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DECEMBER 1960

GROUND-TO-AIR TRANSMITTER, ESS

INSTALLATION MANUAL

THE MITRE CORPORATION
BEDFORD, MASSACHUSETTS

GROUND-TO-AIR TRANSMITTER, ESS INSTALLATION MANUAL

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CHAPTER 1

CHAPTER 1

CONCEPT AND DESIGN

1.1 INTRODUCTION

This manual documents the installation of an experimental ground-to-air transmitter-receiver facility (GATR) for SAGE weapons control. The GATR site is located near the Lincoln Laboratory of the Massachusetts Institute of Technology in Lexington, Mass. The designation GATR-ESS defines the joint function of the installation: it is a SAGE-GATR prototype which also provides communications for testing in the Evaluation SAGE Sector (ESS). The manual is divided into three chapters:

Chapter 1- Concept and Design
Chapter 2- Installation and Functional Description
Chapter 3- Equipment Specifications

Each chapter is designed for a different purpose and is self-sufficient. Chapter 1 explains the purpose, history, and overall function of the GATR installation; Chapter 2 summarizes the overall design and describes the installation and interconnection of the functional units; Chapter 3 presents the electrical details of the MITRE-designed or modified equipment and gives the designation of government furnished and commercial equipment. A list of commonly used abbreviations is given below.

LIST OF COMMONLY USED ABBREVIATIONS

AICC	Air intercept common channel
ASIA	Automatic sensitivity indicator alarm
ASTRA	Automatic substitution and transmitter and receiver alarm

CODAN	Carrier operated device anti-noise
CUG	Common user group (Telephone Company)
DDR	Digital data receiver
EMERG	Emergency channel
ESS	Evaluation SAGE Sector
FDDL	Frequency division data link
GATR	Ground-to-air transmitter-receiver
GEEIA	Ground Electronics Engineering Installation Agency
GFE	Government Furnished Equipment
PTP	Patch test panel
SAGE	Semi-automatic ground environment
SSD	Spare substitution device
TDDL	Time division data link
Telco	Telephone toll plant system (SAGE system)
TMA	Transmitter monitor alarm
uhf	Ultra high frequency
vhf	Very high frequency
TAC	Tactical channel (SAGE system)

1.2 GATR CONCEPT

SAGE operations call for both voice radio (uhf and vhf) and data link (uhf) communications between SAGE direction centers and the weapons they control. Within the uhf band each SAGE sector is assigned a different frequency family in the 225 to 399.9 mc range: each family has 20 tactical channels (TAC) for voice communication and 5 channels for data link. Three additional channels are provided: an air intercept common channel (AICC) and two emergency channels (EMERG), one in the uhf band and one an octave below at the vhf frequency of 121.5 mc. These 28 channels make up a SAGE frequency family. Of these, 25 channels (23 voice and 2 data link) can be operated simultaneously.

The simultaneous operation of 25 channels at one radio site clearly implies mutual interaction between signals. The intermodulation between products of transmitted frequencies could be expected to interfere with one or more received frequencies. For this reason the original SAGE operations plan specified that the transmitting facilities be separated from the receiving facilities by 1,000 ft or 60 db. Therefore, two buildings and two antenna arrays were necessary.

The possibility of collocating the transmitters and receivers in a single building adjacent to a consolidated antenna layout was raised in mid-1955, when three technical developments took form: compatible frequency assignments, uhf multicouplers, and expanded equipment performance data. In that year Lincoln Laboratory began an investigation to assign values to the parameters of single-site operation. Research on frequency selection indicated that intermodulation interference could be minimized and that a joint transmitter and receiver site was feasible in the SAGE environment. Single-site operation resulted in the following savings:

(a) The cost of one building and its subsequent operation and maintenance;

(b) the cost of land;

(c) the cost of one complete set of antennas, multicouplers, transmission lines, telephone poles, and internal cabling, and their maintenance.

In September 1957, Lincoln Laboratory published a summary memorandum* which presented analytical criteria for single-site operation and a proposed equipment layout. In recommending single-site operation the memorandum specified the following:

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*MIT Lincoln Laboratory Group Report 331-20, "Consideration for the Design of a Combined SAGE Transmitter Receiver Site for UHF and VHF Ground-To-Air Communications," by R. G. Enticknap and H. Sherman, September 1957.

(a) Simplex operation of each channel (push to talk).

(b) 10 mc separation between all channels using the same multicoupler and antenna.

(c) Antennas separated by 50 ft in the same horizontal plane. Channel assignment to antennas based upon calculations of their intermodulation products.

(d) The use of multicouplers on each voice channel.

In January 1958 Lincoln Laboratory, with the concurrence of the Air Defense Command, began a program to carry out the recommendations of Lincoln Laboratory Group Report 331-20*. In June 1958 a successful demonstration of single-site operation was conducted at the Lincoln Laboratory ground-to-air voice transmitter site at South Truro, Mass., for representatives from participating Air Force agencies. As a result of the demonstration and the interest expressed by all concerned, Lincoln Laboratory obtained concurrence from responsible Air Force agencies on the type of building to be constructed, the layout of equipment, and the proposals for installation of the equipment recommended by Lincoln Laboratory. At the same time, details of the siting criteria were discussed. A brief history of the conferences pertaining to the above points is given below.

July to August 1958 RAFD (GEEIA) at Rome, New York:
Investigation of the Air Force inventory to obtain a definitive building drawing compatible with single-site requirements.

August to September 1958 (ADSID, GEEIA) at Rome, New York:
Initiation of the basic design of a new building for the GATR single site; discussion of proposals for equipment layouts and installation details.

September to November 1958 (ADSID, GEEIA, ADC) at Rome, New York:
Lincoln Laboratory building and equipment drawings and proposals expanded and concurred upon by all parties concerned.

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*Ibid.

15-16 December 1958 (ADC) at Colorado Springs, Colorado:

Presentation of the Lincoln Laboratory drawings and proposal for concurrence by all Air Force agencies concerned, in preparation for presentation to USAF.

22 December 1958 (USAF) at Washington, D. C.:

Presentation and explanation to USAF of the Lincoln Laboratory proposal for the GATR single-site installation. The construction by Lincoln Laboratory of a prefabricated metal structure in place of the standard Air Force concrete structure was first discussed at this meeting. Lincoln concurrence on this proposal was delayed at the time, but given at a later meeting.

5-7 January 1959 (GEEIA) at Rome, New York:

A pre-siting conference was held by GEEIA, at which time the single-site criteria for siting and installation were presented and concurred upon.

The acceptance of the GATR single-site building (modified) by USAF on 22 December 1958 and of the single-site criteria by GEEIA on 5 January 1959 provided a basis for proceeding on the construction and installation of the prototype GATR site at the Lexington Field Station.

1.3 GENERAL DESCRIPTION

The GATR-ESS installation is based on the GEEIA standard and is a functional radio prototype for SAGE-GATR sites. All GATR test procedures can be carried out at the GATR-ESS site. Physically the GATR-ESS installation differs from the standard in the following ways:

(a) The operations building does not conform with military specifications. It is larger than operationally necessary because of its dual functions noted in Sec. 1.1. Prefabricated steel construction was used for economy and for speed of installation.

(b) The high-power directional array was not constructed because it was felt that radiation would create a hazard to the nearby radio, radar, and laboratory facilities.

(c) More operational equipment is installed than is normal for SAGE GATR installations because the site furnishes communication facilities for the ESS testing.

Since the GATR-ESS installation is both a prototype and an experimental test bed, versatility and adaptability were considered essential. In particular, the following considerations had to be kept in mind:

(a) All seven SAGE frequency families will be tested at the site.

(b) The compatibility of SAGE radio components will be tested in their prototype environment.

(c) The installation will be highly vulnerable to aperiodic interference from nearby radar and radio facilities.

The GATR-ESS site has been constructed adjacent to the Lexington Field Station of MIT's Lincoln Laboratory in Lexington, Mass. The building and antennas are situated on 2-1/2 acres near the top of a low hill (Figs. 1-1, 1-2).* The equipment in the building is placed to allow minimum intermodulation interference with maximum accessibility for operation and maintenance (Figs. 1-3, 1-4). Interchangeable units of equipment have been assembled in modules of independent functional groups to simplify periodic and emergency maintenance. Modular design also permits rapid and economical changes in the station facilities: channels can be added or taken away without changing the basic design or interrupting station operation.

1.4 GATR-ESS COMMUNICATION COMPLEX

The GATR-ESS communications complex (Fig. 1-5) consists of three subsystems which are functionally divided as follows:

(a) uhf voice

(b) ASTRA control

(c) vhf voice

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*Each text chapter is followed by its respective figures.

(d) frequency division data link

(e) time division data link

(f) uhf high-power amplifier (20 kw)

(g) ESS uhf voice

1.4.1 UHF Voice System

The uhf voice system consists of 24 transmitter-receiver sets for uhf voice communication: the 24 channels include 20 tactical channels (TAC), 1 air intercept common channel (AICC), 1 emergency channel (EMERG), and 2 spares. Normally the 2 spare transmitter-receiver sets provide operational standby for the AICC and EMERG channels.

Each one of the 24 uhf voice channels is made up of a single-channel uhf transmitter and a single-channel uhf receiver mounted in a standard equipment rack with a set of auxiliary maintenance and control devices. The racks are grouped into independent modular units of 5; 4 single-channel equipment racks and 1 containing a 4-channel antenna coupler and module termination devices (Fig. 1-6). The antenna coupler is tied directly to an omni-directional antenna. Six of the five-rack equipment and antenna modules, each providing 4 channels, combine to make up the 24-channel uhf voice complex.

1.4.2 ASTRA Control System

The ASTRA (automatic substitution transmitter-receiver alarm) system automatically transfers a voice radio channel from a malfunctioning receiver and/or transmitter to a properly operating standby. The ASTRA system is composed of 3 major components; the transmitter monitor alarm (TMA), the automatic sensitivity indicator alarm (ASIA), and the spare substitution device (SSD). The SSD provides visual and audible failure alarm for all SAGE voice equipment through a subcomponent, the automatic status board. Operational standby for the 20 SAGE TAC channels is provided by 2 multichannel radio transmitter-receiver sets, each designed to provide 11

pretuned, remotely selected channels. The multichannel equipment is also provided with TMA and ASIA monitoring units for remote status indication.

Each SAGE uhf single-channel transmitter is monitored by a TMA unit to detect a reduction in the transmitter power output or a decrease in the transmitter modulation level. The TMA also monitors the transmission and antenna system to detect an increase in VSWR above an acceptable level. If a malfunction occurs in one or more of the monitored transmitter functions, the TMA provides relay closures which initiate the transfer of the communication channel to a multichannel operational standby transmitter.

Each SAGE uhf single-channel receiver is monitored by an ASIA unit. If the sensitivity of the receiver decreases to an unacceptable level, the ASIA provides relay closures which initiate the transfer of the communication channel to a multichannel operational standby receiver.

The spare substitution device performs the actual transfer. When the SSD is actuated by an alarm relay closure at a TMA unit, one relay in the SSD transfers the key, modulation, and indication circuits of the TAC channel from the malfunctioning transmitter to an operational standby transmitter. Simultaneously, the multichannel transmitter is remotely tuned to the TAC channel by another SSD relay which generates a digitally coded sequence for the remote frequency selector of the multichannel transmitter. An alarm relay closure at an ASIA unit initiates parallel action for receiver substitution. A relay in the SSD transfers the TAC channel audio and CODAN circuits from the malfunctioning receiver to an operational standby receiver. Another relay tunes the multichannel receiver to the TAC channel.

The physical location of the spare substitution device cabinet and the operational standby multichannel equipment is shown in Figs. 1-7 and 1-8.

1.4.3 VHF Voice System

The vhf voice system (Fig. 1-9) provides one operational and one standby channel for operation on the vhf emergency channel (121.5 mc).

The vhf emergency channel is operated in parallel with the uhf emergency channel from the direction center.

1.4.4 Frequency Division Data Link System

A dual frequency division data link system (Fig. 1-10) (two AN/GKA-4) is provided. Two uhf radio transmitter sets, one single-channel and one multichannel, are included with the FDDL units to furnish primary and standby rf carrier output.

1.4.5 Time Division Data Link System

The time division data link system (AN/GKA-5) is a complete unit with integral transmitters. The signal may be transmitted on a low-power antenna or used to excite the uhf high-power amplifier unit. A two-channel Telco digital data receiver is included in the Telephone Company installation.

1.4.6 High-Power Amplifier

A 20 kw amplifier-modulator group (OA-751(XW-2)/GRC) (Fig. 1-11) is included for high-power data link transmission. The amplifier may be excited by the TDDL equipment or by a local multichannel transmitter for alignment and testing.

1.4.7 ESS UHF Voice System

Four uhf voice communication channels are provided in the GATR-ESS installation for ESS communications. The ESS communication equipment (Fig. 1-12) is independent of the SAGE-GATR equipment both physically and functionally.

1.4.8 Construction of the Lexington GATR-ESS Installation

The construction of the GATR-ESS building and antenna farm and the assembly and testing of the ground-to-air radio equipment took place over

the period from 16 April 1959 to 1 December 1959. The construction schedule for the various components of the site is given in Fig. 1-13.

Fig. 1-1 Lexington Field Station GATR – ESS site

Operations building and antenna farm

High-power antenna

Fig. 1-2 GATR – ESS Installation

Fig. 1-3 Equipment room from maintenance area (looking north) shows automatic status board above door

Fig. 1-4 Equipment room (looking south)

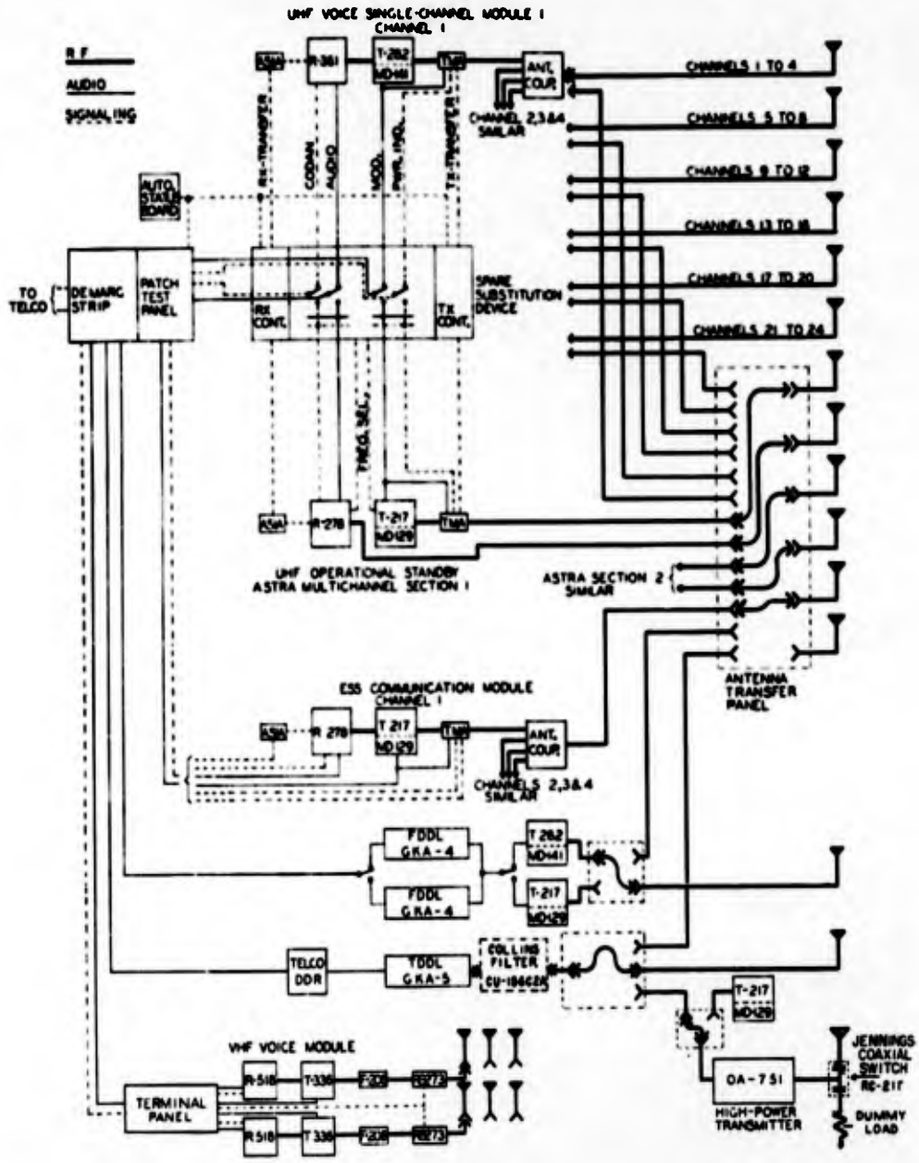
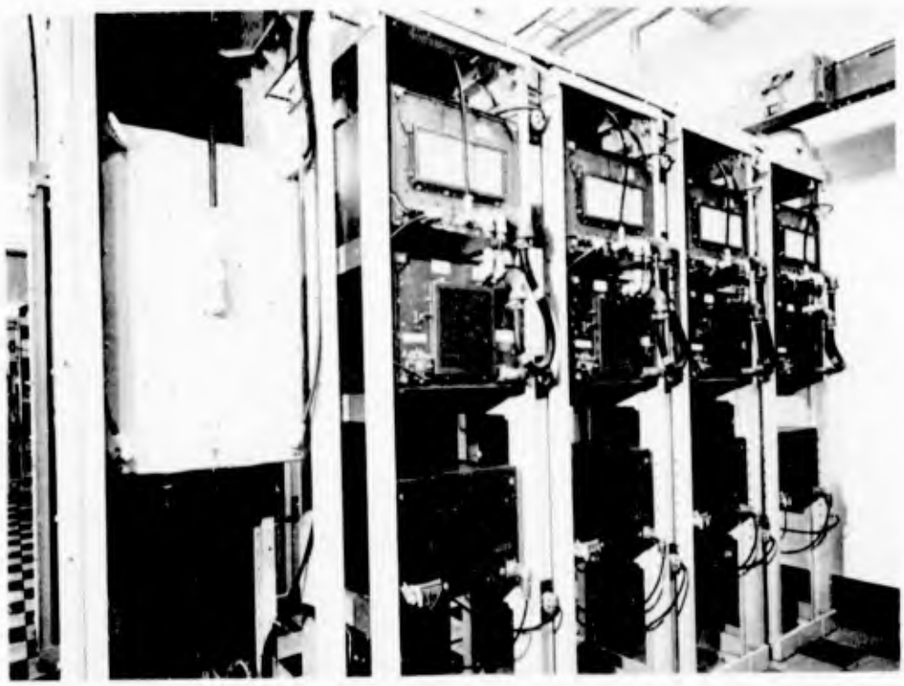
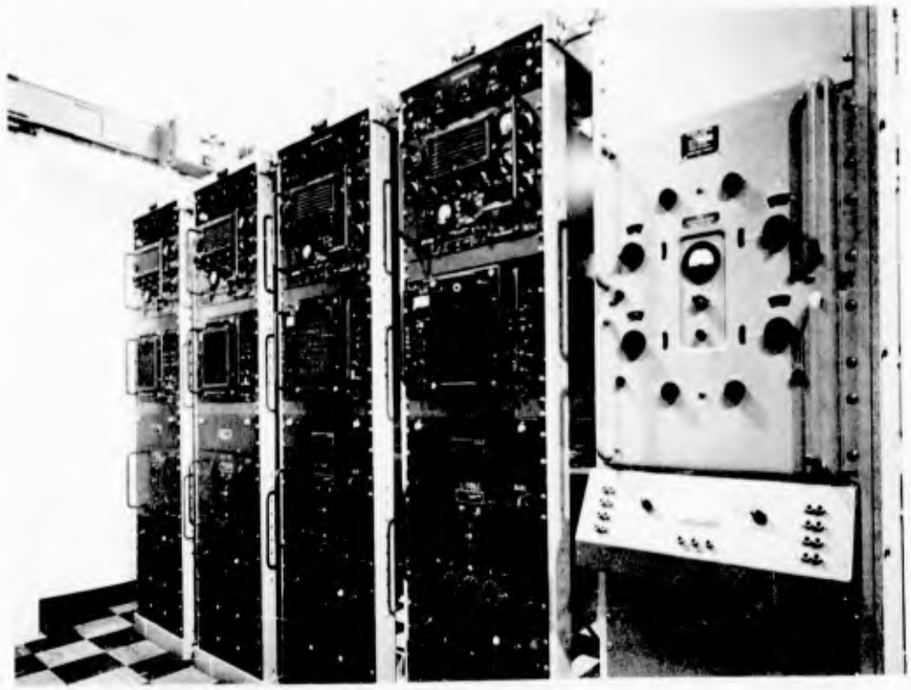


Fig. 1-5 GATR–ESS communications complex



Rear view



Front view

Fig. 1-6 UHF voice single-channel module (station module)

Fig. 1-7 Equipment line, west side of equipment room

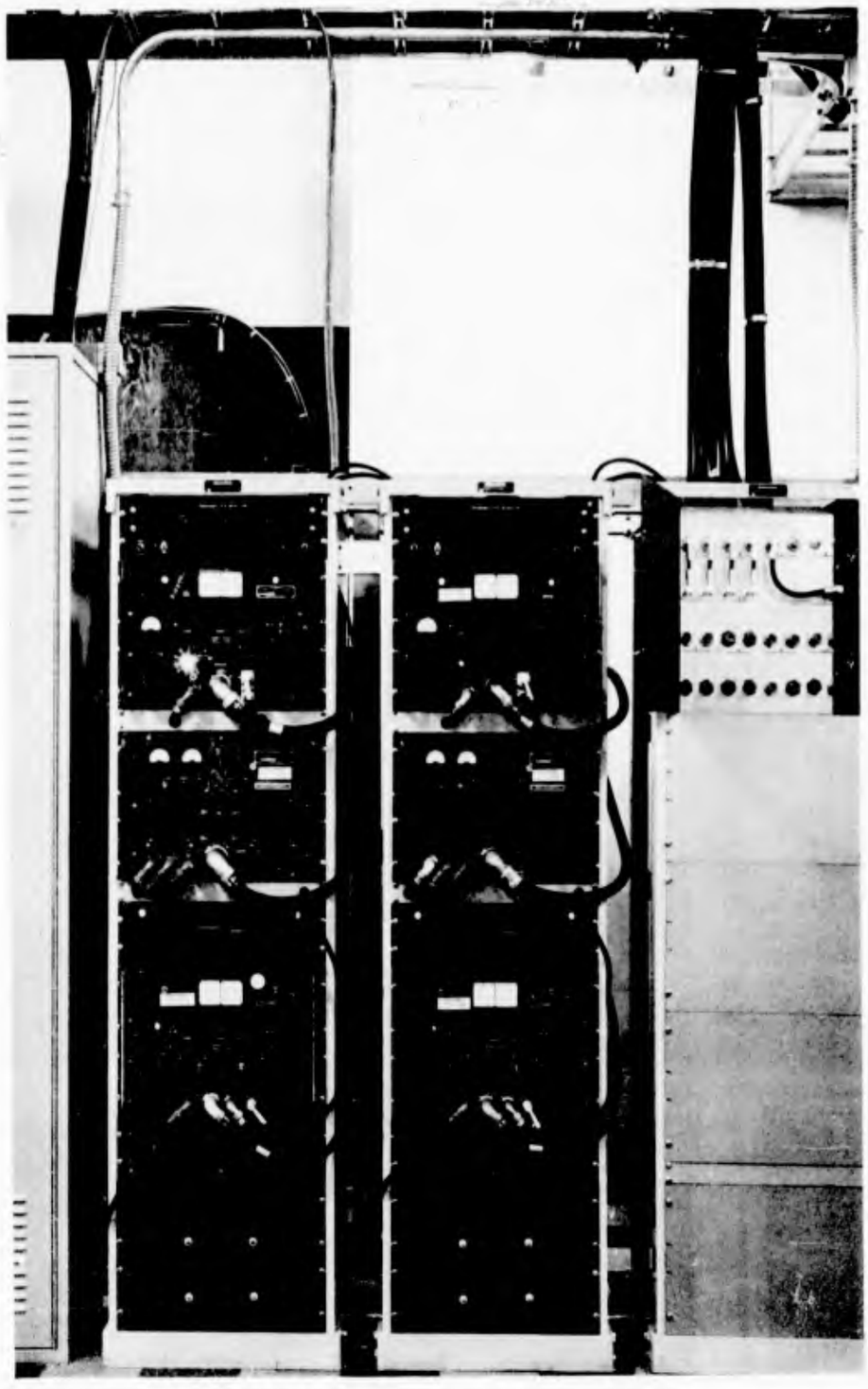


Fig. 1-8 ASTRA multichannel operational standby equipment and antenna transfer panel.

Fig. 1-9 VHF voice module

Fig. 1-10 Frequency division data link installation
(east side, equipment room)

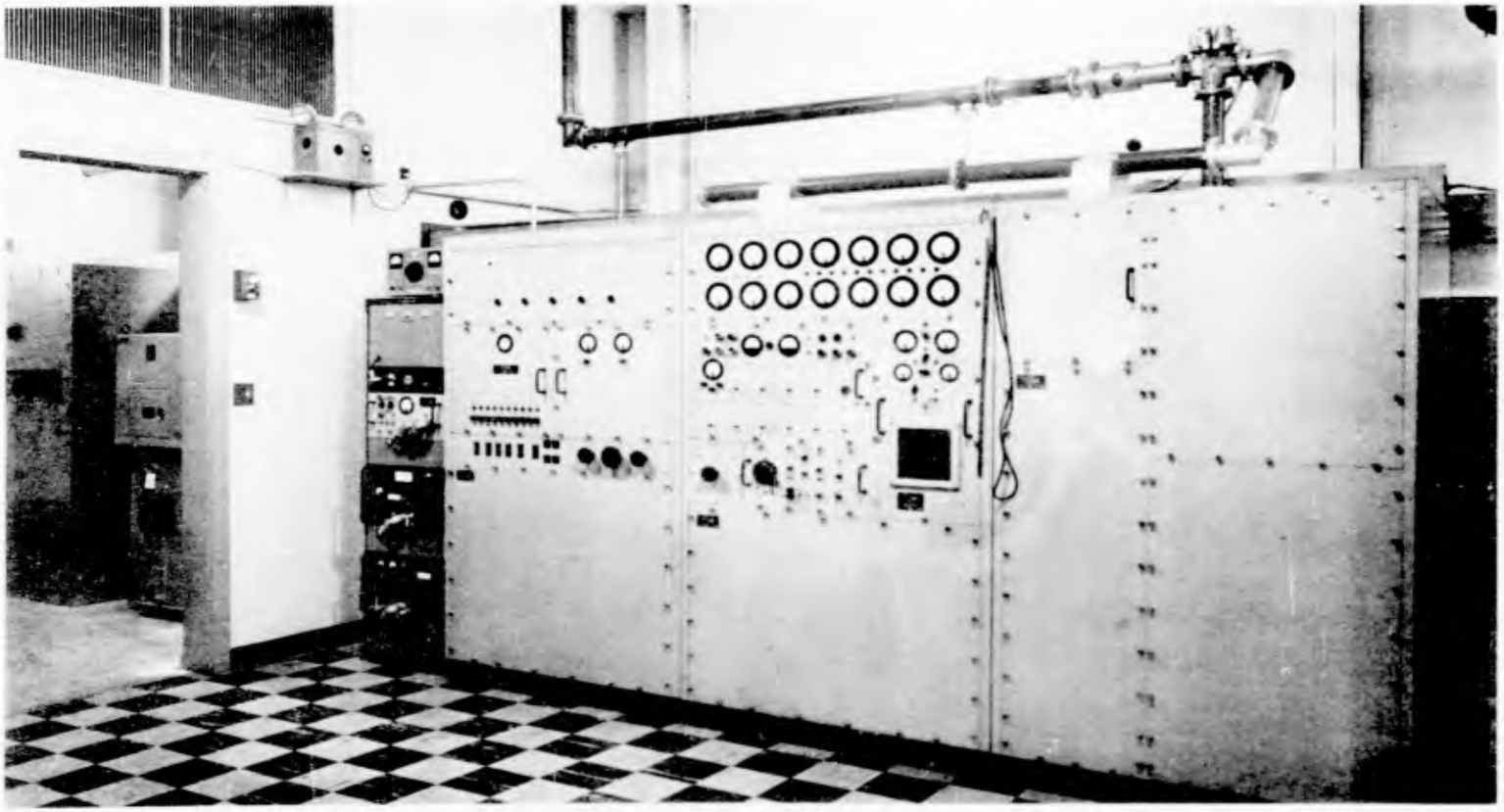


Fig 1-11 High-power amplifier installation.
(OA-751 amplifier – modulator group).

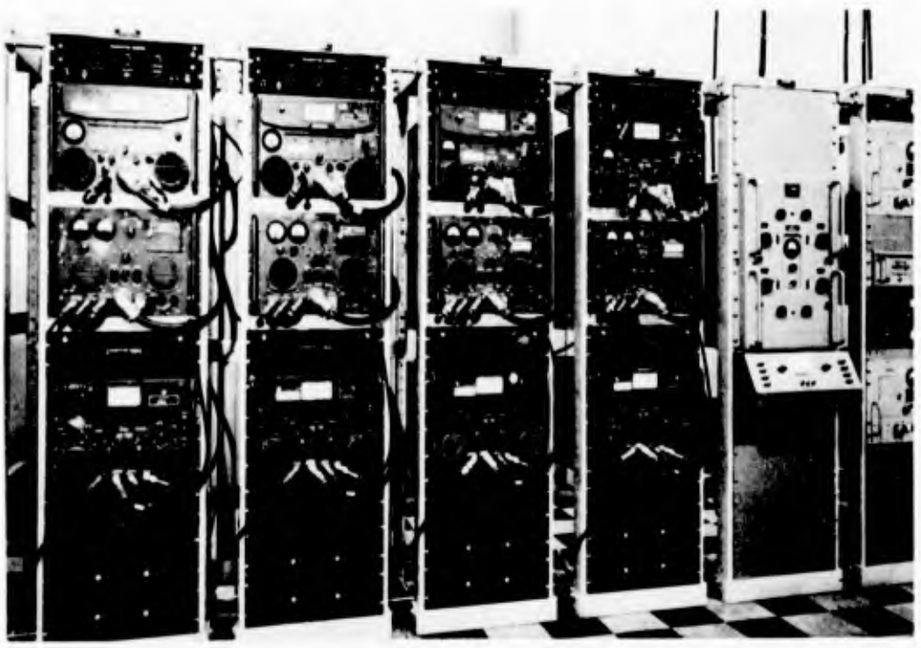


Fig. 1-12 ESS voice communication module

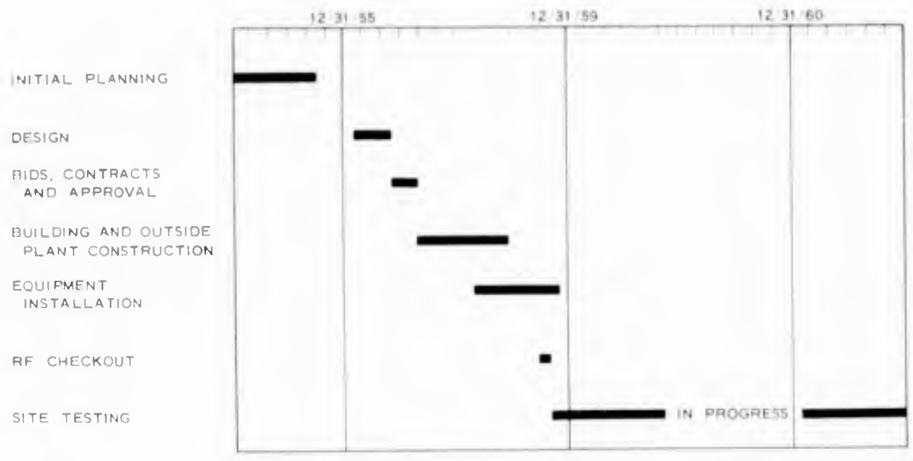


Fig. 1-13 Construction schedule

CHAPTER 2

CHAPTER 2

INSTALLATION AND FUNCTIONAL DESCRIPTION

2.1 INTRODUCTION

This chapter summarizes the overall design and describes the installation and interconnection of the functional units in the GATR-ESS system. Component equipment specifications are given in Chapter 3.

SAGE operations call for both voice radio (uhf and vhf) and data link (uhf) communications between SAGE direction centers and the weapons they control. For this purpose, each SAGE sector may have up to 5 ground-to-air transmitter-receiver (GATR) complexes, each with 28 assigned frequencies—27 between 225 and 399.9 mc in the uhf band and 1 at the vhf frequency 121.5 mc.

The GATR-ESS installation is a prototype of a single site SAGE-GATR communications facility as well as an operating communications site for controlling weapons in the Evaluation SAGE Sector (ESS). It was constructed in 1959 from a design based on Lincoln Laboratory studies and the GEEIA installation standard #ROZMAG 60-1.0. Significant differences between the GATR-ESS installation and GEEIA standard are: (a) larger size, due to the extra equipment needed for ESS test communication; (b) the absence of a high-power directional array, omitted to avoid a possible radiation hazard; and (c) the inclusion of a system that automatically transfers a voice radio channel from a malfunctioning receiver and/or transmitter to a properly operating standby. Details of the GATR-ESS installation have been modified to reflect innovations developed on location, recommendations and proposals from responsible agencies, and experience gained from the GATR test site at South Truro, Mass.

Of the 28 channels provided in the system, 25 can operate simultaneously. Special precautions have therefore been taken in the design of the system and the placement of the equipment to minimize interference:

(a) 10 mc separation between all channels using the same multicoupler and antenna;

(b) antennas separated by at least 100 ft in the same horizontal plane (See Sec. 2.3.1) and channel assignment to antennas based upon calculations of their intermodulation products;

(c) the use of multicouplers on each voice channel;

(d) emphasis on adequate shielding and grounding throughout;

(e) maximum possible separation of high-power from low-power equipment.

In the GATR-ESS installation the standard SAGE ground-to-air radio components are grouped in modules or operational units. Each module is designated as an independent functional unit. Several modular levels have been combined as in Fig. 2-1 to form the SAGE voice complex. The modules forming the SAGE voice complex are:

24 Basic Modules: consists of a transmitter and receiver with auxiliary equipment mounted in a single rack to form a single-channel communications unit. The units are interchangeable and adaptable to any size of radio complex.

6 Station Modules: 4 basic modules, 1 antenna, and 1 antenna coupler.

2 ASTRA Sections: 3 station modules (12 channels) with a remotely controlled, 11-channel transmitter and receiver set, and the necessary transfer equipment; the ASTRA Section provides automatic standby operation for 11 SAGE TAC channels.

1 UHF Voice Complex: 2 ASTRA sections in parallel to provide automatic standby for all 20 TAC channels. 4 of 24 channels are available for primary and standby operation on the AICC (air intercept common channel) and emergency channels.

1 SAGE Voice Complex: 1 uhf voice complex and 1 vhf module.

Four ESS voice communication channels are included which are not a part of the standard SAGE-GATR installations. The equipment for these channels is assembled on a station module basis. The SAGE data link equipment is also modular and is supplied as a unitized group.

Modular design provides flexibility for channel assignment and equipment allocation. Modular construction facilitates preventive maintenance and emergency maintenance, thereby providing better continuity of communications. The benefits derived from modular design are achieved without any increase in cost since the design is essentially a rearrangement of equipment on the standard plan. The module system is therefore recommended for all future GATR installations.

2.2 GENERAL SITE PLAN

The GATR-ESS installation consists of one steel building, 148 by 28 ft, an antenna farm of 14 telephone poles supporting the low-power antenna, and one steel tower supporting the high-power (omni-directional) antenna (Fig. 2-2). The site occupies approximately 2-1/2 acres cleared in a lightly wooded area adjacent to the Lexington Field Station of the Massachusetts Institute of Technology.

2.3 ANTENNA SYSTEM

2.3.1 Introduction

The configuration of the GATR-ESS antenna farm (Fig. 2-2) resulted from a program of intermodulation interference research undertaken at Lincoln Laboratory during the development of the SAGE single-site concept. This research affirmed the possibility of single-site operation through proper frequency selection, equipment isolation, and the use of auxiliary filtering in the form of antenna multicouplers in the transmitter and

receiver lines. The design criteria for contiguous transmitter and receiver operation are as follows:

(a) Four transmitters (T-282/GR) and receivers (R-361/GR) can be operated simultaneously with a single antenna (AS-505) and multicoupler if their frequencies are separated by at least 10 mc.

(b) Channels forming each other's third order intermodulation products should be fed to different antennas with a minimum separation of 36 db. This criterion can be met by the installation of AS-505 antennas with a horizontal separation of 50 ft.

(c) High-power (20-kw) omni-directional transmitting antennas should be erected at least 200 ft from the nearest low-power antenna.

To test the conclusions of the intermodulation interference studies, a single-site mock-up was constructed at the voice data link communications site at South Truro, Mass., and interference tests were conducted employing the full SAGE complement of voice equipment, with multicouplers and AS-505 antennas, and a 20-kw klystron amplifier with a Chu omni-directional antenna. The test program verified the empirical parameters but indicated that the 50-ft spacing of low-power antennas resulted in marginal isolation attenuation when using the R-361/GR receiver. An additional 6 db of attenuation, achieved by increasing the antenna spacing to 100 ft, corrected this marginal condition.

2.3.2 Low-Power Antenna Array

Fourteen low-power antennas (12 AS-505s and 2 AS-4004s) make up the low-power uhf antenna array. The normal SAGE complement of 10 antennas is arranged with 8 antennas (poles 1 through 8, Fig. 2-2) at 100-ft spacing around the perimeter of the circle and 2 antennas (poles 9 and 10) within the circle. Four antennas assigned to the ASTRA multichannel backup equipment (poles 11 through 14) are interspersed within the circular configuration 100 ft from each other and 50 ft from the normal SAGE array.

Six vhf antennas are provided in the low-power antenna array. These antennas are placed 3 at each side of the building on the 6 poles (poles 9 through 14) making up the center of the array. Two of the vhf antennas, required for operation and standby on the vhf emergency channel, are narrow-band CAA antennas. The CA-1563 antenna, a circularly polarized dipole array, is mounted on pole 9. The CA-1594 antenna, a vertically polarized coaxial dipole, is on pole 10. The other 4 vhf antennas (poles 11 through 14), installed for ESS communications and testing purposes, are type RC-81 vertical dipoles.

2.3.3 Antenna Installation Details

The antennas are mounted vertically in the same horizontal plane at a minimum height of 60 ft above the ground. This elevation places the antenna elements above the highest fixed obstruction in the immediate area, thereby avoiding distortion of the antenna pattern. The highest fixed obstruction in normal GATR installations is the high-power directional array structure which is 60 ft high. Co-planar installation is a critical requirement to avoid placing one antenna in the high gain lobe of an adjacent antenna. This condition could lead to severe intermodulation problems.

The vhf antennas are mounted in a horizontal plane, 10 ft below the plane of the uhf antennas.

The coaxial transmission lines for the low-power uhf antennas are type RG-254/U (7/8-in. Spir-O-line cable). The 7/8-in. size is a compromise between line loss and cost. A larger size line would necessitate special reducing fittings at both the antenna and building terminations, and would involve installation problems due to the increased bending radius. The vhf transmission lines employ 1/2-in. Spir-O-line cable.

The antenna cable is clamped to the antenna pole at three-foot intervals by means of Adel insulated cable clamps. Direct contact between the cable and the pole is avoided to prevent chemical deterioration of the cable sheath. From the outlying poles, the cables are run underground by direct burial to

center poles 9 and 10, where they are collected and carried overhead on a messenger structure to the building. The overhead run is 12 ft above ground to provide vehicle clearance.

A ground cable connection is provided at each antenna structure. A #2/0 bare copper conductor is run down each pole, stapled at two-foot intervals and connected to a ground rod driven adjacent to each pole base. All pole grounds are interconnected by #2/0 bare copper ground conductors buried with the antenna cables. The antenna ground system is interconnected with the building ground loop at eack side of the building.

2.3.4 High-Power Omni-Directional Antenna

The high-power omni-directional antenna, AS-726, is 200 ft from the nearest low-power antenna and is mounted in the same horizontal plane established for the low-power uhf array. The original GATR-ESS specifications called for high-power antenna mounting on a single wood-pole structure in a manner similar to the low-power antenna installation. This specification was subsequently changed to provide a type G-36 triangular steel tower, composed of 3 20-ft sections. The steel tower facilitates frequent removal and reinstallation of the antenna for testing purposes, as well as possible future installation of a larger high-power omni-directional antenna.

The high-power antenna transmission line is fabricated from 50-ohm, 3-1/8 in. hard-drawn, copper coaxial line (RG-154/U) and accessories. The choice of 3-1/8 in. line over 6-1/8 in. line is based on considerations of cost and line loss for a given power capability.

2.4 EQUIPMENT LAYOUT

The interior of the GATR-ESS building is divided into 5 areas (Fig. 2-3). The communications equipment room is described below. Construction details and utilities are described in Sec. 2.7.

2.4.1 Design Objectives

The communication equipment layout (Fig. 2-4) meets two basic design objectives: maximum physical isolation where intermodulation interference may be expected; and maximum accessibility to all station equipment for operation, maintenance and personnel safety considerations. These design objectives have been realized as follows:

(a) The high-power transmitter equipment is physically separated as far as possible from the low-power equipment. The TDDL equipment, which operates in conjunction with the high-power amplifier, is located adjacent to the high-power amplifier.

(b) Within the 6-module uhf voice complex interference between modules has been eliminated by physical isolation. At the same time, a functional grouping is maintained for operation and maintenance.

(c) An open corridor in the center of the equipment room is provided for access to all equipment. Corridors between racks provide sufficient space for personnel and dolly-mounted test equipment.

(d) Rows of equipment racks provide access to both front and rear of equipment for maintenance and testing.

2.4.2 Conduit and Cable System

All conduits and cables in the GATR-ESS installation are run overhead as illustrated in Fig. 2-5. The power is carried by a 225-ampere, 3-phase, 4-wire, plug-in bus duct running the entire length of the equipment room, 7 ft above the floor. The Wiremold power distribution on the individual equipment modules is connected to the bus duct with plug-in, safety-switch, circuit-breaker units. At the east side of the equipment room, the Wiremold-to-circuit-breaker module connections are made with short lengths of armored flexible cable. The module groups at the west side of the equipment room are connected to the bus-duct circuit breakers by cable run in EMT supported beneath the wireway cable trays.

The cable tray system in the equipment room is fabricated from 12-in. aluminum alloy cable rack, with 3-in. sides and 12-in. rung spacing, suspended from the roof trusses 9 ft 7 in. above the floor. The tray layout has been designed to provide interconnecting wireways for all anticipated grounding, rf antenna cable, and audio and control cable in the station.

The internal station ground system consists of a single #2/0 bare stranded-copper cable, connected to the outside building ground loop, and brought into the building through the antenna cable port on the east wall. The ground cable is laid in the wireway in a continuous unlooped run around the perimeter of the equipment room. The ground connections to the equipment modules are made with #2/0 cable using double-bolted clamp connections. The total ground conductor resistance is less than 1 ohm.

The three conduit and cable plans shown in Fig. 2-5 cover the three stages of plant construction. Usually the power supply, wireway and grounding systems are installed first. The antenna cables are then laid in the trays in a neat and orderly fashion, with properly shaped terminations. Finally, the audio and control cables are placed in the wireways as required. Where possible, the rf and audio cables are isolated within the trays by running similar cables grouped close to the sides, with maximum physical isolation between rf and audio groups.

2.5 COMMUNICATION SUBSYSTEM ASSEMBLY

2.5.1 UHF Voice Single-Channel Module (Station Module)

The uhf voice single-channel module (Figs. 2-6, 2-7) is an assembly of four single-channel racks (Item A, Fig. 2-4) and an antenna coupler rack (Item C, Fig. 2-4). The five standard equipment racks are bolted together to form a single unit. Each of the four racks houses a SAGE single-TAC-channel communications set consisting of a transmitter, receiver, and auxiliary equipment. The fifth rack houses the four-channel antenna coupler,

an audio meter panel, and the module termination panel. The antenna coupler is located in the end rack to minimize intermodulation interference.

2.5.1.1 UHF Single-Channel Rack

The uhf single-channel rack (Figs. 2-6, 2-7) contains the following equipment:

Equipment		Source
1 Transmitter Monitor Alarm	(TMA)	MITRE
1 Radio Transmitter	T-282 ( )/GR	GFE
1 Modulator Power Supply	MD-141 ( )/GR	GFE
1 Distribution Panel	J-390/GR	GFE modified
1 Radio Receiver	R-361/GR	GFE modified
1 Automatic Sensitivity Indicator Alarm	(ASIA)	MITRE
1 Voltage Regulator		Commercial
1 Set of rf audio and control cables		GFE and MITRE

The single-channel rack is designed to function as an autonomous single-channel communications set utilizing a core of Government Furnished Equipment. To adapt the GFE to SAGE operation and to ASTRA operation, the GFE has been modified, and two auxiliary maintenance units, a transmitter monitor alarm (TMA) and automatic sensitivity indicator alarm (ASIA), have been incorporated in the rack unit. These two units and the GFE modifications are described in detail in Chapter 3.

The inclusion of a voltage regulator unit in the single-channel rack is an extension of the module principle applied to the station voltage regulation problem. The sensitivity of the R-361( )/GR receiver is affected by supply voltage variations. A 5-volt decrease of the nominal supply voltage (120 volts) decreases receiver sensitivity 3 to 6 db. For acceptable receiver operation in the SAGE environment, supply voltage variations should be limited to plus or minus one volt. The voltage regulator unit provides plus or minus one percent regulation for the R-361( )/GR receiver and its associated ASIA unit. The ASIA unit monitors the sensitivity of the R-361( )/GR and operates at the same supply voltage.

The rack equipment wiring employs GFE cables for the transmitter-modulator interconnections, and GFE cables, modified by the addition of twist-lock plugs, for the modulator and receiver power supply. Other cables are custom fabricated for the installation. The inter-equipment audio and control cables are assembled to form a shielded harness to reduce installation cost and to facilitate maintenance. The rf antenna cables in the single-channel rack are fabricated with RG-9B/U double-shielded coaxial cable as a precaution against interference.

The location of equipment in the rack is dictated by accessibility considerations. The transmitter unit is tuned from the front, and tuning dials and meters are at eye level. The receiver unit is tuned from the rear, and is placed below waist level for accessibility to tuning positions.

2.5.1.2 Antenna Coupler Rack

The antenna coupler rack with the module termination panel completes the functional four-channel, single-antenna voice module. The rf antenna cables from the four single-channel racks terminate at the antenna coupler. The audio and control cables from the single-channel racks are connected to the equipment terminal strip on the termination panel. A third item in the rack, the audio meter panel, is mounted below the antenna coupler and provides a centralized audio test point for the entire four-channel module.

Two antenna transmission line terminations are provided at the antenna coupler rack. The line for the primary antenna system is run from the wireway directly to the antenna coupler connection and terminated in an LC-to-Spir-O-line coaxial connector. A line for the back-up antenna trunk system is run from the wireway to a coaxial coupler mounted in the rack cover plate. When operation on the trunk system is desired, a prefabricated patch connection is made from the coaxial coupler to the antenna coupler connection.

The audio and control cable connections on the line side of the module termination panel are made with one 26-pair and one 11-pair telephone cable, as shown in Fig. 2-5.

2.5.2 Central Control Group

The line of equipment cabinets and racks at the west side of the equipment room completes the SAGE voice complex installation.

The spare substitution device (SSD) and patch test panel (PTP), (Figs. 2-8, 2-9) have been built into standard Telco equipment cabinets and mounted beside the two Telco digital data receiver (DDR) cabinets adjacent to the Telco main distribution frame (MDF). For power supply purposes, these four cabinets of entrance equipment are considered modular, and are provided with a single Wiremold power distribution frame.

Figure 2-10 shows the facilities for terminating telephone cables in the GATR-ESS installation. All equipment, with the exception of the demarcation terminal strip, was installed by the Telephone Company. The demarcation terminal strip, which is functionally part of the patch test panel, was installed by MITRE.

The automatic status board, which provides the spare substitution device equipment condition display, is detailed in Fig. 2-11. The status board is centrally located in the maintenance area to alert station maintenance personnel to equipment failure.

2.5.3 UHF Voice Multichannel Rack

Six racks of uhf multichannel equipment are mounted in the rack line at the west side of the equipment room. These racks are identified as Item B in Fig. 2-4. Each rack contains the following equipment:

Equipment		Source
1 Transmitter Monitor Alarm	(TMA)	MITRE
1 Radio Transmitter	T-217 ( )/GR	GFE
1 Modulator Power Supply	MD-129 ( )/GR	GFE
1 Distribution Panel	J-390 ( )/GR	GFE modified
1 Radio Receiver	R-278 ( )/GR	GFE modified
1 Automatic Sensitivity Indicator Alarm	(ASIA)	MITRE
1 Voltage Regulator		Commercial
1 Set of rf, audio and control cables		GFE and MITRE

Each rack of uhf multichannel equipment provides a communication set which can be operated as a single-channel unit when both transmitter and receiver are tuned simultaneously to the same frequency, and operate with an antenna coupler and single antenna. When each transmitter and receiver is tuned independently, and is provided with a dual antenna system, each rack of uhf multichannel equipment forms an operational standby unit. Both of these functions are provided in the GATR-ESS installation.

2.5.4 UHF Operational Standby Module

Figure 2-12 shows a three-rack module consisting of two uhf voice multichannel racks providing SAGE uhf voice operational standby, and an antenna transfer panel rack. This three-rack group forms a section of the equipment line at the west side of the equipment room.

2.5.4.1 ASTRA Section Multichannel Rack

Each ASTRA section multichannel rack (Fig. 2-12) provides a multichannel transmitter and receiver unit for operational standby of an ASTRA section consisting of twelve single-channel transmitters and receivers. Each multichannel unit in the rack is under the automatic control of the spare substitution device for both audio and control input, and remote channeling.

The GFE core of multichannel equipment has been modified for SAGE and ASTRA operation. Since the transmitter and receiver are designed for front connection, the equipment separation panels have been drilled as required to permit the control and power cables to be carried to the rear of the rack where the connections are made. GFE cables, both modified and unmodified, have been used where possible in the interconnection of the equipment. Other cables are custom fabricated for the installation. Standard auxiliary units furnished in the equipment rack include TMA, ASIA, and voltage regulator units. The TMA and ASIA units provide remote equipment indication at the automatic status board and "carrier" indication at the direction center. The voltage regulator unit is required to maintain SAGE receiver sensitivity at a constant level.

An audio and control input cable is furnished for each multichannel rack. A 16-pair cable is run from each rack distribution panel to the SSD cabinet.

Since transmitter and receiver substitution operate independently under the ASTRA System, separate antennas are provided for each multichannel transmitter and receiver. The rack antenna cables (RG-9B/U) originate at the equipment units and terminate at the antenna transfer panel. At the antenna transfer panel, the antenna cables are patched to the antenna transmission lines.

2.5.4.2 Antenna Transfer Panel Rack

The third rack in the uhf operational standby module (Fig. 2-12) is the antenna transfer panel rack. The purpose of this rack is to provide a station rf patch panel for limited assignment of equipment channels to spare antennas through a station trunk system.

The transmission lines from 6 of the uhf low-power antennas terminate at the antenna transfer panel. From the antenna transfer panel, coaxial trunk cables are run to the 8 primary SAGE modules (6 uhf station modules,

1 FDDL module, and 1 TDDL module), and to the ESS communication module. The 4 antenna cables for the uhf operational standby equipment also terminate at the antenna transfer panel. Patch cables are provided at the antenna transfer panel for equipment-to-antenna coupling.

The antenna transfer panel is primarily a station unit and secondarily an operational-standby-module antenna unit. If the station test program indicates that the standby multichannel equipment cannot be operational in the GATR environment without the isolation provided by an antenna coupler, the antenna coupler can be mounted in the antenna transfer panel rack with a minimum of station alteration.

2.5.5 VHF Voice Single-Channel Module

The vhf communication equipment for SAGE operation on the vhf emergency channel (121.5 mc) is mounted in a single rack (Item H, Fig. 2-4). The rack houses two vhf communication sets, used for primary and operational standby, and the necessary auxiliary equipment, as detailed in Figs. 2-13 and 2-14. The following equipment is provided:

Equipment		Source
2 Relay Meter Movements	R-273/FSA	GFE
2 Radio Transmitters	T-336( )/URT-7	GFE modified
2 Radio Receivers	R-518( )/FRR-27	GFE modified
1 Audio Attenuation Panel		MITRE
1 Termination and Switching Panel		MITRE
2 Band Suppression Filters	F-206/GR	GFE
1 Set of rf, audio and control cables		MITRE

Four racks are provided in the vhf module. Three spare racks allow space for future expansion of the vhf complex if required for ESS communications.

All inter-rack audio and control cables were fabricated by MITRE for the installation. Two vhf antenna transmission lines terminate in the rack

cover plate of each of the first three racks. The equipment antenna connections are patched inside the rack with type RG-9B/U cable.

2.5.6 Frequency Division Data Link, AN/GKA-4

The FDDL equipment package (Figs. 2-15, 2-16) consists of a line of three cabinet units; a demultiplexer group, a multiplexer group, and a telemetric data monitor. In the duplex installation, the primary FDDL package and standby FDDL package are installed face to face, perpendicular to the wall. A standard equipment rack is added at the wall end of each group for auxiliary equipment. The transmitter function of the FDDL installation is provided by two transmitter sets; a single-channel AN/GRT-3, consisting of a T-282 ( )/GR transmitter and an MD-141 ( )/GR modulation power supply, and a multichannel AN/GRC-27, consisting of a T-217 ( )/GR transmitter and an MD-129 ( )/GR modulation power supply, which are mounted together in the Group 1 auxiliary equipment rack. The rf antenna transmission lines, consisting of a primary antenna cable and a trunk cable from the antenna transfer panel, terminate in coaxial couplers on an rf panel mounted at the top of the transmitter equipment rack. Patch cords are provided to couple the desired antenna-transmitter combination.

The Telco digital data input cable terminates in a Telco terminal box mounted at the side of the Group 2 auxiliary equipment rack. Two single-pair cables provide the data input connection from the terminal box to the audio monitor panel mounted in the top rack position. From the monitor panel, parallel single-pair cable connections are made to FDDL Groups 1 and 2.

The FDDL equipment power supply is provided by duplicate Wiremold distribution frames mounted at each equipment rack. Circuit breakers are provided for each cabinet, and for the transmitter equipment units. The transmitter power cords are provided with twist-lock plugs. The Wiremold is extended to the FDDL cabinet power outlets (located in the base of the equipment) by means of a conduit and outlet box assembly.

2.5.7 Time Division Data Link AN/GKA-5

The experimental TDDL equipment package provided in the GATR-ESS installation is contained in a line of six standard equipment racks (Figs. 2-17, 2-18). The TDDL unit is functionally complete, and the installation requirements are limited to antenna, input audio and control cable, and primary power distribution.

Three antenna transmission lines are provided for the TDDL unit rf output. These lines terminate in coaxial connectors provided in a fabricated antenna transfer panel mounted in the top position of the output equipment rack. Two of the transmission lines provide antenna connection through the primary and trunk antenna systems. The third transmission line provides the TDDL input to the 20-kw amplifier. The equipment antenna cables also terminate at the rf antenna panel. The required output connections are made with coaxial patch cables. The rf output of the TDDL transmitter will be fed through a Collins UHF 156C2A filter.

The 11-pair audio and control input cable for the TDDL equipment terminates in a Telco terminal box mounted on the wall side of the end equipment rack.

2.5.8 20-KW Amplifier-Modulator Group OA-751(XW-2)/GRC

The 20-KW Amplifier-Modulator Group OA-751(XW-2)/GRC (Fig. 2-19) consists of a cooler unit and high-voltage transformer unit, installed in the heat exchanger room, and the amplifier-modulator unit, which is installed in the equipment room. All electric interconnections between units are made overhead in a 6-in.-by-6-in. wireway. The coolant piping between the cooler unit and the rf unit is run in a covered trench.

A standard equipment rack is provided adjacent to the amplifier-modulator unit to house the transmitter local control equipment. The OA-751 local control unit with an AN/GRC-27 transmitter set, consisting of a T-217 ( )/GR transmitter and an MD-129 ( )/GR modulator modified for

OA-751 operation, is mounted in the equipment rack for transmitter testing and alignment; an rf transfer panel, a power indicator device and a dc power supply unit complete the rack installation. The rack is provided with a Wiremold power distribution frame with twist-lock receptacles for equipment plug-in.

In the equipment rack, the antenna lines from the local control AN/GRC-27 transmitter set and from the TDDL equipment group terminate at the rf transfer panel where they may be patched to the single-cable rf exciter input to the OA-751. The exciter input to the OA-751 is a low-level (30-watt) output of a standard Air Force 100-watt uhf transmitter set. The local AN/GRC-27 transmitter set is modified to allow control of the output signal without equipment detuning. When the amplifier-modulator group is excited by the TDDL unit, rf output control is not provided. To attenuate the nominal 100-watt TDDL output to the 30-watt exciter level, the antenna trunk from the TDDL equipment to the OA-751 rf transfer panel is coupled to a calibrated length of RG-21A/U lossy rf cable which provides a nominal attenuation of 6 db over the uhf band.

2.5.9 ESS Communication Module

The ESS communication module (Figs. 2-20, 2-21) is a five-rack, four-channel voice communication system designed on the pattern of the uhf single-channel module (station module). The ESS module provides four communication channels for ESS operations. Functionally, the ESS module is identical with the station module, except that the single-channel rack (Item A, Fig. 2-4) has been replaced by the multichannel rack (Item B, Fig. 2-4) to provide single-channel operation with rapid channel tuning.

For uniformity, the inter-equipment wiring on racks is fabricated to duplicate that on the operational standby rack. The inter-rack cabling is like the station module cabling.

The rf cabling configuration parallels that of the station module for intermodule cabling only. A single antenna-coupler transmission line is provided from the antenna coupler rack to the antenna transfer panel, where it is patched to one of the spare antenna positions.

2.5.10 Screen Room

A double-shielded cell-type enclosure providing 100 db of rf attenuation is included in the GATR-ESS installation. This enclosure or screen room is required to provide an rf interference-free environment for the testing and alignment of SAGE receivers and/or transmitters. The screen room, which is a prefabricated, package type commercial unit is installed in the maintenance area.

The screen room package has a 3-phase, 4-wire power filter panel for filtered power supply connection; an rf connector panel for 5 rf input cables; and a fan-powered air circulation system. The screen room power supply is obtained from the equipment room bus duct. The screen room is grounded to the equipment room ground cable. Plywood panels protect all exposed screens. A Wiremold convenience outlet system is installed on the inside walls of the screen enclosure.

2.6 EQUIPMENT CABLING AND WIRING DETAIL

2.6.1 Inside Plant Antenna Cabling

The station rf cabling (Fig. 2-5) is composed of 2 antenna cabling systems: a primary transmission line system, and a station antenna trunk system. The primary transmission line system provides a 1/2-in. Spir-O-line antenna cable connection from the cable termination panels at the antenna cable ports to each of the 8 modules of primary SAGE uhf equipment. The cable connections for the other 6 uhf antennas terminate at the antenna transfer panel. The 6 vhf antenna transmission lines are run directly to the vhf equipment racks.

The antenna-to-equipment assignment is as follows:

Antenna Number	Antenna	Primary Equipment
1	AS-505	UHF Station Module #2
2	AS-505	UHF Station Module #3
3	AS-505	UHF Station Module #6
4	AS-505	UHF Spare * (Normally ESS Module #7)
5	AS-505	UHF Station Module #4
6	AS-4004	UHF Station Module #5
7	AS-4004	UHF Spare *
8	AS-505	UHF Station Module #1
9	AS-505	UHF TDDL
10	AS-505	UHF FDDL
11	AS-505	UHF Spare * (Normally ASTRA Tx #1)
12	AS-505	UHF Spare * (Normally ASTRA Rx #1)
13	AS-505	UHF Spare * (Normally ASTRA Tx #2)
14	AS-505	UHF Spare * (Normally ASTRA Rx #2)
15	AS-726	UHF High Power Transmitter
9A	CA-1563	VHF Voice, Primary Emergency Channel
10A	CA-1594	VHF Voice, Standby Emergency Channel
11A	RC-81	VHF Future ESS
12A	RC-81	VHF Future ESS
13A	RC-81	VHF Future ESS
14A	RC-81	VHF Future ESS

*Transmission line terminates at the antenna transfer panel where patching is provided for the station trunk system.

The station antenna trunk system provides nine 1/2-in. Spir-O-line cables from the antenna transfer panel to the 8 primary SAGE modules and the single ESS communication module. Four RG-9B/U cables are run to the uhf operational standby multichannel units. The antenna trunk system provides antenna selection at the modules for testing and emergency operation.

2.6.2 Audio and Control Wiring

The audio and control block diagram (Fig. 2-24), the rack interconnection diagrams (Figs. 2-25 through 2-28), and wiring schedules (Figs. 2-29 through 2-44) are placed at the end of this chapter.

2.7 CONSTRUCTION DETAILS

The GATR-ESS site (Fig. 2-22) is longitudinally level, traversing the side of a hill with a pitch of 8 ft in the average width of 240 ft. Electric utility lines, telephone lines and a town water main are adjacent to the site.

The site is cleared of all trees, stumps, and brush in the operating area. Site grading is confined to the immediate building area as required for building foundations. Final grading is crowned to insure water runoff away from the building. A gravel apron 30 ft wide is provided around the operation building for walkways and roadways.

The GATR-ESS building is a prefabricated, galvanized steel structure 148 ft long, 28 ft wide, and 14 ft high to the bottom of the roof trusses. The building is set on a reinforced concrete foundation, and is designed for the following loading:

Vertical Roof	40 psf
Wind - Horizontal	20 psf
Wind - Uplift	25 psf

The building interior (Fig. 2-23) is partitioned into 5 working areas: office, maintenance, equipment, heat exchanger, and machinery. Insulation, consisting of 4-in. glass wool blankets on ceilings and 2-in. glass wool blankets on exterior walls is provided throughout, except in the machinery area. All nongalvanized surfaces are painted. The interior finish is pastel green with darker green trim. Metal acoustic ceiling panels are provided throughout, except in the machinery area. The concrete floors are finished in asphalt tile.

2.7.1 Building Services

The building services are detailed in Fig. 2-22. The following abridged installation specifications are included to present the general scope of installation. The construction drawings are included in Chapter 3.

Sanitary System: The sanitary system employs a 1000-gal. precast concrete septic tank with an 18-in. manhole and sewer cover at finished grade. The septic tank drainage system consists of a 6-ft-by-2-ft-by-2-ft concrete distribution box and a drainage field of 4-in. perforated Orangeburg pipe.

Water Supply: The water line is a 2-in. soft drawn copper tube laid a minimum of 4 ft below grade. The line runs from an existing 4-in. water main adjacent to the site.

Power Supply: The power supply requirements of the GATR-ESS installation are 250 kva, 120/208 volts, Y connected. The distribution of the load is as follows:

Communication equipment	190 kva
Mechanical ventilation and pumping	6 kva
Air conditioning system	77 kva
Lighting and miscellaneous	10 kva
Total	283 kva
Maximum load at 90% demand factor	250 kva

The utility primary power supply available at the site is 2400/4160 volts, 3-phase, 4-wire. The station 120/208 volt supply is provided by a 300 kva substation. The substation consists of three 100 kva, single-phase OISC transformers rated 2400/120 volts, 60 cycles, with four 2-1/2 percent taps below 2400 volts. The transformers are connected 2400/4160 Y primary and 120/208 Y secondary. The secondary leads consist of eight 600 MCM cables, run in two 4-in. rigid galvanized conduits (4 cables in each conduit) from the substation to the main circuit breaker panel located in the machinery room.

Power Distribution: In the GATR-ESS installation ac primary power circuits are isolated from audio and signal circuits. The design of the ac power distribution system is compatible with the modular design philosophy. The distribution system consists of Wiremold type wireway installed on the module rack structure, with twist-lock receptacles provided for equipment

plug-in. The distribution system for each module is connected by means of an individual plug-in circuit breaker to a bus duct which extends the length of the equipment room.

Three emergency power shut-down stations are provided in the communication equipment area for personnel safety. These stations trip the entire communication equipment power supply but do not affect station lighting or mechanical equipment.

Telephone: Telephone cables are brought to the building in a 3-1/2 in. underground conduit.

Grounding: A #2/0 bare stranded copper ground loop is installed around the building at the bottom of the foundation trench. Copper-clad 3/4-in. ground rods 10 ft long are driven at each corner of the building and at 20-foot intervals around the loop. The building base channel is connected to the loop at each corner. The substation and the antenna system are connected to the station ground by means of #2/0 cable. A #2/0 ground tap is also brought into the equipment room through the cable port at the east side of the building. All buried ground connections are brazed.

Shielding: The single-site concept introduces increased probability of interference due to the proximity of transmitters and receivers. To decrease interference in the GATR-ESS installation, the maximum shielding consistent with economy has been provided for rf cables, audio cables, control cables, and equipment units. To provide a low impedance ground path for the rf shielding, the station ground bus system has been designed with conductor resistance less than 1 ohm and conductor-to-ground resistance less than 5 ohms.

Building Lighting: The interior lighting system is designed to provide 30-foot-candle illumination in all areas of the building except the machinery room where the level is 10 foot-candles. Battery-powered emergency lighting units are provided in each partitioned area. Exterior lighting is provided at each corner of the building and at each outside doorway.

Plumbing, Heating and Air Conditioning: The GATR-ESS building sanitary facilities consist of a water closet, wash basin, and janitor's sink located in the lavatory which opens into the office area. Hot water is supplied by an electric hot water heater of 6-gal. storage capacity. The building is heated by an oil-burning steam boiler. A buried 1000-gal. storage tank provides a minimum of eight days' supply of oil. There are three zones: the machinery and heat exchanger rooms employ fan-circulating unit heaters; the office and maintenance rooms are provided with finned pipe radiators; and the equipment room is heated and cooled with an 18,000 cfm air-handling unit and ducting system. The air-conditioning system has a 56-ton capacity.

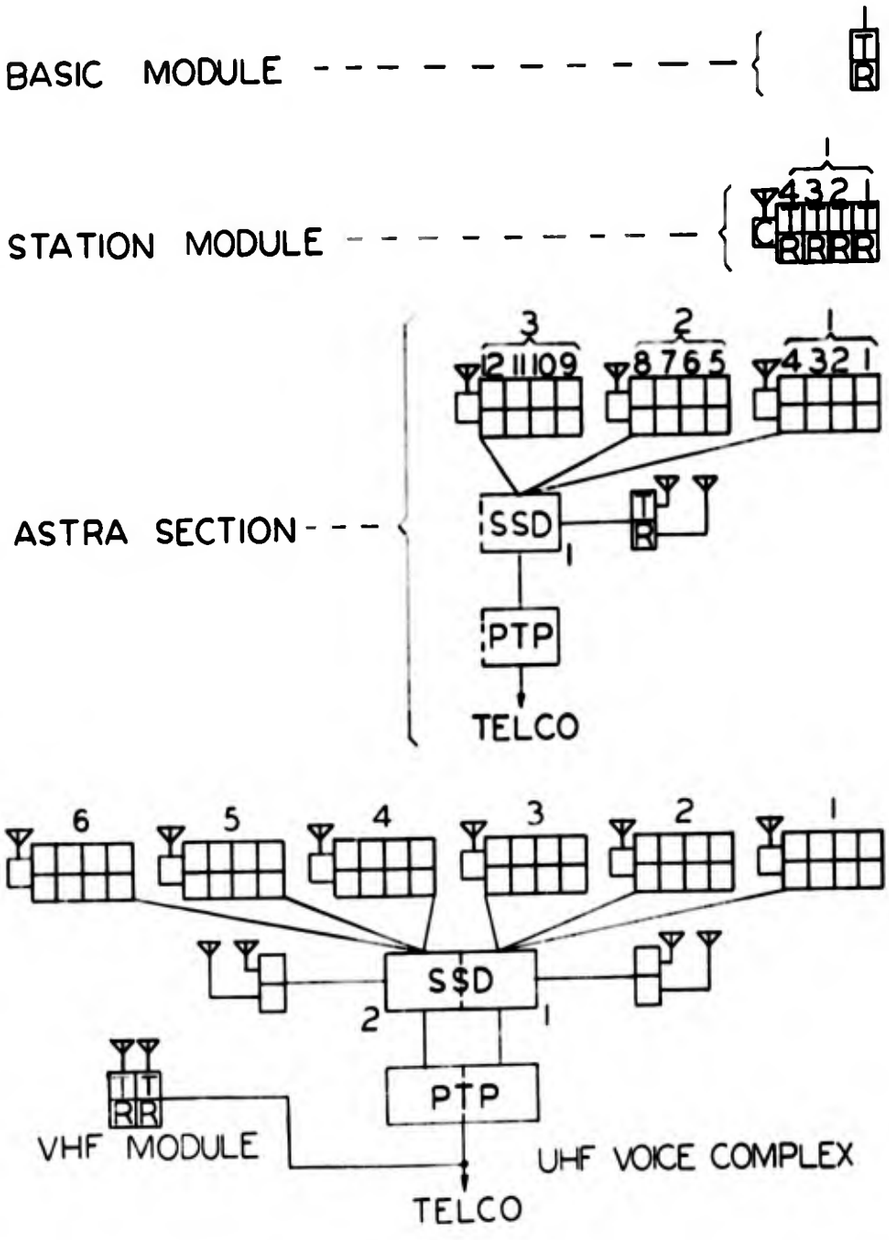
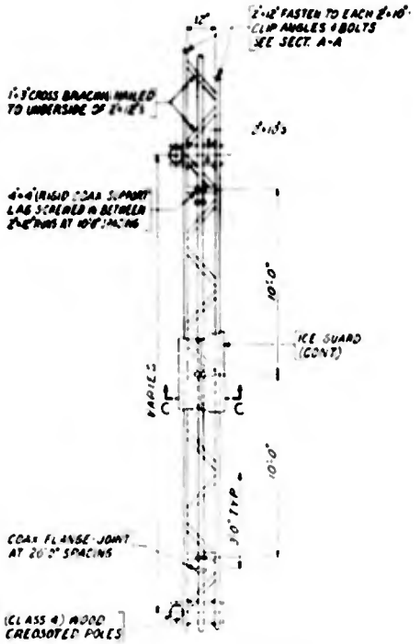
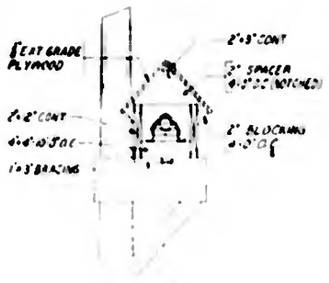


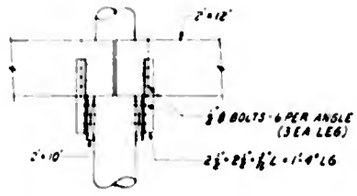
Fig. 2-1 Modular design



PARTIAL PLAN RIGID COAX SUPPORT

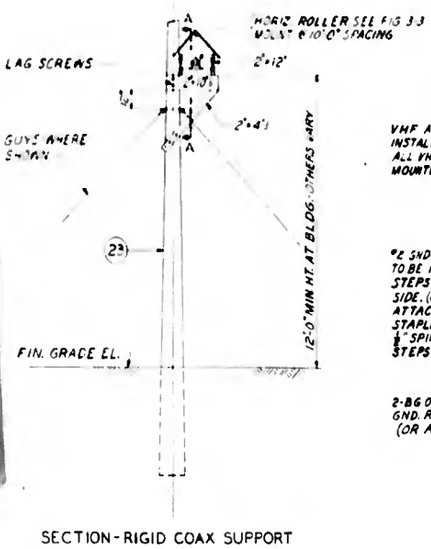


SECTION C-C

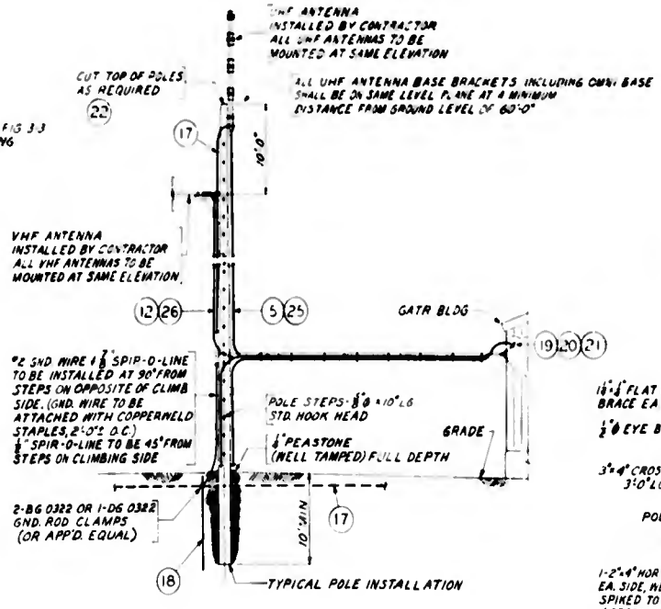


SECTION A-A

DETAIL - T

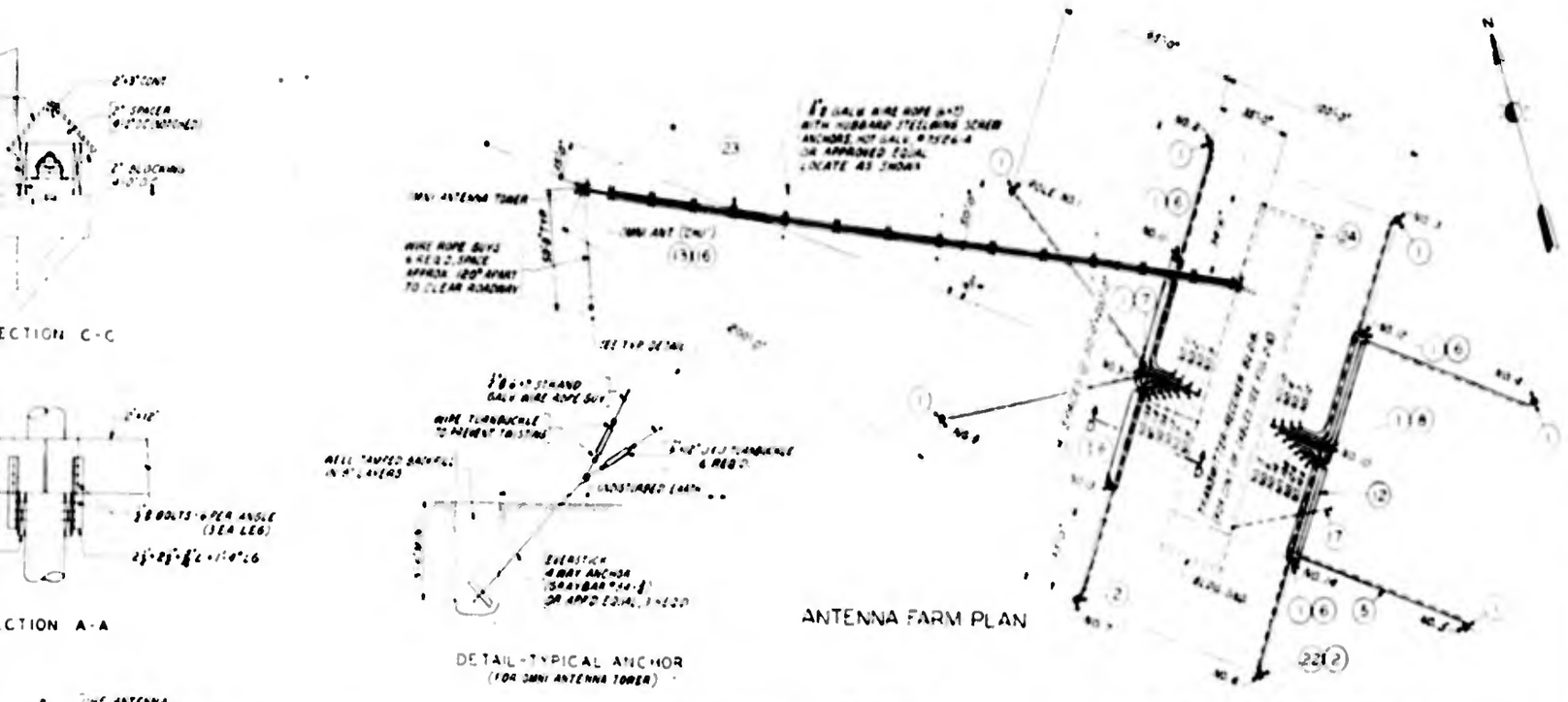


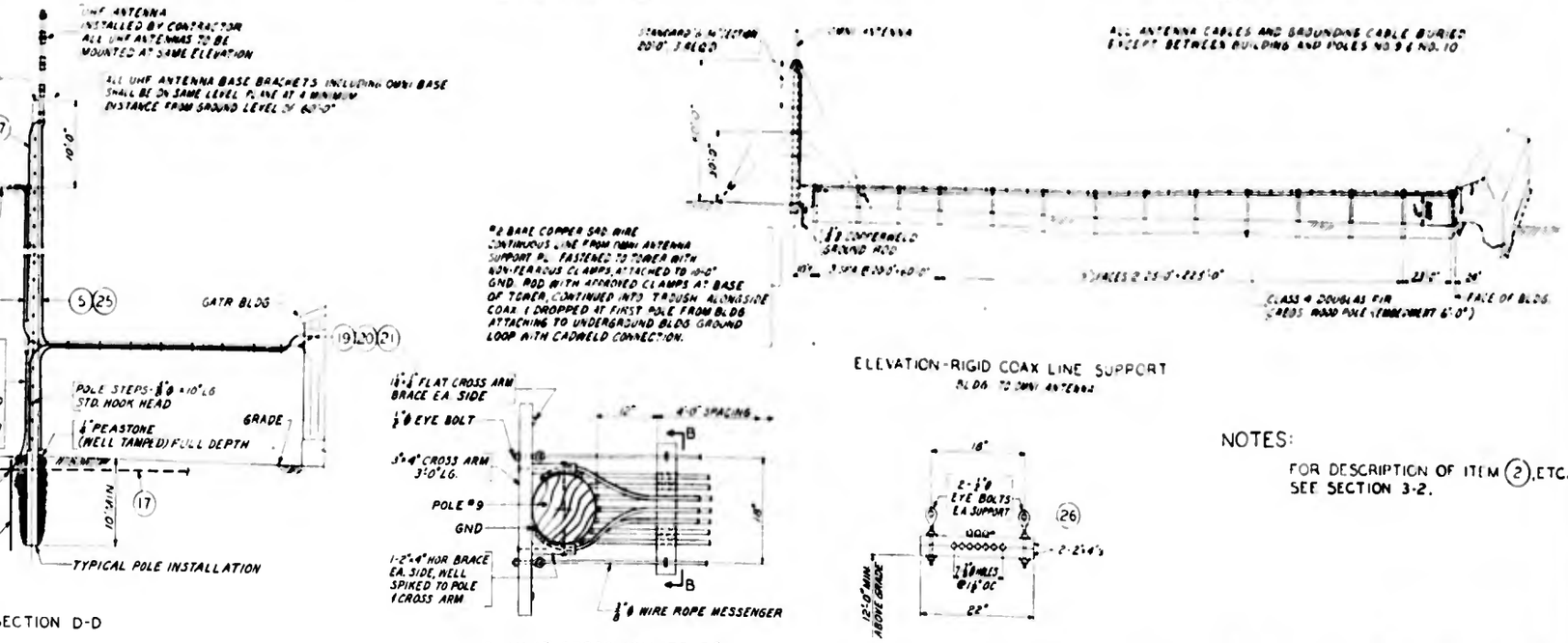
SECTION-RIGID COAX SUPPORT



SECTION D-D

PLAN





NOTES:

FOR DESCRIPTION OF ITEM (2), ETC., SEE SECTION 3-2.

Fig. 2-2 Lexington GATR – ESS antenna farm

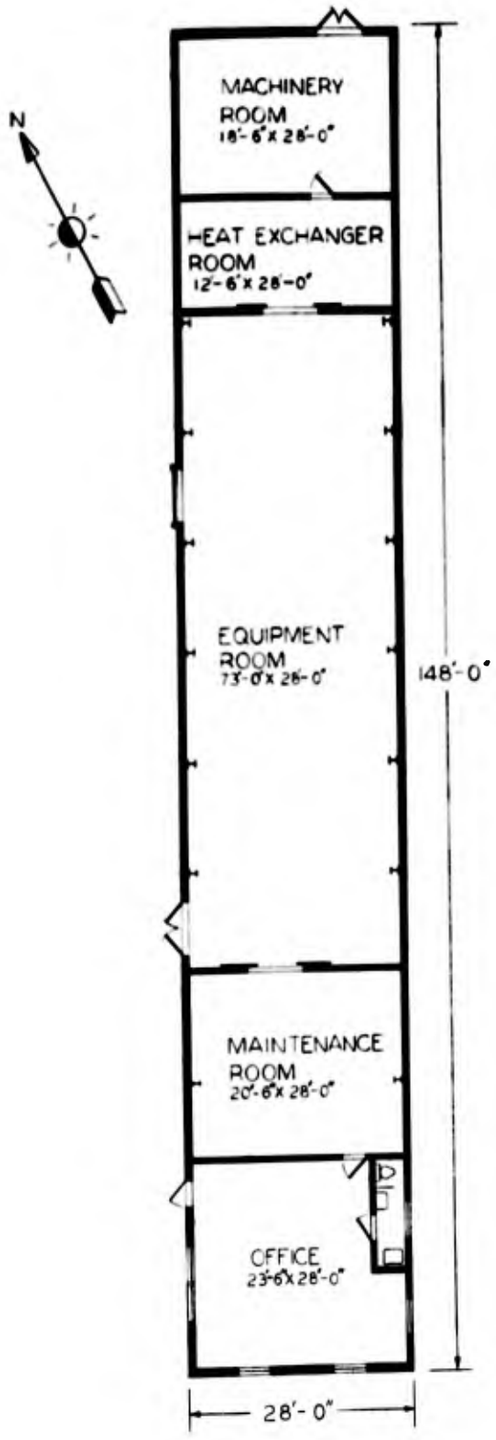
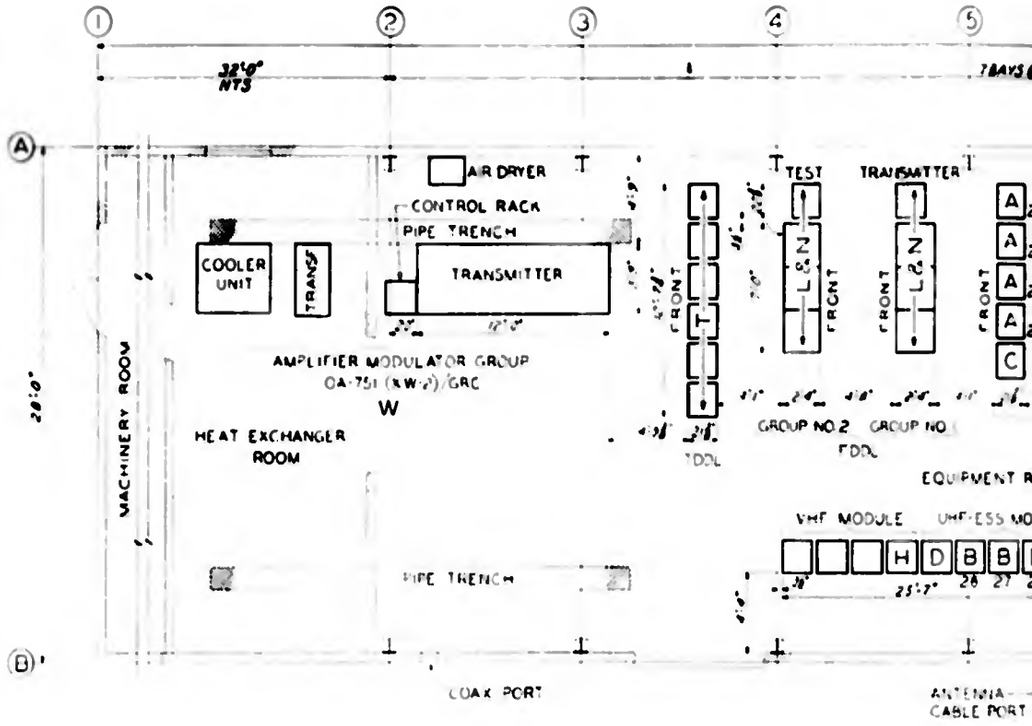


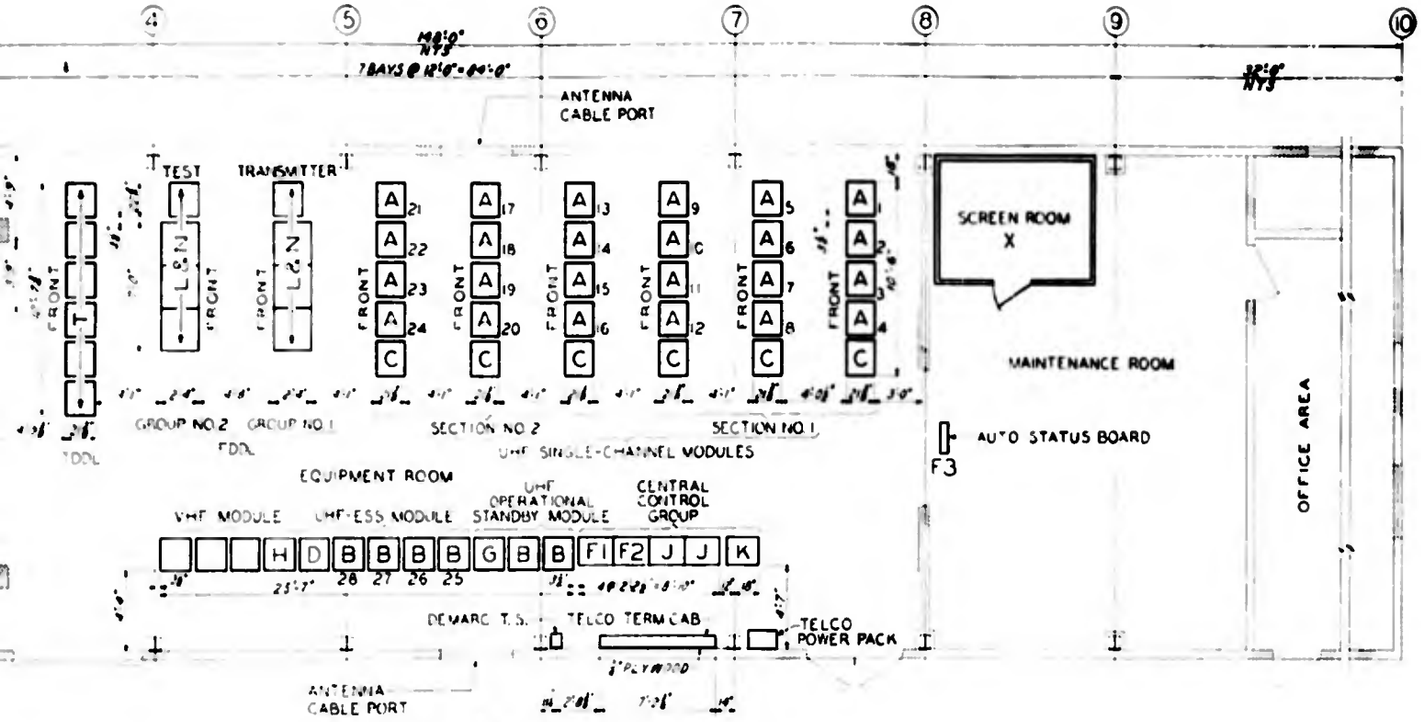
Fig. 2-3 GATR–ESS building



LEGEND:

A	UHF SINGLE-CHANNEL TRANSMITTER & RECEIVER RACK
B	UHF MULTICHANNEL TRANSMITTER & RECEIVER RACK
C	ANTENNA COUPLER & MODULE TERMINATION RACK (SINGLE-CHANNEL)
D	ANTENNA COUPLER & MODULE TERMINATION RACK (MULTICHANNEL)
F1	SPARE SUBSTITUTION DEVICE CABINET
F2	PATCH TEST PANEL CABINET
F3	AUTO STATUS BOARD
G	ANTENNA TRANSFER PANEL RACK
H	VHF SINGLE-CHANNEL TRANSMITTER & RECEIVER RACK
J	TELCO EQUIPMENT CABINET (DDR)
K	TELCO TEST EQUIPMENT RACK
L&N	FREQUENCY DIVISION DATA LINK (FDDL) GKA-4
T	TIME DIVISION DATA LINK (TDDL) GKA-5
W	AMPLIFIER-MODULATOR GROUP OA-751 (XW-2)/GRC (20 KW TRANSMITTER)
X	SCREEN ROOM (DOUBLE SHIELD CELL TYPE ENCLOSURE)

1

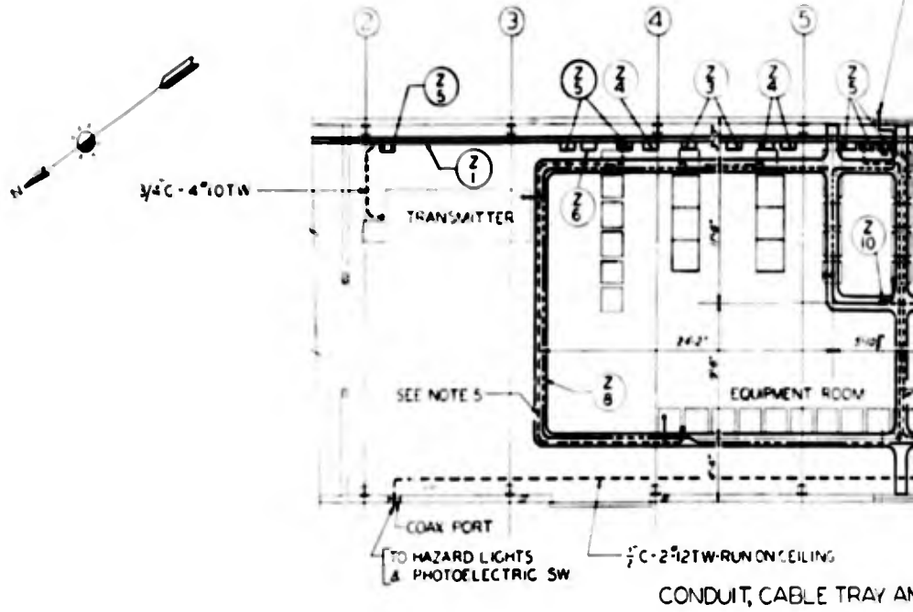


NGLE-CHANNEL)
ULTICHANNEL)

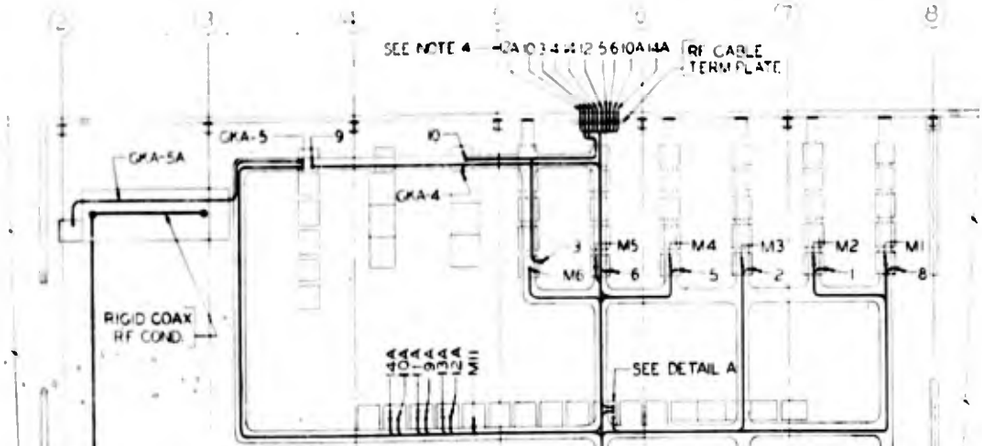
EQUIPMENT ELEVATIONS:	REFERENCE FIGURE NUMBER
UHF SINGLE-CHANNEL MODULE	2-6 & 2-7
CENTRAL CONTROL GROUP	2-8 & 2-9
TELCO ENTRANCE EQUIPMENT & DEMARC T.S.	2-10
AUTO STATUS BOARD	2-11
UHF OPERATIONAL STANDBY MODULE	2-12
VHF SINGLE-CHANNEL MODULE	2-13 & 2-14
FREQUENCY DIVISION DATA LINK (FDDL)	2-15 & 2-16
TIME DIVISION DATA LINK (TDDL)	2-17 & 2-18
AMPLIFIER-MODULATOR GROUP	2-19
ESS COMMUNICATION MODULE	2-20 & 2-21

SURE)

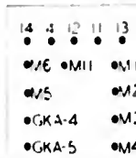
Fig. 2-4 Equipment layout



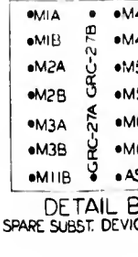
CONDUIT, CABLE TRAY AN



ANTENNA CABLE PLAN

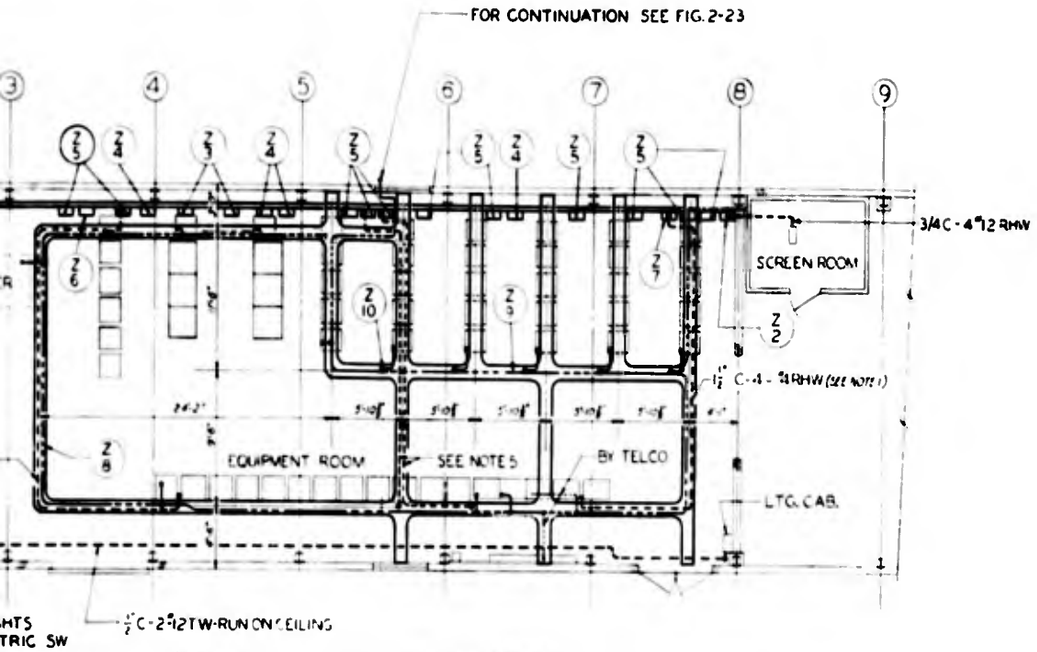


DETAIL A
ANTENNA TRANS
PANEL RACK



DETAIL B
SPARE SUBST. DEVIC

1



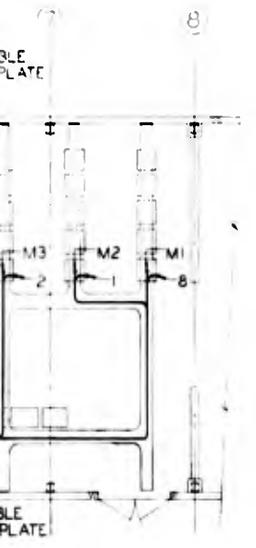
CONDUIT, CABLE TRAY AND GROUNDING PLAN

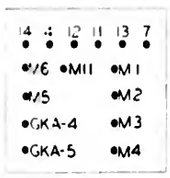
LEGEND:

- ----CONDUIT RUN EXPOSED
- ——CONTROL OR CO-AXIAL CABLE
- -----GROUND CABLE
- CONDUIT OR CABLE TURNING DOWN
- CONDUIT OR CABLE TURNING UP
- PARALLEL, TWO LUG, CONNECTOR

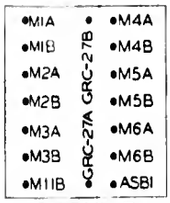
NOTES:

1. ALL CONDUIT SHALL BE CLIPPED TO BOTTOM OF CABLE TRAY EXCEPT AS NOTED.
2. ALL CONDUIT TO BE THIN WALL TYPE.
3. BOTTOM OF CABLE TRAYS TO BE 9'-7" ABOVE FLOOR.
4. FOR CONTINUATION OF ANTENNA CABLE SEE FIGURE 2-2.
5. THIS IS 1" CONDUIT WITH 4 #10 T.W. WIRE.
6. FOR DESCRIPTION OF ITEM (Z/2) ETC: SEE SECTION 3-2.

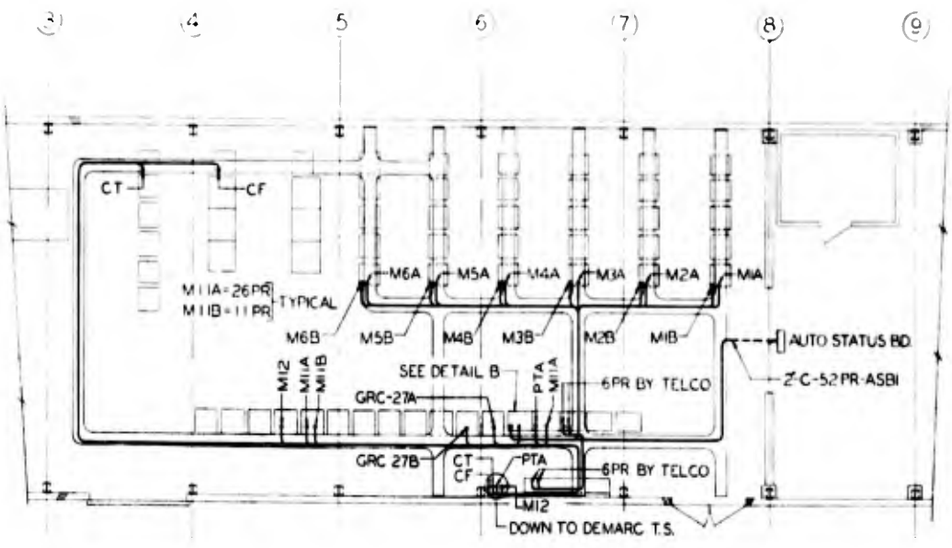




DETAIL A
ANTENNA TRANSFER PANEL RACK



DETAIL B
SPARE SUBST. DEVICE CAB.



AUDIO AND CONTROL CABLE PLAN

2

Fig. 2-5 Conduit and cable system

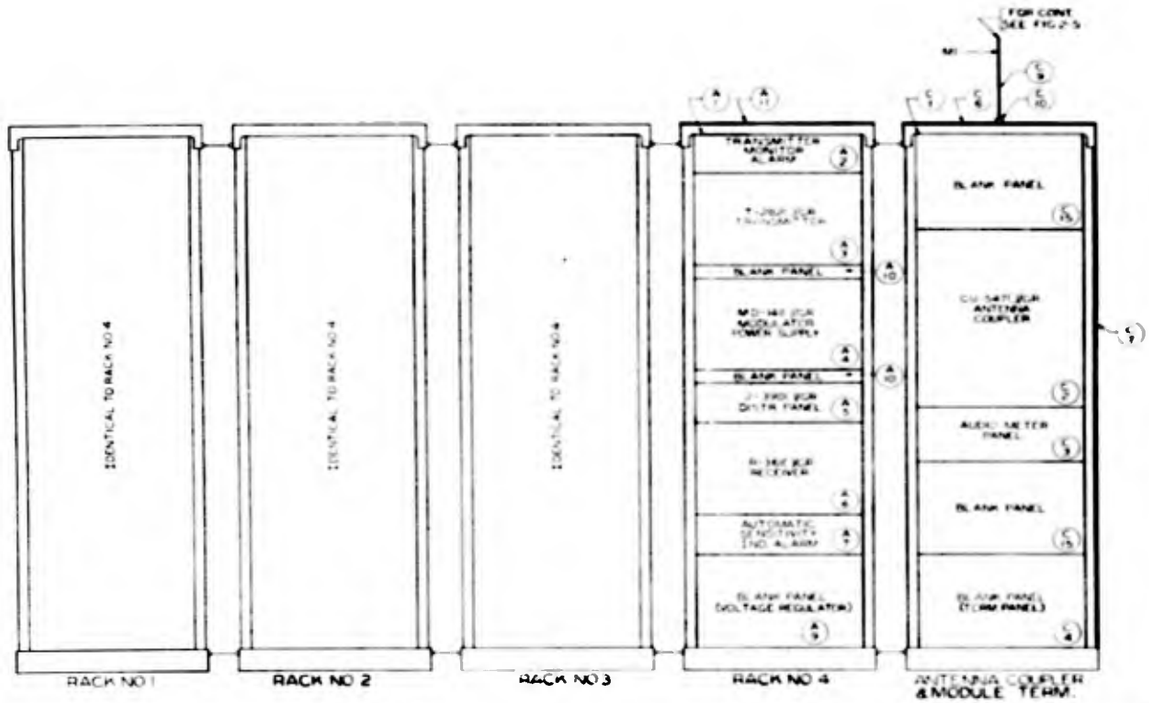


Fig. 2-6 UHF voice single – channel module (front)

NOTES:
1. FOR DESCRIPTION OF ITEM (S ETC) SEE SECTION 3-2.

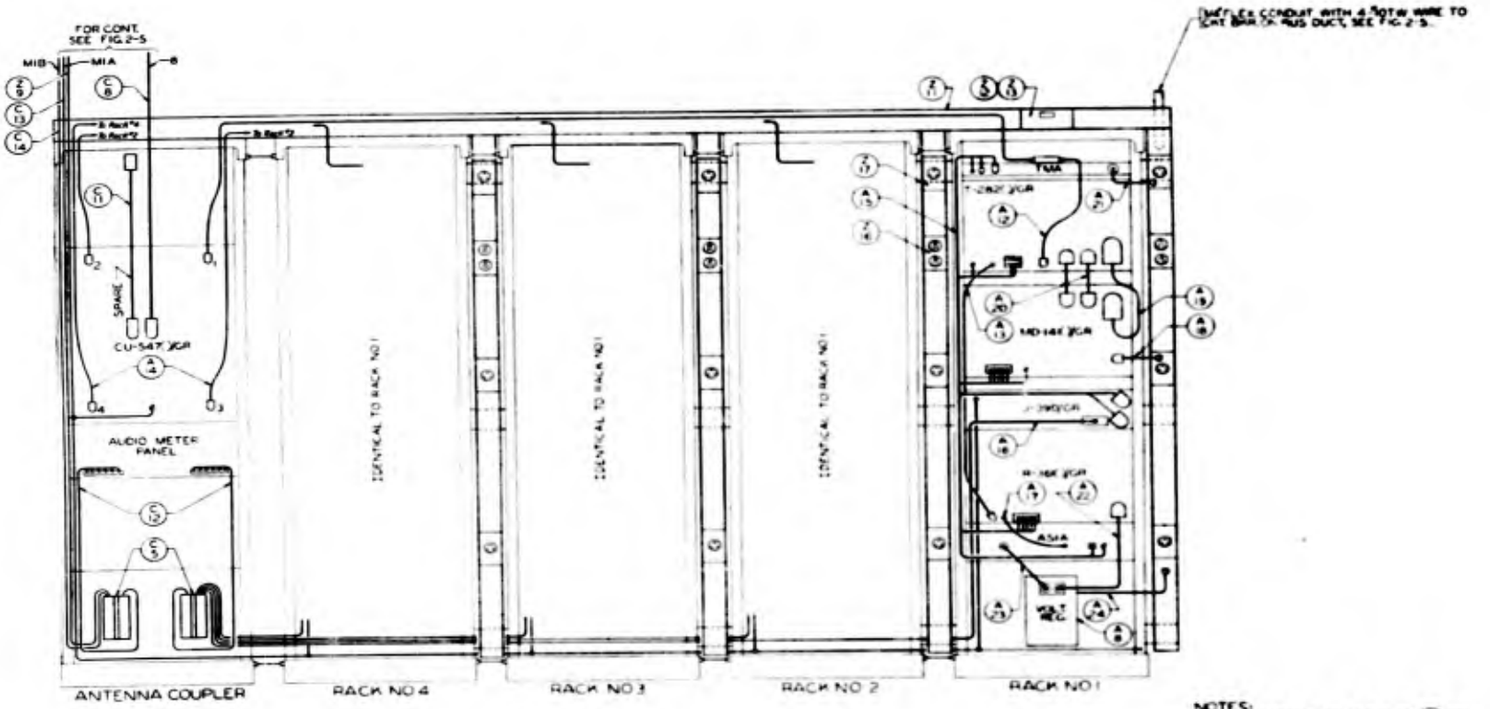


Fig. 2-7 UHF voice single – channel module (rear)

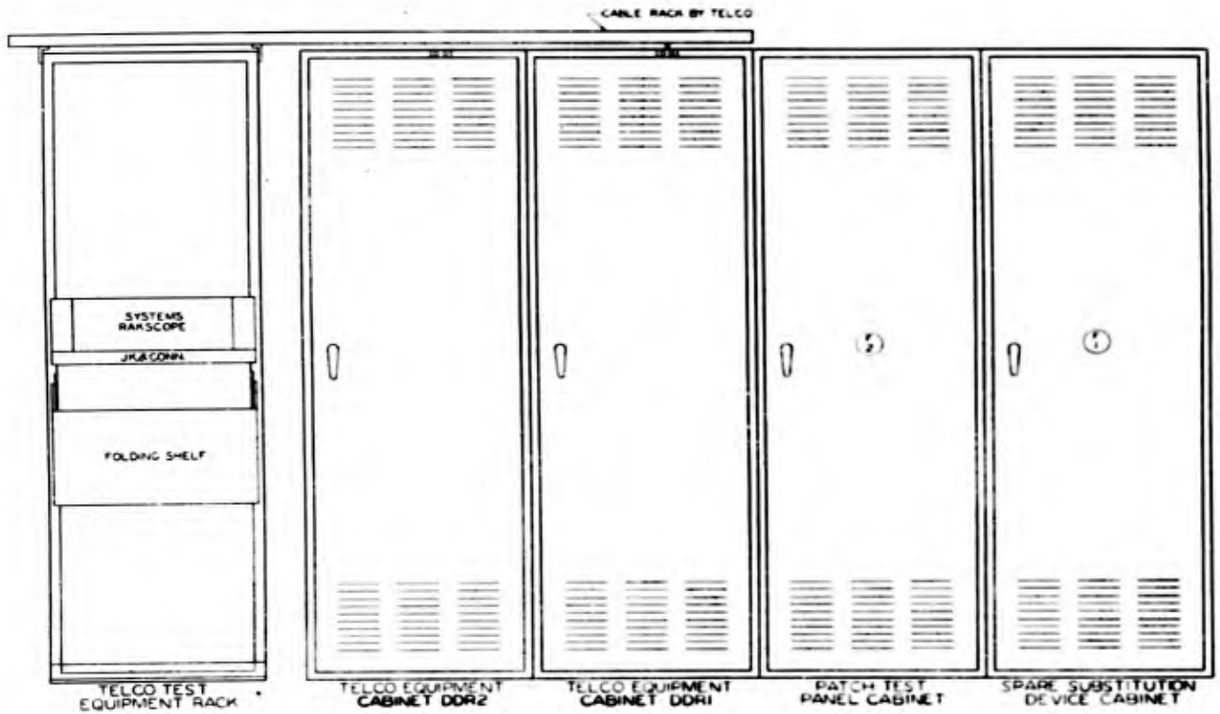
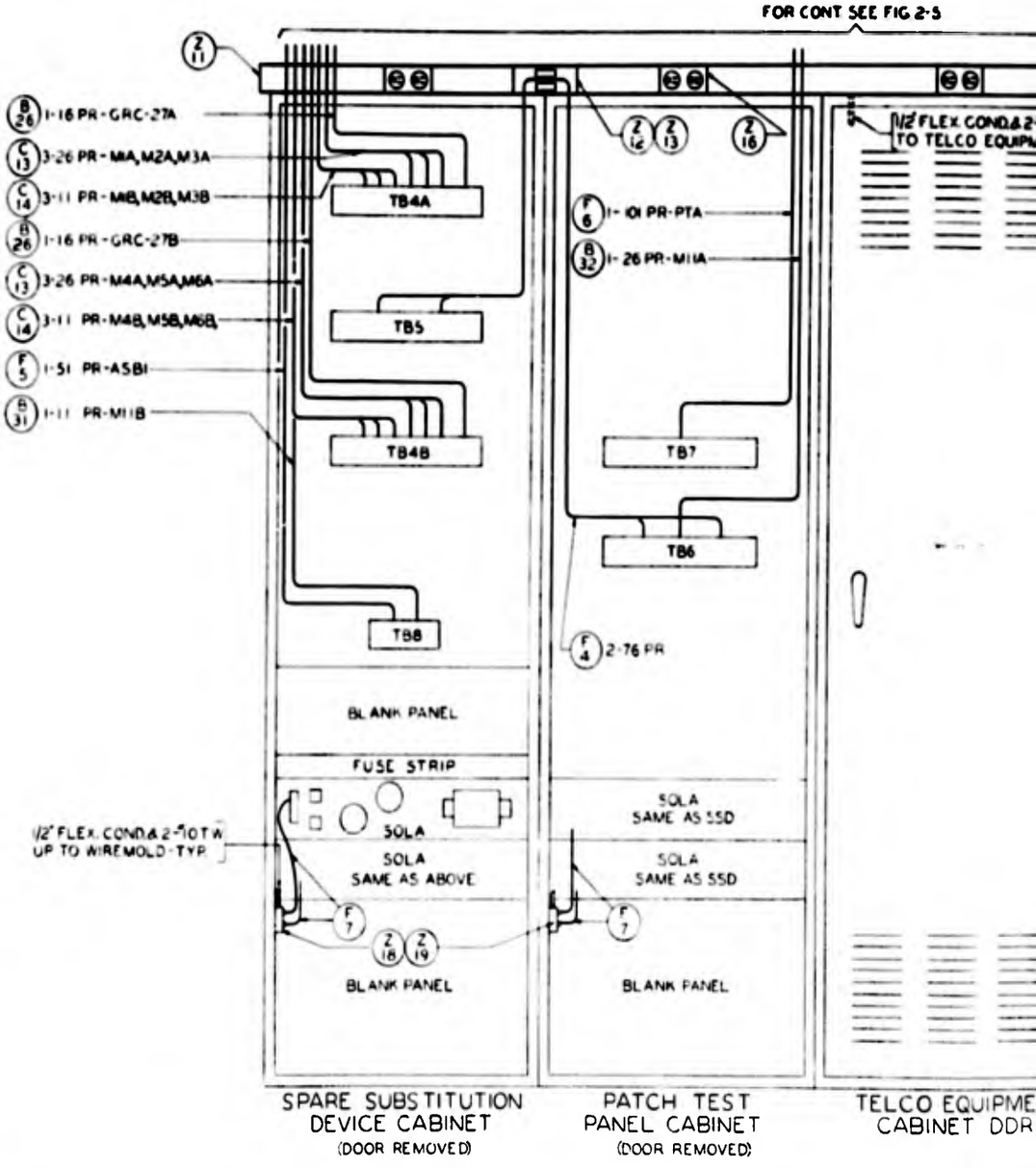
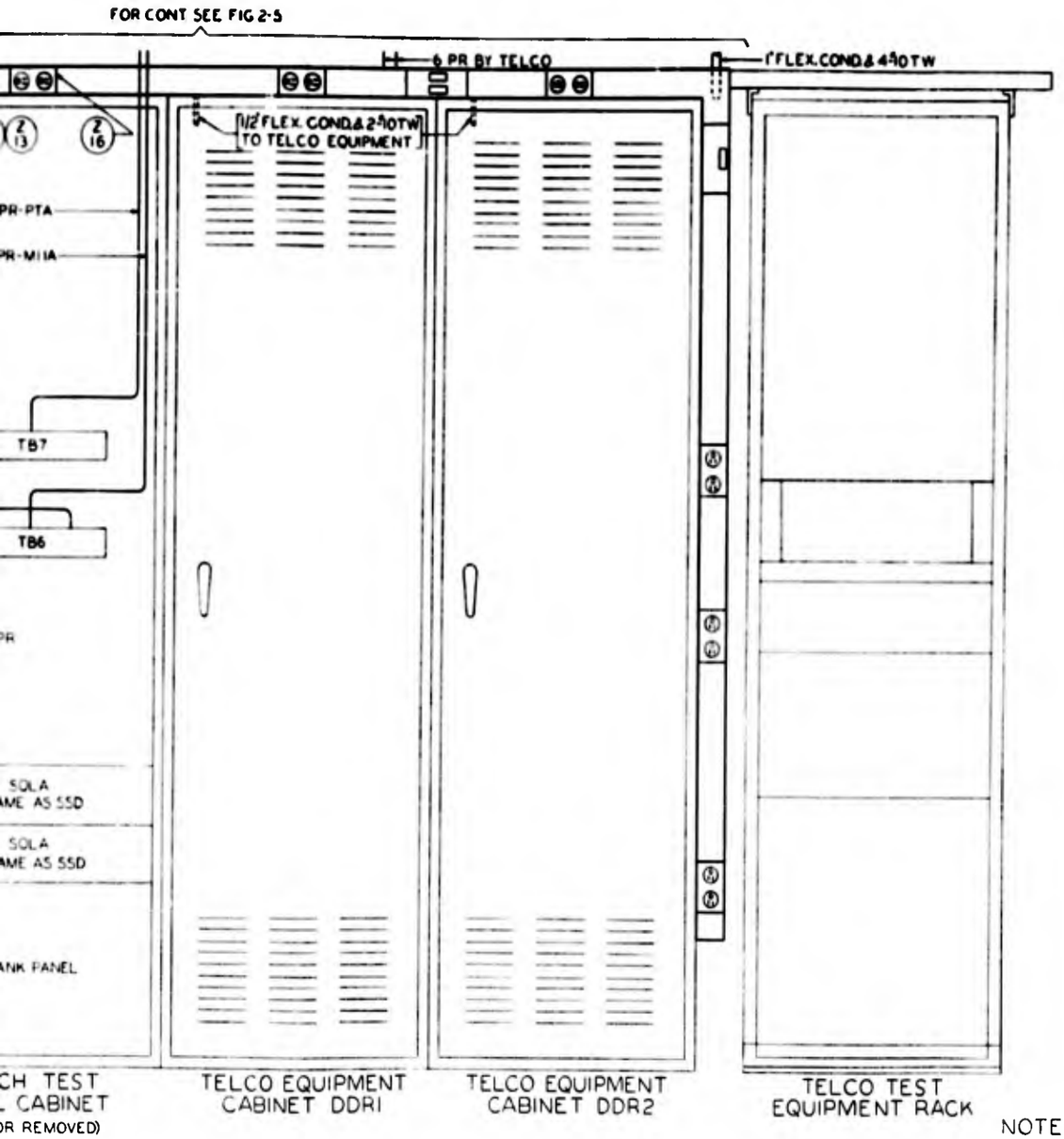


Fig. 2-8 Central control group (front)

NOTES:
1. FOR DESCRIPTION OF ITEM (1) ETC. SEE SECTION 2-3


FOR CONT SEE FIG 2-5
Z 11
B 26 1-16 PR-GRC-27A
C 13 3-26 PR-M1A,M2A,M3A
C 14 3-11 PR-M1B,M2B,M3B
B 26 1-16 PR-GRC-27B
C 13 3-26 PR-M4A,M5A,M6A
C 14 3-11 PR-M4B,M5B,M6B
F 5 1-51 PR-ASBI
B 31 1-11 PR-M11B
TB4A
TB5
TB4B
TB8
Z 12
Z 13
Z 16
F 6 1-101 PR-PTA
B 32 1-26 PR-M11A
TB7
TB6
F 4 2-76 PR
1/2" FLEX. COND. & 2
TO TELCO EQUIP
BLANK PANEL
FUSE STRIP
SOLA
SOLA
SAME AS ABOVE
SOLA
SAME AS SSD
SOLA
SAME AS SSD
1/2" FLEX. COND. & 2-#10 TW
UP TO WIREMOLD-TYP
F 7
Z 18
Z 19
BLANK PANEL
BLANK PANEL
SPARE SUBSTITUTION
DEVICE CABINET
(DOOR REMOVED)
PATCH TEST
PANEL CABINET
(DOOR REMOVED)
TELCO EQUIPME
CABINET DDR

1



NOTES:

1. FOR DESCRIPTION OF ITEM (F/7) ETC: SEE SECTION 3-2.
2. GRC-27A, MIA ETC. ARE CABLE DESIGNATIONS.

Fig. 2-9 Central control group (rear)

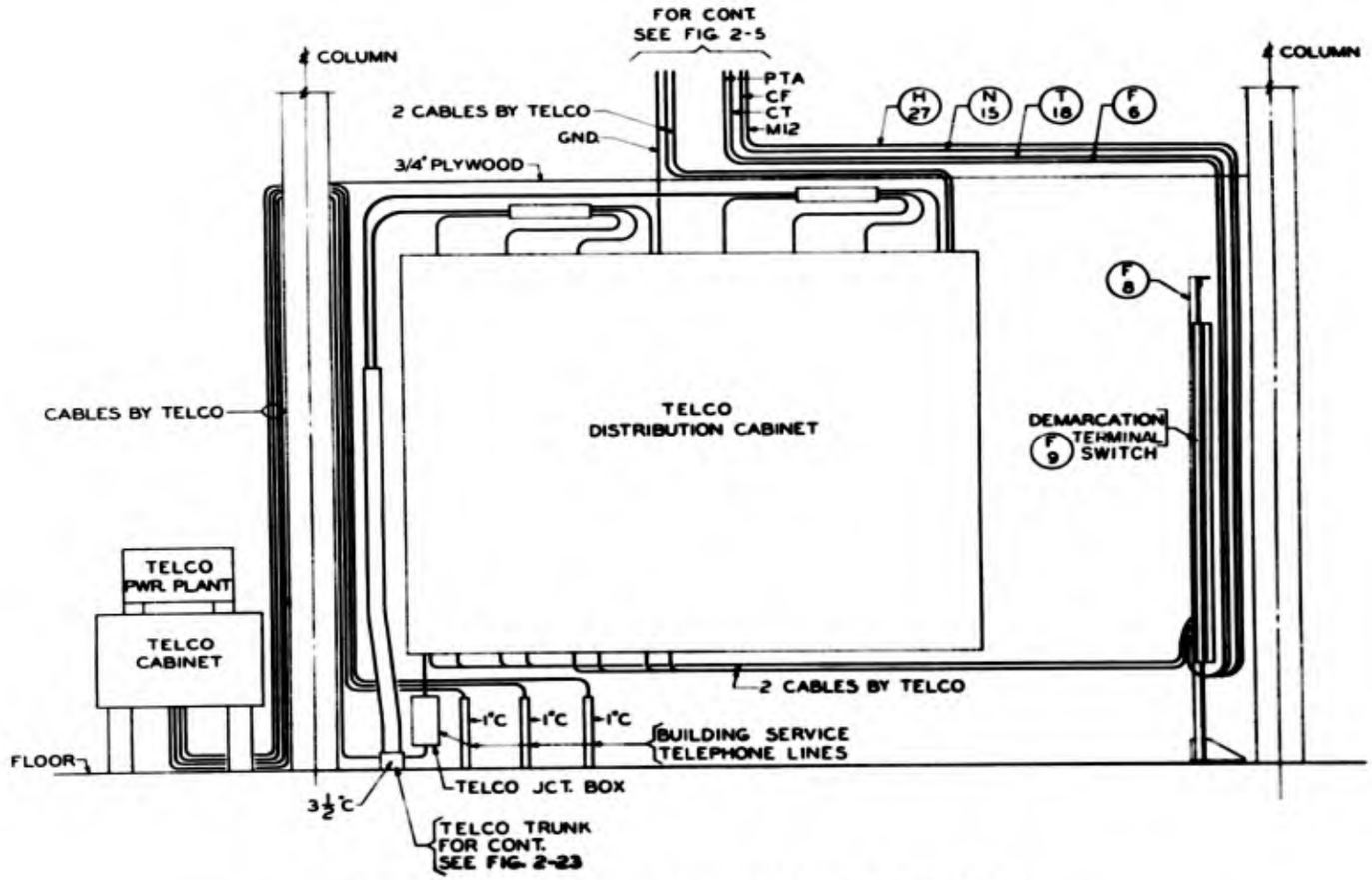


Fig. 2-10 Telco entrance equipment and demarc terminal strip

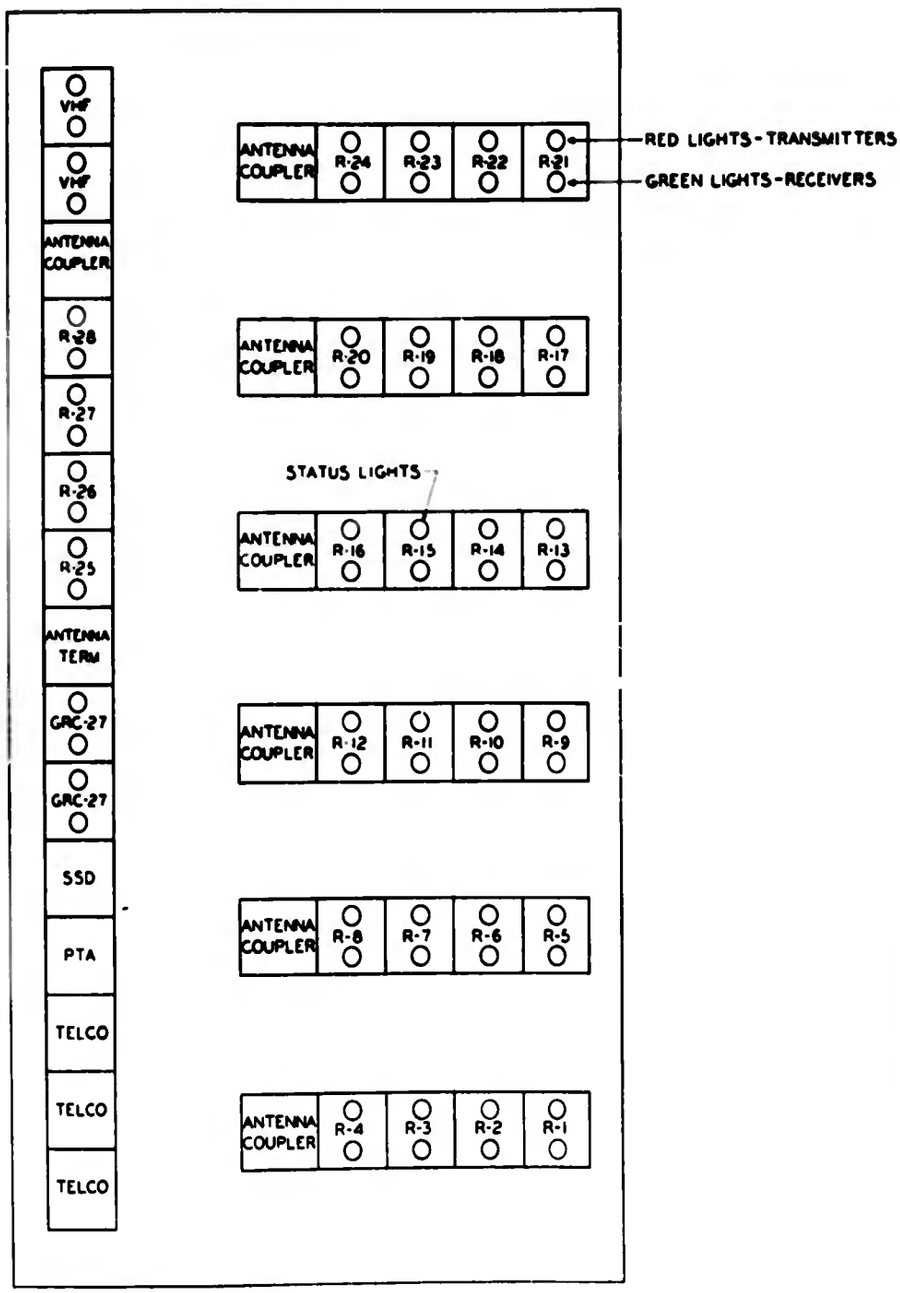
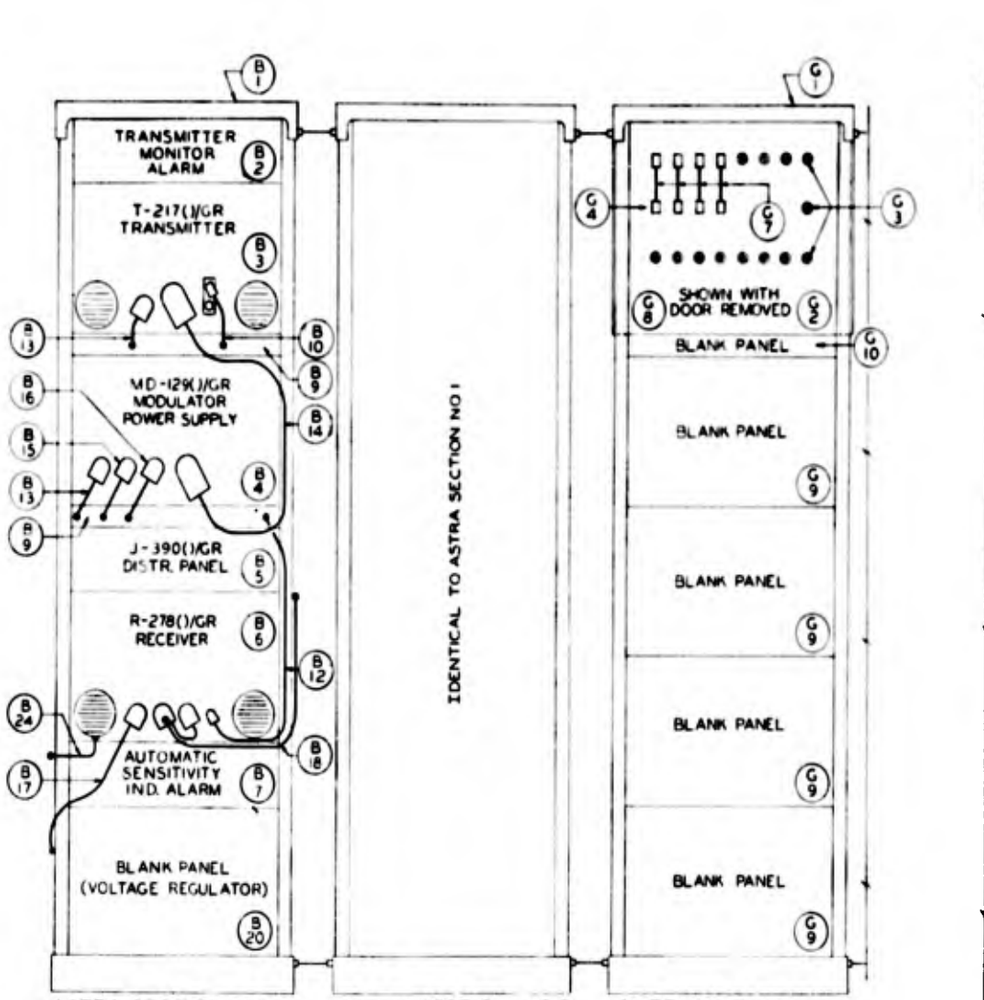
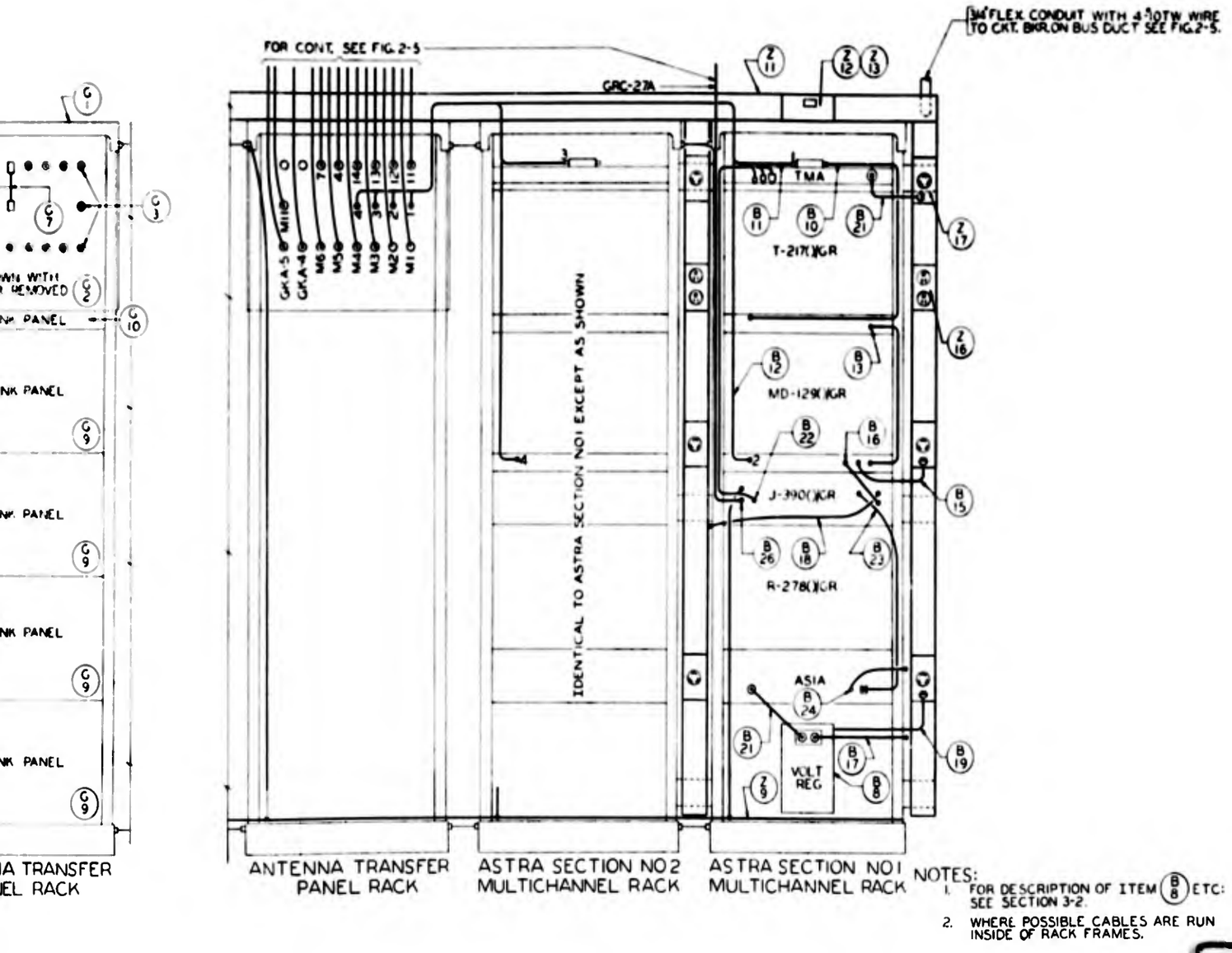


Fig. 2-11 Automatic status board


TRANSMITTER MONITOR ALARM
T-217()/GR TRANSMITTER
MD-129()/GR MODULATOR POWER SUPPLY
J-390()/GR DISTR. PANEL
R-278()/GR RECEIVER
AUTOMATIC SENSITIVITY IND. ALARM
BLANK PANEL (VOLTAGE REGULATOR)
IDENTICAL TO ASTRA SECTION NO 1
SHOWN WITH DOOR REMOVED
BLANK PANEL
BLANK PANEL
BLANK PANEL
BLANK PANEL
BLANK PANEL
FOR CONT.
ASTRA SECTION NO 1 MULTICHANNEL RACK
ASTRA SECTION NO 2 MULTICHANNEL RACK
ANTENNA TRANSFER PANEL RACK
ANTENNA PANE

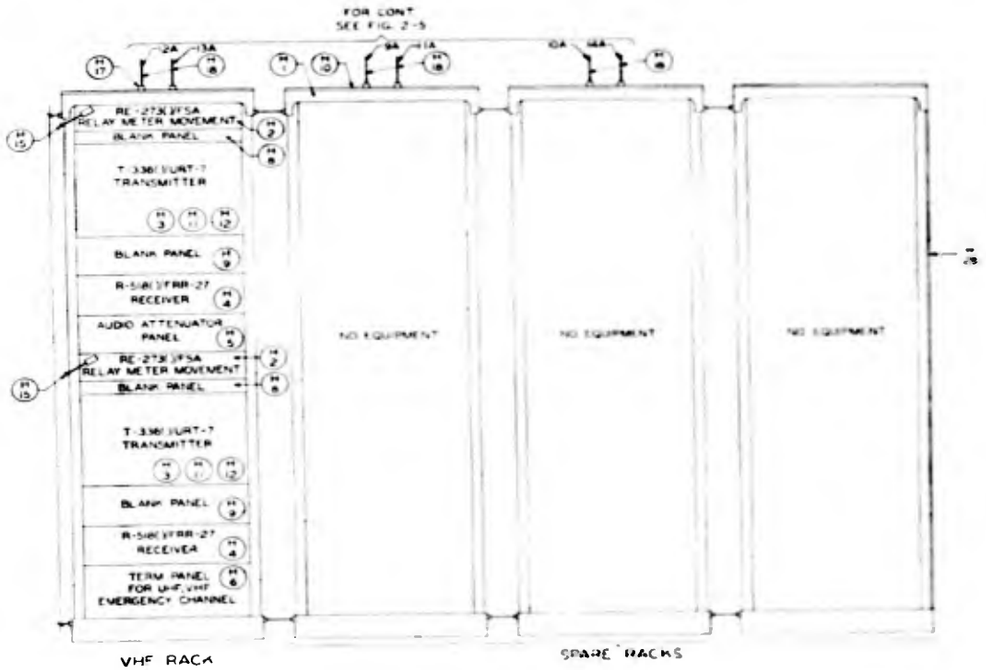
FRONT VIEW

1



REAR VIEW

Fig. 2-12 UHF operational standby module



NOTES:
1 FOR EXCEPTION OF ITEM (2) ETC SEE SECTION 2-2

Fig. 2-13 VHF single – channel module (front view)

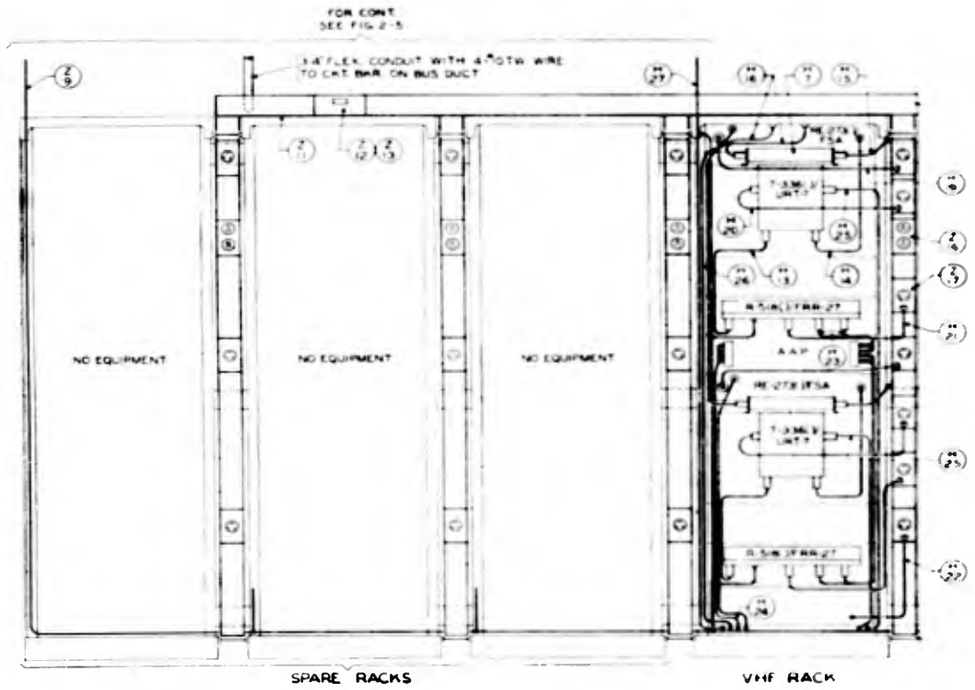
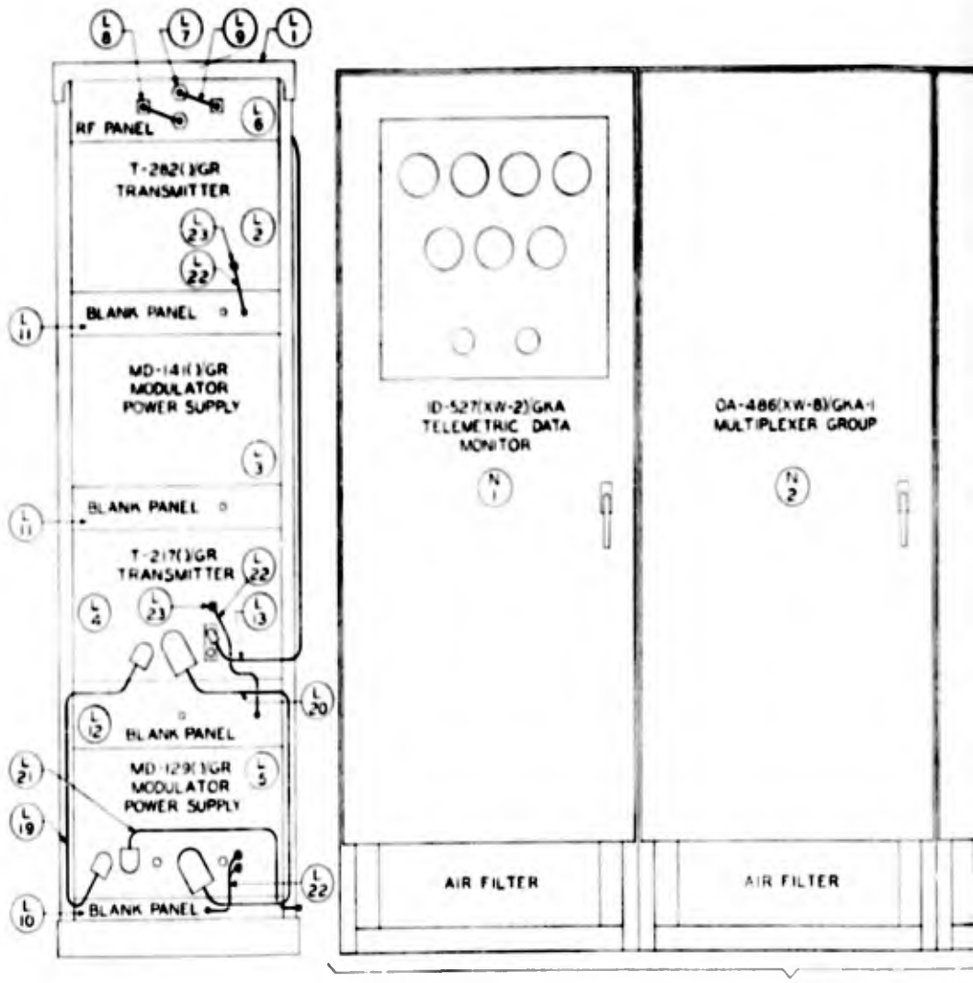


Fig. 2-14 VHF single – channel module (rear view)

NOTES:
1. FOR DESCRIPTION OF ITEM (22) ETC. SEE SECTION 3-2
2. WHERE POSSIBLE CABLES ARE RUN INSIDE OF RACK FRAMES



FDDL RACK
TRANSMITTER

FDDL CABINETS

FDDL GROUP NO. 1
(FRONT VIEW)

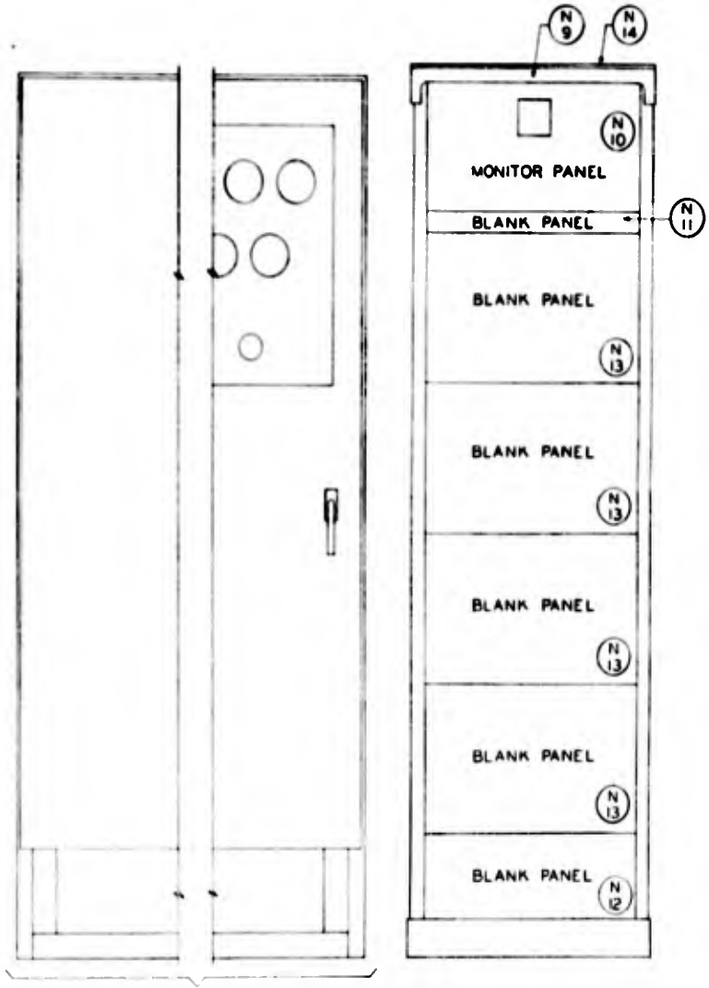
NOTES:

1. FOR DESCRIPTION OF ITEM (N 2) ETC. SEE SECTION 3-2.

1

FDDL CABINETS

DL GROUP NO. 1
(FRONT VIEW)

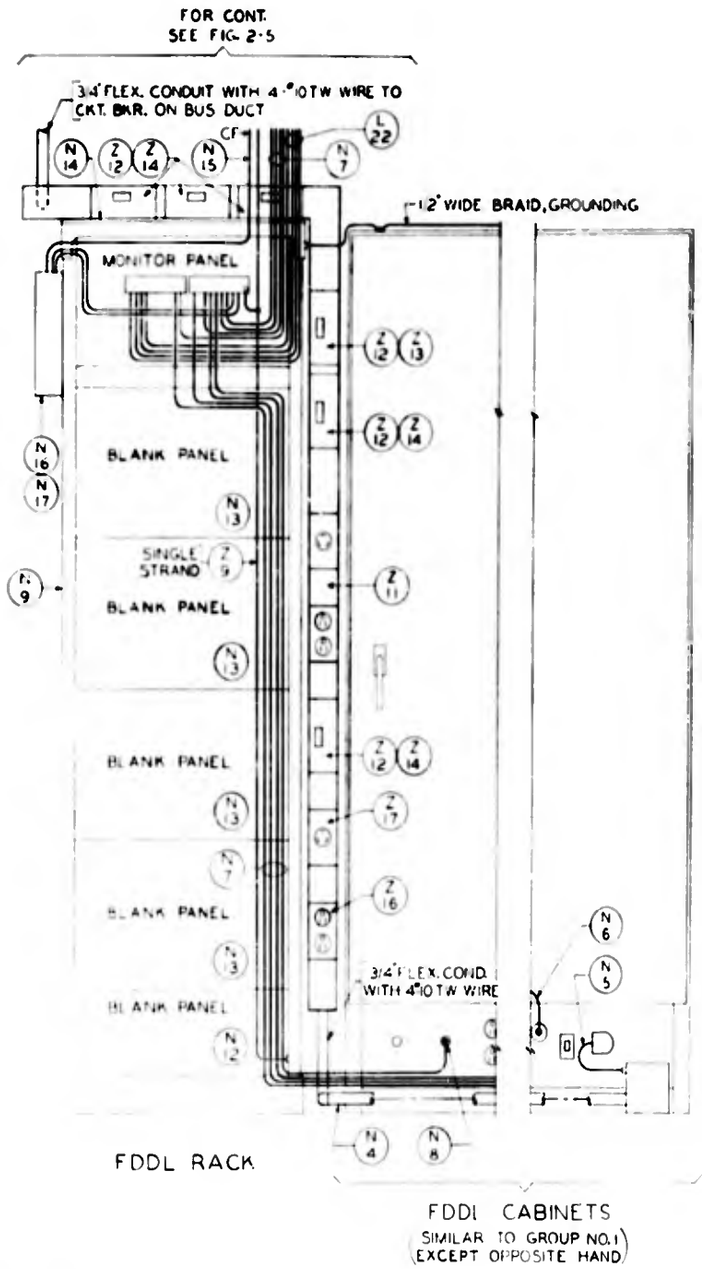


FDDL CABINETS
(SIMILAR TO GROUP NO. 1
EXCEPT OPPOSITE HAND)

FDDL RACK
TEST

FDDL GROUP NO. 2
(FRONT VIEW)

Fig. 2-15 Frequency division data link

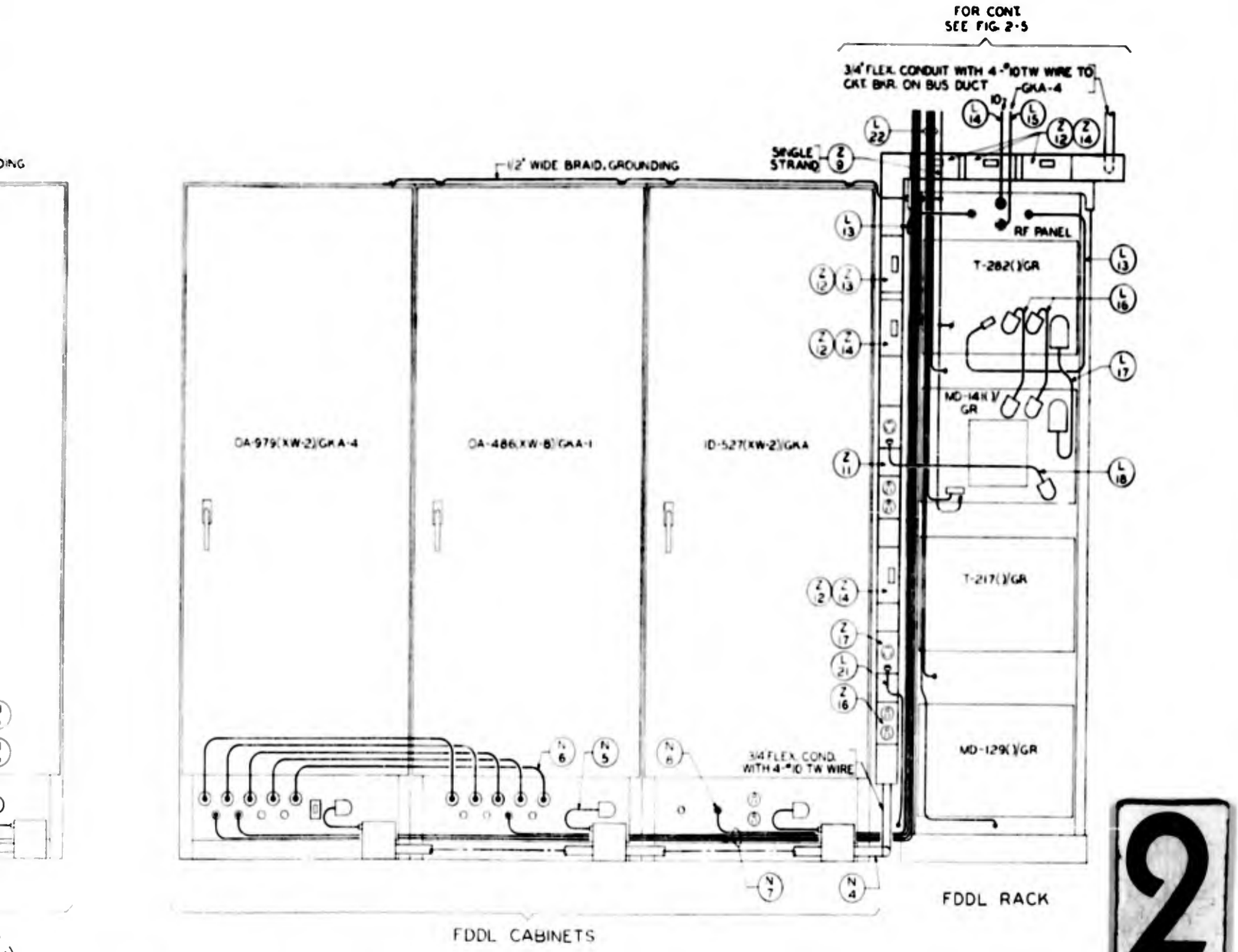


FDDL GROUP NO. 2
(REAR VIEW)

NOTES:

1. FOR DESCRIPTION OF IT
   SEE SECTION 3-2.
2. WHERE POSSIBLE CABL
   INSIDE OF RACK FRAM

1



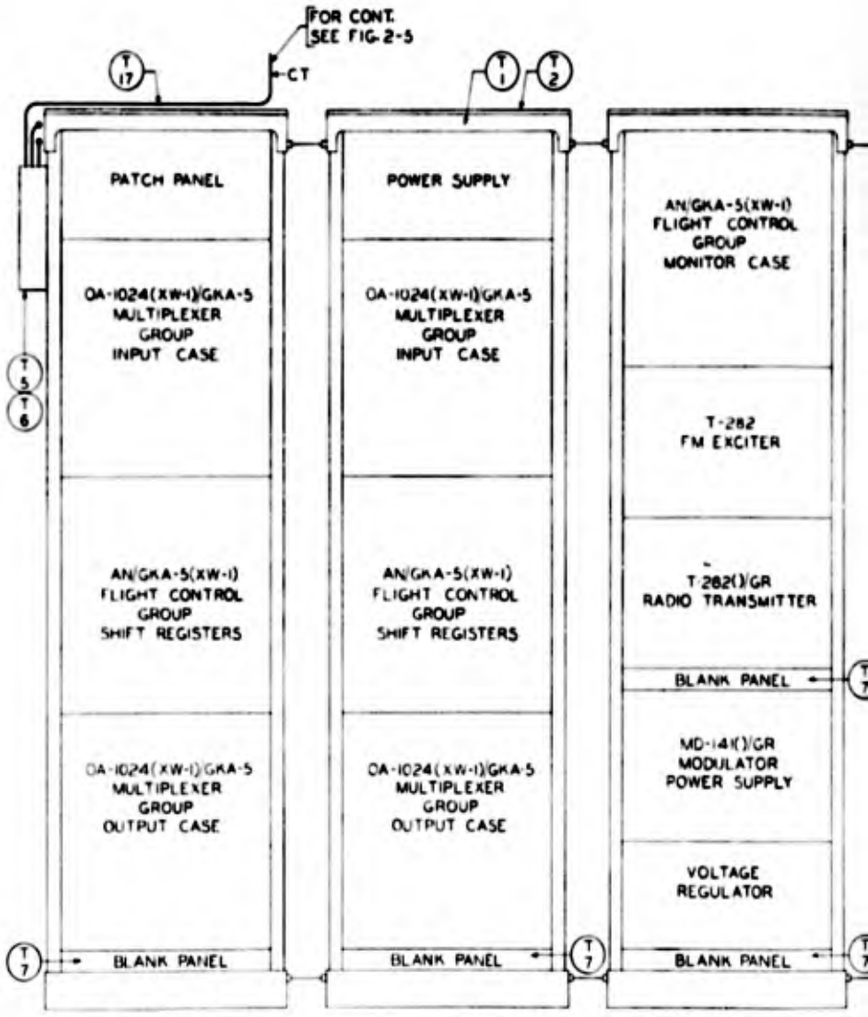
NOTES:

1. FOR DESCRIPTION OF ITEM (N7) ETC. SEE SECTION 3-2.
2. WHERE POSSIBLE CABLES ARE RUN INSIDE OF RACK FRAMES.

FDDL GROUP NO. 1
(REAR VIEW)

Fig. 2-16 Frequency division data link (rear view)

2

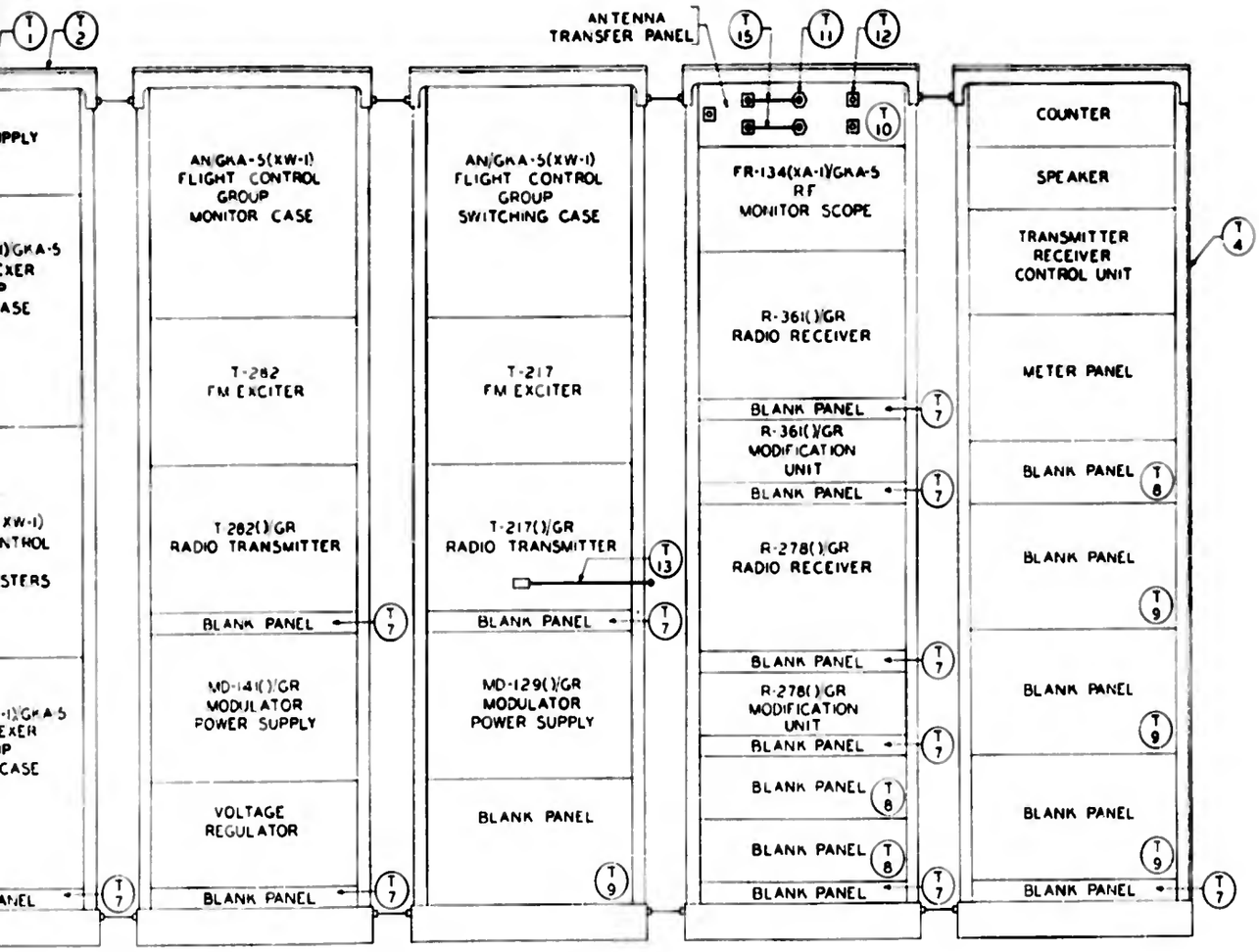


TDDL
(FRONT

NOTES:

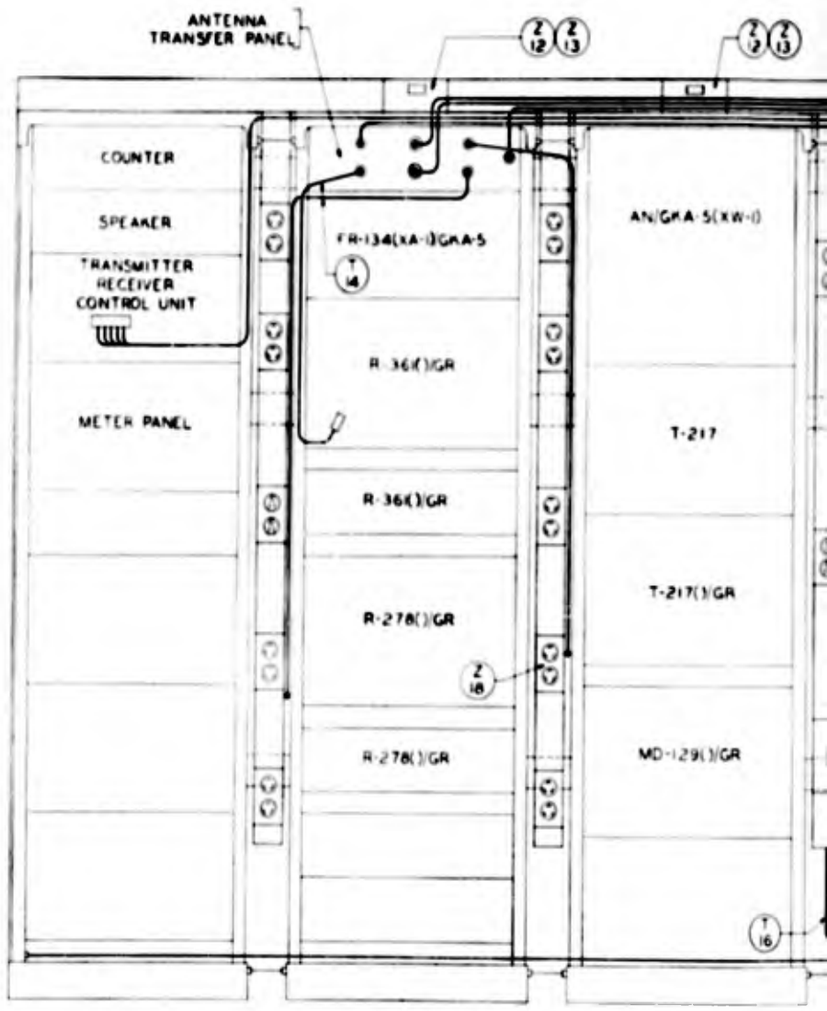
1. FOR DESCRIPTION OF ITEM (T2) ETC: SEE SECTION 3-2.

1



TDDL GROUP
(FRONT VIEW)

Fig. 2-17 Time division data link

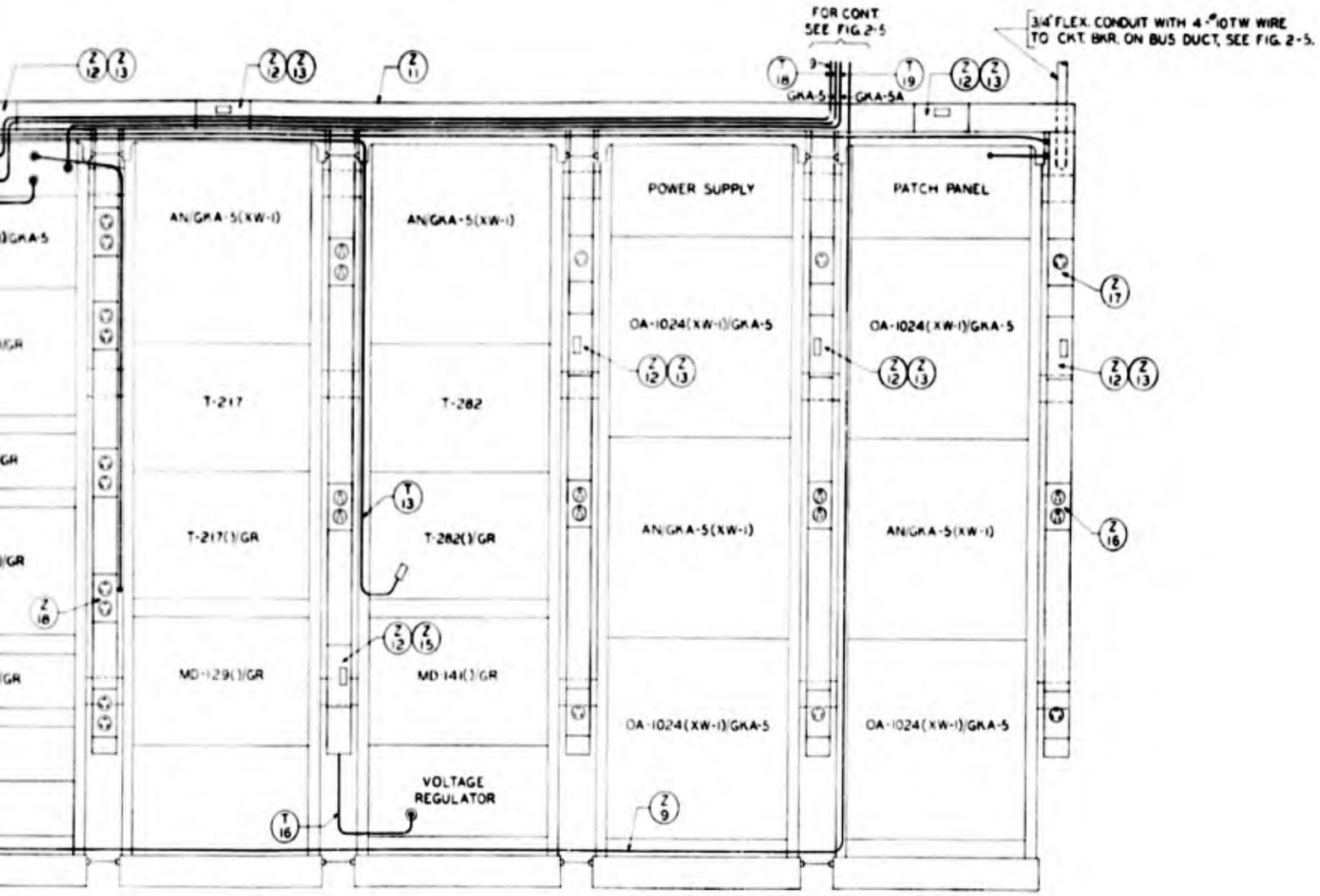


NOTES:

1. OTHER CABLES NOT SHOWN FURNISHED WITH EQUIPMENT.
2. FOR DESCRIPTION OF ITEM (T 16) ETC: SEE SECTION 3-2.
3. WHERE POSSIBLE CABLES ARE RUN INSIDE OF RACK FRAMES.

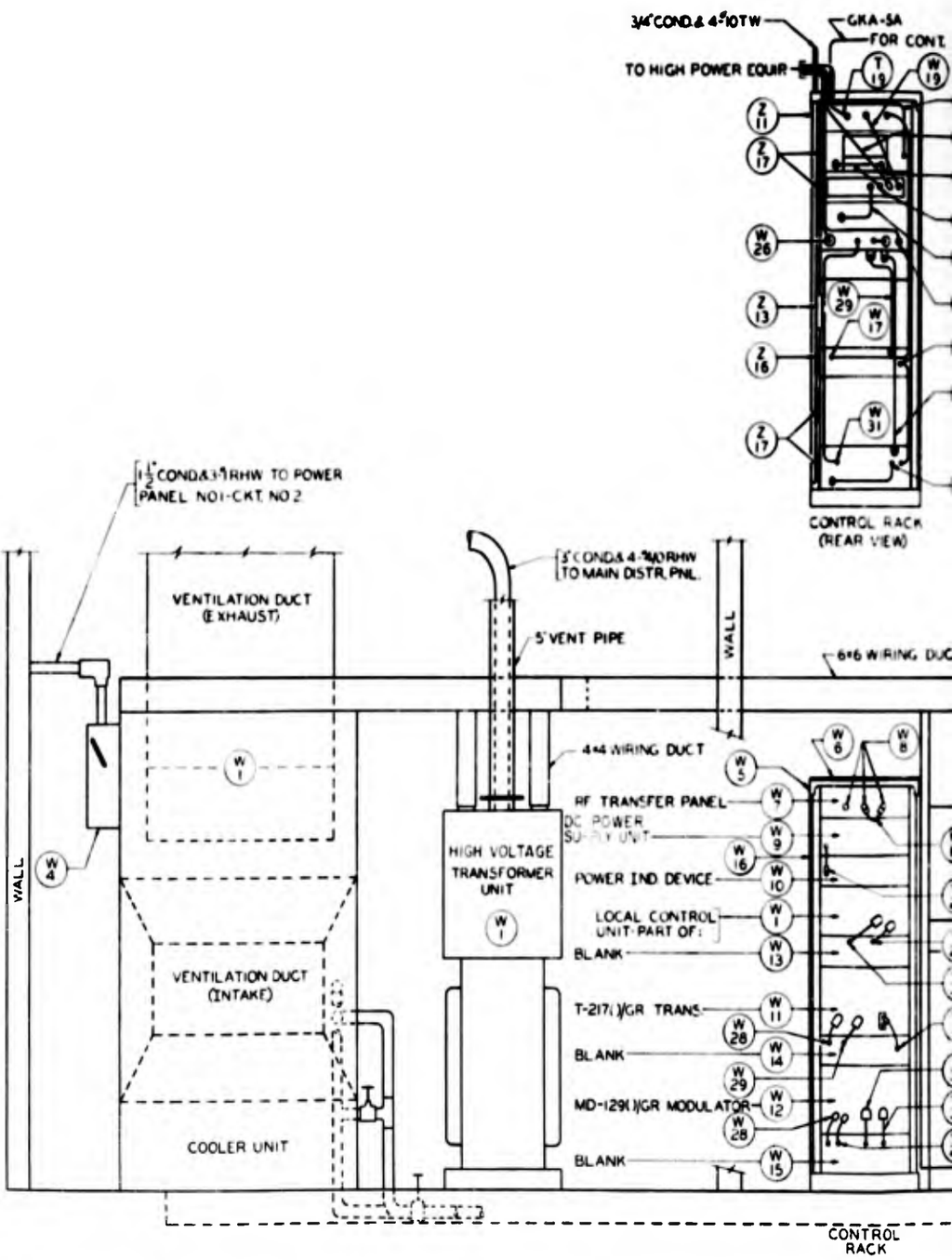
TDDL
(REAR

1

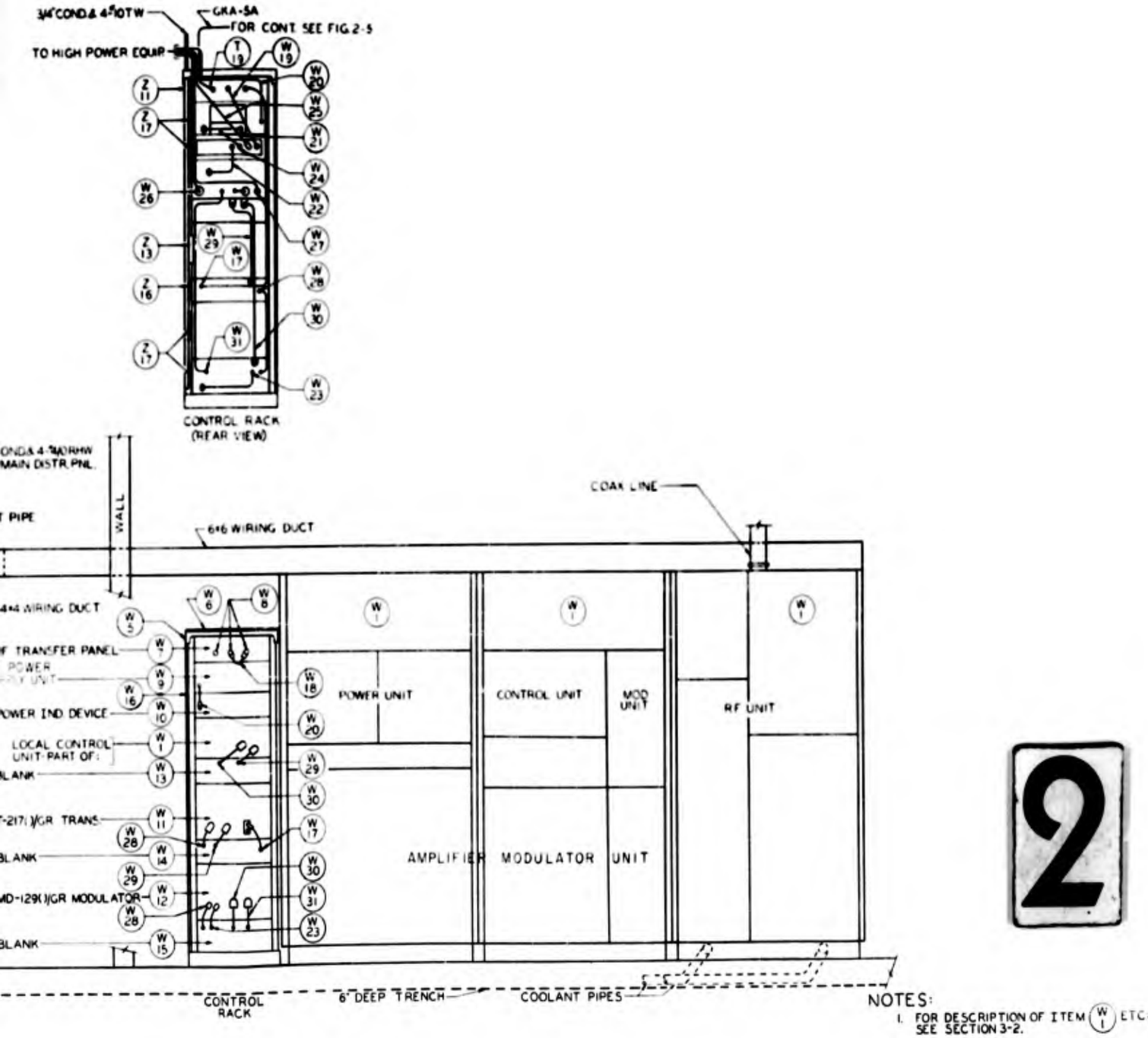


TDDL GROUP
(REAR VIEW)

Fig. 2-18 Time division data link


3/4" COND. & 4-#10 TW
GKA-5A
FOR CONT.
TO HIGH POWER EQUIP.
CONTROL RACK
(REAR VIEW)
1½" COND. & 3-#1 RHW TO POWER PANEL NO1-CKT NO 2
5" COND. & 4-#0 RHW TO MAIN DISTR. PNL.
VENTILATION DUCT (EXHAUST)
5" VENT PIPE
WALL
6×6 WIRING DUCT
4×4 WIRING DUCT
RF TRANSFER PANEL
DC POWER SUPPLY UNIT
POWER IND. DEVICE
LOCAL CONTROL UNIT PART OF:
BLANK
T-217( )/GR TRANS.
BLANK
MD-129( )/GR MODULATOR
BLANK
HIGH VOLTAGE TRANSFORMER UNIT
VENTILATION DUCT (INTAKE)
COOLER UNIT
WALL
CONTROL RACK

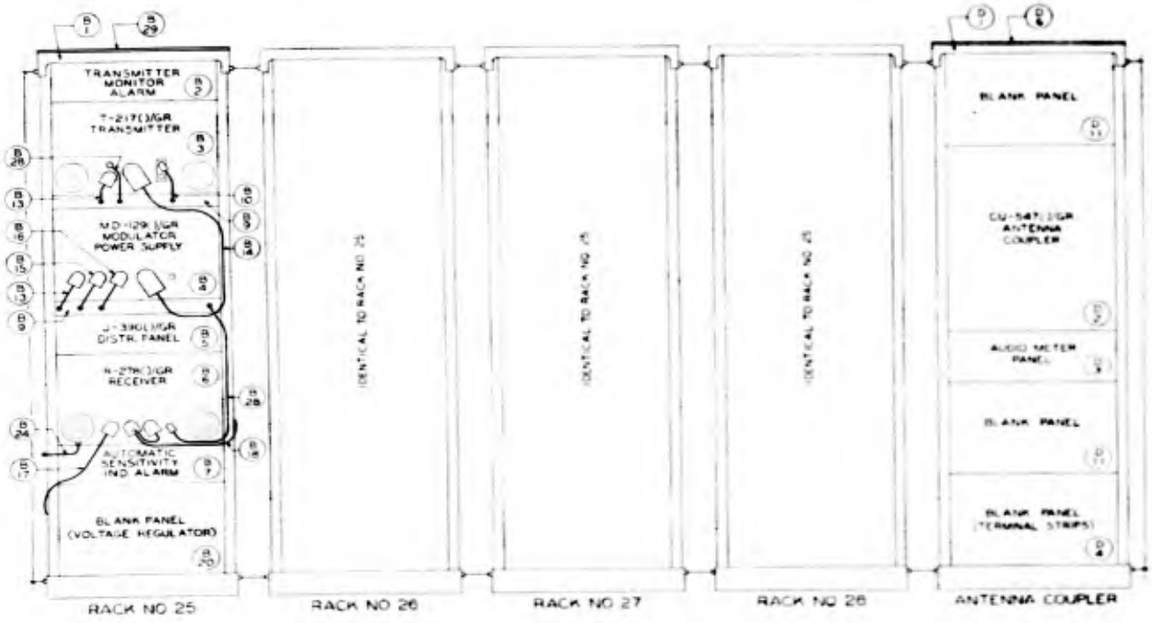
1



NOTES:
1. FOR DESCRIPTION OF ITEM (W 1) ETC. SEE SECTION 3-2.

2

Fig. 2-19 20 – kw amplifier – modulator group



NOTES:
1. FOR DESCRIPTIONS OF ITEM (3) SEE SEE SECTION 3-2.

Fig. 2-20 ESS communication module

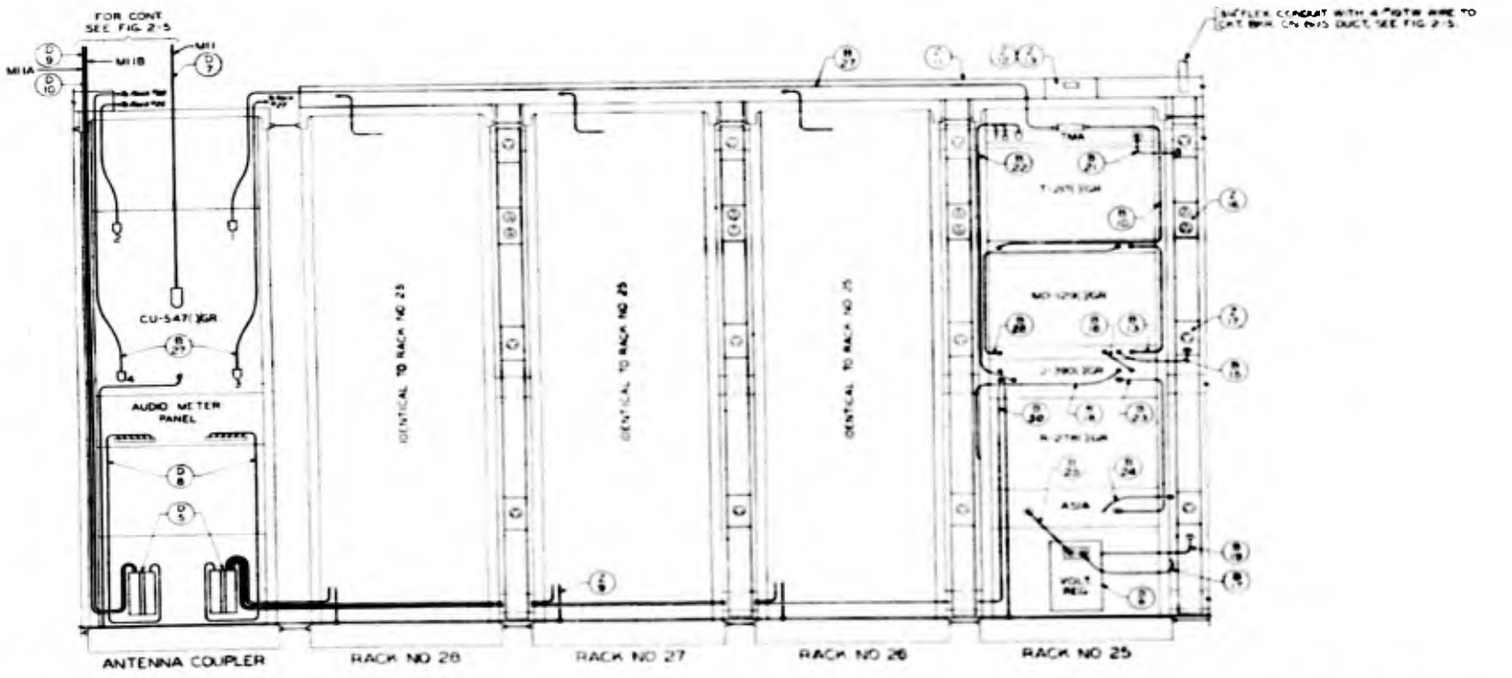
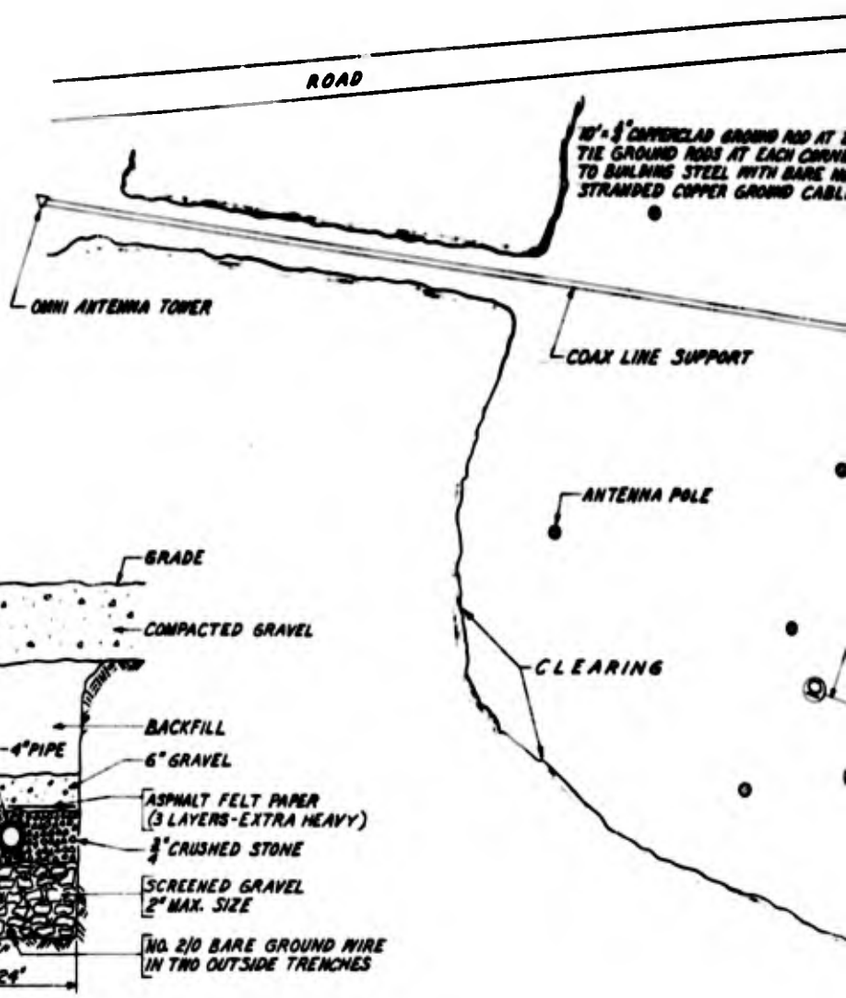


Fig. 2-21 ESS communication module (rear view)



SECTION A-A
(TYPICAL)

1

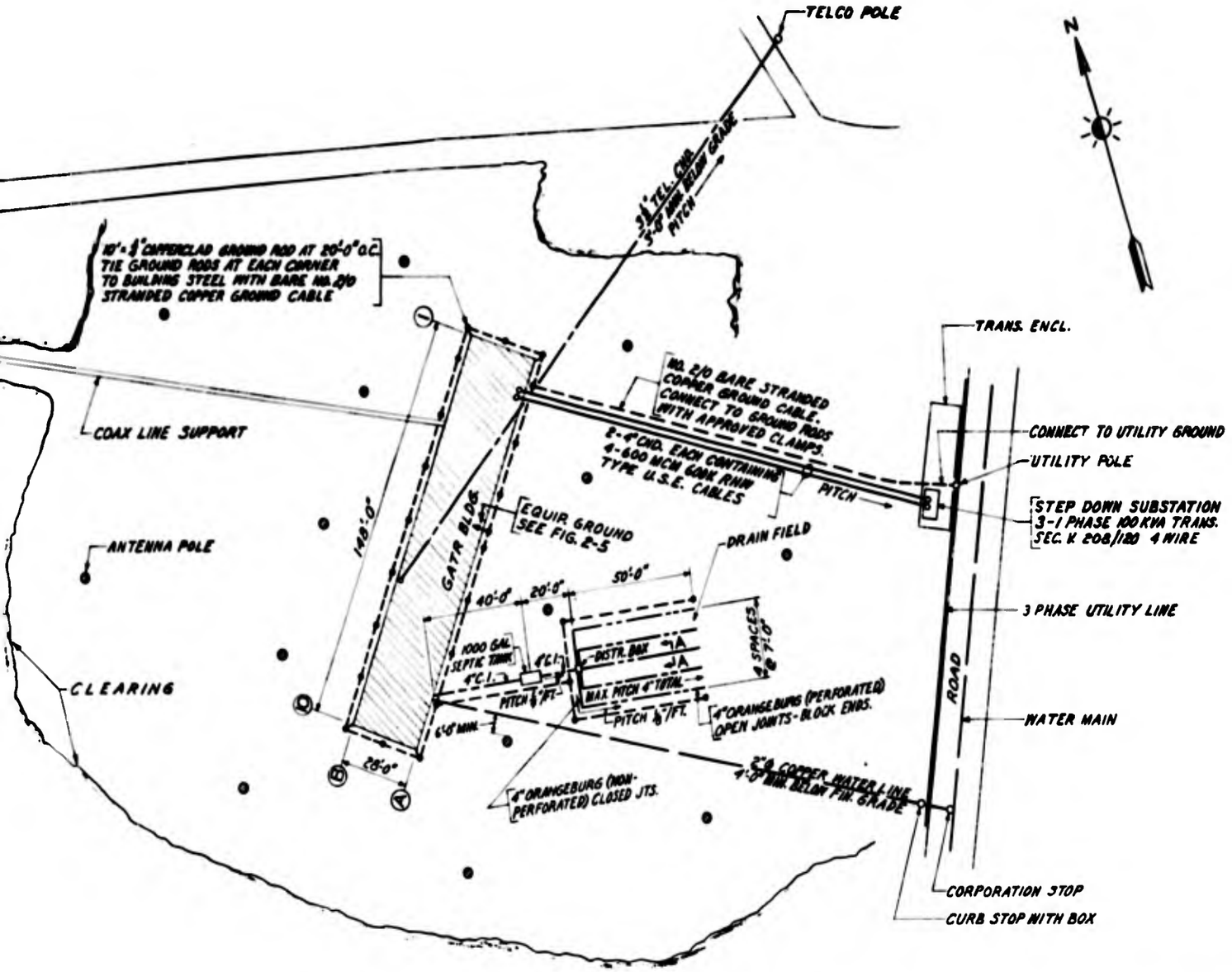
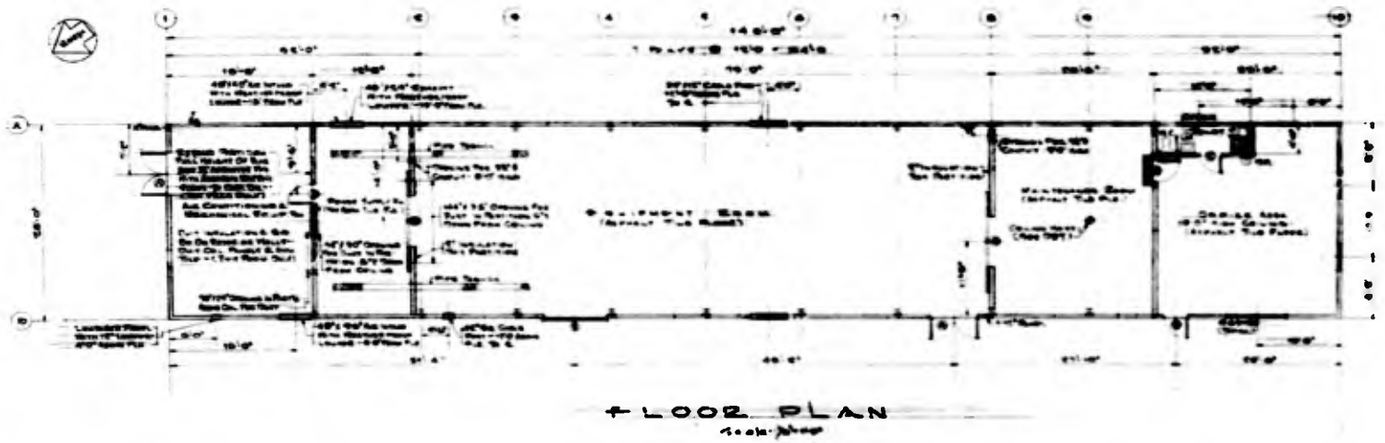


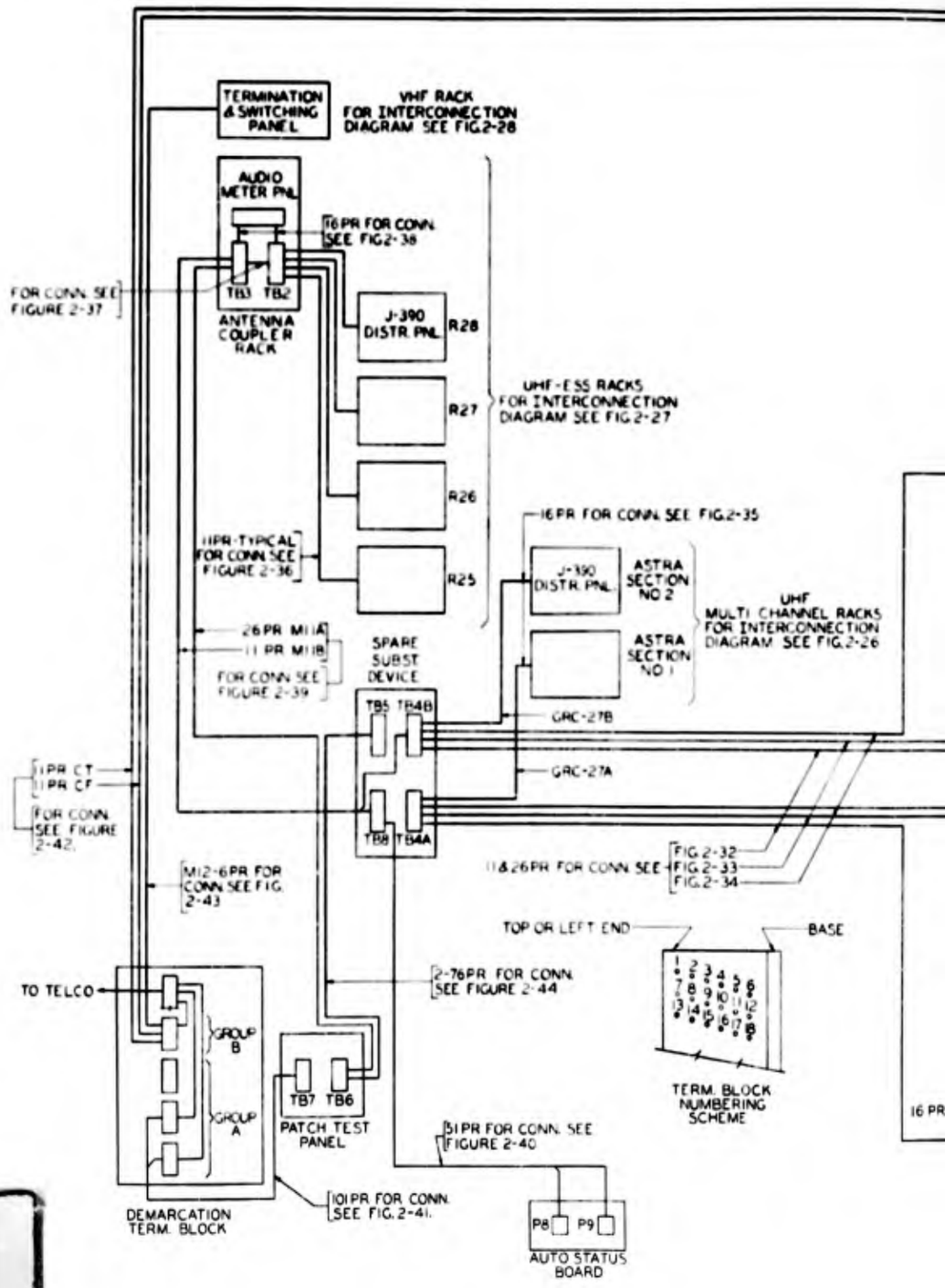
Fig. 2-22 Lexington GATR – ESS building services



FLOOR PLAN

DOOR SCHEDULE			
MARK	SIZE	TYPE	REMARKS

Fig. 2-23 Lexington GATR – ESS floor plan


TERMINATION & SWITCHING PANEL
VHF RACK FOR INTERCONNECTION DIAGRAM SEE FIG.2-28
AUDIO METER PNL
16 PR FOR CONN SEE FIG 2-38
FOR CONN SEE FIGURE 2-37
TB3 TB2
ANTENNA COUPLER RACK
J-390 DISTR PNL
R28
R27
R26
R25
UHF-ESS RACKS FOR INTERCONNECTION DIAGRAM SEE FIG.2-27
16 PR FOR CONN SEE FIG.2-35
11 PR TYPICAL FOR CONN SEE FIGURE 2-36
J-390 DISTR PNL
ASTRA SECTION NO 2
ASTRA SECTION NO 1
UHF MULTI CHANNEL RACKS FOR INTERCONNECTION DIAGRAM SEE FIG.2-26
26 PR M11A
11 PR M11B
FOR CONN SEE FIGURE 2-39
SPARE SUBST DEVICE
TB5 TB4B
GRC-27B
GRC-27A
1 PR CT
1 PR CF
FOR CONN SEE FIGURE 2-42
TB8 TB4A
M12-6PR FOR CONN SEE FIG. 2-43
11 & 26 PR FOR CONN SEE
FIG. 2-32
FIG. 2-33
FIG. 2-34
TOP OR LEFT END
BASE
TO TELCO
2-76PR FOR CONN SEE FIGURE 2-44
GROUP B
GROUP A
TB7 TB6
PATCH TEST PANEL
51 PR FOR CONN SEE FIGURE 2-40
TERM. BLOCK NUMBERING SCHEME
101 PR FOR CONN SEE FIG. 2-41.
DEMARCATION TERM. BLOCK
P8 P9
AUTO STATUS BOARD
16 PR

1

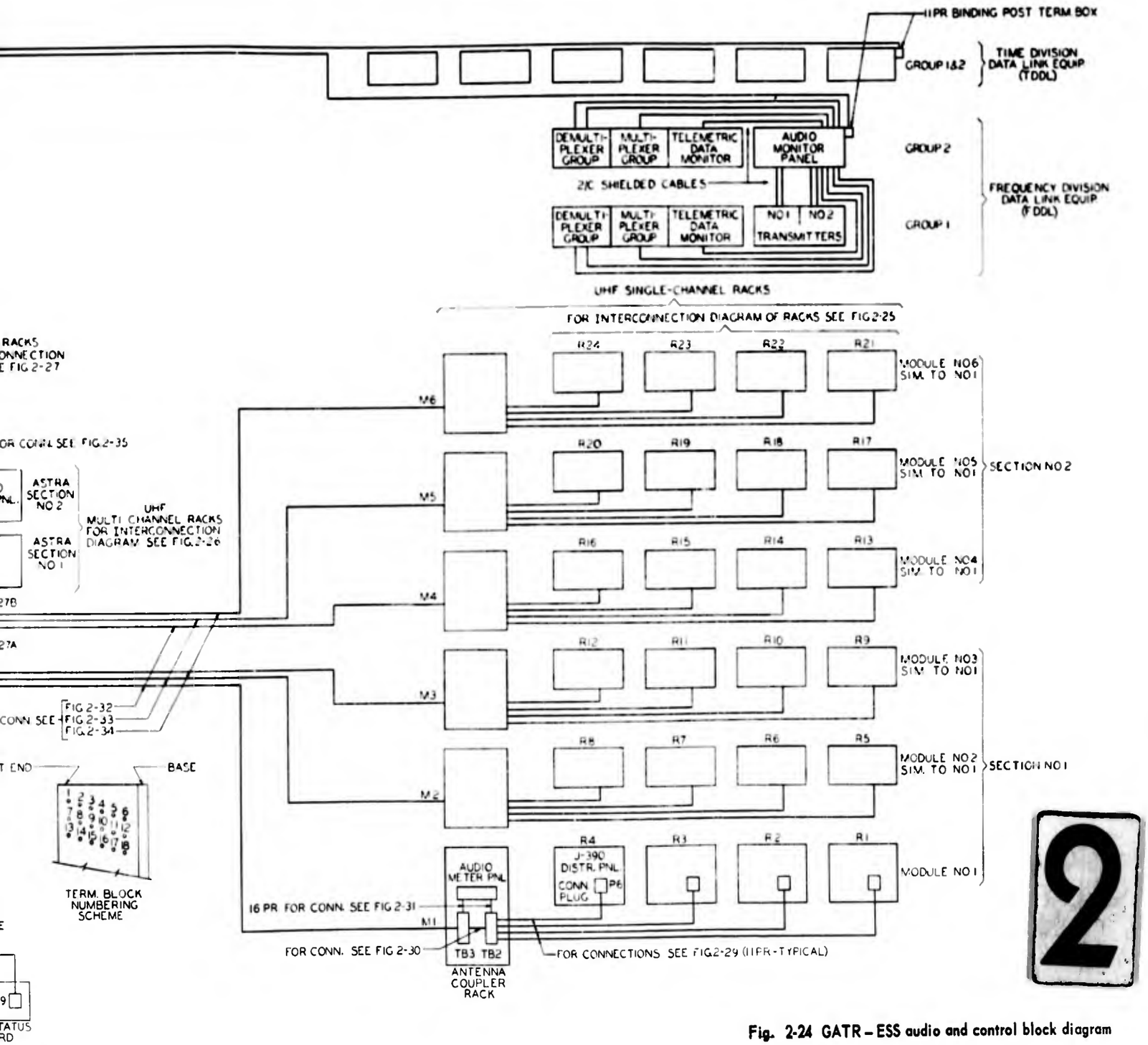
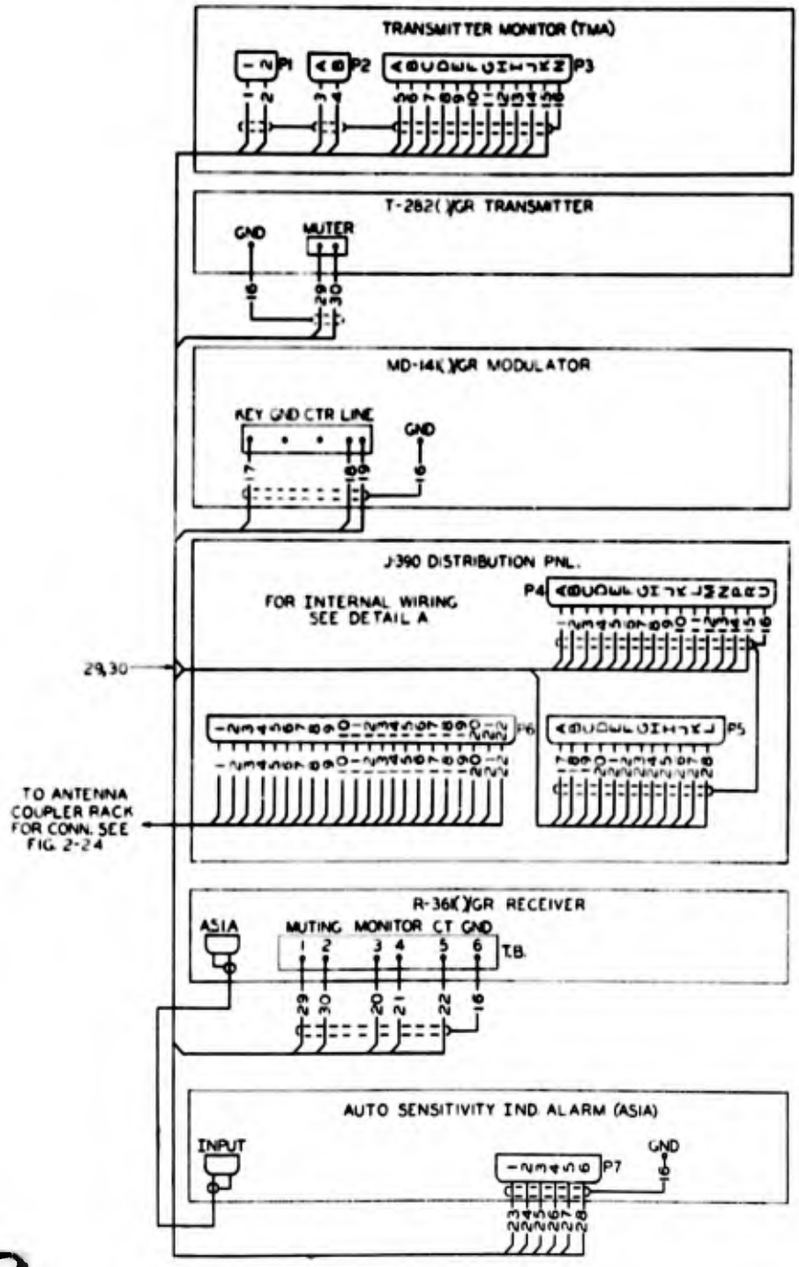
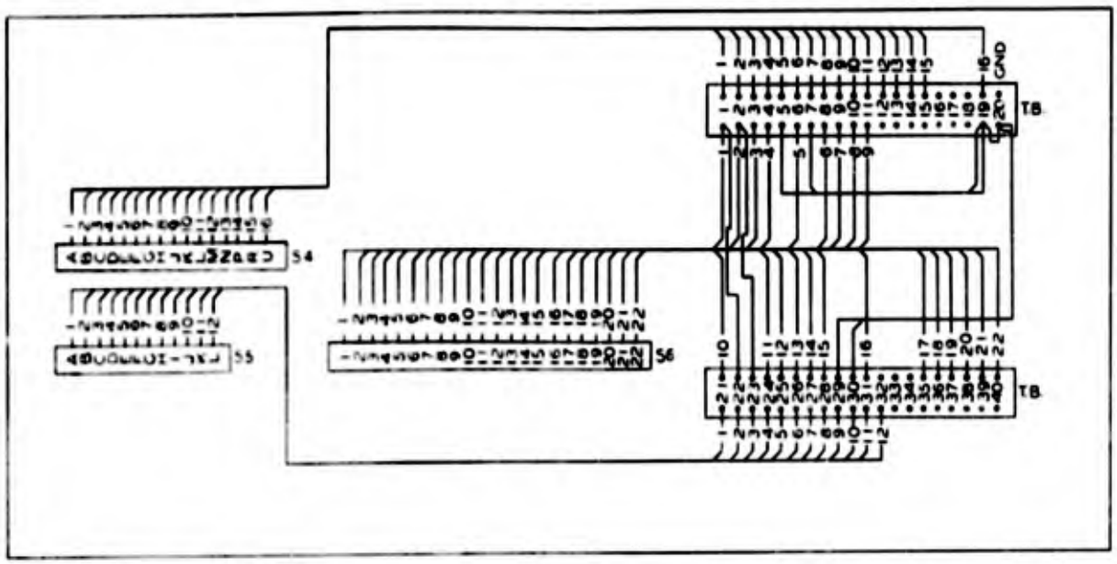


Fig. 2-24 GATR – ESS audio and control block diagram



TYPICAL SINGLE CHANNEL RACK
(REAR VIEW)

1

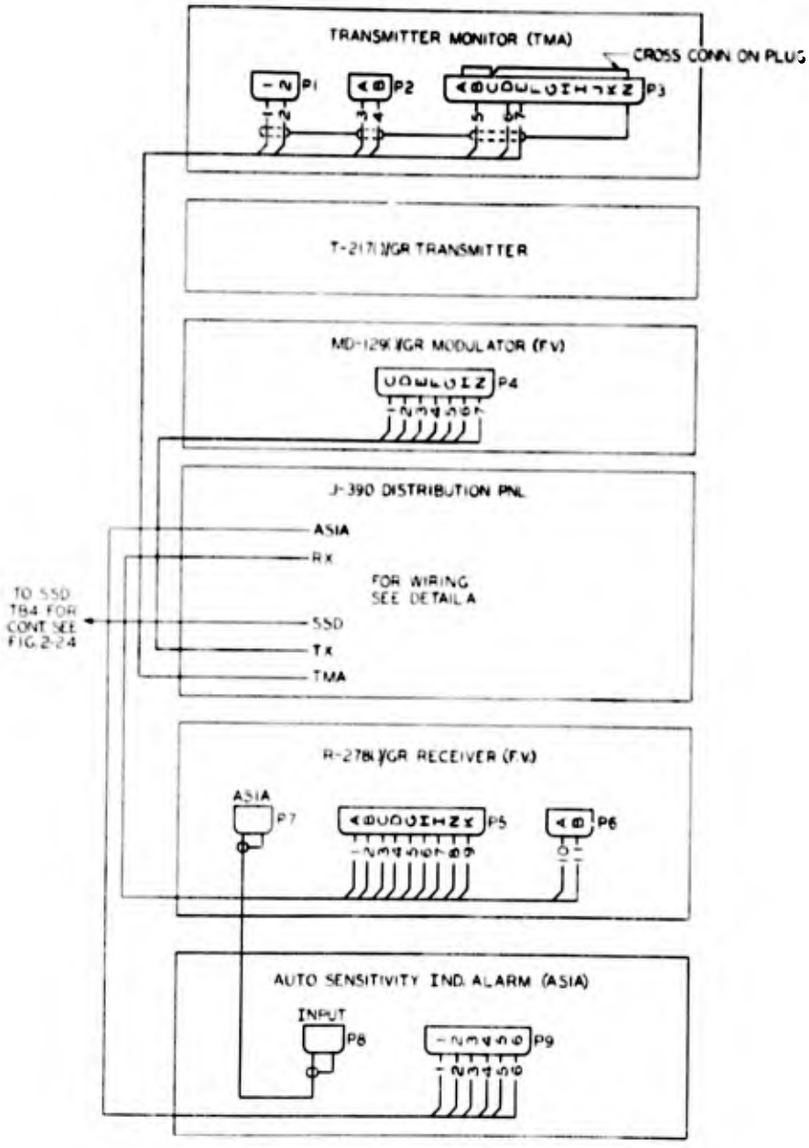


DETAIL A
J-390 DISTRIBUTION PANEL
(FRONT VIEW)

NOTE:

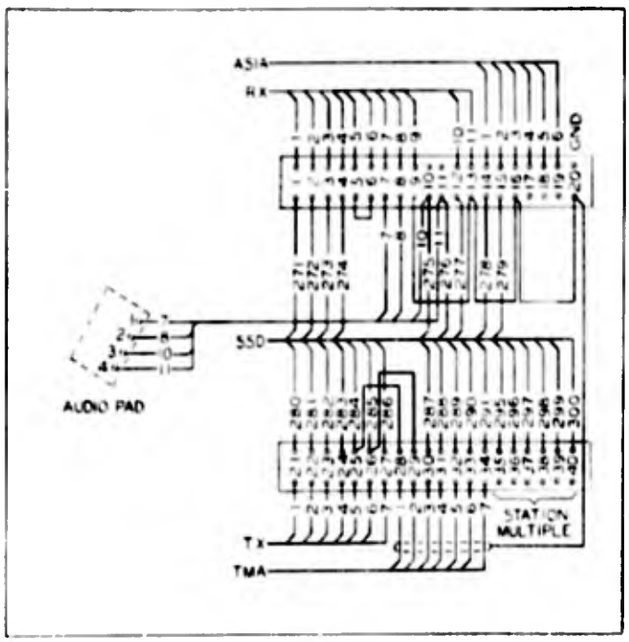
OTHER INTERCONNECTIONS MADE BY STANDARD CABLES AND PLUGS ARE NOT SHOWN. SEE FIGURE 2-7.

Fig. 2-25 Interconnection diagram single – channel rack



TYPICAL MULTICHANNEL RACK
(REAR VIEW)

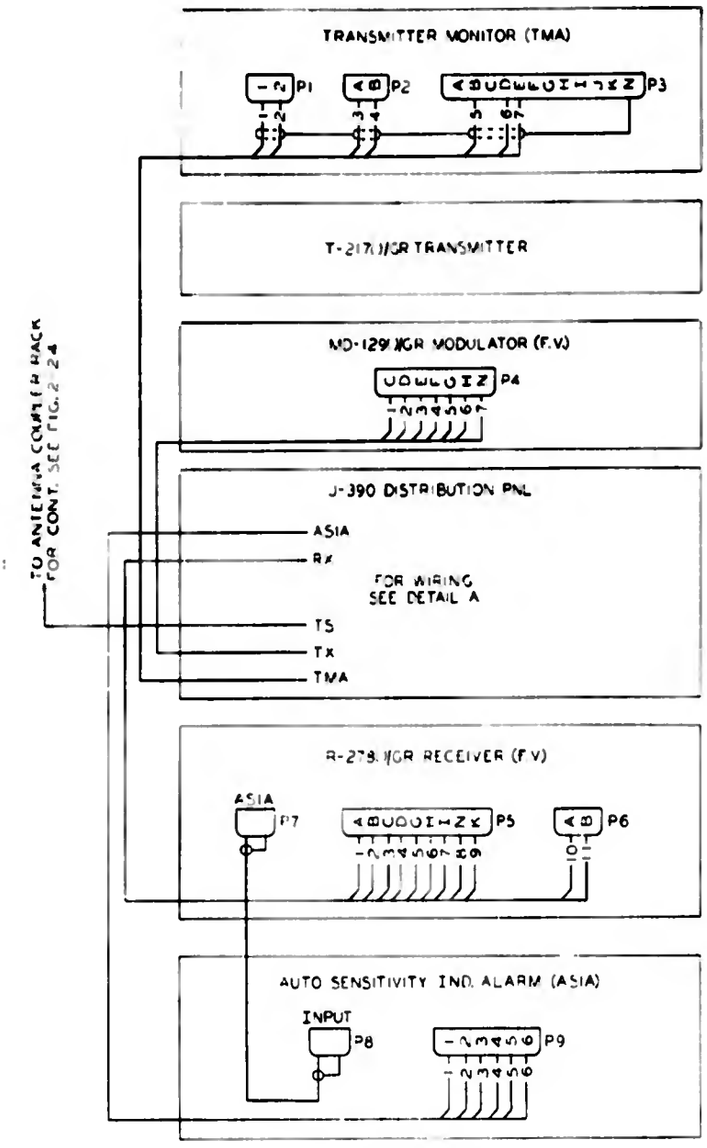
1



DETAIL A
J-390 DISTRIBUTION PANEL
(FRONT VIEW)

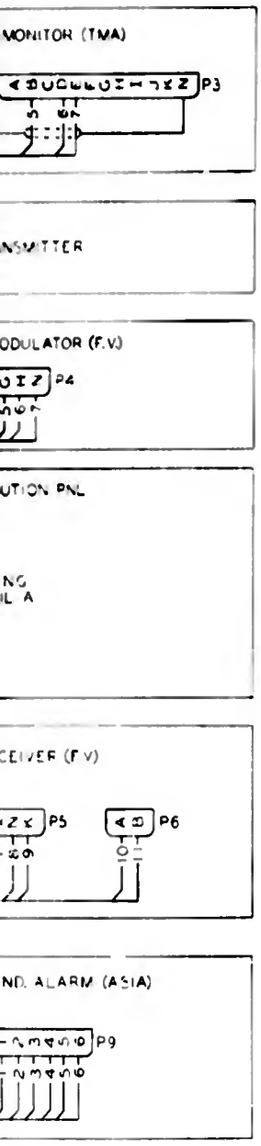
NOTE:
OTHER INTERCONNECTIONS MADE BY STANDARD CABLES AND PLUGS ARE NOT SHOWN SEE FIGURE 2-12.

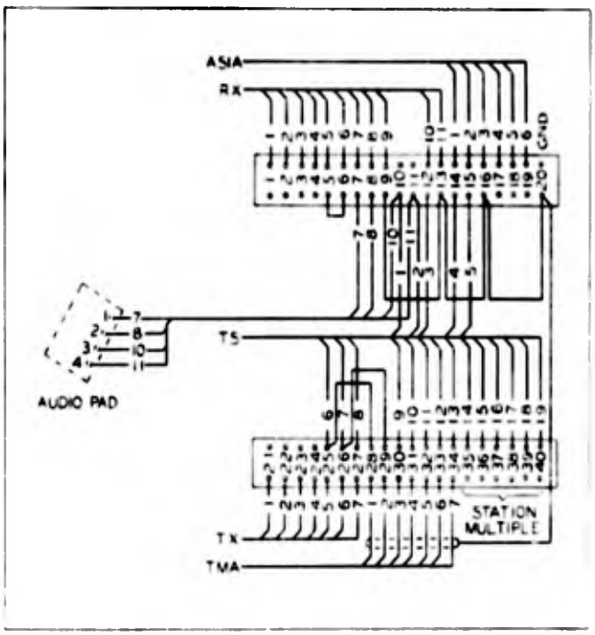
Fig. 2-26 Interconnection diagram multi – channel rack



TYPICAL UHF-ESS RACK
(REAR VIEW)

1





DETAIL A
J-390 DISTRIBUTION PANEL
(FRONT VIEW)

NOTE:
OTHER INTERCONNECTIONS MADE BY STANDARD CABLES AND PLUGS ARE NOT SHOWN SEE FIGURE 2-20 & 2-21.

2

Fig. 2-27 Interconnection diagram UHF – ESS rack

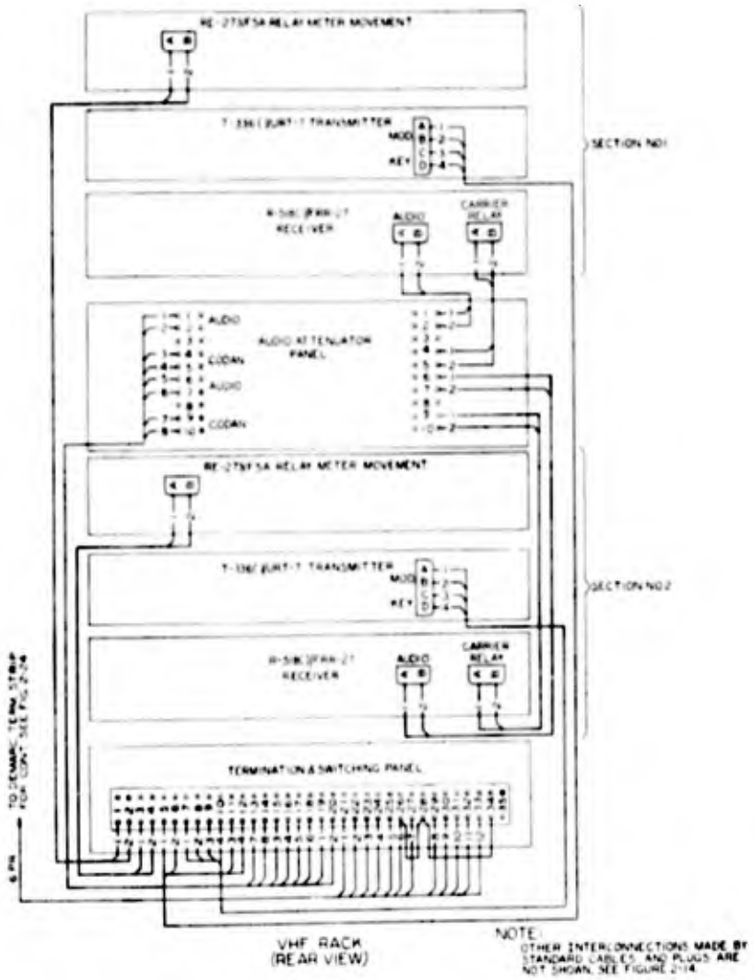


Fig. 2-28 Interconnection diagram VHF rack

Figure 2-29

WIRING SCHEDULE

UHF Single-Channel Modules 1 to 6

Cable Nos: None
11 pr. Cable, Plug, P6, J-390 Distribution Panel to Term. Block, TB2, Antenna Coupler Rack

COND. NO.	TERM. NO.	TERM. NO.	COND. NO.	TERM. NO.	TERM. NO.
	J-390(P6)	TB 2		J-390(P6)	TB 2
	RACK NO.1			RACK NO.3	
1	1	1	1	1	61
2	2	2	2	2	62
3	3	3	3	3	63
4	4	4	4	4	64
5	5	5	5	5	65
6	6	6	6	6	66
7	7	7	7	7	67
8	8	8	8	8	68
9	9	9	9	9	69
10	10	10	10	10	70
11	11	11	11	11	71
12	12	12	12	12	72
13	13	13	13	13	73
14	14	14	14	14	74
15	15	15	15	15	75
16	16	16	16	16	76
17	17	17	17	17	77
18	18	18	18	18	78
19	19	19	19	19	79
20	20	20	20	20	80
21	21	21	21	21	81
22	22	22	22	22	82
	RACK NO.2			RACK NO.4	
1	1	31	1	1	91
2	2	32	2	2	92
3	3	33	3	3	93
4	4	34	4	4	94
5	5	35	5	5	95
6	6	36	6	6	96
7	7	37	7	7	97
8	8	38	8	8	98
9	9	39	9	9	99
10	10	40	10	10	100
11	11	41	11	11	101
12	12	42	12	12	102
13	13	43	13	13	103
14	14	44	14	14	104
15	15	45	15	15	105
16	16	46	16	16	106
17	17	47	17	17	107
18	18	48	18	18	108
19	19	49	19	19	109
20	20	50	20	20	110
21	21	51	21	21	111
22	22	52	22	22	112

Figure 2-30

WIRING SCHEDULE

UHF Single-Channel Modules 1 to 6

Cable Nos: None

Cross Connections, Term Blocks TB2 & TB3, Antenna Coupler Rack

TERM. NO. TB2	TERM. NO. TB2	TERM. NO. TB3	TERM. NO. TB2	TERM. NO. TB2	TERM. NO. TB3
3		3	63		51
4		4	64		52
5		5	65		53
6		6	66		54
7		7	67		55
8		8	68		56
9		9	69		57
14		14	74		62
15		15	75		63
16		16	76		64
17	47		77	107	
18	48		78	108	
19	49		79	109	
20	50		80	110	
21	51		81	111	
22	52		82	112	
33		27	93		75
34		28	94		76
35		29	95		77
36		30	96		78
37		31	97		79
38		32	98		80
39		33	99		81
44		38	104		86
45		39	105		87
46		40	106		88
47	77		107		97
48	78		108		98
49	79		109		99
50	80		110		100
51	81		111		101
52	82		112		102

Figure 2-31

WIRING SCHEDULE

UHF Single-Channel Modules 1 to 6

Cable Nos: None
16 pr. Cables, Term. Blocks TB2 & TB3 to Audio Meter Panel, Antenna Coupler Rack

COND. NO.	TERM. NO.	TERM. NO.	COND. NO.	TERM. NO.	TERM. NO.
	TB2	METER PANEL EQUIP. TERM. BLOCK		METER PANEL LINE TERM. BLOCK	TB3
1	1	1	1	1	1
2	2	2	2	2	2
3	10	3	3	3	10
4	11	4	4	4	11
5	12	5	5	5	12
6	13	6	6	6	13
7	31	7	7	7	25
8	32	8	8	8	26
9	40	9	9	9	34
10	41	10	10	10	35
11	42	11	11	11	36
12	43	12	12	12	37
13	61	13	13	13	49
14	62	14	14	14	50
15	70	15	15	15	58
16	71	16	16	16	59
17	72	17	17	17	60
18	73	18	18	18	61
19	91	19	19	19	73
20	92	20	20	20	74
21	100	21	21	21	82
22	101	22	22	22	83
23	102	23	23	23	84
24	103	24	24	24	85
25	107	25	25		
26	108	26	26		
27	109	27	27		
28	110	28	28		
29	111	29	29 (-)	29	
30	112	30	30 Grd.	30	
31			31		
32			32		

Figure 2-32

WIRING SCHEDULE

UHF Single-Channel Modules 1 and 4

Cable Nos: None

11 pr. & 26 pr. Cables, TB-3 Antenna Coupler Rack to SSD Term. Block, TB-4 (A or B)

COND. NO.	TERM. NO. TB-3	TERM. NO. TB4 (A or B)	COND. NO.	TERM. NO. TB-3	TERM. NO. TB4 (A or B)
26 pr. 1	1	1	45	61	49
2	2	2	46	62	50
3	3	3	47	63	51
4	4	4	48	64	52
5	5	5	49	73	55
6	6	6	50	74	56
7	7	7	51	75	57
8	8	8	52	76	58
9	9	9			
10	10	10			
11	11	11	11 prs. 1	77	59
12	12	12	2	78	60
13	13	13	3	79	61
14	14	14	4	80	62
15	15	15	5	81	63
16	16	16	6	82	64
17	25	19	7	83	65
18	26	20	8	84	66
19	27	21	9	85	67
20	28	22	10	86	68
21	29	23	11	87	69
22	30	24	12	88	70
23	31	25	13	Sta. Multiple 97	79
24	32	26	14	Sta. Multiple 98	80
25	33	27	15	Sta. Multiple 99	81
26	34	28	16	Sta. Multiple 100	82
27	35	29	17	Sta. Multiple 101	83
28	36	30	18	Sta. Multiple 102	84
29	37	31	19	(Spare) 109	71
30	38	32	20	(Spare) 110	72
31	39	33	21	(Spare) 111	
32	40	34	22	(Spare) 112	
33	49	37			
34	50	38			
35	51	39			
36	52	40			
37	53	41			
38	54	42			
39	55	43			
40	56	44			
41	57	45			
42	58	46			
43	59	47			
44	60	48			

Figure 2-33

WIRING SCHEDULE

UHF Single-Channel Modules 2 and 5

Cable Nos: M2 & M5

11 pr. & 26 pr. Cables, TB3 Antenna Coupler Rack to SSD Term Block, TB4 (A or B)

COND. NO.	TERM. NO. TB3	TERM. NO. TB4 (A or B)	COND. NO.	TERM. NO. TB3	TERM. NO. TB4 (A or B)
26 pr. 1	1	91	45	61	139
2	2	92	46	62	140
3	3	93	47	63	141
4	4	94	48	64	142
5	5	95	49	73	145
6	6	96	50	74	146
7	7	97	51	75	147
8	8	98	52	76	148
9	9	99			
10	10	100			
11	11	101	11 pr. 1	77	149
12	12	102	2	78	150
13	13	103	3	79	151
14	14	104	4	80	152
15	15	105	5	81	153
16	16	106	6	82	154
17	25	109	7	83	155
18	26	110	8	84	156
19	27	111	9	85	157
20	28	112	10	86	158
21	29	113	11	87	159
22	30	114	12	88	160
23	31	115	13	Sta. Multiple 97	169
24	32	116	14	Sta. Multiple 98	170
25	33	117	15	Sta. Multiple 99	171
26	34	118	16	Sta. Multiple 100	172
27	35	119	17	Sta. Multiple 101	173
28	36	120	18	Sta. Multiple 102	174
29	37	121	19	(Spare) 109	161
30	38	122	20	(Spare) 110	162
31	39	123	21	(Spare) 111	
32	40	124	22	(Spare) 112	
33	49	127			
34	50	128			
35	51	129			
36	52	130			
37	53	131			
38	54	132			
39	55	133			
40	56	134			
41	57	135			
42	58	136			
43	59	137			
44	60	138			

Figure 2-34

WIRING SCHEDULE

UHF Single-Channel Modules 3 and 6

Cable Nos: M3 & M6
11 pr. & 26 pr. Cables, TB3 Antenna Coupler Rack to SSD Term Block, TB4 (A or B)

COND. NO.	TERM. NO. TB3	TERM. NO. TB4 (A or B)	COND. NO.	TERM. NO. TB3	TERM. NO. TB4 (A or B)
26 pr. 1	1	181	45	61	229
2	2	182	46	62	230
3	3	183	47	63	231
4	4	184	48	64	232
5	5	185	49	73	235
6	6	186	50	74	236
7	7	187	51	75	237
8	8	188	52	76	238
9	9	189			
10	10	190			
11	11	191	11 pr. 1	77	239
12	12	192	2	78	240
13	13	193	3	79	241
14	14	194	4	80	242
15	15	195	5	81	243
16	16	196	6	82	244
17	25	199	7	83	245
18	26	200	8	84	246
19	27	201	9	85	247
20	28	202	10	86	248
21	29	203	11	87	249
22	30	204	12	88	250
23	31	205	13	Sta. Multiple 97	259
24	32	206	14	Sta. Multiple 98	260
25	33	207	15	Sta. Multiple 99	261
26	34	208	16	Sta. Multiple 100	262
27	35	209	17	Sta. Multiple 101	263
28	36	210	18	Sta. Multiple 102	264
29	37	211	19	(Spare) 109	251
30	38	212	20	(Spare) 110	252
31	39	213	21	(Spare) 111	
32	40	214	22	(Spare) 112	
33	49	217			
34	50	218			
35	51	219			
36	52	220			
37	53	221			
38	54	222			
39	55	223			
40	56	224			
41	57	225			
42	58	226			
43	59	227			
44	60	228			

Figure 2-35

WIRING SCHEDULE

ASTRA Section Multichannel Racks

Cable Nos: GRC-27A or GRC-27B
16 pr. Cables, J-390 Distribution Panel to SSD Term. Blocks, TB-4 (A or B)
Section 1 (TB4A) or Section 2 (TB4B)

COND. NO.	TERM. NO. J-390	TERM. NO. TB-4
1	1	271
2	2	272
3	3	273
4	4	274
5	10	275
6	11	276
7	12	277
8	14	278
9	15	279
10	21	280
11	22	281
12	23	282
13	24	283
14	25	284
15	26	285
16	27	286
17	30	287
18	31	288
19	32	289
20	33	290
21	34	291
22	Sta. Multiple 35	295
23	Sta. Multiple 36	296
24	Sta. Multiple 37	297
25	Sta. Multiple 38	298
26	Sta. Multiple 39	299
27	Sta. Multiple 40	300
28		
29		
30		
31		
32		

Figure 2-36

WIRING SCHEDULE

UHF-ESS Module Racks 25, 26, 27, & 28

Cable Nos: None
11 pr. Cables J-390 Distribution Panel to Term. Block, TB-2, Antenna Coupler Rack

COND. NO.	TERM. NO. J-390	TERM. NO. TB-2	COND. NO.	TERM. NO. J-390	TERM. NO. TB-2
	RACK NO. 25			RACK NO. 27	
1	10	1	1	10	61
2	11	2	2	11	62
3	12	3	3	12	63
4	14	4	4	14	64
5	15	5	5	15	65
6	25	6	6	25	66
7	26	7	7	26	67
8	27	8	8	27	68
9	30	9	9	30	69
10	31	10	10	31	70
11	32	11	11	32	71
12	33	12	12	33	72
13	34	13	13	34	73
14	Sta. Multiple 35	14	14	Sta. Multiple 35	74
15	Sta. Multiple 36	15	15	Sta. Multiple 36	75
16	Sta. Multiple 37	16	16	Sta. Multiple 37	76
17	Sta. Multiple 38	17	17	Sta. Multiple 38	77
18	Sta. Multiple 39	18	18	Sta. Multiple 39	78
19	Sta. Multiple 40	19	19	Sta. Multiple 40	79
20			20		
21			21		
22			22		
	RACK NO. 26			RACK NO. 28	
1	10	31	1	10	91
2	11	32	2	11	92
3	12	33	3	12	93
4	14	34	4	14	94
5	15	35	5	15	95
6	25	36	6	25	96
7	26	37	7	26	97
8	27	38	8	27	98
9	30	39	9	30	99
10	31	40	10	31	100
11	32	41	11	32	101
12	33	42	12	33	102
13	34	43	13	34	103
14	Sta. Multiple 35	44	14	Sta. Multiple 35	104
15	Sta. Multiple 36	45	15	Sta. Multiple 36	105
16	Sta. Multiple 37	46	16	Sta. Multiple 37	106
17	Sta. Multiple 38	47	17	Sta. Multiple 38	107
18	Sta. Multiple 39	48	18	Sta. Multiple 39	108
19	Sta. Multiple 40	49	19	Sta. Multiple 40	109
20			20		
21			21		
22			22		

Figure 2-37

WIRING SCHEDULE

UHF-ESS Communication Module

Cable Nos: None

Cross Connections Term. Blocks TB2 & TB3 Antenna Coupler Rack

TERMINAL NUMBERS					
TB2	TB2	TB3	TB2	TB2	TB3
1			61		
2			62		
3			63		
4	34		64	94	
5		51	65		63
6			66		
7			67		
8			68		
9		3	69		27
10		49	70		61
11		4	71		28
12		50	72		62
13	43		73	103	
14	44		74	104	
15	45		75	105	
16	46		76	106	
17	47		77	107	
18	48		78	108	
19	49		79	109	
20					
21					
22					
31			91		
32			92		
33			93		
34	64		94		71
35		57	95		69
36			96		
37			97		
38			98		
39		15	99		39
40		55	100		67
41		16	101		40
42		56	102		68
43	73		103		70
44	74		Sta. Multiple 104		73
45	75		Sta. Multiple 105		74
46	76		Sta. Multiple 106		75
47	77		Sta. Multiple 107		76
48	78		Sta. Multiple 108		77
49	79		Sta. Multiple 109		78
50					
51					
52					

Figure 2-38

WIRING SCHEDULE

UHF-ESS Communication Module

Cable Nos: None
16 pr. Cables, Term. Blocks TB2 & TB3 to Audio Meter Panel, Antenna Coupler Rack

COND. NO.	TERM. NO.	TERM. NO.	COND. NO.	TERM. NO.	TERM. NO.
	TB2	METER PANEL EQUIP. TERM. BLOCK		METER PANEL LINE TERM. BLOCK	TB3
1	1	1	1	1	7
2	2	2	2	2	8
3	3	3	3	3	9
4	6	4	4	4	1
5	7	5	5	5	2
6	8	6	6	6	6
7	31	7	7	7	19
8	32	8	8	8	20
9	33	9	9	9	21
10	36	10	10	10	13
11	37	11	11	11	14
12	38	12	12	12	18
13	61	13	13	13	31
14	62	14	14	14	32
15	63	15	15	15	33
16	66	16	16	16	25
17	67	17	17	17	26
18	68	18	18	18	30
19	91	19	19	19	43
20	92	20	20	20	44
21	93	21	21	21	45
22	96	22	22	22	37
23	97	23	23	23	38
24	98	24	24	24	42
25	104	25	25	25	
26	105	26	26	26	
27	106	27	27	27	
28	107	28	28	28	
29	108	29	29	29	
30	109	30	30	30	
31			31	31	
32			32	32	

Figure 2-39

WIRING SCHEDULE

UHF-ESS Communication Module

Cable Nos: M11 A & M11 B
11 pr. Cable, TB3 Antenna Coupler Rack to TB8 Spare Substitution Device Cable
26 pr. Cable, TB3 Antenna Coupler Rack to TB7 Patch Test Alarm Cable

COND. NO.	TERM. NO.	TERM. NO.	COND. NO.	TERM. NO.	TERM. NO.
	TB3	TB7		TB3	TB7
1	1	217	45		
2	2	218	46		
3	3	219	47		
4	4	220	48		
5	6	222	49		
6	7	223	50		
7	8	224	51		
8	9	225	52		
9	13	226			
10	14	227			
11	15	228			
12	16	229	COND. NO.	TERM. NO.	TERM. NO.
13	18	231		TB3	TB4B TB8
14	19	232	1	49	•
15	20	233	2	50	73
16	21	234	3	51	74
17	25	235	4	55	•
18	26	236	5	56	75
19	29	237	6	57	76
20	28	238	7	61	•
21	30	240	8	62	101
22	31	241	9	63	102
23	32	242	10	67	•
24	33	243	11	68	103
25	37	244	12	69	104
26	38	245	13	Sta. Multiple 73	79
27	39	246	14	Sta. Multiple 74	80
28	40	247	15	Sta. Multiple 75	81
29	42	249	16	Sta. Multiple 76	82
30	43	250	17	Sta. Multiple 77	83
31	44	251	18	Sta. Multiple 78	84
32	45	252	19		
33			20		
34			21		
35			22		
36				* To Fuse #9 Section 1 SSD	
37					
38					
39					
40					
41					
42					
43					
44					

Figure 2-40

WIRING SCHEDULE

Automatic Status Board

Cable No: ASB1

52 pr. Cable – Term. Block, TB8, SSD, to Plugs P8 & P9 at ASB

		SECTION I				SECTION II	
STATUS LAMP	COND. NO.	TERM. NO. SSD TB8	TERM. NO. ASB P8	STATUS LAMP	COND. NO.	TERM. NO. SSD TB8	TERM. NO. ASB P9
T1	1	1	A	T13	51	37	A
R1	2	2	B	R13	52	38	B
T2	3	3	C	T14	53	39	C
R2	4	4	D	R14	54	40	D
T3	5	5	E	T15	55	41	E
R3	6	6	F	R15	56	42	F
T4	7	7	G	T16	57	43	G
R4	8	8	H	R16	58	44	H
T5	9	9	I	T17	59	45	I
R5	10	10	J	R17	60	46	J
T6	11	11	K	T18	61	47	K
R6	12	12	L	R18	62	48	L
T7	13	13	M	T19	63	49	M
R7	14	14	N	R19	64	50	N
T8	15	15	O	T20	65	51	O
R8	16	16	P	R20	66	52	P
T9	17	17	R	T21	67	53	R
R9	18	18	S	R21	68	54	S
T10	19	19	T	T22	69	55	T
R10	20	20	U	R22	70	56	U
T11	21	21	V	T23	71	57	V
R11	22	22	W	R23	72	58	W
T12	23	23	X	T24	73	59	X
R12	24	24	Y	R24	74	60	Y
T25	25	73	Z	VHF-T1	75	97	Z
R25	26	74	a	VHF-R1	76	98	a
T26	27	75	b	VHF-T2	77	99	b
R26	28	76	c	VHF-R2	78	100	c
	29	77	d	T27	79	101	d
	30	78	e	R27	80	102	e
	31	79	f	T28	81	103	f
	32	80	g	R28	82	104	g
	33	81	h		83	105	h
	34	82	i		84	106	i
	35	25	k		85	61	k
	36	26	m		86	62	m
	37	83	n		87	107	n
	38	84	p		88	108	p
	39	85	r		89	109	r
	40	86	s		90	110	s
	41	87	t		91	111	t
	42	88	u		92	112	u

Figure 2-40 Continued

WIRING SCHEDULE

Automatic Status Board

Cable No: ASBI
52 pr. Cable – Term. Block, TB8, SSD, to Plugs P8 & P9 at ASB

		SECTION I				SECTION II	
STATUS LAMP	COND. NO.	TERM. NO. SSD TB8	TERM. NO. ASB P8	STATUS LAMP	COND. NO.	TERM. NO. SSD TB8	TERM. NO. ASB P9
	43	27	v	48 vdc	93	63	v
	44	28	48 vdc w	48 vdc	94	64	w 48 vdc
	45	89	Common x	Bell	95	113	x Common
	46	29	y	48 vdc	96	65	y
	47	30	z	48 vdc	97	66	z
	48	90			98	114	
	49				99		
	50				100		
					101		

Figure 2-41

WIRING SCHEDULE

Patch Test Panel

Cable No: PTA
101 pr. Cable, Patch Test Panel, Term. Block, TB7 to Demarcation Term. Block

COND. NO.	TERM. NO. TB7	TERM. NO. DEMARC. TB GROUP A	COND. NO.	TERM. NO. TB7	TERM. NO. DEMARC. TB GROUP A
1	1	1	46	46	46
2	2	2	Channel 8 47	47	47
Channel 1 3	3	3	48	48	48
4	4	4	49	49	49
5	5	5	50	50	50
6	6	6	Channel 9 51	51	51
7	7	7	52	52	52
8	8	8	53	53	53
Channel 2 9	9	9	54	54	54
10	10	10	55	55	55
11	11	11	56	56	56
12	12	12	Channel 10 57	57	57
13	13	13	58	58	58
14	14	14	59	59	59
Channel 3 15	15	15	60	60	60
16	16	16	61	61	61
17	17	17	62	62	62
18	18	18	Channel 11 63	63	63
19	19	19	64	64	64
20	20	20	65	65	65
Channel 4 21	21	21	66	66	66
22	22	22	67	67	67
23	23	23	68	68	68
24	24	24	Channel 12 69	69	69
25	25	25	70	70	70
26	26	26	71	71	71
Channel 5 27	27	27	72	72	72
28	28	28	73	73	73
29	29	29	74	74	74
30	30	30	Channel 13 75	75	75
31	31	31	76	76	76
32	32	32	77	77	77
Channel 6 33	33	33	78	78	78
34	34	34	79	79	79
35	35	35	80	80	80
36	36	36	Channel 14 81	81	81
37	37	37	82	82	82
38	38	38	83	83	83
Channel 7 39	39	39	84	84	84
40	40	40	85	85	85
41	41	41	86	86	86
42	42	42	Channel 15 87	87	87
43	43	43	88	88	88
Channel 8 44	44	44	89	89	89
45	45	45	90	90	90

Figure 2-41 Continued

WIRING SCHEDULE

Patch Test Panel

Cable No: PTA
101 pr. Cable, Patch Test Panel, Term. Block, TB7 to Demarcation Term. Block

COND. NO.	TERM. NO. TB7	TERM. NO. DEMARC. TB GROUP A	COND. NO.	TERM. NO. TB7	TERM. NO. DEMARC. TB GROUP A
91	91	91	136	136	136
92	92	92	Channel 23 137	137	137
Channel 16 93	93	93	138	138	138
94	94	94	139	139	139
95	95	95	140	140	140
96	96	96	Channel 24 141	141	141
97	97	97	142	142	142
98	98	98	143	143	143
Channel 17 99	99	99	144	144	144
100	100	100	145	145	145
101	101	101	146	146	146
102	102	102	Channel 25 147	147	147
103	103	103	148	148	148
104	104	104	149	149	149
Channel 18 105	105	105	150	150	150
106	106	106	151	151	151
107	107	107	152	152	152
108	108	108	Channel 26 153	153	153
109	109	109	154	154	154
110	110	110	155	155	155
Channel 19 111	111	111	156	156	156
112	112	112	157	157	157
113	113	113	158	158	158
114	114	114	Channel 27 159	159	159
115	115	115	160	160	160
116	116	116	161	161	161
Channel 20 117	117	117	162	162	162
118	118	118	163	163	163
119	119	119	164	164	164
120	120	120	Channel 28 165	165	165
121	121	121	166	166	166
122	122	122	167	167	167
Channel 21 123	123	123	168	168	168
124	124	124	169	169	169
125	125	125	170	170	170
126	126	126	Channel 29 171	171	171
127	127	127	172	172	172
128	128	128	173	173	173
Channel 22 129	129	129	174	174	174
130	130	130	175	175	175
131	131	131	176	176	176
132	132	132	Channel 30 177	177	177
133	133	133	178	178	178
Channel 23 134	134	134	179	179	179
135	135	135	180	180	180

Figure 2-42

WIRING SCHEDULE

Data Link Equipment

Cable Nos: CT, CF
11 pr. Cable TDDL Group Term. Box to Demarc Term. Block
11 pr. Cable FDDL Group Term. Box to Demarc Term. Block

Cable CT			Cable CF		
COND. NO.	TERM. NO. TDDL TERM. BOX	TERM. NO. DEMARC TERM. BLOCK GROUP B	COND. NO.	TERM. NO. FDDL TERM. BOX	TERM. NO. DEMARC TERM. BLOCK GROUP B
1	1	1	1	1	37
2	2	2	2	3	38
3	3	3	3	5	39
4	4	4	4	7	40
5	5	5	5		
6	6	6	6		
7	7	7	7		
8	8	8	8		
9	9	9	9		
10	10	10	10		
11	11	11	11		
12	12	12	12		
13	13	13	13		
14	14	14	14		
15	15	15	15		
16	16	16	16		
17	17	17	17		
18	18	18	18		
19	19	19	19		
20	20	20	20		
21	21	21	21		
22	22	22	22		

Figure 2-43

WIRING SCHEDULE

Cable No: VHF-1
6 pr. Cable VHF Rack Termination & Switching Panel to Demarc Term. Block

Cable VHF-1 — Jumpers

COND. NO.	TERM. NO.	TERM. NO.	TERM. NO.	TERM. NO.
	VHF TERM. Pnl	DEMARC T.B. GROUP B	DEMARC T.B. GROUP B	DEMARC T.B. GROUP A
1	21	25		
2	22	26		
3	23	27		
4	24	28		
5	25	29		
6	26	30		
7	27	31		
8	29	32	32	69
9	30	33	33	70
10	31	34	34	67
11	32	35	35	68
12	33	36	36	71

Figure 2-44

WIRING SCHEDULE

Cable Nos: None
2 – 76 pr. Cables Spare Substitution Device to Patch Test Panel

COND. NO.	TERM. NO. TB5 (LINE)	TERM. NO. TB6 (EQUIP.)	COND. NO.	TERM. NO. TB5 (LINE)	TERM. NO. TB6 (EQUIP.)
1	1	1	52	52	52
2	2	2	Channel 6 53	53	53
3	3	3	54	54	54
4	4	4	55	55	55
Channel 1 5	5	5	56	56	56
6	6	6	57	57	57
7	7	7	58	58	58
8	8	8	Channel 7 59	59	59
9	9	9	60	60	60
10	10	10	61	61	61
11	11	11	62	62	62
12	12	12	63	63	63
13	13	13	64	64	64
Channel 2 14	14	14	65	65	65
15	15	15	66	66	66
16	16	16	67	67	67
17	17	17	Channel 8 68	68	68
18	18	18	69	69	69
19	19	19	70	70	70
20	20	20	71	71	71
21	21	21	72	72	72
22	22	22	73	73	73
Channel 3 23	23	23	74	74	74
24	24	24	75	75	75
25	25	25	76	76	76
26	26	26	Channel 9 77	77	77
27	27	27	78	78	78
28	28	28	79	79	79
29	29	29	80	80	80
30	30	30	81	81	81
31	31	31	82	82	82
Channel 4 32	32	32	83	83	83
33	33	33	84	84	84
34	34	34	85	85	85
35	35	35	Channel 10 86	86	86
36	36	36	87	87	87
37	37	37	88	88	88
38	38	38	89	89	89
39	39	39	90	90	90
40	40	40	91	91	91
Channel 5 41	41	41	92	92	92
42	42	42	93	93	93
43	43	43	94	94	94
44	44	44	Channel 11 95	95	95
45	45	45	96	96	96
46	46	46	97	97	97
47	47	47	98	98	98
Channel 6 48	48	48	99	99	99
49	49	49	100	100	100
50	50	50	Channel 12 101	101	101
51	51	51	102	102	102

Figure 2-44 Continued

WIRING SCHEDULE

Cable Nos: None
2 – 76 pr. Cables Spare Substitution Device to Patch Test Panel

COND. NO.	TERM. NO. TB5 (Line)	TERM. NO. TB6 (Equip.)	COND. NO.	TERM. NO. TB5 (Line)	TERM. NO. TB6 (Equip.)
103	103	103	155	155	155
104	104	104	156	156	156
Channel 12 105	105	105	157	157	157
106	106	106	Channel 18 158	158	158
107	107	107	159	159	159
108	108	108	160	160	160
109	109	109	161	161	161
110	110	110	162	162	162
111	111	111	163	163	163
112	112	112	164	164	164
Channel 13 113	113	113	165	165	165
114	114	114	166	166	166
115	115	115	Channel 19 167	167	167
116	116	116	168	168	168
117	117	117	169	169	169
118	118	118	170	170	170
119	119	119	171	171	171
120	120	120	172	172	172
121	121	121	173	173	173
Channel 14 122	122	122	174	174	174
123	123	123	175	175	175
124	124	124	Channel 20 176	176	176
125	125	125	177	177	177
126	126	126	178	178	178
127	127	127	179	179	179
128	128	128	180	180	180
129	129	129	181	181	181
130	130	130	182	182	182
Channel 15 131	131	131	183	183	183
132	132	132	184	184	184
133	133	133	Channel 21 185	185	185
134	134	134	186	186	186
135	135	135	187	187	187
136	136	136	188	188	188
137	137	137	189	189	189
138	138	138	190	190	190
139	139	139	191	191	191
Channel 16 140	140	140	192	192	192
141	141	141	193	193	193
142	142	142	Channel 22 194	194	194
143	143	143	195	195	195
144	144	144	196	196	196
145	145	145	197	197	197
146	146	146	198	198	198
147	147	147	199	199	199
148	148	148	200	200	200
Channel 17 149	149	149	201	201	201
150	150	150	Channel 23 202	202	202
151	151	151	203	203	203
152	152	152	204	204	204
153	153	153	205	205	205
Channel 18 154	154	154			

Figure 2-44 Continued

WIRING SCHEDULE

Cable Nos: None
2 – 76 Pr. Cables Spare Substitution Device to Patch Test Panel

COND. NO.	TERM. NO. TB5 (Line)	TERM. NO. TB6 (Equip.)	COND. NO.	TERM. NO. TB5 (Line)	TERM. NO. TB6 (Equip.)
206	206	206	251		
207	Channel 23 207	207	252		
208	208	208	253		
209	209	209	254		
210	210	210	255		
211	211	211	256		
212	Channel 24 212	212	257		
213	213	213	258		
214	214	214	259		
215	215	215	260		
216	216	216	261		
217			262		
218			263		
219			264		
220			265		
221			266		
222			267		
223			268		
224			269		
225			270		
226			271		
227			Spares 272		
228			273		
229			274		
230			275		
231			276		
232			277		
Spares 233			278		
234			279		
235			280		
236			281		
237			282		
238			283		
239			284		
240			285		
241			286		
242			287		
243			288		
244			289		
245			290		
246			291		
247			292		
248			293		
249			294		
250			295	295	295
			296	296	296
			Sta. Multiple 297	297	297
			298	298	298
			299	299	299
			300	300	300
			301		
			302		
			303		
			304		

CHAPTER 3

CHAPTER 3

EQUIPMENT SPECIFICATIONS

3.1 INTRODUCTION

In this chapter, the procurement-level equipment specifications for the GATR-ESS communication complex are given. The organization is as follows:

Section 3.2: Equipment items are tabulated in Bill of Material form. The bill of material is organized in the modular form established in Chapter 2. The GATR-ESS radio complex is assembled around a core of Government Furnished Equipment. All unmodified GFE equipment is so specified in the bill of material.

Sections 3.3 to 3.20: Following the bill of material, GFE equipment items modified by MITRE for the GATR-ESS installation, and auxiliary equipment items which are designed and fabricated by MITRE for the GATR-ESS installation are specified in detail. All detailed specifications are referenced from the bill of material.

3.2 BILL OF MATERIAL

ANTENNA SYSTEM

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
1	12	UHF Omni-directional Antenna	AS-505/GR	
2	2	UHF Omni-directional Antenna	AS-4004 HP	
3	24	Mounting Bracket for AS-505/GR		Fig. 3-1
4	2	Mounting Platform for AS-4004 HP		Fig. 3-1
5	14	RF Antenna Cable Assembly		Fig. 3-2
6	4	VHF Omni-directional Antenna	RC-81	Fig. 3-2
7	1	VHF Omni-directional Antenna	CA-1563	
8	1	VHF Omni-directional Antenna	CA-1594	
9	4	Mounting Bracket for RC-81		Fig. 3-1
10	1	Mounting Bracket for CA-1563		Fig. 3-1
11	1	Mounting Bracket for CA-1594		Fig. 3-1
12	6	RF Antenna Cable Assembly		Fig. 3-2
13	1	UHF Omni-directional Antenna	AS-726 Ser.#5	
14	1	Mounting Plate for AS-726		Fig. 3-1
15	1	Antenna Transmission Line Assembly		Fig. 3-3
16	1	Set, Antenna Obstruction Lights	P/O AS-726	
17	3000'	Ground Cable, #2 A.W.G. Bare Copper		
18	40	Ground Rod, 3/4" Dia. x 10' Lg. Copperweld		
19	2	RF Cable Termination Plate, 1/4" Aluminum Plate		Fig. 3-2
20	14	RF Cable Coupler	Prodelin Cat.#102-875	
21	6	RF Cable Coupler	Prodelin Cat.#80-500	
22	14	80' Poles, Class 2 Douglas Fir Creosoted		
23	14	25' Poles, Class 4, Wood, Creosoted		
24	1	Building-148" long by 28' wide	ARMCO Type S-2	Fig. 3-36f.
25	300	7/8" Cable Clamps	ADEL 754-16-2-8	
26	120	1/2" Cable Clamps	ADEL 754-12-2-8	

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
A1	24	Equipment Rack	MT-686/GR	
A2	24	Transmitter Monitor Alarm (TMA)		Sect. 3-5
A3	24	Radio Transmitter	T-282 D/GR	
A4	24	Modulator-Power Supply	MD-141A/GR	
A5	24	Distribution Panel, Modified	J-390/GR	Sect. 3-6
A6	24	Radio Receiver	R-361/GR	Sect. 3-7
A7	24	Automatic Sensitivity Indicator Alarm (ASIA)		Sect. 3-8
A8	24	Voltage Regulator	SOLA Type CV-1 Cat.#20-13-120	Fig. 3-13
A9	24	Blank Panel, 12-1/4" high drilled for A8		
A10	48	Blank Panel, 1-3/4" high		
A11	24	Rack Cover Plate, 1/8" Aluminum, drilled		
A12	24	RF Cable Assembly, (Transmitter)		Fig. 3-35
A13	24	RF Cable Assembly, (Receiver)		Fig. 3-35
A14	24	RF Cable Assembly, (TMA to Coupler)		Fig. 3-35
A15	24	Audio and Control Cable Harness		Fig. 3-14
A16	24	Audio and Control Cable Assembly		Fig. 3-35
A17	24	Audio Cable Assembly, shielded, (ASIA)		Fig. 3-35
A18	24	Modulator Power Cable Assembly		Fig. 3-35
A19	24	Transmitter Power & Control Cable Assembly	P/O AN/GRT-3	
A20	48	Transmitter HV Cable Assembly	P/O AN/GRT-3	
A21	24	TMA Power Cable Assembly		Fig. 3-35
A22	24	Receiver Power Cable Assembly		Fig. 3-35
A23	24	ASIA Power Cable Assembly		Fig. 3-35
A24	24	Voltage Regulator Power Cable Assembly		Fig. 3-35

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
B1	6	Equipment Rack	MT-686/GR	
B2	6	Transmitter Monitor Alarm (TMA)		Sect. 3-5
B3	6	Radio Transmitter	T-217( )/GR	
B4	6	Modulator Power Supply	MD-129( )/GR	
B5	6	Distribution Panel	J-390( )/GR	Sect. 3-9
B6	6	Radio Receiver	R-278( )/GR	Sect. 3-10
B7	6	Automatic Sensitivity Indicator Alarm (ASIA)		Sect. 3-8
B8	6	Voltage Regulator	Sola Type CV-1 Cat.#20-13-150	Fig. 3-13
B9	12	Blank Panels, 1-3/4" high, drilled		
B10	2	RF Cable Assembly (Transmitter)		Fig. 3-35
B11	2	RF Cable Assembly (TMA to Transfer Pnl.)		Fig. 3-35
B12	6	RF Cable Assembly (Receiver)		Fig. 3-35
B13	6	Transmitter High Voltage Cable Assembly	P/O AN/GRC-27	
B14	6	Transmitter Power Cable Assembly	P/O AN/GRC-27	
B15	6	Modulator Power Cable Assembly		Fig. 3-35
B16	6	Modulator Local Control Cable Assembly	P/O AN/GRC-27	
B17	6	Receiver Power Cable Assembly		Fig. 3-35
B18	6	Receiver Local Control Cable Assembly		Fig. 3-35
B19	6	Voltage Regulator Power Cable Assembly		Fig. 3-35
B20	6	Blank Panels, 12-1/4" high drilled for Voltage Regulator		
B21	6	TMA Power Cable Assembly		Fig. 3-35
B22	6	Audio & Control Cable Assembly		Fig. 3-35
B23	6	Audio & Control Cable Assembly		Fig. 3-35
B24	6	Audio Cable Assembly, shielded, (ASIA)		Fig. 3-35
B25	6	ASIA Power Cable Assembly		Fig. 3-35
B26	6	Audio & Control Cable, 16 pr., No. 22	Plastic W&C PWC Type 122	

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
B27	4	RF Cable Assembly (TMA to Coupler)		Fig. 3-35
B28	4	RF Cable Assembly (Receiver - Transmitter)		Fig. 3-35
B29	4	Rack Cover Plate, 1/8" Aluminum, drilled		
B30	4	Audio & Control Cable, 11 pr. No. 22	Plastic W&C PWC Type 200	
B31	1	Audio & Control Cable, 11 pr. No. 22	Plastic W&C PWC Type 200	
B32	1	Audio & Control Cable, 26 pr. No. 22	Plastic W&C PWC Type 200	

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
C1	6	Equipment Rack	MT-686/GR	
C2	6	Antenna Coupler	CU-547/GR	
C3	6	Audio Meter Panel		Sect. 3-11
C4	6	Blank Panel, 12-1/4" high drilled for Terminal Strips		
C5	12	Terminal Strips, 6 rows, 120 terminals	ADC Type PJ-106	
C6	6	Rack Cover Plates, 1/8" Aluminum drilled		
C7	6	Rack Side Cover Plate, 1/2" thick, novaply		
C8	6	RF Cable Assembly		Fig. 3-35
C9	6	RF Cable Assembly (Antenna Transfer Pnl.)		Fig. 3-35
C10	6	RF Cable Coupler	Prodelin Cat.#97-500	
C11	6	RF Cable Assembly (Spare antenna jumper)		Fig. 3-35
C12	12	Audio Meter Cable, 16 pr. No. 22	W.E. Type PWC No. 122	
C13	6	Audio & Control Cable, 26 pr. No. 22	W.E. Type PWC No. 200	
C14	6	Audio & Control Cable, 11 pr. No. 22	W.E. Type PWC No. 200	
C15	12	Blank Panel, 12-1/4" high		

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
D1	1	Equipment Rack	MT-686/GR	
D2	1	Antenna Coupler	CU-547( )/GR	
D3	1	Audio Meter Panel		Sect. 3-11
D4	1	Blank Panel, 12-1/4" high drilled for Terminal Strips		
D5	2	Terminal Strips 6 rows, 120 terminals	ADC Type PJ-106	
D6	1	Rack Cover Plate, 1/8" Aluminum, drilled		
D7	1	RF Cable Assembly		Fig. 3-35
D8	2	Audio Meter Cable, 16 pr. No. 22	Plastic W&C PWC No. 122	
D9	1	Audio & Control Cable, 26 pr. No. 22	Plastic W&C PWC Type 200	
D10	1	Audio & Control Cable, 11 pr. No. 22	Plastic W&C PWC Type 200	
D11	2	Blank Panel, 12-1/4" high		

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
F1	1	Spare Substitution Device complete with relays, relay strips, control & flasher unit, fuses, terminal strips & 2 constant voltage power supplies in W.E. Co. ED-91981-70 Group 2 NP cabinet, gray finish.		Sect. 3-13
F2	1	Patch Test Panel complete with relays, relay strips, indicating light strip, fuses, plug strips, terminal strips & 2 constant voltage power supplies in W.E. Co. ED-91981-70 Group 2 NP cabinet, gray finish.		Sect. 3-12
F3	1	Auto Status Board, complete with telephone type indicating lights, alarm bell & mounting brackets.		Sect. 3-13
F4	2	Audio & Control Cable, 76 prs. No. 22	Plastic W&C Type 122	
F5	1	Signal Cable Assembly, 51 prs. No. 22		Fig. 3-35
F6	1	Audio & Control Cable, 101 prs. No. 22	Plastic W&C PWC Type 200	
F7	4	Constant Voltage Supply Power Cable Assembly		Fig. 3-35
F8	1	Floor Wall Distributing Frame for 9-M6A Terminal Strips		
F9	9	Terminal Strips, 120 terminals, 6 row, 20 terminals per row	W.E. Co. M6A	

ANTENNA TRANSFER PANEL RACK

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
G1	1	Equipment Rack	MT-686/GR	
G2	1	Aluminum Plate, 17" x 21-1/2" x 3/32" thick, drilled		Sect. 3-14
G3	17	RF Cable Coupler	Predelin Cat.#97-500	
G4	4	RF Cable Coupler (Panel Jack)	UG-22D/U	
G5	6	RF Cable Assembly		Fig. 3-35
G6	4	RF Cable Jumper Assemblies 11" lg		Fig. 3-35
G7	4	RF Cable Jumper Assemblies 4" lg		Fig. 3-35
G8	2	Door, Swinging, 8-3/4" high		
G9	4	Blank Panels, 12-1/4" high		
G10	1	Blank Panel, 1-3/4" high		

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
H1	4	Equipment Rack	MT-686/GR	
H2	2	Relay Meter Movement	RE-273/FSA	
H3	2	VHF Radio Transmitter	T-336( )/URT-7	Sect. 3-15
H4	2	VHF Radio Receiver	R518( )/FRR-27	Sect. 3-16
H5	1	Audio Output and Meter Panel		Sect. 3-17
H6	1	VHF Termination and Switching Panel		Sect. 3-18
H7	2	Band Suppression Filter	F-206/GR	
H8	2	Blank Panels, 1-3/4" high		
H9	2	Blank Panels, 5-1/4" high		
H10	4	Rack Cover plate, 1/8" Aluminum		
H11	4	Side Mounting Plates, 3/32" Aluminum for T-336( )/URT-7		Fig. 3-26
H12	2	Cover Plates, 3/32" Aluminum for T-336( )/URT-7		Fig. 3-26
H13	2	RF Cable Assembly (Receiver)		Fig. 3-35
H14	2	RF Cable Assembly (Transmitter)		Fig. 3-35
H15	2	RF Cable Assembly (Rel. Meter Movement)		Fig. 3-35
H16	2	RF Cable Assembly (Band Suppression Filter)		Fig. 3-35
H17	2	RF Cable Coupler	Prodelin Prod-lox 97-500	
H18	6	RF Cable Assembly, (Rack to Term. Plate)		Fig. 3-35
H19	2	Relay Meter Movement Power Cable Assembly		Fig. 3-35
H20	2	Transmitter Power Cable Assembly		Fig. 3-35

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
H21	2	Receiver Power Cable Assembly		Fig. 3-35
H22	1	Termination Panel Power Cable Assembly		Fig. 3-35
H23	4	Audio & Codan Cable Assembly (2 cond.)		Fig. 3-35
H24	1	Audio & Codan Wire Harness (8 cond.)		Fig. 3-35
H25	2	Audio & Control Cable Assembly (4 cond.)		Fig. 3-35
H26	2	Control Cable Assembly (2 cond.)		Fig. 3-35
H27	1	Audio & Control Cable, 6 pr., No. 22	Plastic W&C Type 122	
H28	1	Rack Side Cover Plate, 1/2" thick, Noveply		

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
L1	1	Equipment Rack	MT-686/GR	
L2	1	Radio Transmitter	T-282( )/GR	
L3	1	Modulator Power Supply	MD-141( )/GR	
L4	1	Radio Transmitter (AN/GRC-27)	T-217( )/GR	
L5	1	Modulator-Power Supply	MD-129( )/GR	
L6	1	Blank Panel, 5-1/4" high, drilled		
L7	2	RF Cable Coupler	Prodelin Cat.#97-500	
L8	2	RF Cable Coupler	UG-22D/U	
L9	2	RF Cable Jumper		Fig.3-35
L10	1	Blank Panel, 1-3/4" high		
L11	2	Blank Panel, 3-1/2" high, drilled		
L12	1	Blank Panel, 5-1/4" high, drilled		
L13	2	RF Cable Assembly (Transmitter to Transfer Panel)		Fig. 3-35
L14	1	RF Cable Assembly (Transfer Panel to Antenna)		Fig. 3-35
L15	1	RF Cable Assembly (Transfer Panel to Antenna Transfer Panel Rack)		Fig. 3-35
L16	2	Transmitter High Voltage Cable Assembly	P/O AN/GRT-3	
L17	1	Transmitter Power Cable Assembly	P/O AN/GRT-3	
L18	1	Modulator Power Supply Cable Assembly		Fig. 3-35
L19	1	Transmitter High Voltage Cable Assembly	P/O AN/GRC-27	
L20	1	Transmitter Power Cable Assembly	P/O AN/GRC-27	
L21	1	Modulator Power Supply Cable Assembly		Fig. 3-35
L22	2	Audio Cable, shielded, 2 cond., No. 22	Belden Type 8422	
L23	1	Phono Plug		

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
N1	2	FDDL Monitor, Telemetric Data, Complete in Cabinet with Doors	ID-527(XW-2)/GKA	
N2	2	FDDL Multiplexer Group, Complete in Cabinet with Doors	OA-486(XW-8)/GKA-1	
N3	2	FDDL Demultiplexer Group Complete in Cabinet with doors	OA-979(XW-2)/GKA-4	
N4	2	Runs 3/4" G.I. Conduit with 3-4" x 4" Junction Boxes and 4 - #10TW Conductors		
N5	6	Power Supply Cable Assemblies		Fig. 3-35
N6	10	FDDL Data Output-Input Cable Assemblies		Fig. 3-35
N7	8	Audio Cable, shielded, 2 cond., No. 22	Belden Type 8422	
N8	8	Connector & Cable Clamp, 3 cond.	Amphenol 212B-44	
N9	1	Equipment Rack	MT-686/GR	
N10	1	Audio Monitor Panel		Sect. 3-19
N11	1	Blank Panel - 1-3/4" high		
N12	1	Blank Panel - 7" high		
N13	4	Blank Panel - 12-1/4" high		
N14	1	Rack Cover Plate, 1/8 Aluminum, drilled		
N15	1	Audio & Control Cable, 11 pr. No. 22	Plastic W&C PWC Type 200	
N16	1	Cable Terminal Box, 10-3/16" x 4-1/2" x 2-9/16"	W.E. Company No. GA-11	
N17	1	Binding Post Chamber, 11 prs., without cable stub	W.E. Company No. G-11	

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
T1	6	Equipment Rack	MT-686/GR	
T2	6	Rack Cover Plates, 1/8" Aluminum		
T3	1	Set Time Division Data Link Equipment, complete with Transmitters, Receivers, Voltage Regulator, distribution panel, and interconnecting cables with connectors for duplex operation.	AN/GKA-5	
T4	1	Rack Side Cover Plate, 1/2" thick, Novaply		
T5	1	Box, Terminal, Cable, 10-3/16" x 4-1/2" x 2-9/16"	W.E. Co. No. GA-11	
T6	1	Chamber, Post, Binding, 11 prs. without Cable Stub.	W.E. Co. No. G-11	
T7	10	Blank Panel, 1-3/4" high		
T8	2	Blank Panel, 5-1/4" high		
T9	4	Blank Panel, 10-1/2" high		
T10	1	RF Transfer Panel, 5-1/4", Drilled		
T11	2	RF Cable Coupler	Prodelin Cat.#97-500	
T12	5	RF Cable Coupler	Amphenol 82-208	
T13	2	RF Cable Assembly (Transmitter)		Fig. 3-35
T14	2	RF Cable Assembly (Receiver)		Fig. 3-35
T15	2	RF Jumpers		Fig. 3-35
T16	1	Voltage Regulator Power Cable Assembly		Fig. 3-35
T17	1	Audio & Control Cable, 11 pr. No. 22	Plastic W&C Type 200	
T18	2	RF Cable Assembly (To Termination Plate)		Fig. 3-35
T19	1	RF Cable Assembly (High Power Trunk)		Fig. 3-35

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
W1	1	UHF High Power Equipment, 20 kw, Complete with Control Unit, Transformer Unit, Cooler Unit, coolant pipes, valves, ventilating ducts and 6" x 6" and 4" x 4" wiring ducts.	OA-751(XW-2)GRC	
W2	1	Air Pump, "Auto-Dryaire," 115V AC, 60 cycles, 1 Phase	Comm. Prod. Co. Cat.#103-307	
W3	1	Set 1/8" Copper Tubing		
W4	1	Safety Sw., 3 P. 125-250V, 100A, Type D	Federal Co. Cat.#7132	
W5	1	Equipment Rack	MT-686/GR	
W6	1	Rack Cover Plate, 1/8" Aluminum		
W7	1	RF Transfer Panel, 5-1/4" high, drilled		
W8	3	RF Cable Coupler (Panel Jack)	UG-22D/U	
W9	1	Rectifier, 120V to 28V, 12 Amps.		
W10	1	Power Indicating Device		Sect. 3-20
W11	1	UHF Radio Transmitter	T-217( )/GR	
W12	1	Modulator Power Supply	MD-129( )/GR	
W13	1	Blank Panel, 5-1/4" high, notched for cables		
W14	1	Blank Panel, 5-1/4" high, notched & drilled		
W15	1	Blank Panel, 7" high, notched & drilled		
W16	1	Rack Side Cover Plate, 1/2" thick, Novaply		

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
W17	1	RF Cable Assembly (Transmitter)		Fig. 3-35
W18	1	RF Cable Jumper (Patch Cord)		Fig. 3-35
W19	1	RF Cable Assembly (To Pwr. Ind. Device)		Fig. 3-35
W20	1	RF Cable Assembly (Hi-power Input)		Fig. 3-35
W21	1	Rectifier Power Cable Assembly		Fig. 3-35
W22	1	Power Ind. Device Supply Cable Assembly		Fig. 3-35
W23	1	Modulation Power Cable Assembly		Fig. 3-35
W24	1	Rectifier Output Cable Assembly		Fig. 3-35
W25	1	Coax Transfer Relay Control Cable Harness		Fig. 3-35
W26	1	Control Unit Control Cable Harness	P/O OA-751	
W27	1	Control Unit Control Cable Harness (Shielded)	P/O OA-751	
W28	1	Transmitter High Voltage Cable Assembly	P/O AN/GRC-27	
W29	1	Transmitter Power & Control Cable Assembly	P/O OA-751	
W30	1	Modulator Power & Control Cable Assembly	P/O OA-751	
W31	1	Modulator Aux. Control Cable Assembly	P/O OA-751	
W32	1	Air Pump Support, 22-1/4" x 13-1/4" x 30" high		

MISCELLANEOUS

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
X1	1	Screen Room, 10'4" long by 8'0" wide by 8'0" high, complete with access door, power line filter panel, r-f service panel, and fan-powered air circulation system.	ACE Co. Cat. No. AC3H3	

ITEM	NUMBER REQUIRED	DESCRIPTION	GOVERNMENT OR MFG. DESIGNATION	DETAIL REFERENCE
Z1	1	Bus Duct, Plug-in Type, 600V, 225A, 3 PH 4W	GE Co. Type DE	
Z2	1	ACB Plug-in Unit E Frame 250V, 20A, 3 PH 4W handle on side	GE Co. Type DE Cat.#DFPE	
Z3	2	ACB Plug-in Unit E Frame 250V, 15A, 3 PH, 4W handle on front	GE Co. Type DFPE	
Z4	4	ACB Plug-in Unit E Frame, 250V, 20A, 3 PH 4W handle on front	GE Co. Type DFPE	
Z5	12	ACB Plug-in Unit E Frame, 250V, 30A, 3 PH, 4W handle on front	GE Co. Type DFPE	
Z6	1	ACB Plug-in Unit E Frame 250V, 50A, 3 PH, 4W handle on front	GE Co. Type DFPE	
Z7	1	ACB Plug-in Unit E Frame 250V, 70A, 3 PH, 4W handle on front	GE Co. Type DFPE	
Z8	1	Cable Tray, Ladder Type 12" wide complete with connectors, angles, etc.	Husky HP 1010	
Z9	400'	Ground Cable, #2/0, 7 strands, bare copper		
Z10	34	Ground Cable Connectors #2/0 to #2/0		
Z11	1	Wiring Channel and Cover, Wiremold Finish	Type 3000 Wiremold	
Z12	32	Wiring Channel Boxes & Covers	Type 3046KD Wiremold	
Z13	23	Circuit Breakers, molded case, 250V 20 amps, 1 pole	Murray Type MP	
Z14	10	Circuit Breakers, molded case, 250V 30 amps, 1 pole	Murray Type MP	
Z15	1	Circuit Breakers, molded case, 250V 40 amps, 1 pole	Murray Type MP	
Z16	52	Grounding Type duplex receptacle, 15A, 125V, 3P, 2W	A-H 5252	
Z17	119	Twist lock receptacle, 3W, 20A, 250V, 10A, 600V, brown, complete with brown bakelite cover	Hubbell 7310	
Z18	11	Twist lock 3W receptacle, 10A, 250V, duplex bakelite	Hubbell Cat.#7580	

3.3 INTRODUCING EQUIPMENT SPECIFICATIONS AND DETAILS

The GATR-ESS radio equipment complex is assembled around a core of government furnished equipment for which detailed specifications are published in handbook form. No attempt has been made in this manual to duplicate these specifications except where the inclusion of pertinent excerpts from existing publications is necessary to outline or explain a modification to an item of government furnished equipment.

The equipment items and devices included in the GATR-ESS complex for which no detailed specifications have been published are described in the following sections. The equipment specifications are arranged in the order presented in the bill of material.

3.4 ANTENNA SYSTEM DETAILS

The mounting brackets required to support the uhf and vhf antennas (Fig. 2-2) were designed and fabricated for GATR-ESS installations. The brackets are detailed in Fig. 3-1.

The low-power uhf and vhf antenna transmission lines are installed in a continuous run from each antenna to an antenna termination panel located at the point where the antenna cables enter the GATR-ESS building. This rf coupling panel serves primarily as an installation demarcation point, to allow the external and internal facility construction to proceed independently. The coupling panel also provides an antenna transfer point where the semi-permanent allocation of antennas to channels may be made. The external rf cables and their termination at the coupling panel may be considered an autonomous system and detailed and installed as such. The detail for this system is shown in Fig. 3-2.

The 3-1/8 in. rigid coaxial transmission line feeding the high-power omni-directional antenna is detailed in Fig. 3-3. This figure contains a parts list and presents an equipment package suitable for a typical high-power transmission line installation.

3.5 TRANSMITTER MONITOR ALARM

The transmitter monitor alarm (TMA) (Fig. 3-4) is a supervisory maintenance device which monitors the operation of the uhf radio transmitter-modulator set. The TMA provides local indication, and initiates remote alarms and transmitter substitution (by the spare substitution device) in the event of transmitter failure. The TMA embraces the power monitoring function of the RE-273/FSA unit and replaces the RE-273/FSA in the GATR-ESS uhf voice complex.

The TMA is conditioned to operate when the transmitter set is keyed and modulated from the intercept director's console at the direction center. During the key closure period the TMA monitors the transmitter functions in the following ways to determine satisfactory operation:

(a) The rf power output of the transmitter is compared with a predetermined minimum acceptable output level (80 watts).

(b) The percentage modulation of the rf carrier is compared with a minimum acceptable modulation level (30 percent).

(c) The voltage standing wave ratio (VSWR) of the transmission system is compared with a specific maximum VSWR limit (2.0 SWR).

When the transmitter is operating satisfactorily the TMA provides a relay closure to illuminate the transmitter power (CARRIER ON) lamp at the intercept director's console in the direction center. If one or more of the three monitored functions becomes unsatisfactory, the TMA control circuitry initiates a failed transmitter alarm with the following indications:

(a) The direction center transmitter power lamp will not light.

(b) One or more of the alarm lights (POWER, MOD. and VSWR) on the front panel of the TMA will be illuminated.

(c) The appropriate transmitter lamp on the automatic status board will begin to flash and an audible alarm will sound.

(d) The spare substitution device (Sec. 3.13) is activated to transfer the transmitter function of the affected channel to a standby multichannel transmitter.

3.5.1 Theory of Operation

The TMA (Fig. 3-5) is composed of three sections, RF Power, VSWR and Modulation. Each section provides measurement, comparison, and control circuitry, operating into the single latching-type relay which provides the remote alarm closures. Each section actuates a local alarm lamp and is provided with level adjustment resistors. The power supply circuit provided in the TMA supplies all required voltages.

When power is applied to the TMA, the filament circuits are energized and the unit is in a standby condition. The unit does not assume a monitoring condition until the transmitter is keyed. When the transmitter is keyed, a 48-volt dc supply from the Patch Test Panel (Sec. 3.12) is applied to relay K4. Relay K4 is energized and applies B^+ to the monitoring circuits of the modulation and rf power sections.

3.5.1.1 RF Power Section

The rf power section consists of three stages of dc amplification. The incident probe dc output of a standard directional coupler, which is inserted in the rf line between the transmitter and the antenna, is applied to the grid of Tube V4A. The circuitry is such that when 80 watts is present at the input of the Micro Match (T3), output voltage on the order of +.88-volt dc is applied to the grid of V4A, driving it positive to the point where V4A conducts. The cathode of V4B being tied to the cathode resistor of V4A becomes positive to the extent that it overcomes the fixed positive grid potential, reducing plate current.

The grid of V5A is tied directly to the plate of V4B and is driven positive, increasing V5A plate current. Plate relay K2 is energized due to

this increase in plate current. Contacts 2 and 4 of relay K2 complete the circuit through relay K6 contacts to illuminate the remote power indicator lamp. Contacts 7 and 8 of relay K2 open the AC2 circuit to the time delay relay (K10), maintaining its contacts 3 and 8 open. Therefore, relay K5 does not become energized and a normal condition exists. The AC2 circuit is made to contact 7 of relay K2 through the contacts of conditioning relay K4, which is energized by the keying relay at the patch test panel.

If the transmitter power output falls below the calibrated level, the grid of V4A becomes less positive. The plate current is reduced and the positive bias on the cathode of V4B is reduced. Tube V4B plate current increases. The positive potential on the grid of V5A is decreased and the plate current of V5A decreases, de-energizing relay K2. AC2 is applied to the time delay relay K10. Relay K10 contacts 3 and 8 make, energizing relay K5. The contacts of relay K5 apply AC2 to the coil of relay K6. The .01 MF capacitor (C21) normally closed to contact "P", is discharged through the 15K resistor (R31) to ground. This momentary surge, through R31, is sufficient to cause the POWER ALARM indicator lamp on the front panel of the TMA to illuminate. The latching-type relay K6, being energized, opens the remote power indicator circuit and closes the remote alarm and transfer circuits.

3.5.1.2 VSWR Section

The VSWR section consists of three stages of dc amplification. The positive dc voltage output from the reflected power probe of the directional coupler is applied to the grid of V6A. As this potential increases, the grid of V6A is driven positive and plate current increases. The increase in plate current of V6A increases the positive potential across the common cathode resistor of V6, and the plate current in V6B is decreased. The grid of V5B, being tied directly to the plate of V6B, is driven positive with respect to its cathode and plate current increases. The increase in plate current through V5B energizes plate relay K3. Relay K3 contacts close to

illuminate the VSWR ALARM indicator lamp on the front panel of the TMA, and energize latch relay K6 to provide alarm and transfer functions.

3.5.1.3 Modulation Section

The modulation section consists of two 2-stage amplifier circuits, each terminating in a dc control tube and plate relay. One amplifier circuit monitors audio input from the telephone line, and the other amplifier circuit monitors the audio modulation of the rf carrier, derived from the incident voltage probe of the directional coupler (T3). The two channels provide a modulation failure indication through the serial closure of their plate relay contacts.

When the transmitter associated with the TMA unit is keyed and modulated from the direction center, relay K4 is energized. Relay K4 applies B^+ to V1 (K4 contacts 5 and 6). The Telco audio input is amplified through tubes V1A and V1B and detected by the diode portion of tube V2, to appear as a negative bias on the triode grid of V2, blocking conduction of V2 and maintaining relay K8 de-energized. When relay K8 is de-energized, contacts 7 and 8 are closed to ground contact 8 of relay K9. The operation of rf carrier modulation circuit is analogous to the audio input circuit. A satisfactory modulation level maintains the plate relay K9 de-energized with contacts 7 and 8 closed. Under this normal condition relay K1 remains de-energized. If the carrier modulation decreases to 30 percent, the signal amplified through tube V3 and detected at tube V10 does not develop sufficient voltage across the 51K ohm resistor R9 to bias tube V10 triode to cutoff. Tube V10 conducts and energizes relay K9. Contacts 6 and 8 of relay K9 close and complete the ground through relay K8 contacts to relay K1, energizing relay K1. Contacts 6 and 8 on relay K1 close and C15 discharges through R19. This surge is sufficient to illuminate the MOD. ALARM indicator lamp on the front panel of the TMA. Contacts 2 and 4 on relay K1 close and apply AC2 to latch relay K6, energizing relay K6. Relay K6 provides the contact closures to initiate the remote alarms.

3.5.1.4 Miscellaneous

The time delay relay K10 has been incorporated in the circuit design to bridge the time gap required for the transmitter to build up output after being keyed. The RESET push-button S1 returns the latch relay K6 to normal after a failure condition has been corrected.

3.5.2 Initial Adjustments

3.5.2.1 Micro Match

(1) Remove tubes V4 and V6 from the TMA unit and loosen the adjustment set screws on both ends of Micro Match T3. Connect a vacuum-tube voltmeter at pin 2 of V4.

(2) Vary the transmitter rf power output and adjust the TRANSMITTER end probe of the Micro Match to the following calibration chart:

Calibration Voltage	RF Power Output
+1.00 volt dc	100 watts
.92	90
.88	80
.82	70
.76	60
.68	50
.62	40
.52	30
.40	20
.26	10

When the calibration procedure is completed, lock the probe in position by tightening the locking set screw.

(3) Connect the VTVM at pin 2 of V6 and adjust the LOAD end probe of the Micro Match until the voltage read at the VTVM agrees with the following calibration chart:

Calibration Voltage	Transmission System VSWR
+0.04 volt dc	1.0
.12	1.1
.16	1.2
.19	1.3
.22	1.4
.24	1.5
.26	1.6
.28	1.7
.30	1.8
.32	1.9
.34	2.0
.36	2.2
.38	2.4
.41	2.6
.43	2.8
.44	3.0

The transmitter VSWR is read at the SWR meter on the antenna coupler unit. After the calibration procedure is completed, lock the probe in final position by tightening the set screw.

(4) Turn off the transmitter and replace tubes V4 and V6.

3.5.2.2 Power Section

(1) Connect a VTVM into the test points on the front panel of the TMA.

(2) Rotate the POWER LEVEL ADJUST potentiometer fully counter-clockwise.

(3) Place switch S3, located on the TMA panel, in the POWER position.

(4) Adjust the CALIBRATE potentiometer until a positive 0.74-volt dc is read on the VTVM.

(5) Rotate the POWER LEVEL ADJUST potentiometer in a clockwise direction until the POWER ALARM lamp illuminates. Precaution: this circuit utilizes a two-second time delay before indicating a failure condition. Adjust slowly so that the failure point is not exceeded in this adjustment.

(6) Return switch S3 to the center position and lock the POWER LEVEL ADJUST.

(7) Wait 10 seconds and push RESET button to return the unit to a normal condition.

3.5.2.3 VSWR Section

(1) With the VTVM still connected at the test points on the front panel of the TMA, rotate the VSWR LEVEL ADJUST fully clockwise and place switch S3 in the VSWR position.

(2) Adjust the CALIBRATE control until +0.34-volt dc is read on the VTVM.

(3) Rotate VSWR LEVEL ADJUST counter-clockwise until the VSWR ALARM lamp illuminates.

(4) Return switch S3 to the center position and lock the VSWR LEVEL ADJUST.

(5) Push RESET button to bring the unit back to normal.

3.5.2.4 Modulation Section

(1) Connect an ohm meter between J3 (on rear of unit) and ground. Rotate TEL LEVEL control fully counter-clockwise and MOD LEVEL control fully clockwise.

(2) While modulating locally at the patch test panel* rotate the TEL LEVEL control slowly until a short-circuit is indicated on the ohm meter. Remove meter and lock control.

(3) While modulating from the patch test panel* set the transmitter modulation level to 30 percent. Rotate the MOD LEVEL control until the MODULATION ALARM lamp illuminates. Lock control and return transmitter modulation to a normal level.

(4) Push RESET button to bring unit back to normal.

*A -16 dbm audio level is required—see Sec. 3.12.1.3.

3.6 MODIFICATION TO DISTRIBUTION PANEL J-390/GR-SINGLE-CHANNEL RACK

Distribution Panel J-390/GR (Fig. 3-6) is included in the uhf single-channel transmitter-receiver rack to distribute the rack audio and control circuits. The J-390/GR is designed as a combination ac primary power, audio, and dc control distribution panel. In the GATR-ESS installation the ac primary power distribution has been isolated by the use of the bus-duct and Wiremold system. The ac power distribution bus structure provided in the J-390/GR is not required and has been removed. The rear panel of the J-390/GR has been modified for the installation of three panel-type cable connectors in the space previously occupied by the ac bus structure. The connectors are permanently wired to the panel terminal strips. The rack equipment side audio and control harness (Fig. 3-14) terminates in two connectors which plug into the modified J-390/GR. The line side audio and control cable to the module termination rack also terminates in a plug-in connector.

3.7 MODIFICATION TO RADIO RECEIVER R-361( )/GR

The R-361( )/GR single-channel uhf receiver is presently in service as the principal rf receiving component of the SAGE ground-to-air voice radio system. For the GATR-ESS installation the R-361( )/GR has been provided with three field modification kits (Fig. 3-7). The first of these modifications is made to adapt the R-361( )/GR for operation with the ASIA sensitivity monitoring unit. The ASIA Modification Kit provides a coaxial jack at the rear of the receiver chassis to allow the ASIA unit to be externally coupled to the R-361( )/GR.

The other two modifications evolved from equipment simplification studies undertaken by MITRE during the construction of the GATR-ESS installation. These studies indicated that the function of two equipment packages, the AM-1442/FSA Direct Current Amplifier, and the (101-30) Audio Output Attenuation Panel, presently included in SAGE ground-to-air voice radio installations,

could be incorporated into the circuitry of the R-361( )/GR receiver with a resultant electrical improvement. One modification is referred to as the CODAN Modification Kit and the other as the Audio Output Attenuation Modification Kit.

3.7.1 ASIA Modification Kit

The ASIA monitoring unit (Sec. 3-8) monitors the voltage developed by internal receiver noise across the second detector load resistor of receiver R-361( )/GR. The ASIA modification kit provides this signal voltage at an external jack mounted on the rear of the R-361( )/GR chassis. From the external jack an rf cable connection is made to the ASIA unit.

The receiver modification is shown physically and schematically in Fig. 3-8. Physically, the modification kit consists of a No. 20 AWG, stranded (19/32), tight concentric lay, single-conductor shielded cable connected to the second detector circuitry at the front pin of switch S 303, and terminating in a BNC coaxial jack (type 91146-UG-109) mounted on the rear of the chassis between the ANT. INPUT jack (J-401) and the barrier terminal strip (E-303). The cable shielding is grounded at both ends. At the S 303 termination the shield is connected to the ground lug adjacent to X305, and at the BNC jack termination end the shield is grounded to a lug secured under one of the J-401 mounting screws. The cable traverses the chassis from front to rear alongside the support bracket for the component mounting board (E-304), using existing cable clips.

3.7.2 CODAN Modification Kit

The AM-1442/FSA direct current amplifier is used in conjunction with the R-361( )/GR receiver in present SAGE ground-to-air voice radio installation to provide a lamp indication on the intercept director's (IND) console at the direction center when an rf signal of 3 microvolts or greater is detected by the receiver. This action is referred to as the CODAN function. In the GATR-ESS installation, the CODAN function of the AM-1442/FSA unit has been incorporated into the R-361( )/GR receiver circuitry by the use of the CODAN modification kit.

The CODAN modification kit (Fig. 3-9) is a dc amplifier-CODAN plate relay unit. The modification kit is installed on the R-361( )/GR receiver chassis and wired into the receiver circuitry. The CODAN unit operates in the following manner. By appropriate setting of the CODAN potentiometer R3, an acceptable level of rf signal input to the R-361( )/GR (for SAGE, 3 microvolts, 30 percent modulated at 1000 cps) will produce a negative AVC voltage level at J-303 to bias V1A and reduce plate current flow through R1. The grid of V1B, being tied to the plate of V1A, is driven positive, causing an increase in plate current in V1B, and actuation of plate relay K1. When K1 is energized, contacts 4 and 6 close to provide a remote CODAN indication. The CODAN pair is provided at terminal strip E303, CT and GND pins.

3.7.3 Audio Output Attenuation Kit

The maximum audio output level at the MUTING terminals of the R-361( )/GR receiver is 1 watt across 600 ohms with an rf input of 50 microvolts modulated 30 percent at 1000 cps. This is +30 dbm (reference level 0 dbm =1 milliwatt across 600 ohms). The receiver MONITOR output provides 15 db of attenuation to this level.

The circuit design of the AVC system of the R-361( )/GR results in audio output compression characteristics such that the audio output level will not exceed a 4-db increase when the rf input is increased from 3 to 100,000 microvolts and the modulation is increased from 30 percent to 90 percent at 1000 cps. The proper receiver audio output level into the SAGE telephone lines has been established as +3 dbm with a receiver rf input of 3 microvolts modulated 30 percent at 1000 cps.

To assure that the receiver audio output will not exceed a maximum level of +7 dbm, the MUTING output of the R-361( )/GR is terminated in an 820-ohm impedance, and the MONITOR output of the R-361( )/GR is attenuated through a 12-db audio attenuation pad and applied to the Telco lines.

The present SAGE R-361( )/GR receiver installations are provided with an audio attenuation panel (standard 19-in. rack panel 1-3/4 in. wide) (Cook Elec. #101-30) on which a five-resistor "H" pad network is fabricated.

The audio output attenuation kit (Fig. 3-10) incorporates the required output attenuation into the R-361( )/GR circuitry. The modification kit is essentially a facsimile of the Western Electric 1C type pad receptacle. The selected amount of audio attenuation (12 db) is obtained by plugging the appropriate Western Electric Type 89 pad into the receptacle unit. The kit is mounted on the R-361( )/GR chassis and wired into the receiver circuitry.

3.8 AUTOMATIC SENSITIVITY INDICATOR ALARM

The Automatic Sensitivity Indicator Alarm (ASIA) (Fig. 3-11) is a supervisory maintenance device which monitors the sensitivity of a uhf radio receiver. The unit detects a decrease in receiver sensitivity, indicative of imminent failure, and provides a local alarm indication to alert station maintenance personnel. Operating as a component of the ASTRA system, the ASIA unit provides contact closures to initiate receiver substitution and remote alarms.

For SAGE ground-to-air voice receiver installations a 3-db decrease in receiver sensitivity establishes receiver failure. When a 3-db decrease in sensitivity is detected, the ASIA unit provides the following alarms:

(1) The alarm lamp on the front panel of the ASIA unit will change from the normal steady illumination to a flashing condition.

(2) The appropriate receiver lamp on the automatic status board will begin flashing and an audible alarm will sound.

(3) The spare substitution device is activated by an ASIA relay closure to transfer the receiver function of the failed channel to a standby multichannel receiver (Sec. 3.13).

3.8.1 Theory of Operation

The ASIA unit (Fig. 3-12) monitors the sensitivity of a radio receiver by measuring the amplified level of the internally generated receiver noise. The noise is sampled at the second detector stage of a receiver. The minimum noise voltage is independent of any rf signal input to the receiver. AVC action on received signals does not affect the noise voltage level measured by the ASIA unit since the unit is operating below the quieting level of the receiver.

Since receivers of the same type may have different noise characteristics, an ASIA unit must be adjusted in conjunction with its associated receiver. The ASIA unit is adjusted to detect a 3-db decrease in sensitivity in the following manner. The receiver rf gain is manually decreased (detuned) 3-db, the ASIA is set to alarm at this level, and the receiver is retuned to normal.

3.8.2 Operation with Receiver R-361( )/GR

The voltage developed across the load resistor of the second detector stage of R-361( )/GR (Fig. 3-8) is applied to the grid of tube V2A (Fig. 3-12) with amplifier switch (S1) in the OUT position. The negative voltage level associated with normal receiver sensitivity biases tube V2A to cutoff, driving the grid of tube V2B positive. Tube V2B conducts, energizing plate relay K2. Contacts 2 and 4 of relay K2 close and illuminate the ALARM lamp. Contacts 1 and 2 of relay K2 open and de-energize alarm relay K1.

When the receiver sensitivity decreases 3 db, the noise level voltage decreases and the bias applied to tube V2A is no longer sufficient to block conductivity. Tube V2A conducts, and the grid of tube V2B is driven negative. Plate current of tube V2B decreases and relay K2 is de-energized. Contacts of relay K2 parallel the ALARM lamp with capacitor C1, and the lamp flashes at a rate determined by the time constant of the R5-C1 circuit.

Relay K1 is energized and provides closures to initiate the automatic status board lamp alarm and the SSD receiver transfer function.

3.8.3 Operation with Receiver R-278( )/GR

The voltage developed across the load resistor of the audio detector stage of receiver R-278( )/GR (Fig. 3-16) is applied to the ASIA unit. The noise voltage levels generated in the R-278( )/GR receiver are of smaller magnitude than those developed in the R-361( )/GR receiver. An additional stage of amplification required to obtain ASIA levels comparable to the R-361( )/GR receiver is inserted at the input of the ASIA unit by placing the amplifier switch (S1) in the IN position. With this amplified level applied to the grid of tube V2A (Fig. 3-12) the operation of the ASIA unit with receiver R-278( )/GR proceeds in the manner outlined in the preceding paragraph for the R-361( )/GR.

3.8.4 Initial Adjustment

Before setting the alarm adjustment of the ASIA unit, the sensitivity of the receiver should be tested in accordance with the procedure outlined in TO 31-1-70D, "Optimization of G/A Radio Equipment for SAGE System Installation", to ascertain that receiver sensitivity is at the 3-microvolt SAGE specification level.

3.8.4.1 Adjustment Procedure with Receiver R-361( )/GR

Step 1: Tune a signal generator (AN/USM-44) to receiver frequency and set output level for 4.2 microvolt input to the receiver, modulated 30 percent with a 1000 cycle tone (4.2 microvolts is 3 db above 3 microvolts).

Step 2: Connect the signal generator to the receiver antenna input. Connect a 600-ohm headset at the receiver audio output. Detune the receiver by turning the first rf plate tuning adjustment (U402) fully clockwise or counter-clockwise.

Check that no audio is present at the headset. Rotate the ALARM SET, located on the front panel of the ASIA unit, fully clockwise.

Step 3: Slowly retune the receiver using the first rf plate tuning adjustment (U402) to the point where the receiver breaks squelch. Disconnect the signal generator. Rotate the ASIA unit ALARM SET adjustment slowly counter-clockwise until the unit fails and the ALARM lamp begins flashing. Lock the ALARM SET in this position.

Step 4: Reconnect the signal generator and connect a VTVM at the receiver ASIA jack. Retune the first rf plate tuning adjustment (U402) to peak receiver sensitivity.

Step 5: Reconnect the antenna and the ASIA unit to the receiver. Depress the ASIA RESET button to return the unit to a normal state.

Step 6: The operation of the ASIA unit can now be tested by removing the first rf tube (V401) from the receiver. This should result in an alarm condition.

3.8.4.2 Adjustment Procedure with Receiver R-278( )/GR

The adjustment procedure for the ASIA unit, when used in conjunction with the R-278( )/GR receiver, follows the pattern outlined in the preceding section, with the following changes:

(1) In Step 2 above, desensitize the receiver with the RF GAIN control rather than detuning it with the first rf plate tuning adjustment.

(2) In Step 3, increase the RF GAIN rather than retuning the first rf plate tuning adjustment.

(3) In Step 4, readjust the RF GAIN control for 3 microvolts sensitivity.

(4) Omit Step 6.

3.9 MODIFICATION OF DISTRIBUTION PANEL J-390/GR-MULTICHANNEL EQUIPMENT RACK

Distribution Panel J-390/GR (Fig. 3-15) is a combination ac primary power, audio and dc control distribution panel. As in the case of the J-390/GR employed in the single-channel rack (Sec. 3.6), the ac power distribution bus structure is not required in the GATR-ESS installation and has been removed. The function of the J-390/GR in the multichannel equipment rack is to provide a termination point for the audio and control circuitry in the multichannel rack. Since all cable terminations to the multichannel equipment are made at the front of the equipment, a cable harness and plug system similar to that designed for the single-channel rack cannot be employed. Therefore, the control cables are brought directly into the rear of the J-390/GR and terminated on the panel terminal strips.

The audio output attenuation modification kit for the R-278( )/GR multichannel receiver (Sec. 3.10) has been mounted on the rear panel of the J-390/GR and wired in series with the receiver audio output circuit.

3.10 MODIFICATION TO RADIO RECEIVER R-278( )/GR

The R-278( )/GR multichannel uhf receiver serves as the operational standby rf receiving component in SAGE ground-to-air voice radio installations, in support of the R-361( )/GR single-channel receiver. As outlined in the discussion of receiver R-361( )/GR modifications (Sec. 3.7), design consideration was given to the criterion of contiguous ASIA unit operation, CODAN indication and audio output attenuation. Of these three considerations, only the contiguous ASIA operation requirement has resulted in a modification to the R-278( )/GR.

The CODAN function is provided in the receiver design. The R-278( )/GR is provided with a carrier-operated relay circuit which is activated whenever an rf signal of sufficient magnitude is detected by the receiver (SAGE criterion 3 microvolts). The CODAN relay provides local indication and a relay closure at the AUX. CONTROL jack (J-1215) for remote CODAN indication.

Audio output attenuation is necessary when the R-278( )/GR is to be operated into SAGE telephone cables with a maximum permissible level of +7 dbm. The MAIN audio output level of the R-278( )/GR receiver is 3 watts across 600 ohms. The low level output is attenuated by an internal pad to +10 dbm at pins E and F of the AUX. CONTROL connector. The AVC characteristics of the receiver limit output variation of the receiver to ±2 db for signal inputs from 10 to 100,000 microvolts, and to ±6 db for inputs from 0.1 to 2 volts. To assure that the audio voltage levels fed into the Telco cables will not exceed the maximum level of +7 dbm, 8 db of attenuation in pad form is provided in the AUX. CONTROL output circuit. Ideally, this attenuation should be provided within the receiver cabinet. The compact design of the R-278( )/GR has made it impossible to include the audio output attenuation modification kit (Fig. 3-10) within the receiver cabinet, and, as an alternative, the kit has been installed on the rack distribution panel and wired into the audio output circuit (Sec. 3.9).

3.10.1 ASIA Modification Kit

The input to the ASIA unit monitoring the sensitivity of the R-278( )/GR receiver is the voltage developed across the load resistor of the receiver audio detector stage (Sec. 3.8). To avoid extensive modification to the receiver circuitry, the sampling connection is made at internal jack J-604. J-604 is located on the front bottom panel of the Third I-F Amplifier Chassis. The ASIA modification kit (Fig. 3-16) consists of a probe inserted in J-604, connected by an RG-58 shielded cable to a BNC coaxial jack (type 91146-V6-109) mounted in the bottom of the front left filter housing. The shielding of the RG-58 cable is grounded at both ends.

3.11 AUDIO METER PANEL

The Audio Meter Panel (Figs. 3-17, 3-18) is a test and maintenance device which provides, at the module location, a common audio test point. At the audio meter panel the audio circuits of four uhf single-channel racks may

be isolated for testing, and the audio and modulation levels on the lines may be observed. An audio meter panel is located at each antenna coupler rack.

3.11.1 Theory of Operation

3.11.1.1 Monitoring

Four pairs of normal-through jacks are mounted at each side of the VU Meter on the front face of the meter panel. The four left-hand jacks provide line and equipment (left to right) jacks for the module transmitters, and four right-hand jacks provide line and equipment jacks for the module receivers. Three station-multiple jacks are mounted below the VU Meter. Three station-multiple pairs are present at all equipment terminal strips for station-wide communication, and are provided with jack terminations at the audio meter panels and at the patch test panel.

3.11.1.2 Metering

The VU Meter is bridged across a selected transmitter or receiver audio circuit by means of the two channel-selection switches provided on the front face of the audio meter panel. The channel-selection switches are five-position, four-stage rotary type. The first two stages on either switch select the desired transmitter or receiver audio pair and this pair is then normal-through the OFF position on the last two stages of the other switch to the VU Meter movement.

An audio amplifier package unit is inserted in the meter circuit of the transmitter audio pair. This amplifier provides an adjustable gain of approximately 20 db to raise the Telco modulation level, generally -16 dbm, to a level of +4 dbm. Transmitter and receiver levels may thus be compared on a single VU Meter range with comparable accuracy. The audio amplifier unit is fabricated as a plug-in package to make it adaptable throughout the installation. The power supply for the amplifier unit is

12-vdc regulated. A 12 vdc power supply is mounted in the SSD cabinet. The VU Meter illumination lamps are supplied from the same source.

3.12 PATCH TEST PANEL

The normal Patch Test and Alarm Panel furnished at SAGE ground-to-air radio sites provides a centralized location for the testing of lines and patching of equipment. The panel represents the physical convergence of the station audio and control circuitry, and, with the demarc terminal strip, which is physically separate but functionally a part of the patch test and alarm panel, the station demarcation point.

In the GATR-ESS installation the test and patch functions of the patch test and alarm panel have been incorporated in a MITRE fabricated patch test panel (PTP), Figure 3-20.

The patch test panel is designed for 30 communication channels. The 30 channels are assigned as follows:

Channels 1 through 24	-	SAGE ground-to-air Voice UHF Single-Channel Racks # 1 through # 24
Channels 25 through 28	-	ESS Communication Module Multichannel Racks # 25 through # 28
Channels 29 and 30	-	Spare positions

Each channel in the patch test panel is provided with the following devices:

Two-stage auxiliary transmitter keying relay
Power indicator lamp
CODAN lamp
Transmitter and receiver line jacks
Transmitter and receiver equipment jacks
Transmitter and receiver monitoring jacks

Two 48-volt dc power supply units provide control power for the relay circuits. Three station-multiple jacks and a single-channel test unit are mounted in a miscellaneous strip.

3.12.1 Theory of Operation

Figure 3-21 is a schematic diagram of the patch test panel. A single typical channel has been detailed for simplicity.

3.12.1.1 Patching and Testing

Three 30-channel double-jack strips are provided at the center of the PTP cabinet. From top to bottom the strips provide normal-through transmitter and receiver line jacks, normal-through transmitter and receiver equipment jacks, and bridging transmitter and receiver monitoring jacks. In all cases the jack sleeve is signalling and the tip and ring springs are audio.

The line jacks permit isolated examination of the Telco lines for trouble shooting, testing and level measurement purposes. The equipment jacks provide parallel functions in the equipment direction. The ability to key and modulate locally at the transmitter equipment jack is necessary for the transmitter monitor alarm set-up procedure outlined in Sec. 3.5.2.

The line and equipment jacks together permit channel patching (interchange and/or substitution) at the PTP cabinet. This patching is constrained to complete equipment channels (transmitter and receiver) if SAGE requirements are to be satisfied. Individual transmitters may be patched with a sacrifice of the remote power indication function.

The monitoring jacks bridge the audio lines with a fixed impedance of 7200 ohms. This impedance level guards against undesirable line loading due to the inadvertent insertion of a shorted plug.

3.12.1.2 Control and Indication Relaying

The six Telco audio and control leads for each channel are wired from the PTP line terminal strip serially through the line and equipment jacks. From the equipment jacks, the two audio pairs (audio and modulation) terminate at the equipment terminal strip, the key circuit terminates at the

coil of control relay K1A, and the CODAN power indicator circuit terminates at pin 5 of control relay K1B.

Relay K1A serves as an auxiliary keying relay. Three SPDT stages (pins 25, 28 and 31) provide ground closures to key the transmitter (TX Key) and to condition the transmitter TMA (TMA Key Closure and TMA Conditional Closure). Two other SPDT stages are provided on relay K1A. One stage (pins 21, 22 and 23) supplies local CODAN and Power Indication at the PTP, and the other stage (pins 18, 19 and 20) couples the equipment CODAN and Power Indication closures to a single circuit to energize K1B.

Relay K1B is an auxiliary indication relay. The relay is energized by a ground closure from the equipment rack (CODAN relay or Power Indication relay). Relay K1B provides two closures. One closure provides a ground on the CODAN circuit for remote indication at the direction center. The other closure provides a ground for local indication, through K1A, at the PTP.

3.12.1.3 Miscellaneous Strip

A miscellaneous strip is provided on the PTP for the mounting of miscellaneous station maintenance devices. The three station multiple pairs (intra-station communication and testing circuits) terminate in telephone jacks at the miscellaneous strip. Also, the patching jacks and the keying switch making up the Local Operation and Test Station are mounted on the miscellaneous strip.

The Local Operation and Test Station is a maintenance device which provides local single-channel operation (key, modulate and monitor) of equipment channels from the PTP. The station consists of a telephone headset jack pair, a strip mounted transmitter keying switch, a pair of headset-to-channel patch jacks, a pair of amplifier jacks, and six multiple jacks The six multiple jacks permit the station to key and modulate up to five channels simultaneously. An adjustable gain audio amplifier unit (gain to 40 db) is

mounted in the PTP cabinet with input and output circuits terminating in jacks mounted on the miscellaneous strip. The amplifier unit is patched into the modulation pair when operating locally. The amplifier gain is adjusted to provide a local modulation level equal to the Telco line modulation level (minus 16 dbm) for local set-up of the transmitter monitoring equipment (TMA units).

3.13 SPARE SUBSTITUTION DEVICE

The employment of automatic sensitivity indicator alarm (ASIA) units and transmitter monitor alarm (TMA) units in the GATR-ESS installation has made it possible to institute a maintenance control system (ASTRA) to provide automatic substitution of standby equipment for primary SAGE voice equipment which has failed. The device that provides the automatic substitution, with alarms and annunciation, is the Spare Substitution Device (SSD).

The spare substitution device is built in two separate units. The control relay and power supply facilities which provide the equipment substitution and alarm activation are built into an equipment cabinet (SSD) located in the equipment room. The alarm display (automatic status board) which must be available to station maintenance personnel is centrally located in the maintenance room.

The SSD Control Cabinet (Fig. 3-22) is designed on the module unit principle, with two sections of control circuitry provided. Each section contains 22 units (3 relay sets) of transfer circuitry: 11 units for transmitter control and 11 units for receiver control. Each section has a 4-socket switching panel and a 48-vdc power supply unit. A control and flasher unit provides failure indication lamps, equipment reset push-buttons, and status board alarm and flasher relays for both sections.

Each section in the SSD provides transfer control for 3 UHF Station Modules (12 uhf single-channel racks). Section I provides transmitter and/or receiver transfer control for channels 1 through 12; Section II provides

transmitter and/or receiver transfer control for channels 13 through 24. Transmitter and receiver substitution operate independently and any combination of channels can be substituted in the SSD.

The automatic status board indicates the condition of all the GATR-ESS installation voice equipment on a lamp display panel. The normal indication is a steady illumination on all lamps. A transmitter or receiver failure is indicated by a flashing lamp and an audible alarm signal. A single dead lamp signals a loss of ac power supply to a monitoring unit (ASIA or TMA), which should be considered an alarm condition. The loss of all lamps indicates a 48-vdc power supply failure.

3.13.1 General Operation

The SSD is designed to provide automatic transmitter and/or receiver substitution for 22 of the 24 uhf single-channel racks. The SSD is divided into two identical sections which accommodate 12 equipment racks. Each section works into one of the two multichannel transmitter and receiver operational standby units. The twelfth equipment rack in each section is wired to a plug/socket arrangement to enable direct connection between equipment and PTP. Since in normal SAGE operation multichannel equipment is used to back up only the 20 TAC channels, two spare backup channels are provided. Flexibility in the assignment of frequencies to single-channel racks, and use of the two backup channels are provided through a plug/socket arrangement on two additional single-channel racks and SSD channels in each section.

The audio and control cables from each station module are terminated on one of the two equipment terminal strips at the rear of the SSD cabinet. In each section of the SSD, the transmitter and receiver audio and signal circuits for 9 of the 12 single channel racks are wired from the equipment terminal strip through the transfer and control circuitry to the line terminal strip. The audio and signal circuits for the other 3 single-channel racks are cabled from the equipment terminal strip and terminate in three Jones

plugs at the switching panel. Three Jones sockets are provided on the switching panel for each section. Two of the sockets are wired through the remaining transfer and control circuits and terminate at the line terminal strip. The third socket in each section is wired directly to the line terminal strip.

The AICC and emergency channels may be assigned to racks 8, 11, 12, 20, 23 or 24 only. These are the only single-channel rack/SSD channels included in the plug/socket arrangement. The operational standby units for the AICC and emergency channels, and the primary units for the remaining TAC channels are assigned to the unused single channel rack/SSD channels above.

3.13.1.1 Receiver and Transmitter System Operation

Receiver and transmitter substitution in the SSD control system operate independently. The receiver and transmitter control systems are, however, similar in operation. The basic difference in the operation of the systems stems from the communication continuity requirements of SAGE. The SSD control system provides locked-in receiver substitution, as contrasted with conditioned transmitter substitution. If a primary receiver fails, the SSD provides a multichannel receiver for the failed channel until the SSD is reset. Since the transmitter control system is conditioned for operation by keying action, it has been possible to design the SSD control such that a multichannel transmitter is assigned to a failed primary transmitter only as long as the failed channel is keyed. The multichannel transmitter is available to another failed channel as soon as keying terminates.

In the following discussion of SSD circuit operation (Fig. 3-23) one channel of the SAGE uhf voice system will be discussed as typical of the operation of all channels. A receiver failure and transmitter failure are discussed separately.

Receiver System: Receiver substitution is initiated by the alarm relay closure at the Rack # 8 ASIA unit. The ASIA closure provides system ground at pin 18 of the SSD RX CONTROL RELAY coil, energizing the relay. The CONTROL RELAY is held energized by its own contacts (5, 6 and 13, 14). CONTROL RELAY closures initiate the following actions:

1. Contacts 3 and 4 close to energize the receiver LOCKOUT RELAY. Contacts 8 and 9 of the LOCKOUT RELAY open to remove the 48-volt dc supply to the LOCKOUT BUS, thus deactivating all other receiver control relays in Section I. Other LOCKOUT RELAY contact closures (1, 2 and 3) transfer the Section I receiver indication on the Control and Flasher Panel from NORMAL to ALARM, and (4 and 5) activate the RX FLASHER RELAY and AUDIBLE ALARM RELAY. The RX FLASHER RELAY applies an intermittent ground to the Rack # 8 receiver status lamp at the automatic status board (ASB) and the AUDIBLE ALARM RELAY triggers the ASB audible alarm.
2. Contacts 1 and 2 close to energize both the SUB. RELAY and the FREQ. SEL. RELAY. The substitution relay, SUB. RELAY # 8, transfers the Channel # 8 audio and CODAN leads at the SSD line terminal strip (in an SPDT action) from Single-Channel Rack # 8 to the ASTRA Section I multichannel receiver. The frequency selector relay (FREQ. SEL. RELAY # 8) closes to present a digital coded ground sequence to the four remote control leads of the multichannel receiver frequency selector unit channeling the receiver to the desired frequency.

The RESET button on the control and flasher unit resets the receiver system to an available condition when the primary receiver ASIA unit is reset for normal operation.

Transmitter System: Transmitter substitution is initiated by an alarm relay closure at the Rack # 8 TMA unit. The TMA closure provides

system ground to one side (pin 16) of the TX CONTROL RELAY coil. The other side of the coil goes to -48 vdc via normally closed contacts (11 and 12) and transmitter LOCKOUT RELAY contacts (8 and 9). The CONTROL RELAY is held energized by its own contacts (11 and 10). CONTROL RELAY closures provide the following action:

1. Contacts 3 and 4 close to energize the LOCKOUT RELAY. The LOCKOUT RELAY deactivates all other transmitter CONTROL RELAYS in Section I and provides ALARM lamp indication on the control and flasher unit. LOCKOUT RELAY closures also activate the TX FLASHER RELAY and AUDIBLE ALARM RELAY at the control and flasher unit to give transmitter alarm indication at the automatic status board.

   This action parallels the receiver system action outlined above. A further refinement is provided in the transmitter alarm circuitry. An auxiliary relay is provided on the control and flasher panel to lock in transmitter failure indication. The auxiliary relay also provides a contact set to switch a single dc power supply to the AUDIBLE ALARM FLASHER.

2. Contacts 1 and 2 close to energize both the transmitter substitution and transmitter frequency selector relays. The substitution relay transfers the transmitter Mod., Key and Power Indication leads to the multichannel transmitter. The frequency selector relay provides a digital coded signal to channel-up the multichannel transmitter.

   The TX RESET button on the control and flasher panel clears failure indication when a transmitter TMA unit has been returned to normal condition.

3.14 ANTENNA TRANSFER PANEL

The antenna transfer panel is a coaxial cable patching panel for the assignment of uhf antennas. In the normal SAGE ground-to-air voice radio

antenna configuration of 10 poles, 8 antennas are assigned to the 8 modules of primary voice and data link equipment and 2 standby antennas are assigned to the standby voice equipment. In the GATR-ESS installation the transmission lines for the 2 standby antennas terminate in coaxial connectors at the antenna transfer panel (Fig. 3-24). Four additional poles carry antennas provided in the GATR-ESS installation for the ASTRA system multichannel standby equipment. The 4 antenna transmission lines are also terminated in coaxial connectors at the antenna transfer panel.

The primary rf cable system, which ties the primary SAGE equipment directly to the SAGE antenna configuration, has been augmented by a back-up rf trunk system which provides an alternate rf cable from each primary unit of SAGE equipment to the antenna transfer panel. The 4 rf antenna cables for the SAGE voice multichannel standby equipment also terminate at the antenna transfer panel as does the single rf antenna cable for the ESS Communication Module. Prefabricated jumpers on the antenna transfer panel patch the trunks or the standby or ESS equipment to available antennas. Under normal conditions, the multichannel standby equipment is patched through to antennas 11 through 14, and the ESS equipment is patched to either antenna 4 or 7. Under emergency or testing conditions any patching configuration may be assumed.

3.15 MODIFICATION TO RADIO TRANSMITTER T-336/URT-7

The present SAGE ground-to-air voice radio commitments require one operational channel on the VHF Emergency Channel, 121.5 mc. In the GATR-ESS installation the T-336/URT-7 is employed as the vhf transmitter component.

To adapt the T-336/URT-7 for use in the SAGE operational environment, modifications are required to the transmitter keying and audio input circuitry. The T-336/URT-7 is designed for simplex keying and modulation. The internal circuit modifications illustrated in Fig. 3-25 adapt the transmitter keying circuitry to SAGE duplex keying operation. In

addition to these internal modifications, an isolation transformer is required in the audio modulation input circuit. This transformer has been physically located in the VHF Termination and Switching Panel (Sec. 3.18.1.2) because of space limitations within the T-336 cabinet.

A physical interference is present when the T-336 unit is mounted in the standard equipment rack (MT-686). The transmitter case must be removed for mounting and, in order to protect maintenance personnel from dangerous voltages, cover plates have been designed (Fig. 3-26) and installed on the equipment rack. These plates prevent access to hazardous points in the transmitter.

3.16 MODIFICATION TO RADIO RECEIVER R-518/FRR-27

The R-518/FRR-27 has been installed in the GATR-ESS installation as the vhf receiving component of the SAGE ground-to-air voice radio system on the vhf emergency channel. To make the R-518 receiver compatible to SAGE system operation the following modifications are required:

(a) The ground center-tap (to terminals 4 and 5) of the audio output transformer (T302) is disconnected. This modification adapts the R-518 receiver to operation on the SAGE Telco systems.

(b) A CODAN modification kit, shown in Fig. 3-9, has been fabricated and installed in the R-518 receiver cabinet. The CODAN unit is mounted on the Audio-Power Supply Sub-Chassis and wired into the receiver circuitry as indicated in Fig. 3-27. The remote CODAN indication pair is carried to the rear of the R-518 chassis and connected to pins 8 and 10 of a 3-pin Amphenol socket mounted on the underpart of the protruding rear chassis of the receiver case.

Audio output attenuation is required when the R-518 is operating into the SAGE Telco lines. An audio pad is provided at the VHF Audio Output and Meter Panel (Sec. 3.17) since internal mounting is restricted by the space limitations within the R-518 cabinet.

3.17 VHF AUDIO OUTPUT AND METER PANEL

The VHF Audio Output and Meter Panel (Figs. 3-28, 3-29) is included in the vhf equipment rack to provide a metering and test point for the vhf receiving equipment. The panel also provides a convenient location for the audio output attenuation pads required for the R-518 in SAGE operation (Sec. 3.16).

The audio and CODAN cables are brought from the primary (# 1) and standby (# 2) R-518 receivers to terminal strip E_1 in the vhf audio output and meter panel. The audio pair of each receiver is internally wired through an impedance-matching audio attenuation pad (fabricated as a plug-in unit) and a normally-through audio jack to output terminal strip E_2. The CODAN pairs are wired through the CODAN jacks to terminal strip E_2.

The panel-mounted VU Meter may be switched (Switch S1) to measure the audio level at the attenuated output of either receiver. Switch S2 provides an OFF position and three VU Meter ranges, +4 dbm, +7 dbm, and +10 dbm.

Pin jacks J_5 and J_6 are provided on the meter panel for calibration purposes.

3.18 VHF TERMINATION AND SWITCHING PANEL

The VHF Termination and Switching Panel serves a dual purpose in the vhf equipment rack. The panel serves as a cable terminal point and switching location for the local selection of primary or standby vhf equipment. The panel is also the location of the relay and coupling circuitry which provides simultaneous parallel operation of the vhf and uhf emergency channels (121.5 mc and 243 mc) from the intercept director's console in the direction center. The consolidation of these functions in the panel and equipment chassis unit is illustrated in Fig. 3-30 and 3-31.

3.18.1 Theory of Operation

3.18.1.1 VHF Equipment Switching

Two equipment selection switches (S2 and S3) are provided on the front panel of the vhf termination and switching panel (TSP). S2, composed of three DPDT sections, transfers the vhf modulation, keying and power indication circuit pairs from transmitter # 1 to transmitter # 2. S3, two DPDT sections, transfers the audio and CODAN pairs from receiver # 1 to receiver # 2.

3.18.1.2 Parallel Emergency Channel Operation

At the SAGE direction center no provision is made on the intercept director's console for individual operation on both the UHF Emergency Channel (243 mc) and the VHF Emergency Channel (121.5 mc). A single channel-selector button for emergency channel operation is provided. Since equipment for operation on both uhf and vhf channels is provided in the GATR-ESS installation, it is necessary to operate the uhf and vhf channels in a simultaneous-parallel manner: simultaneous for transmitter keying and modulation, and parallel for audio reception. A single EMERG. communication channel is provided from the direction center to the GATR-ESS site, and the uhf and vhf channels are paralleled at the vhf termination and switching panel.

The emergency channel control and audio circuits from the direction center terminate at the demarc strip. The 7 control and audio leads (2 modulation, 2 audio, and a single key, CODAN and Ground) are picked up at the demarc strip and cabled to the vhf termination and switching panel, where the following functions are provided:

(a) When the transmitter is keyed, relay K1 is energized to provide two closures; one closure (2 and 4) keys the vhf transmitter and the other closure (6 and 8) is wired to the line terminal strip for uhf keying.

(b) The Telco audio and modulation pairs are wired to a repeating coil that provides parallel outputs for vhf equipment and uhf equipment. A supplementary 1.1 isolating transformer is provided in the vhf modulation circuit. This is a part of the T-336 transmitter keying modification described in Sec. 3.15.

(c) Relay K2 is energized by a closure at the vhf CODAN or power indicator equipment. When K2 is energized contacts 4 and 6 close to provide continuity for the CODAN or CARRIER ON indications in the intercept director's console.

The uhf circuits key, modulation and audio pairs, now paralleled with the vhf channel, are run back to the demarc strip, and from the demarc strip in the normal manner to the patch test panel for uhf channel control.

3.19 FDDL MONITOR PANEL

The FDDL Monitor Panel (Figs. 3-32, 3-33) provides centralized equipment selection switching, line monitoring, and line level measurement equipment for the dual GRA-4 FDDL system. The unit is included in the FDDL complex to supersede the SB-722/GKA-4 patch panel unit normally employed in a FDDL installation to provide equipment selection and monitor points. The FDDL monitor panel functions as an operation and maintenance device.

3.19.1 Theory of Operation

3.19.1.1 Equipment Selection Function

Three equipment selection switches are provided on the front panel of the FDDL monitor panel:

1. TEL LINE TO DE-MUX INPUT SELECTOR: The three-position line selector switch selects Telco line input to the primary FDDL group (DE-MUX 1), the standby FDDL group (DE-MUX 2) or parallel input to both groups (PAR.).

2. TRANSMITTER INPUT SELECTOR: Four positions are provided on the transmitter input switch. The output of the FDDL group 1 Multiplexer (MUX 1), FDDL group 2 Multiplexer (MUX 2), a test tape (TAPE), or the output of a digital message generator unit (PSM-7) may be selected as the modulator input to the GKA-4 transmitter set.
3. TRANSMITTER SELECTOR: The transmitter selector switch takes the selected output of the TRANSMITTER INPUT SELECTOR and applies it to either the GRC-27 multichannel transmitter set or the GRT-3 single-channel transmitter set, both of which are provided for FDDL transmission. The TRANSMITTER SELECTOR switch also selects the sidetone output of the "in-use" transmitter for monitoring by one of the TDM units or for VU Meter measurement.

3.19.1.2 Monitoring Selection Function

The TDM SYSTEM SELECTOR switch allows the multiplexer (MUX) output of each FDDL group to be connected to the same group TDM (NORMAL) or to the other group TDM (REVERSED). In series with the TDM SYSTEM SELECTOR switch, the SIDETONE TO TDM SELECTOR switch permits either TDM to be disconnected from the multiplexer output and connected to monitor the transmitter sidetone output. With the switch in the OFF position there is MUX input to both TDMs. When the switch is put in the TDM-1 position, there is MUX input to the TDM-2 unit only, and the transmitter sidetone output is connected to TDM-1. The parallel effect is achieved in the TDM-2 position.

An adjustable attenuation pad is provided in the sidetone input circuit so that the level may be set for observation on the VU Meter.

3.19.1.3 Metering Function

A panel-mounted VU Meter and the associated METER FUNCTION switch provide a level measurement point. Monitoring, testing and recording jacks are provided for remote line observation.

3.20 POWER INDICATOR PANEL

The Power Indicator Panel (Fig. 3-30) is a basic rf carrier monitoring device. The unit is modified in this installation to provide interlocked remote actuation of the high-power transmission line coaxial switch. The power indicator panel is mounted in the OA-751 Control Rack and monitors the OA-751 unit excitation input which is provided by the local GRC-27 exciter unit or the TDDL equipment.

3.20.1 Theory of Operation

The voltage level derived from the rf sampling connection of a Micro Match coupler, inserted in the coaxial cable exciter input to the OA-751, is amplified to actuate a dc plate relay. When an rf level of driver amplitude is detected at the Micro Match, the plate relay closes and the CARRIER ON lamp on the panel is illuminated. Another plate relay contact opens the power supply circuit of the coaxial switch remote actuator, rendering the actuator circuit inoperative. This interlock prevents switching the 20-kw transmission line under load.

An actuator switch (SPDT, spring return to center) is provided on the front panel of the power indicator panel to select the OA-751 output loading. The actuator switch selects ANTENNA or DUMMY LOAD, and panel mounted indicating lamps provide local indication of the coaxial switch position. Since the Jennings Coaxial Switch solenoid actuators are designed for low duty-cycle operation, auxiliary relays are provided in the actuator circuitry to give momentary energization action.

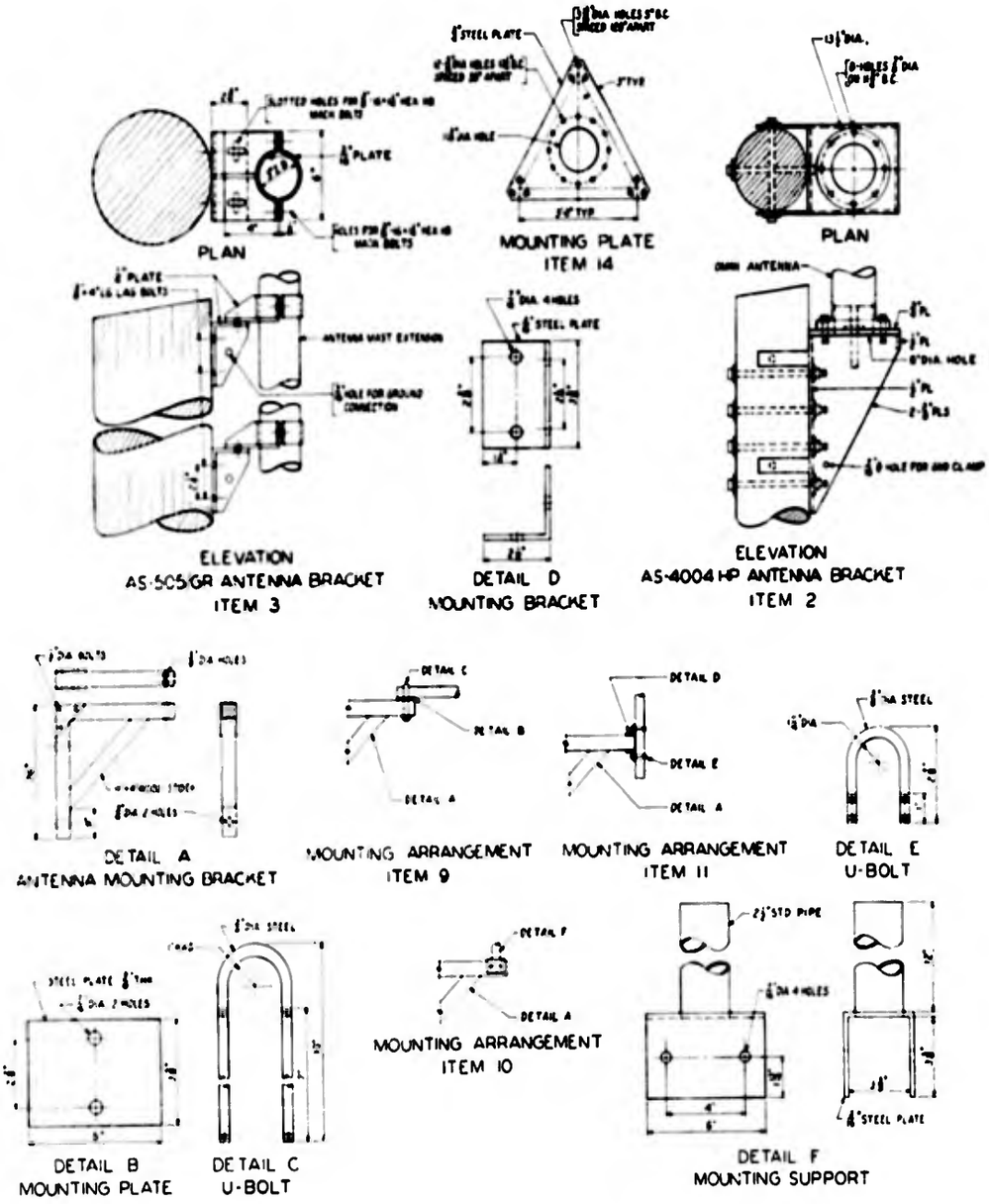


Fig. 3-1 Antenna mounting bracket details

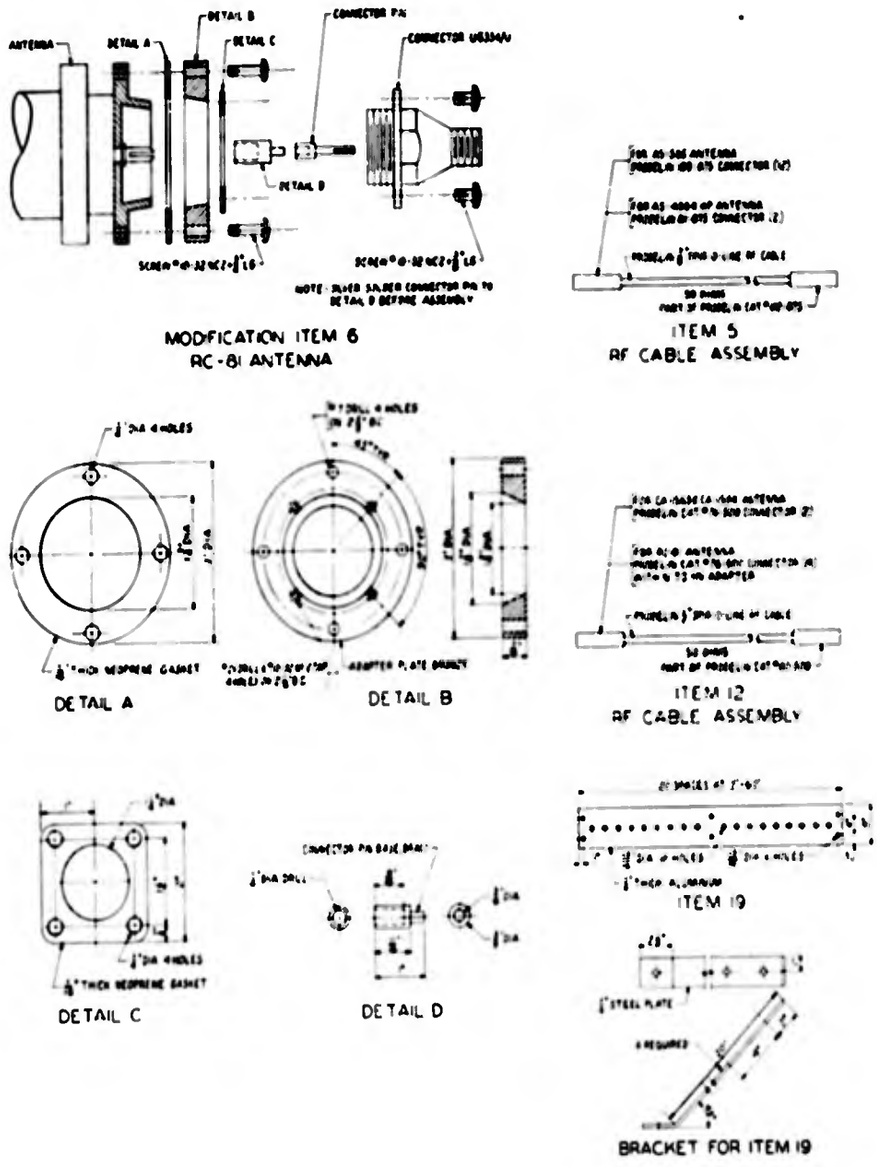
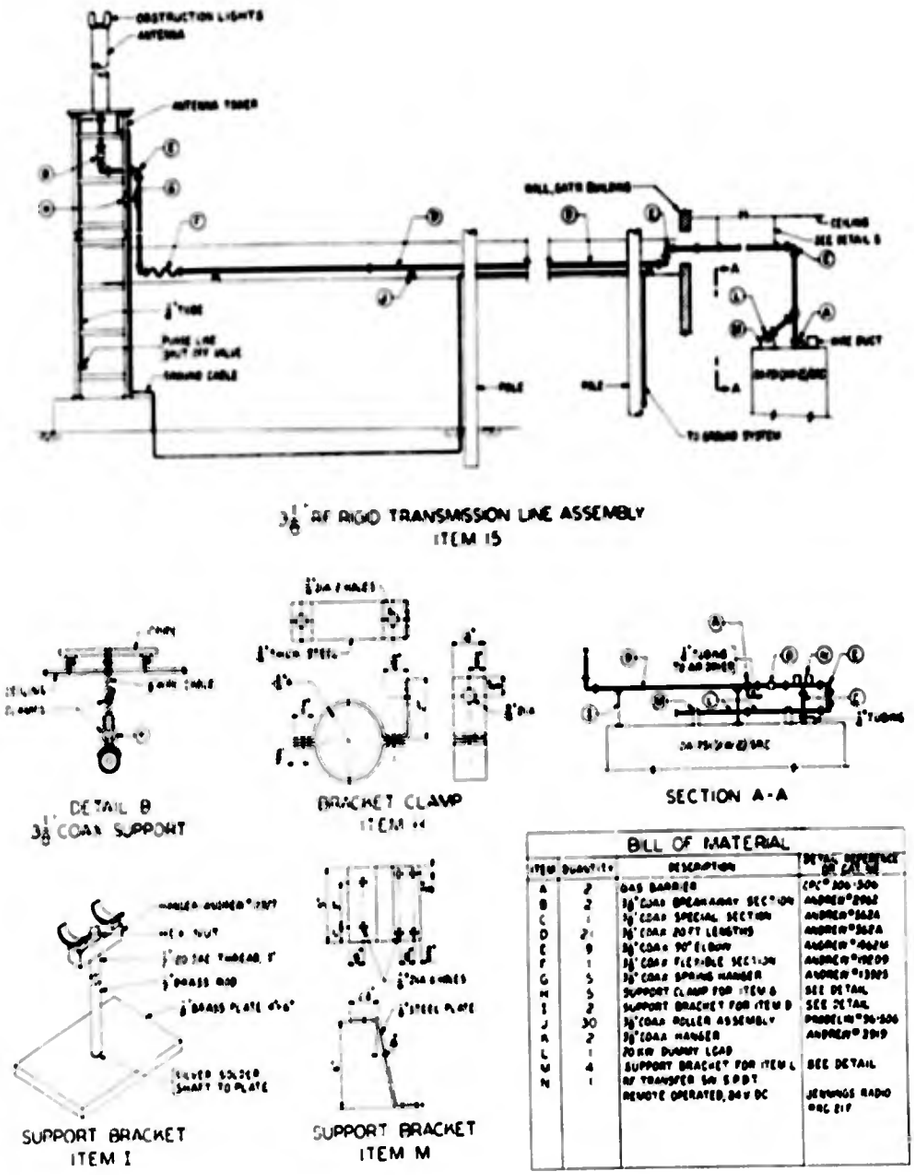


Fig. 3-2 Antenna transmission coaxial detail

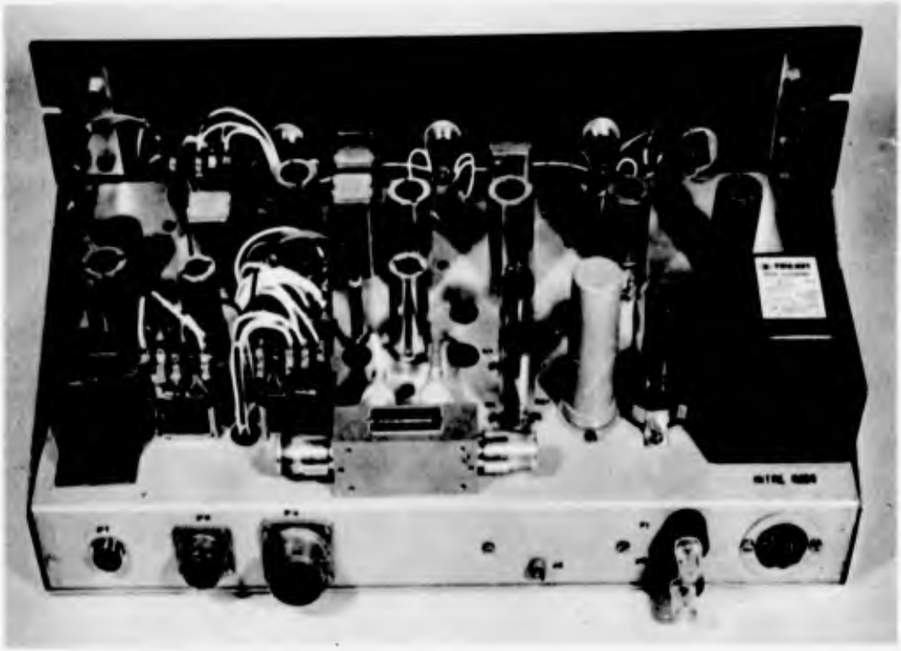


BILL OF MATERIAL

ITEM	QUANTITY	DESCRIPTION	DETAIL REFERENCE OR CAT. NO.
A	2	GAS BARRIER	CPC® 300-506
B	2	3⅛" COAX BREAKAWAY SECTION	ANDREW® 2982
C	1	3⅛" COAX SPECIAL SECTION	ANDREW® 2624
D	2/	3⅛" COAX 20 FT LENGTHS	ANDREW® 2624
E	9	3⅛" COAX 90° ELBOW	ANDREW® 4662A
F	1	3⅛" COAX FLEXIBLE SECTION	ANDREW® 19209
G	5	3⅛" COAX SPRING HANGER	ANDREW® 13095
H	5	SUPPORT CLAMP FOR ITEM B	SEE DETAIL
I	2	SUPPORT BRACKET FOR ITEM B	SEE DETAIL
J	30	3⅛" COAX ROLLER ASSEMBLY	PROBELL® 96-506
K	2	3⅛" COAX HANGER	ANDREW® 2949
L	1	70 KW DUMMY LOAD	
M	4	SUPPORT BRACKET FOR ITEM L	SEE DETAIL
N	1	RF TRANSFER SW SPDT REMOTE OPERATED, 24 V DC	JENNINGS RADIO CRC 217

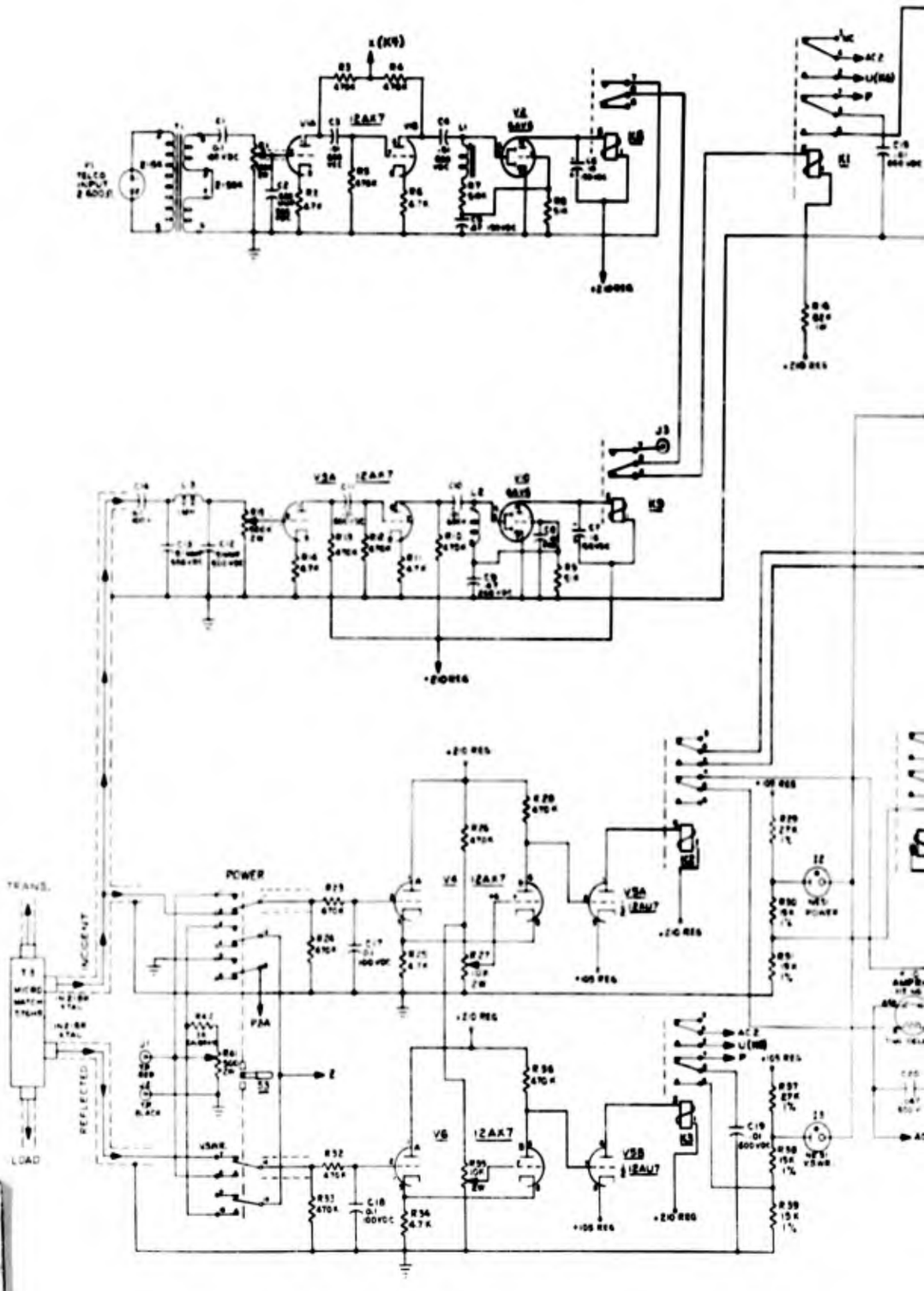
Fig. 3-3 High power omni antenna transmission line details

Front view



Rear view

Fig. 3-4 Transmitter monitor alarm



1

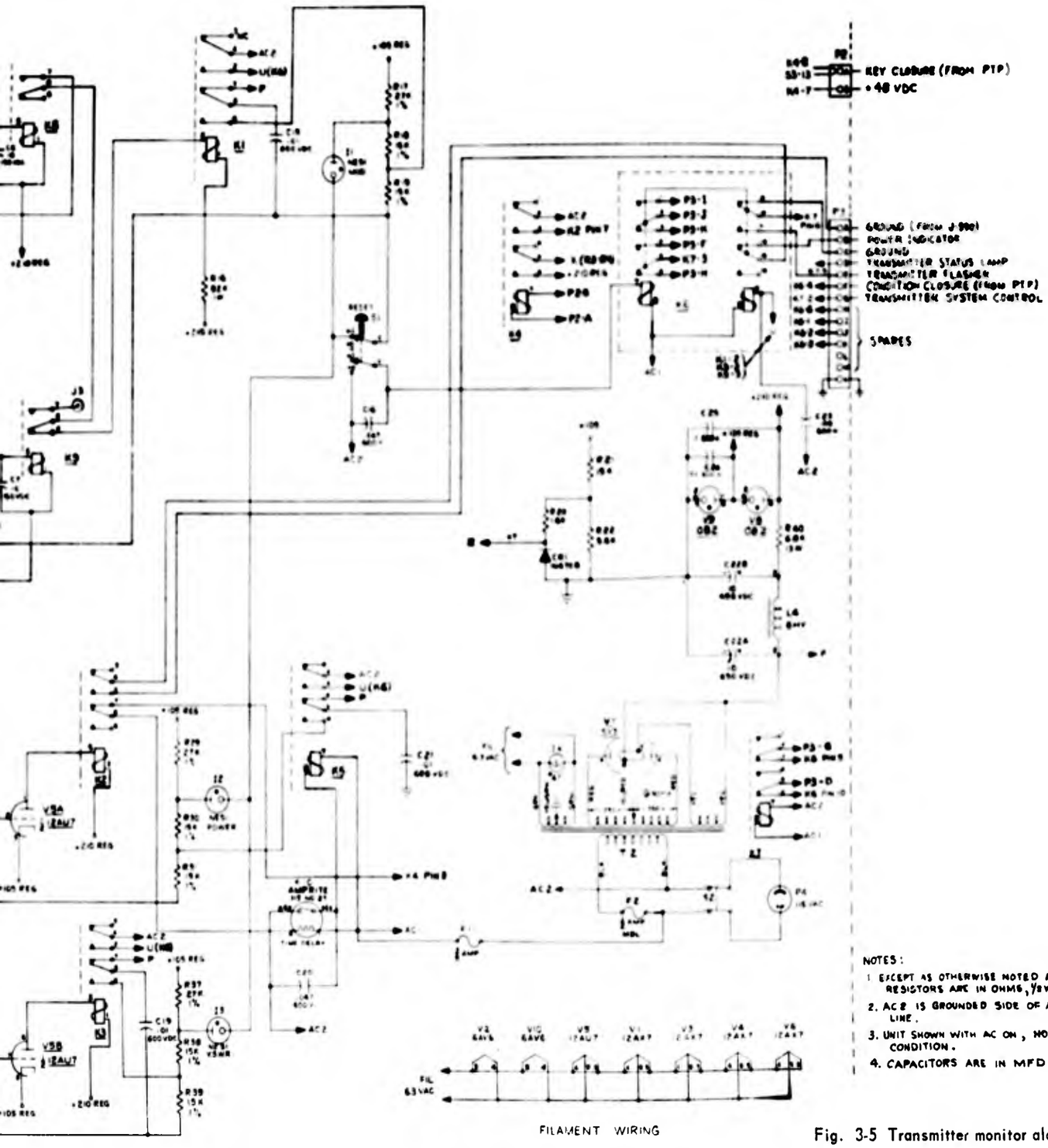
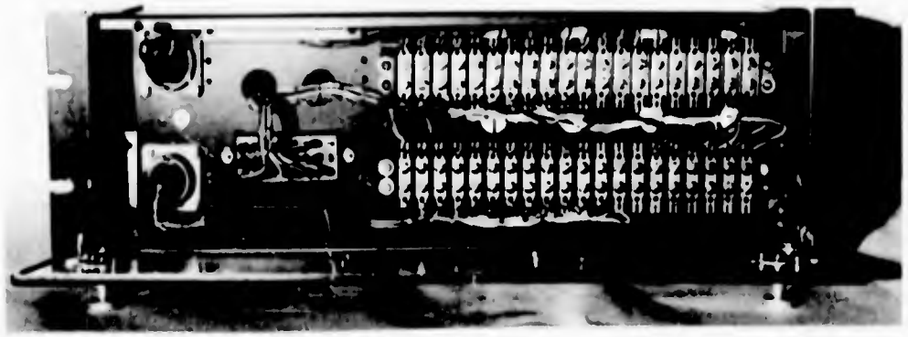


Fig. 3-5 Transmitter monitor alarm schematic

Front view



Rear view

Fig. 3-6 Modification to J-390/GR distribution panel

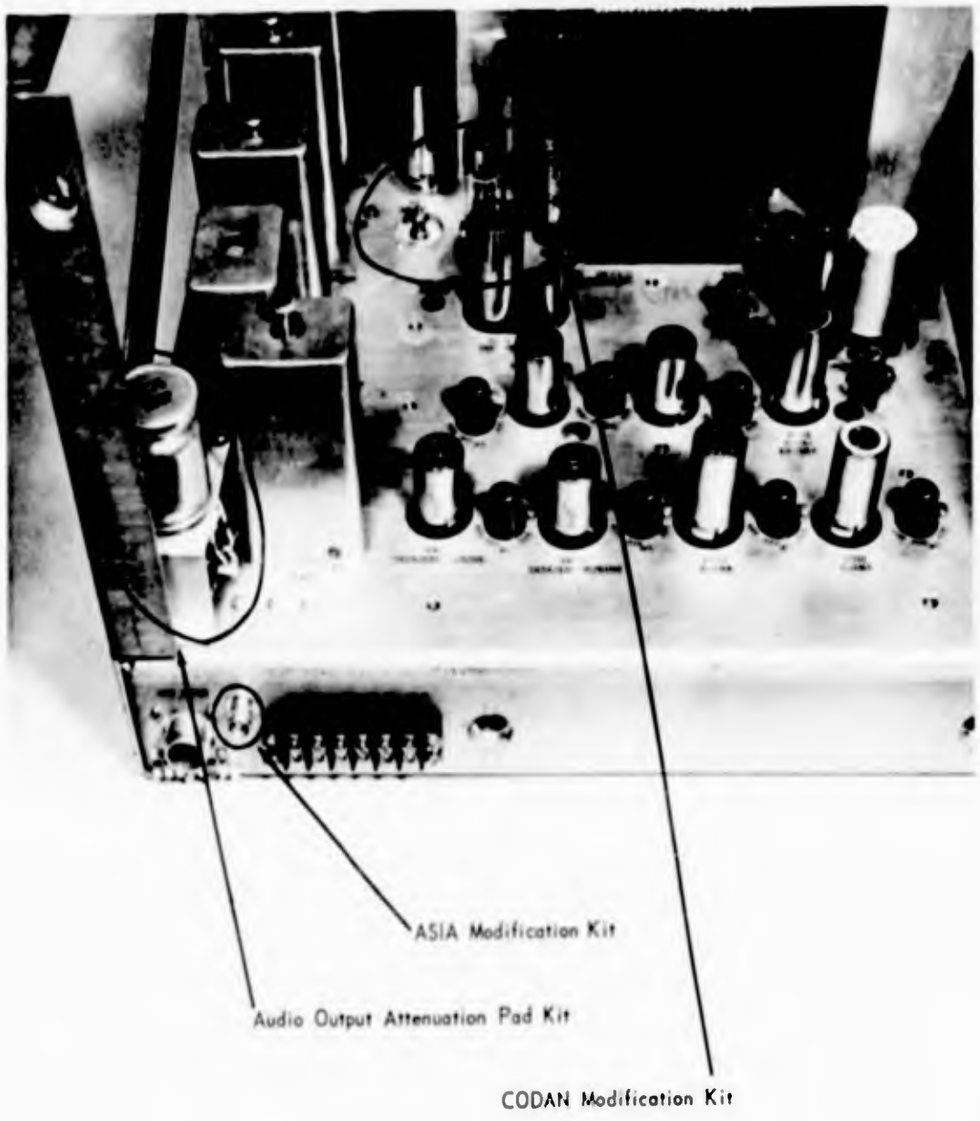
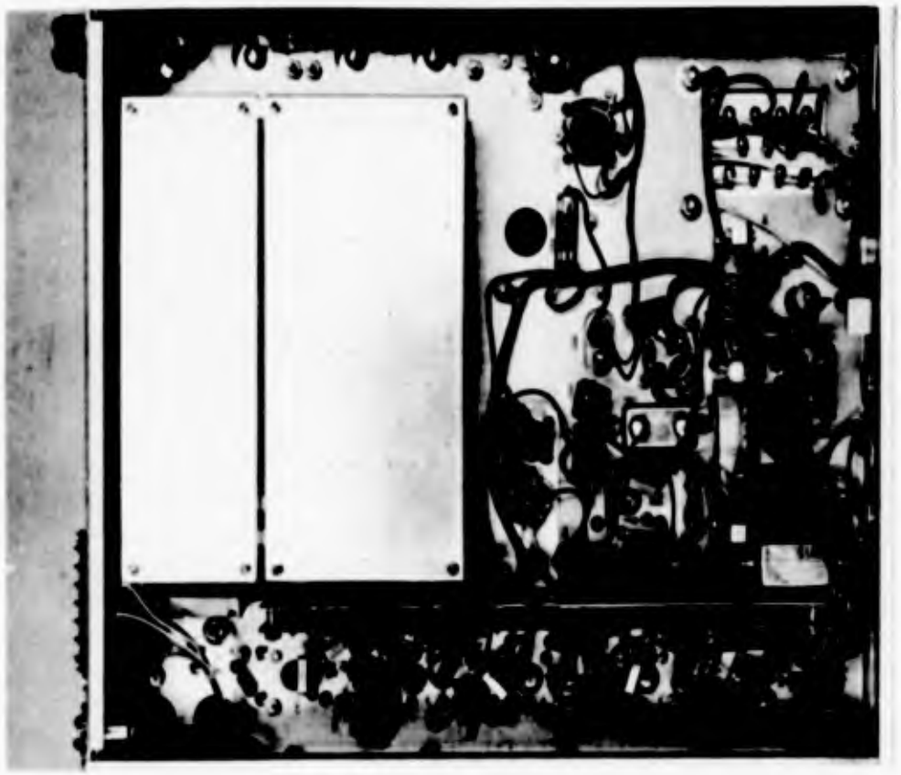


Fig. 3-7 Modifications to receiver R-361 ( )/GR



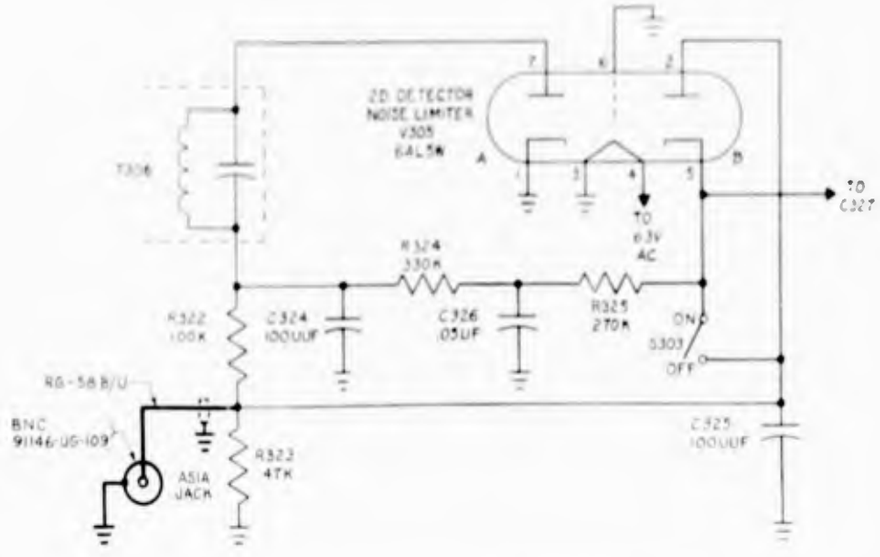
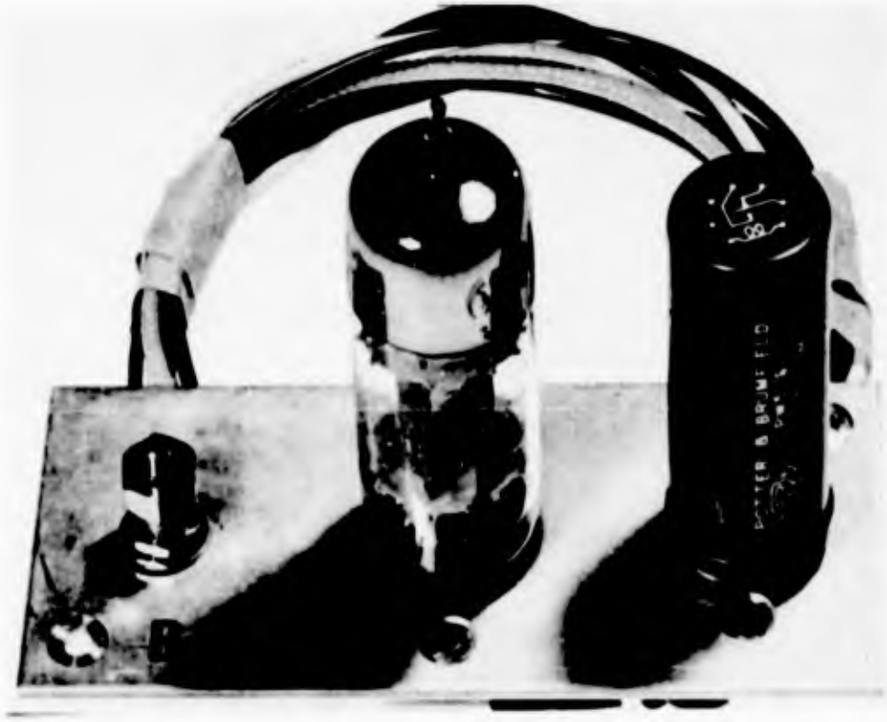


Fig. 3-8 ASIA modification to Receiver R-361 ( ) /GR



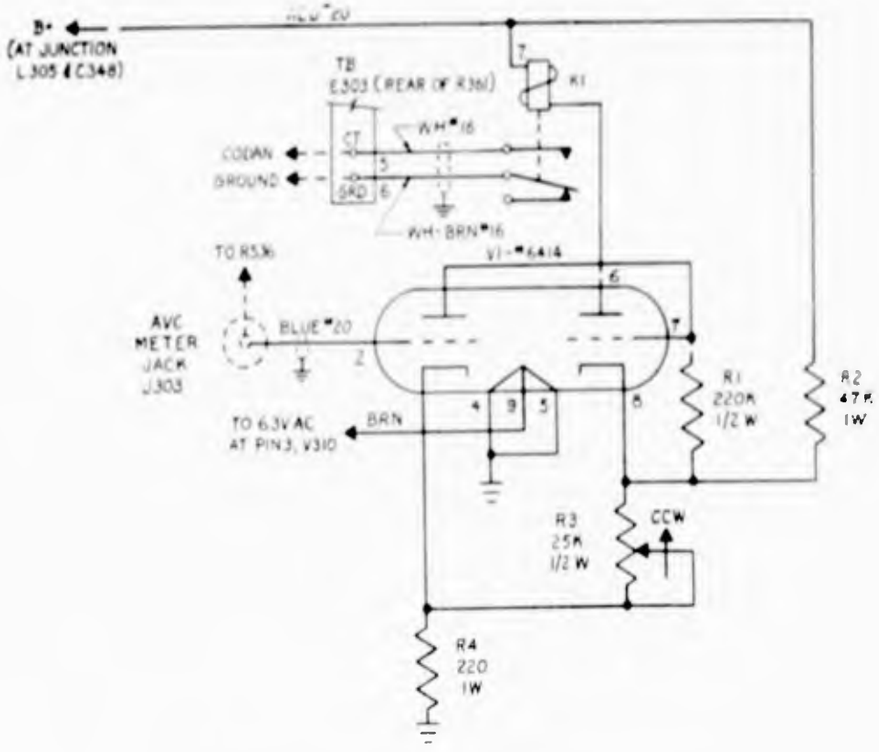
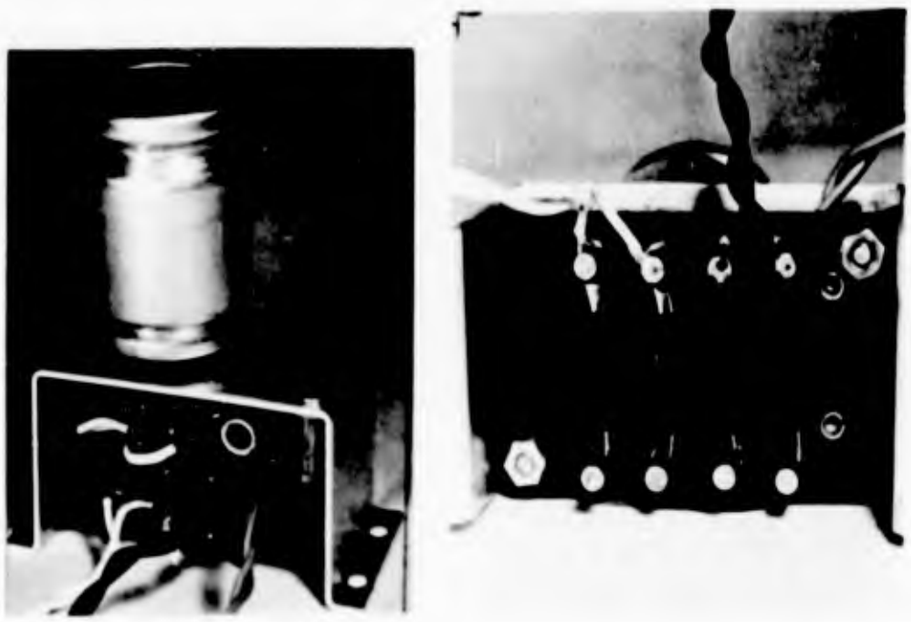


Fig. 3-9 CODAN modification to Receiver R-361 ( ) /GR



Attenuation pad kit

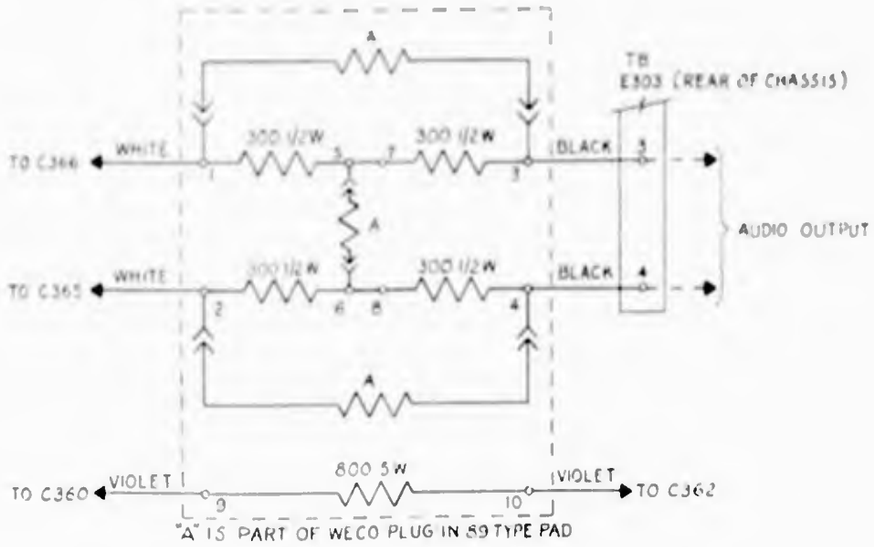
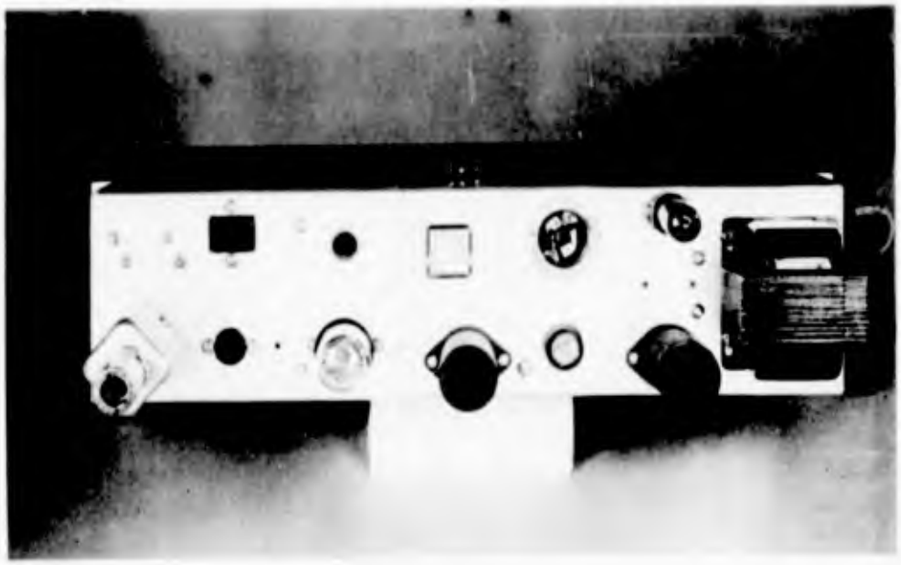


Fig. 3-10 Audio output attenuation modification to Receiver R-361

Front view



Rear view

Fig. 3-11 Automatic sensitivity indicator alarm

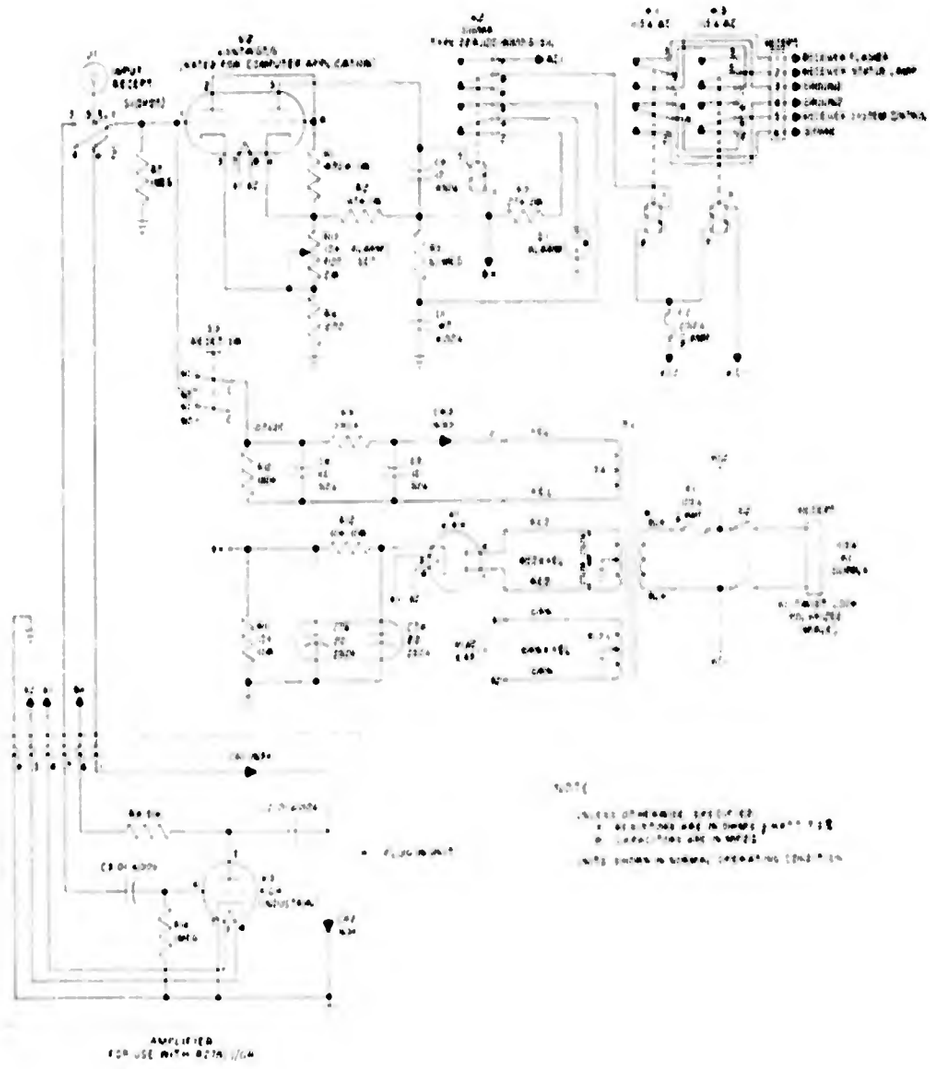


Fig. 3-12 Automatic sensitivity indicator alarm schematic

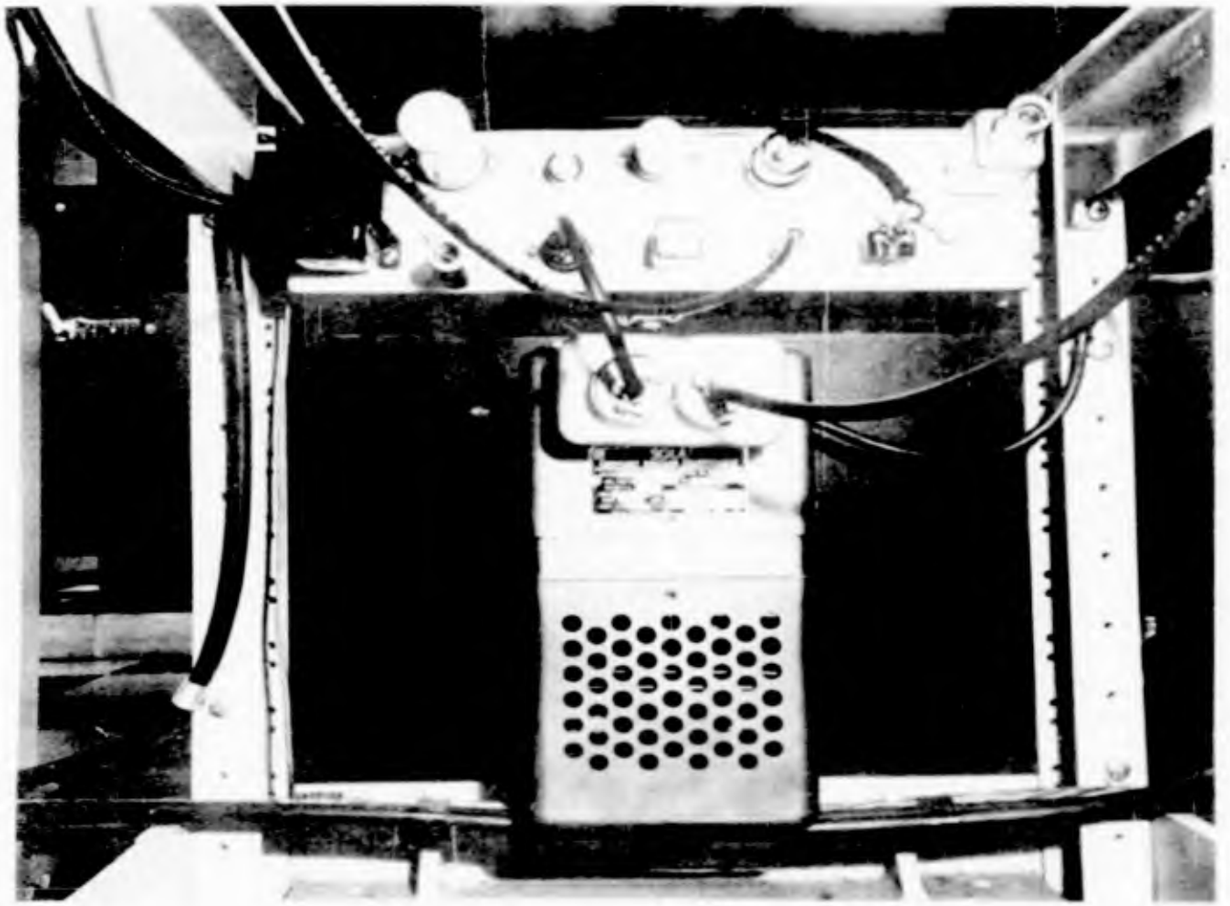


Fig. 3-13 Voltage regulator mounting detail

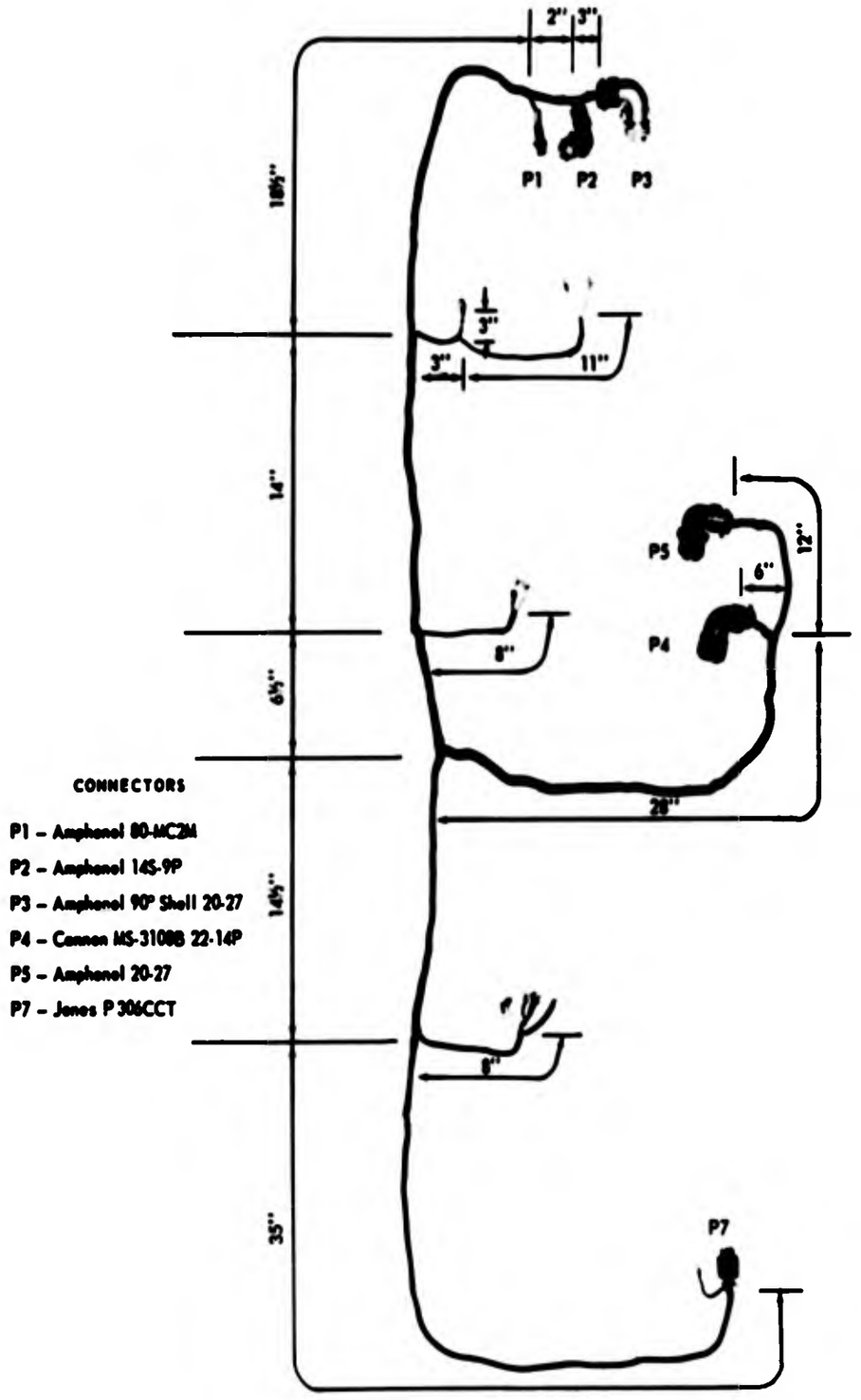


Fig. 3-14 SAGE UHF single – channel rack harness assembly
Lexington Field Station GATR – ESS Installation

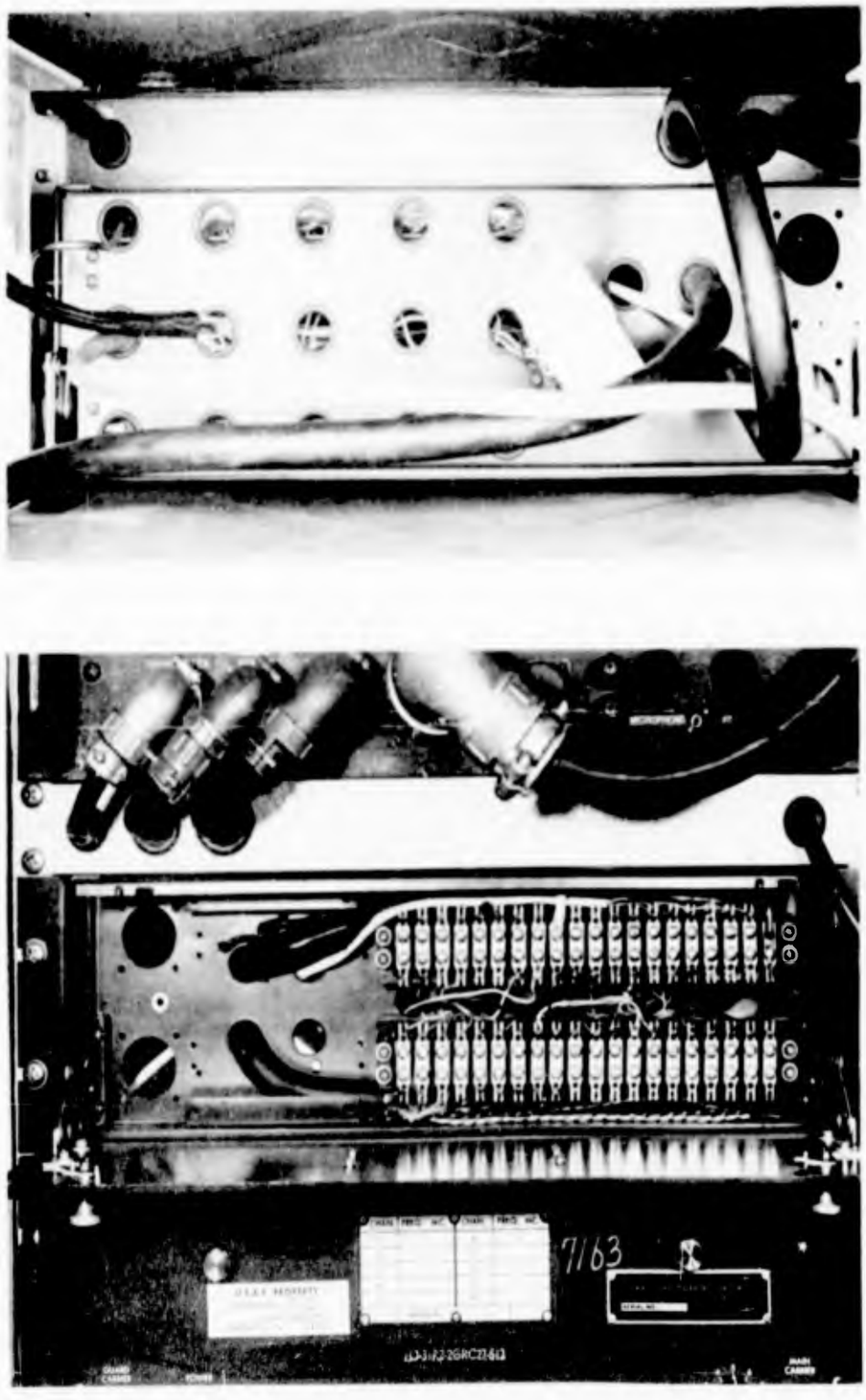
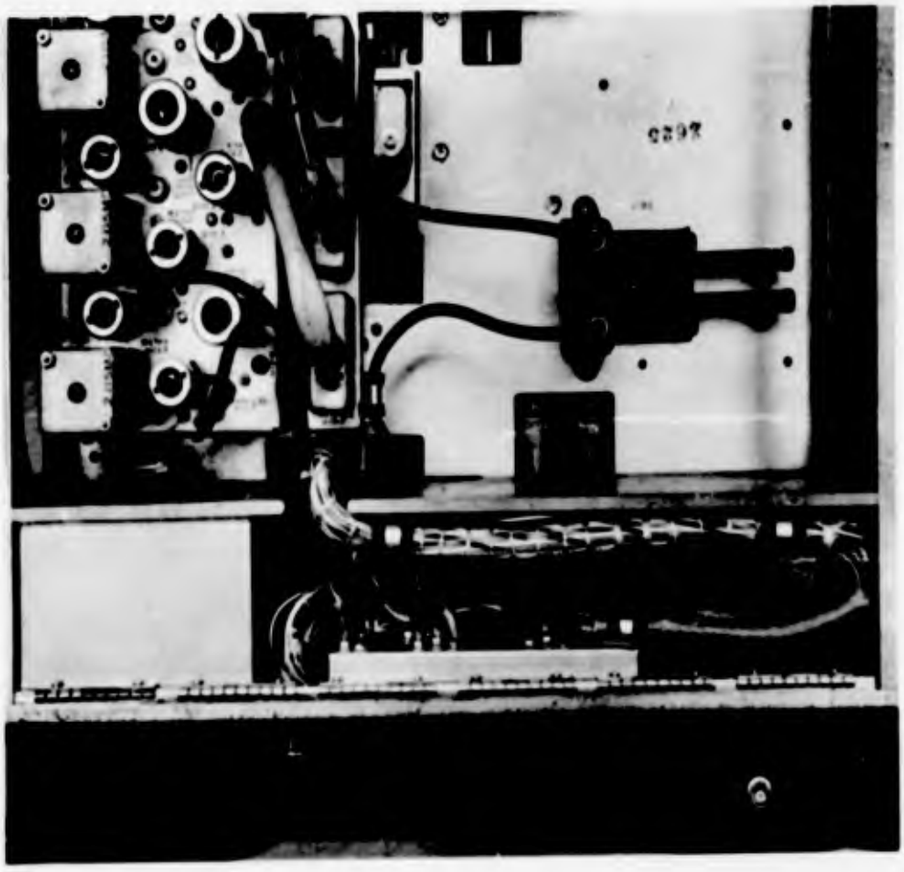


Fig. 3-15 Modification to J-390 GR distribution panel



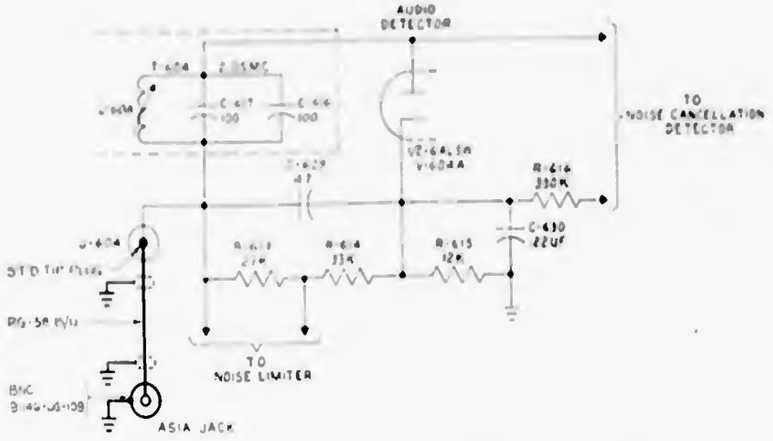
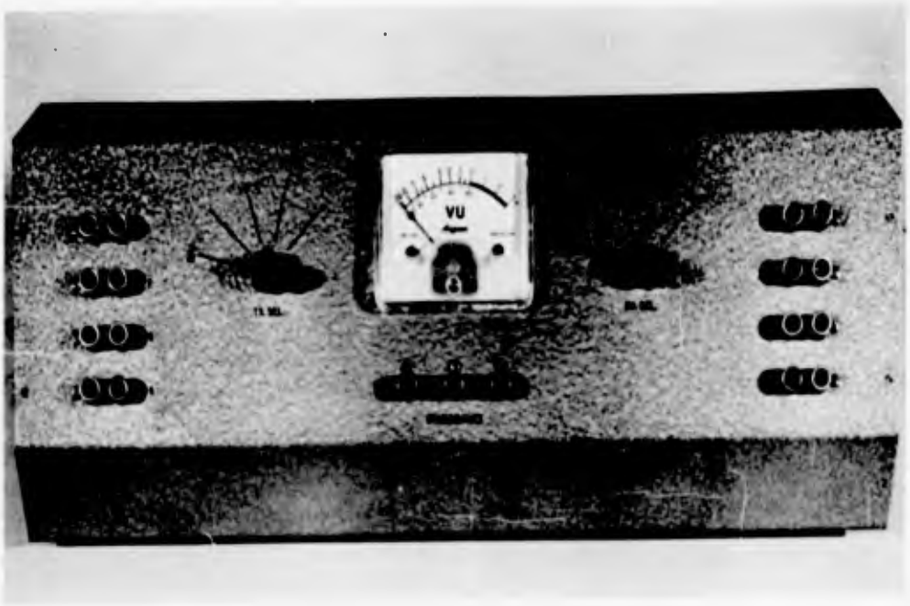


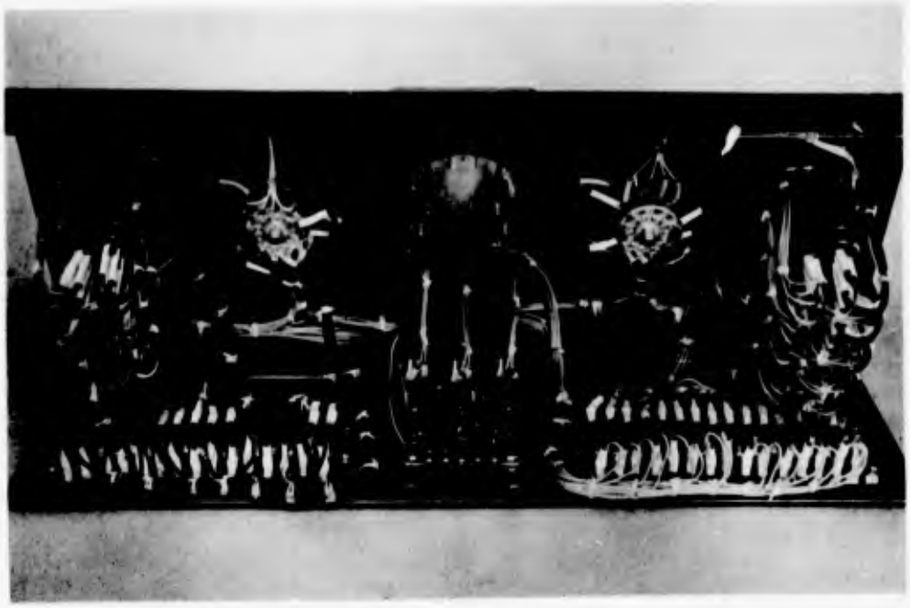
Fig. 3-16 ASIA modification to Receiver R-278( )/GR

Physical modification

Schematic diagram

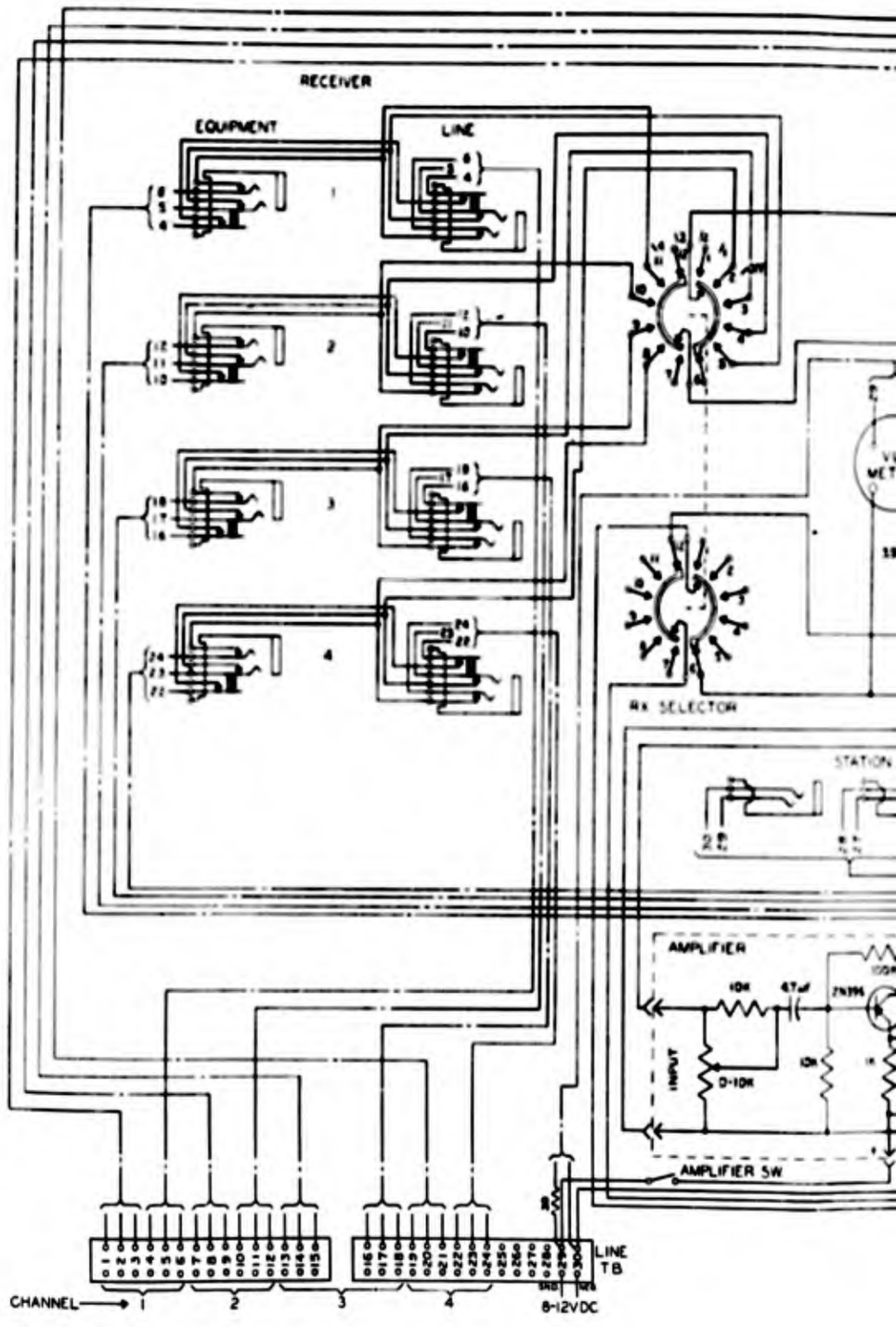


Front view

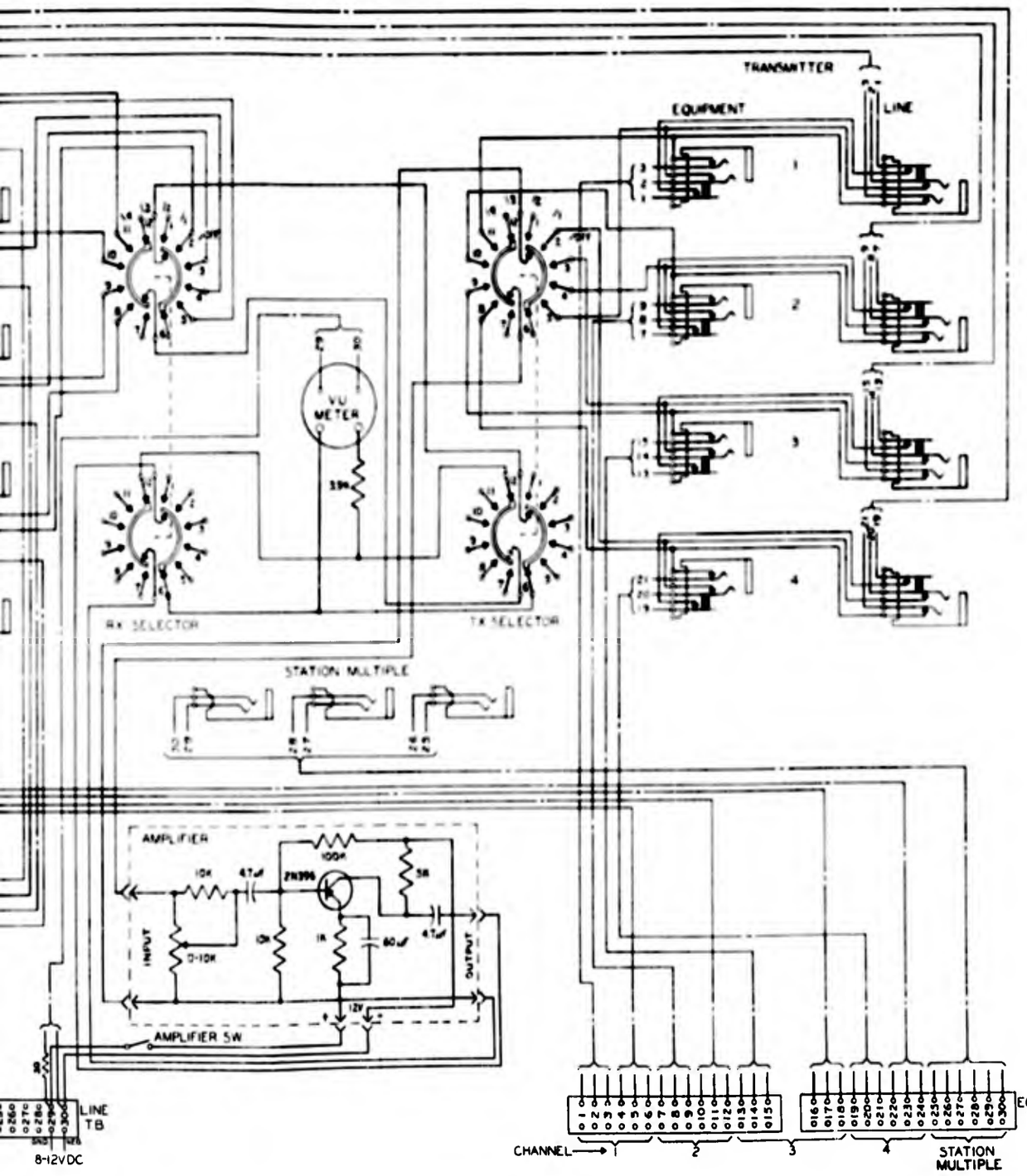


Rear view

Fig. 3-17 Audio meter panel


RECEIVER
EQUIPMENT
LINE
Rx SELECTOR
AMPLIFIER
10K
4.7uF
2N396
INPUT
0-10K
AMPLIFIER SW
LINE TB
CHANNEL
1
2
3
4
8-12VDC

1



2

Fig. 3-18 Audio meter panel schematic

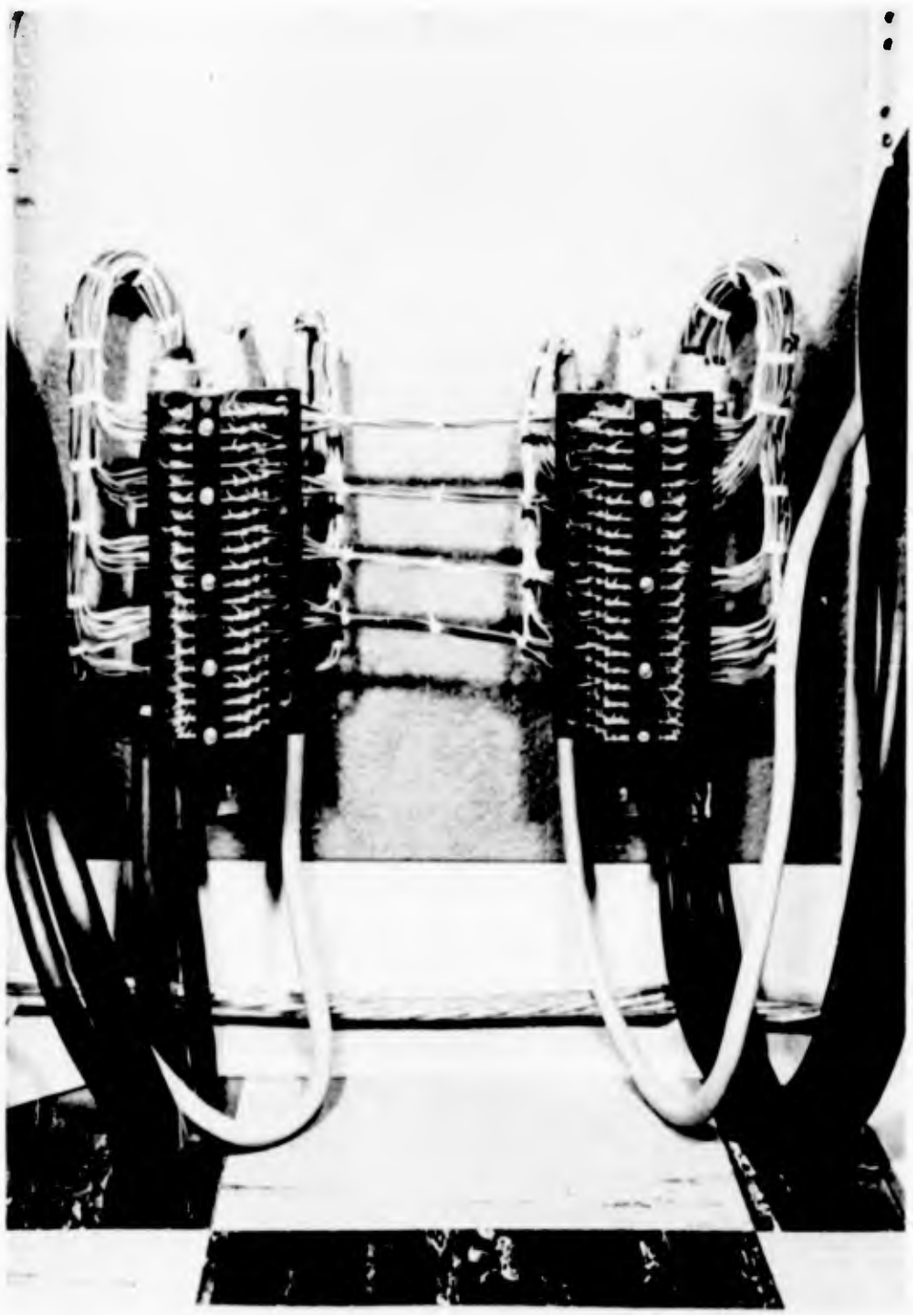


Fig. 3-19 Module termination panel

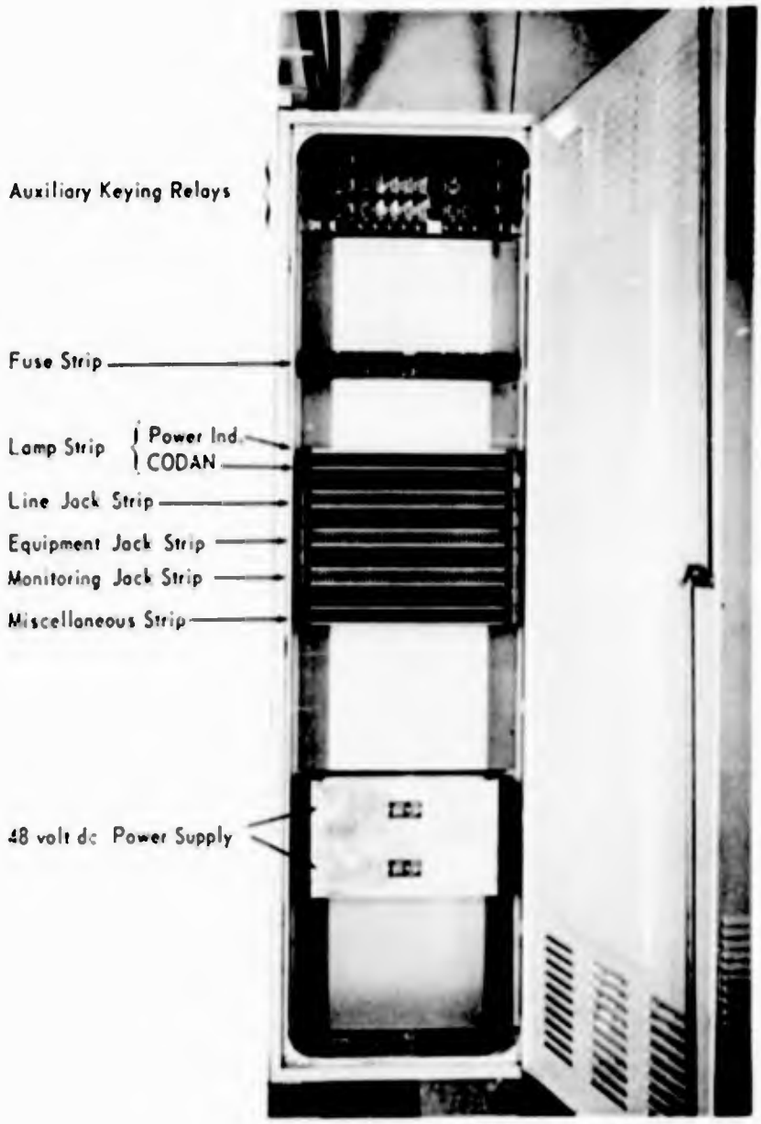
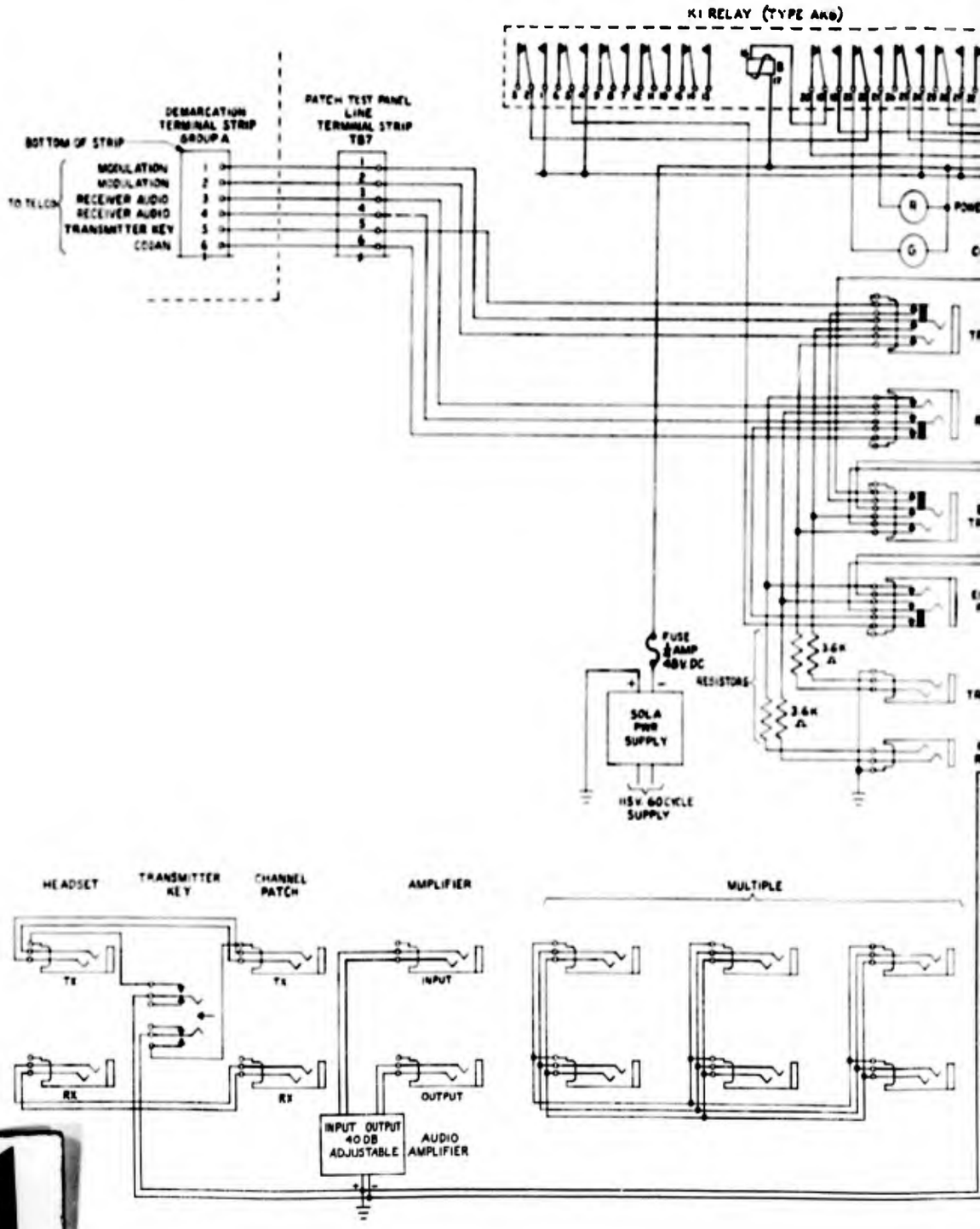
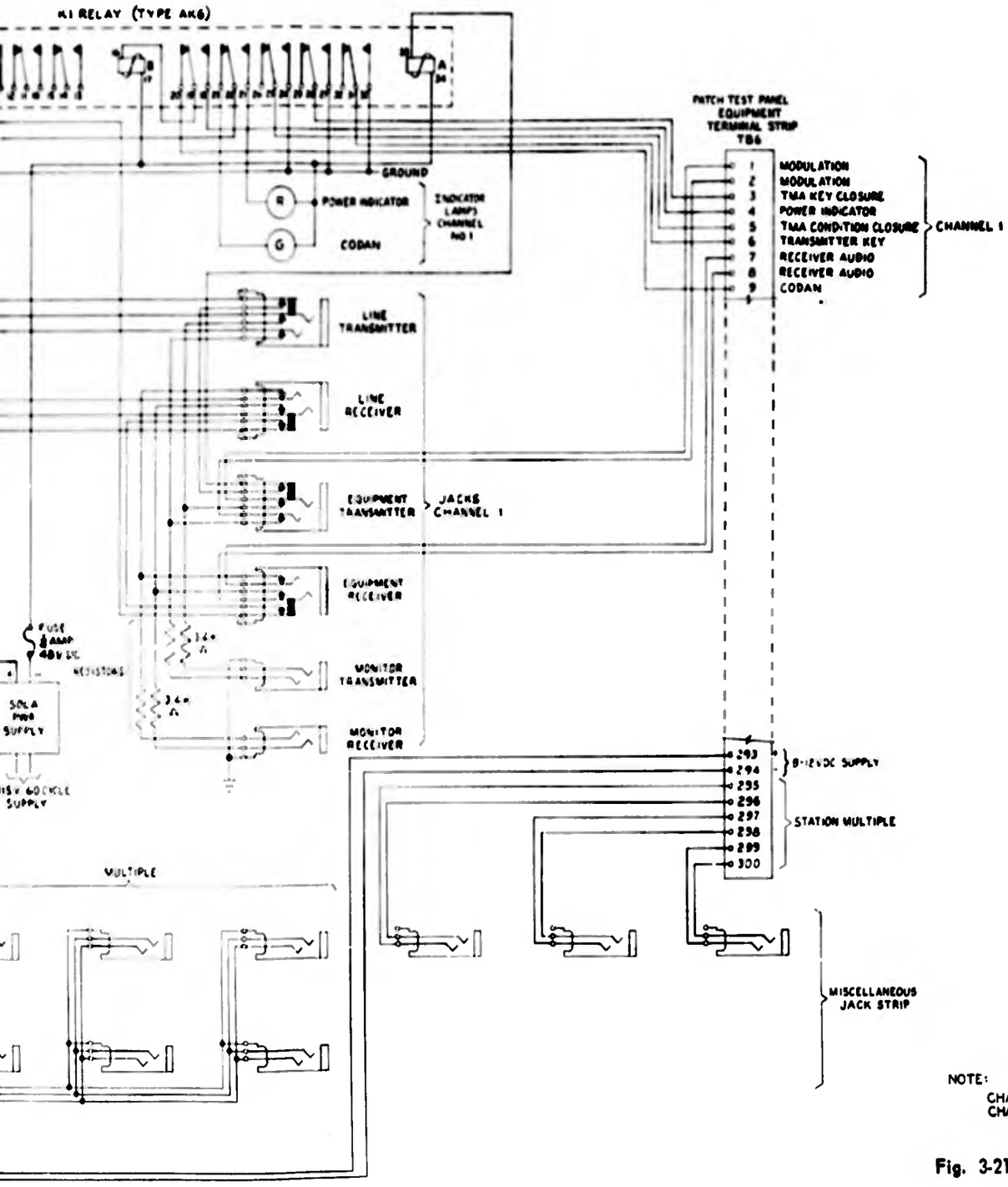


Fig. 3-20 Patch test panel


K1 RELAY (TYPE AK8)
DEMARCATION TERMINAL STRIP GROUP A
PATCH TEST PANEL LINE TERMINAL STRIP TB7
BOTTOM OF STRIP
MODULATION
MODULATION
RECEIVER AUDIO
RECEIVER AUDIO
TRANSMITTER KEY
COMM
TO TELCO
FUSE 1 AMP 48 V DC
RESISTORS
3.6K Ω
3.6K Ω
SOLA PWR SUPPLY
115 V. 60 CYCLE SUPPLY
HEADSET
TRANSMITTER KEY
CHANNEL PATCH
AMPLIFIER
MULTIPLE
TX
RX
TX
RX
INPUT
OUTPUT
INPUT OUTPUT 40 DB ADJUSTABLE
AUDIO AMPLIFIER

1



2

NOTE:
CHANNEL NO1 IS SHOWN. ALL OTHER CHANNELS ARE SIMILAR.

Fig. 3-21 Patch test panel schematic

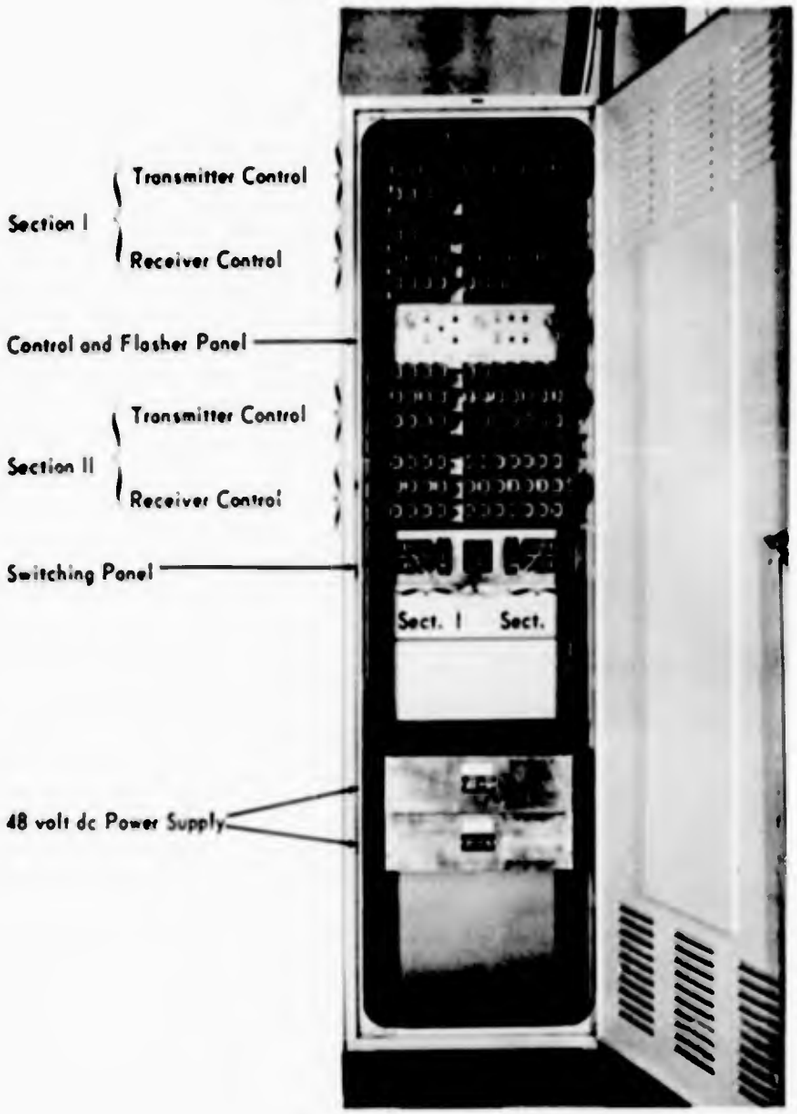
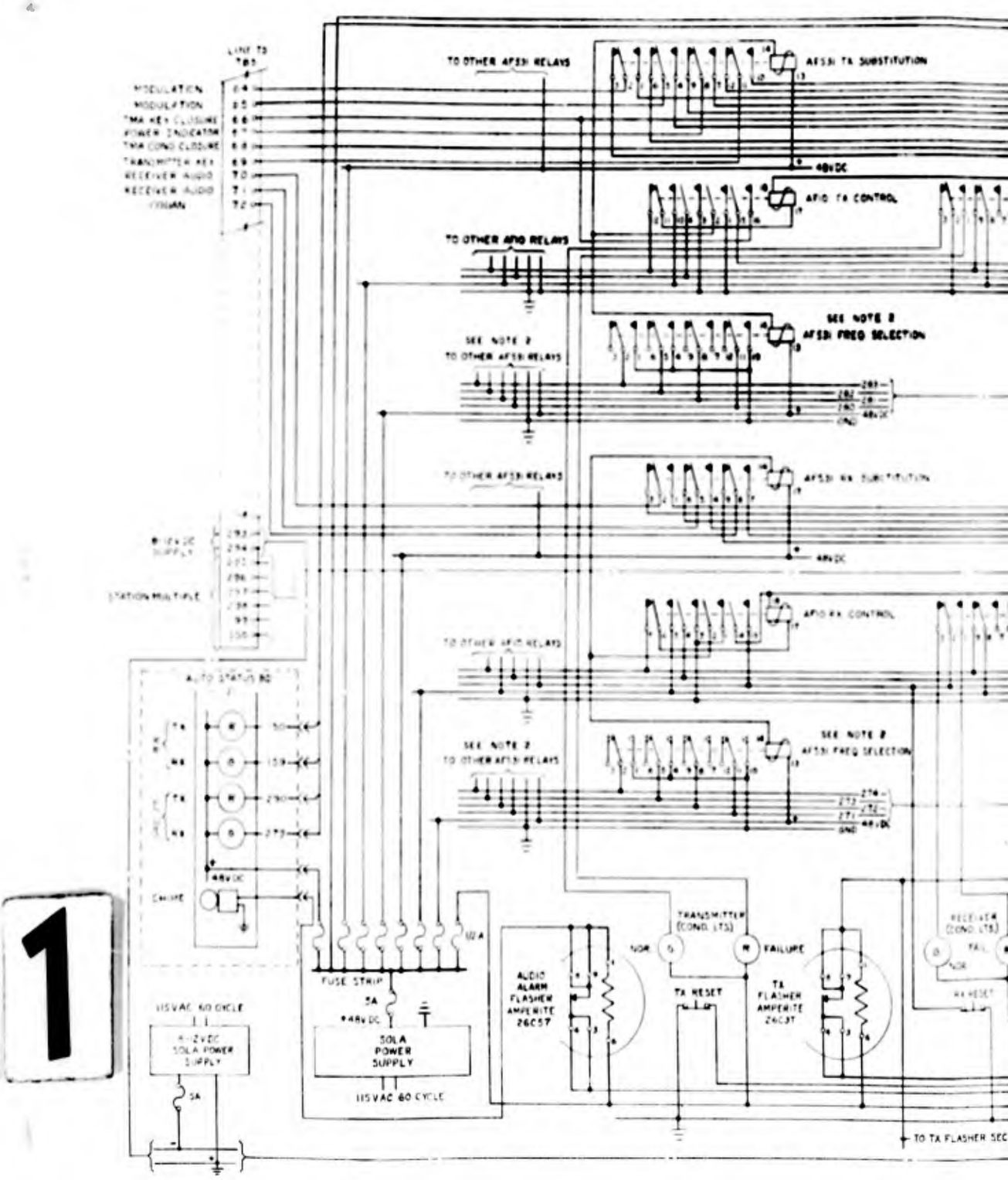


Fig. 3-22 Spare substitution device


TO OTHER AFSSI RELAYS
AFSSI TX SUBSTITUTION
48VDC
AFIO TX CONTROL
TO OTHER AFIO RELAYS
SEE NOTE 2
AFSSI FREQ SELECTION
SEE NOTE 2
TO OTHER AFSSI RELAYS
AFSSI RX SUBSTITUTION
AFIO RX CONTROL
AUTO STATUS BD
FUSE STRIP
5A
SOLA POWER SUPPLY
115VAC 60 CYCLE
AUDIO ALARM FLASHER AMPERITE 26C57
TRANSMITTER (COND. LTS)
FAILURE
TX RESET
TX FLASHER AMPERITE 26C37
RECEIVER (COND. LTS)
RX RESET
TO TX FLASHER SEC

1

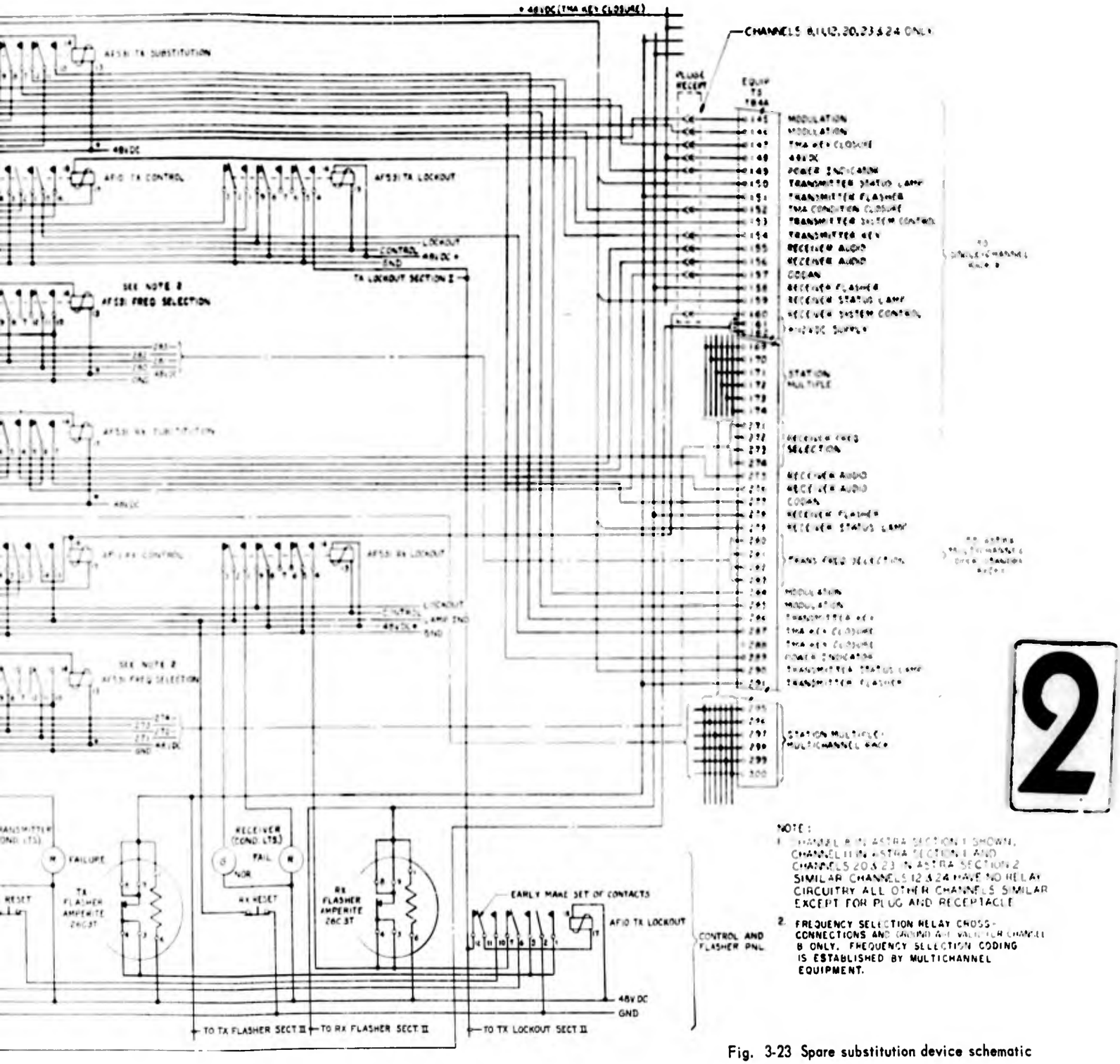


Fig. 3-23 Spare substitution device schematic

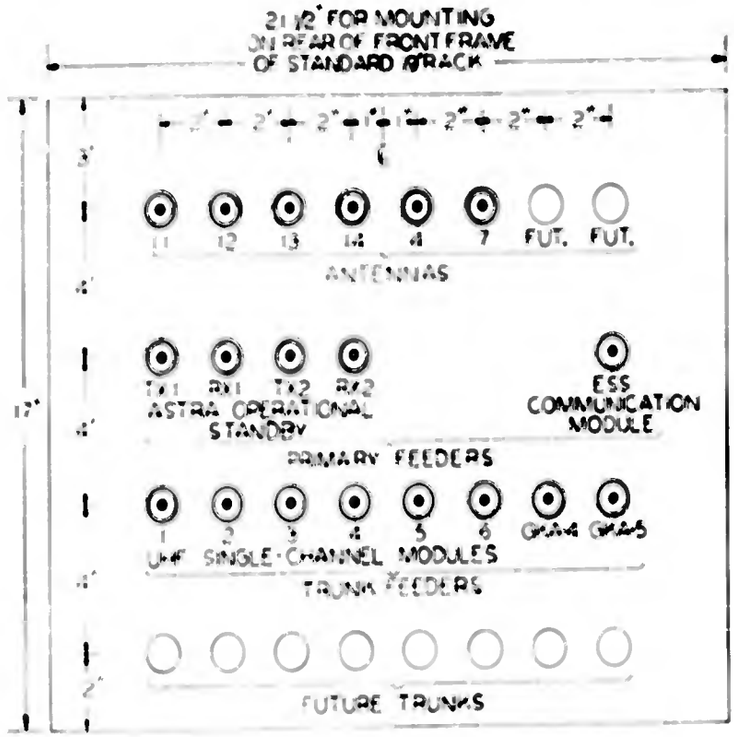


Fig. 3-24 Antenna transfer panel (front view)

Modifications to internal wiring of T-336C vhf transmitter for operation in the SAGE System.

a. Remove wire from #3 of T101 to K101.

b. Remove wire from #1 of T101 to C133.

c. Remove wire from #4 of T101 to C130.

d. Connect jumper wire from #2 of T101 to #3 of T101.

e. Remove jumper wire from #5 of E502 to #10 of E502.

f. Remove wire from #3 of T101 to C101.

g. Remove wire from #3 of T101 to junction of C128 and K101.

h. Connect wire from junction of C128 and K101 to pin #9 of J101.

i. Remove and tape lead from the center contacts of S405.

j. Remove and tape lead from the outside contacts of S405.

k. Connect wire from two outside contacts of S405 to chassis ground.

l. Connect wire from pin #9 of P401 to pin #16 of P403.

m. Connect wire from center contact of S405 to pin #16 of P403.

n. Connect wire from pin #16 of J501 to #5 of E502. (This wire should run in existing cable harness from J501 to E502.)

o. Mount a male ac socket on left side of transmitter terminal box.

p. Connect two wires from ac socket to #17 and #18 of E501.

q. Mount a four-pin Amphenol panel-socket on right side of transmitter terminal box.

r. Connect four wires from Amphenol socket to E502 as follows:

pin A to terminal #5
pin B to terminal #8
pin C to terminal #6
pin D to terminal #10

Fig. 3-25 Modifications to internal wiring T-336

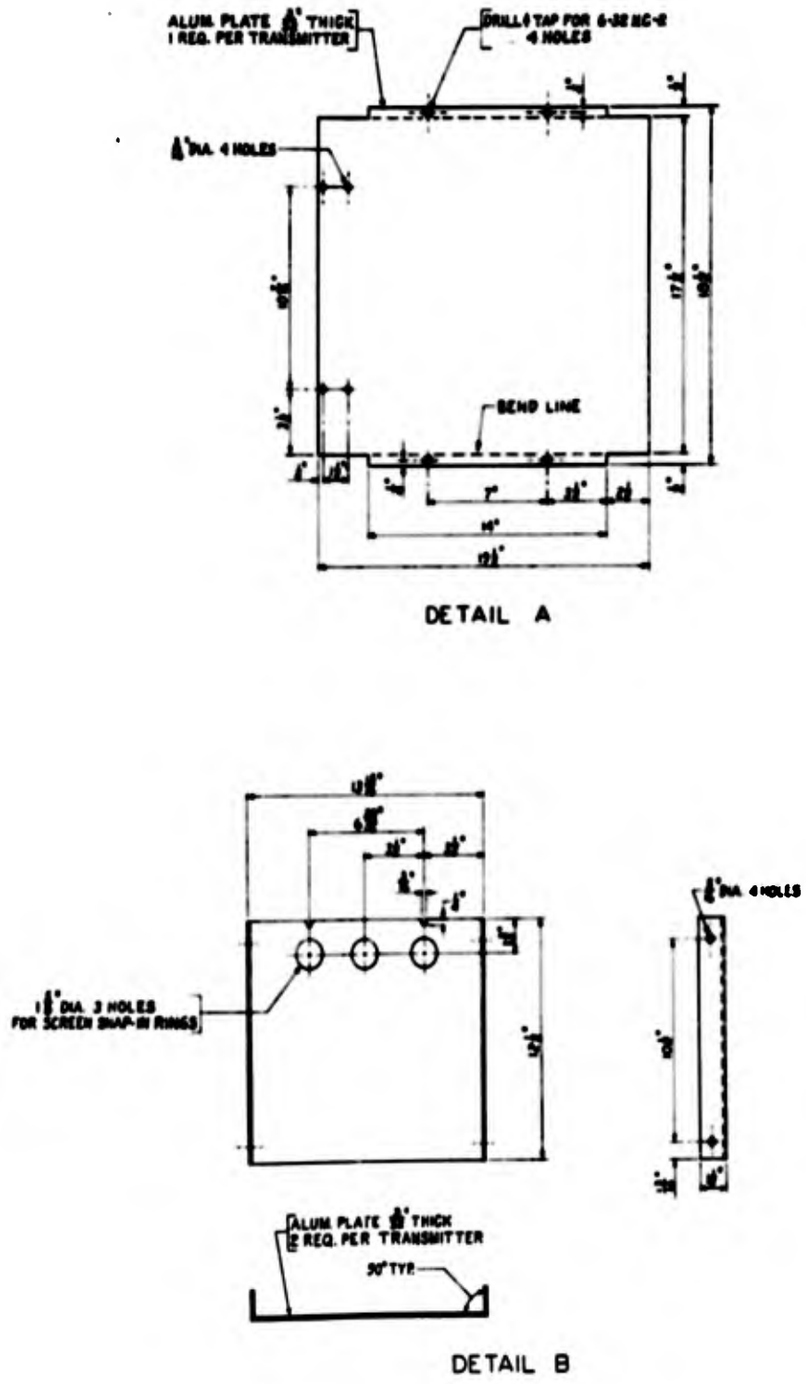


Fig. 3-26 Radio transmitter (T – 336) equipment protection plates

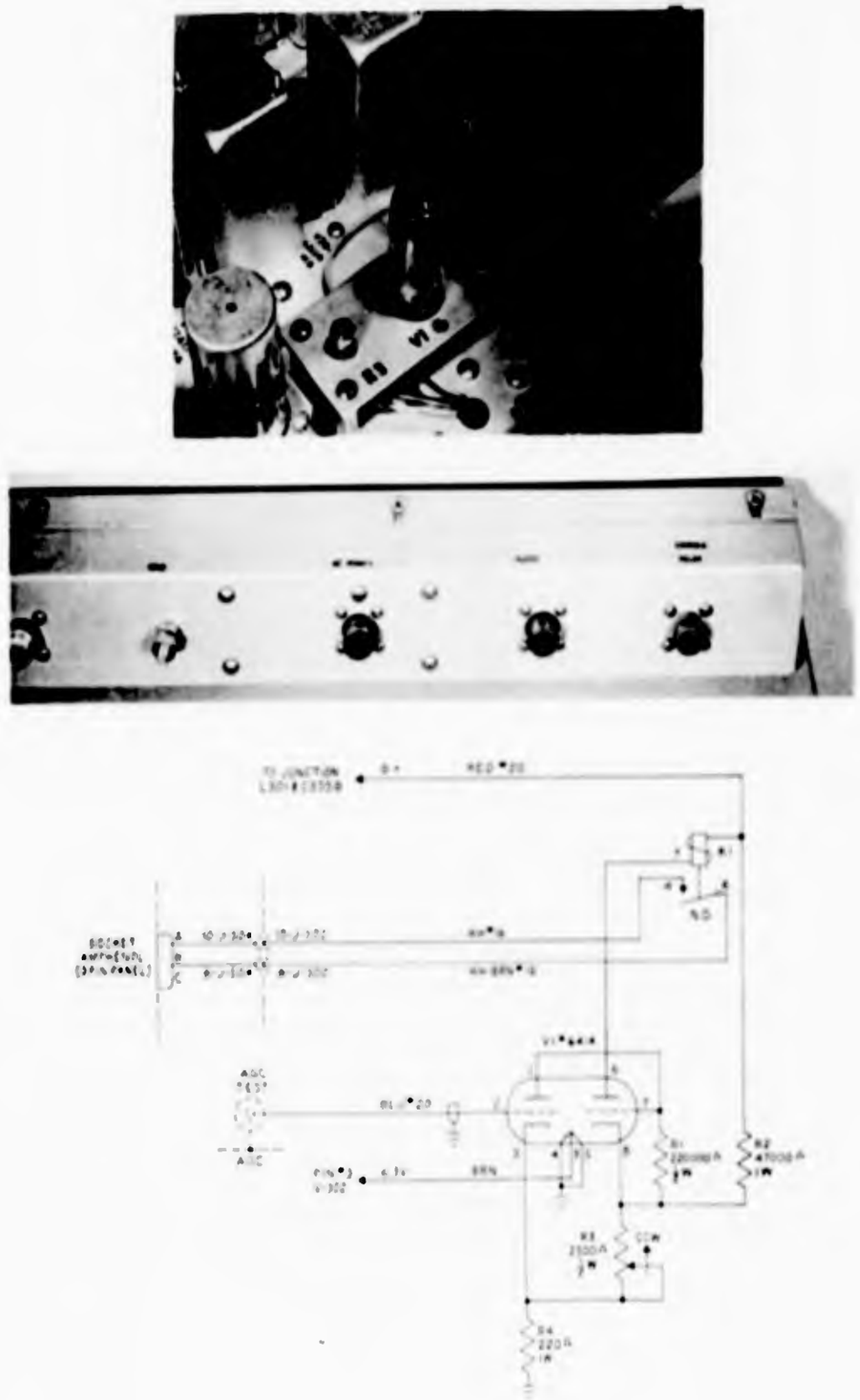


Fig. 3-27 CODAN modification kit mounting detail

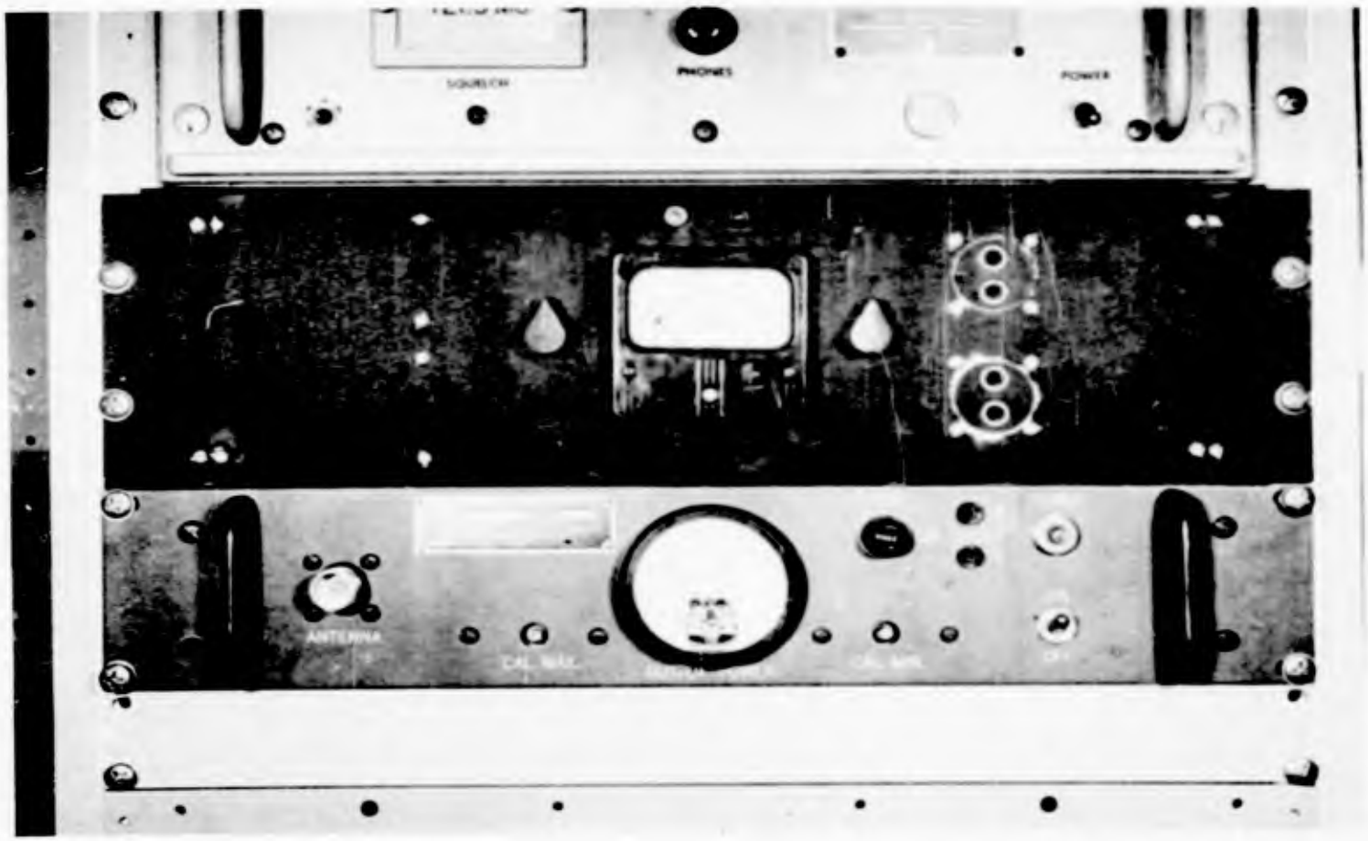


Fig. 3-28 VHF audio output and meter panel

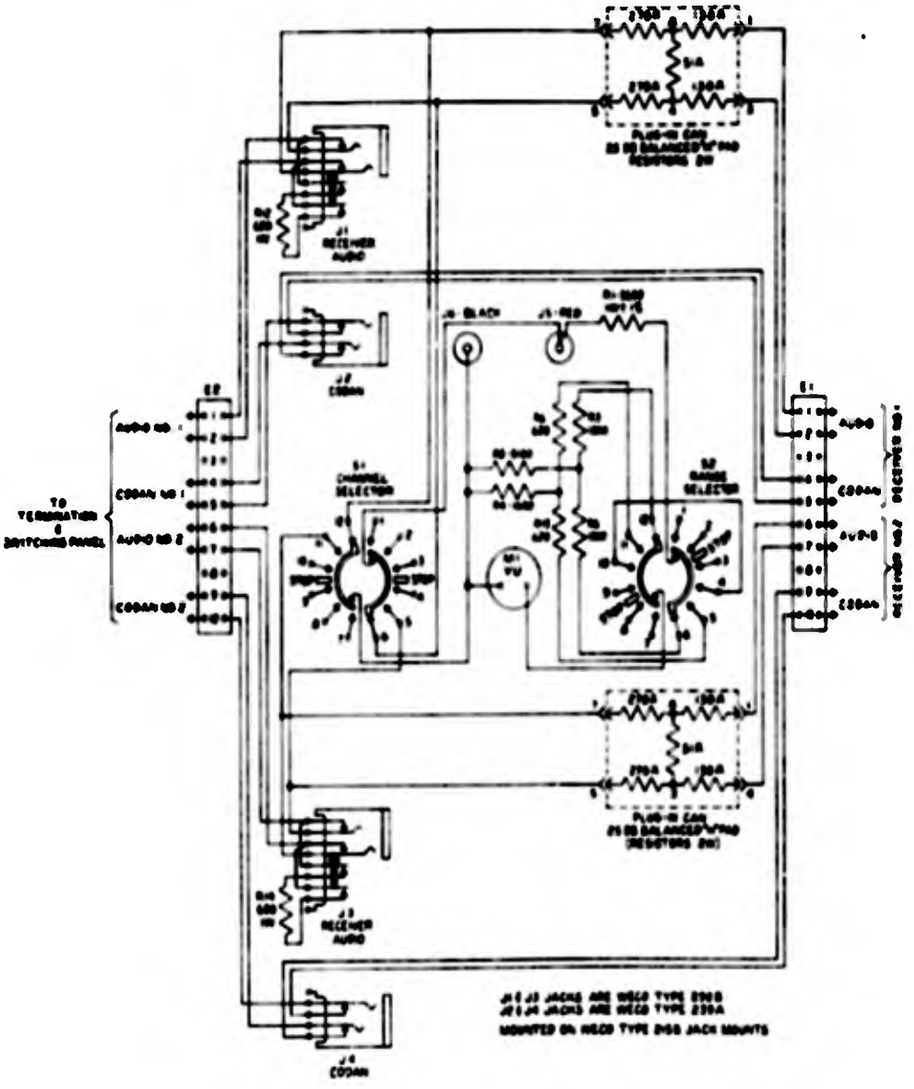


Fig. 3-29 VHF audio output and meter panel schematic

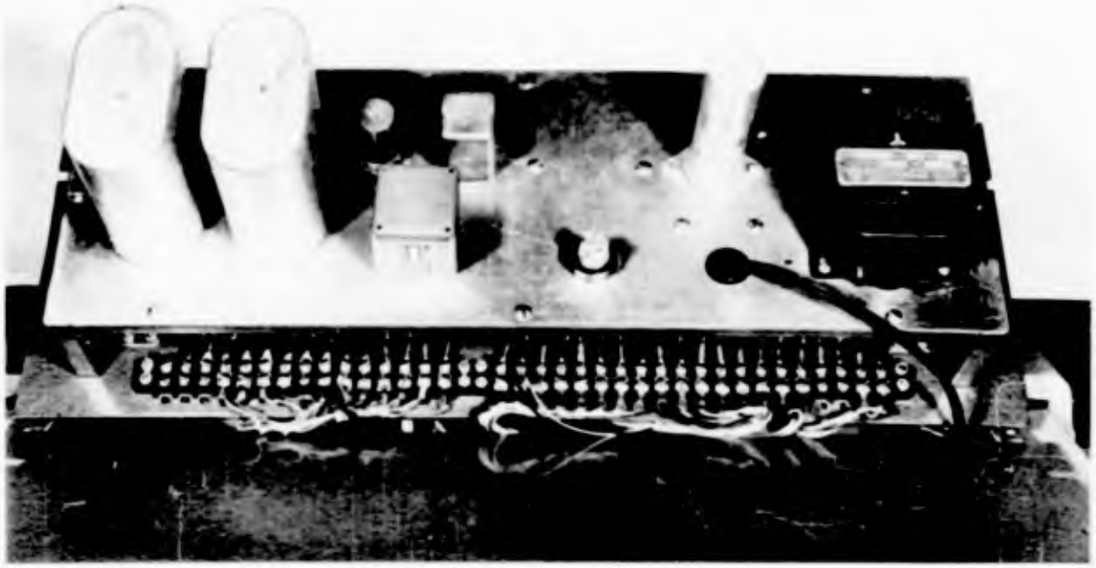


Fig. 3-30 VHF termination and switching panel (rear view)

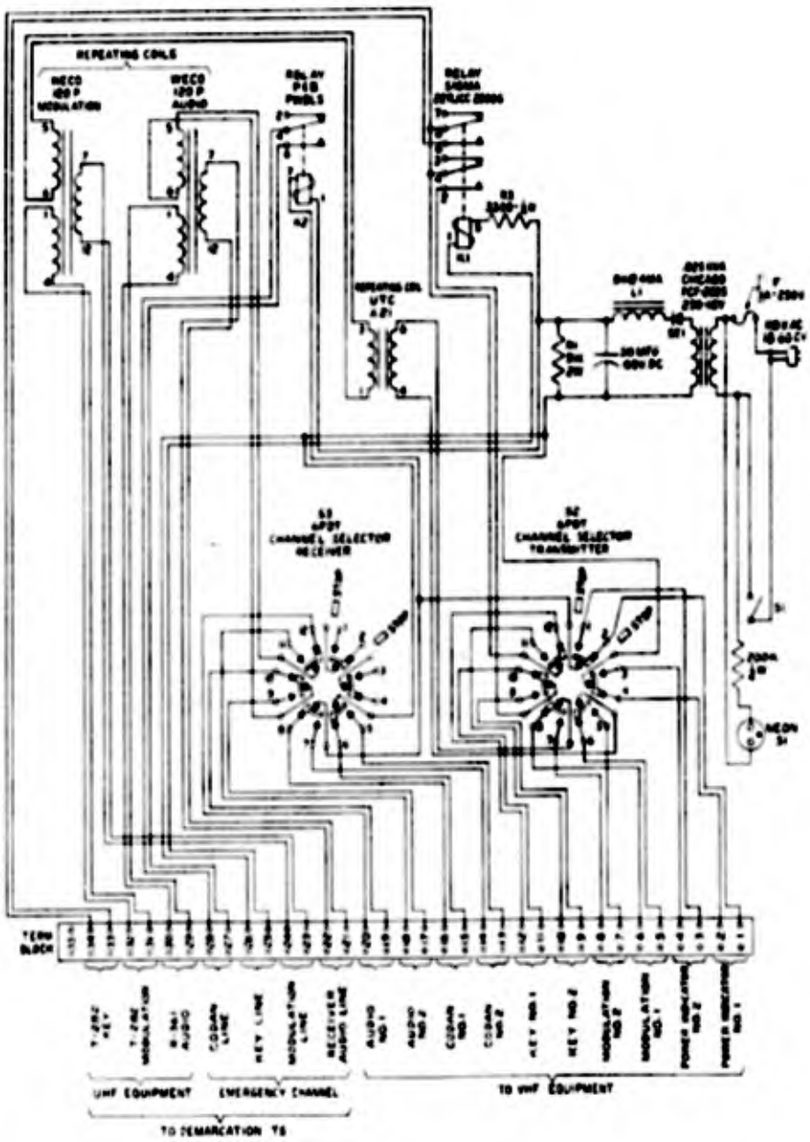


Fig. 3-31 VHF termination and switching panel schematic

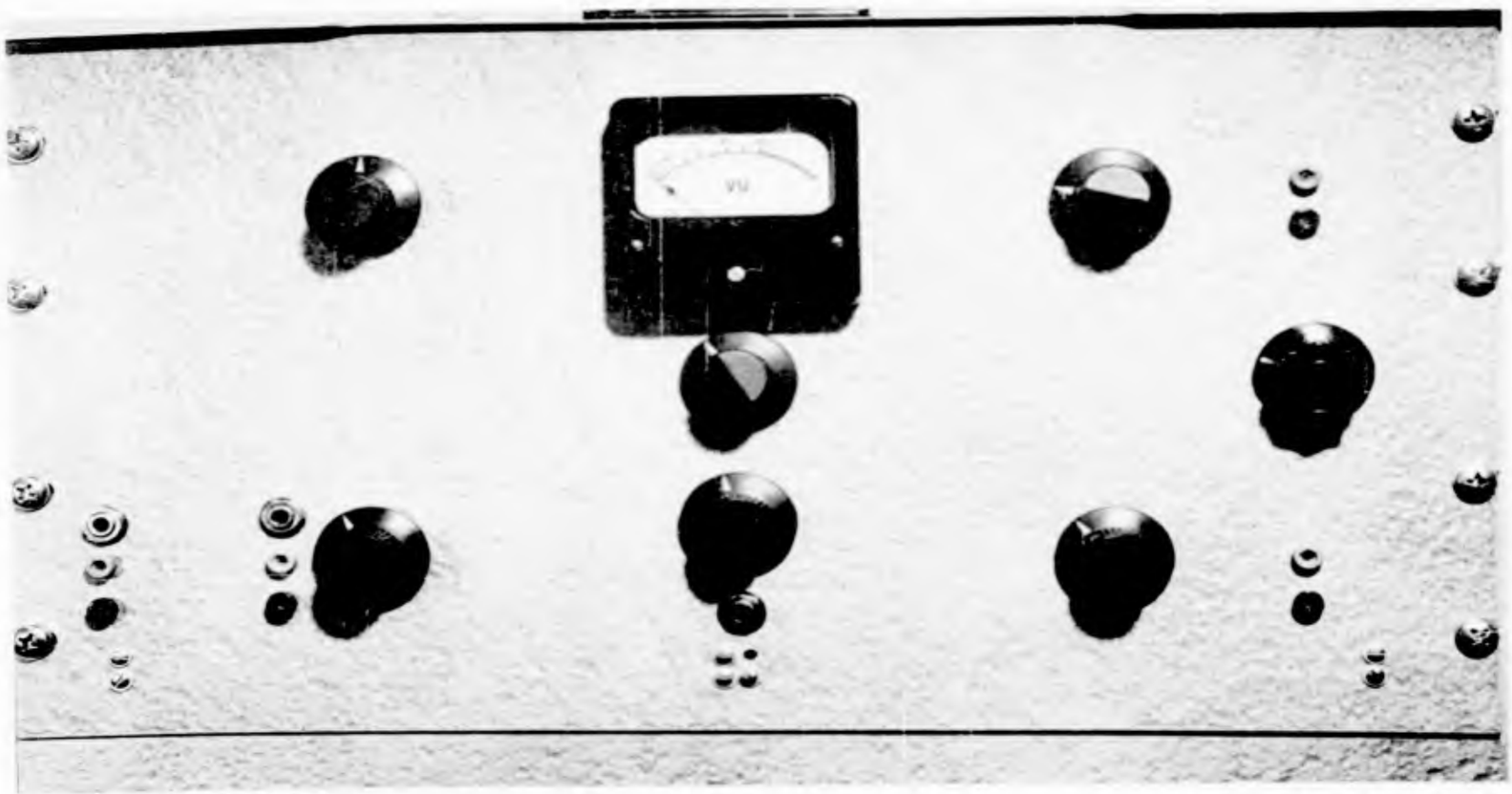
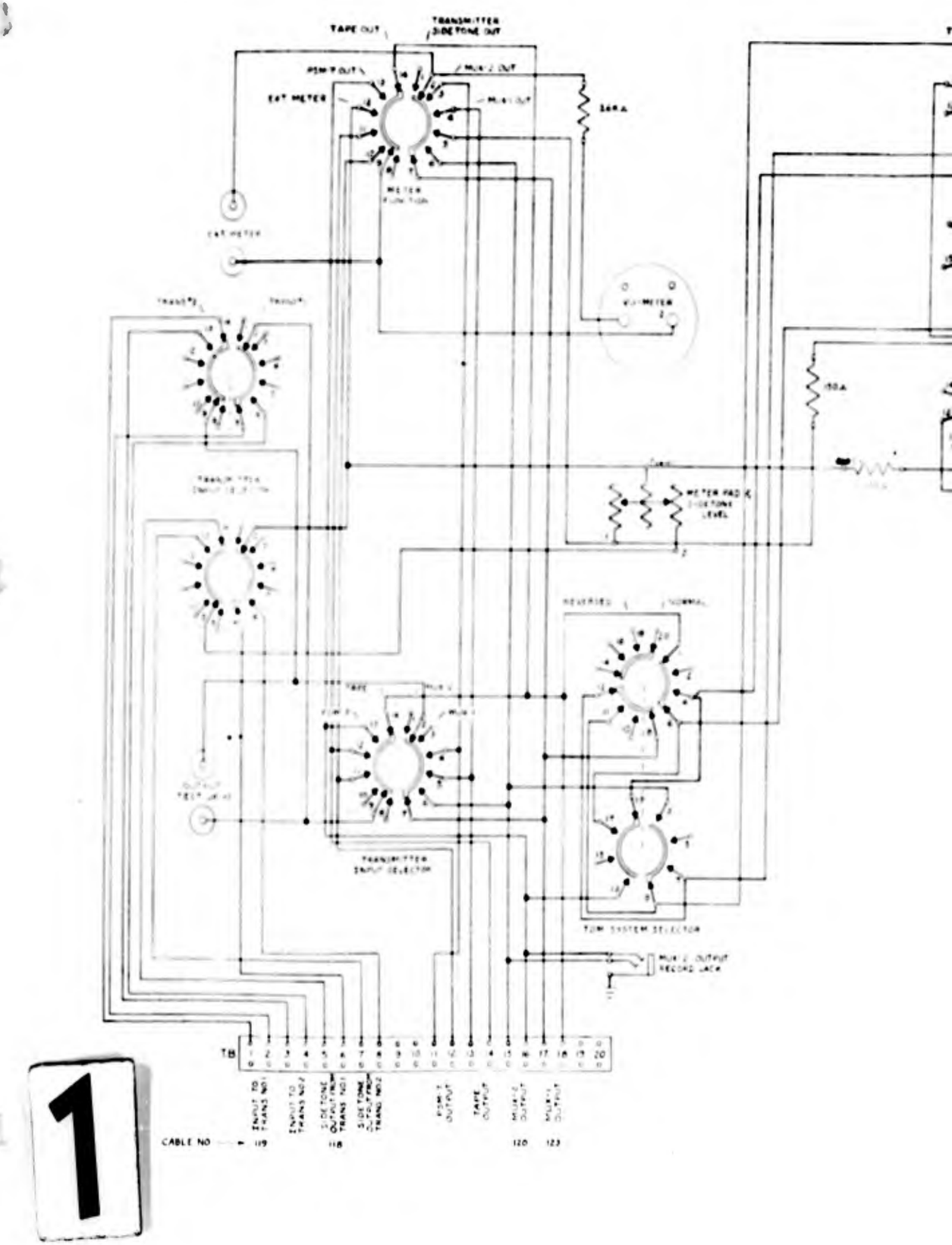
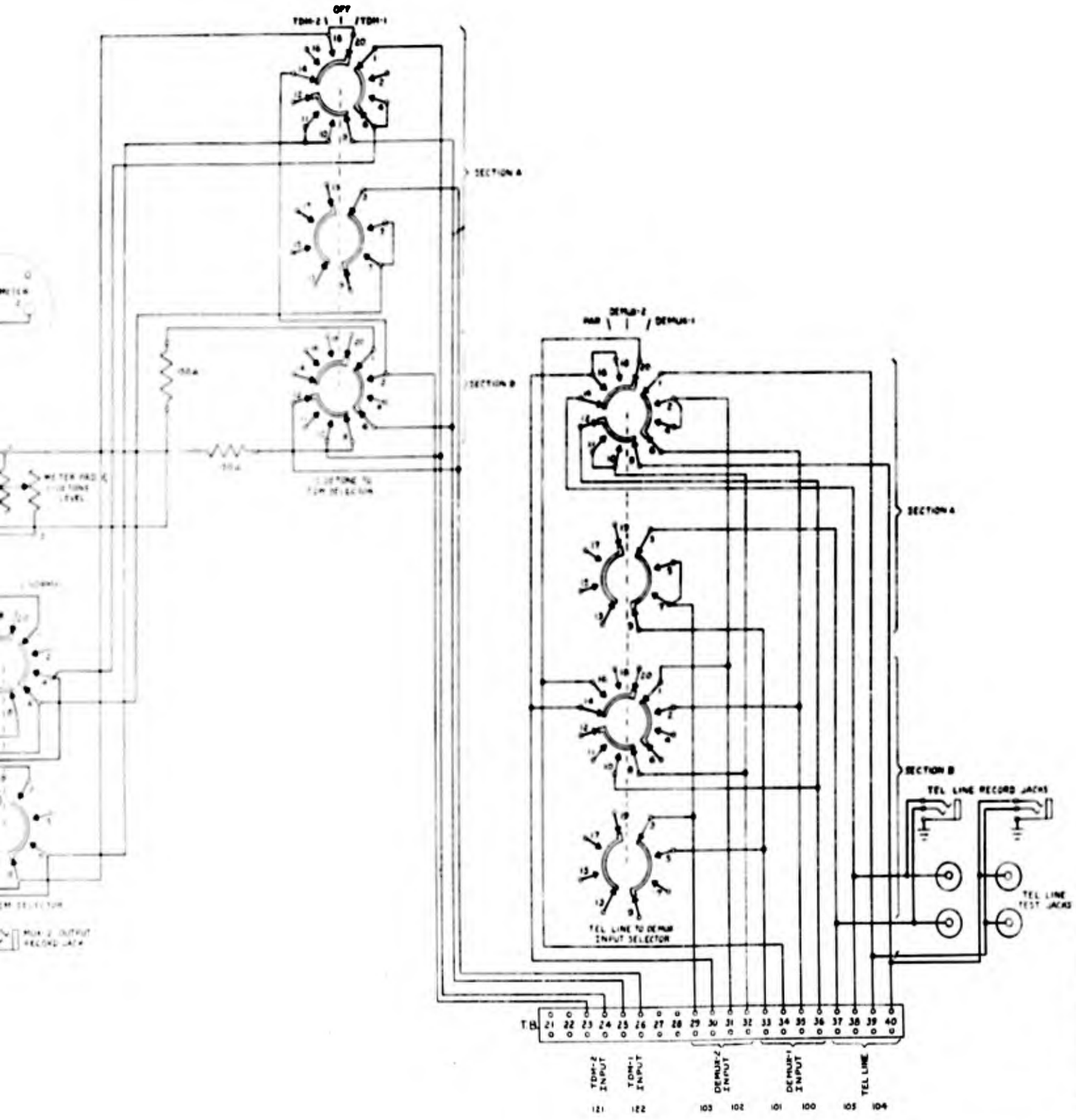


Fig. 3-32 Audio monitor panel


TAPE OUT
TRANSMITTER SIDETONE OUT
PSM 2 OUT
MUX 2 OUT
EXT METER
MUX 1 OUT
50K A
METER
EXT METER
VU METER 2
150 A
METER PAD & SIDETONE LEVEL
REVERSED
NORMAL
TAPE
MUX 2
MUX 1
TRANSMITTER INPUT SELECTOR
TDM SYSTEM SELECTOR
MUX 2 OUTPUT RECORD JACK
TB
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
ENPUT TO TRANS NO 1
ENPUT TO TRANS NO 2
SIDETONE OUTPUT FROM TRANS NO 1
SIDETONE OUTPUT FROM TRANS NO 2
PSM 2 OUTPUT
TAPE OUTPUT
MUX 2 OUTPUT
MUX 1 OUTPUT
CABLE NO
119
118
120
123

1



2

Fig. 3-33 Audio monitor panel schematic

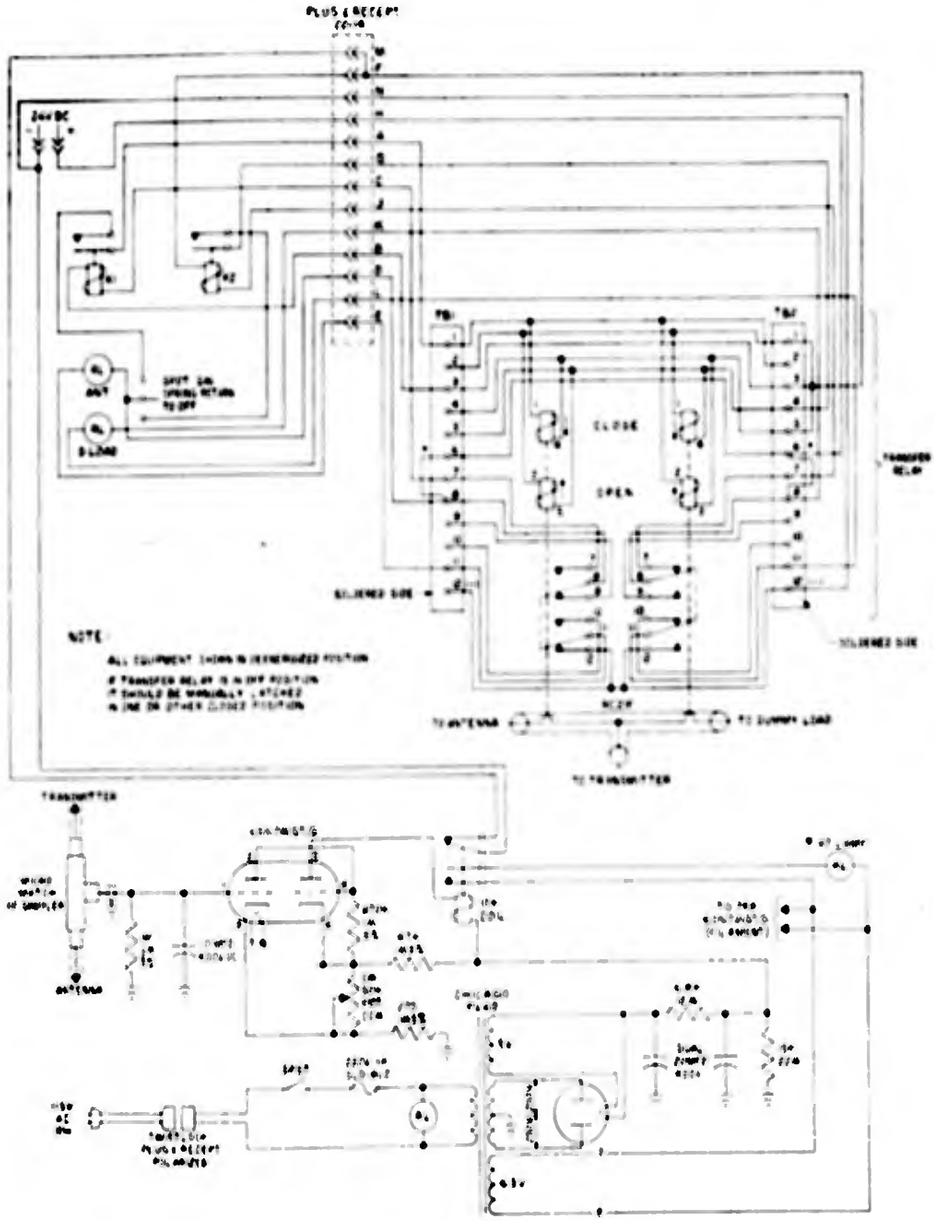
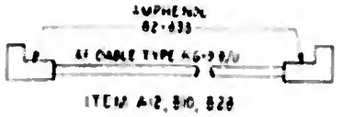
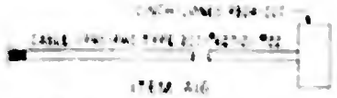


Fig. 3-34 Power indicator panel schematic

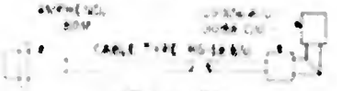


ITEM A12, B10, B28

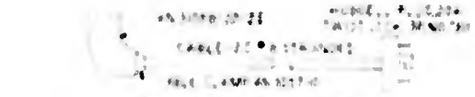
ITEM A13, A14, B27

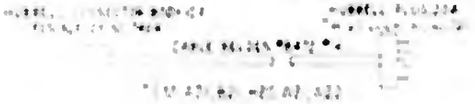


ITEM A16



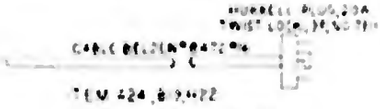
ITEM A17, B24





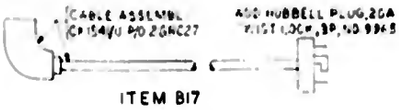
ITEM A22

ITEM A23, B21

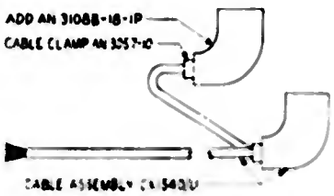


ITEM A24, B9, B22

ITEM B1, B12, B13, B14, W17

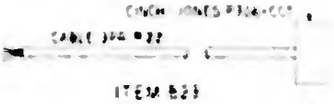


ITEM B17



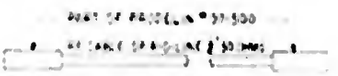
ITEM B18

ITEM B22

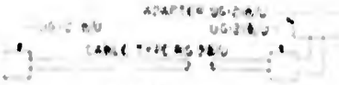


ITEM B23

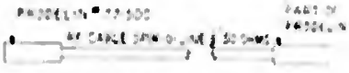
ITEM C9, L14



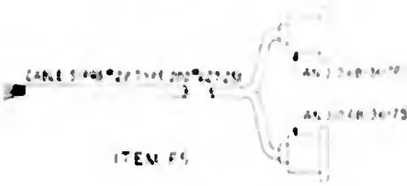
ITEM C9, L15, T1-H



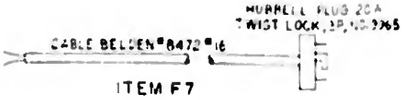
ITEM C11



ITEM D7



ITEM F5



ITEM F7

1

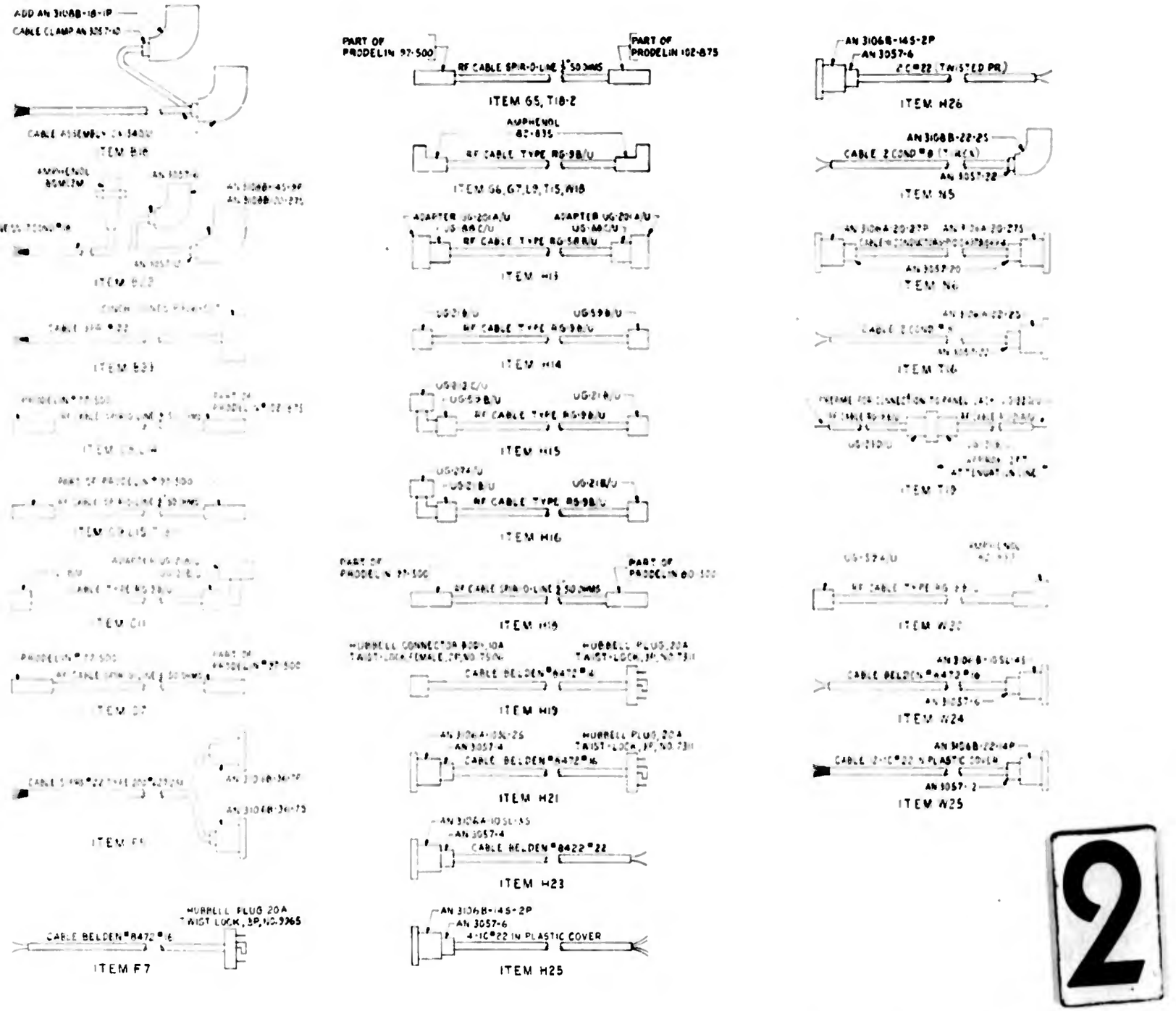
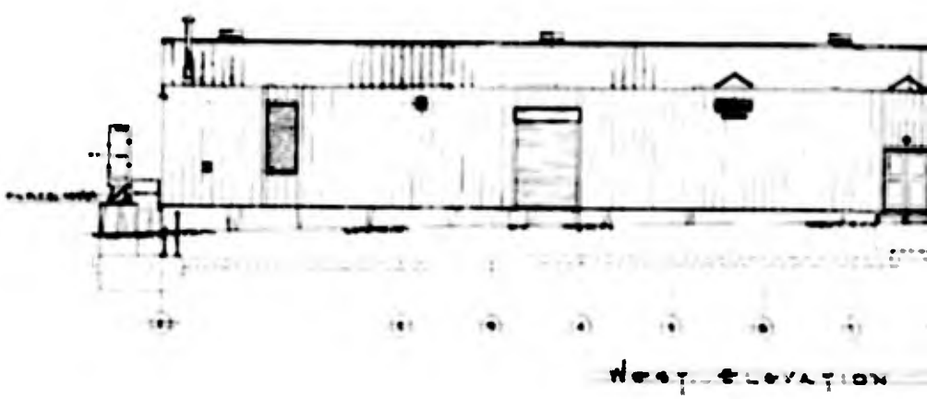


Fig. 3-35 Cable assembly details: RF, audio and control

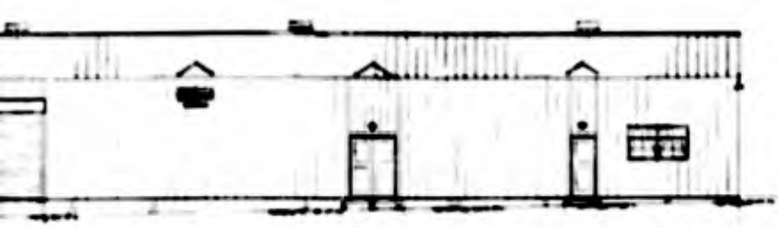


WEST ELEVATION

EAST ELEVATION

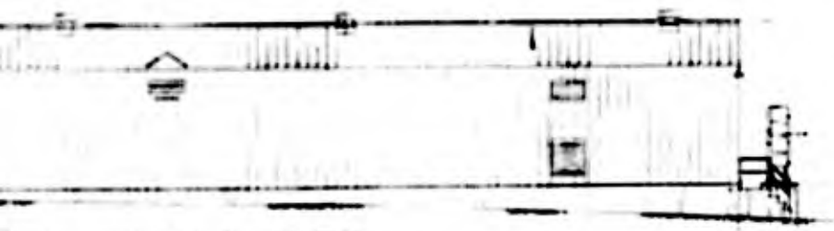
1

1 2-0316-D



WEST ELEVATION

SOUTH ELEV.



EAST ELEVATION

NORTH ELEV.

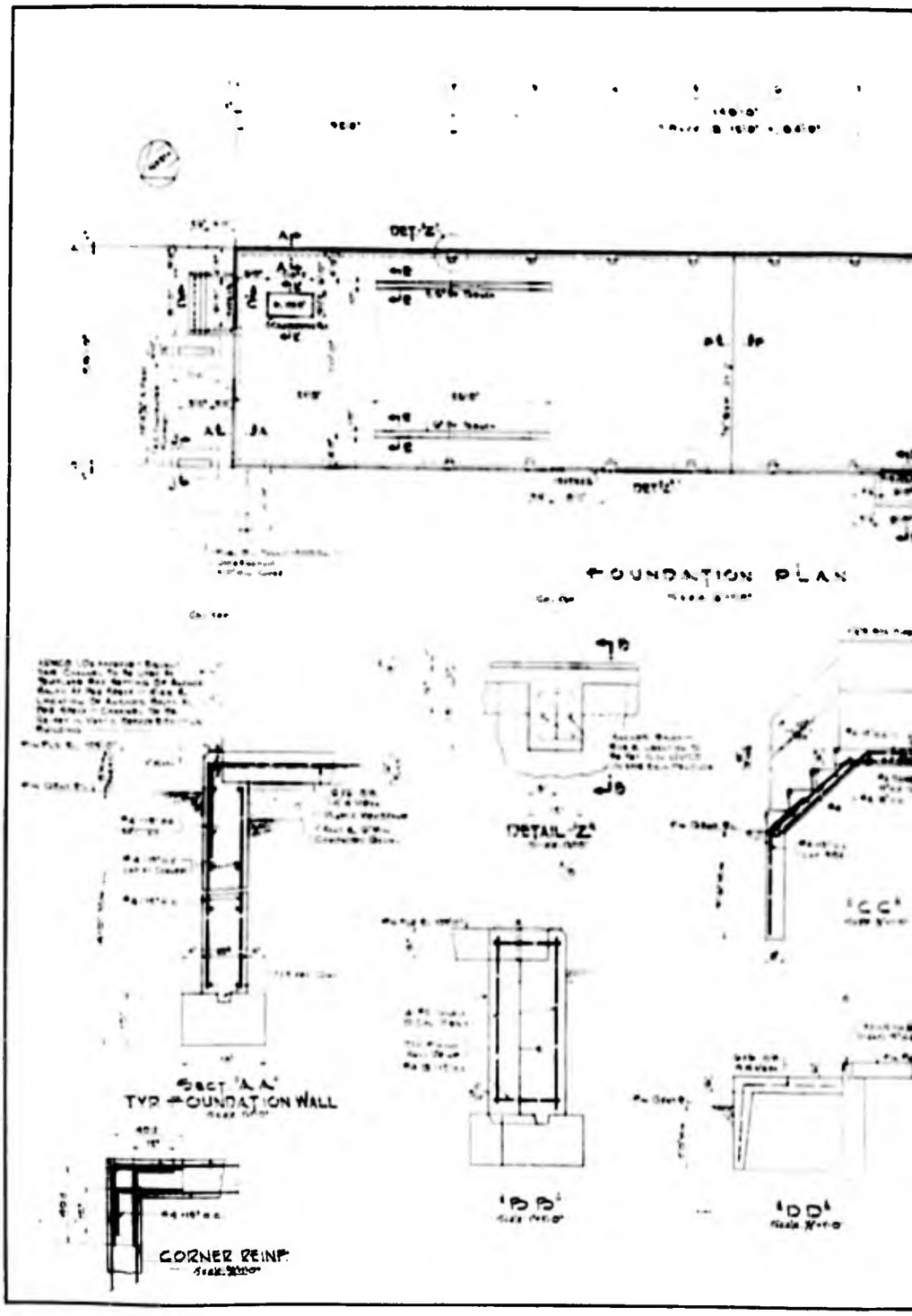
SHOP NOTES

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASS.

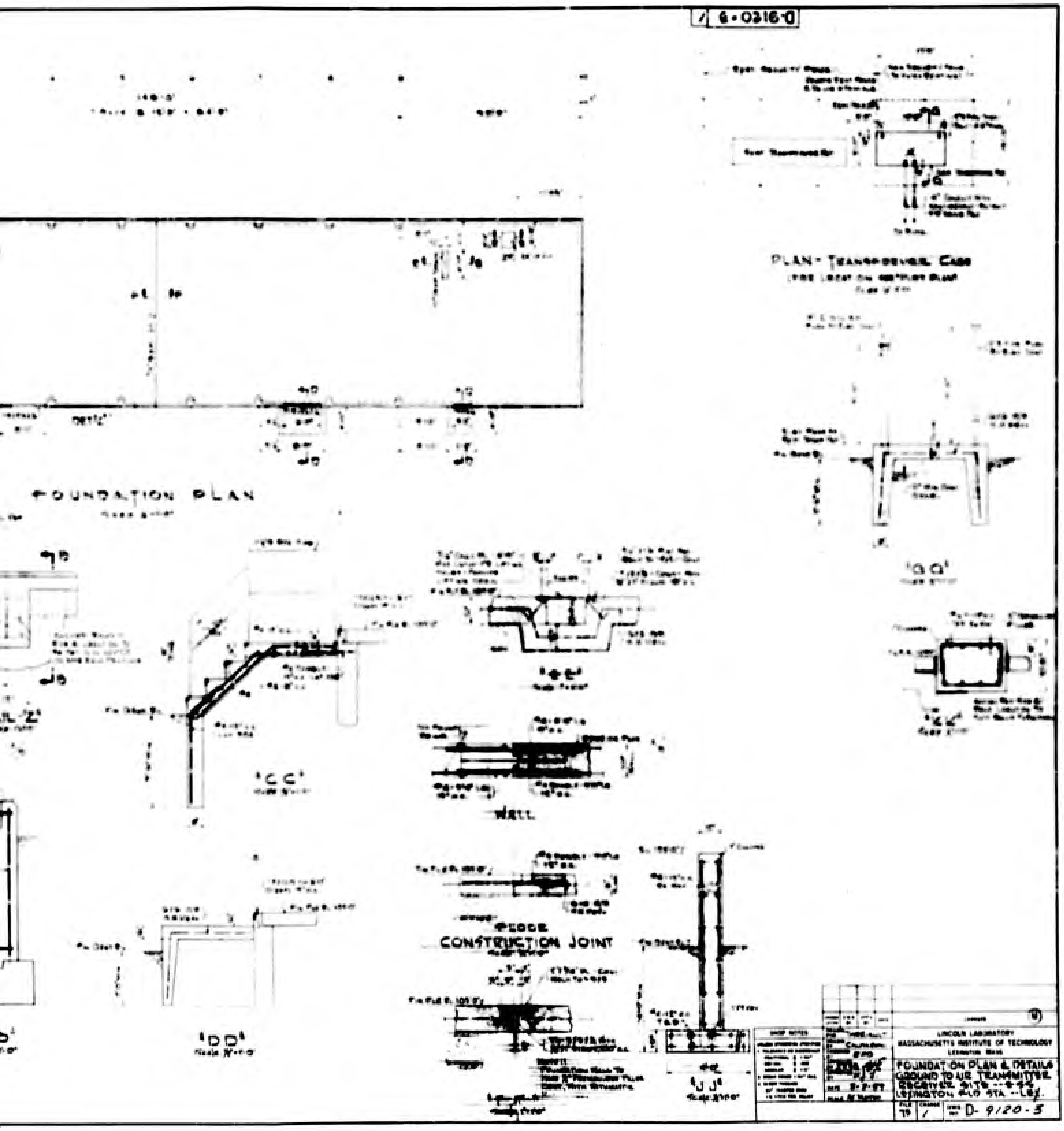
ELEVATIONS
GROUND TO AIR TRANSMITTER
RECEIVER SITE --- R-9
LEXINGTON, MASS. STA. - LEX

DRAWING NO. D-9120-2

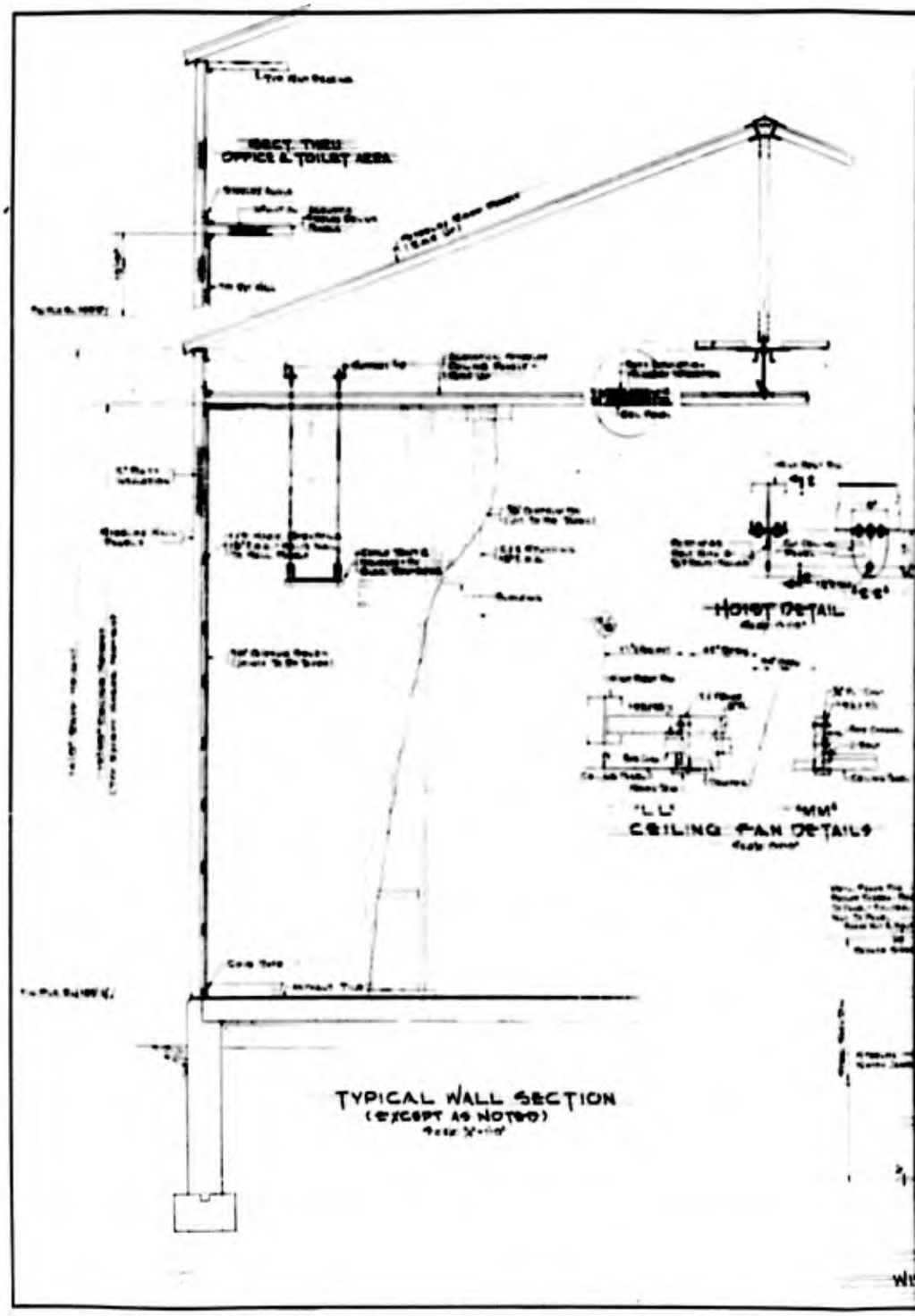
2


FOUNDATION PLAN
DETAIL 'Z'
SECT 'A-A'
TYP FOUNDATION WALL
CORNER REINF
'BB'
'CC'
'DD'

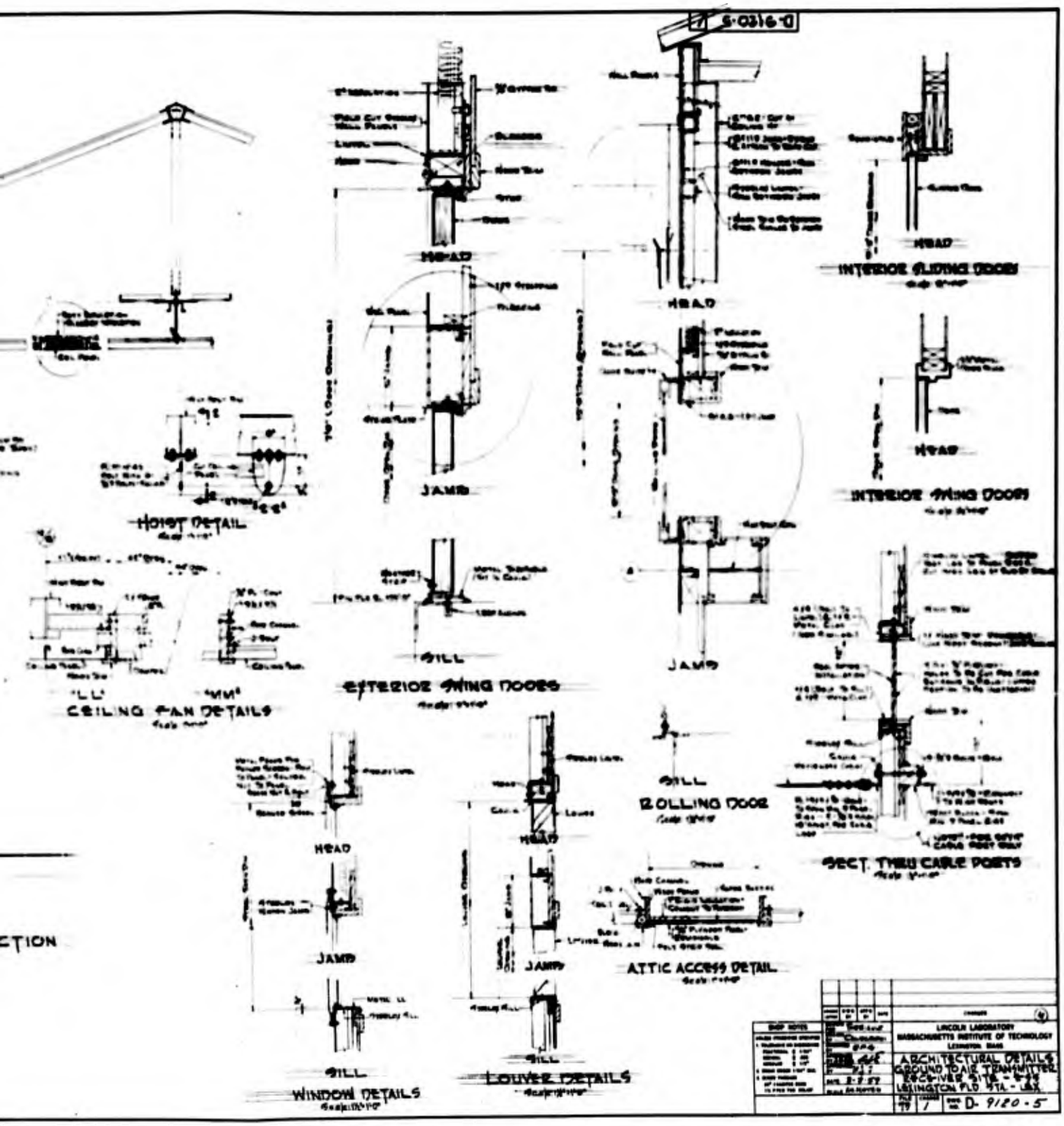
1


6-0316-0
FOUNDATION PLAN
PLAN - TRANSFORMER CAGE
'CC'
'DD'
'EE'
'GG'
'JJ'
WALL
CONSTRUCTION JOINT
LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASS.
FOUNDATION PLAN & DETAILS
GROUND TO UR TRANSMITTER
LEXINGTON FLD STA.
D-9120-5

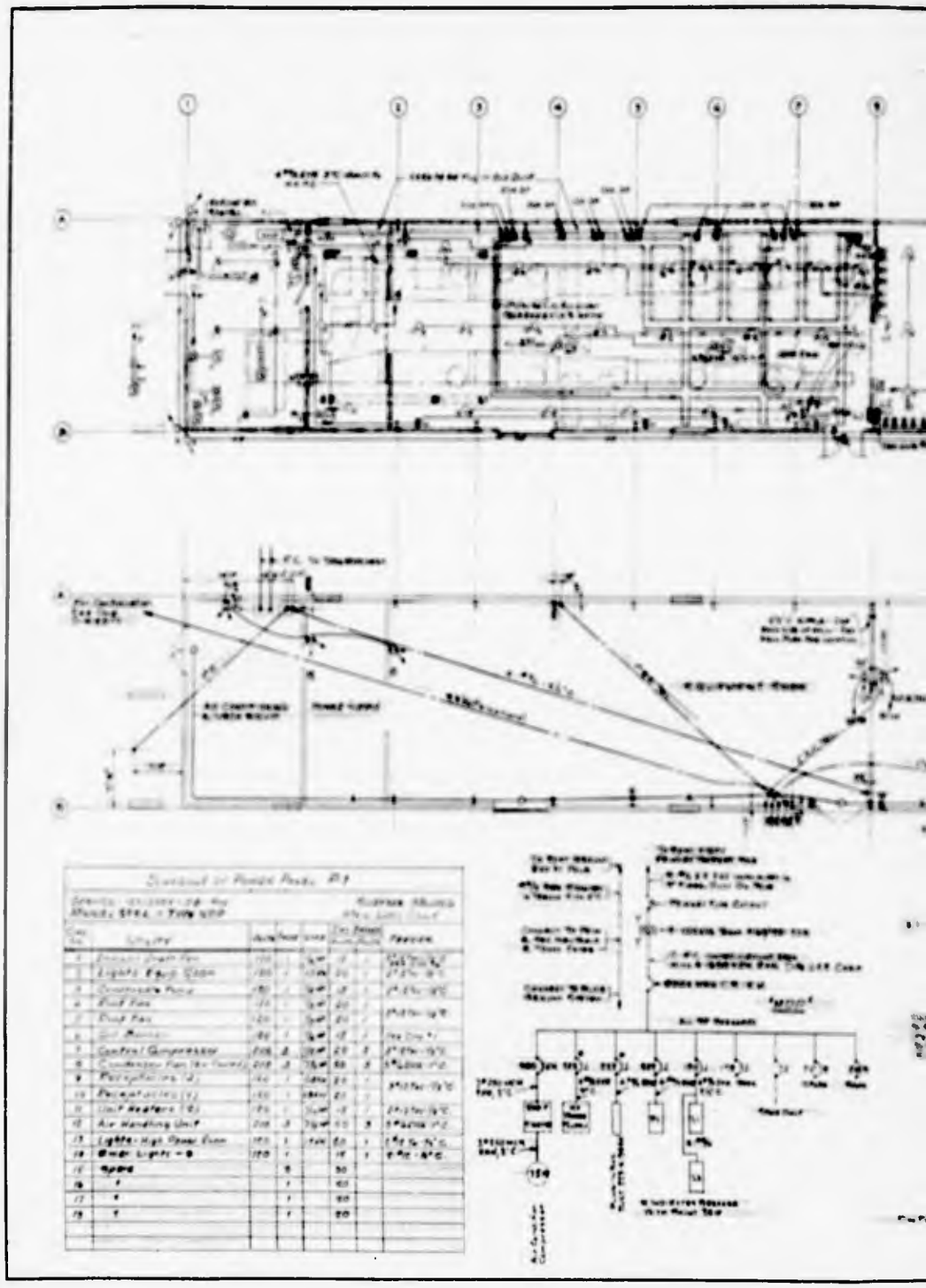
2


SECT. THRU
OFFICE & TOILET AREA
HOIST DETAIL
'LL'
'MM'
CEILING FAN DETAILS
TYPICAL WALL SECTION
(EXCEPT AS NOTED)

1


S-0316-D
HEAD
JAMB
HOIST DETAIL
SILL
EXTERIOR SWING DOORS
"LL"
"MM"
CEILING FAN DETAILS
HEAD
JAMB
SILL
WINDOW DETAILS
HEAD
JAMB
SILL
LOUVER DETAILS
HEAD
SILL
ROLLING DOOR
JAMB
ATTIC ACCESS DETAIL
HEAD
INTERIOR SLIDING DOORS
HEAD
INTERIOR SWING DOORS
SECT. THRU CABLE POSTS
LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASS.
ARCHITECTURAL DETAILS
GROUND TO AIR TRANSMITTER
RECEIVER SITE - B-16
LEXINGTON, MASS.
D-9120-5

2



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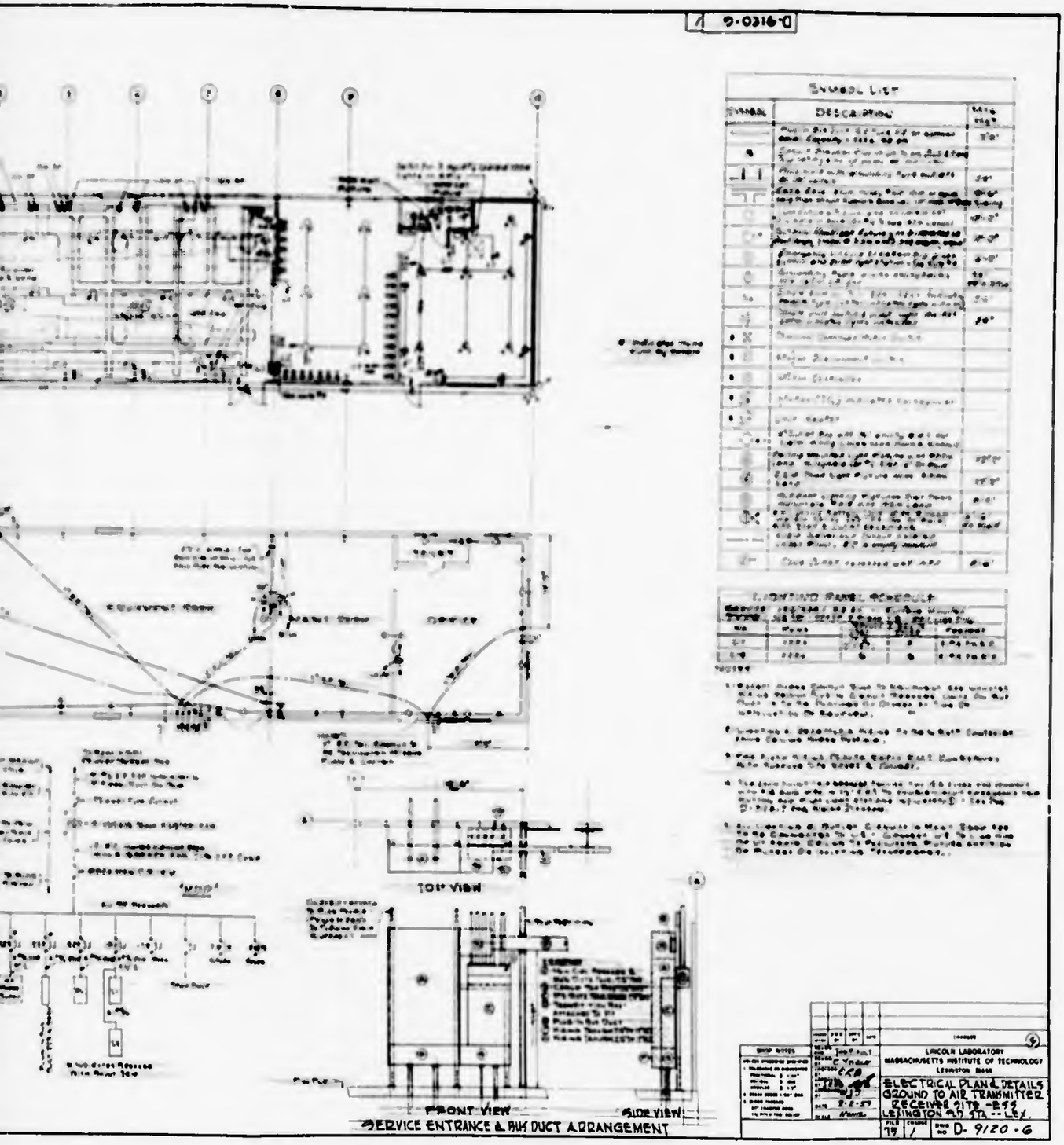
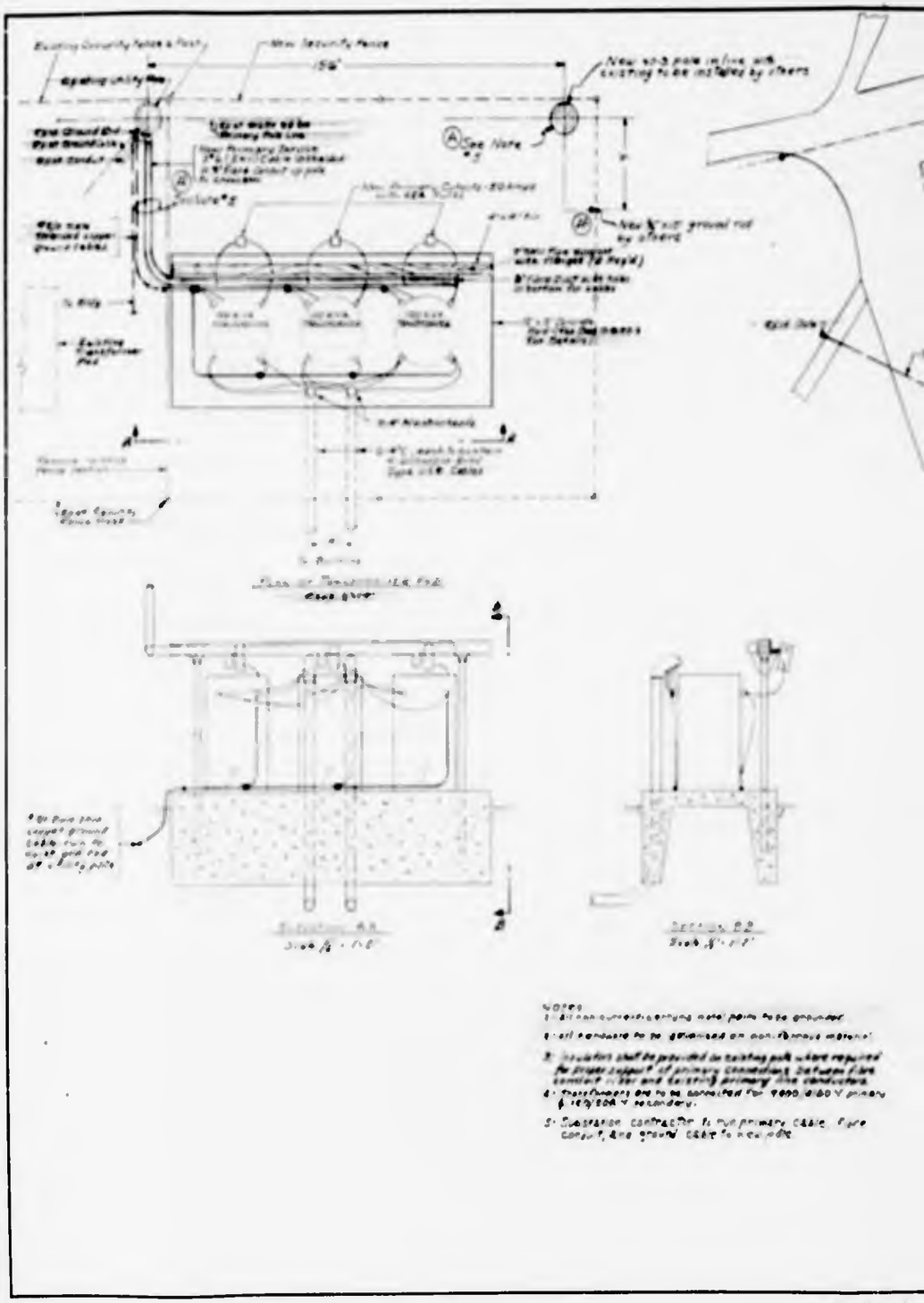

SYMBOL LIST
SYMBOL
DESCRIPTION
LIGHTING PANEL SCHEDULE
TOP VIEW
FRONT VIEW
SIDE VIEW
SERVICE ENTRANCE & BUS DUCT ARRANGEMENT
LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON MASS
ELECTRICAL PLAN & DETAILS
GROUND TO AIR TRANSMITTER
RECEIVER SITE - B-99
LEXINGTON MASS STA -- LEX.
D-9120-6

2



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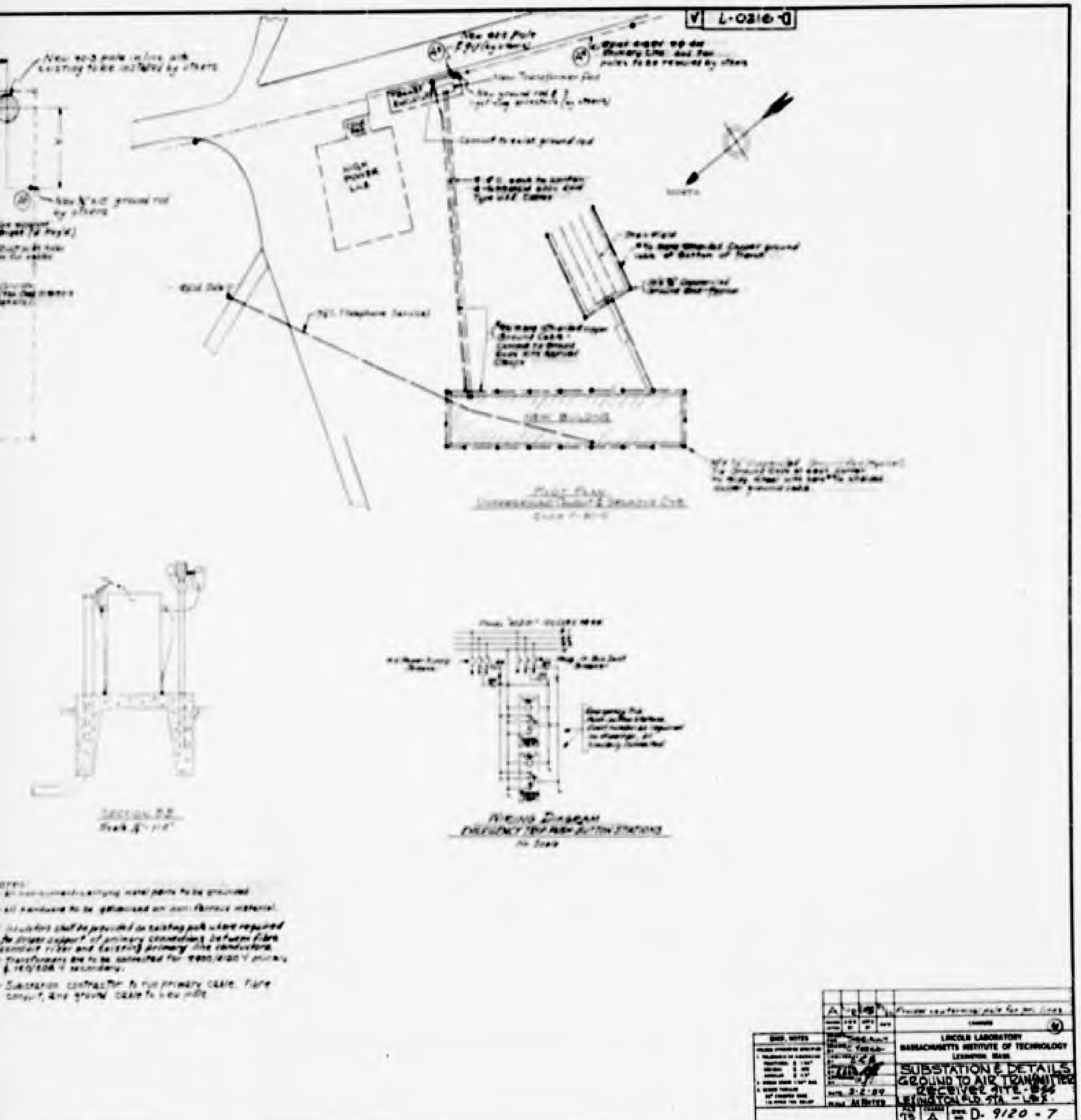
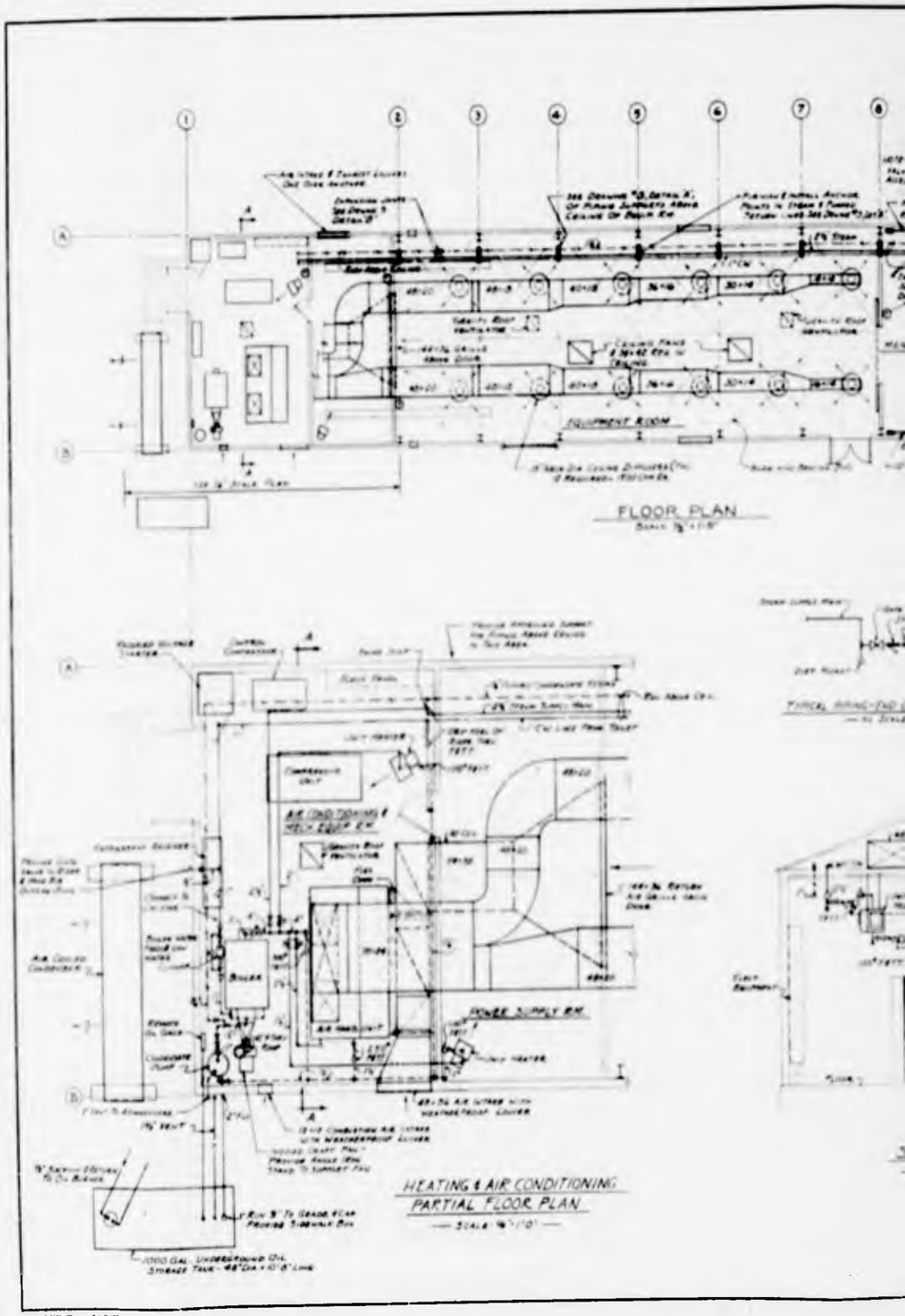
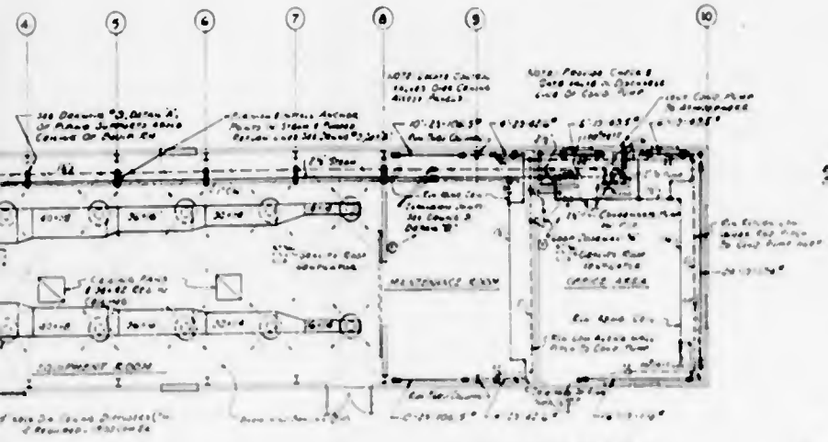

L-0316-D
HIGH POWER LAB
NEW BUILDING
SUBSTATION & DETAILS
GROUND TO AIR TRANSMITTER
D-9120-7

2

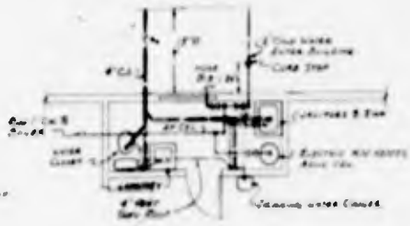

FLOOR PLAN
HEATING & AIR CONDITIONING
PARTIAL FLOOR PLAN
EQUIPMENT ROOM
POWER SUPPLY RM
AIR COND TOWING & HEAT EQUIP RM
1000 GAL. UNDERGROUND OIL STORAGE TANK

1

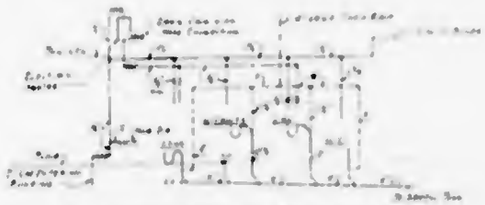
D-9120-8



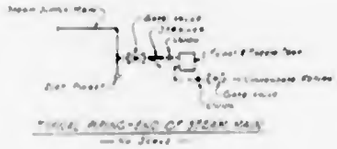
FLOOR PLAN



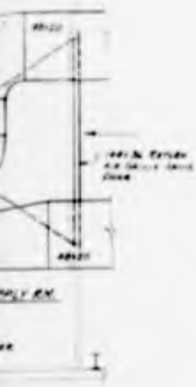
PLUMBING - PART A FLOOR PLAN

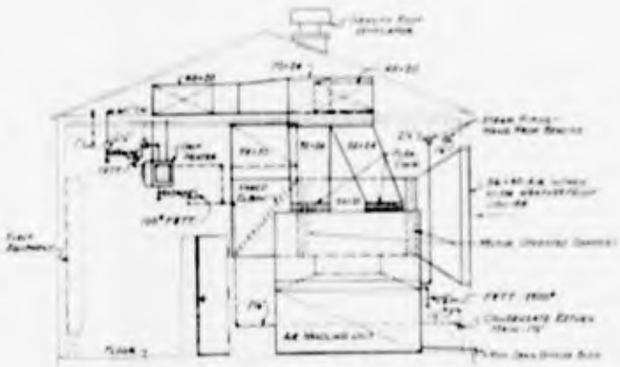


PLUMBING - SANITARY AND DRAIN



TYPICAL ARRANGING OF STEAM MAIN





SECTION A-A

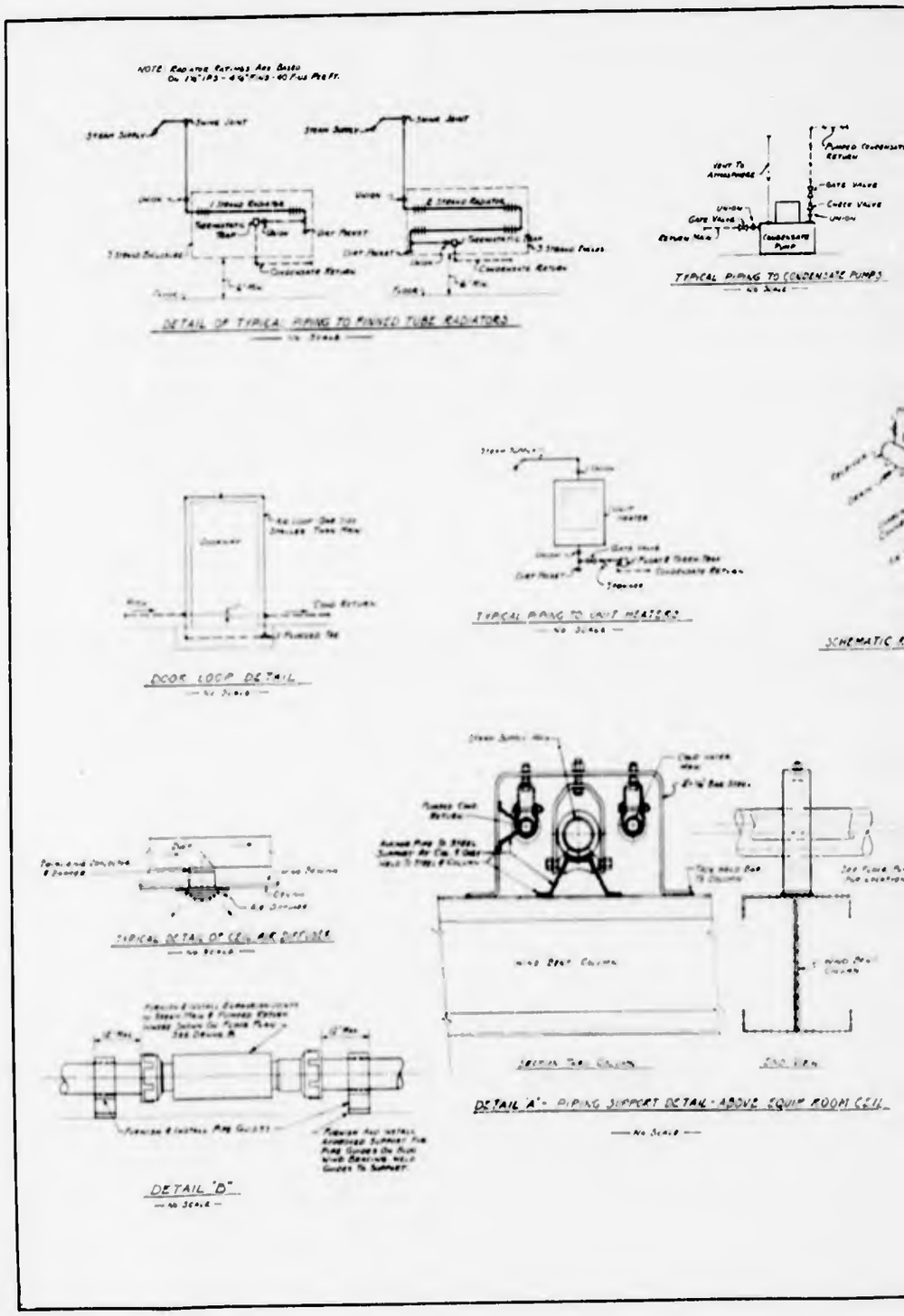
NDITIONING
PLAN

LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASS.

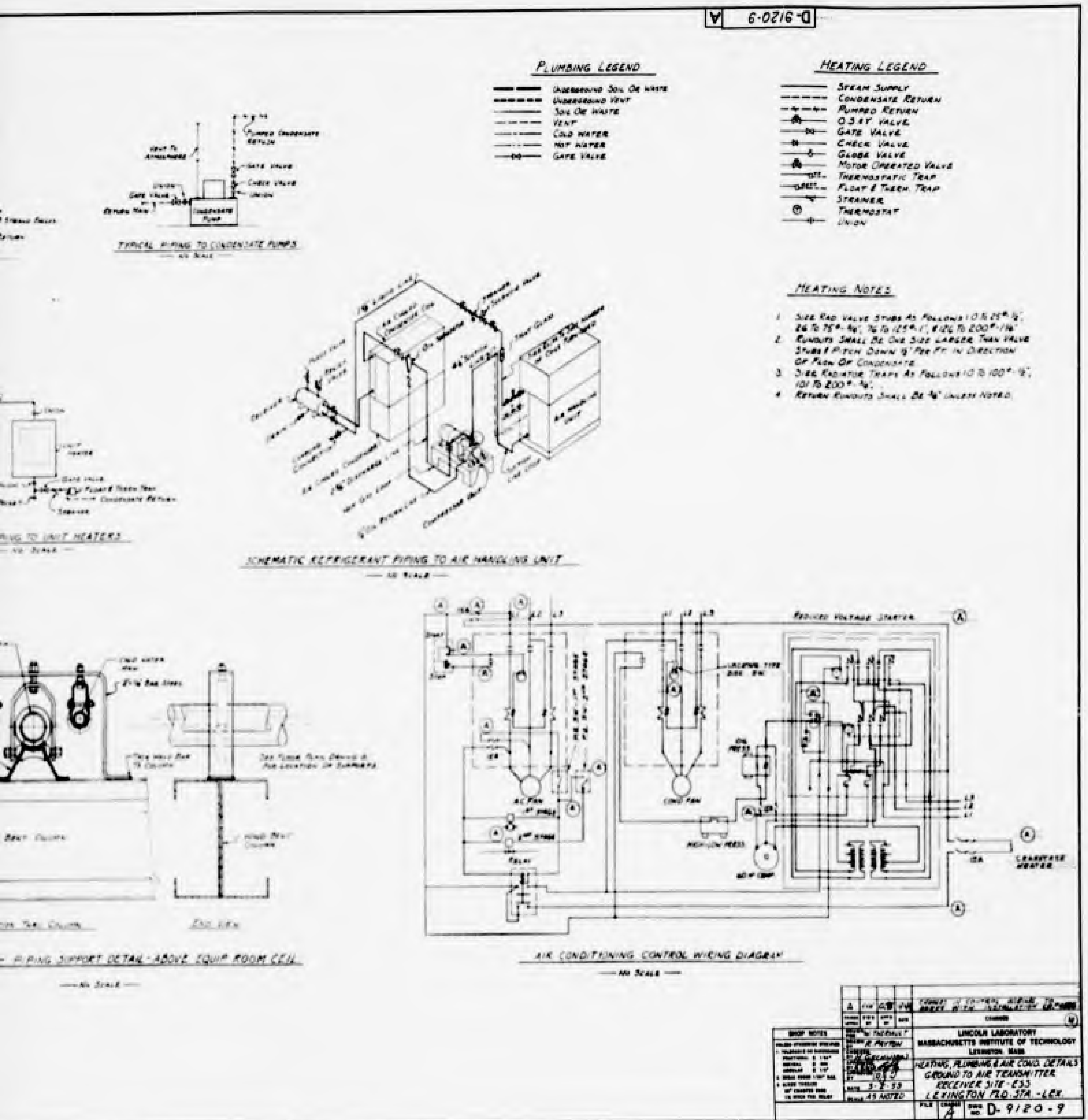
HEATING PLUMBING & AIR COND PLAN
GROUND TO A/C TRANSMITTER
RECEIVER SITE - ESS
LEXINGTON F.O. STA. - LEX

SIZE D DWG NO D-9120-8

2


NOTE RADIATING RATINGS ARE BASED ON 170°F.S. - 60°F.R.S. - 70°F.A.S. PER FT.
DETAIL OF TYPICAL PIPING TO FINNED TUBE RADIATORS
TYPICAL PIPING TO CONDENSATE PUMPS
DOOR LOOP DETAIL
TYPICAL PIPING TO UNIT HEATERS
TYPICAL DETAIL OF CEIL. AIR DIFFUSER
DETAIL 'A' - PIPING SUPPORT DETAIL - ABOVE EQUIP. ROOM CEIL.
DETAIL 'B'

1


D-9120-9 A
PLUMBING LEGEND
UNDERGROUND SOIL OR WASTE
UNDERGROUND VENT
SOIL OR WASTE
VENT
COLD WATER
HOT WATER
GATE VALVE
HEATING LEGEND
STEAM SUPPLY
CONDENSATE RETURN
PUMPED RETURN
O.S.&Y. VALVE
GATE VALVE
CHECK VALVE
GLOBE VALVE
MOTOR OPERATED VALVE
THERMOSTATIC TRAP
FLOAT & THERM. TRAP
STRAINER
THERMOSTAT
UNION
HEATING NOTES
1. SIZE RAD. VALVE STUBS AS FOLLOWS: 10 TO 25#-1/2", 26 TO 75#-3/4", 76 TO 125#-1", & 126 TO 200#-1 1/4"
2. RUNOUTS SHALL BE ONE SIZE LARGER THAN VALVE STUBS & PITCH DOWN 1/2" PER FT. IN DIRECTION OF FLOW OF CONDENSATE
3. SIZE RADIATOR TRAPS AS FOLLOWS: 10 TO 100#-1/2", 101 TO 200#-3/4".
4. RETURN RUNOUTS SHALL BE 3/4" UNLESS NOTED.
TYPICAL PIPING TO CONDENSATE PUMPS
NO SCALE
PUMPED CONDENSATE RETURN
VENT TO ATMOSPHERE
GATE VALVE
CHECK VALVE
UNION
CONDENSATE PUMP
RETURN MAIN
PIPING TO UNIT HEATERS
NO SCALE
UNIT HEATER
GATE VALVE
FLOAT & THERM. TRAP
CONDENSATE RETURN
STRAINER
SCHEMATIC REFRIGERANT PIPING TO AIR HANDLING UNIT
NO SCALE
AIR HANDLING UNIT
COMPRESSOR UNIT
PIPING SUPPORT DETAIL - ABOVE EQUIP ROOM CEIL.
NO SCALE
COLD WATER MAIN
END VIEW
AIR CONDITIONING CONTROL WIRING DIAGRAM
NO SCALE
REDUCED VOLTAGE STARTER
AC FAN
COND FAN
RELAY
OIL PRESS
HIGH-LOW PRESS
CRANKCASE HEATER
LINCOLN LABORATORY
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
LEXINGTON, MASS.
HEATING, PLUMBING & AIR COND. DETAILS
GROUND TO AIR TRANSMITTER
RECEIVER SITE - C33
LEXINGTON FLD. STA. - LEX.
SHOP NOTES
CHANGE
DATE 3-2-53
SCALE AS NOTED
DWG NO. D-9120-9

2

UNCLASSIFIED