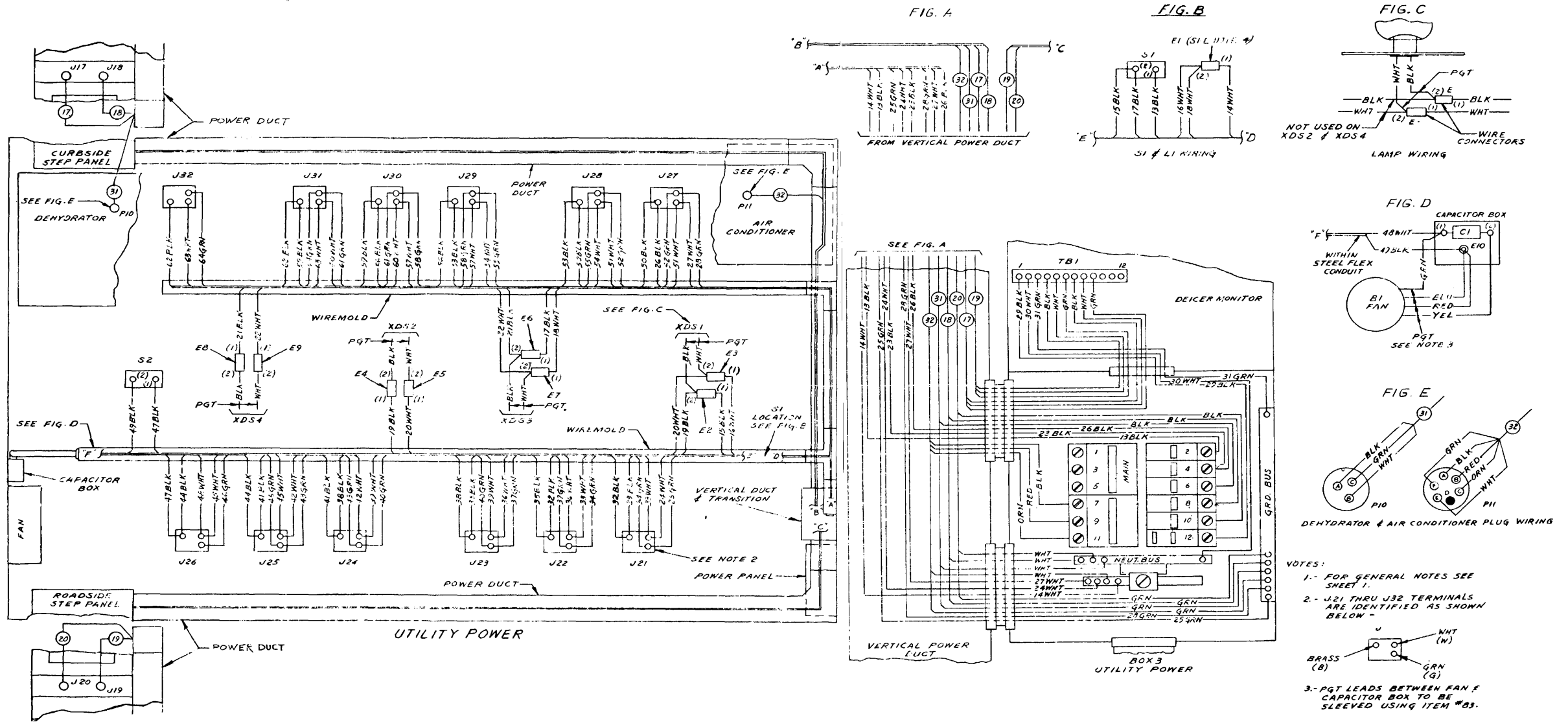


Figure 21. Shelter interconnection diagrams (part 2 of 5).

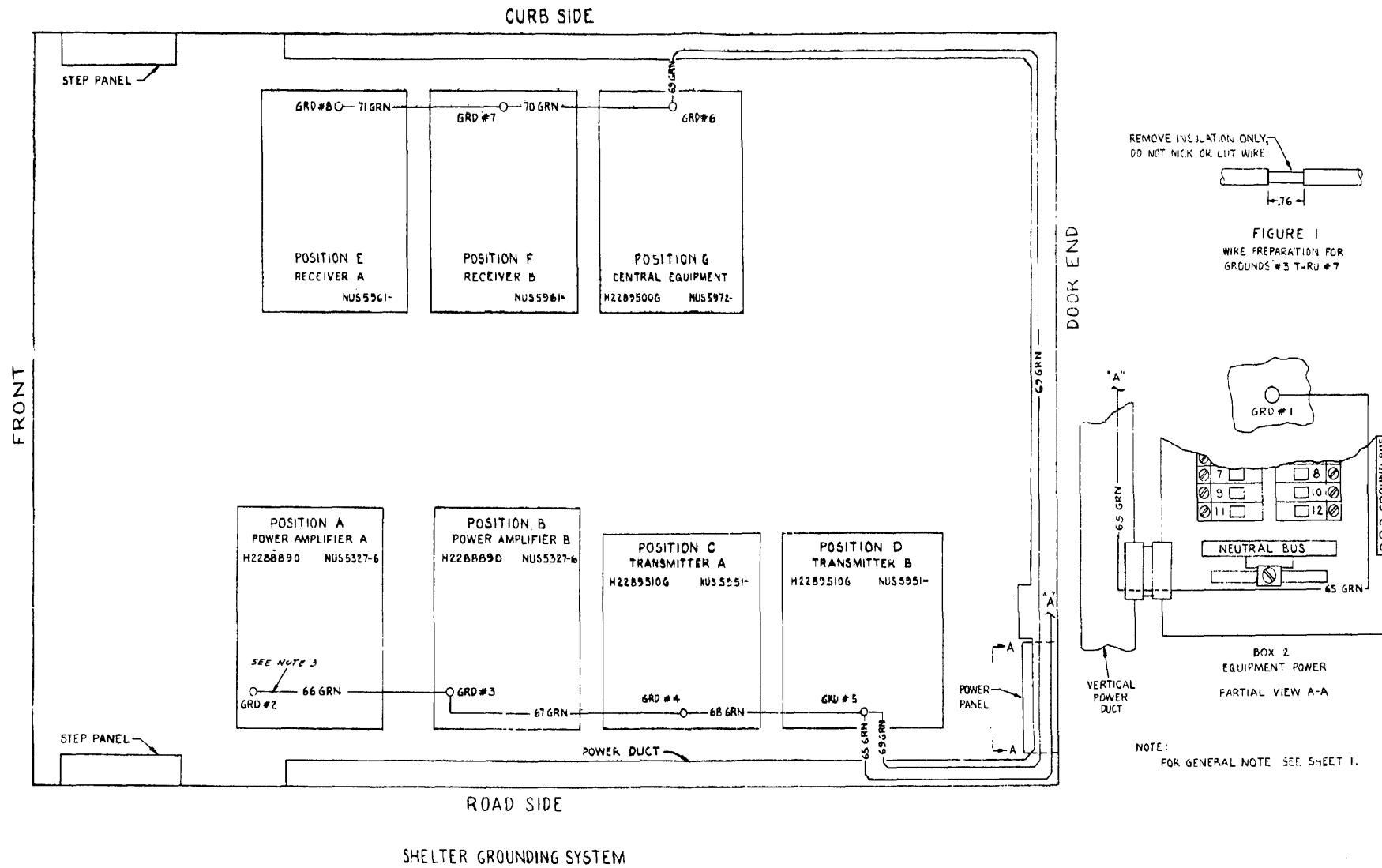


Figure 21. Shelter interconnection diagrams (part 4 of 5).

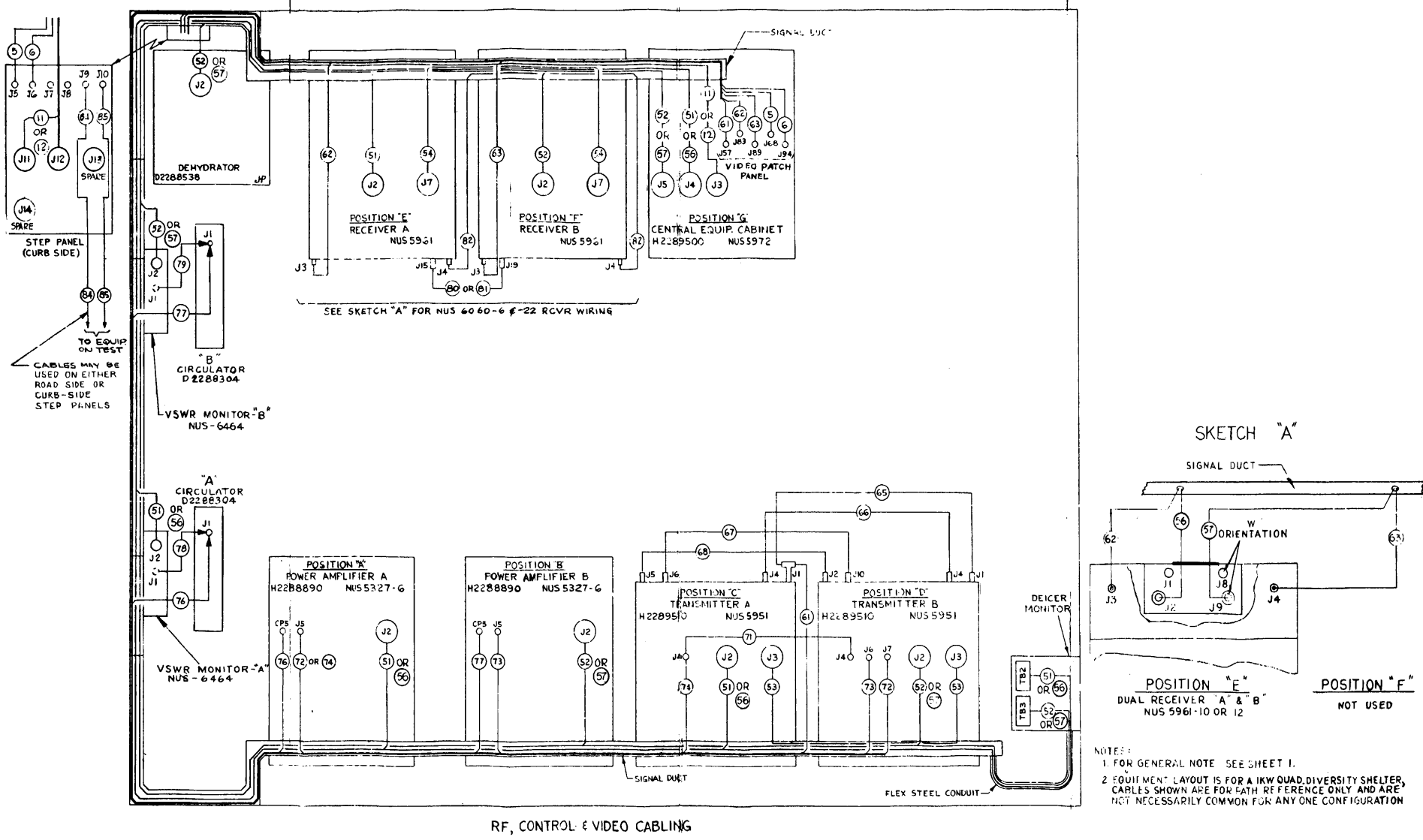


Figure 21. Shelter interconnection diagrams (part 5 of 5).

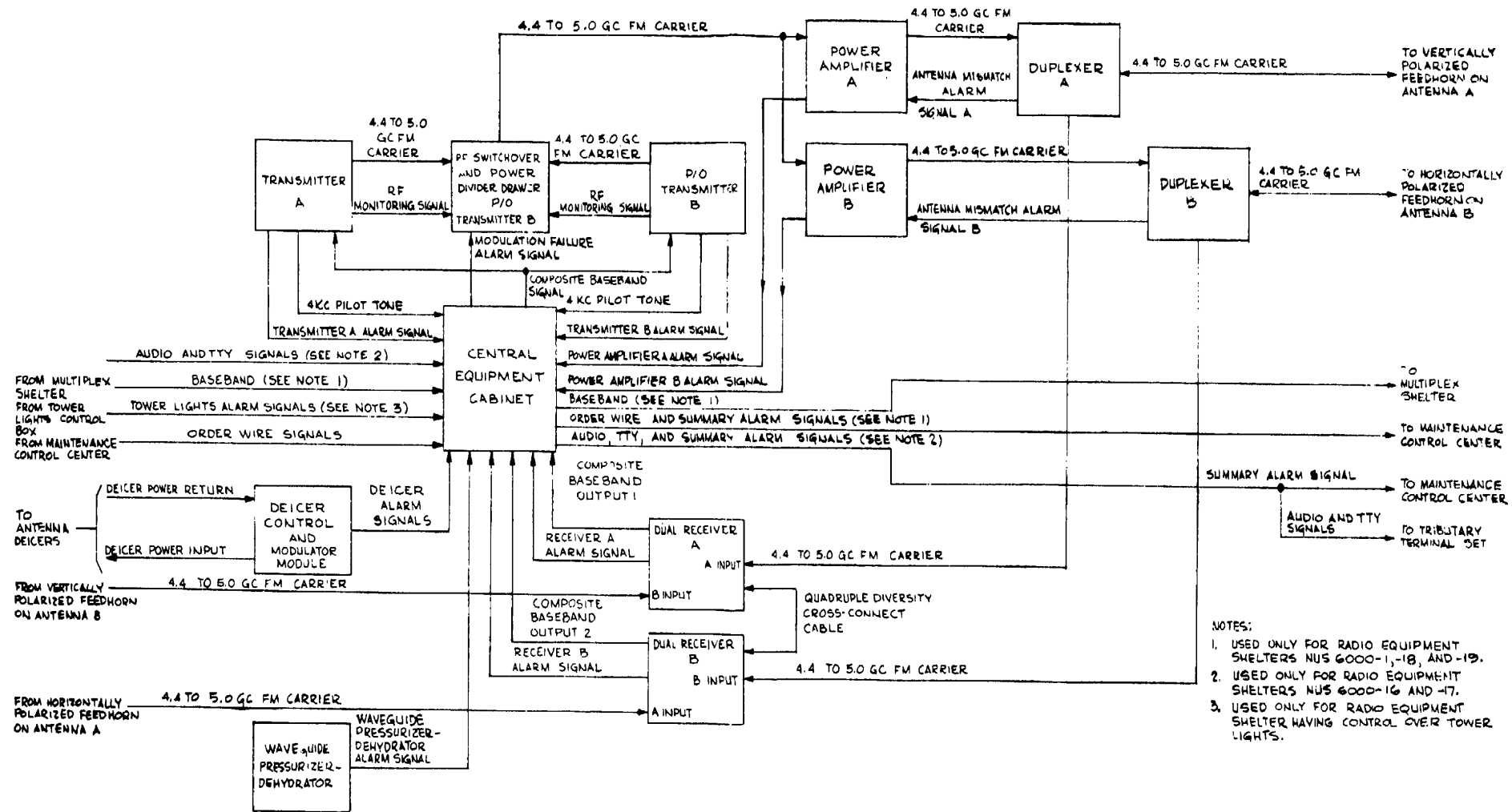


Figure 22. 1kw quadruple diversity shelter configurations, block diagram.

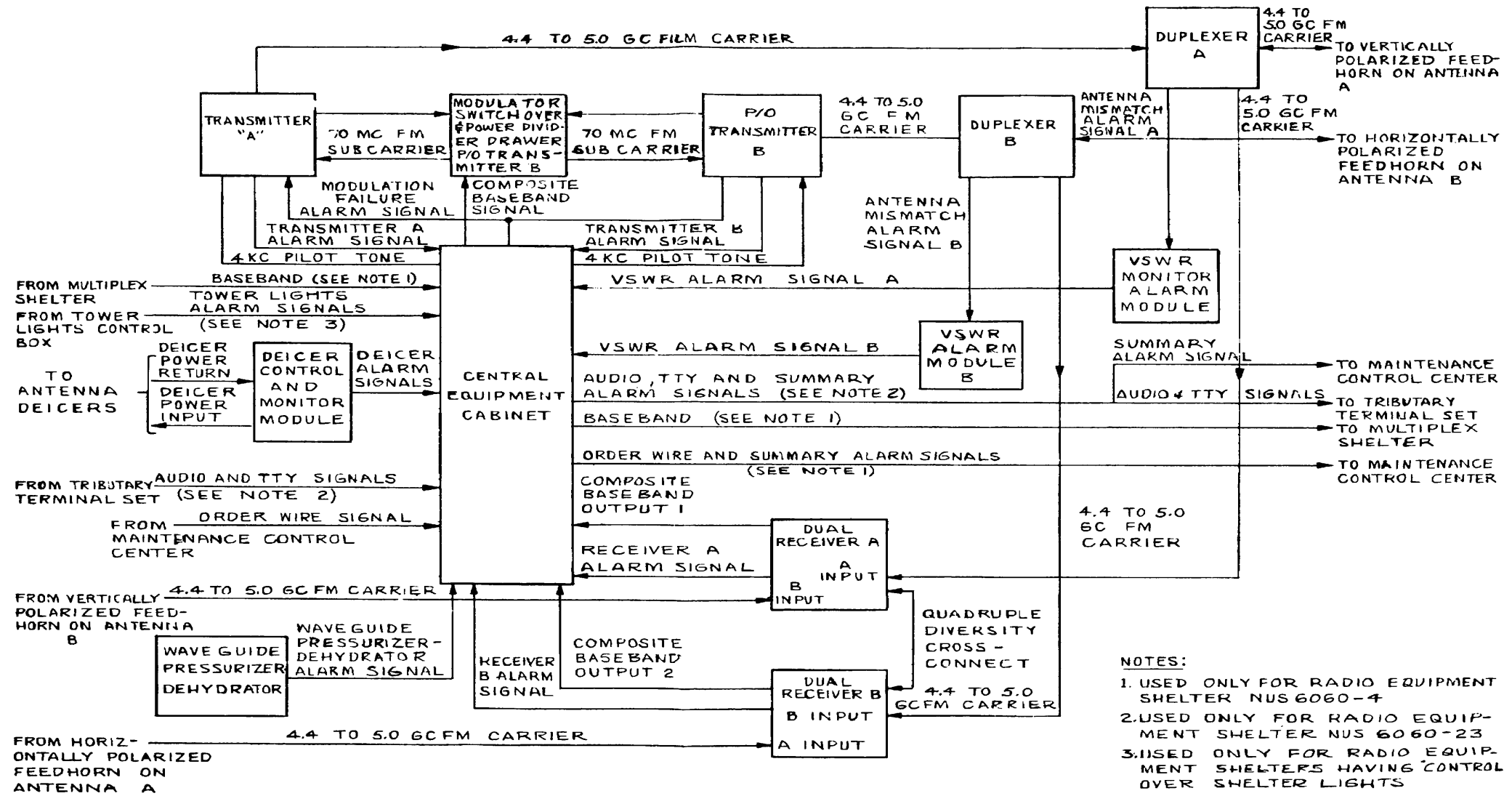
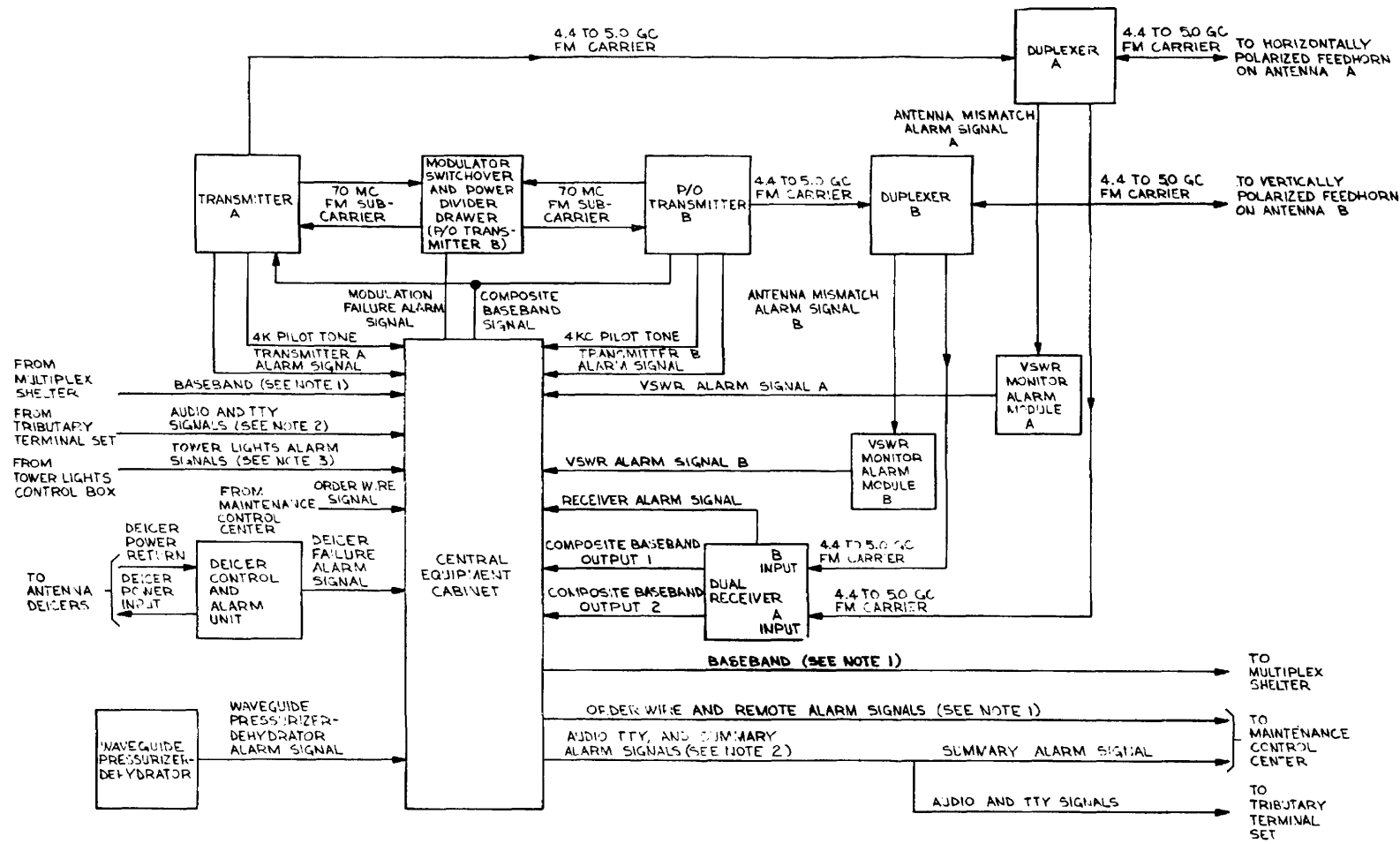


Figure 23. 1 watt quadruple diversity shelter configurations, block diagram.



- NOTES:
1. USED ONLY FOR RADIO EQUIPMENT SHELTER NUS 6060-6.
 2. USED ONLY FOR RADIO EQUIPMENT NUS 6060-22.
 3. USED ONLY FOR RADIO EQUIPMENT SHELTER HAVING CONTROL OVER TOWER LIGHTS.

Figure 24. 1 watt dual diversity shelter configurations, block diagram.

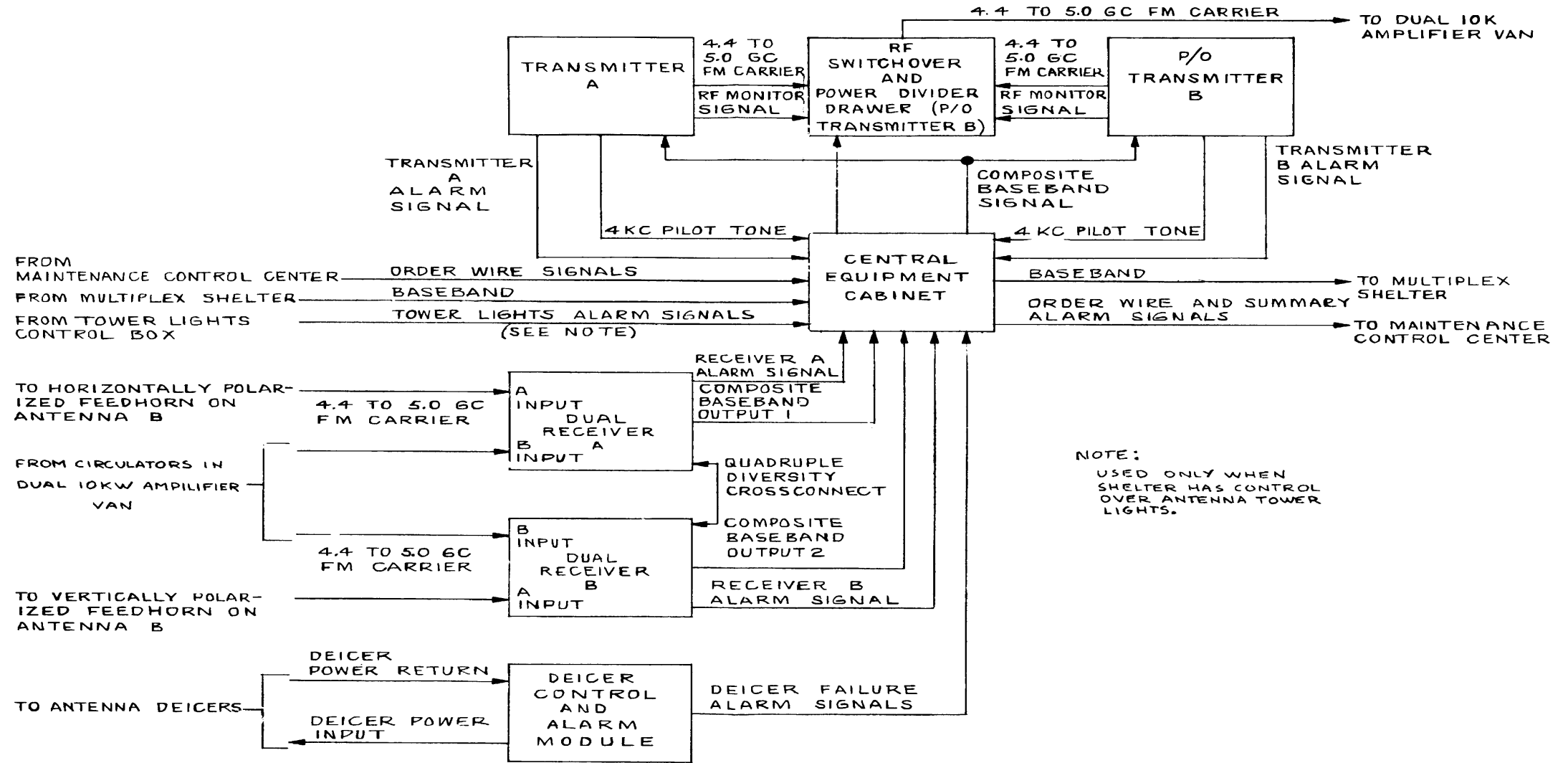


Figure 25. 1 watt, 10 kw amplifier driver shelter configurations, block diagram.

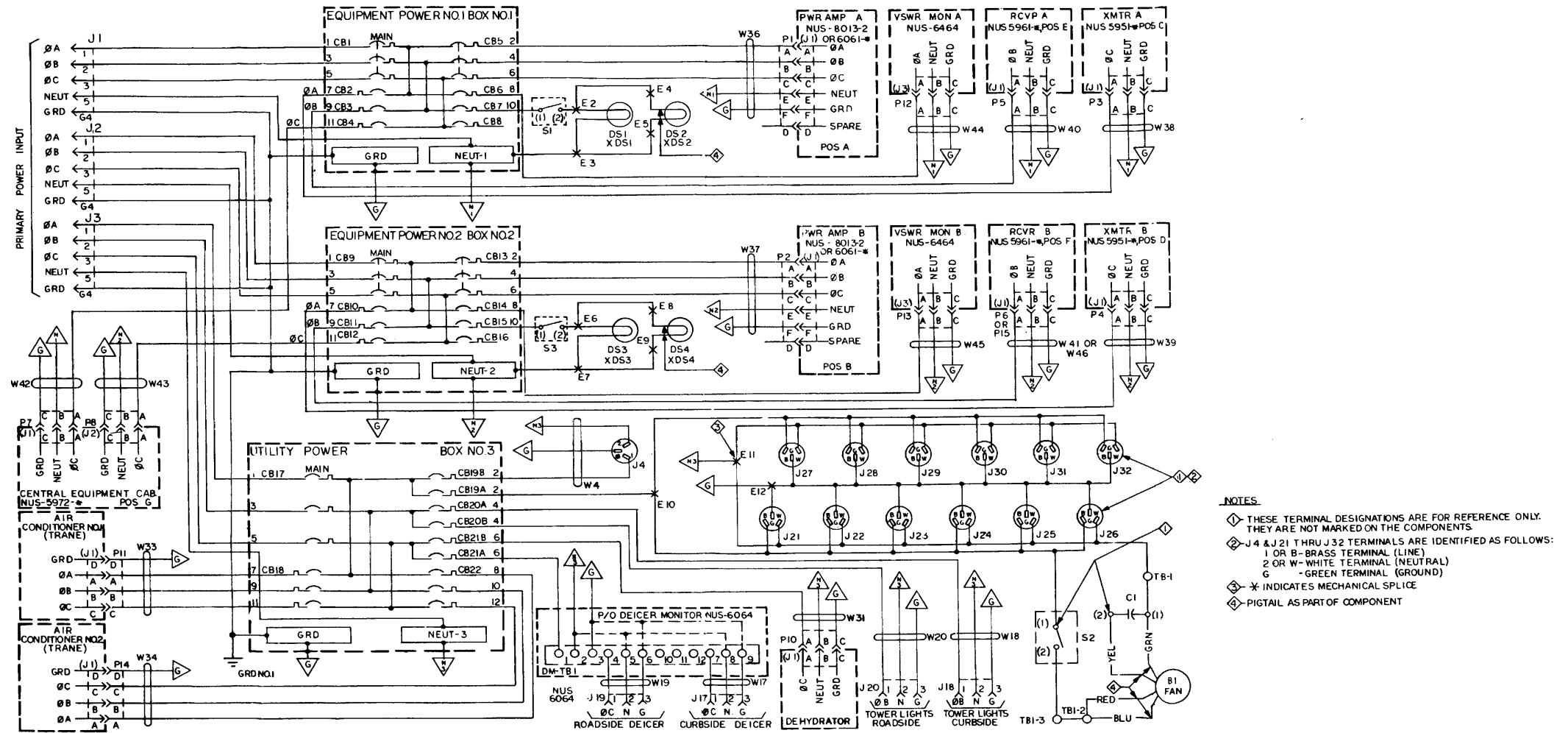


Figure 26. Radio equipment shelter schematic diagrams (part 1 of 4).

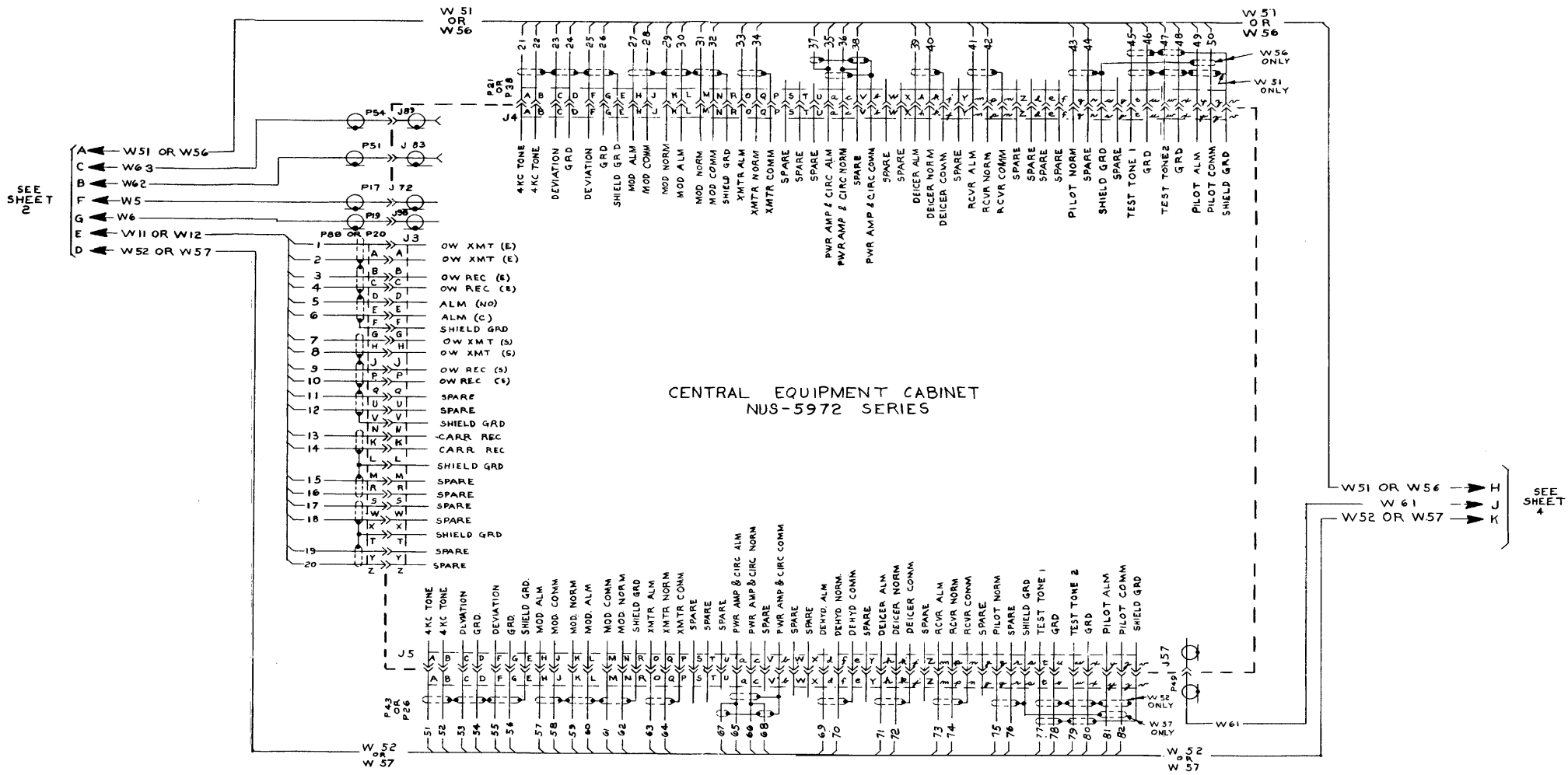


Figure 26. Radio equipment shelter schematic diagrams (part 3 of 4).

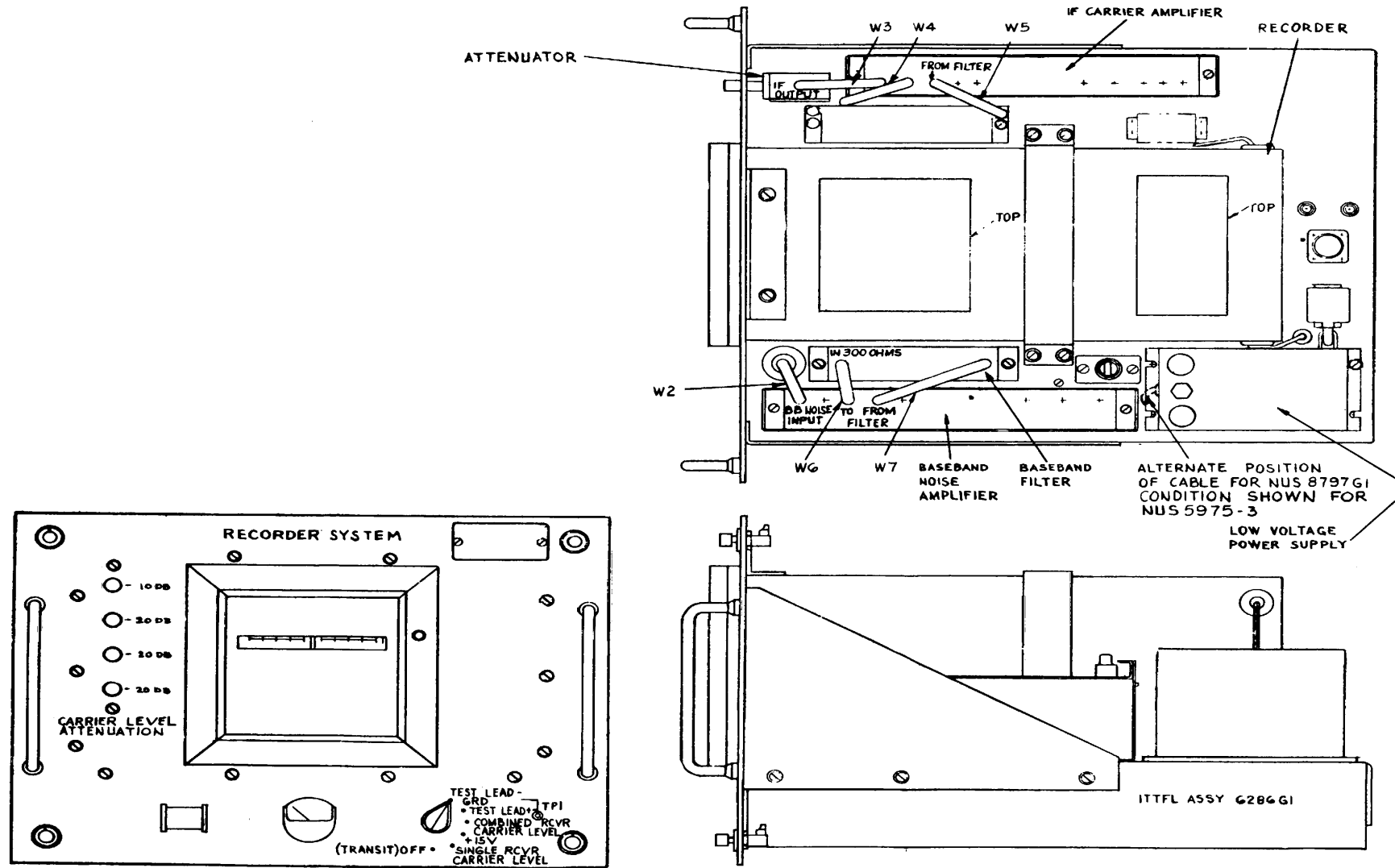


Figure 1. Recorder System NUS 6285, Component Location

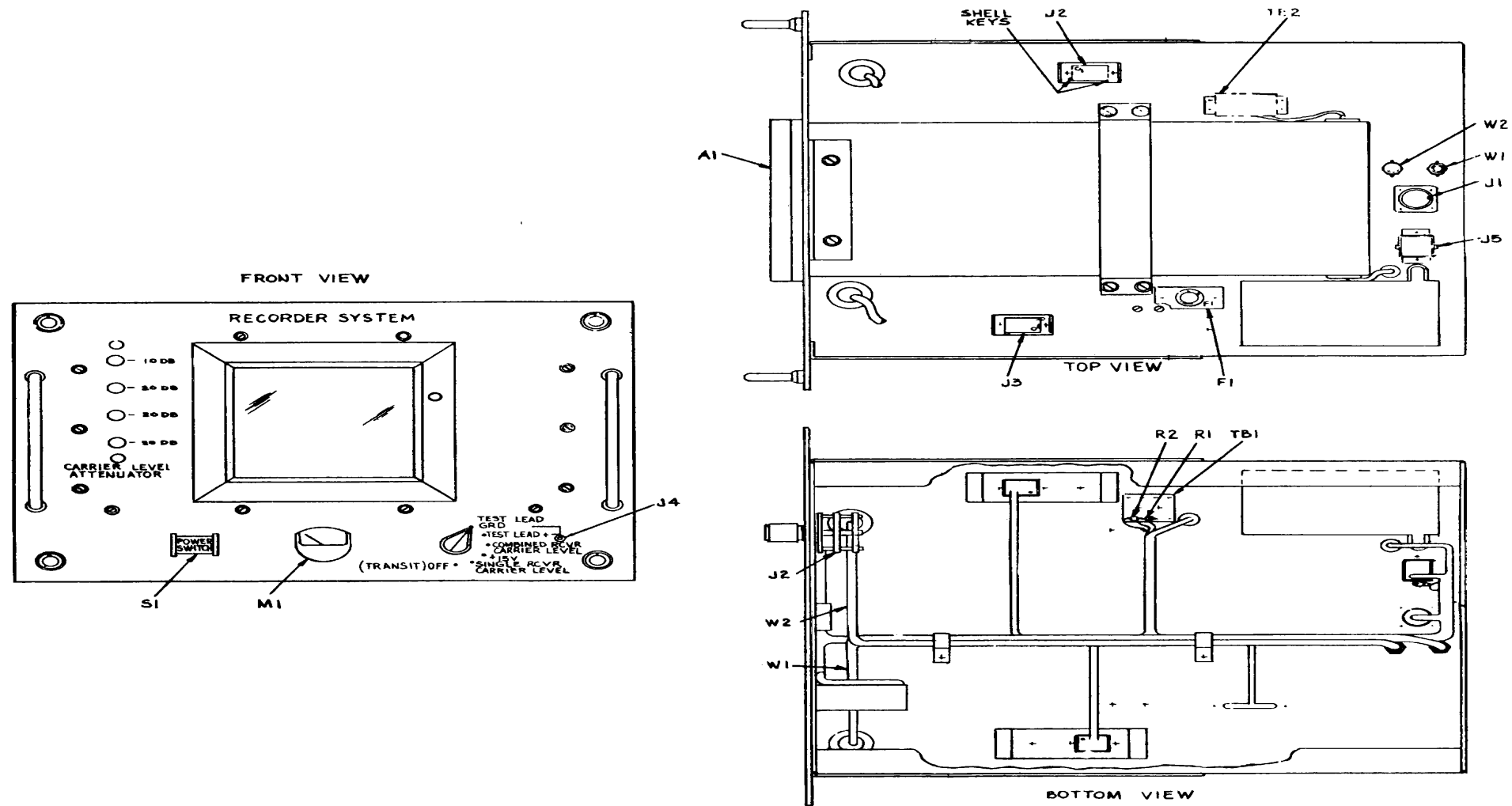


Figure 2. Recorder System NUS 6285, Drawer Assembly Cable and Plug Locations

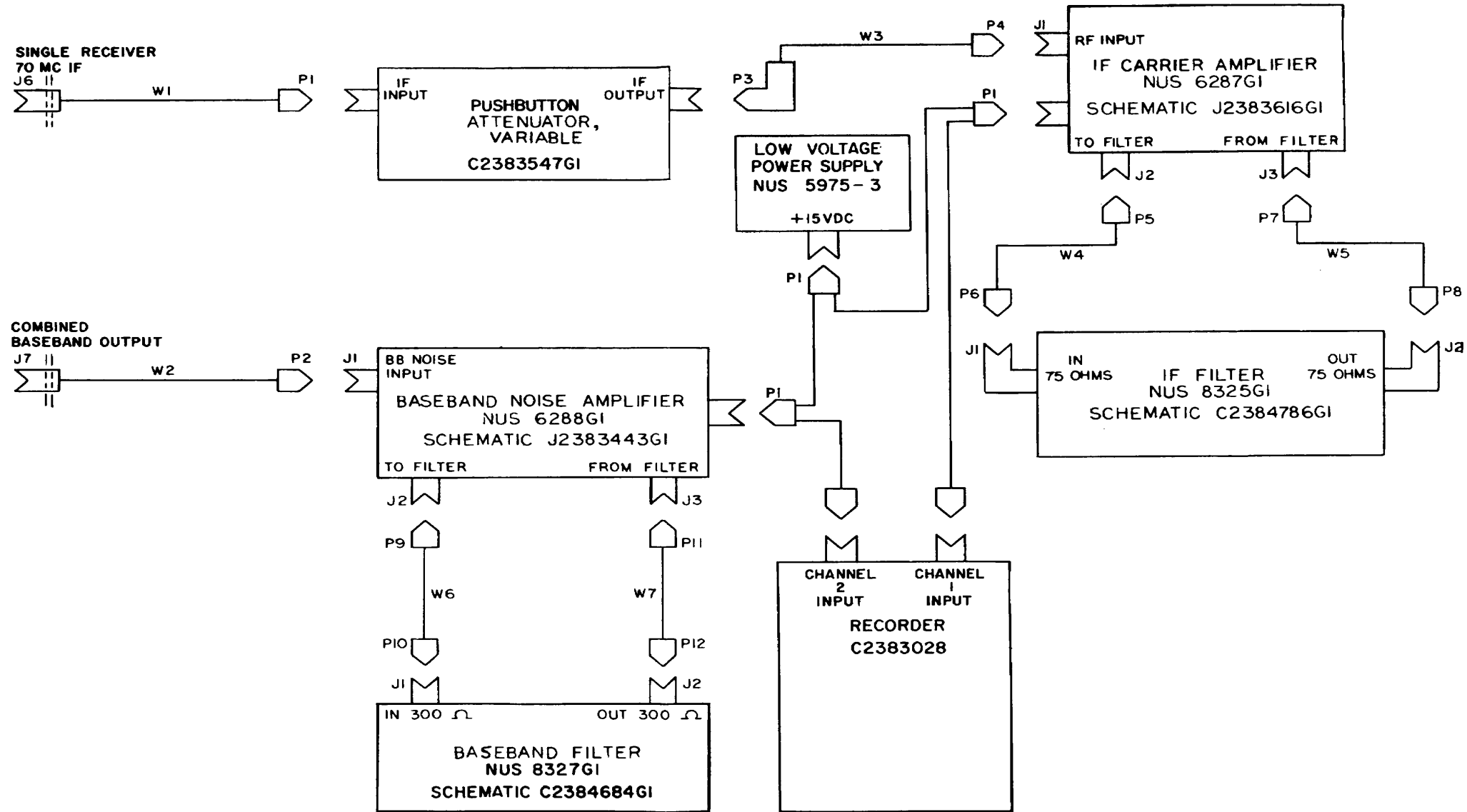


Figure 3. Recorder System NUS 6285, RF Interconnection Diagram

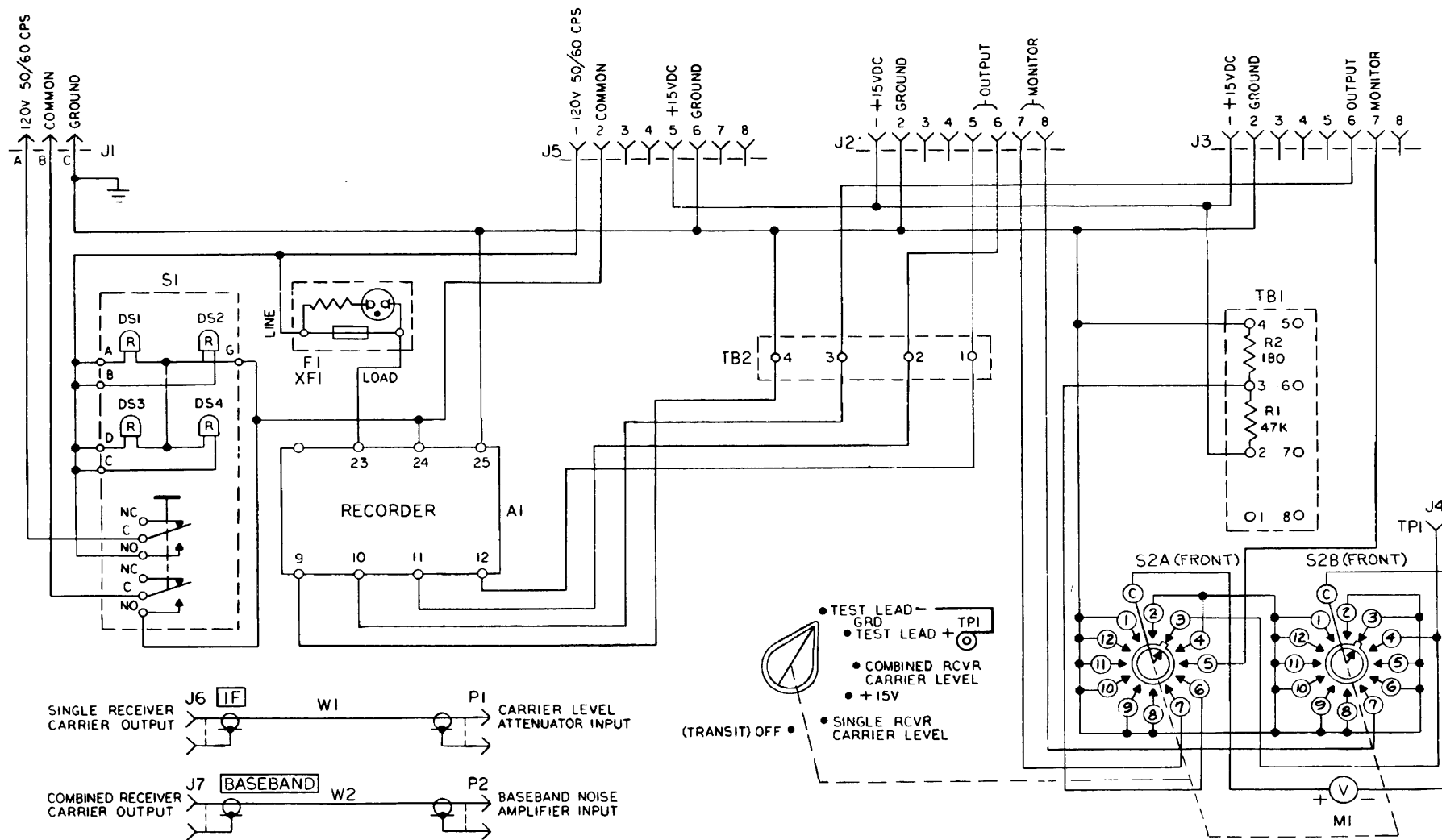


Figure 4. Recorder System NUM 6285, Schematic Diagram

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