CHAPTER 5

THE RECEIVER STATION

5.1 GENERAL

The receiver station is equipped with all the facilities needed to receive propagated RF energy and to convert it into signals that comprise the receive circuits from distant locations. The basic elements of the station are the antenna field and the building housing the electronic equipment. The antennas intercept the RF energy from the propagating medium and the electronic equipment converts this RF energy into communications signals that are then relayed to the communications center for direct use or for retransmission to other users. The receiving equipment is installed to satisfy the station's requirements for specific number and types of circuits. Some redundancy in equipment installation is provided to facilitate maintenance and this may allow for a small expansion of capability. Table 5-1 lists typical equipment that may be found at a receiver station. However, the particular equipments required at the receiver station to implement a specific circuit are shown by the applicable NAVELEX standard plan. See chapter 2.

Reception of desired radio signals is the controlling factor when a radio receiver station is designed and constructed. Any other consideration, such as the need for survivability against bomb damage or a natural disaster, must not be permitted to degrade the ability of the station to function as a radio receiving station. The principal factors entering into the general arrangement and construction of the station are:

a. Fundamental suitability for conducting efficient communications.

b. Adaptability to meet normal expansion requirements and emergencies.

c. Total cost.

The above factors can be assessed by: first, determining the reception capabilities to be provided; second, evaluating the construction and arrangement against certain minimum necessary conditions that must be satisfied in order to permit the desired reception and third, weighing the relative advantages of each factor with respect to the required minimum specified. One of the methods of integrating the above factors into the design is to provide for maximum flexibility in the use of antennas and receivers. An accepted method for accomplishing this is to include (1) multicouplers to supply multiple outputs from a single antenna, (2) RF switches and patchboards to feed any receiver with any RF input, and (3) audio and DC circuit patchboards to distribute the receiver and ancillary equipment outputs. The station designer must also carefully evaluate each requirement against the corollary objective of eliminating or reducing the need for circuit and equipment operators.

Table 5-1. Typical Receiver Station Equipment

FREQ (MHz)	RCVR TYPE	EMISSION TYPE	SENSITIVITY µV	ANT. Z	OUTPUT Z AND DC	POWER REQUIREMENTS WATTS	VOLTS	PHASE	FREQ (Hz)	DIMENSIONS HT IN.	WIDTH IN.	DEPTH IN.	VOL CU FT	WT LBS	MANUFACTURER	ADDITIONAL DATA AND REMARKS
.014-.030	AN/BRR-3	A1, A2, F1	0.2	50	600-200	138	105-125	1	50-60	8-3/4	17-1/4	20	1.8	85		Has built-in FSK
.014-.6	AN/FRR-21	A1, A2, F1	3.5-8	73 Bal 200 Bal	600	87	105, 115, 125	1	50, 60, 400	9	19	18	2	75	RCA	Identical to AN/SRR-11 Cabinet mounted version
.014-.6	AN/SRR-11	A1, A2, F1	3.5-8	73 Bal 200 Bal	600	87	105, 115, 125	1	50, 60, 400	9	19	18	2	75	RCA	Table version of AN/FRR-21
.015-1.5	R-389/URR	A1, A2, A3, F1	6	125 Bal	600	225	115, 230	1	48-62	11	19	17	2.5	85	Collins	Tuned manually or motor tuning
.014-.6	AN/WRR-3 3A, 3B	A1, A2, F1	0.5-4.0	50 200 µµF	600 (2)	60	105, 115, 125	1	50, 60, 400	9	17	17	1.5	70	Magnavox	
.05-.4-.5 2-32	R-5007/ FRR-502	A1, A2, A3, F1	1	73 Bal 300	600	85	110, 220	1	50, 60	6	19	15	0.9	35	TMC	Band changes by plug-in units
.02-32	AN/FRR-49	A1, A2, A3, F1	10	50	600	85	110, 220	1	50, 60	5-1/4	19	15			TMC	Tuner Drawer Storage Panels Same Dimensions
.03-.3	SRR-19	A1, A2, A3, A3A, A3B, F1	1-2	50 Unbal	600	200	105, 115, 125	1	50, 60, 400	12-1/4	17-1/4	22-1/2	2.75	125	National Co., Inc.	
.25-8	AN/FRR-22	A1, A2, A3, F1	3	73 200	600	87	105, 115, 125	1	50, 60, 400	9	19	18	2.2	75	RCA	Rack mounted AN/SRR-12
.25-8	AN/SRR-12	A1, A2, A3, F1	3	73 200	600	87	105, 115, 125	1	50, 60, 400	9	19	18	2.2	75	RCA	Table version of AN/FRR-22
.5-54	AN/FRR-28	A1, A2, A3, F1, F4	2.3	73	600 8000	570	115, 230	1	50, 60,	88	24	23	56	344	Press Wireless	2 Type SP-600-JX6 rcvrs for diversity operation
.5-32	AN/FRR-38	A1, A2, A3, F1	1	50 Bal 125 Bal	600	270	115, 230	1	48-62	76	21	21	18	490	Hoffman	2 Type R-390/URR rcvrs, with CV-116/ URR converter f r diversity terminal
.5-32	R-390/URR	A1, A2, A3	1-3	50 Bal 125	600	270	115, 230	1	48-62	11	19	17	2.4	70	Collins and Others	R-390A/URR has same characteristics
.5-4	RBB	A1, A2, A3	6	73 1500 (1) Wire	600	100	110-120	1	55-65	15	19	21	3	82	RCA	Power supplied separately and can supply two rcvrs

Table 5-1. Typical Receiver Station Equipment (Continued)

FREQ (MHz)	RCVR TYPE	EMISSION TYPE	SENSITIVITY µV	ANT. Z	OUTPUT Z AND DC	POWER REQUIREMENTS WATTS	VOLTS	PHASE	FREQ (Hz)	DIMENSIONS HT IN.	WIDTH IN.	DEPTH IN.	VOL CU FT	WT LBS	MANUFACTURER	ADDITIONAL DATA AND REMARKS
.54-54	R-274/FRR	A1, A2, A3, F1	2.3	50 Bal 200	600	130	95-260	1	50, 60	11	19	18	2	58	Hammarlund	SP-600-JX6
.54-30.5	R-388/URR	A1, A2, A3	5	125 Bal Hi Z	4/600 IF 50	85	115, 230	1	47-75	11	19	13	2	43	Collins	51-J-4
.54-31	R-840/URR	A1, A2, A3, A4	1	75 Bal 200 Bal	4/8/16/ 600	90	115, 230	1	50, 60	11	19	14	2		TMC	
2-30	R-1051/URR R-1051B/ D & E	A1, A3A, A3B, A9, F1, F4	A9-2 A3-4	50	600 and 600	55	115	1	48-450	7	17.38	18.9	1.33	70	General Dynamics and Bendix	Separate shock mount MT-3114/UR
2-32	AN/WRR-2 AN/FRR-59	A1, A2, A3, A9, F1, F4	A1-1.5 A2-3.0 A3-6.0 A9-4.0	50	600 and 600	250	105, 125	1	50, 60	25.8	22	24	8.6	250	National Co. and Arvin Ind.	Separate mounting MT-2293/WRR-2
2-32	AN/FRR-19	A1, A2, A3, F1	4-5	73 200	600	87	105, 115, 125	1	50, 60, 400	9	19	18	2.2	75	RCA	AN/FRR-23 with CV-57/URR or CV-60/URR converter
2-32	AN/FRR-23	A1, A2, A3, F1	4-5	73 200	600	87	105, 115 125	1	50, 60, 400	9	19	18	2.2	75	RCA	Rack mounted model of AN/SRR-13
2-32	AN/SRR-13	A1, A2, A3, F1	6-10	73	600	87	105, 125	1	50, 60 400	9	19	18	2.3	75	RCA	Table mounted FRR-23
2-30	AN/GRR-17	A1, A2, A3, F1, A3J	0.6-2.5	50	600	24 50	24 FCD 115 VAC	- 1	DC 50, 60, 400	7 9	17 19	10 13	0.7 1.3	33 40.5	National Co., Inc.	Rack mounted or transit case
2-32	AN/FRR-60 (V) 2	A1, A2, A3, F1, A4, A3J, A9B	1.0	50	600 (8)		115, 230	1	48-62	69	47	30	58	660	TMC	DDR - 5A Model
2-32	AN/FRR-60 (V) 3	Same	1.0	50	600 (4)	1000	115, 230	1	48-62	69	25	30	30	637	TMC	DDR - 5B Model
2-32	AN/FRR-60 (V) 5	Same	1.0	50	600 (8)	2000	115, 230	1	48-62	69	47	30	58	1162	TMC	DDR-5L Model
2-32	AN/FRR-60 (V) 6	A1, A2, A3, F1, A4, A3J, A9B	1.0	50	600	1000	115, 230	1	48-62	83	25	30	36	878	TMC	DDR-R-5BR Model
2-32	AN/FRR-60 (V) 7	Same	1.0	50	600	1500	115, 230	1	48-62	69	47	30	58	660	TMC	DDR-RR-5M Model

Table 5-1. Typical Receiver Station Equipment (Continued)

FREQ (MHz)	RCVR TYPE	EMISSION TYPE	SENSITIVITY µV	ANT. Z	OUTPUT Z AND DC	POWER REQUIREMENTS WATTS	VOLTS	PHASE	FREQ (Hz)	DIMENSIONS HT IN.	WIDTH IN.	DEPTH IN.	VOL CU FT	WT LBS	MANUFACTURER	ADDITIONAL DATA AND REMARKS
2-32	AN/FRR-60 (V) 8	Same	1.0	50	600	1500	115, 230	1	48-62	69	47	30	58	660	TMC	DDR-R-5M Model
2-32	AN/FRR-60 (V) 11	Same	1.0	50	600	1500	115,230	1	48-62	83	25	30	36	878	TMC	DDR-5BR1 Model
2-32	AN/URR-63 (V) 1*	A1, A2, A3, A3A, A3B, A3J, A7J, A9B, A9J	0.5	50	(4) 600 (1) 4 (1) Hdst	390	115/230 ± 10%	1	50/60	87-9/16	22-3/8	24	20.2	465	TMC	Remote Controllable. Mounted in modified CY-597A/G cabinet. Single Receiver.
2-32	AN/URR-63 (V) 2*	Same	0.5	50	(8) 600 (1) 4 (2) Hdst	725	Same	1	Same	Same	Same	Same	20.2	619	TMC	Remote Controllable. Mounted in modified CY-597A/C Cabinet. Dual Receivers.
2-32	AN/URR-64 (V) 1*	Same	0.5	50	(8) 600 (2) 4 (1) Hdst	360	Same	1	Same	Same	Same	Same	20.2	491	TMC	Dual Receivers. Mounted in CY-597A/C Cabinet.
2-32	AN/URR-64 (V) 2*	Same	0.5	50	(4) 600 (2) 4 Hdst	180	Same	1	Same	Same	Same	Same	20.2	391	TMC	Single Receiver Mounted in CY-597A/C Cabinet.
2-32	AN/URR-64 (V) 3	Same	0.5	50	(8) 600 (2) 4 Hdst	300	Same	1	Same	Same	Same	Same	20.2	450	TMC	Dual Receivers, Space Diversity Only, Mounted in CY-597A/G Cabinet
2-32	AN/FRR-72	A1, A2, A3, A4, A3J, A9J, F1	1.0	50	600	1070	115, 230	1	48-62	83	25	30	58	880	TMC	DDR-5A/MSGA-1/ ARCA-1 model
225-400	AN/URR-13	A2, A3	8	50	600	125	115	1	50, 60	9	19	18	1.5	57	Federal Telephone	Single channel
225-400	AN/URR-28	A2, A3	8	50	600	197	115	1	50, 60	9	19	23	.3	62	National Co., Inc.	10 Preselected Xtal controlled channels
225-400	AN/URR-35	A2, A3	8	50	600 50 Video	98	115	1	50, 60	9	19	18	1.5	57	Federal Telephone	Preset or manual controlled channels

* Under Tactical and Operational Testing

5.2 HF RECEIVERS

HF receivers capable of processing the various types of emissions in table 4-1 are preferred. Use of multipurpose receivers provides operational flexibility and allows equipment substitution for maintenance and for equipment failure. However, the need for flexibility must not be allowed to overshadow other considerations such as:

a. The cost of special purpose versus general purpose equipment.

b. The availability of equipment for use on other circuits.

c. The percentage of time that an equipment would be needed for special purpose use.

d. The requirements for additional units during maintenance periods or for replacement of a failed unit.

e. The availability of the equipment by the time the installation is required for operations.

For proper facility planning, it is important that the designer have a thorough knowledge of all such factors.

HF receivers in use at shore stations vary from those that receive only a single channel 3-kHz sideband to those that receive an independent sideband (ISB) modulated RF carrier consisting of an upper and a lower sideband, each 6 kHz wide. Usually receivers are controlled manually at the front of the unit, but some later model receivers, and those undergoing development, may be controlled remotely from a distant operator position. Remote control from the distant operator position is usually accomplished by sending teletype or digital instructions to a receiver control unit which automatically makes the proper adjustment. The ISB receiver itself may demultiplex each of the 6-kHz sidebands into two 3-kHz audio channels. Receivers that include all necessary demultiplexing and converting equipment are preferred over those with separate demultiplexers. HF receivers capable of receiving single-channel frequency shift keying (FSK) or on-off keying (CW) signals are also required at various receiver stations. The outputs of these receivers are converted into audio tones for further distribution and processing. Here again, the preferred receivers are those that perform this conversion as an integral function without the use of auxiliary devices.

5.3 SIGNAL PROCESSING AND DISTRIBUTION

A minimum of signal processing is accomplished at the receiver building. Most 3-kHz circuits are relayed to the communications center where the signal is processed to extract the intelligence. Information received on CW circuits is relayed via teletype to the communications center for distribution or retransmission; however, the CW circuit is usually operated from within the receiver building. From the operational standpoint, the converter/comparator equipment associated with diversity reception of single-channel FSK performs best when located in the receiver building. The resulting DC signal is routed to a processing room in the receiver building or is relayed over the intersite communications link via a VFCT system to the communications center for processing. Experience has shown that better operation of the Primary

Ship/Shore circuit is obtained when all processing is accomplished within the receiver building. Therefore, a receiver building usually contains a ship/shore room for signal processing.

Signals are distributed within the receiver building in accordance with the NAVELEX standard plan for the particular circuit being implemented. The NAVELEX standard plan for the circuit specifies whether the information is to be processed within the receiver building or relayed to the communications center for processing. The location selected for processing is the one that has been found to be the most operationally and technically efficient.

5.4 CHANNELIZATION AND ROUTING

All receiver radio outputs, except those in the ship/shore room are routed to the receiver control area. There, they are monitored for proper level adjustment and quality before transmission to the communications center or processing in the ship/shore room. Each receiver output is distributed through overall shielded, twisted-pair cabling to distribution frames and patchboards. The main distribution frame and intermediate distribution frame(s) may be combined. The wiring criteria for such distribution are described in chapter 9. When an intersite communications link between the receiver building and the communications center is required, the main distribution frame is the place of interface. All information to be passed over this intersite link, which may be a telephone cable system as well as a microwave system, must be in an audio form capable of being passed over a 4-kHz bandwidth circuit. Some telephone cable and all microwave intersite link systems cannot directly pass DC signals. The DC signals are converted by VFCT prior to transmission over the intersite link. DC signaling may be permitted where the intersite cable link characteristics allow such operation.

5.5 RECEIVER PATCHBOARDS

The outputs of receivers are terminated at audio patchboards in the receiver control area. These outputs are arranged in a logical sequence usually starting from the upper left-hand portion of the board. ISB receiver outputs are labeled as to sideband and channel in accordance with table 5-2 and the outputs on the patchboard are arranged as shown in figure 5-1, or 5-2. The arrangement shown in figure 5-1 is for use with an up-to-date receiver; that shown in figure 5-2 is for use with systems that employ separate demultiplexers. When receivers have separate outputs for FSK or CW signals these outputs are terminated on the audio patchboard. All FSK outputs are grouped together and arranged in numerical order according to the receiver number. Separate outputs for CW signals are terminated and arranged in a similar manner. The standard receiver audio output level shall be at -13dbm for single and multichannel tone data signals and at -10dbm mean value for composite speech at the audio patch board measuring point. Test tone levels observed under such settings will be either 0 dbm or -10dbm depending on the transmitting location standards.

5.6 RF DISTRIBUTION

Present day antennas, receivers and intermediate equipments are designed for RF 50-ohm impedance matching. Therefore, when new systems are being planned, all RF signal distribution is to be accomplished using 50-ohm coaxial cables. Many

Table 5-2. Receiver Output Nomenclature

DESIGNATION	SIDEBAND OR SIDEBAND PART
A_1/A_2	6-kHz Upper Sideband
B_1/B_2	6-kHz Lower Sideband
A_1	3-kHz Inner Portion, Upper Sideband
A_2	3-kHz Outer Portion, Upper Sideband
B_1	3-kHz Inner Portion, Lower Sideband
B_2	3-kHz Outer Portion, Lower Sideband

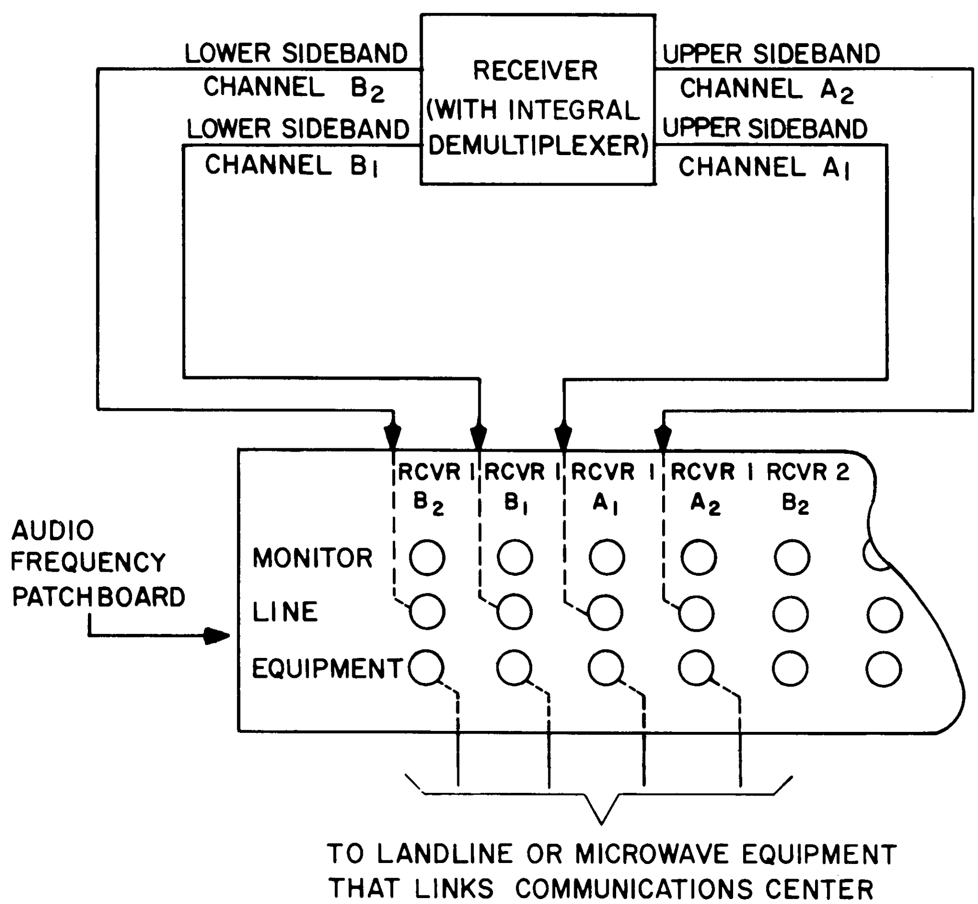


Figure 5-1. Receiver Patchboard (Integral Demultiplexer)

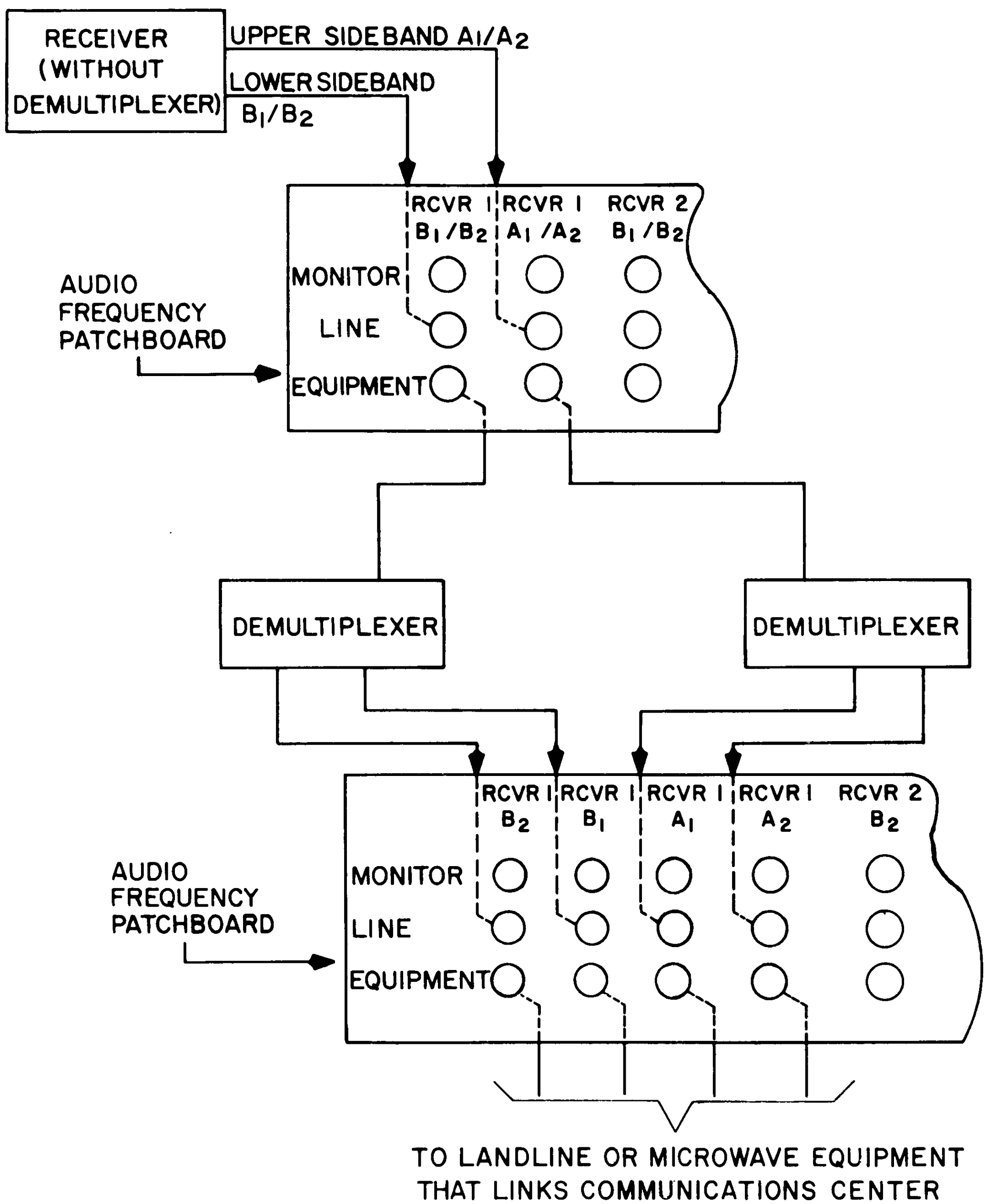


Figure 5-2. Receiver Patchboard (Separate Demultiplexer)

existing receiver sites have 70- and 75-ohm coaxial cables serving as the RF distribution system. The 70- and 75-ohm systems are not to be updated with 50-ohm cables, except on an individual basis as may be required because of deterioration or other communications considerations. Updating to 50-ohm coaxial cables may also be authorized when major installations at the site would make replacement economically feasible. When new items of equipment are installed at sites using 70- or 75-ohm cabling systems, the impedance mismatch is usually acceptable.

Switching matrices, or patchboards, such as the one shown in figure 5-3, provide for flexibility in the RF distribution system by terminating:

a. Each antenna output.

b. Each multicoupler input and output.

c. Each receiver RF input.

These switching matrices, or patchboards, are used by operators to test, substitute and bypass equipment. Combined multicouplers and switching matrices are under development to replace the present separate multicoupler and RF patch board systems.

5.6.1 Antenna Multicouplers

Receiver multicouplers permit the use of a single antenna as the signal source for more than one receiver by providing several outputs identical to the input. Although passive multicouplers are used occasionally, most multicouplers are active devices with amplification limited to that which is necessary to raise the output of each channel to the level of the input. Multicouplers can be cascaded to provide additional multiple outputs.

It is an accepted practice to install multicouplers in a cascaded "normal-through" arrangement when operations require more than 8 outputs of a single antenna. Up to 5 multicouplers have been successfully cascaded without degrading the signal below acceptable limits. For each installation, at least one installed spare multicoupler is necessary to permit the manual cascading of multicouplers and to provide backup for a defective unit. Where large groups of multicouplers are employed, there should be one installed spare for every ten multicouplers. Multicouplers and installed spares should be distributed as shown in figure 5-4.

Multicouplers are installed in groups by antenna types in CY-597A/G or CY-2675 standard equipment cabinets and each multicoupler is identified with the antenna to which it is normally connected. Multicouplers within a group are numbered in sequence from the upper left, top to bottom of each cabinet.

5.6.2 Normal Receiver Station Antenna RF Distribution

Antenna outputs are normally distributed as shown by figure 5-5. The patching equipment and RF multicouplers are normally collocated within the receiver building. All antenna transmission lines enter the receiver building through the cable vault where any necessary reduction in cable size or change of cable type takes place. RF distribution within the receiver building is usually accomplished with a smaller diameter cable than that used from the antenna to the building.

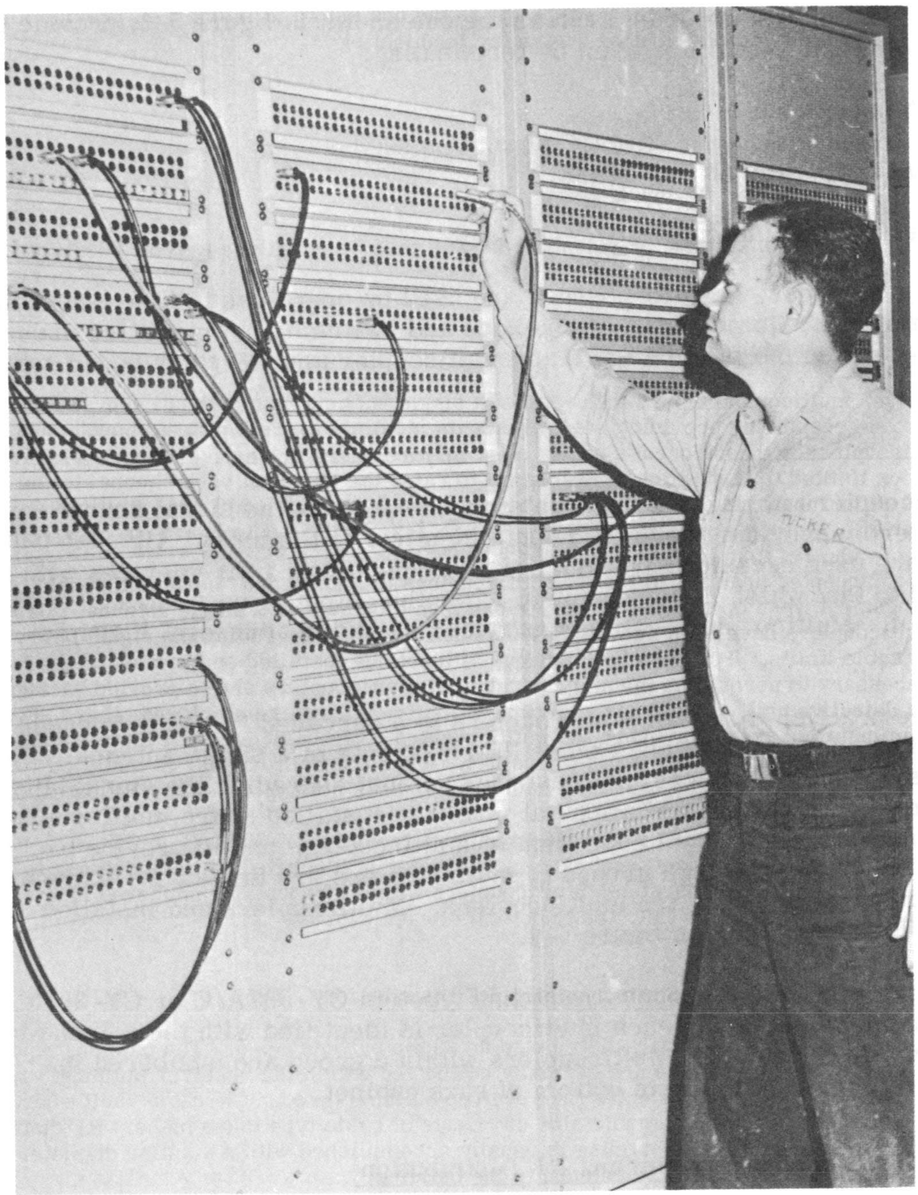


Figure 5-3. RF Receiver Coaxial Patchboard

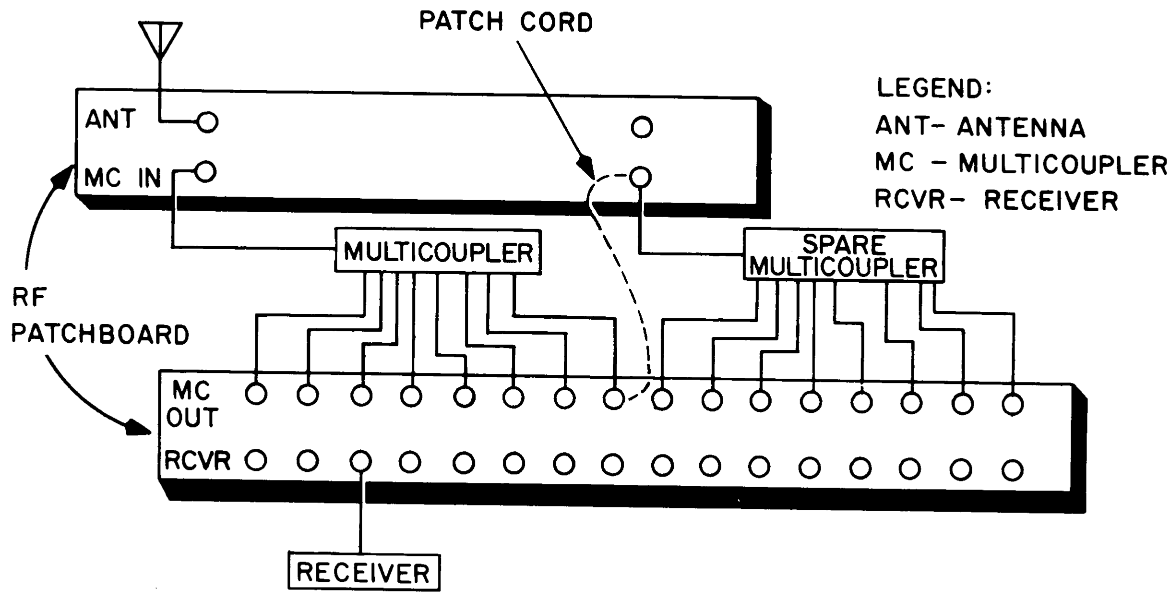


Figure 5-4. Multicoupler and Spare Multicoupler Installation

5.6.3 Wullenweber Antenna RF Distribution

The Wullenweber antenna, used for communications, is a multiple-function receiving antenna array that can produce simultaneously an omnidirectional pattern and several directional beams. The array consists of numerous vertical antennas symmetrically located around a cylindrical screen. All of the antennas are connected to multicouplers with transmission lines precisely cut to equal electrical lengths so that the phase delay will be the same for all lines. The outputs of these multicouplers can be used in the following ways:

a. To select an individual antenna for a specific receiver.

b. To combine selected antennas to operate as an omnidirectional antenna.

c. To combine signals from several selected antennas through beam-forming (delay-line) networks to produce a high-gain directional beam pattern.

Several beam-forming networks are included so that a corresponding number of beams are formed. These beams are aimed in appropriate directions to meet operational requirements. Thus, several options are available for antenna and receiver combinations. The omnidirectional pattern, one of several beams or any individual antenna can be selected for use with any receiver. Figure 5-6 is a simplified drawing of the RF energy distribution from a communications-type Wullenweber array. Descriptions of various Wullenweber antennas are given in NAVELEX 0101,104 — "HF Radio Antennas Systems." Additional information on Wullenweber antennas, related to criteria for naval security group sites, are included in NAVELEX Publication 0101, 108.

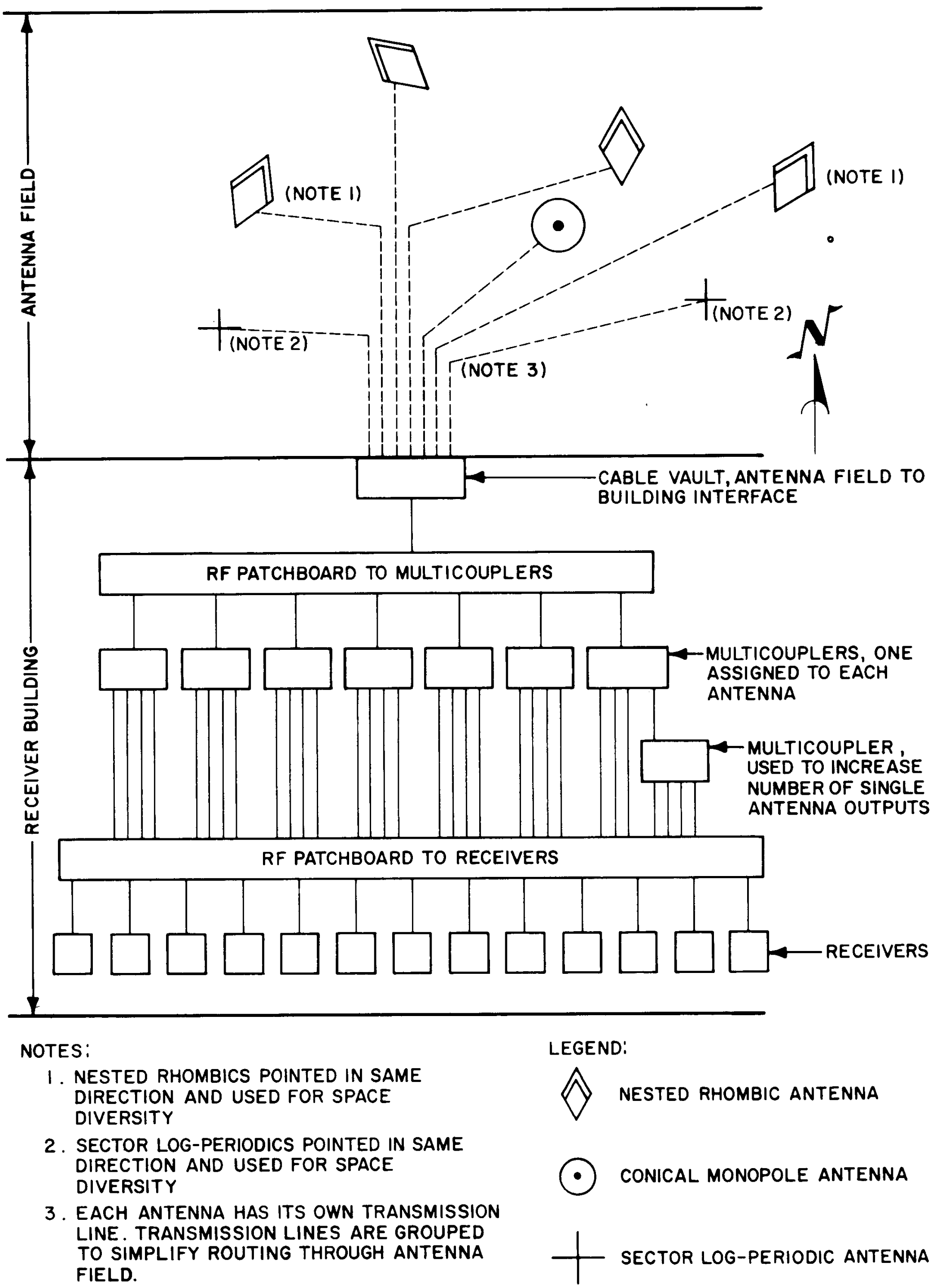
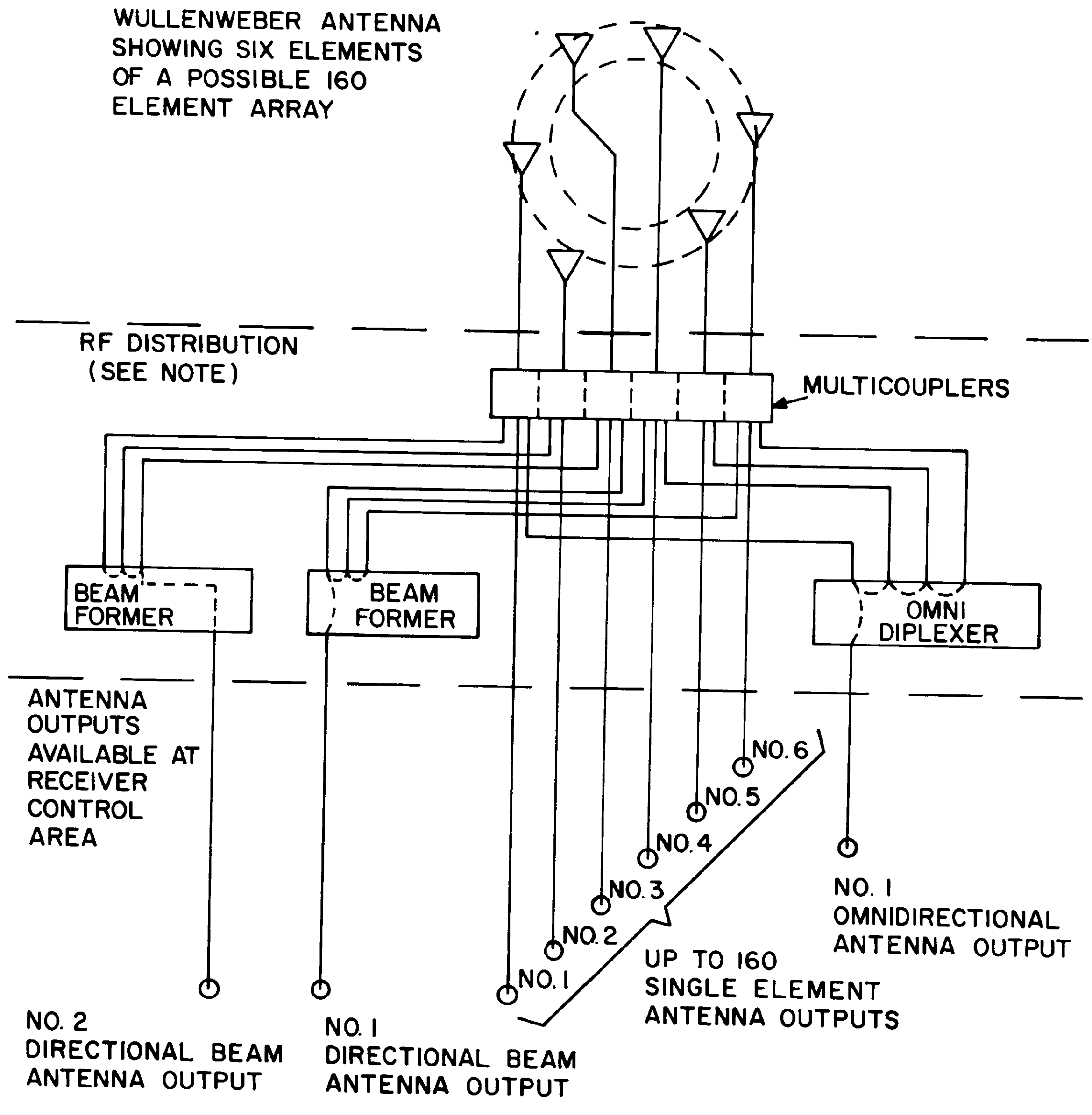


Figure 5-5. Normal Receiver Station Antenna RF Distribution



NOTE: EACH OF THE 160 ELEMENTS FEED THE RF DISTRIBUTION IN A SIMILAR MANNER, ADDITIONAL BEAM AND OMNIDIRECTIONAL UNITS ARE INSTALLED IN ACCORDANCE WITH OPERATIONAL REQUIREMENTS.

Figure 5-6. Typical Wullenweber Array RF Output Capabilities

5.7 RECEIVER SUPERVISORY AREA

A centralized receiver supervisory area is required for each receiver station. This area is to include facilities for all elements of receiver control other than receiver tuning and initial turn-on. The following equipments and controls are in the supervisory area:

a. Circuit patchboards (both audio and DC) for each receiver output and for each channel of the communications link between the communications center and the receiver station.

b. RF patchboards that include antenna outputs, multicoupler inputs and outputs, and receiver RF inputs.

c. A display to show antenna assignment and receiver circuit employment. This display may be provided by on-site personnel or, in the case of large complex systems, it may be part of the installed equipment and it may include an automated updating capability.

d. Controls for directing rotatable-type antennas such as the rotatable log-periodic (RLPA). Since RLPA antennas are used to meet specific operational requirements, multicoupling of a particular RLPA for other than its intended operational application is discouraged.

e. Teletype and voice communications equipment to coordinate operations with the communications center and within the receiver building.

f. Monitoring receivers to facilitate supervision and control.

g. A central time and frequency standard to control the frequency synthesizers of individual equipments. This standard is being implemented as funds become available. The control frequencies are distributed through small coaxial cables which may be routed in the same trays and ducts in which signal and control cables are routed.

5.7.1 Supervisor's Console

The supervisor's console may range from a desk at smaller stations to an automated console at a large complex installation. The supervisor's console must be centrally located with the above listed equipments and functional controls. When special operational difficulties are anticipated, specific items of this equipment may be incorporated within the console itself.

An example of a special console, shown in figure 5-7, is the one installed at the receiver station, Sugar Grove, West Virginia. This station has a switching matrix to switch receiver RF inputs to the individual elements of the Wullenweber antenna array or to the various beams and omnidirectional RF outputs derived from the Wullenweber. The console incorporates control of this matrix and includes readouts from a sensing system within the matrix that show the signal levels of individual antennas. The console operator selects the antenna receiving the best signal.

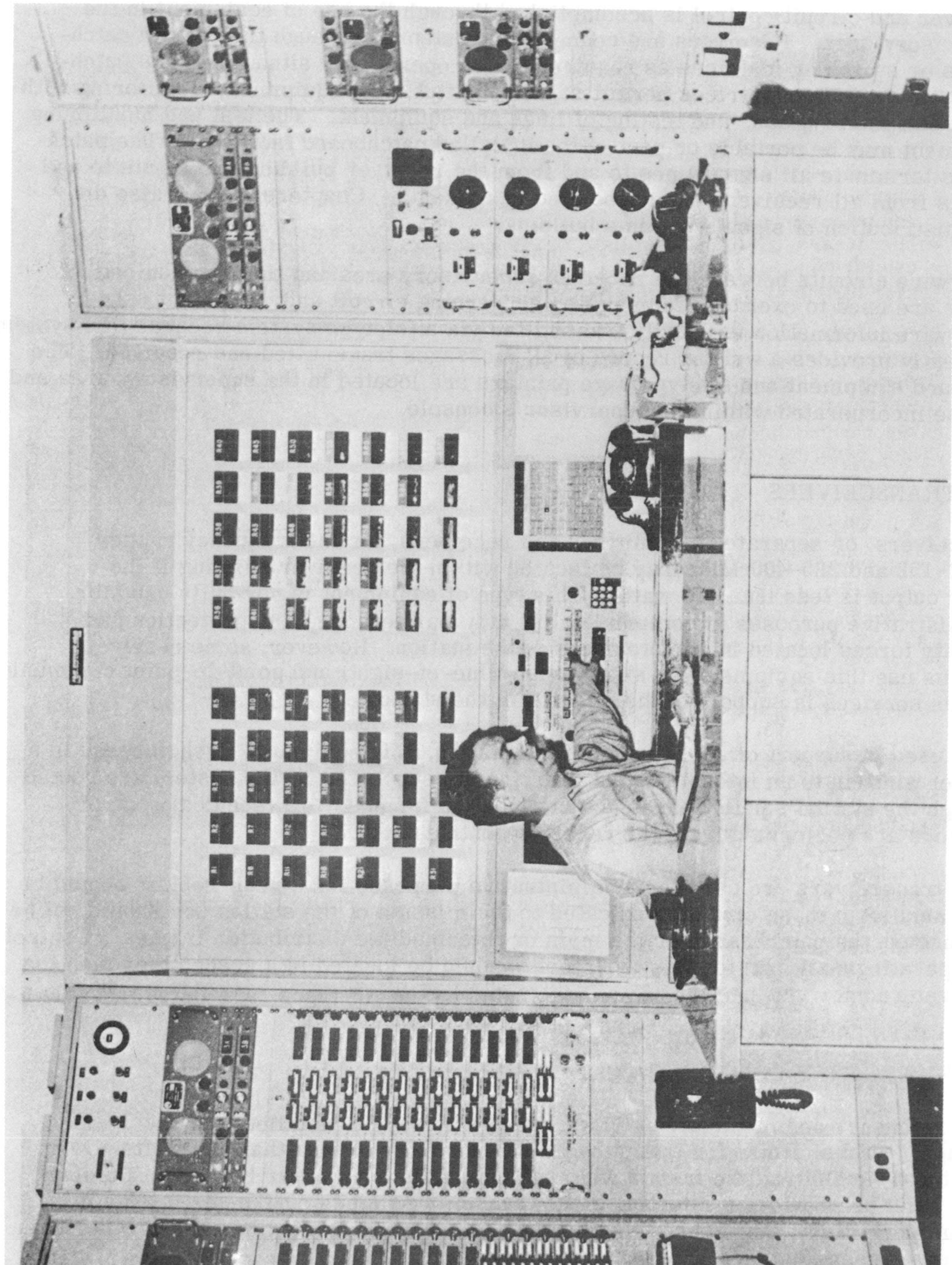


Figure 5-7. Supervisor's Console, Sugar Grove, West Virginia

5.7.2 Receiver and Circuit Control

Receiver and circuit control is accomplished through the use of equipment in the supervisory area. Receivers are connected to antennas through the coaxial patchboards or switching matrices as required by the operational situation. The patchboards or switching matrices permit rapid substitution of equipment, monitoring without circuit interruption, and testing of lines and equipment. The test and monitoring equipment may be portable or part of the installed patchboard facilities. The patchboards terminate all signal lines to and from the receiver building and inputs to and outputs from all receivers and associated equipments. Chapters 3 and 9 also discuss distribution of signals within a building.

Orderwire circuits between the receiver supervisory area and the communications center are used to exchange information concerning circuit and equipment usage. Orderwire information is usually transmitted via a teletype system because this system inherently provides a written record of all messages transmitted and received. The keyboard equipment and teletype page printers are located in the supervisory area and may be incorporated within the supervisor's console.

5.8 TRANSCEIVERS

Tranceivers, or separate transmitters and receivers, for the frequency ranges of 132-152 and 225-400 MHz may be located within the receiver building if the power output is less than 100 watts. This type of equipment is normally used for administrative purposes in communicating with maintenance, fire protection and security forces located in remote areas of the station. However, some receiver stations use this equipment for short range (line-of-sight) and point-to-point communications services in support of the mission of the station.

When used in support of the mission of the station, this equipment is engineered in a manner similar to an intersite link. All circuits supported by the system are routed through the station's patchboards and distribution frames. All technical control functions are performed from the receiver control area.

When transceivers are used for administrative purposes the circuit routing should be separated from those circuits dedicated to the mission of the station and should not be run through the patchboards or the main or intermediate distribution frames. Control and operating positions for this equipment should be located in a space other than the receiver room. Typical transceivers, including the HF types, are listed in Table 5-3.

5.9 EMERGENCY COMMUNICATIONS

For emergency communications HF transmitters may be installed in a receiver building. Transmitters for this purpose are normally of less than 100 watts power output and usually radiate from a whip antenna on the roof of the building. Dummy loads must be provided for testing these transmitters since on-the-air testing is seldom permitted. Any such transmitters are normally located in a room other than a receiver room.

Table 5-3. Typical Transceiver Equipment

NOMENCLATURE	FREQ RANGE MHz	EMISSION TYPES	PWR. OUT WATTS	10 DB SENS'TY VOLT	ANT. IMP. OHMS	AUDIO OUTPUT OHMS	POWER INPUT DATA				DIMENSIONS			SIZE		REMARKS
							WATTS	VOLTS	PH.	FREQ HZ	H IN.	W IN.	D IN.	VOL FT^3	WT LBS	
AN/PRC-25	2-11.99	A1, A3J	100	2.0	50	Handset	320-TX 20-RX	24 VDC 115 VAC	1	400	13.25	21.625	7.5		49.5	
AN/URC-58	2-15	A1, A3A A3J, A7J	25 100	1.0	52	600.		115/230 VAC ± 10%	1	50-60	7.75	17	14.75		59	Conus Instl Auth on Case Basis Only
AN/URC-32, A, B	2-30	A1, A2, A3 A3J, A7J A9J	125 500	1.0	52	600/600	1700	115/230 VAC	1	50-60	73	21.5	17.5	48.7	470	
AN/WRC-1, A, B	2-32	A1, A3A, A3J, A7J A9J	25 50 100	1.0	50	600	235	115 VAC ±10%	1	48-450	21	17.5	19		220	
AN/URC-35, A	2-32	A1, A3A A3J	25 50 100	1.0	50	600	220	115V AC	1	48-450	14	17.375	19		180	
AN/PRC-25	20-70	F3	1		Whip			24 VDC								Single Channel Narrow Band
AN/PRC-81	30-42	F3	1.4	0.6	Int. Whip	Int. Spkr.		* 115 VAC	* 1	* 60	10.5	3	2		3	*Built-in Battery Charger Single Channel Narrow Band
AN/PRC-97	30-42	F3														Single Channel Narrow Band
AN/FRC-36	30-42	F3	50	0.45	50	600	435	115 VAC	1	50-60						Single Channel
AN/FRC-42	30-54	F3	75	0.4				117 VAC	1	60	27	12	42			Single Channel
AN/FRC-52, A, B	25-54	F3	35	0.4	52	600		115 VAC	1	50-60	11	19	26		75	Single Channel
AN/FRC-58	30-42	F3	50		52	600		115 VAC	1	60						Single Channel
AN/FRC-143	25-50	F3	100		50	600	340	117 VAC ±10%	1	50-60	42	23	12.25		170	Single Channel
AN/VRC-60	33-42	F3	25 35	0.5	52	3.2	158	12/24 VDC			6 4.75	7.25 6.25	13.25 7.5		10 5	Single Channel
AN/VRC-77	30-42	F3	35	0.25	52	3.2	140	12/24 VDC			3.875	19	13.625		33	Single Channel
AN/PRC-40, AX	132-152	F3	1		Int. Whip	3.2 Spkr.		1.5/7.5/ 75 VDC								Single Channel

Table 5-3. Typical Transceiver Equipment (Continued)

NOMENCLATURE	FREQ RANGE MHz	EMISSION TYPES	PWR. OUT WATTS	10 DB SENS'TY VOLT	ANT. IMP. OHMS	AUDIO OUTPUT OHMS	POWER INPUT DATA				DIMENSIONS			SIZE		REMARKS
							WATTS	VOLTS	PH.	FREQ. HZ	H IN.	W IN.	D IN.	VOL FT^3	WT LBS	
AN/PRC-46	144-174	F3	1					1.5/10.5/ 150 VDC								
AN/PRC-61	132-152	F3	1.5	0.5	Int. Whip	Handset		1.5/6/ 67.5 VDC			10.125	3.125	12.125		7	Single Channel
AN/PRC-68	132-150.8	F3	25													
AN/PRC-73	132-174	F3	1.5	0.5	Int. Whip	2000 and Spkr.		22.5 VDC			10.125	3.125	1.25		4	Single Channel
AN/PRC-91, A	132-150.8	F3	2.2	0.35	Int. Whip	Spkr.		15 VDC			2.0	3.375	10.5		1.8	Single Channel
AN/GRC-168	116-149.97	A3	20	2.5	50	600		22-30 VDC 110/ 220 VAC ± 10%	1	50-400	5.25	19	20		65	1360 Channels Remotely Controllable
AN/FRC-59	132-152	F3	50	0.5	50	3.2 600		115 VAC	1	60	54.25	20	18			Single Channel
AN/FRC-70, A	132-152	F3	50	0.6	52	4 500		117 VAC ± 10%	1	50-60	25.5	18.75	10.5		75	Single Channel
AN/FRC-83	132-152	F3	80	0.5	52	600	38	117 VAC ± 10%	1	50-60	42	27	12.25		60	Single Channel
AN/FRC-144	132-150.8	F3	80		52	600	340-TX 95-RX	117 VAC ±10%	1	50-60	42	23	12.25		170	Single Channel
AN/FRC-150	132-150.8	F3	50	0.5	50	600	230	117 VAC ± 10%	1	60	31.5	15.5	12			Single Channel
AN/VRC-37	132-152	F3	25	0.6	50	3.2	220	6/12/24 VDC			6.125	15.375	20.25			Single Channel
AN/VRC-42	132-152	F3	25		52	Spkr.		6/12/24 VDC			5.625	11	13.5		38	Single Channel
AN/VRC-51	132-152	F3	25				170	12/24 VDC			5.5	9.25	12.5		25	Single Channel
AN/VRC-52	132-150.8	F3	25/35					12/24 VDC								Single Channel
AN/VRC-56	132-150.8	F3	30	0.5	52	3.2	225	12/24 VDC			9.875	4.625	15.75		18.5	Single Channel
AN/VRC-78	132-150.8	F3	25	0.5	50	4	150	12/24 VDC			3.5	10.25	17.25		23	Single Channel

Table 5-3. Typical Transceiver Equipment (Continued)

NOMENCLATURE	FREQ. RANGE MHz	EMISSION TYPES	PWR. OUT WATTS	10 DB SENS'TY VOLT	ANT. IMP. OHMS	AUDIO OUTPUT OHMS	POWER INPUT DATA				DIMENSIONS			SIZE		REMARKS
							WATTS	VOLTS	PH.	FREQ. HZ	H IN.	W IN.	D IN.	VOL FT^3	WT LBS	
AN/PRC-41	225-400	A3	3	3.0	50	300	85-TX 59-RX	26 VDC 115/230 VAC	1	50-400	13.25	11.125	4.25	0.25	22.5	1750 Channels
AN/SRC-20	225-400	A2, A3	100	6.0	50	600 (3 ea)	1440	115/230 VAC	1	50-60	52.5	22.125	26.75		511	1750 Channels
AN/SRC-21	225-400	A2, A3	25	6.0	50	600 (3 ea)	1440	115/230 VAC	1	50-60	35.5	22.125	26.75		284	1750 Channels
AN/URC-9	225-399.9	A3	15	6.0	52	600/600	440	115/230 VAC ±10%	1	50-60	12.25	19	19.5		157	1750 Channels
AN/URC-67	225-400	A3	100	16.8 db N.F.	50	600	2130	115 VAC ±10%	1	50-400	29.75	19	22		324	Auto Tuning 3500 Channels
AN/URC-69	225-400	A3	100	16.8 db N.F.	50	600	2130	115 VAC ±10%	1	50-400	29.75	19	22		292	3500 Channels
AN/GRC-164	225-399.95	A3	50	N/A	50	N/A	750	115V AC ±10%	1	47-420	12.25	17.75	18.5	N/A	113	Single Channels 50KHz

5.10 CONSTRUCTION AND INSTALLATION

Receivers and their associated equipments are adaptable for installation in most existing structures. The controlling criterion for the structure is that it must provide an acceptable environment for the equipment and personnel. Receiver buildings are usually permanent structures; however, in overseas areas on foreign soil, current DOD instructions state that communication facilities be transportable rather than permanent structures. When new construction is contemplated the general criteria of chapter 7 and the specific criteria of this section are applicable to the receiver building.

5.10.1 Receiver Building Features

a. The building must be a rectangular single floor structure.

b. The receiver room and rooms for other electronic equipment must be windowless and free from obstructions.

c. The floor may be concrete, and it must be designed to support a loading of 150 pounds per square foot.

d. The equipment rooms must have a 10-foot clearance between floor and ceiling. This clearance must be maintained when raised floors and suspended ceilings are installed.

e. The electronics maintenance shop must contain a screen room, measuring about 10 by 15 feet, that provides 60 dB attenuation in the frequency range of 10 kHz to 100 MHz.

f. Cable vaults are required to serve as the entrance for all antenna transmission lines.

5.10.2 Receiver Building Lighting

Fluorescent lighting may be used in the receiver building and in the receiver room when the fixtures are equipped with power line filters and are grounded with the green, third wire of the power line feeder.

5.11 EQUIPMENT ARRANGEMENT AND LAYOUT

Equipment is placed so as to promote operator efficiency and to ensure sufficient space for maintenance accessibility. A standard layout has not been established because station operational requirements differ greatly. A layout with the operating equipment surrounding the supervisor's control area is the most desirable arrangement. At smaller stations all receiving and associated equipment can be observed from the supervisory area. Figure 5-8 shows an example of a small station layout. In this example the station is in one room of a building; space required for personnel and support services is not shown. At larger stations the quantity of equipment installed precludes such a simple layout, but the general principle should be followed as far as possible. In a large station equipments must be assembled in lines facing

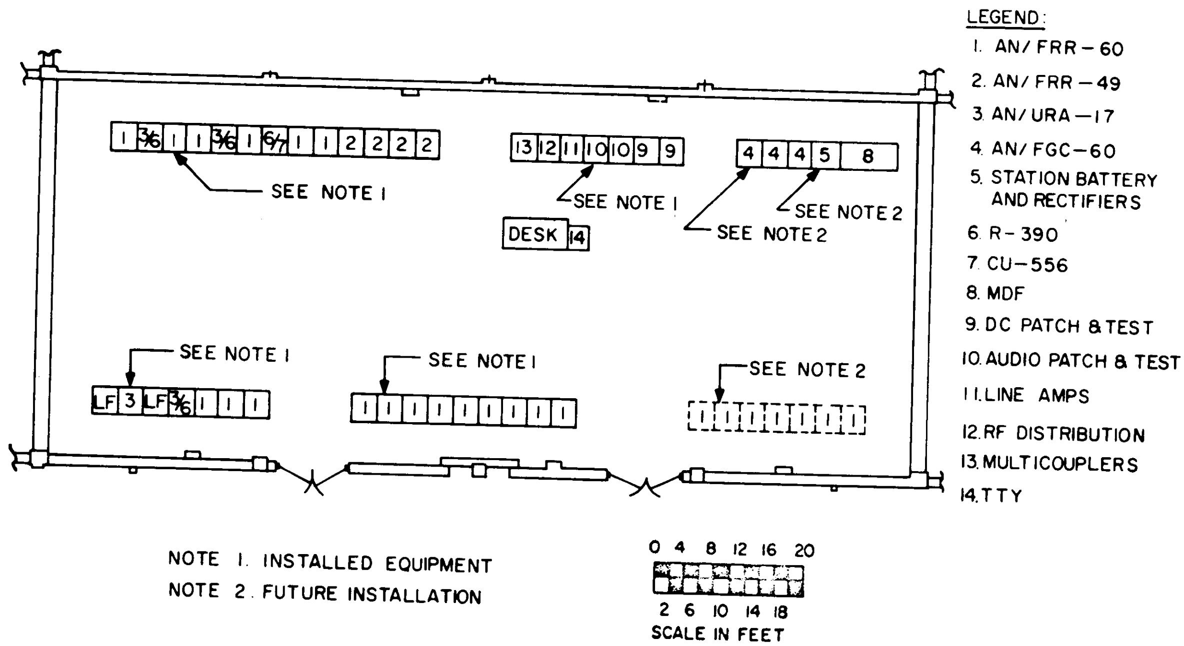


Figure 5-8. Receiver Room, Small Receiver Station

front-to-front. Between the fronts there must be a minimum of 6.4 feet to form an aisle which will be accessible to operators and maintenance crews. Figure 5-9 shows an example of the layout for a large station specifically designed for receiving purposes.

5.12 RECEIVER BUILDING GROUND

Receiver building and equipment grounding has been investigated by the Naval Electronic Systems Test and Evaluation Facility, St. Inigoes, Maryland. The conclusions were:

a. The controlling factor affecting RF signal reception is external noise (atmospheric, cosmic and man-made) entering the receiver via the antenna.

b. A very low resistance earth ground connection is expensive to install, hard to maintain and adds nothing to the operational efficiency of a modern receiver.

c. Bonding and grounding of all structural metal which is no longer than 24 inches is of value only when reradiation of a signal is deemed to be a possibility.

The recommendations of this report have been accepted as the grounding criteria for the receiver building, provided Red and Black processing (exclusive of orderwire traffic) will not be required. When Red and Black circuit processing is to be accomplished within the receiver building the signal grounding system must be in accordance with the latest issue of NAVELEX Instruction 011120.1. A discussion of Red and Black signal grounding is also included in chapter 12.

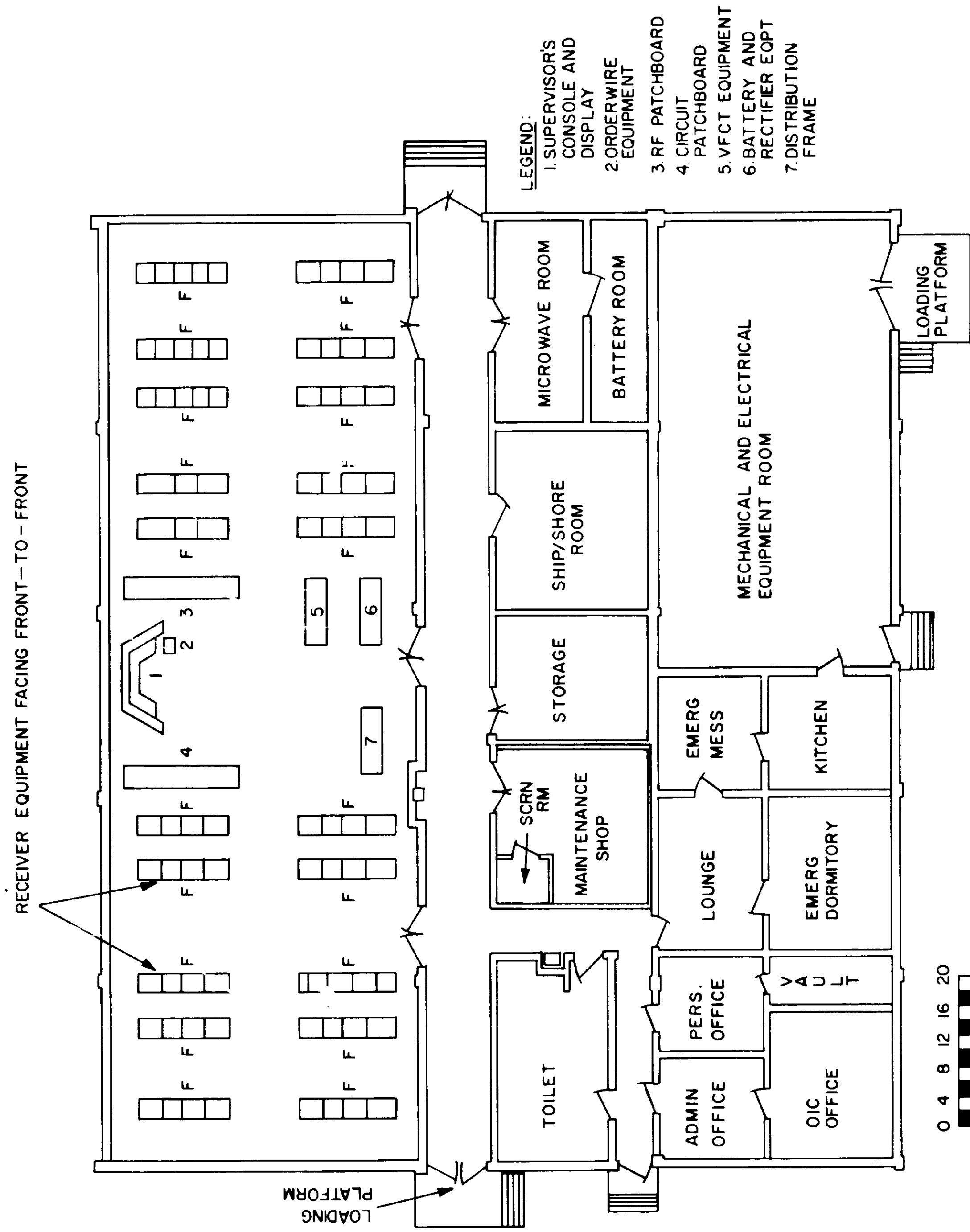


Figure 5-9. Receiver Building, Large Receiver Station

The following criteria govern the grounding system of the receiver building the location of which presumed to be as recommended, provided that the building is not collocated with a transmitter site.

a. One ground connection point will be used. Separate earth ground points for electrical and communications systems will not be used.

b. Resistance of the ground system to solid earth must comply with the provisions of article 250-84 of the National Electrical Code which requires a resistance to ground of not more than 25 ohms.

c. Bonding and grounding of structural metal which is longer than 24 inches is not normally required. Such a requirement is to be treated on an individual case basis.

5.12.1 Receiver Building Earth Ground Connection

A good earth ground connection can be established by selecting a grounding electrode recommended in articles 250-81, 250-82, and 250-83 of the National Electrical Code Handbook (NECH), 1968, which states than an underground water piping system, either local or one that supplies a community, is preferred as the ground point. This handbook permits other ground point possibilities such as the metal frame of a building, other underground pipe or tank systems (exclusive of gas service piping), and electrodes installed in the ground. A general discussion of installed electrodes, together with recommended test methods, is found in chapter 12.

5.12.2 Receiver Building Ground Distribution Systems

The ground distribution system in the receiver building emanates from a ground bus that is connected to the selected earth ground connection point. All ground systems must be terminated on this common ground bus.

5.12.3 Ground Bus to Earth Ground Point Interconnection

The accepted criteria for the connection between the ground bus and ground point for the receiver building are:

a. Connection between ground bus and earth ground point must be made with a conductor that runs either directly to the earth ground point or to the main electrical service entry point ground lead which is in turn run to the earth ground point.

b. The size of the conductor connecting the bus and earth ground point must not be less than that specified by article 250-94 of the NECH. Number 6 copper wire, or its equivalent, in ampere rating capacity is sufficient to connect to any electrode installed to serve as the ground point.

c. The conductor connecting the ground bus to the earth ground connection point must be attached by a suitable ground clamp, a terminal screw, or a pressure connection.

5.12.4 Ground Bus to Equipment Distribution

The accepted criteria for the ground distribution between equipment and the ground bus for the receiver building are:

a. All electronic equipments and component parts of an electronic system must be provided with a separate grounding conductor to connect the electronic equipment to the ground connection point. This conductor is normally the third wire, green AC protective ground, provided as part of the power feeder.

b. Grounding conductors must be routed with circuit power conductors from electric distribution panelboards to the cabinet or rack that houses electronic equipment.

c. Grounding conductors must have a green covering with or without yellow stripes.

d. The grounding conductor must be the same size as the power conductors with which it is routed.

5.12.5 Ground Conductor Termination

The accepted criteria for terminating the ground conductor to electronic equipments in the receiver building are:

a. The grounding conductor must be terminated directly to the ground terminal (if provided) on the electronic equipment. This type of installation can be accomplished easily when a single power feeder supplies power to an individual equipment.

b. If grounding terminals are not provided on equipments, grounding can be a accomplished by bonding the ground wire to the equipment enclosure.

c. When several equipments are mounted in a cabinet or rack and power is supplied by a single power feeder, a ground bus such as that shown in figure 5-10, should be installed to facilitate grounding. The following restrictions and procedures apply to this installation:

(1) The bus should be of highly conductive metal. (Copper is preferred.)

(2) The bus should be provided with easy access points so that equipments can be grounded easily.

(3) The ground conductor should be bonded to the bus.

(4) Bonding between the ground bus and equipment must be accomplished using approved bonding techniques.

(5) The third wire (green) of the AC plug and power cord is retained but does not by itself meet the grounding requirement.

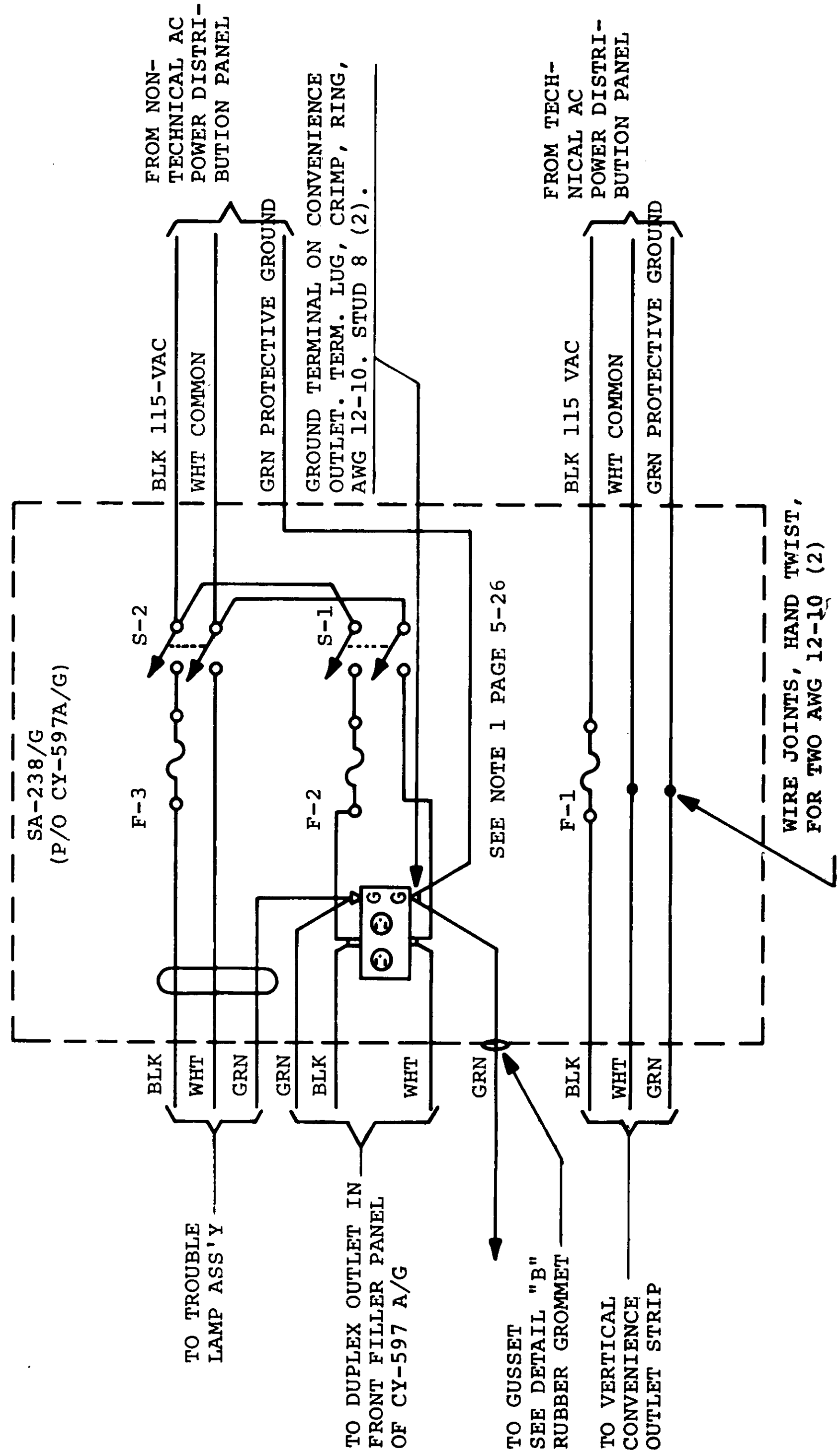


Figure 5-10. Typical Equipment Cabinet Grounding Detail

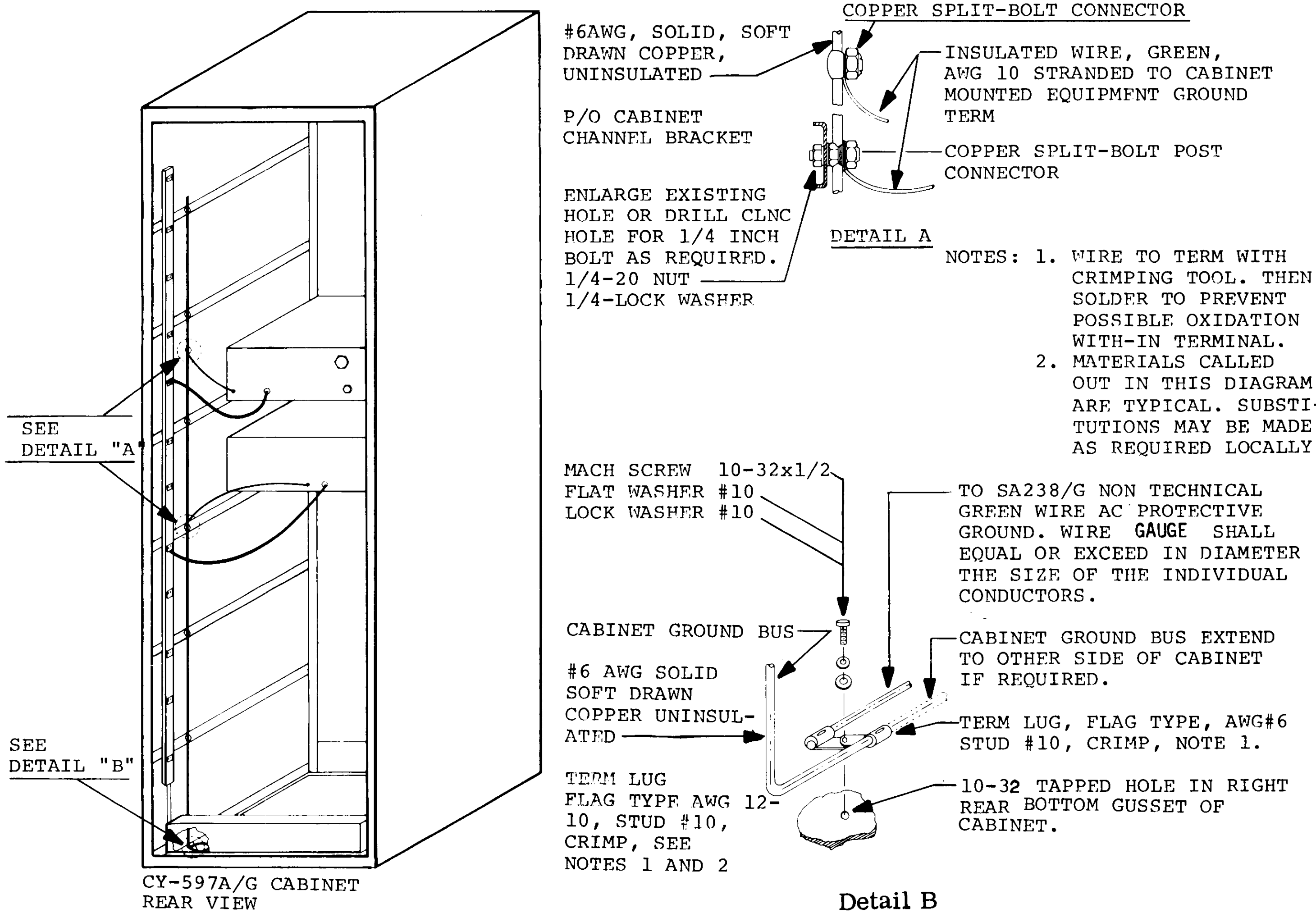


Figure 5-10. Continued

5.12.6 Ground System Testing

The connections of the grounding distribution system should show a resistance no greater than 0.5 ohms between the following:

a. Equipment ground (terminal or enclosure) and grounding electrode (ground wire leading to equipment).

b. Equipment ground (terminal or enclosure) and ground bus of the AC power source (grounded neutral of the power feeder).

c. Equipment ground (terminal or enclosure) and cabinet or rack in which it is installed.

d. Equipment ground (terminal or enclosure) and all other grounding systems within the building.

5.13 SITING

The general geographic site for the receiver station is selected based upon the operational requirements and the adaptability of the site for receiver purposes as discussed in NAVELEX 101, 103 — "HF Radio Propagation and Facility Site Selection." Table 5-4 is the accepted criteria which establish the minimum distances for separating the receiver building and its associated antenna park from possible interference sources. This table is applicable once the general geographic location has been selected. The receiver building must be located in the center of the antenna park. When a station is erected, the reasons for selection along with initial background noise measurements must be recorded for future reference. This recorded information provides a base line for future evaluation of requests to permit other facilities to encroach upon the receiver location and for determination of the seriousness of any noise pollution problems.

A receiver station must be protected from encroachment by establishing a protective corridor and a legal restricted area, each one mile wide as shown in figure 5-11. The protective corridor is located within the station boundary and can be used for installation of temporary antennas. The legal restricted area is a land area surrounding the boundary of the station in which it is illegal to develop the land in any way that would be detrimental to the mission of the receiver station. Constant vigilance is required to maintain the "status quo" once the legal restricted area is established.

5.14 INTERFERENCE

One of the most important factors to consider when siting or installing receiver systems is to minimize the effects of interference. This applies to self-generation of radio interference as well as provision against external interference. Poor installation and poor maintenance practice can result in the existence of high levels of radio interference even though the original installation was not located in an area of high radio interference levels. This condition is caused by the subsequent installation and operation of radio interference sources in proximity to a receiving activity without taking corrective action towards rendering these sources ineffective by means of shielding or filtering as necessary.

Table 5-4. Receiver Station Separation Distances

SOURCES OF INTERFERENCE	MINIMUM DISTANCE
High-power transmitter stations:	
Very low frequency	25 mi
Low frequency/high frequency	15 mi.
Other transmitters not under Navy control	5 mi.*
High-voltage power transmission lines 100 kV or greater	2 mi
Receiver Station power feeders	1000 ft from nearest antenna
Airfields and glide paths:	
For general communications	5 mi
For aeronautical receiving at air station	1500 ft
Teletype and other electromechanical systems:	
Low level operation or installed in shielded room	No minimum
High level operation installed in unshielded room	
Large installation (communications center)	2 mi from nearest antenna
Small installation (1 to 6 instruments)	200 ft from nearest antenna
Main highways (maximum hourly traffic count exceeds 1200)	3000 ft
Habitable areas (beyond limits of restriction)	1 mi
Areas capable of industrialization (beyond limits of restriction**):	
Light industry	3 mi
Heavy industry	5 mi
Radar installation	***
Primary power plants	5 mi

*The following NAVELEX requirements also govern distances to non-Navy transmitter stations:
—Signal from non-Navy station shall not exceed 10 millivolts per meter (field intensity) at Navy site boundary.
—Harmonic or spurious radiation from non-Navy station shall not exceed 5 microvolts per meter (field intensity) at Navy site boundary.

**The restriction limit is the protective corridor i. e. that area between the outer limits of the antenna field and the site boundary.

***Calculate using EMI prediction procedures in NAVELEX 0101, 106.

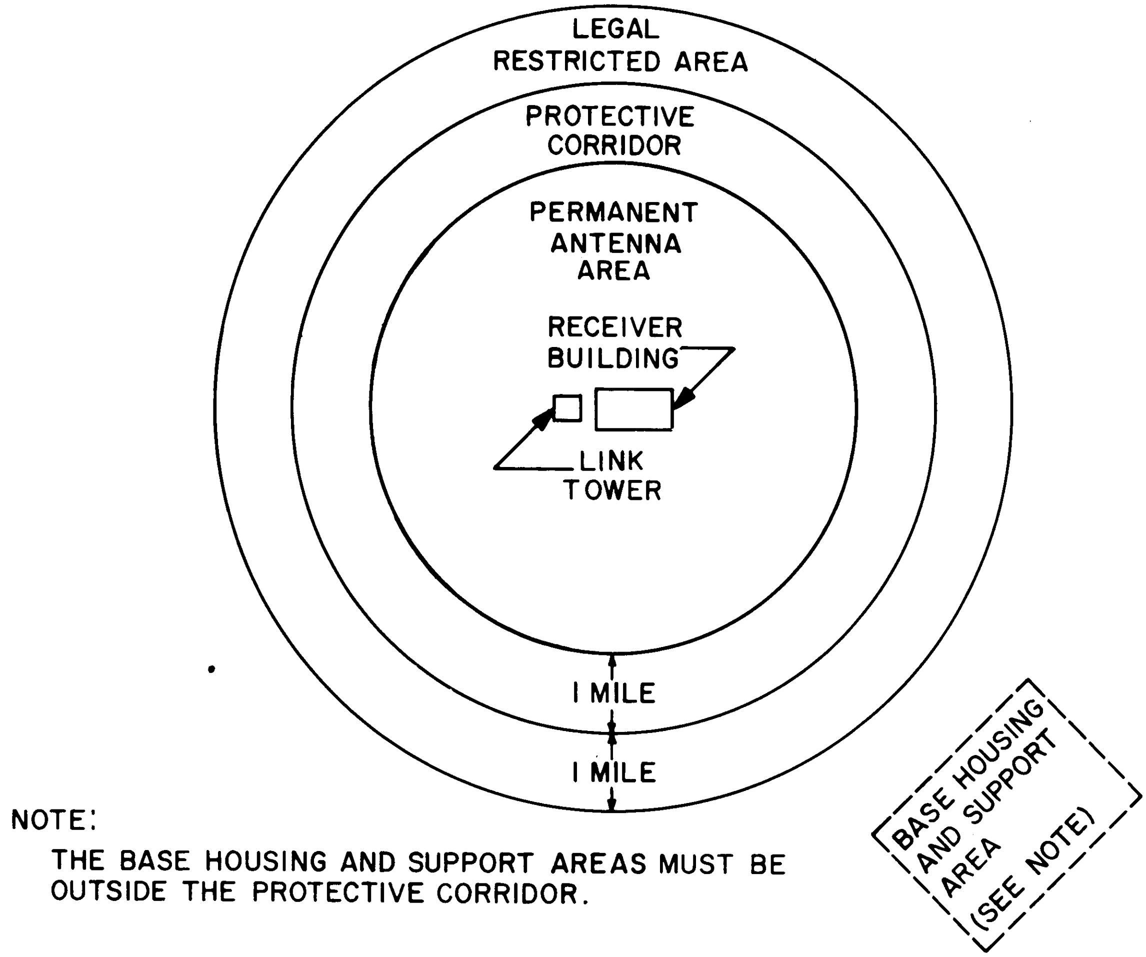


Figure 5-11. Receiver Station Site Plan

The best time to minimize future sources of interference is in the initial planning stages. Periodic checks of local activity near the receiving facility should be performed to verify that separation distances specified in table 5-4 are not changed. Often, if local authorities can be convinced of the need for restrictions, potential interference can be averted.

Man-made noise appears to be increasing on an exponential curve. Therefore, at all existing sites periodic noise measurements should be made for future reference. A record of noise intensities could aid in solving encroachment problems and may help in isolating sources of new man-made interference problems.

Intermodulation (IM) products are one of many kinds of interference effects which are among the most difficult to recognize since to a receiver it is as though another signal were superimposed on the desired one. IM products can be readily generated at any metal joint in structures, equipment and even in antenna connections in the presence of an RF field, and they are subject to increases of significant proportions if the joints are worn, loose or corroded.