ARMY TM11-5895-826-14
NAVY NAVELEX 0967-LP-465-4010
AIR FORCE TO 31Z3-640-41

SYSTEM OVERVIEW MANUAL

SATELLITE COMMUNICATIONS

TERMINAL AN/MSC-46

AS USED IN THE EARTH

TERMINAL COMPLEX

NODAL AND NON-NODAL

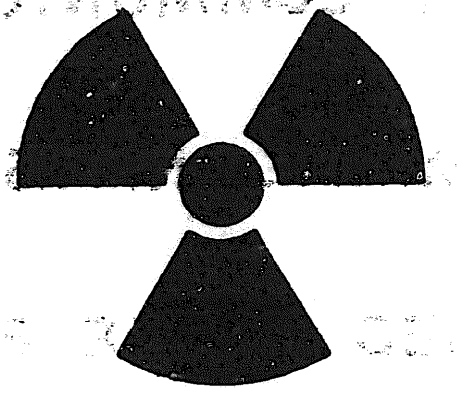
DEPARTMENTS OF THE ARMY, THE NAVY, AND THE AIR FORCE

SEPTEMBER 1976

The following are general safety precautions that are not related to any specific procedures and, therefore, do not appear elsewhere in this publication. These are recommended precautions that personnel must understand and apply during many phases of operation and maintenance.

WARNING

ELECTROMAGNETIC RADIATION



STD-RW-2

DO NOT STAND IN THE DIRECT PATH OF THE ANTENNA WHEN THE POWER IS ON! DO NOT WORK ON THE WAVE GUIDES WHILE THE POWER IS ON!

High frequency electromagnetic radiation can cause fatal internal burns. It can literally "cook" internal organs and flesh. If you feel the slightest warming effect while near this equipment **MOVE AWAY QUICKLY!**

W A R N I N G

This equipment radiates electromagnetic waves of dangerous frequencies. Comply with the requirements of AR 40-583 before using this equipment.

WARNING

DANGEROUS VOLTAGES EXIST **IN THIS EQUIPMENT**

HIGH VOLTAGE is used in this equipment. DE**ATH ON CONTACT may result if** safety precautions are not observed. Under no circumstances should any personnel reach within or enter an equipment enclosure for the purpose of servicing or adjusting the equipment without the immediate presence of another person capable of rendering aid and assistance.

WARNING

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

WARNING

Do not operate the equipment without suitable ground connections. Electrical defects in the equipment can cause DEATH by electrocution when contact is made with an ungrounded system.

WARNING

For the successful execution of methods of equipment destruction involving the use of demolition materials, all personnel should become familiar with the pertinent provisions of FM 5-25.

WARNING

DANGEROUS EXHAUST GASES ARE PRODUCED - Exhaust gases produced by diesel engine generator sets are poisonous. Inhalation may result in illness or DEATH. Provide adequate ventilation if the generator sets are operated in enclosed or covered areas. Exhaust gas pickup by the air conditioners should be carefully avoid&

WARNING

When filling the diesel generator sets fuel tanks, do not smoke or use an open flame in the immediate vicinity. Always provide metal-to-metal contact between the container and the fuel tank. This will prevent a spark from being generated as fuel flows over the metallic surfaces. Do not fill the generator fuel tank while the diesel engine is in operation. Failure to observe these warnings may result in DEATH to personnel.

WARNING

GASES UNDER PRESSURE - Careful handling and proper use of equipment in pressurized systems are required to prevent injury to personnel. Observe warning labels and be familiar with manufacturer’s instructions.

WARNING

Under no circumstances should the Cesium Beam Frequency Standard C-field be adjusted, the phase lock opened, or time changed.

LIST OF EFFECTIVE PAGES

Insert latest changed pages: dispose of superseded pages in accordance with applicable regulations.

NOTE: On a changed page. the portion of the text affected by the latest change is indicated by a vertical line. or other change symbol. in the outer margin of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Total number of pages in this manual is 99 consisting of the following:

Page No.	* Change No.	Page No.	* Change No.
A	0	6-1	0
B Blank	0	6-2 Blank	0
i-iv	0	A-1 - A-4	0
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2-1 - 2-17	0	Index 1 - Index 5	0
3-1 - 3-22	0	Glossary 1- -Glossary	0
4-1 - 4-5	0	F O - 1 - F O - 1 3	0
5-1 - 5-12	0		

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TM 11-5895-826-14
NAVELEX 0967-LP-465-4010
TO 31Z3-640-41

TECHNICAL MANUAL
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TECHNICAL MANUAL
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TECHNICAL ORDER
To 31Z3-640-41

DEPARTMENTS OF THE ARMY
THE NAVY, AND THE AIR FORCE

WASHINGTON, **DC, 24** ***September 1976***

SYSTEM OVERVIEW MANUAL

SATELLITE COMMUNICATIONS TERMINAL AN/MSC-46

AS USED IN THE EARTH TERMINAL COMPLEX

NODAL AND NON-NODAL

TABLE OF CONTENTS

This technical manual is a system overview and does not conform with the format and content specified in AR 310-3.

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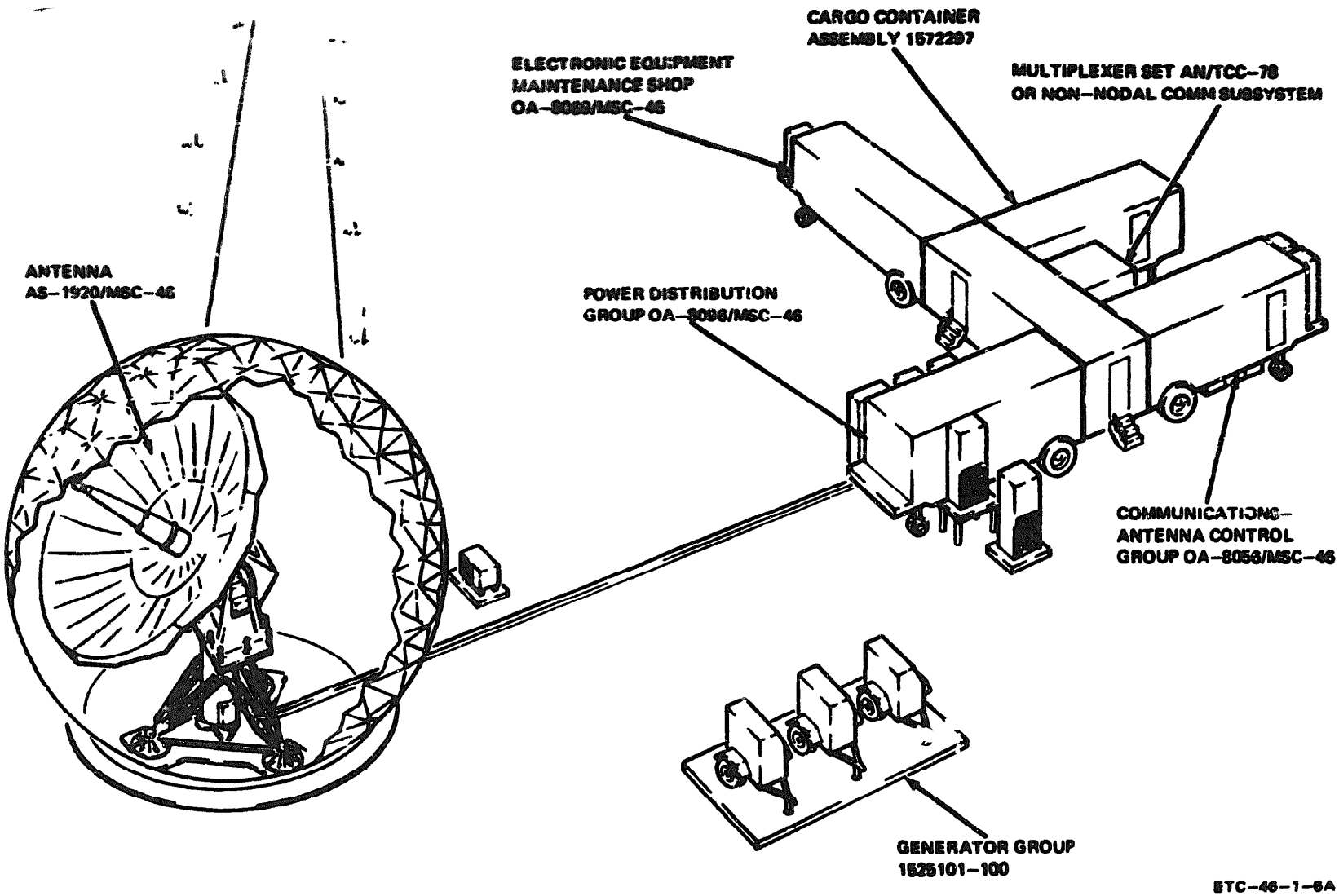


Figure 1-1 Typical ETC using the satellite communication terminal AN/MSC-46 (nodal and non-nodal)

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Scope

The purpose of this technical manual is to provide the equipment user and/or site planner with an overview of the Earth Terminal Complex (ETC) Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). The scope of this manual is addressed to coverage of the Major Subsystems of the ETC and Major Subgroups of the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) as deployed for Phase II, Stage lb. Extensive references are made to technical manuals that cover the individual Major Subsystems and Major Subgroups. However, all details concerning interconnection, interfaces, input and output data will be provided in detail in this manual. A complete listing of applicable documents and technical manuals associated with the operation and maintenance of the equipment located in this ETC can be found in appendix A. A perspective view of a typical ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) is illustrated in figure 1-1.

1-2. Reporting of Errors

The reporting of errors, omissions and recommendations for improvement of this publication by the individual user is encouraged. Reports should be submitted on DA Form 2028 (Recommended Changes to Publications and Blank Forms) and forwarded direct to Commander, U.S. Army Electronics Command, ATTN: DRSEL-MA-Q, Fort Monmouth, NJ 07703.

1-3. Maintenance Forms and Records

a. Department of the Army forms and procedures used for equipment maintenance will be those prescribed by TM 38-750.

b. Department of the Air Force forms and procedures used for equipment maintenance will be those prescribed by AFM 66-1, Volume X and applicable 00-20 series TO's.

c. Department of the Navy forms and procedures used for equipment maintenance will be those prescribed by Maintenance and Material Management (3-M Manual) OPNAV 43-P2.

Section II. DESCRIPTION AND DATA

1-4. ETC Purpose and Use

a. Purpose. The ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) is a transportable facility. The ETC provides communications with one or more satellite communications terminals or systems through a synchronous repeater satellite. There are fourteen of these ETC's strategically located throughout the world. The ETC mission is to provide highly reliable, global communications to the users in the DSCS network. These ETC's are operated by the Army, Navy and Air Force as assigned by the Joint Chiefs of Staff (JCS).

b. Use.

(1) *ETC using the satellite communications terminal AN/MSC-46 (nodal).* In a typical configuration, the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) provides an FM communications path for its Technical Control Facility (TCF). Communications through a repeater satellite to TCF's associated with up to seven other compatible satellite communications terminals is possible using FM communications equipment. The ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) can also communicate with other satellite communications terminals using the Radio Communications Subsystem AN/URC-55 or Digital Data Modem MD-921/G (PSK Modem) as required. In the Phase II, Stage lb concept, the ETC Using the Satellite Communications Terminal AN/MSC46 will handle a large portion of the communications traffic to the other ETC's operating in the same satellite network.

(2) ETC using the satellite communications terminal AN/MSC-46 (non-nodal). The ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) provides an FM voice communications path for its TCF through the repeater satellite to the

TCF associated with another ETC using FM communications equipment. The ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) can also communicate with another satellite communications terminal using the Radio Communications Subsystem AN/URC-55 or Digital Data Modem MD-921/G (PSK Modem) as required.

c. System Configuration. An example of how individual ETC's can be organized into a communications network within the DSCS Phase II Satellite System is shown in figure 1-2. As depicted, a single ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) provides communications paths for four ETC's Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) and three ETC's Using the Satellite Communications Terminal AN/TSC-54. However, the DSCS Phase II satellite system also incorporates other compatible satellite communications systems not depicted in figure 1-2.

1-5. ETC Equipment Tree

Provided in figure 1-3 is the equipment tree for the major equipments of a typical ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). This equipment as designated for use within the ETC is depicted in either a "part of' or "used with" relationship to the Satellite Communications Terminal AN/MSC-46.

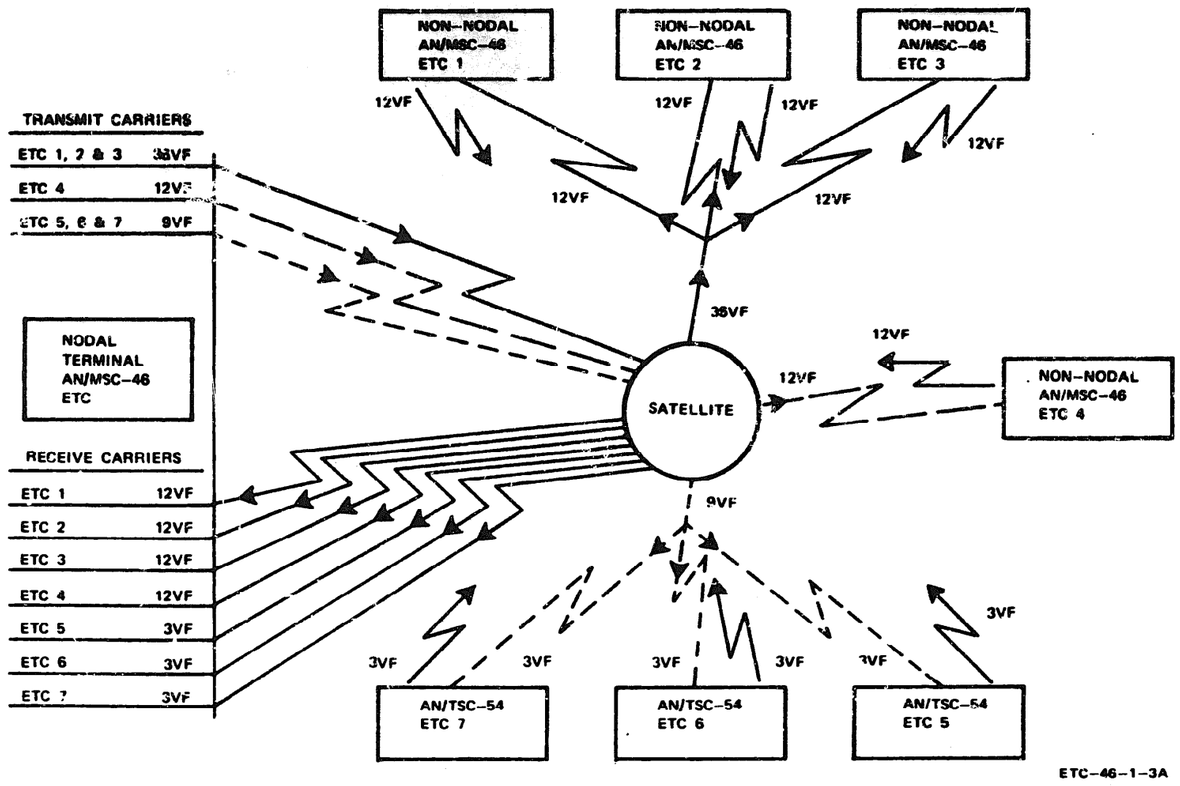


Figure 1-2. Typical communications network within the DSCS phase II satellite system.

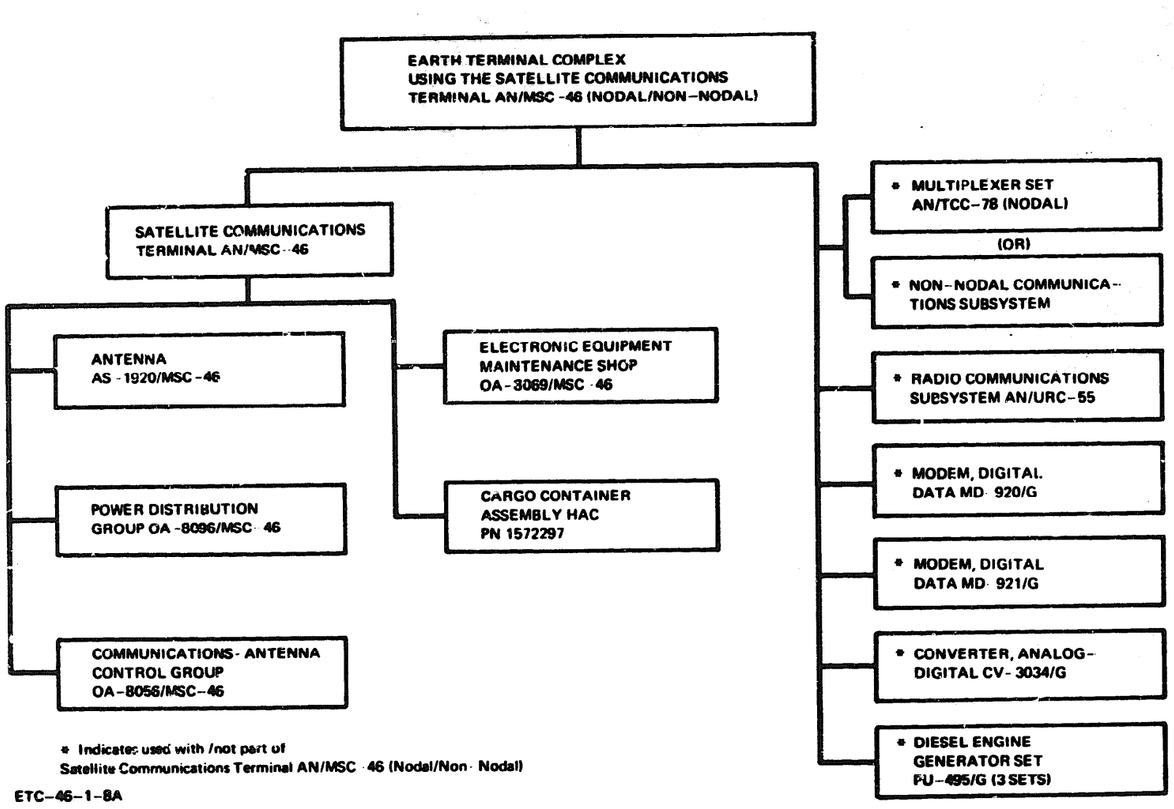


Figure 1-3. Typical equipment tree for ETC using the satellite communications terminal AN/MSC-46 (nodal and non-nodal).

1-6. ETC Technical Characteristics

a. ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal), Technical Characteristics. Provided in table 1-1 is a listing of technical characteristics of the Major Subsystems of an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal). For detailed characteristics refer to appendix A for applicable equipment technical manuals.

b. ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal), Technical Characteristics. Provided in table 1-2 is a listing of technical characteristics of the Major Subsystems of an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal). For detailed characteristics refer to appendix A for applicable equipment technical manuals.

1-7. ETC Physical Site Configuration

A typical site configuration for the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) is shown in Figure FO-1. The relative positions of equipment vans have been optimized: however, if terrain conditions require, the vans may be positioned anywhere on the site, behind the antenna, as interconnect cables will permit.

Table 1-1. Technical Characteristics of ETC

Using the Satellite Communications Terminal AN/MSC-46 (Nodal)

Major subsystem	*Technical characteristics*	
Satellite Communications Terminal AN/MSC-46 (Nodal)	***IF, inputs:*** **(expandable to 6)**	
	frequency	**70 MHz**
	bandwidth	**±20 MHz at ±1.0 bD**
	level	**−10 to +10 dBm**
	RF output:	
	Frequency	**7.9 to 8.4 GHz**
	bandwidth	**500 MHz at ±0.5 dB**
	power (measured at antenna directional coupler)	
	LPA	**1 kW maximum**
	HPA	**5 kWmaximum**
	RF input:	
	frequency	**7.25 to 7.75 GHZ**
	banqwidth	**500 MHz at ±0.5 dB**
	IF outputs: **(expandable to 15)**	
	frequency	**70 MHz**
	bandwidth	**±20 MHz at ±1.0 dB**
	level	**0 ±0.5 dBm for input signal of −43 dBm**
	Power requirements:	
	voltage	**120/208 Vac, 50/60 Hz, 3-phase**
	power (includes communications subsystem)	**178 kW maximum**
Radio Communications Subsystem AN/URC-55	***Transmitter:***	
	Input:	
	Channel capacity	**up to 4 VF channels and 3 TTY channels with 1 TCF to TCF TTY orderwire and 1 ETC to ETC TTY orderwire**
	bandwidth	**0 to 4 kHz per channel**
	level	**0 dBm per channel**
	Output:	
	modulation	**pseudonoise**
	frequency	**70 MHz nominal**
	bandwidth	**spread spectrum**
	Receivers: **(No. 1 and No. 2)**	
	Input:	
	frequency	**70 MHz nominal**
	bandwidth	**spread spectrum**

Table 1-1. Technical Characteristics of ETC
Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Major subsystem	*Technical characteristics*	
	***Receivers:* No. 1 and No. 2—Continued**	
Radio Communications Subsystem AN/URC-55—Continued	**Output:**	
	channels	**up to 4 VF channels and 3 TTY channels with 1 TCF to TCF TTY orderwire and 1 ETC to ECT TTY orderwire**
	bandwidth	**0 to 4 kHz per channel**
	level	**0 dBm per channel**
	Power requirements:	
	voltage	**120 V ac, 50/60 Hz, single phase**
Multiplexer Set AN/TCC-78 (Nodal)	***Input:* (from TCF)**	
	baseband capacity	**72 multiplexed VF channels (Supergroup 1 and Supergroup 2, group 1)**
	bandwidth	**60 to 360 kHz**
	level	**−15 dBm**
	***Output:* (to Satellite Communications Terminal AN/MSC-46 expandable to 3)**	
	modulation	**angle modulated**
	frequency	**70 MHz**
	bandwidth	**±20 MHz at 1 dB**
	level	**0 to +17 dBm**
	***Input:* (from Satellite communications Terminal AN/MSC-46, expandable to 7)**	
	modulation	**angle modulated**
	frequency	**70 MHz**
	bandwidth	**±20 MHz at ±1 dB**
	level	**−55 to −5 dBm**
	***Output:* (to TCF)**	
	baseband capacity	**72 multiplexed VF channels (Supergroup 1 and Supergroup 2, group 1)**
	bandwidth	**60 to 360 kHz**
	level	**−45 dBm**
	Power requirements:	
	voltage	**120/208 V ac, 50/60 Hz, 3-phase**
	load	**50 A nominal**
Modem, Digital Data MD-920/G (ICF Modem)	***Modulator:***	
	Input: (digital data)	
	data rate	**19.2 kbs to 9.9999 Mbs**
	one state	**+6 ±1.5 V dc**
	zero state	**−6 ±1.5 V dc**
	Output: (bipolar)	
	data rate	**19.2 kbs to 9.9999 Mbs**
	level	**−12 dBm (radio link) +23, +10 or 0 dBm (RF cable)**
	Demodulator:	
	Input: (bipolar)	
	data rate	**19.2 kbs to 9.9999 Mbs**
	level	**−25 to −35 dBm (radio link) +5 to −15 dBm (RF cable)**
	Output: (digital data)	
	data rate	**19.2 kbs to 9.9999 Mbs**
	one state	**+6 ±1.5 V dc**
	zero state	**−6 ±1.5 V dc**
	Power requirements:	
	voltage	**120 V ac +10%, 45 to 420 Hz, single phase**
	power	**300 W maximum**

Table 1-1. Technical Characteristics of ETC

Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Major subsystem	Technical characteristics	
Modem, Digital Data MD-921/G (PSK Modem)	*Modulator:*	
	Input:	
	data rate	19.2 kbs to 9.9999 Mbs
	level	−25 to −35 dBm (radio link) +5 to −15 dBm (RF cable)
	Output:	
	modulation	binary phase-shift keying (PSK)
	frequency	70 MHz
	level	+10 dBm
	Demodulator:	
	Input:	
	modulation	binary phase-shift keying (PSK)
	frequency	70 MHz
	level	−20 to −75 dBm or 0 to −55 dBm
	Output:	
	data rate	19.2 kbs to 9.9999 Mbs
	level	−12 dBm (radio link) +23, +10 or 0 dBm (RF cable)
	Power requirements:	
	voltage	120 V ac ±10%, 45 to 420 Hz, single phase
	power	500 W maximum
Converter, Analog-Digital CV-3034/G	*Transmitter:*	
	Input:	
	voice mode	
	capacity, 1 VF channel	
	level	−16 to −46 dBm (low level) 0 to −30 dBm (high level)
	hybrid mode	
	capacity	1 VF channel or 50 kbs data signal
	level	0 to −30 dBm (voice) 0 to −15 dBm (data)
	Output:	
	data rate	50 kbs
	level	±3 V bipolar
	Receiver:	
	Input:	
	data rate	50 kbs
	level	±3 V bipolar (minimum acceptable ±0.1 V)
	Output:	
	voice mode	
	capacity	1 VF channel
	level	0 to −30 dBm (low level) +7 to −23 dBm (high level)
	hybrid mode	
	capacity	1 VF channel or 50 kbs data signal
	level	0 to −30 dBm (voice) 0 to ±1 dBm (data)
	Power requirements:	
	voltage	120 V ac ±10% 45 to 420 Hz, single phase
	power	30 W
Diesel Engine Generator Set PU-495/G (ETC includes 3 diesel engine generator sets)	*Output:*	
	voltage	120/208 V ac, 50/60 Hz, 3-phase
	power	100 kW (each deisel engine generator set)

Table 1-2. Technical Characteristics of ETC

Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal)

Major subsystem	*Technical characteristics*	
Satellite Communications Terminal AN/MSC-46 (Non-nodal)	*IF inputs:* (2 typical.)	
	frequency	70 MHz
	bandwidth	±20 MHz at ±1.0 dB
	level	−10 to +10 dBm
	RF output:	
	frequency	7.9 to 8.4 GHz
	bandwidth	500 MHz at ±0.5 dB
	power (measured at antenna directional coupler)	
	LPA	1 kW maximum
	HPA	5 kW maximum
	RF input:	
	frequency	7.25 to 7.75 GHz
	bandwidth	500 MHz at ±0.5 dB
	IF outputs: (3 typical)	
	frequency	70 MHz
	bandwidth	±20 MHz at ±1.0 dB
	level	0 ±0.5 dBm for input signal of −43 dBm
		120/208 V ac, 50/60 Hz, 3-phase
	Power requirements:	
	voltage	167 kW maximum
	power (includes communications subsystem)	.167 kW maximum
Radio Communications Subsystem AN/URC-55	*Transmitter:*	
	Input:	
	channel capacity	up to 4 VF channels and 3 TTY channels wit
		1 TCF to TCF TTY orderwire and 1 ECT t
		ETC TTY orderwire
	bandwidth	0 to 4 kHz per channel
	level	0 dBm per channel
	Output:	
	modulation	pseudonoise
	frequency	70 MHz nominal
	bandwidth	spread spectrum
	Receivers; (No. 1 and No. 2)	
	Input:	
	frequency	70 MHz nominal
	bandwidth	spread spectrum
	Output:	
	channels	up to 4 VF channels and 3 TTY channels wit
		1 TCF to TCF TTY orderwire and 1 ETC t
		ETC TTY orderwire
	bandwidth	0 to 4 kHz per channel
	level	0 dBm per channel
	Power requirements:	
	voltage	120 V ac, 50/60 Hz, single phase
Non-Nodal Communications Subsystem	*Input:* (from TCF)	
	channel capacity	12 VF user channels and 1 VF orderwi
		channel
	bandwidth	0 to 4 kHz per channel
	level	0 dBm per channel
	Output: (to Satellite Communications Terminal AN/MSC-46)	
	modulation	angle modulated
	frequency	70 MHz
	bandwidth	±20 MHz at ±1 dB
	level	0 to +17 dBm
	Input: (from Satellite Communications Terminal AN/MSC-46)	
	modulation	angle modulated
	frequency	70 MHz
	bandwidth	±20 MHz at ±1 dB
	level	−55 to −5 dBm

Table 1-2. Technical Characteristics of ETC

Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal)-Continued

Major subsystem	Technical characteristics	
Non-Nodal Communications Subsystem—Continued	*Output:* (to TCF)	
	channel capacity	12 VF user channels and 1 VF orderwire channel
	bandwidth	0 to 4 kHz per channel
	level	0 dBm per channel
	Power requirements:	
	voltage	120/208 V ac, 50/60 Hz, 3-phase
	Modulator:	
	Input: (digital data)	
Modem, Digital Data MD-920/G (ICF Modem)	date rate	19.2 kbs to 9.9999 Mbs
	one state	+6 ±1.5 V dc
	zero state	−6 ±1.5 V dc
	Output: (bipolar)	
	data rate	19.2 kbs to 9.9999 Mbs
	level	−12 dBm (radio link) +23, +10 or 0 dBm (RF cable)
	Demodulator:	
	Input: (bipolar)	
	data rate	19.2 kbs to 9.9999 Mbs
	level	−25 to −35 dBm (radio link) +5 to −15 dBm (RF cable)
	Output: (digital data)	
	data rate	19.2 kbs to 9.9999 Mbs
	one state	+6 ±1.5 V dc
	zero state	−6 ±1.5 V dc
	Power requirements:	
	voltage	120 V ac ±10%, 45 to 420 Hz, single phase
	power	300 W maximum
Modem, Digital Data MD-921/G (PSK Modem)	*Modulator:*	
	Input:	
	data rate	19.2 kbs to 9.9999 Mbs
	level	−25 to −35 dBm (radio links) +5 to −15 dBm (RF cable)
	Output:	
	modulation	binary phase-shift keying (PSK)
	frequency	70 MHz
	level	+10 dBm
	Demodulator:	
	Input:	
	modulation	binary phase-shift keying (PSK)
	frequency	70 MHz
	level	−20 to −75 dBm or 0 to −55 dBm
	Output:	
	data rate	19.2 kbs to 9.9999 Mbx
	level	−12 dBm (radio link) +23, +10, or 0 dBm (RF cable)
	Power requirements:	
	voltage	120 V ac ±10%, 45 to 45 Hz, single phase
	power	500 maximum
Converter, Analog-Digital CV-3034/G	*Transmitter:*	
	Input:	
	voice mode	
	capacity	1 VF channel
	level	−16 to −46 dBm (low level) 0 to −30 dBm (high level)
	hybrid mode	
	capacity	1 VF channel or 50 kbs data signal

Table 1-2. Technical Characteristics of ETC

Using the Satellite Communications Terminal AN/MSC--46 (Non-Nodal)-Continued

Major subsystem	Technical characteristics	
	Transmitter—Continued	
Converter, Analog-Digital CV-3034/G—Continued	Output:	
	data rate	50 kbs
	level	±3 V bipolar
	Receiver:	
	Input:	
	data rate	50 kbs
	level	±3 V bipolar (minimum acceptable ±0.1 V)
	Output:	
	voice mode	
	capacity	1 VF channel
	level	0 to −30 dBm (low level) +7 to −23 dBm (high level)
	hybrid mode	
	capacity	1 VF channel or 50 kbs data signal
	level	0 to −30 dBm (voice) 0 ±1 dBm (data)
	Power requirements:	
	voltage	120 V ac ±10%, 45 to 420 Hz, single phase
	power	30 W
Deisel Engine Generator Set PU-495/G (ETC includes 3 diesel engine generator sets)	*Output:*	
	voltage	120/208 V ac, 50/60, Hz, 3-phase
	power	100 kW (each diesel engine generator set)

1-8. Major Subsystems and Major Subgroups of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)

a. ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal). Provided in table 1-3 is a list of the Major Subsystems and Major Subgroups of a typical ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal). However, all the equipment listed will not always be present in the different configurations of the ETC depending upon ETC mission and location. A list of test equipment required to maintain the ETC is contained in appendix B.

b. ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal). Provided in table 1-4 iw a list of the Major Subsystems and Major Subgroups of a typical ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal). However, all the equipments listed will not always be present in the different configurations of the ETC depending upon ETC mission and location. A list of test equipment required to maintain the ETC is contained in appendix B.

Table 1-3. List of Major Subsystems and Major Sub-Groups Comprising the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Nomenclature	Common name	QTY	Reference
Satellite Communications Terminal AN/MSC-46 (Nodal)			IM 11-5895-539-12
Antenna AS-1920/MSC-46	Antenna	1	
Power Distribution Group OA-8096/MSC-46	Transmitter van	1	
Communications-Antenna Control Group OA-8056/MSC-46	OCV	1	
Electronic Equipment Maintenance Shop OA-8069/MSC-46	Maintenance van	1	
Cargo Container Assembly HAC PN 1572297	Storage van	1	
Radio Communications Subsystem AN/URC-55	URC	1	IM 11-5895-544-12
Multiplexer Set AN/TCC-78 (Nodal)	Nodal comm subsystem	1	DTM 11-5895-796-12-1
Modem, Digital Data MD-920/G	ICF modem	1	DTM 11-5820-804-12
Modem, Digital Data MD-921/G	PSK modem	1	DTM 11-5820-803-12
Converter, Analog-Digital CV-3034/G	A/D converter	1	DTM 11-5895-797-14
Diesel Engine Generator Set PU-495/G	Motor generator	3	TM 5-6115-293-12 TO 35C2-3-329-1

Table 1-4. List of Major Subsystems and Major Sub-Groups Comprising the ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal)

Nomenclature	Common name	Qty	Reference
Satellite Communications Terminal AN/MSC-46 (Non-Nodal)			IM 11-5895-539-12
Antenna AS-1920/MSC-46	Antenna	1	
Power Distribution Group OA-8096/MSC-46	Transmitter van	1	
Communications-Antenna Control Group OA-8056/MSC-46	OCV	1	
Electronic Equipment Maintenance Shop OA-8069/MSC-46	Maintenance van	1	
Cargo Container Assembly HAC PN 1572297	Storage van	1	
Radio Communications Subsystem AN/URC-55	URC	1	IM 11-5895-544-12
Non-Nodal Communications Subsystem	Non-nodal comm subsystem	1	DTM 11-5895-796-12-2
Modem, Digital Data MD-920/G	ICF modem	1	DTM 11-5820-804-12
Modem, Digital Data MD-921/G	PSK modem	1	DTM 11-5820-803-12
Converter, Analog-Digital CV-3034/G	A/D converter	1	DTM 11-5895-797-14
Diesel Engine Generator Set PU-495/G	Motor generator	3	TM 5-6115-293-12 TO 35C2-3-329-1

1-9. Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) (fig. 1-4 ① thru ⑥)

The Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) contain transmit and receive equipment that provides the RF link via satellite between ETC's. These terminals consist of the following Major Subgroups.

a. Antenna AS-1920/MSC-46 (Nodal and Non-Nodal) (fig. 1-4 ①).

b. Power Distribution Group OA-8096/MSC-46 (Nodal and Non-Nodal) (fig. 1-4 ②).

c. Communications-Antenna Control Group GA-8056/MSC-46.

(1) Nodal (fig. 1-4 ③).

(2) Non-Nodal (fig. 1-4 ④).

d. Electronic Equipment Maintenance Shop OA-8069/MSC-46 (Nodal and Non-Nodal) (fig. 1-4 ⑤).

e. Cargo Container Assembly, HAC PN 1572297, (Nodal and Non-Nodal) (fig. 1-4 ⑥).

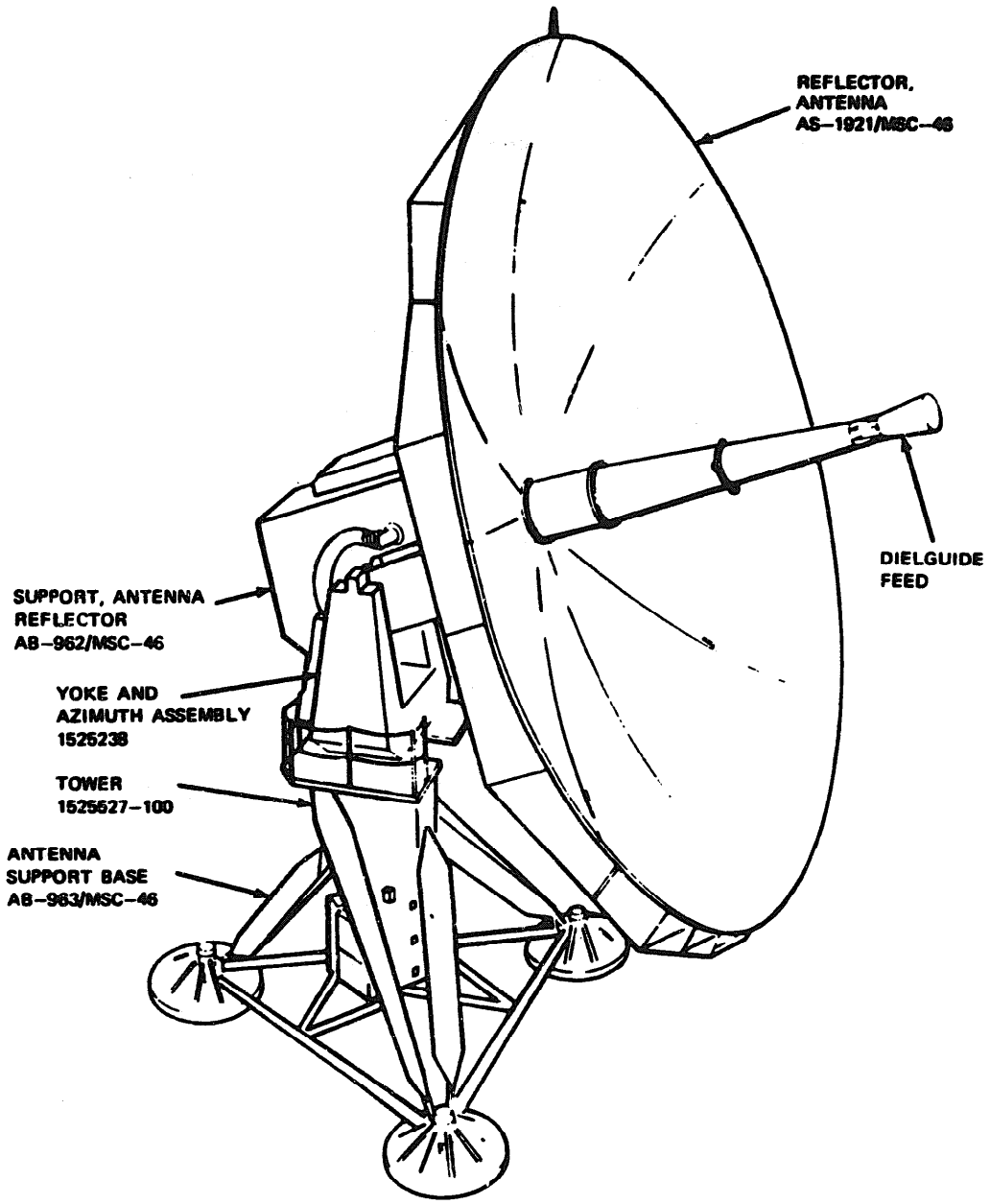


Figure 1-4 ① . Satellite communications terminal AN/MSC-46 (nodal and non-nodal), equipment identification (sheet 1 of 6).

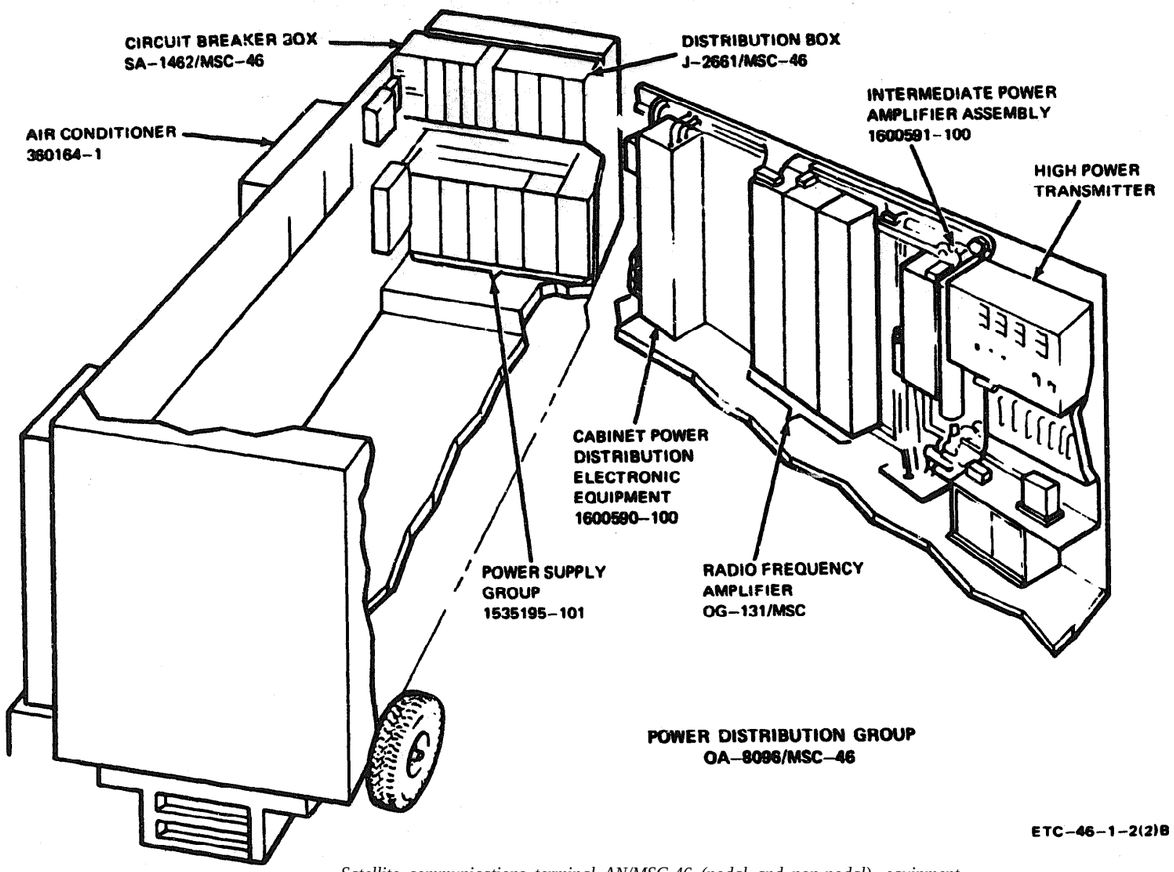


Figure 1-4 (2). Satellite communications terminal AN/MSC-46 (nodal and non-nodal), equipment identification (sheet 2 of 6).

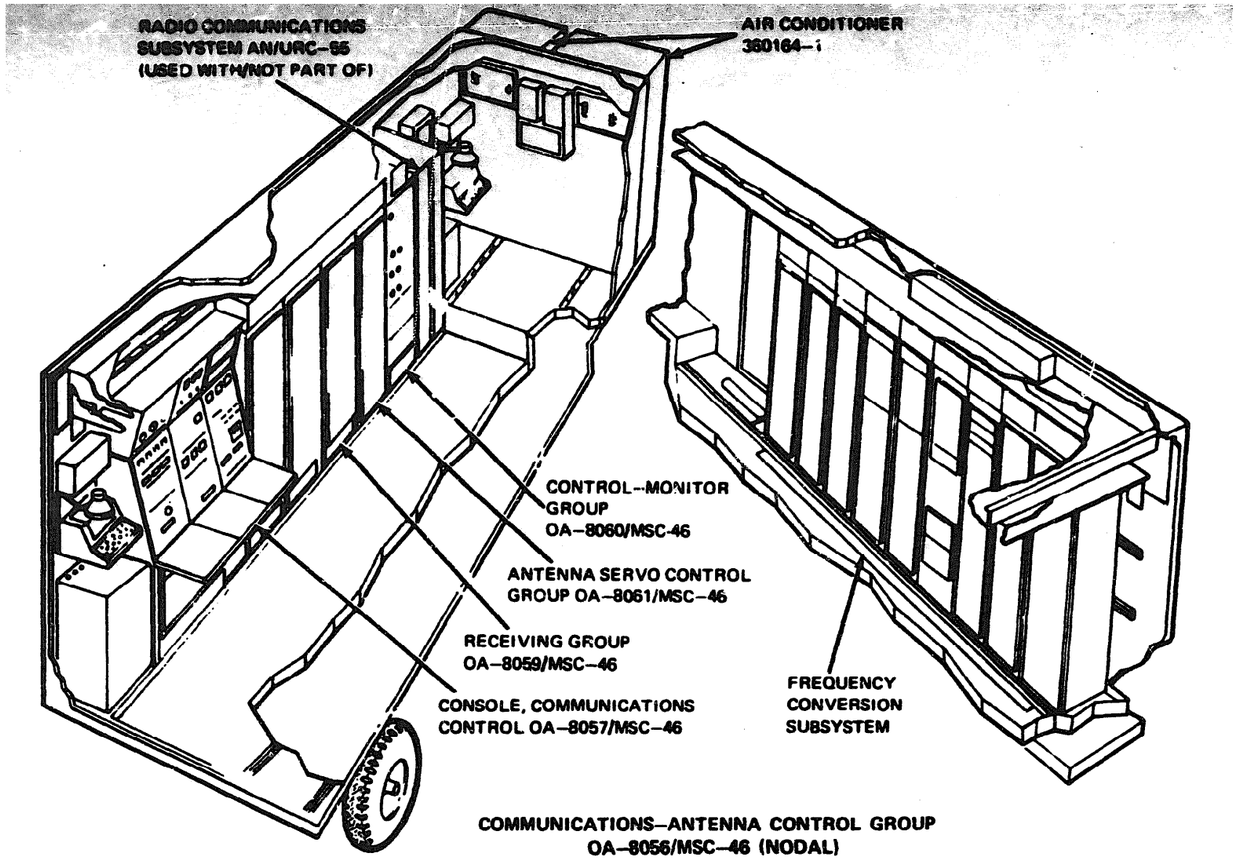


Figure 1-4 (3). Satellite communications terminal AN/MSC-46 (nodal and non-nodal), equipment identification (sheet 3 of 6).

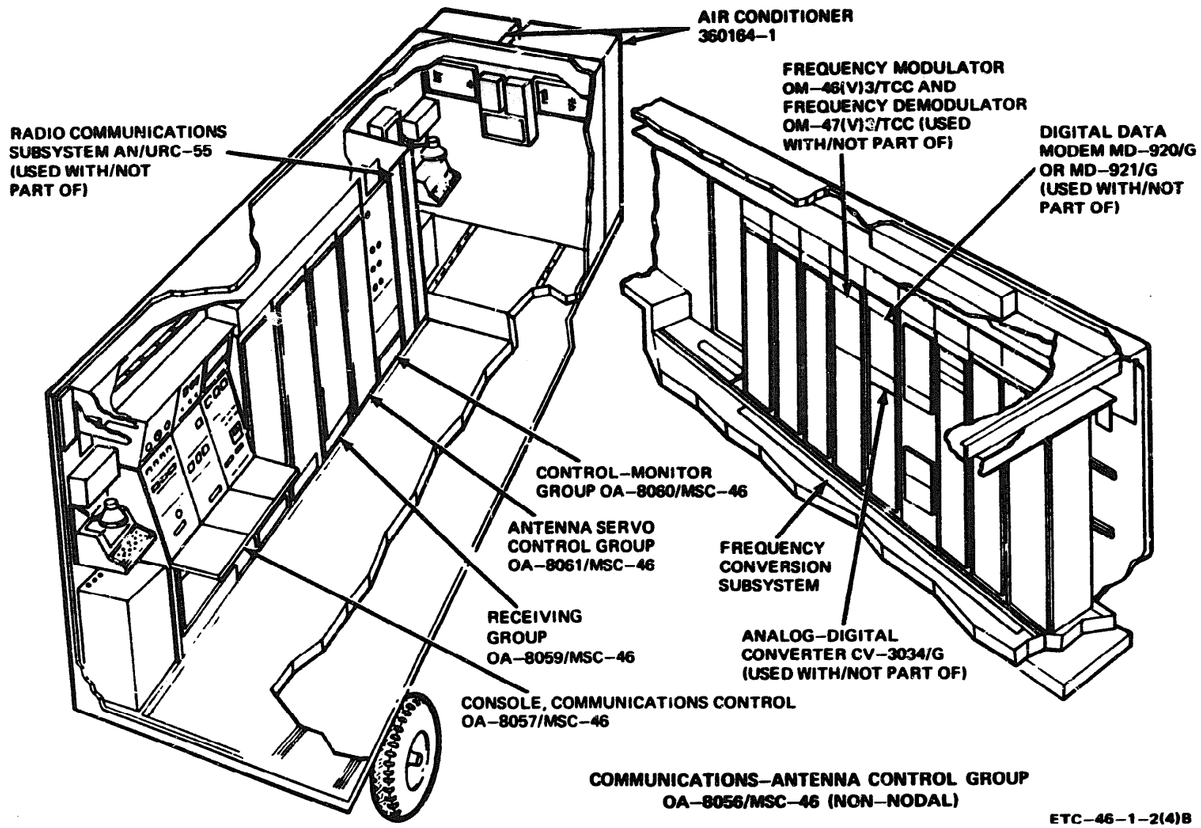
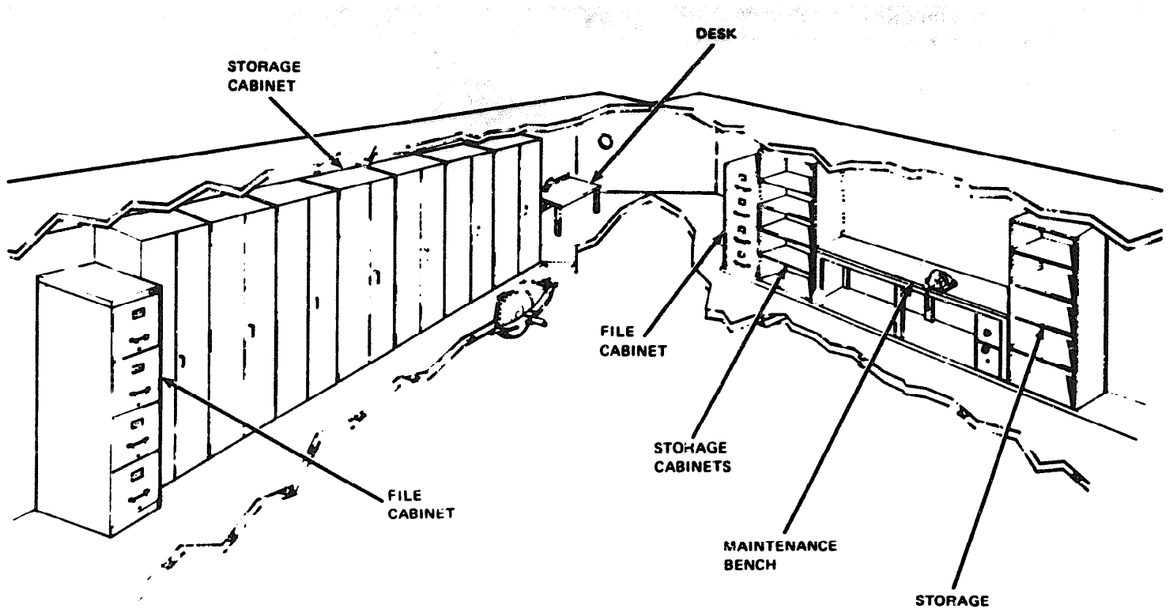


Figure 1-4. Satellite communications terminal AN/MSC-46 (nodal and non-nodal), equipment identification (sheet 4 of 6).



ELECTRONIC EQUIPMENT MAINTENANCE SHOP
OA–8069/MSC–46

ETC–46–1–2(5)B

Figure 1-4 ⑤ Satellite communications terminal AN/MSC-46 (nodal and non-nodal), equipment identification (sheet 5 of 6).

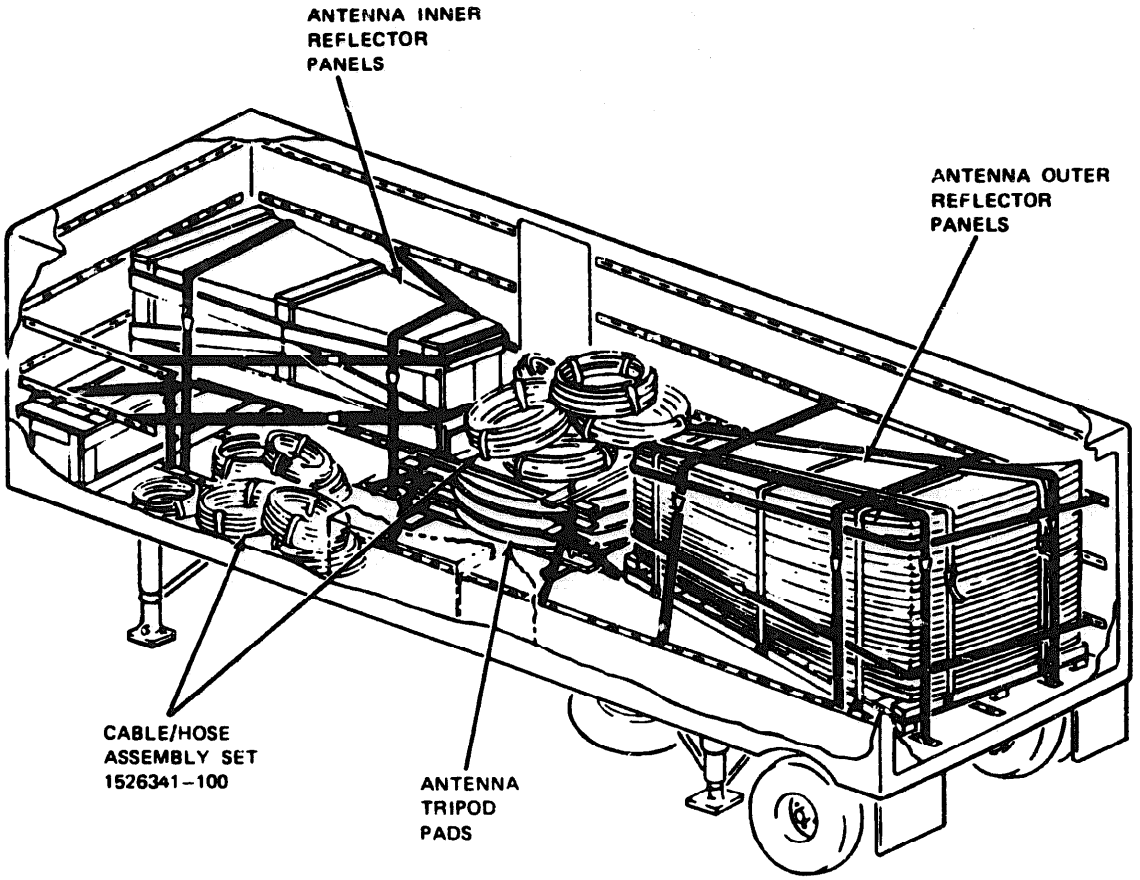


Figure 1-4 (6). Satellite communications terminal AN/MSC-46 (nodal and non-nodal), equipment identification (sheet 6 of 6).

1-10. Radio Communications Subsystem AN/URC-55

The Radio Communications Subsystem AN/URC-55 is a spread spectrum multiple access (SSMA) modem which provides an anti-jam capability through spread spectrum modulation techniques. Refer to figure 1-4 (1) and (4), for equipment location. The Radio Communications Subsystem AN/URC-55 consists of the following Major Subgroups.

a. Link Terminal Timing Central (LTTC).
b. Doppler Augmentor Range Corrector.
c. Transmitter.
d. Receiver No. 1.
e. Receiver No. 2.
f. Link Simulator-Test Adapter.

1-11. Multiplexer Set AN/TCC-78 (Nodal) (fig. 1-5)

The Multiplexer Set AN/TCC-78 processes the TCF baseband signals providing the IF interface with the Satellite Communications Terminal AN/MSC-46 (Nodal). The Multiplexer Set AN/TCC-78 consists of the following Major Subgroups.

a. Multiplexer AN/UCC-4(V).
b. Modem Group OM-45(V)1/TCC.
c. Frequency Modulators OM-46(V)1/TCC and Frequency Demodulators OM-47(V)1/TCC.
d. Voice Orderwire Equipment.
e. DC Telegraph Equipment.
f. Line Conditioning Equipment.

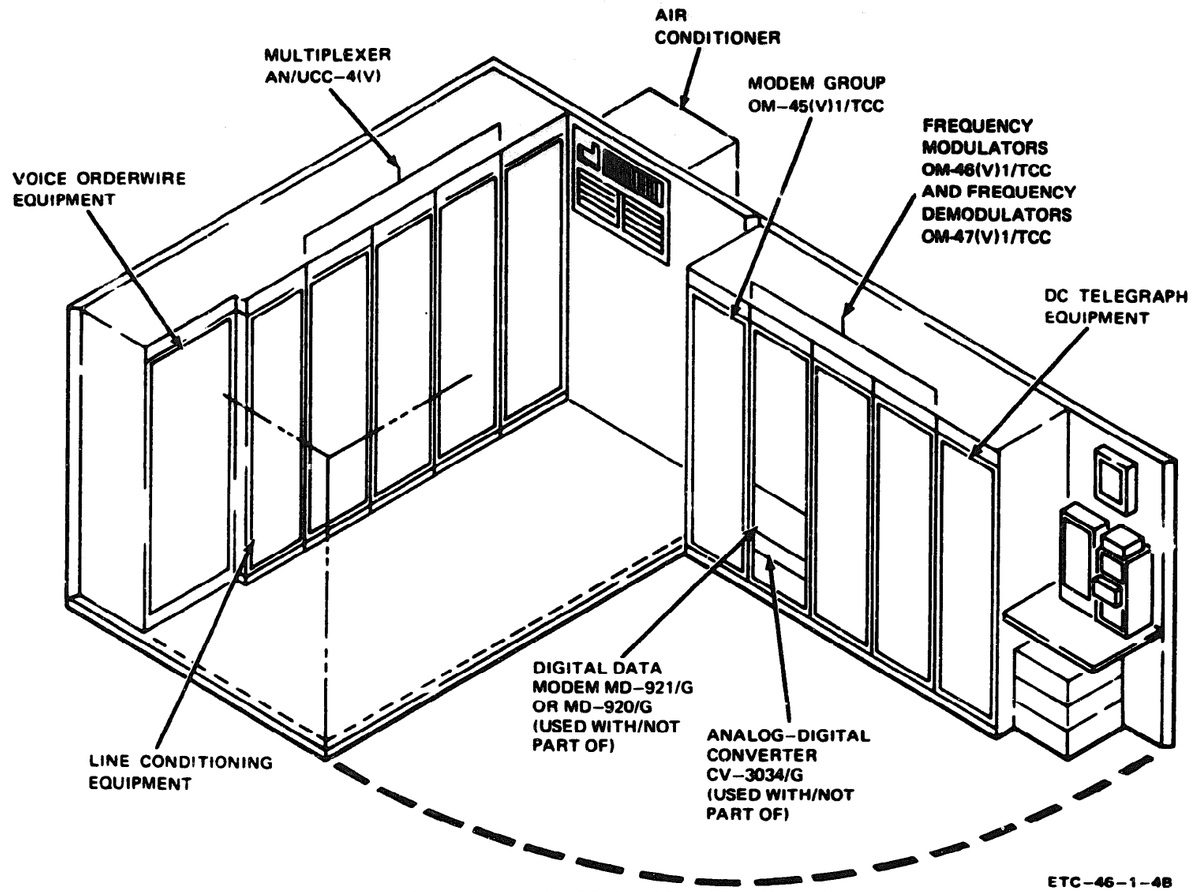


Figure 1-5. Multiplexer set AN/TCC-78 (nodal) equipment identification.

1-12. Non-Nodal Communications Subsystem (fig. 1-6)

The Non-Nodal Communications Subsystem processes TCF and user baseband signals providing the FM interface with the Satellite Communications Terminal AN/MSC-46 (Non-Nodal). The Frequency Modulator OM-46(V)3/TCC and Frequency Demodulator OM-47(V)3/TCC are mounted externally in the Communications-Antenna Control Group OA-8056/MSC-46 (Non-Nodal), (fig. I-4 ④). The Non-Nodal Communications Subsystem consists of the following Major Subgroups.

a. Multiplexer AN/FCC-55.

b. Frequency Modulator OM-46(V)3/TCC and Frequency. Demodulator OM-47(V)3/TCC.

c. Voice Orderwire Equipment.

d. Line Conditioning Equipment.

1-13. Digital Data Modem MD-920/G

The Digital Data Modem MD-920/G (ICF Modem) provides the digital interface between the user and the Digital Data Modem MD-921/G (PSK Modem). This allows the user to be located remotely. Refer to figure 1-5 for location in a ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal). Refer to figure 1-4④, for location in an FTC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal).

1-14. Digital Data Modem MD-921/G

The Digital Data Modem MD-921/G (PSK Modem) processes the digital data from the user into a phase-shifted keyed (PSK) signal. This provides the IF. interface with Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). Refer to figure 5 for location in an ETC Using the Satellite communications Terminal AN/MSC-46 (Nodal). Refer to figure 1-4 ④ for location in an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal).

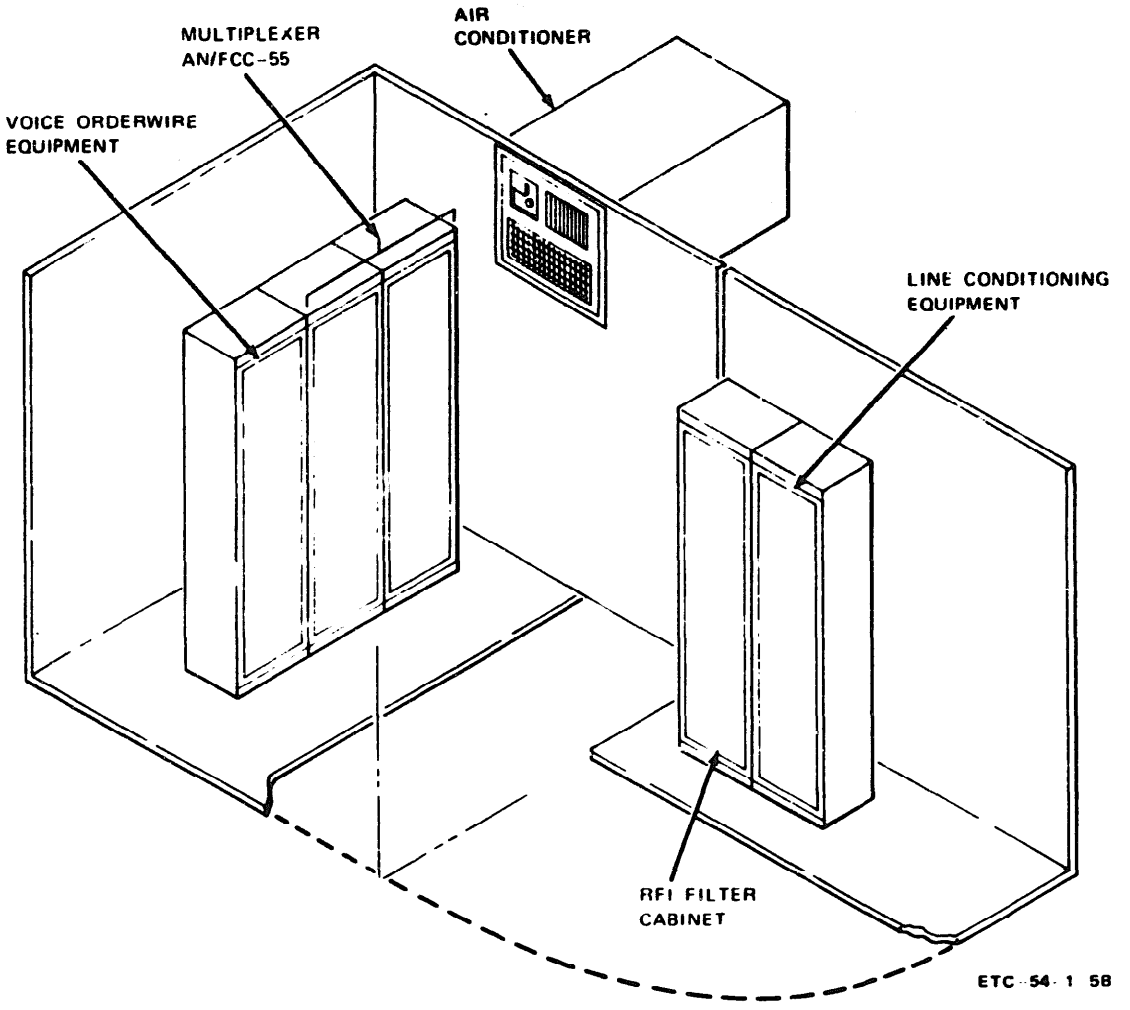


Figure 1-6. Non-nodal communications subsystem equipment identification.

1-15. Analog-Digital Converter CV-3034/G

The Analog-Digital Converter CV-3034/G processes analog (voice) or 50 kbs secure voice signals providing the digital interface to/from the Digital Data Modem MD-921/G (PSK Modem). Refer to figure 1-5 for location in an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal). Refer to figure 1-4 ④, for location in an ETC Using Satellite Communications Terminal AN/MSC-46 (Non-Nodal).

1-16. Diesel Engine Generator Sets PU-495/G

The Diesel Engine Generator Sets PU-495/G provide ac prime power to the ETC when commercial power is not available. Refer to figure FO-1 for location of Diesel Engine Generator Sets PU-495/G in an ETC configuration.

CHAPTER 2

ETC PLANNING AND INSTALLATION PROCEDURES

Section I. INSTALLATION PLANNING PROCEDURES

2-1. Planning Considerations.

Deployment of an ETC is by direction of the Joint Chiefs of Staff (JCS) through the Defense Communications Agency (DCA). Consideration is given to mission requirements, available geographical site locations and satellite position.

2-2. Installation Planning Procedures

The following subparagraph provide basic requirements to be considered in site selection for an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal).

a. Site Selection. ETC side selection in governed by mission requirements. However, when selecting a site, consideration should also be given to the following:

(1) The ETC site should be a relatively level area clear of gullies, ditches, trees or other overhead obstructions. The area should be large enough to accommodate the Complex equipment as well as a 220 foot by 40 foot ground field, a 100 foot minimum straight roadway 10 to 12 feet wide leading to the antenna area, and a 66 foot by 115 foot staging area adjacent to the antenna roadway.

(2) If helicopter support is required, additional space should be provided that is clear of overhead obstructions, loose material and debris.

(3) The slope of the land should be considered For adequate drainage of the site area during heavy rains. The accepted minimum standard is a slope of no less than 2 degrees.

(4) The site area should have terrain features which have to provide protection from high winds and inclement weather. The possible effects of drifting snow due to prevailing winds should be carefully considered.

(5) The site area should be accessible to terminal support vehicles.

(6) When possible, the ETC should be located away from electrical interference sources such as radar sets, field hospitals, X-ray equipment and power transmission lines.

b. Soil Cons&ration. The soil requirements set up for an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) are rigid due to the point accuracy required of the antenna system. Any shift or settling of antenna support pads will require alignment of the antenna. These soil requirements have been established to include a soil load requirement of 4,000 pounds per square foot with a bulk modulus of 250 pounds per square inch. A soil or clay surface (rather than rock) is desirable to facilitate ground field installation. Marshy areas should be avoided.

c. Site Clearing and Earth Grading. In most cases, ETC sites will require some preparation prior to installation of the equipment. This must be considered in the site selection. When possible, a site should be cleared of all obstructions that could possibly impair operation of the Complex. Earth moving operations might be required to insure proper drainage of the site. Leveling jacks on the antenna tripod are designed to correct for a slope of up to 5°. This must also be considered when grading the area designated for the antenna. Ditches, ravines and gullies should not be filled in, even when dry. They provide natural drainage during heavy rains and filling them may create a flooding hazard on the site.

d. Installation of Ground Field. Installation of the ETC site ground field should be accomplished prior CO the installation and interconnection of the ETC equipment. It is normally done during site clearing and earth grading operations. With the ground field established, each piece of equipment can be properly grounded at the time of it's installation. This reduces the hazard of electrical shock. Location of the ground field should be such that it will not interfere with normal operation and maintenance of the diesel engine generator sets, operation of the ETC equipment or power and signal cables. Refer to figure FO-1 for location of the ground field in a typical ETC site configuration.

2-3. Service Upon Receipt and Equipment Placement

Upon arrival at the site, the ETC equipment vans are positioned within a staging area for unloading. After the equipment stored in the vans for transport has been unloaded, inventoried and inspected for damage, the vans are moved into position. When the site location is in the northern hemisphere, the

antenna pedestal should be positioned such that the area of interest (the area the antenna faces) is toward the equator (south), at zero cable wrap. When the site location is in the southern hemisphere, the area of interest is to the north. The order in which the vans are moved into position is provided below. Refer to figure FO-1 for placement of FTC vans for optimum performance.

a. Antenna AS-1920/MSC-46.

b. Power Distribution Group OA-8096/MSC-46.

c. Communications Antenna Control group OA-8056/MSC-46.

d. Cargo Container Assembly HAC PN 1572297.

e. Electronic Equipment Maintenance Shop OA-8069/MSC-46.

2-4. Equipment Requirements for Installation

A list of test equipment required for the installation of an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) are contained in appendix B.

2-5. Equipment Installation and Cable Interconnection

This paragraph provides the sequence for installation and interconnection of the Major Subsystems and Major Subgroups of the ETC. Interconnect cable lists for the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) are provided in tables 2-1 and 2-2 respectively. Refer to figures FO-4 and FO-5 for interconnect cabling diagrams for typical ETC site configurations.

a. ETC Equipment Installation. Installation of the ETC Equipment should be performed in the order as listed below. Detailed procedures for installation are contained in applicable equipment technical manuals. Refer to appendix A for a list of applicable technical manuals.

(1) Ground field installation (para. 2-2d) Refer to IM 11-5895-539-12.

(2) Equipment placement (IM 11-5895-539-12).

(3) Ground strap installation.

WARNING

Ground field ground straps must be installed on each major unit (Power Distribution Group OA-8096/MSC-46, Communications-Antenna Control Group OA-8056/MSC-46, Antenna AS-1920/MSC-46 and Electronic Equipment Maintenance Shop OA-8069/MSC-46) before proceeding with equipment installation and cable interconnection. Ground potential differences may exist between major units if they are not properly grounded resulting in a serious electrical hazard to personnel. Ensure that ground straps are installed on each of the following units as it is installed and before proceeding to the next unit.

(4) Air Conditioner 360164-1 (transmitter van air conditioner) installation (IM 11-5895-539-12).

(5) Liquid Cooler Heat Exchanger HD-955/GR (LPA heat exchanger) installation (IM 11-5895-539-12).

(6) Filter, Particle, Electronic Coolant 1606941-100 (HPA/LPA in-line coolant filter) installation (IM 11-5895-539-12).

(7) Cooler, Liquid Electron Tube HD-742/MSC-46 (HPA heat exchanger) installation (IM 11-5895-539-12).

(8) Air Conditioner 360164-1 (LPA air conditioner) installation (IM 11-5895-539-12).

(9) Cooling Unit 360065-1 installation (IM 11-5895-539-12).

(10) Central building construction (IM 11-5895-539-12).

(11) Multiplexer Set AN/TCC-78 (Nodal) or Non-Nodal Communications Subsystem installation (IM 11-5895-539-12).

(12) Diesel Engine Generator Sets PU-495/G (IM 11-5895-539-12).

b. ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) Cable Interconnection. During interconnection, connect both ends of a cable or hose prior to connection of another cable or hose. Check connections to ensure that excessive pressure is not exerted on the connector and that the cable or hose is not resting on sharp objects. Refer to tables 2-1 and 2-2 for listings of interconnect cables and wiring for the ETC's and figures FO-4 and FO-5 for interconnect cable diagrams.

(1) Generator cable set 1525103-100. Connect the Diesel Engine Generator Sets PU-495/G to the Satellite Communications Terminal AN/MSC-46 (Nodal) using Generator Cable Set 1525103-100. For detailed interconnection procedures refer to IM 11-5895-539-12.

(2) Cable, hose assembly set 1526341-100. Interconnect the Major Subgroups of the Satellite Communications Terminal AN/MSC-46 (Nodal) using the Cable, Hose Assembly Set 1526341-100. For detailed interconnection procedures refer to IM-11-5895-539-12.

(3) Multiplexer set AN/TCC-78 (nodal) interconnect cables. Interconnect the Multiplexer Set AN/TCC-78 with the Communications-Antenna Control Group OA-8056/MSC-46 (Nodal) User Interface Panel 1616664 using Multiplexer Set AN/TCC-78 interconnect cables.

(4) Commercial power hook-up. When the system is to be operated from commercial power, interconnect the commercial power source with the

Power Distribution Group OA-8096/MSC-46 (transmitter van) Circuit Breaker Box SA-1462/MSC-46. For detailed interconnect procedures refer to IM 11-5895-539-12.

c. ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) Cable Interconnection.

(1) Generator cable set 1525103-100. Connect the Diesel Engine Generator Sets PU-495/G to the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) using Generator Cable Set 1525103-100. For detailed interconnecting procedures refer to IM 11-5895-539-12.

(2) Cable, hose assembly set 1526341-100. Interconnect the Major Sub-Groups of the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) using the Cable, Hose Assembly Set 1526341-100. For detailed interconnection procedures refer to IM 11-5895-539-12.

(3) Non-Nodal communications subsystem interconnect cables. Interconnect the Non-Nodal Communications Subsystem with the Communications-Antenna Control Group OA-8056/MSC-46 (Non-Nodal) User Interface Panel 1616664 using Non-Nodal Communications Subsystem interconnect cables.

(4) Commercial power hook-up. When the system is to be operated from commercial power, interconnect the commercial power source with the Power Distribution Group OA-8096/MSC-46 (transmitter van) Circuit Breaker Box SA-1462/MSC-46. For detailed interconnection procedures refer to IM 11-5895-539-12.

d. Waveguide Interconnection. Waveguide interconnection of the Antenna AS-1920/MSC-46, Power Distribution Group OA-8096/MSC-46 (transmitter van) and Communications-Antenna Control Group OA-8056/MSC-46 (OCV) is the same for Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). For detailed waveguide interconnection procedures refer to IM 11-5895-539-12.

e. Antenna AS-1920/MSC-46 (Nodal and Non-Nodal) Installation.

WARNING

Prior to applying prime power to the ETC, verify that all equipment has been properly grounded.

Preliminary installation of the Antenna AS-1920/MSC-46 can be started before ETC cable interconnection is completed. However, antenna tower erection requires 120 V ac, 50/60 Hz, 3-phase power to operate the Portable Controller 360163 (controller) and Motor Driven Ball Screw Actuator 360146 (ball screw actuator), therefore ETC cable interconnection and generator power application must be completed before antenna installation can be finished. For detailed Antenna AS-1920/MSC-46 installation and generator power application procedures refer to IM-11-5895-539-12.

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W8	1525635	P18	J18	OCV, Interconnecting Box J-2641/MSC-46	P30	J30	Antenna, Interconnecting Box J-2640/MSC-46	
W11	1525638	P2	J2	↕	P64	J64	↕	
	↕	P4	J4		P70	J70		
		P6	J6		P68	J68		
		P8	J8		P72	J72		
		P10	J10		P66	J66		
W11	1525638	P12	J12	OCV, Interconnecting Box J-2641/MSC-46	P74	J74	Antenna, Interconnecting Box J-2640/MSC-46	
W12	1525639	P16	J16	OCV, Control Monitor Group OA-8060/MSC-46	P9	J9	Transmitter van, Circuit Breaker Box SA-1462/MSC-46	
W13	1525640	P50	J50	OCV, Interconnecting Box J-2641/MSC-46	P50	J50	Antenna, Interconnecting Box J-2640/MSC-46	
	↕	P52	J52	↕	P48	J48	↕	
		P60	J60		P54	J54		
W13	1525640	P62	J62	OCV, Interconnecting Box J-2641/MSC-46	P52	J52	Antenna, Interconnecting Box J-2640/MSC-46	
W36	1525784	P5	J5	Maintenance van, AC Power Panel	P2	J2	Generator Intercom Station	
W48	1525931-003	P40	J40	OCV, Interconnecting Box J-2641/MSC-46	P26	J26	Antenna, Interconnecting Box J-2640/MSC-46	
W49	1525931-004	P38	J38	↕	P18	J18	↕	

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W51	1525925	P22	J22	OCV, Interconnecting Box J-2641/MSC-46	P8	J8	Antenna, Interconnecting Box J-2640/MSC-46	
W52	1525926	P2	J2	Transmitter van, Circuit Breaker Box SA-1462/MSC-46	P2	J2	Cooler, Liquid Electron Tube HD-742/MSC-46	
W53	1525941	P5	J5	Transmitter van, Circuit Breaker Box SA-1462/MSC-46	P1	J1	Maintenance van, AC Power Panel	
W55	1525929-001	P4	J4	Transmitter van, Circuit Breaker Box SA-1462/MSC-46	P1	J1	Antenna, Power Distribution Panel	
W56	1525929-002	P7	J7	↕	P13	J13	OCV, Control Monitor Group OA-8060/MSC-46	
W57	1525931-001	P1	J1	Transmitter van, Circuit Breaker Box SA-1462/MSC-46	P14	J14		
W58	1525931-002	P4	J4	Transmitter Van, Distribution Box J-2661/MSC-46	P15	J15	OCV, Control Monitor Group OA-8060/MSC-46	
W61	1525934-002	P26	J26	OCV, Interconnecting Box J-2641/MSC-46	P2	J2	Maintenance van, AC Power Panel	
W63	1525934-003	P28	J28	↕	J1	P1	Generator Intercom Station	
W64	1525934-00[illegible]	P32	J32		P44	J44	Antenna, Interconnecting Box J-2640/MSC-46	
W105	1525979	P42	J42	OCV, Interconnecting Box J-2641/MSC-46	P20	J20	Antenna, Interconnecting Box J-2640/MSC-46	

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W130		P10	J10	Transmitter van, Circuit Breaker Box SA-1462/MSC-46	P12	J12	Antenna, Power Distribution Panel	
W146	1525736-012	P54	J54	OCV, Interconnecting Box J-2641/MSC-46	P3	J3	Maintenance van, AC Power Panel	
W147	1525770-013	P44	J44	OCV, Interconnecting Box J-2641/MSC-46	P4	J4	Maintenance van, AC Power Panel	
W224	1529762-1	P1	J1	Transmitter van, Distribution Box J-2961/MSC-46	L0, L1, L2, L3	L0, L1, L2, L3	Diesel Engine Generator Set PU-495/G (Gen No. 1)	
W225	1529762-2	P1	J2	Transmitter van, Distribution Box J-266 MSC-46	L0, L1, L2, L3	L0, L1, L2, L3	Diesel Engine Generator Set PU-495/G (Gen No. 2)	
W226	1529762-3	P1	J3	Transmitter van, Distribution Box J-2661/MSC-46	L0, L1, L2, L3	L0, L1, L2, L3	Diesel Engine Generator Set PU-495/G (Gen No. 3)	
W227	1529763-1	P3	J5	Transmitter van, Distribution Box J-2661/MSC-46	P1 P2	J1 J2	Diesel Engine Generator Set PU-495/G (General No. 1)	
W228	1529763-2	P3	J6	Transmitter van, Distribution Box J-2661/MSC-46	P1 P2	J1 J2	Diesel Engine Generator Set PU-495/G (Gen. No. 2)	
W229	1529763-3	P3	J7	Transmitter van, Distribution Box J-2661/MSC-46	P1 P2	J1 J2	Diesel Engine Generator Set PU 495/G (Gen. No. 3)	
*W249	1535691-001	P20	J20	OCV, Control Monitor Group OA-8060/MSC-46	P1	J1	Antenna, Controller Portable 360163-1	

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
*W250	1535691-002	P2	J2	Antenna, Controller, Portable 360163-1	P1	J1	Antenna, Motor Driven Ball Screw Actuator 360146-1	
*W251	1535704	P3	J3	Antenna, Controller Portable 360163-1	P2	J2	Antenna, Motor Driven Ball Screw Actuator 360146-1	
W273	1541626-002		E1	Antenna, Power Distribution Panel			Ground	
W274	1541626-003		E1	OCV, Control Monitor Group OA-8060/MSC-46			Ground	
W275	1541626-001		E5	Transmitter van, Distribution Box J-2661/MSC-46			Ground	
W276	1541626-004		E1	Maintenance van, AC Power Panel			Ground	
W277	1541626-005		Ground Terminal	Diesel Engine Generator Set PU-495/G (Gen No. 1)			Ground	
W278	1541626-006		Ground Terminal	Diesel Engine Generator Set PU-495/G (Gen No. 2)			Ground	
W279	1541626-007		Ground Terminal	Diesel Engine Generator Set PU-495/G (Gen No. 3)			Ground	
W280	1541626-010		E1	Antenna, Power Distribution Panel		E6	OCV, Interconnecting Box J-2641/MSC-46	

*This cable is used during installation and preparation for reshipment of the Antenna AS-1920/MSC-46 and is stored in the bin at the rear of the antenna bogey.

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W401	1614918	P1	J27	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J1 (REMOTE CONTROL)	Cooler, Liquid Electron Tube HD-742/MSC-46	
W402	1614919	P1	J26	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J1	Liquid Cooler, Heat Exchanger HD-955/GR	
W403	1614920	P1	J24	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100		TB1	Liquid Cooler, Heater Exchanger HD-955/GR	
W404	1614921	P1	J28	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J2	Air Conditioner 360164-1 (LPA air conditioner)	
W405	1614922	P1	J22	↕	P2	J3	Air Conditioner 360164-1 (LPA air conditioner)	
W406	1614923	P1	J30	Transmitter van, Cabinet Power Distribution Electronic Equipment 1600590-100	P2	J1	Cable W413	
W407	1614924	P1	J33	Transmitter van, Cabinet Power Distribution Electronic Equipment 1600590-100	P2	J86	OCV, Interconnecting Box J-2641/MSC-46	

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
	↕	P1	J34	↕	P2	J88	↕	
		P1	J35		P2	J90		
		P1	J36		P2	J92		
		P1	J37		P2	J78		
W407	1614924	P1	J38	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J80	OCV, Interconnecting Box J-2641/MSC-46	
W408	1614925-1		E2	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100			Ground	
W409	1614926	P1	J29	↕	P2	J82	OCV, Interconnecting Box J-2641/MSC-46	
W410	1614927	P1	J31	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J84	OCV, Interconnecting Box J-2641/MSC-46	
W411	1614928	P1	J25	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J14	Cable W135 Ref High Voltage Warning Light	
W412	1614929	P1	J32	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	P2	J94	OCV, Interconnecting Box J-2641/MSC-46	

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W413	1614956	P1	J20	OCV, Interconnecting Box J-2641/MSC-46	J1 J2	P2 P1	Cable W406 Cable W415	
W414	1614957	P1	J36	Antenna, Interconnecting Box J-2640/MSC-46	P2	J96	OCV, Interconnecting Box J-2641/MSC-46	
W415	1614958	P1	J2	Cable W413	P2	J40	Antenna, Interconnecting Box J-2640/MSC-46	
W416	1614959	P1	J98	OCV, Interconnecting Box J-2641/MSC-46	P2	J38	Antenna, Interconnecting Box J-2640/MSC-46	
W417	1616611-1		E2	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100		E1	Liquid Cooler, Heat Exchanger HD-955/GR	
W418	1616611-2		E1	Liquid Cooler Heat Exchanger HD-955/GR		E1	Air Conditioner 360164-1 (LPA air conditioner)	
W01	SMF-736301-1	P1	J10	Mulitplexer Set AN/TCC-78, Signal Panel 1A5	P2	J48	OCV, User Interface Panel 1616664	50'
W04	SMF-736301-2	P1	J03	Mulitplexer Set AN/TCC-78, Signal Panel 1A5	P2	J49	OCV, User Interface Panel 1616664	50'
W07	SMF-736302		J05	Multiplexer Set AN/TCC-78, Signal Panel 1A5		J10	OCV, User Interface Panel 1616664	50'
W08	SMF-736303-1		J31	Multiplexer Set AN/TCC-78, Signal Panel 1A3		A1J2	OCV, User Interface Panel 1616664	50' 50'

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W09	SMF-736303-2		J32			A2J2		50'
W10	SMF-736303-3		J33			A3J2		50'
W11	SMF-736303-4		J34			A4J2		50'
W12	SMF-736303-5		J23			A5J2		50'
W13	SMF-736303-6		J24			A6J2		50'
W14	SMF-736303-7		J25	Multiplexer Set AN/TCC-78, Signal Panel 1A3		A7J2	OCV, User Interface Panel 1616664	50'
W15	SMF-736303-8		J26	Multiplexer Set AN/TCC-78, Signal Panel 1A3		A8J2	OCV, User Interface Panel 1616664	50'
W16	SMF-736303-9		J27			A9J2		50'
W17	SMF-736303-10		J28			A10J2		50'
W18	SMF-736303-11		J29			A11J2		50'
W19	SMF-736303-12		J30			A12J2	OCV, User Interface Panel 1616664	
W20	SMF-736304-1		J09				Interconnect Facility	100'
W21	SMF-736304-2		J10	Multiplexer Set AN/TCC-78, Signal Panel 1A3			Interconnect Facility	100'
W22	SMF-736304-3		J11	Multiplexer Set AN/TCC-78, Signal Panel 1A3			Interconnect Facility	100'

Table 2-1. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)-Continued

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W23	SMF-736304-4		J12					100'
W24	SMF-736304-5		J13					100'
W25	SMF-736304-6		J14					100'
W26	SMF-736304-7		J15					100'
W27	SMF-736304-8		J16					100'
W28	SMF-736304-9		J17					100'
W29	SMF-736304-10		J18				Interconnect Facility	100'
W30	SMF-736304-11		J19	Multiplexer Set AN/TCC-78, Signal Panel 1A3			Interconnect Facility	100'
W31	SMF-736304-12		J20					100'
W32	SMF-736304-13		J21					100'
W33	SMF-736304-14		J22	Multiplexer Set AN/TCC-78, Signal Panel 1A3			Interconnect Facility	100'
W34	SMF-736305-1		J03	Mulitplexer Set AN/TCC-78, Power Panel 1A4		J23	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	100'
W36			E1	Multiplexer Set AN/TCC-78, Signal Panel 1A5			Ground Rod	50'

Table 2-2. Interconnect Cables and Wiring for ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal)

Cable No.	Part No.	Cable P or J No. (from)	Panel or J box P or J No. (from)	Major subsystem/ subgroup panel or J box identification (from)	Cable P or J no. (to)	Panel or J box P or J No. (to)	Major subsystem/ subgroup panel or J box identification (to)	Cable Length
W1 to W418				Same as for Nodal Terminal			Same as for Nodal Terminal	
NNW 001	SMF-736466		J2	Non-Nodal Communications Subsystem, Signal Panel 1A1			User Input	
NNW 002	SMF-736467		J10	↕			OCV, User Interface Panel 1616664	
NNW 003			J8				User Input	
NNW 004			J9	Non-Nodal Communications Subsystem Signal Panel 1A1			User Input	
NNW 005			J1	Non-Nodal Communications Subsystem, Signal Panel 1A1			OCV, User Interface Panel 1616664	
NNW 006			J7	↕			↕	
NNW 008			J3			J36		
NNW 009			J4	Non-Nodal Communications Subsystem, Signal Panel 1A1		J37	OCV, User interface Panel 1616664	
	SMA-733441-1		J1	Non-Nodal Communications Subsystem, Power Panel 1A2		J23	Transmitter van, Cabinet Power Distribution, Electronic Equipment 1600590-100	

Section II. PREPARATION FOR USE

2-6. General

This section provides the sequence for preliminary visual inspections, prime power application and. subsystem turn-on and checkout of the ETC. Procedures are provided in applicable manuals listed in appendix A.

2-7. Preliminary Visual Inspections of the ETC

Prior to application of power to the ETC, visual inspections contained in applicable technical manuals should be made to locate any obvious damage. Special attention should be given to the following:

a. Electrical Inspections.

(1) Insure that the commercial power source and Diesel Engine Generator Sets PU-495/G are OFF.

(2) Check that all equipment is properly grounded to the station ground.

b. Mechanical Inspections.

(1) Check that all equipment is securely mounted and that mountings and hardware are tight.

(2) Check all equipment for signs of oil leaks and proper lubricant levels (IM 11-5895-539-12 and TM 5-6115-293-12/TO 35C2-3-329-1).

(3) Check heat exchangers for proper coolant levels (IM 11-5895-539-12).

(4) Check for obvious damage to van exteriors, antenna reflector, and dielguide feed system.

c. Power Inspection.

(1) Verify that all main power circuit breakers and power distribution panel circuit breakers are set to OFF.

(2) Verify that all equipment front panel switches are set to OFF.

(3) Verify that all connections from the commercial power source and Diesel Engine Generator Sets PU-495/G are correct and that the connections are tight and not damaged. Refer to figures FO-4 and FO-5 for interconnect cable diagrams.

d. Interconnect Cable Inspections.

(1) Check all interconnect cables for proper installation and tight connection. Refer to table 2-1 or 2-2 for cable listing.

(2) Check all interconnect cables for damage or possible cutting by installation vehicles.

(3) Check all interconnect cable connections for undue stress and ensure that protective covers are installed at cable entrance panels.

2-8. AC Power Application

Prior to subsystem turn-on and checkout, ac power must be applied to the ETC and connections from commercial power source and Diesel Engine Generator Sets PU-495/G must be verified for proper phase relationship as described in IM 11-5895-539-12. Remote control of Diesel Engine Generator Sets PU-495/G and power distribution checks must be performed. The ac power application sequence and checks are contained in chapter 3, section I I.

2-9. Subsystem Turn-On and Checkout

a. General. This paragraph provides the turn-on and checkout sequences for the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). For detailed turn-on and checkout procedures for ETC subsystems refer to applicable equipment technical manuals.

b. Order of Turn-On and Checkout for an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal). The following turn-on and checkout procedures ensure that the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) meets operational requirements.

(1) Perform generator power application in accordance with IM 11-5895-539-12. If commercial power is available; turn-on, checkout and secure Diesel Engine Generator Sets PU-495/G, then apply commercial power.

(2) Perform commercial power application in accordance with IM 11-5895-539-12.

(3) Perform Satellite Communications Terminal AN/MSC-46 (Nodal) turn-on and checkout in accordance with IM 11-5895-539-12.

(4) Perform Multiplexer Set AN/TCC-78 (Nodal) turn-on and checkout in accordance with DTM 11-5895-796-12-1.

(5) Perform Radio Communications Subsystem AN/URC-55 turn-on and checkout in accordance with IM 11-5895-544-12.

(6) Perform Digital Data Modem MD-920/G (ICF Modem) turn-on and checkout in accordance with DTM 11-5820-804-12

(7) Perform Digital Data Modem MD-92 (PSK Modem) turn-on and checkout in accorda with DTM 11-5820-803-12

(8) Perform Analog-Digital Converter 3034/G turn-on and checkout in accordance with 11-5895-797-14.

c. Order of Turn-On and Checkout for an E Using the Satellite Communications Termi AN/MSC-46 (Non-Nodal). The following turn and checkout procedures for the ETC Using Satellite Communications Terminal AN/MSC

(Non-Nodal) insure that subsystem equipment is operational and that output levels meet operational requirements.

(1) Perform generator power application in accordance with IM 11-5895-539-12. If commercial power is available; turn-on, checkout and secure Diesel Engine Generator Sets PU-495/G. then apply commercial power.

(2) Perform commercial power application in accordance with IM 11-5895-529-12.

(3) Perform Satellite Communications Terminal AN/MSC-46 (Non-Nodal) turn-on and checkout in accordance with IM 11-5895-539-12.

(4) Perform Non-Nodal Communications Subsystem turn-on and checkout in accordance with DTM 11-5895-796-12-2.

(5) Perform Radio Communications Subsystem AN/URC-55 turn-on and checkout in accordance with IM 11-5895-544-12.

(6) Perform Digital, Data Modem MD-920/G (ICF Modem) turn-on and checkout in accordance with DTM 11-5820-804-12.

(7) Perform Digital Data Modem MD-921/G (PSK Modem) turn-on and checkout in accordance with DTM 11-5820-803-12.

(8) Perform Analog-Digital Converter CV-3034/G turn-on and checkout in accordance with IM 11-5895-797-14.

Section III. ANALYSIS AND SYSTEM CHARACTERIZATION

2-10. General

Upon completion of turn-on and checkout of individual subsystems, ETC system adjustments and characterization tests are performed. These tests and adjustments ensure that the ETC meets performance standards prior to entering the satellite network. A list of the tests and adjustments is provided below.

a. Tests as cited in DCA Circular 310-70-57, Supplement 6, for performance by the Technical Evaluation Program (TEP) team.

b. Tests as cited in DCA Circular 831-70-( ) for performance by each ETC.

c. ETC System Adjustments.

d. Link Performance Tests.

2-11. Tests for Performance by TEP Team

A comprehensive set of performance-measurement test procedures are provided in DCA Circular 310-70-57, Supplement 6. Selected tests from this circular may be performed by the TEP team as directed by the SATCOM Net Controller.

2-12. Tests for Performance by each ETC

A catalog of tests which may be requested by the SATCOM Net Controller to establish/confirm ETC performance baseline are included in DCA Circular 831-70-( ). These tests fall into three categories provided below.

a. Tests to be performed prior to establishing each link.

b. Tests to be performed immediately after establishing each link.

c. Tests to be performed periodically.

2-13. ETC System Adjustments

ETC system adjustments are performed to insure that interface signal levels between Major Subsystems are correct. These adjustments should not be attempted until turn-on and checkout procedures for individual subsystems have been completed. ETC system adjustments include setting; IF interface levels, receive baseband gain, RF transmit frequency and RF receive frequency. Detailed ETC System Operating Procedures are provided in chapter 3, section II.

2-14. ETC Transmit Power Calibration

Transmission of multiple carriers through a single repeater satellite requires that power allocations be assigned to each transmit carrier. Prior to accessing the satellite, it is necessary to calibrate each Electronic Frequency Up-Converter CV-3084/MSC-46 RF POWER meter. Such calibration is essential for multiple carriers and is recommended even for single carrier assignments. This insures that addition of carriers and substitution of the spare up-converter can be accomplished with minimum system outage. For multiple carriers, this calibration permits setting, readjustment and monitoring individual carrier powers without interrupting transmissions. Detailed Transmit Power Calibration procedures are contained in chapter 3, section II.

2-15. Link Performance Tests

Control of the satellite assets requires that certain indicators of FTC performance be reported to the SATCOM Net Controller. These reports enable the Controller to maintain correct satellite power distribution and thus provide the desired communication services. The most useful parameter for determining overall performance of an FM link is the circuit test tone-to-noise ratio (TTNR). Routine measurement of TTNR is not practical since it requires interruption of traffic channels. Performance of FM channels can be characterized by measuring Out-of-Band Noise (OBN). OBN is

monitored to note any substantial change in system performance. Spread Spectrum Multiple Access (SSMA) link performance is monitored using equipment threshold margin meters. PSK link performance is monitored using Bit Error Rate.

Section IV. PREPARATION FOR RESHIPMENT

2-16. General

This section provides information relating to disassembly and preparation for reshipment of the ETC. The following paragraphs provide the sequence for disconnecting cables, removing equipment and loading equipment vans for transport. If a radome is installed, the O & M Service will arrange for its disassembly and reshipment. Refer to Transportation and Storage Plan, appendix II, of Logistic Support Plan for Earth Terminal Complex Using Staellite Communications Terminal AN/MSC-46, Phase II Stage lb and applicable technical manuals for detailed procedures.

2-17. ETC Cable Disconnection and Equipment Removal

This paragraph provides the order in which ETC cables are disconnected and equipment removed. Detailed procedures are contained in applicable technical manuals.

a. Waveguide Component Disassembly.

CAUTION

Extreme care must be exercised when removing any part of the waveguide subsystem. The flanges should be covered with the proper sized plastic caps to prevent dust and dirt from entering the waveguide and protect the flanges from mechanical damage. If plastic caps are not available, barrier material may be placed over the end of the waveguide and held in place with tape. Tape should not be applied over flanges.

The disassembly procedure for waveguide is approximately the reverse of the installation procedure. Each component should be identified and packed with mounting hardware as it is removed. Refer to IM 11-5895-539-12 for detailed procedures or waveguide component removal.

b. Antenna AS-1920/MSC-46 Disassembly. Handling fixtures and crates should be brought to the antenna area prior to disassembly. As components are moved and inspected for damage, they can be immediately crated for transport. Preliminary lowering of the Antenna AS-1920/MSC-46 requires 120 V ac, 50/60 Hz, 3-phase power to operate the Portable Controller 360163 (controller) and Motor Driven Ball Screw Actuator 360146 (ball screw actuator). Preliminary lowering, therefore, must be accomplished prior to cable disconnection. Refer to IM 11-5895-539-12 for detailed procedures on Antenna AS-1920/MSC-46 disassembly.

c. Air Conditioner 360164-1 (Transmitter Van Air Conditioner) Removal. The Power Distribution Group OA-8096/MSC-46 (transmitter van) cannot be made ready for transit until the Air Conditioner 36016-1 (transmitter van air conditioner) is removed. Prior to removal, the transmitter van air conditioner should be pumped down to prevent the loss of refrigerant and all cable and hose assemblies disconnected (IM 11-5895-539-12).

d. Air Conditioner 360164-1 (LPA Air Conditioner) Removal. Prior to removal, the Air Conditioner 360164-1 (LPA air conditioner) should be pumped down to prevent the loss of refrigerant and all cable and hose assemblies disconnected (IM 11-5895-539-12).

e. Cooler, Liquid Electron Tube HD-742/MSC-46 (HPA Heat Exchanger) Removal. Prior to removal, all cable and hose assemblies should be disconnected and excess coolant drained (IM 11-5895-539-12).

f. Filter, Particle, Electron Coolant 1606941-100 (HPA/LPA In-Line Coolant Filter) Removal. Prior to removal, all cable and hose assemblies should be disconnected and excess coolant drained (IM 11-5895-539-12).

g. Liquid Cooler Heat Exchanger HD-955/GR (LPA heat exchanger) Removal. Prior to removal, all cable and hose assemblies should be disconnected and excess coolant drained (IM 11-5895-539-12).

h. Cooling Unit 260065-1 Removal. Prior to removal, all cable and hose assemblies should be disconnected (IM 11-5895-539-12).

i. ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) Cable Disconnection.

WARNING

Prior to disconnecting any cable insure that the Diesel Engine Generator Sets PU-495/G have been turned off, all commercial power circuit breakers have been set to OFF and all circuit breakers that control power for the assemblies to be disconnected are set to OFF. Serious injury or death can result from power being applied to the cable during disconnection.

The procedure for disconnecting interconnect cables and wiring is in general the reverse of the installation

procedures. Care should be taken to prevent damage to cable connectors. Protective covers should be installed. After all cables have been disconnected, protective covers should be installed on the van distribution boxes. ETC cable assemblies should be disconnected in the following order:

(1) Generator Cable Set 1525103-100.

(2) Cable, Hose Assembly Set 1526341-100.

(3) Multiplexer Set AN/TCC-78 (Nodal) or Non-Nodal Communications Subsystem interconnect cables.

(4) Commercial power cable.

2-18. Van Close Down and Loading

When preparing the vans for movement; van air conditioners should be pumped down, tire pressure checked, and leveling jacks retracted and stowed. Electrical systems such as running lights, turn indicators and brake lights should be checked. Wheel chocks should be removed and stowed in compartments provided. The vans are then towed to the staging area for loading. Detailed van close down and loading procedures are contained in applicable technical manuals. The desired loading sequence for equipment vans is as follows:

a. Electronic Equipment Maintenance Shop OA-8069/MSC-46 (maintenance van). Refer to IM 11-5895-539-12.

b. Power Distribution Group OA-8096/MSC-46 (transmitter van (IM 11-5895-539-12).

c. Communications-Antenna Control Group OA-8056/MSC-46 (OCV) (IM 11-5895-539-12).

d. Cargo Container Assembly HAC PN 1572297 (storage van) (IM 11-5895-539-12).

e. Antenna Installation Alteration Trailer 1547764 (bogey) (IM 11-5895-539-12).

f. Multiplexer Set AN/TCC-78 (Nodal) or Non-Nodal Communications Subsystem. Refer to IM 11-5895-796-12-1 or IM 11-5895-796-12-2, respectively.

g. Diesel Engine Generator Set PU-495/G (TM 5-6115-293-12/TO 35C2-329-1).

CHAPTER 3

OPERATION

Section I. OPERATIONAL CAPABILITIES AND LIMITATIONS

3-1. General

This section defines the maximum and minimum capabilities of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). Special capabilities provided at selected terminals only are also identified.

3-2. Capability and Limitations of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal)

a. The ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) is capable of handling a maximum of 21 RF carriers. These carriers are processed by Electronic Frequency Up-Converters CV-3084/MSC-46 and Electronic Frequency Down-Converters CV-3085/MSC-46. In its maximum configuration, an ETC will contain six Electronic Frequency Up-Converters CV-3084/MSC-46 providing six transmit communications carriers. A maximum of fifteen Electronic Frequency Down-Converters CV-3085/MSC-46 provide fourteen receive communications carriers and one receive beacon carrier. The beacon carrier is dedicated to the Receiving Group OA-8059/MSC-46 (tracking receiver cabinet). The ETC provides a maximum output power of 5 kW nominal into the feed using the high Power Transmitter (HPA). A maximum output power of 1 kW nominal into the feed is available using the Radio Frequency Amplifier OG-131/MSC (LPA). The actual measured maximum output power is dependent upon waveguide component losses and will differ between ETC's. The ETC is capable of handling transmit frequencies in the range of 7.9 to 8.4 GHz. The ETC receive frequency range is 7.25 to 7.75 GHz.

b. The Multiplexer Set AN/TCC-78 (Nodal) provides three FM transmit trunks using Frequency Modulators OM-46(V)1/TCC and seven FM receive trunks using Frequency Demodulators OM-47(V)1/TCC. Each trunk is capable of handling from three to forty-eight FM voice channels plus an FM voice orderwire. Channel capacity is selected through use of preset modules. Channel, group and supergroup patch facilities provide interface flexibility to the ETC.

c. The Digital Data Modem MD-921/G (PSK Modem) is capable of transmitting and receiving data from 19.2 kbs to 9.9999 Mbs.

d. The Radio Communications Subsystem AN/URC-55 provides a spread-spectrum multiple access (SSMA) capability to the ETC. The SSMA capability supports high priority communications under conditions of severe electronic environment. The Radio Communications Subsystem AN/URC-55 provides up to four voice or digital channels plus a TTY orderwire circuit. A built-in time transfer unit (TTU) feature can be utilized to perform Precise Time and Time Interval (PTTI) measurements for accurate time transfer.

e. At selected points throughout the ETC, switchable and patchable spare equipment has been provided. Therefore, service can be quickly restored in the event of failure or degradation of on-line units. The High Power Transmitter (HPA) and Radio Frequency Amplifier OG-131/MSC (LPA) capabilities, however, are not identical. The LPA, whose output is 1 kW nominal at the feed, provides an instantaneous bandwidth of 500 MHz. The HPA, whose output is 5 kW nominal at the feed, is limited in bandwidth to approximately 125 MHz for each of five channels. In addition to switchable and patchable spare equipment, alternate configuration modes are available. These modes permit either full or limited communications capability in the event of equipment degradation or failure. Some examples of alternate configuration modes are; reduced FM channel density and quality, use of SSMA during severe electronic conditions and manual antenna tracking when autotrack capability is lost.

3-3. Capability and Limitations of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal)

a. In a typical configuration, an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) contains two Electronic Frequency Up-Converters CV-3084/MSC-46 providing two transmit communications carriers. Three Electronic Frequency Down-Converters CV-3085/MSC-46, provide two receive communications carriers and one receive beacon carrier. The beacon carrier is dedicated to the Receiving Group OA-8059/MSC-46

(tracking receiver cabinet). The ETC provides a maximum output power of 5 kW nominal into the feed using the High Power Transmitter (HPA). A maximum output power of 1 kW nominal into the feed is available using the Radio Frequency Amplifier OG-131/MSC (LPA). The actual measured maximum output power is dependant upon waveguide component losses and will differ between ETC's. The ETC transmit frequency range is 7.9 to 8.4 GHz. The ETC receive frequency range is from 7.25 to 7.75 GHz.

b. The Non-Nodal Communications Subsystem provides one FM transmit trunk using the Frequency Modulator OM-46(V)3/TCC and one FM receive trunk using the Frequency Demodulator OM-47(V)3/TCC. The FM trunk provides from three-to forty-eight FM voice channels plus an FM voice order-wire. Channel capacity is selectable through use of preset modules.

c. The Digital Data Modem MD-921/G (PSK Modem) is capable of transmitting and receiving data from 19.2 kbs to 9.9999 Mbs.

d. The Radio Communications Subsystem AN/URC-55 provides a spread-spectrum multiple access (SSMA) capability to the ETC. The SSMA capability supports high priority communications under conditions of severe electronic environment. The Radio Communications Subsystem AN/URC-55 provides up to four voice or digital channels plus a TTY orderwire circuit. A built-in time transfer unit (TTU) feature can be utilized to perform Precise Time and Time Interval (PTTI) measurements for accurate time transfer.

e. At selected points throughout the ETC, switchable and patchable spare equipment has been provided. Therefore, service can be quickly restored in the event of failure or degradation of the on-line unit. 'The High Power Transmitter (HPA) and the Radio Frequency Amplifier OG-131/MSC (LPA) capabilities, however, are not identical. The LPA, whose, output is 1 kW nominal at the feed, provides an instantaneous bandwidth of 500 MHz. The HPA, whose output is 5 k W nominal at the feed, is limited in bandwidth to approximately 125 MHz for each of five channels. In addition to switchable and pat-&able spare equipment, alternate configuration modes are available. These modes permit either full or limited communications capability in the event of equipment degradation or failure. Some examples of alternate configuration modes are: reduced FM channel density and quality, use of SSMA during severe electronic conditions and manual antenna tracking when autotrack capability is lost.

3-4. Special Capabilities Provided at Selected ETC's

At selected ETC's, additional equipment has been installed to provide support to the SATCOM Net Controller.

a. At selected ETC's, a Beacon Signal Demodulator and Display Unit (beacon display unit) is installed at the Communications Control Console OA-8057/MSC-46. The beacon display unit demodulates and displays the satellite command word transmitted on the earth coverage (EC) beacon. For front panel illustration, providing beacon display unit Operator controls and indicators, refer to IM 11-5895-539-12.

b. At designated primary or secondary Net Control Terminals, additional equipment has been installed to provide a monitoring capability. The monitor equipment provides information required by the SATCOM Net Controller. The Controller can control the assets of the satellite, identify and analyze system problems and direct restorations using this equipment. The monitor equipment consists of a manual and/or automatic spectrum analyzer with its supporting equipment. The monitor equipment shares, on a non-interferring basis, the ETC's receive antenna and parametric amplifier. The monitor equipment normally interfaces with the ETC at the RF Patch Panel.

Section II. SYSTEM OPERATING PROCEDURES

3-5. General

This section contains system operating procedures that are performed by the ETC Operator. These procedures assist the Operator in fulfilling his primary responsibility; providing a highly reliable, full-time communications link to the Defense Satellite Communications System (DSCS). In performing his duties, the Operator will continuously monitor the coverall performance of the ETC. The Operator must respond to directions of the SATCOM Net Controller, identify, and react to ETC degradtion or failure symptoms. In addition, the Operator will maintain station logs and make status reports as necessary. To satisfactorily perform these duties, the Operator must be thoroughly familiar with the capabilities, limitations and available configurations of the ETC equipment. The Operator must be thoroughly familiar with key indicators of system performance and quickly respond to audible and visual indications of degradation or failure.

a. Operator Duties. During routine operation of the ETC, the Operator is responsible for performing the following tasks:

(1) Monitor overall system performance. A list of key indicators to be used in monitoring overall operation of the ETC is provided in table 3-3. The Operator must be thoroughly familiar with the location and established normal indication for each of these indicators. In addition, the Operator should remain alert to detect audible and visual indicators of degraded equipment performance.

(2) Respond to directions of the SATCOM Net Controller. To maintain the communications quality of assigned circuits, the Operator may be directed by the SATCOM Net Controller to change transmit power, reconfigure ETC equipment or perform measurements and tests on an unscheduled basis. To insure a timely response to these requests, the Operator should be thoroughly familiar with the established procedures for measurement and adjustment of link parameters.

(3) Identify and react to ETC degradation or failure symptoms. The ETC has a full time commitment to its assigned mission. Therefore, it is essential that the Operator be prepared to restore equipment operation as quickly as possible. At key points throughout the system. switchable or patchable spare units have been provided. The Operator should be thoroughly familiar with those units having standby replacements and procedures for placing them on-line to restore service.

(4) Maintain logs and make reports as required.

(5) At selected Net Control Terminals, the Operator may be assigned additional tasks in the operation of the Automatic Spectrum Analyzer HP 8580B and Manual Spectrum Analyzer AIL707.

b. Operating Restrictions. The ETC must be operated within established restrictions and unauthorized radiation prevented. Therefore, the Operator should be thoroughly familiar with and observe the following restrictions:

(1) Unless specifically directed by the SATCOM Net Controller, no transmission is authorized other than at assigned carrier power, frequency and mode during assigned schedule.

(2) Unless specifically directed by the SATCOM Net Controller, no transmission is authorized in any direction other than assigned satellite.

(3) Unless specifically authorized by the SATCOM Net Controller, no carrier will be transmitted without normal modulation. This requires that the Frequency Modulator OM-46(V)( )/TCC dispersal generator be turned on. The Digital Data Modem MD-921/G (PSK Modem) must not be allowed to transmit a steady single-state carrier. The Radio Communications Subsystem AN/URC-55 must not be allowed to transmit a coherent (non-spread) carrier.

(4) Unless specifically directed by the SATCOM Net Controller, no changes will be made to equipment configuration that will alter uplink power, frequency or deviation.

(5) During non-transmitting periods when satellite tracking is maintained, beam power will be removed from the on-line power amplifier.

3-6. ETC Normal Configuration

This paragraph provides the recommended configuration of ETC switchable and patchable equipment. The recommended readiness condition of off-line spare equipment is also provided.

a. Power Amplifier Configuration. Due to bandwidth limitations of the High Power Transmitter (HPA). it is recommended that the Radio Frequency Amplifier OG-131/MSC (LPA) be selected as on-line power amplifier. When in standby, it is recommended that the HPA heat exchanger, filament power and Ion pump be turned on. Beam power should be turned off and the appropriate klystron channel selected for the highest priority link assignment. The standby power amplifier should be tested off-line, daily, as provided in IM 11-5895-539-12, to maintain readiness confidence.

b. Intermediate Power Amplifier Configuration. Selection of the on-line Intermediate Power Amplifier (IPA) is left to the preference of the site supervisor. Normal configuration of the LPA/HPA Select Panel on the Communications Control Console OA-8057/MSC-46 is TRANSMITTER SELECT, IPA NORM. In this configuration, IPA No. 1 is connected to High Power Transmitter (HPA) and IPA No. 2 is connected to Radio Frequency Amplifier OG-131/MSC (LPA). The standby IPA should be tested off-line, daily as provided in IM 11-5895-539-12, to maintain readiness confidence.

c. Electronic Frequency Up-Converter CV-3084/MSC-46 Configuration. The Electronic Frequency Up-Converters CV-3084/MSC-46 (up-converters) are patched and adjusted to meet mission requirements. Selection of up-converters to meet these requirements is left to the preference of the site supervisor. It is recommended that any spare up-converters be turned on, with their RF OUTPUT switch set to OFF-LINE position. The spare up-converters should be adjusted to the assigned carrier frequency and power level of the highest priority link assignments.

d. Electronic Frequency Down-Converter CV-3085/MSC-46 Configuration: The Electronic Frequency Down-Converters CV-3085/MSC-46 (down-converters) are patched and adjusted to meet

mission requirements. Selection of down-converters to meet these requirements is left to the preference of the site supervisor. It is recommended that any spare down-converters be turned on and tuned to the carrier frequency of the highest priority link assignments.

e. Interfacilities Link Amplifier Assembly Configuration. The selection of the on-line Interfacilities Link Amplifier (IFL Amplifier) is left to the preference of the site supervisor. The standby IFL amplifier should be tested off-line, weekly to maintain readiness confidence. The on-line IFL amplifier should be tested for gain during Preventive Maintenance Downtime (PMDT).

f. Parametric Amplifier AM-6602/MSC-46 Configuration. The selection of the on-line Parametric Amplifier AM-6602/MSC-46 (paramp) is left to the preference of the site supervisor. It is recommended that the off-line paramp be turned on and maintained at operating temperature. This will avoid a delay in service restoration when the on-line paramp fails. The off-line paramp should be exchanged with on-line during each PMDT period to maintain readiness confidence.

g. Frequency Modulators OM-46(V) ( )/TCC and Frequency Demodulators OM-47 (V) ( )/TCC Configuration. The Frequency Modulators OM-46(V) ( )/TCC and Frequency Demodulators OM-47(V) ( )/TCC are patched and configured to meet mission requirements. It is recommended that any spare Frequency Modulators OM-46(V) ( )/TCC and Frequency Demodulators OM-47(V) ( )/TCC be turned on. Appropriate plug-in modules should be installed to support the highest priority link assignment.

h. Digital Data Modem MD-921/G (PSK Modem). The Digital Data Modem MD-921/G (PSK Modem) is patched and configured to meet mission requirements. If the assigned mission does not require its use, the PSK Modem should be turned off.

i. Radio Communications Subsystem AN/URC-55. The Radio Communications Subsystem AN/URC-55 is patched and configured to meet mission requirements. When the assigned mission does not require its use, it is recommended that it be turned on and maintained operational. It should be connected back-to-back through the Link Simulator-Test Adapter to maintain readiness confidence.

j. Receiving Group OA-8059/MSC-46 (Tracking Receiver Cabinet). Normally both tracking receivers are patched to the Electronic Frequency Down-Converter CV-3085/MSC-46 dedicated to the Receiving Group OA-8059/MSC-46 (Tracking receiver cabinet). Therefore, antenna tracking error signals to the Antenna Servo Control Group OA-8061/MSC-46 are not interrupted when one tracking receiver fails. In the event of failure, the failed tracking receiver should be turned off. Its input signal patch should be removed until troubleshooting and repair can be accomplished.

k. Performance Monitoring Equipment. An FM out-of-band noise monitor as described in paragraph 5-7 should be maintained on-line when there is an FM mission. It is recommended that a suitable spectrum analyzer be configured to monitor the satellite downlink as described in paragraph 5-9.

3-7. Preoperational Procedures

This paragraph provides the recommended sequence of operations to be followed in preparing the ETC for operation. This sequence assumes turn-on and checkout procedures referenced in paragraph 2-9 have been accomplished and that mission configuration instructions have been received.

a. Verify all Frequency Modulators OM-46(V) ( )/TCC and Frequency Demodulators OM-47(V) ( )/TCC have appropriate plug-in modules installed. Verify Frequency Modulator OM-46(V) ( )/TCC dispersal generators are operating by observing CARRIER DEVIATION meters indicate between -3 dB and 0 dB.

b. Remove all analog or digital inputs to Frequency Modulators OM-46(V) ( )/TCC, Radio Communications Subsystem AN/URC-55 and Digital Data Modem MD-921/G to prevent the possible transmission of undesired signals.

c. Verify that the IF. Patch Panel has been configured to meet mission requirements.

d. Perform Frequency Modulator OM-46(V) ( )/TCC IF output level adjustment as provided in paragraph 3-8.

e. Verify Frequency Demodulator OM-47(V) ( )/TCC, DEMOD BB AMPL A4 module attenuators S1 and S2 are set for 14 dB attenuation. When returning to operation after a short non-operational period, verify S1 and S2 are set to 14 ±3 dB. Verify MANUAL OVERRIDE switch is set to OFF. Refer to DTM 11-5895-796-34-1 for parts location illustration.

f. Change. as necessary, Electronic Frequency Up-Converter CV-3084/MSC-46 and Electronic Frequency Down-Converter CV-3085/MSC-46 operating frequency as provided in paragraph 3-9 and 3-10 to meet mission requirements.

g. Acquire and autotrack the assigned communications satellite as provided in paragraph 3-11.

h. Perform Electronic Frequency Up-Converter CV-3084/MSC-46 IF input level adjustment as provided in paragraph 3-12.

i. Perform ETC transmit power calibration as provided in paragraph 3-13.

j. When scheduled receive RF carriers are available from associated partner ETC's, verify and set receive IF. signal levels as follows:

(1) At each Frequency Demodulator OM-47(V) ( )/TCC, set input attenuator (AT1) for 0 dB indication on CARRIER INPUT LEVEL meter. Once set, input attenuator AT1 should not be changed to compensate for short term changes in signal strength. Refer to table 3-1 for the minimum amount of attenuation, that should be set into input attenuator (AT1) for the assigned mode. Insufficient attenuation indicates probable degradation of receive system gain and may prevent operation in lower channel capacity modes. Refer to DTM 11-5895-796-34-1 for illustration providing location of input attenuator (AT1).

(2) At the Digital Data Modem DM-921/G (PSK Modem), set METER selector switch to AGC position. Verify MONITOR meter indicates on scale; adjust, if necessary, using procedure provided in DTM 11-5820-803-12.

k. Perform FM, PSK and URC link establishment procedures as provided in paragraphs 3-15, 3-16 and 3-17.

l. Verify that the order-wire patch panel has been configured meet mission requirements and establish orderwire communications.

m. At each Frequency Demodulator OM-47(V) ( )/TCC, adjust DEMOD BB AMPL A4 module attenuators as provided in paragraph 3-20.

n. Upon completion of link establishment, perform the following measurements and report results to the SATCOM Net Controller as required by DCA Circular 831-70-( ).

(1) At each Frequency Demodulator OM-47(V) ( )/TCC, perform a Test Tone-to-Noise Ratio (TTNR) measurement as provided in paragraph 5-6.

Table 3-1. Frequency Demodulator OM-47(V)( )/TCC Input Attenuator (AT1) Minimum Settings

Channel capacity	At 1 minimum setting
3T	5 dB
6T	6 dB
9T	7 dB
3	8 dB
6	10 dB
9	10 dB
12	13 dB
24	15 dB
36	16 dB
48	17 dB
72	18 dB

(2) At the Digital Data Modem MD-921/G (PSK MODEM) perform a Digital Error Rate measurement as provided in paragraph 5-8.

(3) At the Radio Communications Subsystem AN/URC-55, verify that DB MARGIN meters indicate nominal threshold margins.

(4) At each Electronic Frequency Down Converter perform a Noise Power Density Measurement as provided in paragraph 5-10.

o. At this point, if the results of any of the measurements performed above are abnormal, the SATCOM Net Controller may require readjustment of carrier powers as provided in paragraph 3-13. If FM receive carrier levels are changed, j(1) above should be repeated for the associated Frequency Demodulator OM-47(V)( )/TCC.

p. Verify that the following upper and lower trip set alarms are set as indicated below or as directed by the SATCOM Net Controller:

(1) Electronic Frequency Up-Converter CV-3084/MSC-46, RF POWER meters set to assigned carrier level ±0.5 dB.

(2) LPA/HPA Select Panel, TOTAL POWER METER set to authorized total power ±1 dB.

(3) Frequency Modulator OM-46(V) ( )/TCC, CARRIER OUTPUT LEVEL meter set to ±0.5 dB of current normal indication, within 2 dB of center scale.

(4) Frequency Modulator OM-46(V) ( )/TCC, CARRIER DEVIATION meter set to ±1 dB of current normal indication, within 2 dB of center scale.

(5) Frequency Demodulator OM-47(V) ( )/TCC, CARRIER INPUT LEVEL meter set to 0 ±2 dB.

(6) Frequency Demodulator OM-47(V) ( )/TCC, CARRIER DEVIATION meter set to ±1 dB of current normal indication, within 2 dB of center scale.

(7) If Out-of-Band Nosie (OBN) monitor meter is equipped with a trip-set alarm, it should be set to normal indication ±2 dB.

q. Upon completion of testing. notify the associated Technical Control Facility (TCF) that trunk is ready for TCF to TCF testing and link characterization tests.

3-8. Frequency Modulator OM-46(V) ( )/ TCC IF Output Level Adjustment

To establish a standard IF interface level. Frequency Modulator OM-46(V) ( )/TCC outputs are adjusted to 0 dBm using output attenuator (AT1). The output attenuator (AT1) is located at the inside top rear of the Frequency Modulator OM-46(V) ( )/TCC cabinet. Refer to DTM 11-5895-796-34-1 for location drawing.

a. On each Frequency Modulator OM-46(V) ( )/TCC to be adjusted, set output attenuator (AT1) for 20 dB attenuation.

b. Turn-on and warmup an RF power meter, Boonton 42B or equivalent.

c. At the IF Patch Panel 7A1, located in the Communications-Antenna Control Group OA-8056/MSC-46 (OCV), remove looping plug associated with Frequency Modulator OM-46(V) ( )/TCC to be adjusted. Connect RF power meter, set to read 0 dBm in its place.

d. Set the output attenuator (AT1) on the Frequency Modulator OM-46(V) ( )/TCC for a 0 dBm indication on the power meter. Verify that the output attenuator (AT1) is set to 20 db ±3 dB; if out of tolerance, refer to DTM 11-5895-796-34-1 for troubleshooting and repair procedures.

e. Verify that the dispersal generator ON/OFF switch S1, located on the MOD BB AMPL A2 module is set to ON.

f. Repeat steps c. through e. for remaining Frequency Modulators OM-46(V) ( )/TCC if applicable.

g. Reconnect 50-ohm coaxial looping plugs removed in step c.

3-9. Electronic Frequency Up-Converter CV-3084/ MSC-46 Frequency Change Procedure

Upon receipt of transmit carrier frequency assignments, it may be necessary to change the operating frequency of the Electronic Frequency Up-Converter CV-3084/MSC-46 as provided below. For front panel illustration providing Electronic Frequency Up-Converter CV-3084/MSC-46 controls and indicators, refer to IM 11-5895-539-12.

a. On front panel of Electronic Frequency Up-Converter CV-3084/MSC-46 requiring frequency change, set RF OUTPUT switch of OFF-LINE.

b. Insure that POWER ON/OFF switch is set on ON and observe that POWER ON lamp is lit.

c. Set TRANSMIT FREQUENCY SELECTOR MHZ thumbwheel switches to new operating frequency.

d. Check status of RF LEVEL and RF LO lamps and RF AUDIBLE alarm. Observe that lamps are lit and audible alarm sounds.

e. Press and hold down AUDIBLE ALARM DEFEAT pushbutton to silence audible alarm.

f. Set status selector switch to RF LO TUNE and adjust TRANSMIT FREQ FINE TUNE control for center-scale indication on STATUS meter.

g. Release AUDIBLE ALARM DEFEAT pushbutton and observe that audible alarm remains silent.

h. Verify that RF LEVEL and RF LO lamps are not lit.

i. Leave RF OUTPUT switch in OFF-LINE position.

j. Verify that for FM operations, MODE SELECTION is set to FM. For all other operations set MODE SELECTOR to DGTL.

k. Record new operating frequency and MODE SELECTOR setting on MISSION LOG tag (fig. 3-1)

l. Repeat steps a through k for remaining up-converters, as necessary.

3-10. Electronic Frequency Down-Converter CV 3085/ MSC-46 Frequency Change Procedure

Upon receipt of receive carrier frequency assignments. it may be necessary to change the operating frequency of the Electronic Frequency Down-Converter CV-3085/MSC-46 as provided below. This procedure is used for setting both communications and satellite beacon carrier frequencies into the appropriate Electronic Frequency Down-Converters CV-3085/MSC-46. When setting the Electronic Frequency Down-Converter CV-3085/MSC-46 that is assigned to the satellite beacon, it is set to a frequency exactly 20.00 MHz higher than the beacon carrier frequency. For the earth coverage (EC) beacon. which operates at 7250.1 MHz, the Electronic Frequency Down-Converter CV-3085/MSC-46 is set to 7270.100 MHz. For a front panel illustration providing Electronic Frequency Down-Converter CV-3085/MSC-46 Operator controls and indicators refer to IM 11-5895-539-12.

a. On front panel of Electronic Frequency Down-Converter CV-3085/MSC-46 requiring frequency change, verify that POWER ON/OFF switch is set to ON and observe that POWER ON lamp is lit.

b. Set RECEIVE FREQUENCY SELECTOR MHZ thumbwheel switches to new operating frequency.

c. Check status of RF LO lamp and LO AUDIBLE alarm. Observe that lamp is lit and audible alarm sounds.

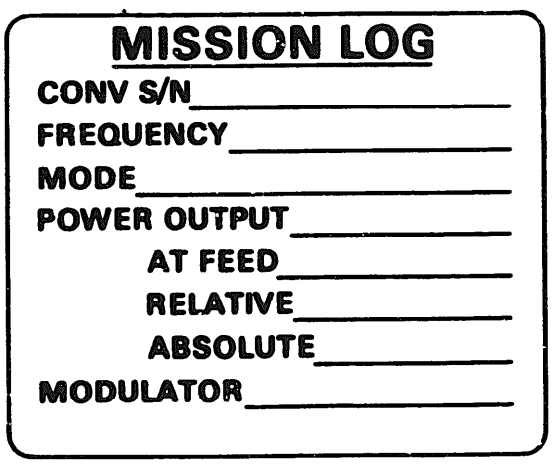


Figure 3-1. Electronic frequency up-converter CV-3084/MSC-46 MISSION LOG tag.

d. Press and hold down AUDIBLE ALARM DEFEAT pushbutton to silence audible alarm.

NOTE

Filter A2FL1 is required for receive frequencies between 7.25 and 7.55 GHz. Filter A2FL2 is required for receive frequencies between 7.55 and 7.75 GHz. Check filter in use placard to insure that filter connected between connector J2 on RF input stripline assembly and connector J1 on RF conversion stripline assembly will accommodate new frequency assignment.

e. Set STATUS SELECTOR switch to RF LO TUNE and adjust RECEIVE FREQUENCY FINE TUNE control for center-scale indication on STATUS meter.

f. Release AUDIBLE ALARM DEFEAT pushbutton and observe that LO AUDIBLE alarm remains silent.

g. Verify that RF LO lamp is not lit.

h. Set STATUS SELECTOR switch to each position and observe following indications on STATUS meter:

Switch position	Meter indication
+ 24V	Green scale
STD LVL	Blue scale
RF LO	Blue scale
IF LO	Blue scale
700 MHZ	Approximately 0 to 3
70 MHZ IF.	Varies with input signal level
RF LO TUNE	Red scale

i. Verify that for FM operations, MODE SELECTOR is set to FM. For all other operations set MODE SELECTOR to DGTL.

j. Record new operating frequency and MODE SELECTOR setting on MISSION LOG tag (fig. 3-2)

k. Repeat steps a through j for remaining down-converters, as necessary.

3-11. Satellite Acquisition

Acquisition data for the assigned communications satellite is provided oy the SATCOM Net Controller. Since the DSCS Phase II satellites are in synchronous orbits, acquisition data is nearly time independent. However, since small variations do occur during the course of a day, acquisition data is provided for several, time periods during the day. The Operator is cautioned that during the process of acquiring the satellite, beam power should be removed from the on-line power amplifier. This is to prevent accidental interference with communications traffic already in progress on the satellite. For front panel illustrations providing the Antenna Control Panel, Power Distribution Panel, Antenna Position Readout Panel and tracking receiver AGC Meter Panel controls and indicators (IM 11-5895-539-12).

a. Antenna Manual Positioning. Determine predicted satellite angles fur the time of day using the angle prediction chart for geographical location of the ETC; then proceed as follows:

(1) Verify that beam power is removed from the on-line power amplifier.

(2) At the Antenna Control Panel, press ANTENNA SERVO MODE, STANDBY switch lamp and verify that it lights.

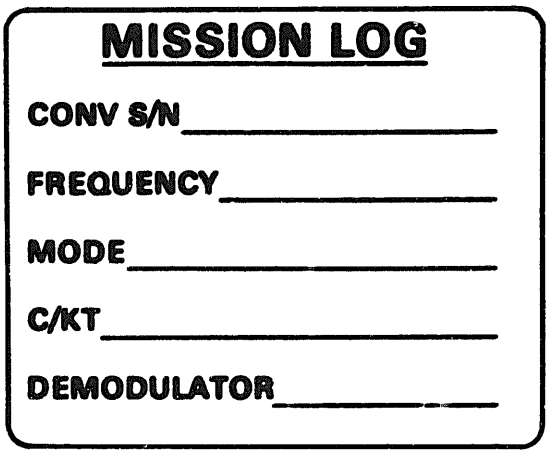


Figure 3-2. Electronic frequency down-converter CV-3085/MSC-46 MISSION LOG tag.

(3) At the Power Distribution Panel, press POWER CONTROLS, ANTENNA DRIVE ON switchlamp; verify that it lights and POWER CONTROLS, ANTENNA DRIVE OFF switchlamp is not lit.

(4) At the Antenna Control Panel, press ANTENNA SERVO MODE, SLEW switchlamp. Verify that it lights and ANTENNA SERVO MODE, STANDBY, AZIMUTH BRAKE and ELEVATION BRAKE lamps are not lit.

(5) Using Antenna Control Panel SLEW AZIMUTH and SLEW ELEVATION controls, position antenna until AZIMUTH POSITION and ELEVATION POSITION indicators located on the Antenna Position Readout Panel indicate within 1 or 2° of predicted angles.

(6) At the Antenna Control Panel, press ANTENNA SERVO MODE, STANDBY switchlamp; then ANTENNA SERVO MODE, MANUAL switchlamp and verify that it lights.

(7) Using AZIMUTH MANUAL SET and ELEVATION MANUAL SET handcranks, located on the Antenna Control Panel, fine position the antenna to the predicted angles. When the satellite is

acquired, the TRACKING STATUS, ACQUISITION LOCK ON lamp will light.

NOTE

When the predicted satellite position is approached, the TRACKING STATUS, ACQUISITION LOCK ON lamp may go on and off due to sidelobe crossover.

b. Main-Lobe Acquisition. When the TRACKING STATUS, ACQUISITION LOCK ON lamp lights steadily, verify that the equipment is locked onto the satellite main lobe as follows:

(1) Successively center the azimuth and elevation position in the region until DEGREE AZIMUTH TRACK ERROR and DEGREE ELEVATION TRACK ERROR meter pointers are nulled and steady; this indicates that the antenna is on the main lobe. The successive centerings involve searching with one of the controls at a time over an area of 1 or 2°, while observing the regions in which the TRACKING STATUS, ACQUISITION LOCK ON lamp lights. If there are an odd number of such regions, center in the middle region; if an even number, center between the center two regions (probably in a region in which there is no lock on). In determining the boundaries. always note the position where TRACKING STATUS, ACQUISITION LOCK ON lamp goes from off to on, since the positions where lock on is obtained and lost are quite different.

(2) Continue manual adjustment of AZIMUTH MANUAL SET and ELEVATION MANUAL SET handcranks until both DEGREE AZIMUTH and DEGREE ELEVATION TRACK ERROR meter pointers are nulled and steady.

(3) Press ANTENNA SERVO MODE, AUTOTRACK ENABLED switchlamp and verify that TRACKING STATUS, AUTOTRACK lamp lights.

(4) When acquiring the satellite for the first time, perform a beacon C/kT measurement and report result to SATCOM Net Controller. If he verifies that indication is normal, antenna is probably locked on the main lobe; if abnormal, repeat steps (1) through (4) until normal C/kT is achieved.

(5) For initial acquisition, read and record TRACK 1 AGC and TRACK 2 AGC meter readings on AGC Meter Panel and TRACKING RECEIVER, THRESHOLD MONITOR meter reading on Power Distribution Panel. In future acquisitions, main lobe acquisition is indicated by normal readings on these meters.

(6) On Antenna Control Panel, press OPERATION/MAINTENANCE switchlamp; verify OPERATION section is lit and ALARM DISABLE lamp is not lit.

3-12. Electronic Frequency Up-Converter CV-3084/ MSC-46 IF. Input Level Adjustment

Upon completion of IF. patching to configure the ETC for mission requirements, it may be necessary to adjust the IF input level to the Electronic Frequency Up-Converter CV-3084/MSC-46 as provided below. For front panel illustration providing Electronic Frequency Up-Converter CV-3084/MSC-46 controls and indicators refer to IM-11-5895-539-12.

a. On front panel of Electronic Frequency Up-Converter CV-3084/MSC-46 requiring input signal level change, set RF OUTPUT switch to OFF-LINE.

b. Verify patching from Multiplexer Set AN/TCC-78 or Non-Nodal Communications Subsystem to Electronic Frequency Up-Converter CV-3084/MSC-46 to be adjusted.

c. Set POWER ON/OFF switch to ON and observe that POWER ON lamp is lit.

d. Set status selector switch to 70 MHZ IF and set IF. LEVEL ATTENUATOR switches for center-scale indication on STATUS meter.

e. Verify that RF LEVEL, RF LO, and IF. .LO lamps are not lit and audible alarm is not sounding.

f. Set status selector switch to each position and observe following indications on STATUS meter:

Switch position	Meter indication
70 MHZ IF	Blue scale
700 MHZ IF	Blue scale
+24V	Green scale
RF LO TUNE	Red scale
STD LVL	Blue scale
RF LO	Blue scale
IF LO	Blue scale

g. Leave RF OUTPUT switch in the OFF-LINE position.

h. Verify that for FM operations, MODE SELECTOR is set to FM. For all other operations, set MODE SELECTOR to DGTL.

i. Repeat steps a through h for remaining up-converters as necessary.

3-13. ETC Transmit Power Calibration

This procedure assumes that turn-on and checkout procedures provided in equipment operation manuals have been completed. For front panel illustration providing Electronic Frequency Up-Converter CV-3084/MSC-46, Radio Frequency Amplifier OG-131/MSC (LPA) and LPA/HPA

Select Panel and indicators refer to IM 11-5895-539-12.

a. On front panel of each Electronic Frequency Up-Converter CV-3084/MSC-46, verify that RF OUTPUT switch is set to OFF-LINE.

b. Set the frequency assignment of the highest priority link in the spare up-converter.

c. Check the zero set on the RF POWER meter of each up-converter by disconnecting the coaxial jumper between the RF POWER METER INPUT and RF POWER MONITOR connectors. Adjust, if necessary, the POWER METER ERO ADJ control. Reconnect coaxial jumper.

d. Set POWER METER RANGE switch on each up-converter to 0 DBM position.

e. On first up-converter, disconnect RF output cable from output connector J1 (located on top rear of unit) and connect an RF microwattmeter, Boonton 42B or equivalent, in its place.

f. Set up-converter RF OUTPUT switch to ON-LINE and adjust RF OUTPUT LEVEL ADJ control for a 0.5 milliwatt indication on RF microwattmeter.

g. Observe up-converter RF POWER meter and adjust POWER MONITOR ATTENUATOR for a 0.5 milliwatt indication on RF POWER meter.

A. Set up-converter RF OUTPUT switch to OFF-LINE, disconnect RF microwattmeter and reconnect RF output cable to up-converter output connector J1.

i. Connect RF microwattmeter to up-converter RF TEST OUTPUT connector; read and record RF TEST OUTPUT level in milliwatts for future recalibration.

j. Repeat steps e through i for each remaining up-converter.

k. On up-converter assigned to the carrier having the highest authorized power, set RF OUTPUT LEVEL ADJ control to 5 (5 dB of attenuation).

l. On LPA/HPA Select Panel, press LPA SELECT or HPA SELECT switchlamp to connect up-converters to power amplifier selected for operation.

m. Verify that power amplifier selected for operation has beam power turned off and is connected to the antenna.

n. On LPA/HPA Select Panel, press and hold LOWER LIMIT switchlamp until switchlamp lights.

o. When authorized by SATCOM Net Controller to radiate, apply beam power to power amplifier selected for operation. Set RF OUTPUT switch on up-converter assigned to the carrier having the highest authorized power to ON-LINE.

p. On LPA/HPA Select Panel, observe TOTAL POWER METER and press and hold UPPER LIMIT switchlamp until TOTAL POWER METER indicates the watt level of the highest assigned carrier.

CAUTION

Once step p has been accomplished, do not operate LPA/HPA Select Panel UPPER LIMIT or LOWER LIMIT switchlamps until all up-converters have been adjusted.

q. On up-converter assigned to the next highest assigned carrier power, set RF OUTPUT switch to ON-LINE and adjust RF OUTPUT LEVEL ADJ control until TOTAL POWER METER indicates the sum of the watt levels of the previously established carrier(s) and the carrier being added.

NOTE

In the went that the watt level of the lowest assigned transmit carrier is less than approximately 2% of the highest assigned transmit carrier, a calibrated 10 dB or 20 dB attenuator must be inserted on the up-converter output lead.

r. Repeat step q. until all assigned carriers have been established. Record TOTAL POWER METER indication.

s. On each up-converter MISSION LOG tag (fig. 3-1) record; assigned carrier power on POWER AT FEED line, RF POWER Meter indication on POWER RELATIVE line, and RF TEST OUTPUT level as measured with RF microwattmeter on POWER ABSOLUTE line.

t. Notify SATCOM Net Controller that assigned carrier has been established and proceed with link establishment procedures.

3-14. Orderwire Configuration

The configuration of orderwires will be established by DCA directives issued in connection with the establishment of the ETC and/or its links. Operation and use of orderwire facilities will be in accordance with DCA Circular 310-55-1. The SATCOM Net Controller will specify orderwire configuration when it is not inherent to the link. Normally the following orderwires will be established.

a. One FM voice orderwire in the 4 to 8 kHz baseband for each FM link, to be used for ETC to ETC coordination.

b. A ground TTY Critical Control orderwire between the SATCOM Net Controller at the Area Communications Operations Center (ACOC) and the ETC for control purposes.

c. A TTY and/or voice orderwire between the associated Technical Control Facility (TCF) and the ETC for coordination.

3-15. FM Link Establishment

Prior to establishment of an FM communications link, an off-line pre-calibration of the associated

Frequency Demodulator OM-47(V)( )/TCC must be performed for ad least the receive channel capacity assigned.

In addition, it is recommended that any spare unit be calibrated in all assigned receive channel capacities. The pre-calibration procedure is provided in DCA Circular 831-70-( ). Initial link establishment is accomplished by reinstalling coaxial looping plugs that were removed in paragraph 3-7 b.

Scheduling and coordination of FM link establishment is carried out on the critical control orderwire. When the initial full duplex link is achieved, system adjustments and Test Tone-to-Noise Ratio (TTNR) measurements are performed using the link FM voice orderwire for coordination. Patching procedures for initial link establishment using the Multiplexer Set AN/TCC-78 (Nodal) or Non-Nodal Communications Subsystem, as applicable, are provided below.

a. At the Multiplexer Set AN/TCC-78 (Nodal), IF/BB Patch Assembly 13A2, install monitor type coaxial looping plugs, Whistler W.B.P.-7/BNC, between FM MODULATOR IN 1 through 3 and GP A OUT (TX) 1 through 3 jacks as required by mission.

b. At the Non-Nodal Communications Subsystem, IF Patch Panel 7A2. located in the Communications-Antenna Control Group OA-8056/MSC-46 (OCV), connect. a monitor type coaxial looping plug, Whistler W.B.P. -7/BNC, between the Frequency Modulator OM-46 (V) 3/TCC input and baseband output.

3-16. PSK Link Establishment

The establishment of a PSK communications link requires that several measurements and adjustments be performed, in the sequence provided in paragraph 3-7, prior to completing the end to end link. An off-line calibration of the Digital Data Modem MD-921/G (PSK Modem) error rate and signal-to-noise meters, as a function of E_b/N_o, should be performed using the procedure provided in TM 11-5820-803-12. This procedure uses the Modem Test Set TS-7580 ( )/G and should be performed for at least the receive modes and data rates specified by the SATCOM Net Controller. The results of these calibrations may be requested by the SATCOM Net Controller. It is also recommended that calibration data be used to plot curves of bit error rate versus signal/noise meter readings similar to the example provided in TM 11-5820-803-12. When error correcting codes are used, the range of the error rate curve should be linearly extrapolated to 10^{-10}. The step-by-step procedures for establishing PSK link are as follows:

a. Measure the IF. output level of the Digital Data Modem MD-921/G (PSK Modem) using an RF Power Meter with its calibrated thermistor mount.

b. Verify that switch S1 on the PSK Modern, Input Filter Card is set to Position 2, refer to TM 11-5820-803-12 for illustration providing location of S1.

c. Perform Electronic Frequency Up-Converter CV-3084/MSC-46 IF. input level adjustment and frequency change procedures provided in paragraphs 3-9 and 3-12, if necessary, for the up-converter assigned to the PSK Modem.

d. Perform Electronic Frequency Down-Converter frequency change procedure provided in paragraph 3-10, if necessary, for the down-converter assigned to the PSK Modem.

e. Perform PSK Modem preliminary starting and self test procedures provided in TM 11-5820-803-12.

f. Verify that front panel TRANSMIT and RECEIVE controls are set as required for assigned mission, the METER selector switch is set to AGC position and the SOURCE selector switch is set to LINK.

g. Verify and adjust, if necessary, the Electronic Frequency Up-Converter CV-3084/MSC-46 to assigned carrier output level as provided in paragraph 3-13 and place its RF OUTPUT switch to ON-LINE when authorized. Coordinate with partner ETC, using orderwire circuit designated by the SATCOM Net Controller for use with the PSK Link.

h. When receive PSK carrier is acquired, verify that MONITOR meter indicates on scale; then set METER selector switch to SIG/NOISE position and observe signal-to-noise indication. Perform a digital error rate measurement. as provided in paragraph 5-8.

i. Report results of error rate measurement to SATCOM Net Controller.

j. Monitor SIG/NOISE indication on MONITOR meter and report to the SATCOM Net Controller any change greater than 1 order of error rate.

For example: if the established normal error rate is 10^{-7}, any change resulting in an error rate poorer than 10^{-6} or better than 10^{-8} should be reported.

3-17. URC Link Establishment

The initial, establishment of a spread spectrum multiple access (SSMA) link using the Radio Communications Subsystem AN/URC-55 is accomplished using the critical control orderwire for scheduling and coordination. After link establishment, an internal TTY orderwire will normally be used for coordination on the URC link. The procedures for establishing a communications link with another Radio Communications Subsystem AN/URC-55 and with a Radio Communications Subsystem AN/URC-61 are identical. When operating with a Radio Communications Subsystem AN/URC-61, however, the link channel capacity is limited to one voice or one digital channel plus a TTY

orderwire. When operated in conjunction with an FM or PSK link, the URC link can cause considerable reduction of performance on those links with frequency assignments within approximately 10 MHz of the center of the SSMA band. This is caused by an increase in background noise and is evidenced by an increase in channel noise and out-of-band noise (OBN) on FM links and an increase of digital error rate on PSK links. It is important that the Operator is aware of this possibility during establishment of an URC link and not attribute these symptoms to ETC equipment degradation of failure. The step-by-step procedures for establishing an URC link are as follows:

a. Verify that the RF OUTPUT switch on the Electronic Frequency Up-Converter CV-3084/MSC-46 assigned to the Radio Communications Subsystem AN/URC-55 is set to OFF-LINE.

b. At the Radio Communications Subsystem AN/URC-55, set switches and controls as described in preliminary control settings table provided in IM 11-5895-544-12.

c. When authorized by the SATCOM Net Controller, set the Electronic Frequency Up-Converter CV-3084/MSC-46, RF OUTPUT switch to ON-LINE. Adjust the RF OUTPUT LEVEL ADJ control until RF POWER meter indicates assigned carrier power authorized by the SATCOM Net Controller for acquisition.

d. Accomplish code synchronization with the partner ETC using procedures provided in IM 11-5895-544-12. The particular method used to achieve synchronization, Reset synchronization or Timing Control normal start procedure is dependent upon specified link establishment procedure and conditions existing at the time of link establishment.

e. After the two way communications link is established, readjust the Electronic Frequency Up-Converter CV-3084/MSC-46 RF OUTPUT LEVEL ADJ control until the RF POWER meter indicates assigned carrier power authorized for operation. Verify that partner ETC has readjusted power to the assigned operational level.

f. Observe DB MARGIN meter indications and report to SATCOM Net Controller.

g. At this point, the SATCOM Net Controller may direct readjustment of carrier output levels to achieve proper link quality and/or margins.

h. When normal performance has been established, read and record the Radio Communications Subsystem AN/URC-55, DB MARGIN meter indications. DB MARGIN meter indications are monitored and any change greater than ±3 dB reported to the SATCOM Net Controller.

i. In the event of failure of the URC link, restart time is established and coordinated using the link orderwire. Restart procedures are provided in IM 11-5895-544-12.

3-18. Precise Time and Time Interval (PTTI) Measurement

The Precise Time and Time Internal (PTTI) measurement capability of the ETC is employed for synchronization of timing equipments in support of a world-wide PTTI program. Step-by-step PTTI procedures are as follows:

a. Establish a full duplex SSMA link with the partner ETC for the PTTI measurement as provided in paragraph 3-17.

b. Perform the Calibration of a Remote Time Reference procedure provided in IM 11-5895-544-12 at time specified by the SATCOM Net Controller.

c. Compute and record time difference.

d. Complete necessary PTTI reports as required by NAVOBSY TS/PTTI-O1M and DCA Circular 310-55-1.

3-19. Maintaining and Changing RF Power

ETC participation in the multiple access satellite system requires that the assigned power of each carrier accessing the satellite be carefully controlled and maintained. After a communications link has been established, the SATCOM Net Controller may direct readjustment of carrier powers to normalize communications quality due to non-nominal conditions at linked ETCs, changes in satellite performance or loading and changes in propogation conditions. The maintenance of assigned carrier power levels requires that the LPA/HPA Select Panel, TOTAL POWER METER and Electronic Frequency Up-Converters CV-3084/MSC-46 RF POWER meters be monitored to quickly detect any change in assigned output power levels. Procedures for maintaining and changing both individual carrier RF power levels and total RF power levels are provided below :

a. Maintaining and Changing Individual Carrier Power Levels.

Individual carrier powers are maintained and changed by adjusting the associated Electronic Frequency Up-Converter CV-3084/MSC-46 as follows:

(1) Check and reset, if necessary, RF POWER meter zero by disconnecting the coaxial jumper connected between RF POWER METER INPUT and RF POWER MONITOR connectors and adjusting POWER METER ZERO ADJ control. Reconnect coaxial jumper.

(2) Verify that Electronic Frequency Up-Converter CV-3084/MSC-46, STATUS meter indication is normal when set to 70 MHZ IF. position.

If STATUS meter indication is abnormal, adjust associated IF input level as follows:

CAUTION

When making attenuator adjustments while passing traffic, the desired adjustment (adding and/or removing attenuation) must be made in a single action to avoid incorrect in-line attenuation, even momentarily.

(a) To raise the IF. input level; observe RF POWER meter and adjust RF OUTPUT LEVEL ADJ for an indication of 1 dB below the assigned carrier power. Remove 1 dB of attenuation at the IF LEVEL ATTENUATOR. Repeat procedure until STATUS meter indication is normal.

(b) To reduce the IF. input level: observe RF POWER meter and adjust RF OUTPUT LEVEL ADJ for an indication at the assigned carrier power. Add 1 dB of attenuation at the IF LEVEL ATTENUATOR. Repeat procedure until STATUS meter indication is normal.

(3) Carries are maintained by adjusting the RF OUTPUT LEVEL ADJ control to provide an RF POWER meter indication as posted on the POWER RELATIVE line of the appropriate MISSION LOG label. Carrier levels are changed in response to direction received from the SATCOM Net Controller. The RF OUTPUT LEVEL ADJ control is adjusted until the RF POWER meter indicates an increase or decrease in output level by the number of dB requested.

b. Maintaining and Changing Total RF Power Output. The total RF power output is set and maintained at the Communications Control Console OA-8057/MSC-46, LPA/HPA Select Panel as follows:

(1) Check and reset, if necessary, TOTAL POWER METER zero set by placing ALARM ACTIVE/INACTIVE switch to INACTIVE and adjusting ZERO SET control for meter zero.

CAUTION

Failure to restore ALARM ACTIVE/INACTIVE switch to ACTIVE position leaves TOTAL POWER METER connected to dummy load, making it possible to transmit large amounts of unmonitored power.

(2) Set alarm active/inactive switch to ACTIVE.

(3) Adjust total output power to establish level by pressing TRANSMITTER SELECT, UPPER LIMIT switchlamp to raise power or TRANSMITTER SELECT, LOWER LIMIT switchlamp to lower power until TOTAL POWER METER indicates established total RF power output.

3-20. FM Receive Baseband Adjustment

The Frequency Demodulator OM-47 (V)/TCC, DEMOD BB AMPL A4 module attenuators were initially set to 14 dB attenuation for link establishment. After link establishment through the satellite, the Frequency Demodulator OM-47 (V) ( )/TCC should be readjusted to interface with the Frequency Modulator OM-46 (V) ( )/TCC at the associated transmit ETC. This adjustment should be accomplished off-line, prior to carrying traffic or following changes in equipment, however, it may be performed on-line without affecting traffic. To perform this procedure on-line, it is necessary to use monitor type looping plugs for baseband connections to Frequency Modulator OM-46 (V) ( )/TCC and Frequency Demodulator OM-47 (V) ( )/TCC. The FM receive baseband adjustment procedure is provided below, refer to DTM 11-5895-796-34-1 for illustration providing location of DEMOD BB AMPL A4 module attenuators.

a. At the transmit ETC, set Transmission Test Set Assembly switches and controls as follows:

(1) Oscillator frequency dial and RANGE as appropriate for assigned channel capacity test signal; refer to table 3-2.

(2) Oscillator AMPLITUDE fully counterclockwise.

(3) Patch Panel INPUT and OUTPUT IMPEDANCE to 900.

(4) Patch Panel MEAS-CAL to MEAS.

NOTE

This procedure describes use of the built-in Sierra 303A Frequency Selective Levelmeter. When necessary, a suitable wave analyzer (HP-310A, HP-312A or HO5-312A) may be used. However, equivalent switch settings and appropriate correction factors must be used. The correction factor for an HP-310A Wave Analyzer is -9 dB. The correction factor for an HP-312A Wave Analyzer is +2 dB. No correction factor is required for an HP-312A Wave Analyzer.

b. At transmit and receive ETC's, set Frequency Selective Levelmeter (Sierra 303A) switches and controls as follows:

(1) INPUT to 75 ohms,

(2) BRIDGING/TERMINATING (IN) to BRIDGING (out position).

(3) UNBALANCED/BALANCED (IN) to UNBALANCED (out position).

(4) SENSITIVITY to NORMAL.

(5) SELECTIVITY to 3.1 kHz.

Table 3-2. FM Receive Baseband Adjustment Test Frequencies

Channel capacity	Test frequency
3 global	25 kHz
6 global	37 kHz
9 global	49 kHz
12 global	61 kHz
24 global	109 kHz
36 global	157 kHz
48 global	205 kHz
72 global	301 kHz
3 tactical	25 kHz
6 tactical	37 kHz
9 tactical	49 kHz

(6) TUNE pushbutton in.

(7) COARSE and FINE TUNE as required for test frequency from table 3-2.

(8) INPUT LEVEL to -30.

c. At transmit ETC, connect Transmission Test Set, Patch Panel OUTPUT to a frequency counter, HP-5245L or equivalent.

d. On transmission Test Set, Oscillator: adjust AMPLITUDE control clockwise until frequency counter begins to count, adjust frequency dial to test frequency ±100 Hz, and reset AMPLITUDE control fully counter-clockwise.

e. At transmit ETC, connect Transmission Test Set and Sierra 303A using a BNC T adapter to the monitor jack on the coaxial looping plug connected to the associated Frequency Modulator OM-46 (V) ( )/TCC input.

f. At transmit ETC, adjust Transmission Test Set, Oscillator AMPLITUDE control for -30 dBm indication on Sierra 303A.

g. At receive ETC, connect Sierra 303A to monitor jack on coaxial looping plug connected to the output of the associated Frequency Demodulator OM-47 (V) ( )/TCC.

h. At receive ETC, readjust COARSE and FINE TUNE controls as required for peak indication on levelmeter. When operating in a 3 channel mode, set SELECTIVITY selector to 80 Hz and repeak.

NOTE

Adjustment of Frequency Demodulator OM-47 (V) ( )/TCC, DEMOD BB AMPL A4 module attenuators S1 and S2 may require a corresponding adjustment of voice channel levels.

i. Observe Sierra 303A levelmeter and adjust Frequency Demodulator OM-47 (V) ( )/TCC, DEMOD BB AMPL A4 module attenuators S1 and S2 as required below:

CAUTION

When adjusting attenuators on-line, use judgement to avoid adding or removing excess attenuation which affects traffic quality.

(1) If levelmeter indicates -30 dBm ±1dBm, no adjustment is necessary.

(2) If levelmeter indicates -30 dBm ±3dBm, adjust S1 and S2 to within -30 dBm ±1 dBm.

(3) If levelmeter indicates beyond -30 dBm ±3 dBm, there is a probable maladjustment of receive ETC Frequency Demodulator OM-47 (V) ( )/TCC or transmit ETC Frequency Modulator OM-46 (V) ( )/TCC, refer to DTM 11-5895-796-12 for fault isolation and adjustment procedures.

3-21. Key Indicators Used in Monitoring Overall Operation

Provided in table 3-3 is a list of key indicators used in monitoring overall operation of the ETC. In addition to the indicators listed in table 3-3, the ETC Operator must monitor built-in audible alarms to detect system degradation and the on-line spectrum analyzer tuned to display the satellite beacon as required by DCA Circular 831-70-( ).

Table 3-3. Key Indicators Used in Monitoring Overall Operation of the

ETC Using the Satellite Communications Terminal AN/MSC-46

(Nodal and Non-Nodal)

Name	*Location*	*Upper/ lower limit*
CRYOGENIC TEMP CHANNEL 1	Communications Control Console OA-8057/MSC-46, Cryogenic Parametric Amplifier Remote Control /Monitor Panel	Green area 15 to 25 K
CRYOGENIC TEMP CHANNEL 2	Communications Control Console OA-8057/MSC-46, Cryogenic Parametric Amplifier Remote Control/Monitor Panel	Green area 15 to 25 K

Table 3-3. Key Indicators Used in Monitoring Overall Operation of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)-Continued

Name	Location	Upper/ lower limit
TRACKING RECEIVER THRESHOLD MONITOR	Communications Control Console OA-8057/MSC-46, Power Distribution Panel	Established normal reading for satellite being tracked
DEGREE ELEVATION TRACKING ERROR	Communications Control Console OA-8057/MSC-46, Antenna Control Panel	0 ±0.06°
DEFREE AZIMUTH TRACKING ERROR	Communications Control Console OA-8057/MSC-46, Antenna Control Panel	0 ±0.06°
TRACK 1 AGC	Communications Control Console OA-8057/MSC-46, AGC Meter Panel	7 to 10 V dc
TRACK 2 AGC	Communications Control Console OA-8057/MSC-46, AGC Meter Panel	7 to 10 V dc
TOTAL POWER METER	Communications Control Console OA-8057/MSC-46, LPA/HPA Select Panel	Assigned carrier power ±1 dB or as established by Controller
DB MARGIN RECEIVER NO. 1	Radio Communications Subsystem AN/URC-55	10 dB or as specified
DB MARGIN RECEIVER NO. 2	Radio Communications Subsystem AN/URC-55	10 dB or as specifiied
AZIMUTH CW	Communications Control Console OA-8057/MSC-46, Antenna Drive Motor Current Monitor Panel	Not more than 40 A when totaled with AZIMUTH CW meter
AZIMUTH CCW	Communications Control Console OA-8057/MSC-46, Antenna Drive Motor Current Monitor Panel	Not more than 40 A when totaled with AZIMUTH CW meter
ELEVATION DOWN	Communications Control Console OA-8057/MSC-46, Antenna Drive Motor Current Monitor Panel	Not more than 40 A when totaled with ELEVATION UP meter
ELEVATION UP	Communications Control Console OA-8057/MSC-46, Antenna Drive Motor Current Monitor Panel	Not more than 40 A when totaled with ELEVATION DOWN meter
Out-of-Band Noise Monitor Meter	Multiplexer Set AN/TCC-78 (Nodal) Or Communications Control Console OA-8057/MSC-46, (Non-Nodal)	Upper and lower limits established by Controller
MONITOR meter (METER selector set to ERROR COUNT position)	Digital Data Modem MD-921/G	Established normal reading for data link

Section III. SYSTEM DEGRADATION AND FAILURE

3-22. General

This section provides guidance to assist the ETC Operator in the identification of and recommended response to degradation or failure of a communications link. ETC degradation symptoms, limited to built-in audible and visual alarms are provided with recommended corrective actions. Corrective actions are limited to replacement of a faulty component with a switchable or patchable spare unit.

3-23. ETC Failures that Affect all Transmit and Receive Communications

ETC equipment failures that result in the loss of all transmit and receive capability are grouped for discussion as follows: primary power and power distribution failures, frequency generation and frequency distribution failures, Interconnect Facility failures, antenna tracking failures and adverse weather conditions. A list of transmit and receive failure symptoms with their probable cause and recommended action, is provided in table 3-4.

a. When a primary power failure occurs, service is restored by switching to an alternate power source. If commercial power is available, it will normally be selected as the prime power source for the ETC. When a commercial power failure occurs, service is restored by placing Diesel Engine Generator Sets PU-495/G on-line. When commercial power is not available, the Diesel Engine Generator Sets PU-495/G are selected as the prime power source. In a typical ETC, three Diesel Engine Generator Sets PU-495/G are provided, two of which are operated in parallel to supply power and the third maintained in standby. Procedures for restoring power to the ETC when commercial power or a Diesel Engine Generator Set PU-495/G fails are provided in paragraph 3-27. There are no standby units provided for the Electronic Equipment Power Distribution Cabinet 1600590-100, Circuit Breaker Box SA-1462/MSC-46, Distribution Box J-2661/MSC-46 or Power Distribution Panel 1525140-102. Therefore if any of these units fail, service cannot be restored unit fault isolation repairs are accomplished.

b. When the Cesium Beam Frequency Standard HP-5061A. Radio Frequency Amplifier AM-6631/MSC-46 or their associated patch panels fail, limited service can be restored by utilizing patching procedures provided in IM 11-5895-539-12.

c. When the Interconnect Facility (ICF) associated with the ETC fails, service cannot be restored until repairs are made or circuits restored.

d. When an antenna tracking failure occurs that disrupts all transmit and receive communications, service can normally be restored by alternate tracking methods. A more detailed discussion of antenna tracking failures is provided in paragraph 3-26.

e. When adverse weather conditions occur that affect both transmit and receive capability, service is normally maintained by adjusting the transmitter powers of the ETCs involved. The ETC Operator is directed to take no independent action to restore service by adjusting transmitter power, without specific direction from the SATCOM Net Controller. The Operator should keep the SATCOM Net Controller informed of any anticipated signal degradation due to adverse weather or radome icing conditions and be prepared to respond to directions.

Table 3-4. Transmit and Receive Communications Failure Symptoms

Symptom	*Probable cause*	*Recommended action*
1. Fault indications as follows: *a.* All up-converter and down-converter audible alarms sounding All up-converter and down-converter RF LO and IF LO FAULT lamps are lit	*a.* Cesium beam frequency standard failure *b.* Distribution amplifier failure	*a.* Perform necessary patching procedures for operation with a cesium beam frequency standard failure provided in IM 11-5895-539-12. *b.* Same as *a* above
2. Commercial power selected as power source *a.* All power is lost *b.* Transmitter van circuit breaker box COMMERICAL POWER IN lamp is not lit	Commercial power failure	Perform emergency operation when commercial power fails procedure, paragraph 3-27*a*.
3. Generator power selected as power source *a.* All or partial power is lost *b.* Power Monitor-Control Panel GENERATOR FAULT lamps for one or both M/G Sets selected are list	Diesel engine generator failure	Perform emergency operation when generator power fails procedure; paragraph 3-27*b*.

3-24. ETC Failures that Affect Transmit Communication

ETC failures that result in reduced transmit capability are normally accompanied by the LPA/HPA Select Panel, TOTAL POWER METER audible alarm. In some cases, when the power level assigned to an individual trunk is less than approximately ten percent of the total assigned power, failure of its up-converter or modulation source will not result in a TOTAL POWER METER audible alarm. To simplify identification, separate discussions are provided of those failures that affect all transmit trunks and those that affect individual trunks. A list of transmit communications failure symptoms, with their probable cause and recommended action, is provided in table 3-5. When reconfiguration of equipment is necessary to restore service, the Operator must be careful to take no action that will result in transmission of unauthorized carrier power, frequency or deviation.

a. ETC Failures that Affect all Transmit Trunks. The failure of any equipment unit located between the output of the up-converter combiner and the antenna transmit feed will affect all transmit trunks. The units that will affect all transmit trunks are; the on-line power amplifier, the on-line intermediate power amplifier and their associated waveguide and antenna feed components. The Radio frequency Amplifier OG-131/MSC (LPA) is normally selected as the on-line power amplifier. When an LPA failure occurs, service can be restored by placing the high Power Transmitter (HPA) on-line. Placing the HPA on-line may result in reduced capability due to the narrower bandwidth of the HPA klystron. When the on-line Intermediate Power Amplifier 1600591-100 (IPA) fails, service is restored by placing the standby IPA on-line. Before switching from a failed unit to its standby unit, the RF drive to the power amplifier should be reduced to minimum to prevent accidental transmission of carriers in excess of assigned power levels. Other failures that affect all transmit trunks, such as: waveguide and waveguide switch failures, waveguide pressurization failures, antenna feed failures and transmitter control, failures cannot be corrected by substitution of standby units and require fault isolation and repair to restore service.

Table 3-5. Transmit Communications Failure Symptoms

Symptom	Probable cause	Recommended action
1. LPA selected as on-line power amplifier:	LPA failure	Place HPA on-line as follows:
a. TOTAL POWER METER audible alarm sounding		*a.* Press and hold TRANSMITTER SELECT, LOWER LIMIT switchlamp until it lights.
b. LPA Remote Control Panel, MAJOR ALARM lamp lit		*b.* Press TRANSMITTER SELECT, HPA SELECT switchlamp; verify that it lights.
c. All up-converter RF AUDIBLE ALARM's silent		*c.* Press POWER CONTROLS, BEAM PWR ON switchlamp; verify that it lights.
		d. Press and hold TRANSMITTER SELECT, UPPER LIMIT switch lamp until TOTAL POWER METER indicates assigned total output power.
		e. Notify SATCOM Controller of any reduced capability due to narrow bandwidth of HPA.
2. LPA selected as on-line power amplifier:	IPA failure	Place standby IPA on-line as follows:
a. TOTAL POWER METER audible alarm sounding		*a.* Press and hold TRANSMITTER SELECT LOWER LIMIT switchlamp until it lights.
b. LPA Remote Control Panel, MAJOR ALARM lamp not lit		*b.* Press IPA REVERSE or IPA NORM switchlamp as required; verify that it lights.
c. All up-converter RF AUDIBLE ALARM's silent		*c.* Press and hold TRANSMITTER SELECT, UPPER LIMIT switchlamp until TOTAL POWER METER indicates assigned total power output.

Table 3-5. Transmit Communications Failure Symptoms-Continued

Symptom	Probable cause	Recommended action
3. LPA selected as on-line power amplifier: *a.* TOTAL POWER METER audible alarm may or may not be sounding *b.* LPA Remote Control Panel, MAJOR ALARM lamp not lit *c.* Up-converter RF AUDIBLE ALARM sounding *d.* Up-converter STATUS meter indicates mid-scale on 70 MHZ IF position	Up-converter failure	If a standby up-converter is available: *a.* Tune standby up-converter to frequency assigned to failed unit if necessary. *b.* Patch modulator associated with failed up-converter to standby unit. *c.* Set standby up-converter output to power level assigned to failed unit. *d.* Place standby up-converter ON-LINE. If no standby up-converter is available, troubleshoot up-converter; refer to IM 11-5895-539-34-1.
4. LPA selected as on-line power amplifier: *a.* TOTAL POWER METER audible alarm may or may not be sounding *b.* LPA Remote Control Panel, MAJOR ALARM lamp not lit *c.* Up-converter RF AUDIBLE ALARM sounding *d.* Up-converters STATUS meter indicates out of blue scale on 70 MHZ IF position	Modulator failure	Troubleshoot failed modulator: *a.* Frequency Modulator OM-46(V) ( )/TCC; refer to DTM 11-5895-7?e-34-1 *b.* Modem, Digital Data MD-921/G; refer to DTM 11-5820-803-34 *c.* Radio Communications Subsystem AN/URC-55; refer to IM 11-5895-544-12.
5. HPA selected as on-line power amplifier: *a.* TOTAL POWER METER audible alarm sounding *b.* POWER CONTROLS, XMTR FAULT XMTR VAN lamp lit *c.* All up-converter RF AUDIBLE ALARM'S SILENT	HPA failure	Place LPA on-line as follows: *a.* Press and hold TRANSMITTER SELECT, LOWER LIMIT switchlamp until it lights. *b.* Press TRANSMITTER SELECT, LPA SELECT switchlamp; verify that it lights. *c.* Apply beam power to LPA. *d.* Press and hold TRANSMITTER SELECT, UPPER LIMIT switchlamp until total power Meter indicates assigned total output power.

b. ETC Failures that Affect Individual Transmit Trunks. The failure of an Electronic Frequency Up-Converter CV-3084/MSC-46 (up-converter) or the modulator equipment associated with an individual trunk will result in a failure of that trunk only. When an up-converter failure occurs, service can be restored by patching the associated modulator to a spare up-converter and adjusting its frequency and output level as assigned for that trunk. The spare up-converter is normally adjusted to the frequency and level of the highest priority link. Therefore, when restoring a trunk other than the priority trunk, care must be taken to insure that the frequency and level of the standby up-converter are correct before placing it on-line. In cases when there is no spare up-converter, the SATCOM, Net Controller may direct the Operator to terminate a lower priority trunk and use its up-converter to restore a higher priority trunk. At an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal), there will not be a spare Frequency Modulator OM-47 (V) 3/TCC available. Therefore, in event of failure, service cannot be restored without fault isolation and repair. At an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal), when a Frequency Modulator OM-46 (V) 1/TCC assigned to a high priority trunk fails, the SATCOM Net Controller may direct the Operator to terminate

a lower priority trunk and use its frequency modulator to restore the high priority trunk. There are no standby spares provided for the Radio Communications Subsystem AN/URC-55 transmit&r, Digital Data Modem MD-921/G modulator, Analog-Digital Converter CV-3034/G transmitter and their associated intercabling and patch facilities. Therefore, a failure in any of these units cannot be restored by substitution and will require fault isolation and repair.

3-25. ETC Failures that Affect Receive Communications

ETC failures that result in reduced receive capability can be quickly isolated to a faulty unit by evaluation of front panel visual and audible alarms. To simplify identification, separate discussions are provided of those failures that affect all receive trunks and those that affect individual trunks. A list of receive communications failure symptoms, with their probable cause and recommended action, is provided in table 3-6.

a. ETC Failures that Affect all Receive Trunks. The failure of any equipment unit located between the antenna receive feed and the input to the down-converter signal divider will affect all receive trunks. The units that will affect all receive trunks are: the on-line parametric amplifier with its associated cryogenic cooling system, the on-line IFL amplifier and their associated waveguide and antenna feed components. When a failure occurs in the on-line Parametric Amplifier, service is restored by placing the standby Parametric Amplifier AM-6602/MSC-46 on-line. When a failure occurs in the on-line Interfacilities Link Amplifier (IFL TWTA), service is restored by placing the standby IFL TWTA on-line. Other failures that affect all receive trunks, such as: waveguide switch failures, antenna feed failures and receiver control failures cannot be corrected by substitution of standby units and require further troubleshooting.

Table 3-6. Receive Communications Failure Symptoms

Symptom	*Probable cause*	*Recommended action*
1. Fault indications as follows: *a.* TRACKING RECEIVER THRESHOLD margin meter indicates loss of signal (full left scale indication) *b.* TRACK 1 AGC and TRACK 2 AGC meters indicate 0 volts *c.* All demodulator audible alarms are sounding with DEVIATION FAULT, LEVEL FAULT and SQUELCH lamps lit	*a.* Paramp failure *b.* IFL amplifier failure	*a.* At Paramp Remote Control Panel, press CHANNEL SELECT 1 or 2 switchlamp as required to switch parametric amplifiers. *b.* At IFL Amplifier set INPUT and OUTPUT switches to place standby IFL amplifier on-line.
2. Fault indication as follows: *a.* Individual Demodulator audible alarm is sounding, with DEVIATION FAULT, LEVEL FAULT and SQUELCH lamps lit *b.* All other demodulator audible alarms silent	Down-converter failure	*a.* If a spare down-converter is available, patch associated demodulator to standby down-converter and tune to assigned frequency of the failed unit. *b.* If a spare down-converter is not available, the down-converter assigned to beacon tracking may be substituted and manual tracking initiated.
3. Fault indications as follows: *a.* Individual demodulator audible alarm sounding and SQUELCH lamp lit, CARRIER INPUT LEVEL meter indicated normal *b.* PSK Modem audible alarm sounding and RECEIVE SECTION FAULT lamp lit *c.* Radio Communications Subsystem AN/URC-55 RECEIVER NO. 1 MARGIN meter indicates below normal threshold	Demodulator failure	Troubleshoot failed demodulator *a.* Frequency Demodulator OM-47(V)( )/TCC) refer to DTM 11-5895-796-12. *b.* Digital Data Modem MD-921/G; refer to DTM 11-5820-803-12. *c.* Radio Communications Subsystem AN/URC-55; set RECEIVER NO. 2 to assigned code for RECEIVER NO. 1 and restore service. Refer to IM 11-5895-544-12 for troubleshooting.

b. ETC Failures that Affect Individual Transmit Trunks. The failure of an Electronic Frequency Down-Converter CV-3085/MSC-46 (down-Converter) or the demodulator equipment associated with an individual receive trunk will result in a failure of that trunk only. When a down-converter failure occurs, service can be restored by patching the associated demodulator to a spare down-converter and setting its frequency to the assigned trunk frequency. The spare down-converter is normally set to the frequency of the highest priority link. Therefore, when restoring a trunk other than the priority trunk, care must be taken to ensure that the spare down-converter is tuned to the new trunk frequency. In cases when there is no spare down-converter, the beacon down-converter may be substituted or the SATCOM Net Controller may direct the Operator to terminate a lower priority trunk and use its down-converter to restore a higher priority trunk. At an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal), there will not be a spare Frequency Demodulator OM-47(V)3/TCC available. Therefore, in event of failure, service cannot be restored without fault isolation and repair. At an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal), when a Frequency Demodulator OM-47(V)1/TCC assigned to a high priority trunk fails, the SATCOM Net Controller may direct the Operator to terminate a lower priority trunk and use its frequency demodulator to restore the high priority trunk. When a failure occurs in the Radio Communications Subsystem AN/URC-55, Receiver No. 1 (communication receiver), service can be restored by substituting the Receiver No. 2 (monitor receiver) and making necessary patches. There are no standby spares provided for the Digital Data Modem MD-921/G demodulator. Analog-Digital Converter CV-3034/G receiver and their associated intercabling and patch facilities. Therefore, a failure in any of these units cannot be restored by substitution and will require fault isolation and repair.

3-26. ETYC Failures that Affect Antenna Tracking

ETC failures that result in the loss of satellite tracking or antenna positioning capability will normally cause a loss of all transmit and receive communications until corrected or alternate procedures employed. A failure in the Receiving Group OA-8059/MSC-46, Modulator Control 152921-100, Phase Shifter 360066-1 or the Electronic Frequency Down-Converter CV-3085/MSC-46 assigned to the tracking receiver will result in a loss of satellite tracking capability. When a failure occurs in the on-line tracking receiver, service is restored by palcing the standby tracking receiver on-line. A failure in the Antenna Servo Control Group OA-8061/MSC-46, Electronic Control Amplifier AM-4574/MSC-46 (el control amplifier) or AM-4575/MSC-46 (az control amplifier), equilibrator or azimuth or elevation drive motors will result in a loss of antenna positioning capability. When a failure of antenna positioning equipment occurs, communications can be maintained by manually positioning the antenna using manual handcranks. A list of antenna tracking failure symptoms, with their probable cause and recommended action is provided in table 3-7.

Table 3-7. Antenna Tracking Failure Symptoms

Symptom	*Probable cause*	*Recommended action*
1. Fault indications as follows:		
a. Antenna Control Panel audible alarm sounding, FAULT INDICATORS TRACKING RECEIVER CHAN 1 and TRACKING RECEIVER CHAN 2 lamps lit and TRACKING STATUS AUTOTRACK and ACQUISITION LOCK ON lamps are not lit	*a.* Receiving Group OA-8059/MSC-46 failure	*a.* Press ANTENNA SERVO MODE MANUAL switchlamp and use AZIMUTH and ELEVATION MANUAL SET handcranks to manually track satellite.
b. AGC Meter Panel TRACK 1 AGC and TRACK 2 AGC meters indicate less than 5 volts less than 5 volts	*b.* Phase shifter-modulator control failure	*b.* Same as a above
c. Power Distribution Panel TRACKING RECEIVER THRESHOLD MARGIN meter sweeps between zero and full scale.		

Table 3-7. Antenna Tracking Failure Symptoms-Continued

Symptom	*Probable cause*	*Recommended action*
2. Antenna Control Panel audible alarm sounding and FAULT INDICATORS SERVO lamp lit	Antenna Servo Control Group OA-8061/MSC-46 failure	Press ANTENNA SERVO MODE STANDBY and POWER CONTROLS ANTENNA DRIVE OFF switchlamps. Maintain satellite tracking using manual handcranks installed at antenna drive motors.
3. Antenna Drive Motor Current Monitor Panel AZIMUTH CCW, AZIMUTH CW and/or ELEVATION UP and ELEVATION DOWN meters indicate abnormal current	*a.* Azimuth Electronic Control Amplifier AM-4575/MSC-46 failure	*a.* Press ANTENNA SERVO MODE STANDBY and POWER CONTROLS ANTENNA DRIVE OFF switchlamps. Maintain satellite tracking using manual handcranks installed at antenna drive motors.
	b. Elevation Electronic Control Amplifier AM-4574/MSC-46 failure	*b.* Same as a above
	c. Antenna equilibrator failure	*c.* Same as a above

3-27. Emergency Operation

a. Emergency Operation of the ETC when Commercial Power Fails. If a power failure occurs when operating on commercial power, perform the following sequence to restore the ETC to operation:

(1) Set all Major Subsystem and Major Subgroup main power circuit breakers to OFF.

(2) Set the POWER SELECT switch on the Power Monitor Control Panel 1525130-100 in the Communications-Antenna Control Group OA-8056/MSC-46 to the M/G SET position.

(3) Start any two of the three Diesel Engine Generator Sets PU-495/G and connect them to the station load.

(4) Set all Major Subsystem and Major Subgroup main power circuit breakers to ON and restore the ETC to operation.

b. Emergency Operation of the ETC when a Diesel Engine Generator Set PU-495/G Fails.

NOTE

When one of the two Diesel Engine Generator Sets PU-495/G selected to supply power to the station load fails, the system will automatically drop the nonessential load until the standby Diesel Engine Generator Set PU-495/G can be put on-line.

If one of the two Diesel Engine Generator Sets PU-495/G selected to supply power to the station load fails, perform the following sequence to restore the ETC to operation:

(1) At the Power Monitor Control Panel 1525136-100 in the Communications-Antenna Control Group OA-8056/MSC-46 press the STOP pushbutton associated with the failed Diesel Engine Generator Set PU-495/G.

(2) Start the standby Diesel Engine Generator Set PU-495/G and connect it to the station load in accordance with IM 11-5895-539-12.

(3) Notify the motor generator repair personnel of the Diesel Engine Generator Set PU-495/G failure.

c. Emergency Operation of the ETC Resulting from a Decrease in Complex Capability. The ETC can be satisfactorily operated under reduced capability through patching and reconfiguration, however, no changes in equipment configurations or settings will be made without specific direction from the SATCOM Net Controller. For detailed patching and reconfiguration procedures refer to appendix A for applicable technical manuals.

d. Emergency Operation of the ETC Resulting from External Electronic Interference. As soon as it is determined that external electronic interference exists, notify the SATCOM Net Controller. Make no changes in equipment configuration or settings without specific direction from the SATCOM Net Controller.

3-28. Identification of Jamming

Jamming signals that are encountered at the ETC are of two basic types; undesired signals that enter the satellite receiver and are retransmitted to the ETC and undesired signals that enter the ETC receive system from local sources. Som possible sources of local interference are radiation from defective industrial equipment, off-channel or maladjusted communications equipment and ETC transmit signals cross feeding into the receive system. Identification of locally generated interference is the responsibility of the affected ETC.

In addition, the SATCOM Net Controller may request the assistance of the ETC Operator in evaluating the effects of undesired signals present in the satellite spectrum. To effectively evaluate the characteristics of the satellite spectrum, the ETC Operator must be thoroughly familiar with the operation of the available spectrum analyzers. Upon noting any loss in communications quality which is not attributable to ETC equipment or local weather conditions, the SATCOM Net Controller should be immediately notified. Since the characteristics of jamming signals cannot be predetermined, the ETC Operator must use judgement in selecting IF bandwidth, sweep width and sweep time for observations. In general, use the narrowest bandwidth for bandwidth measurement and spectrum shape observations and the widest bandwidth for power measurements.

Section IV. CONTROL/OPERATION

3-29. General

This section contains information concerning the DSCS SATCOM Control. Refer to DCA Circular 831-70-( ) for Standard Operating Procedures for Operation and Control of the Defense Satellite Communications System (DSCS).

3-30. DISCS STATCOM Control

Satellite Communications Control involves the technical management of the portion of the SATCOM System that lies between the input to the modulator at one end of a link to the output of the demodulator at the other end of the link. Control of the DSCS during Phase II differs from Phase I and conventional communications in the following respects: first, because a large number of ETC's must access a single satellite, close coordination must be exercised to prevent interference among the complexes: second, because the total communication capacity is limited, a central authority is required to manage and control the satellite's use to the many links in proportion to requirements. The central authority is the SATCOM Net Controller. Within the control concept, two types of Earth Terminal Complexes exist: ETC's that provide communication links and ETC's that provide both communication links and serve as the Net Control Terminal for the Control Subsystem's Spectrum Analysis Equipment. The Hewlett-Packard 8580B Automatic Spectrum Analyzer System and AILTECH 707 Spectrum Analyzer (Manual Spectrum Analyzer) utilize only the antenna and the parametric amplifier of the monitor terminal. All down-link carriers accessing the satellite are monitored at the parametric amplifier output.

a. The DSCS Phase II Control Subsystem involves the responsive participation of each ETC accessing a satellite. The participation required of each ETC is the timely and accurate response to directions received from the SATCOM Net Controller. Control requires adherence to requirements dictated by the SATCOM Net Controller. ETC operators are directed to take no action that will alter the ETC's uplink power, mode, deviation or other RF or IF characteristics. Responsibility for carrying out functions dictated by the SATCOM Net Controller will be delegated by the ETC Commander.

b. The principal functions of t
ETC's that relate to Control are described in Circular 831-70-( ). They include the following:

(1) Prior to establishment of an operational link, the ETC will accomplish baseline data tests and furnish the data to the SATCOM Net Controller.

(2) Receive assignments from the SATCOM Net Controller.

(3) Coordinate with associated TCF both before and during passage of traffic.

(4) Comply with procedures for link establishment and maintenance.

c. In addition to the functions listed in 3-30b. the Earth Terminal Complexes that serve as the Net Control Terminals perform the following:

(1) Operate the Automatic Spectrum Analyzer.

(a) Reload software programs when directed by the Controller.

(b) Respond to Controller's request to make visual observation of Automatic Spectrum Analyzer oscilloscope and report findings.

(c) Respond to SATCOM Net Controller's request to operate Automatic Spectrum Analyzer in manual mode.

(d) Upon failure of remote teleprinter. activate and operate the Automatic Spectrum Analyzer with local printer under the guidance of the SATCOM Net Controller.

(2) Operate the Manual Spectrum Analyzer; observe, and report to the SATCOM Net Controller, any deviations from the prescribed parameters of the down-link carriers.

(3) Maintain the Automatic Spectrum Analyzer and the Manual Spectrum Analyzer.

3-31. ETC Reports

ETC reports that are required by the SATCOM Net

Controller are defined in DCA Circular 831-70-( ). In general, these reports consist of ETC characterization data. ETC link establishment data, ETC operating reports and special reports requested by the SATCOM Net Controller.

a. Link Establishment Data Reports. During the process of establishing a communications link, the results of the following measurements should be reported to the SATCOM Net Controller and recorded at the ETC for future use as an ETC data base:

(1) Output power of each assigned transmit carrier and the total power output of the on-line power amplifier

(2) Test Tone-to-Noise Ratio (TTNR) measurement of each assigned FM link

(3) Digital Error Rate measurement of each assigned PSK link

(4) Threshold Margin indication of the SSMA link

b ETC Operating Reports. During operation the following link parameters are monitored and reported to the SATCOM Net Controller as follows

(1) TTNR for each FM link: reported every four hours or when it changes by more than ±2 dB from established normal.

(2) Digital Error Rate for PSK link; reported every four hours or when the error rate changes by more than ±1 order of error rate.

(3) Threshold margin of SSMA link; reported every four horrs or when it changes by more than ±3 dB from established normal.

(4) Current or anticipated adverse weather conditions that affect ETC operation.

(5) Any change in ETC configuration or capabilities.

CHAPTER 4

ETC THEORY

4-1. Introduction

This chapter contains general discussions of the overall functional operation of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). Refer to figures FO-2 and FO-3 for simplified block diagrams.

4-2. Functional Operation of the ETC Using the Satellite Communications Terminal AN/ M-SC-46 (Nodal)

The DSCS Phase II satellite system, Stage lb configuration, provides multiple access capabilities to ETC's that operate in the DSCS. In addition, greatly increased channel capacity and quality are available. The general concept is that the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) provides communications paths for several other satellite communications terminals operating in the same satellite network. Brief functional descriptions of the Major Subsystems and Major Sub-Groups of a typical ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) are provided below. However, some ETC's, depending upon mission and location, will not contain all of this equipment. Refer to figure FO-2 for a simplified block diagram of the ETC.

a. Multiplexer Set AN/TCC-78 (Nodal). The Multiplexer Set AN/TCC-78 processes baseband signals from/to TCF providing the FM interface with the Satellite Communications Terminal AN/MSC-46 (Nodal). Brief functional descriptions of the Major Subgroups of the Multiplexer Set AN/TCC-78 are provided below.

(1) Multiplexer AN/UCC-4. The Multiplexer AN/UCC-4 performs multiplex/demultiplex operations on the baseband signals (60 to 360 kHz) from/to TCF. The TCF transmit baseband is processed into three separate baseband signals. The first (60 to 108 kHz) contains Supergroup 1, group 1 or Supergroup 2, group 1 signals. The second (60 to 108 kHz) contains Supergroup 1, group 2 signals. The third contains Supergroup 1, groups 3, 4 and 5 signals. These baseband signals are applied to the Modem Group OM-45(V)1/TCC (Group A Modem). The Multiplexer AN/UCC-4 also accepts seven demodulated receive signals (60 to 108 kHz) from the Modem Group OM-45(V)1/TCC and processes them into one TCF receive baseband (60 to 360 kHz).

(2) *Modem group OM-45[V)1/TCC.* The Modem Group OM-45(V)1/TCC (Group A Modem) equipment translates the transmit baseband inputs from the Multiplexer AN/UCC-4. The translated outputs are 12 to 60 kHz, 12 to 60 kHz and 12 to 156 kHz. Three voice orderwire signals (4 to 8 kHz) are hybrid combined resulting in modulation inputs of 4 to 60 kHz, 4 to 60 kHz and 4 to 156 kHz for the Frequency Modulators OM-46(V)1/TCC. The Modem Group OM-45(V)1/TCC also accepts seven input signals of 4 to 60 kHz from the Frequency Demodulators OM-47(V)1/TCC and hybrid extracts the voice orderwire signals (4 to 8 kHz) from each receive input. The remaining seven 12 to 60 kHz signals are translated to 60 to 108 kHz and applied to the Multiplexer AN/UCC-4.

(3) Frequency modulators OM-46(V)1/TCC and frequency demodulators OM-47(V)1/TCC. The Frequency Modulators OM-46(V)1/TCC and Frequency Demodulators OM-47(V)1/TCC (FM modems) process baseband plus voice orderwire signals. The Frequency Modulators OM-46(V)1/TCC accept 4 to 60 kHz or 4 to 156 kHz inputs from the Modem Group OM-45(V)1/TCC. These inputs are frequency modulated onto three 70 MHz carriers for application to the up-conversion equipment in the Satellite Communications Terminal AN/MSC-46 (Nodal). The Frequency Demodulators OM-47(V)1/TCC accept 70 MHz receive signals from the down-conversion equipment in the Satellite Communications Terminal AN/MSC-46 (Nodal). The 70 MHz receive signals are demodulated into baseband signals of 4 to 60 kHz. The receive baseband signals are applied to the Modem Group OM-45(V)1/TCC.

(4) Voice orderwire equipment. The Multiplexer Set AN/TCC-78 contains, voice orderwire equipment for three ETC to ETC voice orderwire circuits. Transmit voice orderwire signals (4 to 8 kHz) are applied to the Modem Group OM-45(V)1/TCC. There they are hybrid combined with the TCF baseband signals (12 to 60 kHz or 12 or 156 kHz) as party of the Frequency Modulator OM-46(V)1/TCC input. Seven receive voice orderwire signals (4 to 8 kHz) are accepted from the Modem Group OM-45(V) 1/TCC. Receive signals 1, 2 and 3 are hybrid combined to form voice orderwire circuit 1 (4 to 8 kHz). Receive signal 4 becomes voice orderwire circuit 2 (4 to 8 kHz). Receive signals 5, 6

and 7 are hybrid combined to form voice orderwire circuit 3.

(5) DC telegraph equipment. The DC telegraph tone keyers process the keyed dc output of the Teletype Page Printer AN/UGC-77 into frequency-shift keyed (FSK) signals. The DC telegraph tone converters process the received FSK signals into keyed dc for input to the Teletype Page Printer AN/UGC-77. The DC telegraph equipment provides ETC to ETC teletype communications when patched to a voice frequency channel.

(6) Line conditioning equipment. Line conditioning equipment, included in the Multiplexer Set AN/TCC-78, is used with the Multiplexer AN/UCC-4 to standardize signal levels where required. Dual line amplifiers and dual strappable attenuator pad assemblies are provided to set proper input and output levels for the multiplexer VF channels, DC telegraph equipment and the Radio Communications Subsystem AN/URC-55 VF equipment.

b. Radio Communications Subsystem AN/URC-55. The Radio Communications Subsystem AN/URC-55 is a spread spectrum multiple access transmitter/receiver which is capable of handling four voice frequency/digital data and three TTY channels of wideband traffic with a TCF to TCF TTY order-wire and an ETC to ETC TTY orderwire. Brief functional descriptions of the Major Sub-Groups of the Radio Communications Subsystem AN/URC-55 are provided below.

(1) Link terminal timing central (LTTC). The LTTC is a highly accurate time reference, which provides timing signals for the modulator/-demodulator group coders. The LTTC also interfaces with the Cesium Beam Frequency Standard HP-5061A through the Tire Transfer Unit (TTU) for timing signal comparison and calibration of the LTTC.

(2) Doppler augmentor range corrector. The doppler augmentor range corrector provides the means for offsetting the frequency of the transmit and receive local oscillators to correct for Doppler errors associated with Dopple shift to and from the satellite repeater.

(3) Transmitter. The Radio Communications Subsystem AN/URC-55 transmitter operates in either of two modes to transmit voice/teletype information or digital data. The transmitter output is pseudonoise, double-sideband, suppressed-carrier, 70 MHz IF signal that is applied to the Satellite Communications Terminal AN/MSC-46 (Nodal) for up-conversion and transmission.

(4) Receiver No. 1. The Radio Communications Subsystem AN/URC-55 receiver No. 1 (communications receiver) demodulates and demultiplexes the received 70 MHz spread spectrum signal from the Satellite Communications Terminal AN/MSC-46 to recover the voice/teletype or digital data. The wideband characteristics of the receiver, made possible by spread spectrum transmission methods, makes the receiver highly resistant to jamming.

(5) Receiver No. 2. The Radio Communications Subsystem AN/URC-55 receiver no. 2 (monitor receiver) functions identically to the communication receiver. The monitor receiver monitors local transmissions as they are retransmitted by the satellite for round-trip propagation time or range measurements and verification of back-to-back link through the satellite.

(6) Link simulator-test adopter. The Link Simulator-Test Adapter provides a means of establishing a jamming-to-signal ratio of 1:1 for testing in the standard test configuration with the Radio Communications Subsystem AN/URC-55 configured back-to-back. Jacks are available on the front panel of the Link Simulator-Test Adapter for voice communications over the repeater satellite.

c. Digital Data Modem MD-921/G (PSK Modem). The Digital Data Modem MD-921/G (PSK Modem) provides a digital data interface between ETC's. The PSK Modem is capable of processing data at rates between 19.2 kbs and 9.9999 Mbs. The 70 MHz IF. output from the PSK modulator is applied to an Electronic Frequency Up-Converter CV-3084/MSC-46 in the Satellite Communications Terminal AN/MSC-46. The 70 MHz IF. input to the PSK demodulator is supplied by an Electronic Frequency Down-Converter CV-3085/MSC-46 in the Satellite Communications Terminal AN/MSC-46. At selected ETC's, the PSK Modem is used in conjunction with an Asynchronous Digital Multiplexer/Demultiplexer (ADMD) for Muscle Trunk application.

d. Satellite Communications Terminal AN/MSC-46 (Nodal). The Satellite Communications Terminal AN/MSC-46 (NOdal) provides the radio frequency (RF) interface between the ETC and the satellite repeater for transmitting and receiving communications signals. The Satellite Communications Terminal AN/MSC-46 (Nodal) consists of the following Major Subgroups:

(1) Communications-antenna control group OA-8056/MSC-46 (nodal). The Communications-Antenna Control Group OA-8056/MSC-46 (Nodal) contains up-conversion (transmit), down-conversion (receive), and control and monitor equipment for the Satellite Communications Terminal AN/MSC-46 (Nodal). Electronic Frequency Up-Converters CV-3084/MSC-46 accept 70 MHz IF input signals and up-convert them to transmit frequency (7.9 to 8.4 GHz). Three 70 MHz FM signals are available from

the Multiplexer Set AN/TCC-78. One 70 MHz spread spectrum multiple access (SSMA) signal is available from the Radio Communications Subsystem AN/URC-55. One 70 MHz phase-shift keyed (PSK) signal is available from the Digital Data Modem MD-921/G. The outputs of the Electronic Frequency Up-Converters CV-3084/MSC-46 are combined and routed to the Power Distribution Group OA-8096/MSC-46 (transmitter van) for amplification. The Electronic Frequency Down-Converters CV-3085/MSC-46 accept receive RF signals (7.25 to 7.75 GHz) and down-convert them to 70 MHz IF signals. The down-converted signals are routed to the Multiplexer Set AN/TCC-78, Radio Communications Subsystem AN/URC-55 and Digital Data Modem MD-921/G. One Electronic Frequency Down-Converter CV-3085/MSC-46 is dedicated for use by the Receiving Group OA-8059/MSC-46 (tracking receivers) and system noise temperature measuring equipment. Reference signals for the Electronic Frequency Up-Converters CV-3084/MSC-46, Electronic Frequency Down-Converters CBV-3085/MSC-46, Multiplexer Set AN/TCC-78, Radio Communications Subsystem AN/URC-55 and Digital Data Modem MD-921/G are provided by the Cesium Beam Frequency Standard HP-5061A through the Radio Frequency Amplifier AM-6631/MSC-46 (distribution amplifier). The Communication;-Antenna Control Group OA-8056/MSC-46 also contains the Test Translator RFC 703 (self-test translator) which provides the ability to translate the output (7.9 to 8.4 GHz) of a selected Electronic Frequency Up-Converter CV-3084/MSC-46 to receive frequency (7.25 to 7.75 GHz) and connect it to a selected Electronic Frequency Down-Converter CV-3085/MSC-46 for self-testing. At selected Net Control Terminals, the Communications-Antenna Control Group OA-8056/MSC-46 contains either an Automatic Communications Monitor (ACM) or manual spectrum analyzer to monitor all down-link carriers accessing the satellite.

(2) Power distribution group OA-8096/MSC-46 (transmitter van). The Power Distribution Group OA-8096/MSC-46 accepts the combined output of the Electronic Frequency Up-Converters CV-3084/MSC-46 in the Communication-Antenna Control Group OA-8056/MSC-46 and amplifies it to an output level suitable for transmission. The Power Distribution Group OA-8096/MSC-46 contains two intermediate power amplifiers (IPA's), a radio Frequency Amplifier OG-131/MSC (LPA) and a High Power Transmitter (HPA). Mission requirements determine whether the Radio Frequency Amplifier OG-131/MSC (LPA), capable of 1 kW output power into the feed, or the High Power Transmitter (HPA), capable of 5 kW output power into the feed, is selected for operation.

(3) Antenna AS-1920/MSC-46. The Antenna AS-1920/MSC-46 consists of a forty foot parabolic main reflector, a dielguide feed system and two parametric amplifiers. Transmit signals are routed from the Power Distribution Group OA-8096/MSC-46 (transmitter van) through transmit waveguide to the dielguide feed for transmission. Receive signals are processed to identify antenna pointing errors. They are then applied to the on-line Parametric Amplifier AM-6602/MSC-46, a cryogenically cooled, low noise amplifier whose output is sent to the Communications-Antenna Control Group OA-8056/MSC-46 for down-conversion. The Antenna AS-1920/MSC-46 may be positioned either manually using slew controls on the Communications Control Console OA-8056/MSC-46 (control console) located in the Communications-Antenna Control Group OA-8056/MSC-46 or automatically using autotrack error signals from the Receiving Group OA-8059/MSC-46 (tracking receivers).

e. Digital Data Modem MD-920/G (ICF Modem). The Digital Data Modem MD-920/G (ICF Modem) is used in conjunction with the Digital Data Modem MD-921/G (PSK Modem) allowing the user to be located remotely. The ICF Modem accepts user uplink data, in bipolar form, from a microwave link and converts it to nonreturn to zero (NRZ) form for application to the PSK Modem. The ICF Modem accepts downlink data, in NRZ form, from the PSK Modem and converts it to bipolar form for transmission to the user over the microwave link. The ICF Modem is normally located remotely at the user, however, when installed at the ETC, it will be housed in the Multiplexer Set AN/TCC-78 in an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) or the Communications-Antenna Control Group OA-8056/MSC-46 (OCV) in an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal).

f. Analog-Digital Converter CV-3034/G. The Analog-Digital Converter CV-3034/G (A/D Converter) interfaces with the Digital Data Modem MD-920/G (ICF Modem) or Digital Data Modem MD-921/G (PSK Modem). When the input signal is analog (voice) it operates as an analog-to-digital converter (voice digitizer) providing a 50 kbs digital output. When the input is 50 kbs digital data, it operates as a digital data repeater. If both digital and analog signals are present, the digital data signal automatically takes precedance. When the receiver section recognizes a pseudo random (PR) sequence imbedded in the 50 kbs digital stream, it functions as a digital-to-analog converter. It then provides the original analog (voice) signal a

output. If no PR sequence is present, the receiver operates as a digital data repeater.

g. Diesel Engine Generator Sets PU-495/G. The ETC contains three Diesel Engine Generator Sets PU-495/G. Each consists of a diesel engine that is directly coupled to its main generator. The main generator is a S-phase, 50/60 Hertz, 100 kW unit. The Diesel Engine Generator Set PU-495/G can be operated locally at the generator and engine control panels or remotely from the Control-Monitor Group OA-8060/MSC-46 located in the Communications-Antenna Control Group OA-8656/MSC-46. In normal operations, two of the three Diesel Engine Generator Sets PU-495/G are connected in parallel to supply the station load with the third in standby.

4-3. Functional Operation of the ETC Using the Satellite Communications Terminal AN/ M-SC-46(Non-Nodal)

An ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) as deployed for Phase II, Stage lb, provides twelve voice frequency channels on a single F-M carrier for local users and/or TCF through the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) associated with the same satellite network. Brief functional descriptions of the Major Subsystems and Major Subgroups comprising an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) are contained below. Refer to figure FO-3 for a simplified block diagram of an ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal).

a. Non-Nodal Communications Subsystem. The Non-Nodal Communications Subsystem processes the baseband signals to and from local users and/or TCF and provides the IF interface with the Satellite Communications Terminal AN/MSC-46 (Non-Nodal). Brief functional descriptions of the Major Subgroups of the Non-Nodal Communications Subsystems are provided below.

(1) Multiplexer AN/FCC-55. The Multiplexer AN/FCC-55 accepts a maximum of twelve voice frequency channel inputs (0 to 4 kHz) from TCF, and/or local users and multiplexes them together. A voice orderwire channel is combined forming a baseband signal from 4 to 60 kHz. A second, supergroup signal (60 to 204 kHz), which is used mainly for testing is added resulting in the 4 to 204 kHz input for the Frequency Modulator OM-46(V)3/TCC located in the Communications-Antenna Control Group OA-8056/MSC-46. The Non-Nodal Communications Subsystem demultiplexer equipment accepts the baseband output (4 to 204 kHz) from the Frequency Demodulator OM-46(V)3/TCC located in the Communications-Antenna Control Group OA-8056/MSC-46 and demultiplexes it to retrieve a maximum of twelve voice frequency (0 to 4 kHz) channels, a voice orderwire and a supergroup signal (60 to 204 kHz).

(2) Frequency modulator OM-46(V)3/TCC and frequency demodulator OM-47(V)3/TCC. The Non-Nodal Communications Subsystem contains one Frequency Modulator OM-46(V)3/TCC and one Frequency Demodulator OM-47(V)3/TCC which process the baseband output and input (4 to 204 kHz) from and to the Multiplexer AN/FCC-55 providing the 70 MHz IF interface with the Satellite Communications Terminal AN/MSC-46 (Non-Nodal).

(3) Voice orderwire equipment. The Non-Nodal Communications Subsystem contains voice orderwire equipment for one ETC to ETC voice orderwire circuit (4 to 8 kHz). Transmit voice orderwire signals are applied to the Multiplexer AN/FCC-55 to be hybrid combined with the user baseband signal (12 to 60 kHz) and the supergroup signal (60 to 204 kHz) for application to the Frequency Modulator OM-46(V)3/TCC. Receive voice order-wire signals (4 to 8 kHz) are hybrid extracted from the receiver baseband (4 to 204 kHz) in the multiplexer AN/FCC-55 and applied to the receive voice orderwire equipment.

(4) Line conditioning equipment. Line conditioning equipment is included in the Non-Nodal Communications Subsystem to standardize signal levels and provide delay equalization for voice frequency signals where necessary.

b. Radio Communications Subsystem AN/URC-55. The Radio Communications Subsystem AN/URC-55 function is identical for ETC's Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) (para 4-2b).

c. Digital Data Modem MD-921/G (PSK Modem). The Digital Data Modem MD-921/G (PSK Modem) function is identical for ETC's Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) (Para 4-2c).

d. Satellite Communications Terminal AN/MSC-46 (Non-Nodal). The Satellite Communications Terminal AN/MSC-46 (Non-Nodal) functions are identical to a Satellite Communications Terminal AN/MSC-46 (Nodal) with fewer up-link and down-link capabilities. Brief functional descriptions of the Major Sub-Groups of a Satellite Communications Terminal AN/MSC-46 (Non-Nodal) are provided below.

(1) Communications-antenna control group OA-8056/MSC-46 (Non-Nodal). The Communications-Antenna Control Group OA-8056/MSC-46 (Non-

Nodal) contains up-conversion (transmit) and down-conversion (receive) equipment as well as control and monitor equipment for the Satellite Communications Terminal AN/MSC-46 (Non-Nodal). The Electronic Frequency Up-Converter CV-3084/MSC-46 and Electronic Frequency Down-Converter CV-3085/MSC-46 functions are identical to the Communications-Antenna Control Group OA-8056/MSC-46 (Nodal). A typical Communications-.Antenna Control Group OA-8056/MSC-46 (Non-Nodal) will contain two Electronic Frequency Up-Converters CV-3084/MSC-46 and three Electronic Frequency Down-Converters CV-3085/MSC-46. Normally, one Electronic Frequency Up-Converter CV-3084/MSC-46 will be used with the Digital Data Modem MD-921/G or the Frequency Modulator OM-46(V)3/TCC and the other will be used with the Radio Communications Subsystem AN/URC-55. All other functions are identical to the Communications-Antenna Control Group OA-8056/MSC-46 (Nodal) (para 4-2d (1).

(2) Power distribution group OA-8096/MSC-46 (transmitter van). The Power Distribution Group OA-8096/MSC-46 function is identical for the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) (para 4-2d (2).

(3) Antenna AS-1920/MSC-46. The Antenna AS-1920/MSC-46 function is identical for the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) (para 4-2 d (3).

e. Digital Data Modem MD-920/G (ICF Modem!. The Digital Data Modem MD-920/G (ICF Modem) function is identical for ETC's Using the Satellite Communications Terminals AN/MSC-46 (Nodal and Non-Nodal (para 4-2 e).

f. Analog-Digital Converter CV-3034/G. The Analog-Digital Converter CV-3034/G function is itentical for ETC's Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) para 4-2 f).

g. Diesel Engine Generator Sets PU-495/G. The Diesel Engine Generator Sets PU-495/G functions are identical for ETC's Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). (para 4-2 g).

CHAPTER 5

ETC MAINTENANCE

Section I. ETC MAINTENANCE PHILOSOPHY

5-1. General

The ETC is a component of a full-time high-priority communications network usually carrying traffic which cannot be carried by other means. It is therefore essential that maintenance procedures, described in applicable equipment manuals, be carefully followed and organized to minimize the system downtime. Redundant and Switchable Spare equipments are provided in certain critical areas so that operation can be continued with minimal interruption and/or system degradation thereby permitting repair of defective units off-line. Throughout the ETC, equipment design supports a repair by replacement concept in which subassemblies and/or modules are replaced to restore operation in a minimum of time. On-site repair actions which require unusual skills, special tools and test equipment or extended maintenance periods are minimized. Normally these repair actions are referred to the appropriate maintenance facility.

5-2. Nature and Extent of Maintenance

The following paragraphs describe the types of maintenance functions to be accomplished at each echelon of maintenance.

a. Organizational/Direct Support Maintenance (On-Site/Off-Site). Organizational through direct support maintenance may be accomplished by on-site maintenance technicians as outlined in applicable technical manuals for each subsystem. The following maintenance functions will be accomplished on-site.

(1) Scheduled preventive maintenance.

(2) Troubleshoot, repair, and align electronic, electro-mechanical, and mechanical units to the subassembly or module level. This includes:

(a) Replacements of units.

(b) Repair of subassemblies and/or modules as authorized by the Repair Parts and Special Tools List (RPSTL).

(c) Replacement of piece parts not integral to modules and/or subassemblies such as switches, knobs, fuses, connectors, etc. This applies to test equipment except when such replacement affects calibration.

(3) Realign subsystem after unit, subassembly, and/or module replacement.

(4) Perform organizational maintenance on power generation and environmental equipment.

(5) Request for test equipment calibration services.

(6) Arrange for visits of off-site higher echelon maintenance teams when required.

b. General Support or Base Support Facility. The following maintenance functions are to be performed at General Support or Base Support Facility:

(1) Repair test equipment within limitations of facility.

(2) Repair all teletype, telephone, and other standard communications equipment.

13) Repair any modules or subassemblies within the existing capability of the facility.

(4) Repair all power generation and environmental equipment (this service normally provided by an Area Support Command or Base Support Unit).

(5) Provide structural and heavy machine shop support.

(6) Provide test equipment calibration service.

c. Depot Level Maintenance. The following maintenance functions are to be accomplished by the applicable depot:

(1) Repair of all satellite communication peculiar units, subassemblies, and modules beyond General Support or Base Support capability

(2) Arrange and manage repair contracts with equipment manufacturers for repair and return of units, subassemblies, and modules beyond depot repair capability

(3) Provide on-site support of ETC equipment when required

(4) Maintain a repair cycle float to replace units returned for overhaul

5-3. Preventive and Corrective Maintenance

Preventive maintenance is scheduled periodic maintenance (daily, weekly, monthly, semi-annually) for the routine replacement of expended material and the identification of problems within the subsystems of the Earth Terminal Complex. Corrective maintenance is the additional maintenance required for the repair of problems identified during normal operation or preventive maintenance.

Preventive and corrective maintenance may be performed either in-service or out-of-service. The ETC's, modified for Phase II operation, have added selective redundant equipment which allows considerable preventive and corrective maintenance to be performed in-service. Due to the high degree of availability required from the ETC's, one of the goals for Phase II operation is the performance of required out-of-Pervice preventive maintenance with minimum impact on availability. As a result, distinctly separate preventive and corrective maintenance downtimes are recognized.

a. Preventive Maintenance Downtime (PMDT). Preventive Maintenance Downtime (PMDT) is regularly scheduled downtime which is used exclusively for the inspect, check and lubricate phase of that maintenance which must be accomplished out-of-service. Scheduling of this maintenance will be a responsibility and coordinating function of SATCOM control. Each DSCS SATCOM Controller assigned operational control of a Phase II satellite will coordinate with ETC's accessing that satellite to establish downtime requirements.

b. Corrective Maintenance Down time (CMDT). Corrective Maintenance Downtime (CMDT) is the additional downtime to be requested as required to repair problems identified during PMDT. This downtime will be requested as required. In-service checks and inspections made during normal operation may also reveal deteriorating conditions, particularly with non-redundant units, which require CMDT for repair. CMDT requests are the responsibility of the Site Commander.

c. PMDT versus CMDT. A policy of fix-after-failure is not implied by separating out-of-service maintenance into PMDT and CMDT. PMDT provides a means to detect degraded operation of the ETC prior to marginal performance of catastrophic failure. When PMDT or in-service checks reveal the need for CMDT, a request for CMDT will be made.

Section II. SYSTEM TESTING

5-4. General

This section provides ETC System Testing procedures that are performed by the ETC Operator immediately prior to and/or during operation to evaluate system performance.

5-5. Carrier-to-Noise Density Ratio (C/ kT) Measurement

Carrier-to-noise density ratio (C/kT) measurements are normally made at the 70 MHZ SAMPLE connector of the associated Electronic Frequency Down-Converter CV-3085/MSC-46. These measurements are made using suitable spectrum analyzers or wave analyzers and can be accomplished on-line without disrupting service. C/kT measurements can be made at RF frequencies using suitable spectrum analyzers, when necessary. Although the Field Strength and Noise Meter NF-105 has been used for C/kT measurements in the past, its use is not recommended. NF-105 noise power measurements are in error because metering is not rms. In addition, the IF bandwidth is not calibrated during depot maintenance. C/kT measurement procedures using suitable wave analyzers and spectrum analyzers are provided below.

a. C/kT Measurement using an HP-310A or HP-312A Wave Analyzer.

This procedure provides accurate results only when measuring unmodulated carriers or modulated carriers whose bandwidth is substantially less than 3.0 kHz. Therefore, this procedure is recommended for off-line measurement of unmodulated carriers or on-line measurement of beacon carriers only. Before using this procedure examine the measurement and image frequency spectrum (2MHz above measurement frequency) using a suitable spectrum analyzer. There can be no signal other than noise at the image frequency. Noise densities at measurement and image frequencies must be equal within 1 dB.

(1) Connect test equipment as provided in figure 5-1.

(2) Set wave analyzer switches and controls for 3000 Hz bandwidth and tune to 1 MHz.

(3) Set signal generator controls as required for a 71 MHz output at 0 dBm.

(4) If necessary, reset the wave analyzer RANGE selector for an on scale indication. Fine tune signal generator for a peak indication. Record reading.

(5) Adjust wave analyzer COARSE and FINE tuning controls to 1010 kHz and reset RANGE selector for an on scale indication. Adjust FINE tuning control for a minimum indication within 100 kHz and record as noise level.

(6) Repeat step (5) at 990 kHz.

(7) Average the noise levels measured in steps (5) and (6) and algebraically subtract the result from the signal level measured in step (4) to obtain $\frac{C + N}{N}$ in dB.

(8) Add a 37 dB correction factor and report as C/kT.

b. C/kT Measurement using an HP-851/8551

Spectrum Analyzer. **This procedure** provides ac**curate results only when measuring** unmodulated **carriers or modulated carriers whose** bandwidth is less than 1 MHz. When using this procedure, a special graticule (fig. 5-2) must be installed on the spectrum analyzer display screen.

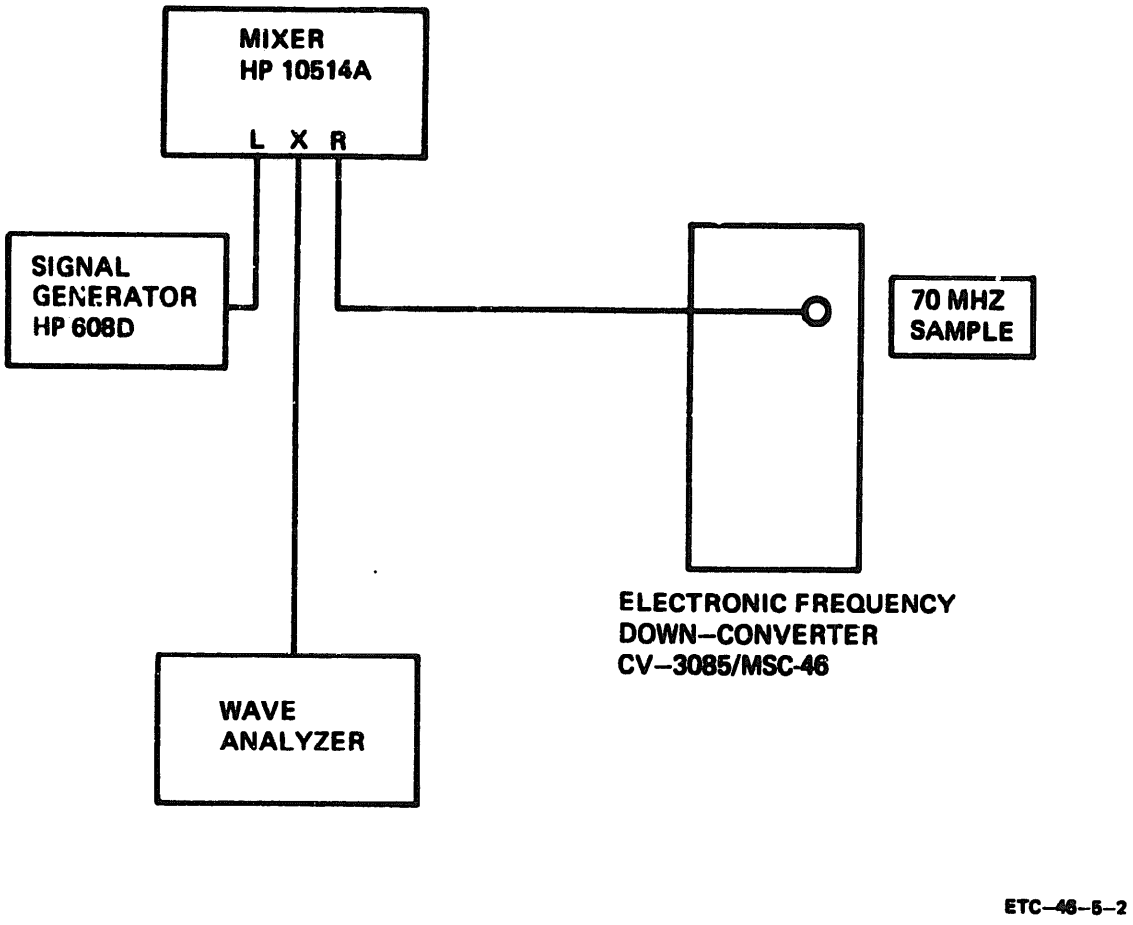


Figure 5-1. Test Equipment Setup for Carrier-to-Noise Density Ratio (C/kT) Measurement Using the Wave Analyzer.

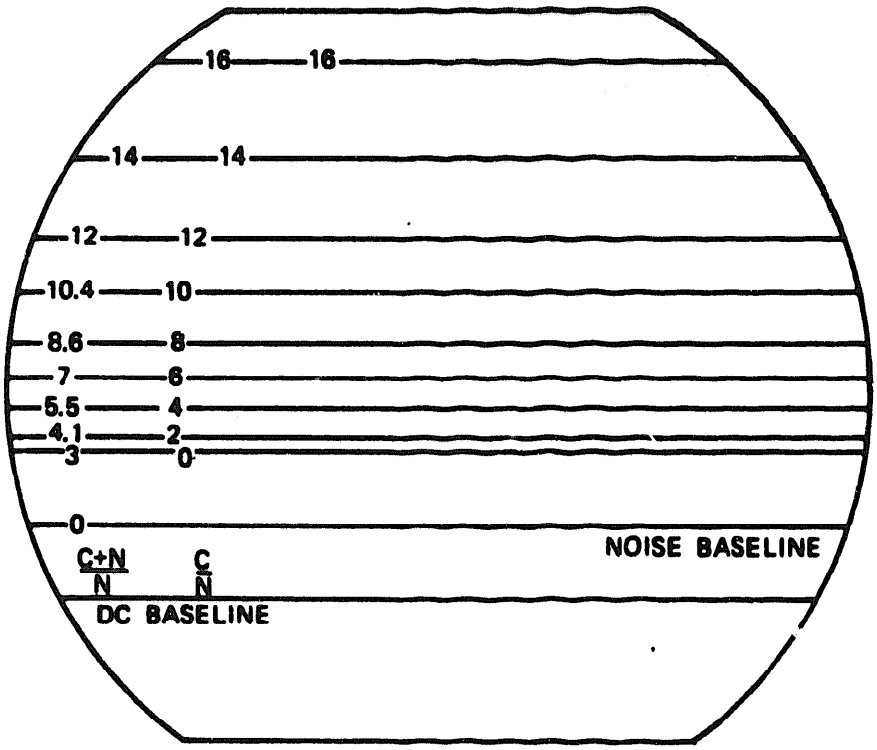


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Figure 5-2. Special Graticule for HP-8551 Spectrum Analyzer Display Section.

(1) Connect the HP-851/8551 Spectrum **Analyzer to the 70 MHZ SAMPLE** connector on the **associated Electronic Frequency** Down-Converter **CV-3085/MSC-46.**

(2) Set HP-851 Spectrum Analyzer Display **Sec**tion Switches and controls as follows:

(a) SYNC to LINE.
(b) VERT DISPLAY to LIN.
(c) IF. BANDWIDTH to 1 KC.
(d) **SWEEP TIM**E to 10 MILLISEC/CM.
(e) IF. VERNIER fully counterclockwise.
(f) IF. GAIN (DB) to 0.
(g) VIDEO FILTER to OFF.

(3) **Set HP-8551 Spec**trum Analyzer RF Section **switches and controls as** follows:

(a) FREQUENCY (GC) as required.
(b) SPECTRUM WIDTH to 1.0 MC/CM.
(c) STABILIZATION to UNSTABILIZED.
(d) TUNE as required between 50 and 90 MHz.
(e) ATTENUATOR (DB) to 0.
(f) SIGNAL IDENTIFIER (F_s) to OFF.

(4) Carefully adjust VERT POS screwdriver adjust until the display baseline coincides with the DC BASELINE on the special graticule, refer to figure 5-2,

(5) Set HP-851 Display Section GAIN (DB) and HP-8551 RF Section TUNE controls to display the desired carrier on the center line of the display screen.

(6) While observing the display, sequentially reduce the spectrum analyzer bandwidth using the HP-8551 RF Section SPECTRUM WIDTH control until the displayed carrier occupys at lease one-third of the display screen and measure the bandwidth of the displayed carrier.

(7) Using the results of step (6), set the HP-851 Display Section IF. BANDWIDTH control as required below:

(a) If the carrier bandwidth is less than 10 kHz; set IF. BANDWIDTH control to 10 KC and use a C/N to C/kT conversion factor of 40 dB.

(b) If the carrier bandwidth is more than 10 kHz and less than 100 kHz; set IF. BANDWIDTH control to 100 KC and use a C/N to C/kT conversion factor of 50 dB.

(c) If the carrier bandwidth is more than 100 kHz; set I.F. BANDWIDTH control to 1 MC and use a C/N to C/kT conversion factor of 60 dB.

(8) Adjust the HP-851 Display Section IF. GAIN (DB) and IF. VERNIER controls until the noise level on the display coincides with the NOISE BASELINE on the special graticule.

(9) Adjust the HP-851 Display Section SWEEP TIME control for the slowest sweep that provides an acceptable display and set the VIDEO FILTER switch to ON.

(10) Check and reset, if necessary the noise baseline as provided in step (7).

NOTE

The C/kT indication may be in error if the combination of the HP-851 Display Section SWEEP TIME and IF. BANDWIDTH control settings are not optimized or the carrier bandwidth is greater than 1 MHz.

(11) Observe the vertical height of the displayed carrier over a period of serveral sweeps and using the highest indication, read C/N from the special graticule. Convert C/N to C/kT by adding the conversion factor established in step (7) to the indicated C/N. If the HP-851 Display Section IF. BANDWIDTH control is set to 1 MC, C/kT may be read directly from the special graticule if a C/kT scale is provided. When measuring carriers exceeding 1 MHz bandwidth, report and record the carrier bandwidth in addition to the C/kT.

(12) If the carrier level results in an off-screen indication, reduce IF gain using the IF. GAIN (DB) control until an on-screen indication is obtained. It should be noted that the noise baseline will no longer coincide with the NOISE BASELINE on the special graticule, this is a normal indication. Repeat step (11), add the number of dB by which the IF. GAIN (DB) control was adjusted and report/record as **C/kT.**

c. C/kT Measurement using an HP-141T/8555A Spectrum Analyzer. This procedure provides acceptable results only when measuring unmodulated carriers or modulated carriers whose bandwidth is less than 300 kHz. C/kT measurements using the HP-141T/8555A Spectrum Analyzer can be up to 3 dB in error. Therefore, all results obtained using this procedure should be regarded as estimates. This procedure is recommended for C/kT measurement of beacon carriers only when no other procedure can be used.

(1) Connect the HP-141T/8555A Spectrum Analyzer to the 70 MHZ SAMPLE connector on the associated Electronic Frequency Down-Converter CV-3085/MSC-46.

(2) Set HP-8555A Spectrum Analyzer-RF Section switches and controls as follows:

(a) FREQUENCY as required

(b) BANDWIDTH to 100 kHz

(c) SCAN WIDTH PER DIVISION to 100 kHz

(d) INPUT ATTENUATION as required

(3) Set HP-8552B Spectrum Analyzer-IF Section switches and contols as follows:

(a) SCAN TIME PER DIVISION to 10 MILLISECONDS

(b) VIDEO FILTER to 100 Hz

(c) 2 dB LOG/10 dB LOG/LINEAR to 10 dB LOG

(d) SCAN MODE to INT

(e) SCAN TRIGGER to AUTO

(4) Set HP-141T Display Section controls for nonstorage mode at a convenient brightness.

(5) Adjust HP-8555A RF Section, FREQUENCY FINE TUNE control to display desired signal on center line of display screen.

(6) Observe HP-141T Display Section screen and adjust noise baseline to coincide with the -60 dB graticule line. Use HP-8552B IF. Section, LOG REF LEVEL control for coarse adjustment and LINEAR SENSITIVITY control for fine adjustment. If noise baseline is irregular, use noise level at left edge of signal trace for adjustment.

(7) Count the number of divisions that the displayed signal rises above the baseline and multiply by 10.

(8) Add a 52.5 dB conversion factor to obtain approximate C/kT.

5-6. Test Tone-To-Noise Ratio (TTNR) Measurement

Test tone-to-noise ratio (TTNR) measurements are normally made at the voice frequency (VF) interface by the associated Technical Control Facility (TCF). When an ETC has a VF channel interface capability, the Operator may be requested to make a TTNR measurement at the VF interface as provided in DCA Circular 310-70-57, Supplement 1. Normally,

TTNR measurements will be made at the output of the Frequency Demodulator OM-47(V) ( )/TCC at the top channel or an out-of-band frequency. TTNR measurements taken at the VF interface or the top channel frequency require that the VF channel under test be terminated, disrupting service for the duration of the measurement. Step-by-step procedures for performing TTNR measurements at both baseband and out-of-band frequencies are provided below.

a. TTNR Measurement at In-Band Baseband Frequency. Performance of this TTNR measurement requires that the channel under test be terminated for the duration of the measurement and that Pomona LPa-50 monitor type coaxial looping plugs are used for baseband connections to Frequency Modulators OM-46 (V) ( )/TCC and Frequency Demodulators OM-47 (V) ( )/TCC.

(1) At the transmit ETC, set Transmission Test Set Assembly switches and controls as follows:

(a) Oscillator frequency dial and RANGE as appropriate for baseband test tone frequency of channel under test; refer to DTM 11-5895-796-12-1 or DTM 11-5895-796-12-2 as applicable for modulation plan.

(b) Oscillator AMPLITUDE fully counterclockwise.

(c) Patch Panel INPUT and OUTPUT IMPEDANCE to 900.

(d) Patch Panel MEAS-CAL to MEAS.

(2) At transmit ETC, connect Transmission Test Set, Patch Panel OUTPUT to a frequency counter, HP-5245L or equivalent.

(3) On Transmission Test Set Oscillator; adjust AMPLITUDE control clockwise until frequency counter begins to count. Adjust frequency dial to baseband test tone frequency of channel under test ±100 Hz. Reset AMPLITUDE control fully counterclockwise.

NOTE

This procedure describes use of the built-in Sierra 303A Frequency Selection Levelmeter. When necessary, a suitable wave analyzer (HP-310A, HP-312A or HO5-312A) may be used. However, equivalent switch settings and appropriate corrections factors must be used. The correction factor for an HP-310A Wave Analyzer is -9 dB. The correction factor for an HO5-312A Wave Analyzer is +2 dB. No correction factor is required for an HP-312A Wave Analyzer.

(4) At transmit and receive ETC's set Frequency Selective Levelmeter (Sierra 303A) switches and controls as follows:

(a) INPUT to 75 ohms.

(b) BRIDGING/TERMINATING (IN) to BRIDGING (out position).

(c) UNBALANCED/BALANCED (IN) to UNBALANCED (out position).

(d) SENSITIVITY to NORMAL.

(e) SELECTIVITY to 3.1 kHz.

(f) TUNE pushbutton in.

(g) COARSE AND FINE TUNE as required for baseband test. frequency of channel under test

(5) At transmit ETC, connect a BNC T adapter to the monitor jack on the coaxial looping plug connected to the Frequency Modulator OM-46(V)( )/TCC input as shown in figure 5-3①.

(6) At transmit ETC connect the Sierra 303A to one input of the BNC T adapter as shown in figure 5-3①. Coordinate with TCF and verify that channel under test has been properly terminated. A properly terminated channel should indicate less than -80 dBm.

(7) Connect Transmission Test Set Patch Panel OUTPUT to the remaining input of the BNC T adapter as shown in figure 5-3①. Adjust Transmission Test Set Oscillator AMPLITUDE control for a -30 dBm indication on Sierra 303A.

(8) At receive ETC, connect Sierra 303A to monitor jack on coaxial looping plug connected to the output of the Frequency Demodulator OM-47(V) ( )/TCC to be tested, as shown in figure 5-3②.

(9) At receive ETC, readjust COARSE and FINE TUNE controls as required for peak indication on levelmeter. Indication should be -30 ±3 dBm.

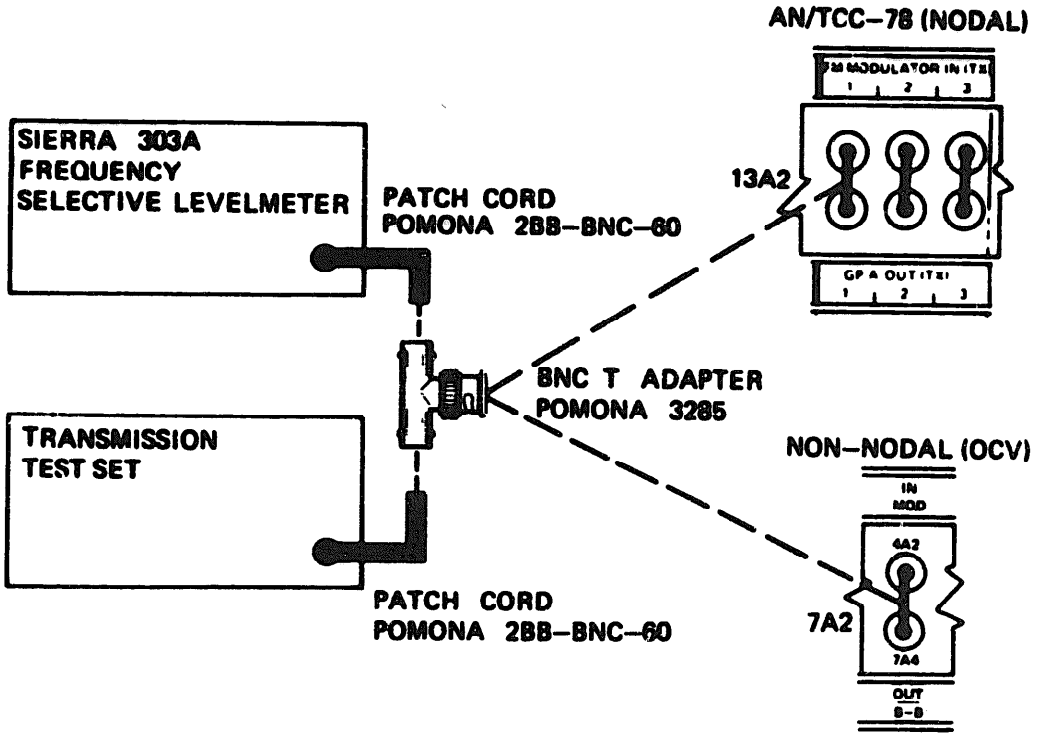

Figure 5-1(1). Test equipment setup for tone-to-noise ratio (TTNR) measurement (sheet 1 of 2).

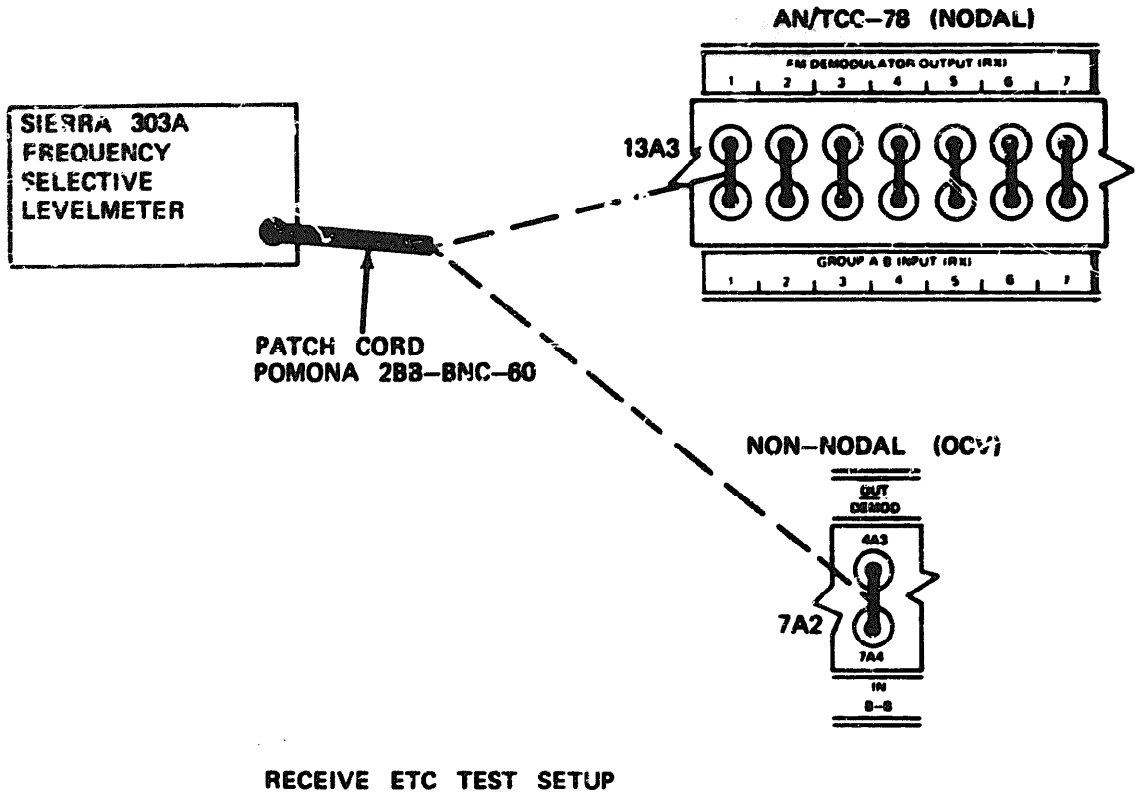

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Figure 5-3 ②. Test equipment setup for test tone-to-noise ratio (TTNR) measurement (sheet 2 of 2).

(10) The test tone measured in step (7) is being transmitted at -10 dBm0 to avoid overloading baseband equipment. Therefore, add 10 dB to the measured level and record as test tone level for channel under test. Test tone level should be -20 ±3 dBm.

(11) At receive ETC, coordinate with transmit ETC to have test tone removed.

(12) At receive ETC, readjust INPUT LEVEL control on Sierra 303A for an on-scale indication and adjust FINE TUNE control for minimum indication.

(13) Convert measured noise level from step (10) to C-message weighted noise by subtracting 1 dB. (Example: if measured noise level is -64 dBm, C-message weighted noise = -64 dBm - 1 dB = -65 dBm.)

(14) Algebraically subract C-message weighted noise level from test tone level and report as TTNR. (Example: test tone level is -20 dBm and C-message weighted noise level is -65 dBm, TTNR = -20 dBm - (-65 dBm) = 45 dB.)

b. TTNR Measurement at Out-of-Band Frequency. TTNR measurements can be performed during normal operations, without interrupting traffic by making measurements at frequencies beyond the normal baseband limits. The procedure for measuring TTNR at an out-of-band frequency is the same as the in-band measurement provided in paragraph 5-6a., except that the test tone frequency is selected from table 5-1 for the assigned channel capacity and quality.

5-7. Out-of-Band Noise (OBN) Measurement

Out-of-Band Noise (OBN) measurements are performed on-line, without interrupting or degrading communications traffic, to provide an indication of circuit quality. Two methods of measuring OBN are provided; one method using a Frequency Selective Levelmeter (Sierra 303A or equivalent), and a second method using a DC millivoltmeter connected to the Frequency Demodulator OM-47(V) ( )/TCC OBN module.

Table 5-1. Out-of-Band TTNR Test Tone Frequencies

Channel capacity	Test frequency
3 global	25 kHz
6 global	37 kHz
9 global	49 kHz
12 global	61 kHz
24 global	109 kHz
36 global	157 kHz
48 global	205 kHz
72 global	301 kHz
3 tactical	25 kHz
6 tactical	37 kHz
9 tactical	49 kHz

a. OBN Measurement using Q Frequency Selective Levelmeter.

NOTE

This procedure describes use of the built-in **Sierra 303A Frequency Selective Levelmeter. When necessary, a suitable** wave analyzer (HP-310A, HP-312A or HO5-312A) may be used. However, equivalent switch settings and appropriate correction factors must be used. The correction factor for an HP-310A Wave Analyzer is -9 dB. The correction factor for an HP-312A Wave Analyzer is +2 dB. No correction factor is required for an HP-312A Wave Analyzer.

(1) Set Sierra 303A switches and controls as **follows:**

(a) INPUT to 75 ohms.

(b) BRIDGING/TERMINATING (IN) to **B**RIDGING (out position).

(c) UNBALANCED/BALANCED (IN) to **U**NBALANCED (out position).

(d) SENSITIVITY to NORMAL.

(e) SELECTIVITY to 3.1 kHz.

(f) TUNE pushbutton in.

(g) COARSE and FINE TUNE as required to achieve LOCK light at test frequency from table 5-1.

(A) INPUT LEVEL to -30.

(2) Connect Sierra 303A to monitor jack on Pomona LPA-50 coaxial looping plug connected between **baseband** equipment and Frequency Demodulator OM-47(V) (\ )/TCC to be tested.

(3) Reset INPUT LEVEL control as necessary to obtain an on-scale meter indication.

(4) Adjust FINE TUNE control 3 kHz above and below measurement frequency and observe meter for minimum indication. Record minimum indication as measured noise level.

(5) Convert measured noise level to C-message weighted noise by subtracting 1 dB. (Example: measured noise level is -84 dBm, C-message weighted noise = -64 dBm -1 dB = -65 dBm.)

(6) Algebraically subract C-message weighted noise level from the measured standard test tone level (-20 dBm nominal) to obtain TTNR. (Example: C-message weighted noise level is -65 dBm, TTNR = -20 dBm -(-65 dBm) = 45 dB.)

(7) Repeat steps (1) through (5) for remaining Frequency Demodulators OM-47 (V) ( )/TCC.

b. OBN Measurement using a DC Millivoltmeter. Prior to using this procedure for measuring OBN, the FM Receive Baseband Adjustment provided in paragraph 3-20 must be performed and the OBN module output must be calibrated as follows:

(1) Connect a DC millivoltmeter, (John Fluke 871A or equivalent) across TP5 and TP2 (ground) on the Frequency Demodulator OM-47(V) ( )/TCC OBN module to be tested, as provided in figure 5-4.

(2) Perform a test tone-to-noise ratio (TTNR) measurement as provided in paragraph 5-6a or 5-6b as appropriate.

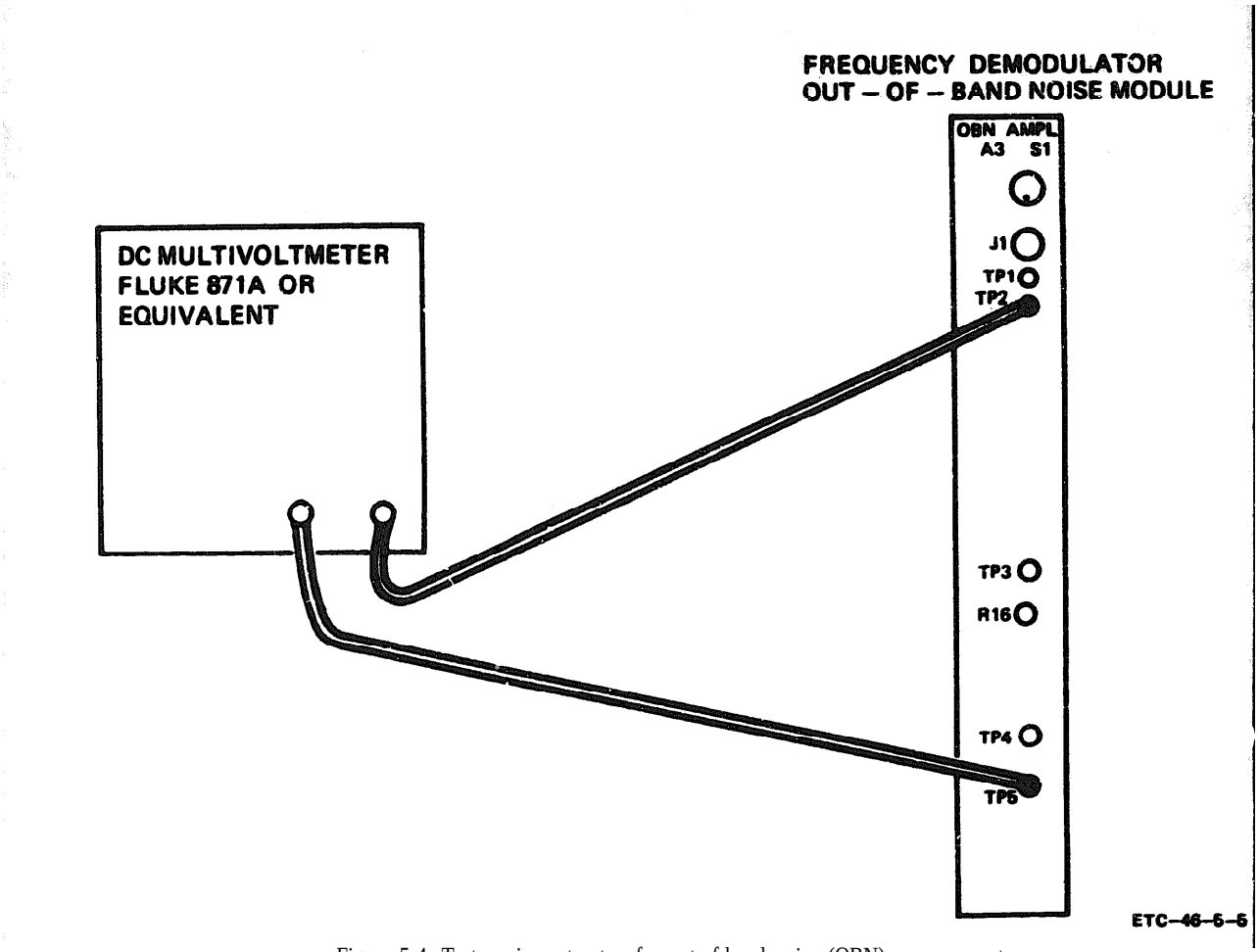


Figure 5-4. Test equipment setup for out-of-band noise (OBN) measurement.

(3) Using measured TTNR and table 5-2, determine nominal millivolt output of OBN module for assigned channel quality (global or tactical).

(4) On Frequency Demodulator OM-47(V) ( )/TCC, set squelch MANUAL OVERRIDE switch to ON.

(5) Observe DC millivoltmeter and adjust R-16 on the OBN module to the value determined in step (3).

(6) On Frequency Demodulator OM-47(V) ( )/TCC set squelch MANUAL OVERRIDE switch to OFF.

(7) Repeat steps (1) through (6) for remaining Frequency Demodulators OM-47(V) ( )/TCC.

(8) Future measurements of the OBN module output in millivolts can be converted to TTNR using table 5-2. (Example: If the Frequency Demodulator OM-47(V) ( )/TCC is configured for 12 channel Global operation and the OBN module output is 155 millivolts. the TTNR is 44 dB.)

(9) Any adjustment of R16 on the OBN module will affect the level at which the SQUELCH alarm occurs; therefore, following an adjustment of R16, the squelch threshold potentiometer (R44) should be adjusted to alarm at 900 to 1000 millivolts on the OBN meter at the earliest opportunity to go off-line.

5-8. Digital Error Rate Measurement

The digital error rate measurement is performed immediately after establishing a PSK link to determine link quality and to verify the calibration of on-line error rate indicators.

Table 5-2. OBN module output to TTNR conversion table.

OBN module output (mV)	*Tactical TTNR (dB)*	*Global TTNR (dB)*	*OBN module output (mV)*	*Tactical TTNR (dB)*	*Global TTNR (dB)*
40	37.5	50.5	205	29.5	42.5
45	37	50	230	29	42
51	36.5	49.5	250	28.5	41.5
55	36	49	280	28	41
61	35.5	48.5	305	27.5	40.5
68	35	48	340	27	40
75	34.5	47.5	375	26.5	39.5
83	34	47	415	26	39
92	33.5	46.5	465	25.5	38.5
100	33	46	510	25	38
112	32.5	45.5	560	24.5	37.5
125	32	45	620	24	37
137	31.5	44.5	690	23.5	36.5
155	31.0	44	755	23	36
167	30.5	43.5	860	22.5	35.5
185	30	43	930	22	35

NOTE

This procedure may be performed at any time when directed by the SATCOM Net Controller and digital data traffic can be interrupted.

a. Connect an HP 5245L, Electronic Frequency Counter to the ERROR jack on the Digital Data Modem MD-921/G; refer to TM 11-5820-802-12 for location of ERROR jack and front panel controls and

b. Coordinate with SATCOM Net Controller, the associated TCF and partner ETC and set SOURCE selector switch to LINK.

c. Observe error count on frequency counter. The time interval required for this measurement depends upon the data rate and link carrier-to-noise conditions. Practical, time intervals limit error rate measurements to approximately the following:

(1) For 20 kHz; 10^{-5} to 10^{-6} .
(2) For 200 kHz; 10^{-6} to 10^{-7} .
(3) For 1 MHz: 10^{-7} to 10^{-8} .
(4) For 10 MHz; 10^{-8} to 10^{-9} .

d. Set METER selector switch to ERROR COUNT; read and record indication. (This step applicable only for error rates in excess of 1%.)

e. Set METER selector switch to SIG/NOISE; read and record indication. (This step applicable for all coded modes and non-coded mode-s above error rates of 10^{-5} only.)

f. When authorized by SATCOM Net Controller, set SOURCE selector switch to OPERATE.

g. Compare results of steps d and e with calibration plot prepared during turn-on and checkout to identify any significant correction that must be applied to on-line error rate indicators.

5-9. Satellite Downlink Monitor

Satellite downlink monitoring provides the ETC Operator with information regarding satellite output as receive at the ETC. In addition, the SATCOM Net Controller may request assistance to identify changes in satellite performance or presence of jamming signals in the satellite spectrum. Monitoring, may be accomplished routinely or upon request as directed by the Site Commander. The HP-851/8551 or HP-141T/8555A Spectrum Analyzer is used to perform this monitoring. Due to the different characteristics of these two instruments, general instructions only are provided for their use.

a. Single Carrier Monitoring. In normal operation, a single assigned receive carrier will be selected for monitoring. This carrier is usually the beacon carrier, the highest priority communications carrier, or the carrier having the poorest margin.

(1) Connect the spectrum analyzer to the 70 MHZ SAMPLE connector on the Electronic Frequency Down-Converter CV-3085/MSC-46 assigned to the selected carrier.

(2) Tune spectrum analyzer to 50 MHz to monitor the beacon or 70 MHz to monitor a communications carrier.

(3) Set spectrum analyzer IF bandwidth controls to the widest available bandwidth. (300 kHz for HP-141T/8555A or 1 MHz for HP-851/8551)

(4) Set spectrum analyzer sweep speed to the slowest sweep that is visually acceptable.

(5) Set spectrum analyzer sweep width so that displayed signal is 2 to 4 centimeters wide.

(6) Adjust spectrum analyzer gain until amplitude of displayed carrier coincides with a convenient reference line on display screen. Reference

line should be at approximately 80 percent of screen height. Mark or record position of gain control so that it can be reset if disturbed.

b. Multiple Carrier Monitoring. Multiple carriers can be monitored at either the IF interface or the RF interface. When all the carriers of interest fall within ±20 MHz of an assigned receive carrier frequency, monitoring is accomplished at the 70 MHZ SAMPLE connector of the Electronic Frequency Down-Converter CV-3085/MSC-46 assigned to that carrier group. When all the carriers do not fall within 20 MHz, monitoring is accomplished at the RF interface as provided below.

(1) At ETC's that are equipped with three IFL TWTA's, connect the spectrum analyzer to J1 on the RF Patch Panel 7A1 using an RG-214 coaxial cable not more than six feet in length. At ETC's that are not equipped with the third IFL TWTA, connect a coaxial cable between J1 and J2; then connect the spectrum analyzer to J4 on the RF Patch Panel 7A1 as described above.

(2) Set spectrum analyzer tuning and sweep width controls to center the carriers of interest on the display screen. It is recommended that observations be made in increments of 100 MHz or less due to the tendency to crowd signals and suppress amplitudes at bandwidths in excess of 100 MHz. When monitoring more than one 100 MHz segment, set spectrum analyzer gain to a reference line on the display screen using the EC beacon carrier. For observations of other carrier amplitudes, maintain the above gain setting and read display screen for dB above or below EC beacon reference.

5-10. Noise Power Density Measurement

Noise power density measurements are made to determine that the receive system gain is adequate for the demodulators. Unsatisfactory results indicate degradation of the Parametric Amplifier AM-6602/MSC-46, IFL TWT amplifier, Electronic Frequency Down-Converter CV-3085/MSC-46 or associated cabling or waveguide components. Measurements are normally made at the 70 MHZ SAMPLE connector on the associated Electronic Frequency Down-Converter CV-3085/MSC-46 while in operation. Measurements can be made either on or off the satellite. When out of operation, however, noise powers will be lower.

a. Connect a suitable spectrum analyzer HP-851/8551 or HP-141T/8555A to the 70 MHZ SAMPLE connector on the associated Electronic Frequency Down-Converter CV-3085/MSC-46.

b. Tune spectrum analyzer to display the desired carrier and its adjacent noise baseline.

c. Set spectrum analyzer bandwidth to 100 kHz, video filter on. (100 Hz position for HP-8552A IF Section), and log/linear controls for 10 dB log display.

d. Set spectrum analyzer sweep speed control for the slowest visually acceptable sweep. Set spectrum analyzer scan width control until the displayed carrier is 2 to 4 centimeters wide.

e. Observe noise baseline adjacent to displayed carrier and adjust spectrum analyzer gain for a convenient noise reference level. The noise reference level should be approximately one-third of display screen height.

f. Disconnect spectrum analyzer from Electronic Frequency Down-Converter CV-3085/MSC-46. Reconnect spectrum analyzer to a suitable, calibrated, VHF signal generator HP-608D or equivalent.

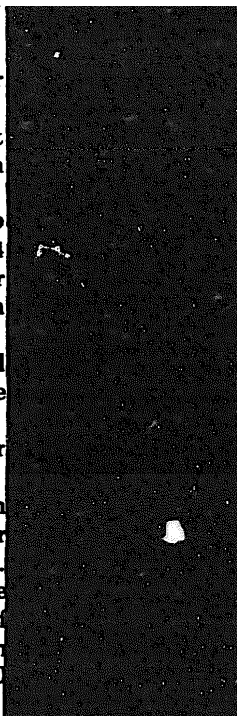
g. Adjust signal generator frequency and output level to display its output signal on the spectrum analyzer display screen.

h. Reset, if necessary, spectrum analyzer sweep width until displayed signal is approximately 2 to 4 centimeters wide. Fine adjust signal generator frequency until displayed signal coincides with center line of display screen.

i. Fine adjust signal generator output level until the top of the displayed signal coincides with noise reference level of step e.

j. Read signal generator output attenuator setting in dBm (Example: -40 dBm)

k. Algebraically subract a 47.5 dB correction factor from signal generator output attenuator setting and record as normal noise power density. This corrected power density should not be more negative than - 117 dBm to ensure operation of demodulators nor significantly more negative than previously recorded normal values (Example: -40 dBm -47.5 dBm = -87.5 dBm)



CHAPTER 6

ETC INTERCONNECTION DIAGRAMS

6-1. Introduction

This chapter provides interconnect cable and signal flow diagrams for the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal), which are located following the Alphabetical Index. These diagrams identify the input/output signal flow, levels and external cables between the Major Subsystems and Major Subgroups of the ETC. A listing of interconnect cables and wiring for the ETC is provided in chapter 2, section I, of this manual. For detailed circuit diagrams pertaining to this equipment refer to appendix A for applicable technical manuals.

6-2. Interconnect Cable Diagrams

Interconnect cable diagrams for the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal) are furnished in figures FO-4 and FO-5. These diagrams show interconnection of external cables between the Major Subsystems and Major Subgroups of the ETC's.

6-3. Signal Flow and Level Diagrams

Signal flow and level diagrams are furnished in figures FO-6 and FO-7 for the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). These diagrams depict signal flow and level through the ETC.

APPENDIX A

DOCUMENTS AND TECHNICAL MANUALS

A-1. Scope

Appendix A contains a list of documents and technical manuals required for the operation and maintenance of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal). Publications necessary for the clarification of symbols, designations, abbreviations, etc., such as applicable specification standards and exhibits used in the preparation of this ETC System Manual, are also listed in this appendix.

A-2. Explanation of Columns

The following is an explanation of the columns in the Documents and Technical Manuals listing (table A-1).

a. Publication Number Column.
This column indicates the publication number of the document or technical manual listed. Publication numbers listed in this column are in numerical sequence.

b. Nomenclature Column. This column indicates the official nomenclature of the document or technical manual, with model number or other identifying information.

A-3. Requisitioning of Publications

Draft technical manuals (DTMs) and instruction manuals (IMs) are not available through AG publication channels. Requests for the DTMs and IMs listed below should be sent to Commander, US Army Satellite Communications Agency, ATTN: DRCPM-SC-8, Fort Monmouth, NJ07703.
included in this galley, pages 245 and 270

Table A-1. Documents and Technical Manuals for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)

Publication number	*Nomenclature*
	Logistic Support Plan for Earth Terminal Complex Using Satellite Communication Terminal AN/MSC-46 Phase II Stage 1b (Dated May 1974).
DCA Circular 300-195-1 Supplement 1	DSC Technical Evaluation Program (TEP) Performance-Measurement Procedures for Multichannel Broad and Telecommunications Systems.
DCA Circular 310-70-1	DSC Technical Control Methods and Procedures.
DCA Circular 831-70-( )	Operation and Control of the DSCS (Draft) Standard Operation Procedures.
Plan 25	Plan 25 for Earth Terminal Complex Technical Manuals.
MIL-M-38784	Manuals, Technical: General Requirements for Preparation of.
MIL-M-63000C (TM)	Manuals, Technical: General Requirements for Manuscripts.
MIL-M-63019 (TM)	Manuals, Technical: Telecommunications Equipment (Except Teletypewriter).
TM 38-750	Technical Manual: The Army Maintenance Management System (TAMMS).
TM 5-6115-293-12 TO 35C2-3-329-1	Operator and Organizational Maintenance Manual, Generator Set. Diesel Engine: Precise Power; 100 kW, AC, 120/208 V, 240/416 V, 3 phase, 60 Hz, at 1800 RPM, 83.3 kW, 120/208 V, 240/416 V, 3 phase, 50 Hz, at 1500 RPM; Skid Mounted (Detroit Diesel Div., General Motors Corp. Model 6910A) FSN 6115-798-3444 (Diesel Engine Generator Set PU 95/G).
TM 5-6115-293-20P	Organizational Maintenance Repair Parts and Special Tool Lists, Generator Set, Diesel Engine: Precise Power; 100 kW, AC, 120/208 V, 240/416 V, 3 phase, 60 Hz, at 1800 RPM, 83.3 kW, 120/208 V, 240/416 V, 3 phase, 50 Hz, at 15 RPM; Skid Mounted (Detroit Diesel Div., General Motors Corp. Model 6910A) FSN 6115-798-3444 (Diesel Engine Generator Set PU-495/G).
TM 5-6115-293-35 TO 35C2-3-329-22	Field and Depot Maintenance Manual, Generator Set, Diesel Engine: Precise Power; 100 kW, AC, 120/208 V, 240/416 V, 3 phase, 60 Cycle at 1800 RPM, 83.3 kW, 120/208 V, 240/416 V, 3 phase, 50 Cycle, at 1500 RPM; Skid Mounted (Detroit Diesel Divn. General Motors Corp. Model 6910A) FSN 6115-798-3444 (Diesel Engine Generator Set PU-495/G).
TM 5-6115-293-35P	Direct and General Support and Depot Maintenance Repair Parts and Special Tools Lists, Generator Set, Diesel Engine: Precise Power; 100 kW, AC, 120/208 V, 240/416 V, 3 phase, 60 Hz, at 1800 RPM, 83.3 kW, 120/208 V, 240/416 V, 3 phase, 50 Hz, at 1500 RPM; Skid Mounted (Detroit Diesel Div General Motors Corp. Model 6910A) FSN 6115-798-3444 (Diesel Engine Generator Set PU-495/G).

Table A-1. *Documents and Technical Manuals for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)—Continued*

Publication number	*Nomenclature*
TM 11-5805-507-15/1 (TO 31W1-2UCC4-2 NAVSHIPS 0967-337-7180)	Multiplexer Set AN/UCC-4(V) (Service).
TM 11-5805-507-15/2 (TO 31W1-2UCC4-3 NAVSHIPS 0967-337-7190)	Multiplexer Set AN/UCC-4(V) (Circuit Diagrams).
TM 11-5805-507-15/3 (TO 31W1-2UCC4-4 NAVSHIPS 0967-337-7200)	Multiplexer Set AN/UCC-4(V) (Illustrated Parts Breakdown).
TM 11-5805-507-15/3P	Organizational Maintenance Repair Parts List, Multiplexer Set AN/UCC-4(V).
DTM 11-5820-801-12	Operator's and Organizational Maintenance Manual, Amplifier, Parametric AM-6602/MSC-46(V).
DTM 11-5820-801-34	Direct Support, General Support, and Depot Maintenance Manual, Including Repair Parts and Special Tools List, Amplifier, Parametric AM-6602/MSC-46(V).
DTM 11-5820-803-12	Operator and Organizational Maintenance Manual for Modem, Digital Data-Phase Shift Keying MD-921/G.
DTM 11-5820-803-20P	Organizational Maintenance Repair Parts and Special Tools List for Modem Digital Data-Phase Shift Keying MD-921/G.
DTM 11-5820-803-34	Direct Support and General Support Maintenance Manual for Modem, Digital Data-Phase Shift Keying MD-921/G.
DTM 11-5820-803-34P	DS, GS and Depot Maintenance Repair Parts and Special Tools List for Modem, Digital Data-Phase Shift Keying MD-921/G.
DTM 11-5820-804-12	Operator and Organizational Maintenance Manual for Modem, Digital Data-Interconnect Facility MD-920/G.
DTM 11-5820-804-20P	Organizational Maintenance Repair Parts and Special Tools List for Modem, Digital Data-Interconnect Facility MD-920/G.
DTM 11-5820-804-34	Direct Support and General Support Maintenance Manual for Modem, Digital Data-Interconnect Facility MD-920/G.
DTM 11-5820-804-34P	GS, DS and Depot Maintenance Repair Parts and Special Tools List for Modem, Digital Data-Interconnect Facility MD-920/G.
IM 11-5820-816-12	Operator and Organizational Maintenance Manual, Including Repair Parts and Special Tools List, Radio Frequency Amplifier OG-131/MSC and Electron Tube Liquid Cooler HD-955/GR.
IM 11-5820-816-34	Direct and General Support Maintenance Manual, Including Repair Parts and Special Tools List, Radio Frequency Amplifier OG-131/MSC and Electron Tube Liquid Cooler HD-955/GR.
DMWR 11-5820-816-50	Depot Maintenance Work Requirement for Radio Frequency Amplifier OG-131/MSC and Electron Tube Liquid Cooler HD-955/GR.
IM 11-5895-539-12	Operator and Organizational Maintenance Manual, Satellite Communications Terminal AN/MSC-46(V) (Consisting of Part 1, Part 2 and Part 3).
IM 11-5895-539-20P	Operator and Organizational Support, Repair Parts Selection List (RPSL), Satellite Communications Terminal AN/MSC-46(V).
DTM 11-5895-539-34-1	Direct Support and General Support Maintenance Manual, Frequency Conversion Subsystem for Satellite Communications Terminal AN/MSC-46(V) (Consisting of Volume I, Volume II and Volume III).
IM 11-5895-539-34-2	Direct and General Support Maintenance Manual, Antenna AS-1920/MSC-46(V), (Antenna).
IM 11-5895-539-34-3	Direct and General Support Maintenance Manual, Support, Antenna Reflector AB-962/MSC-46(V), (RF Room).
IM 11-5895-539-34-4	Direct and General Support Maintenance Manual, Power Distribution Group OA-8096/MSC-46(V), (Transmitter Van).
IM 11-5895-539-34-5	Direct and General Support Maintenance Manual, RF Power Amplifier 1525055-101, Power Supply Group 1525195-101, Resistor Box 1541639, Electron Tube Liquid Cooler HD-742/MSC-46(V), Bandpass Filter 996399-1, (HPA).
IM 11-5895-539-34-6	Direct and General Support Maintenance Manual, Communications-Antenna Control Group OA-8056/MSC-46(V), (OCV).
IM 11-5895-539-34-7	Direct and General Support Maintenance Manual, Receiving Group OA-8059/MSC-46(V), (Tracking Receiver Cabinet).
ITM 11-5895-539-34-8	Direct and General Support Maintenance Manual, Antenna Servo Control Group OA-8061/MSC-46(V), Amplifiers, Electronic Control AM-4574/MSC-46(V), (Servo).
IM 11-5895-539-34P-1	Direct and General Support Maintenance Repair Parts and Special Tools List, Frequency Conversion Subsystem for Satellite Communication Terminal AN/MSC-46(V) (RPSTL).

Table A-1. *Documents and Technical Manuals for ETC Using the Satellite Communications Terminal* AN/MSC-46 (Nodal and Non-Nodal) - Continued

Publication number	*Nomenclature*
IM 11-5895-539-34P-2	Direct and General Support. Repair Parts Selection List (RPSL). Antenna AS-1920 /MSC-46(V).
IM 11-5895-539-34P-3	Direct and General Support. Repair Parts Selection List (RPSL). Support, Antenna Reflector AB-962/MSC-46(V).
IM 11-5895-539-34P-4	Direct and General Support. Repair Parts Selection List (RPSL). Power Distribution Group OA-8096 /MSC-46(V).
IM 11-5895-539-34P-5	Direct and General Support. Repair Parts Selection List (RPSL). RF Power Amplifier 1525055-101. Power Supply Group 1525195-101. Resistor Box 1541639. Electron Tube Cooler HD-742 /MSC-46 Bandpass Filter 996399-1 (High Power Transmitter).
IM 11-5895-539-34P-6	Direct and General Support. Repair Parts Selection List (RPSL). Communication-Antenna Control Group OA-8056/MSC-46(V).
IM 11-5895-539-34P-7	Direct and General Support. Repair Parts Selection List (RPSL). Receiving Group OA-8059/MSC-46(V).
IM 11-5895-539-34P-8	Direct and General Support. Repair Selection List (RPSL). Antenna Servo Control Group OA-8061/MSC-46(V). Amplifiers. Electronic Control AM-4574 /MSC-46 and AM-4575/MSC-46.
DMWR 11-5895-539-50	Depot Maintenance Work Requirement. Frequency Conversion Subsystem for Satellite Communication Terminal AN/MSC-46(V).
DTM 11-5895-539-50P	Depot Maintenance Repair Parts Selection List (RPSL). Frequency Conversion Subsystem for Satellite Communication Terminal AN/MSC-46(V).
IM 11-5895-544-12	Operator and Organizational Maintenance Manual. Radio Communications Subsystem AN/URC-55.
(S) IM 11-5895-544-34/1	Direct Support and General Support Maintenance Manual. Radio Communications Subsystem AN/URC-55 (Functional Description and Performance Testing) (U).
IM 11-5895-544-34/2	Direct Support and General Support Maintenance Manual. Radio Communications Subsystem AN/URC-55 (Maintenance Data).
IM 11-5895-544-34/3	Direct Support and General Support Maintenance Manual. Radio Communications Subsystem AN/URC-55 (Diagrams).
(S) IM 11-5895-544-34/4	Direct Support and General Support Maintenance Manual. Radio Communications Subsystem AN/URC-55 (Diagrams) (U).
DTM 11-5895-796-12-1	Operator and Organizational Maintenance Manual. Communications Subsystem (Multiplexer Set AN/TCC-78). AN/TCC-78 Multiplexer Set Maintenance Allocation Chart (MAC).
DTM 11-5895-796-12-2	Operator and Organizational Maintenance Manual. Communcations Subsystem (Non-Nodal Terminal). Non-Nodal Subsystem Modification Kit Maintenance Allocation Chart MAC).
DTM 11-5895-796-20P-1	Organizational Maintenance Repair Parts and Special Tools List. Multiplexer Set AN/TCC-78.
DTM 11-5895-796-20P-2	Organizational Maintenance Repair Parts and Special Tools List. Non-Nodal Communications Subsystem.
DTM 11-5895-796-34-1	Direct Support. General Support. and Depot Maintenance Manual. Frequency Modulator OM-46(V)1/TCC. OM-46(V)2/TCC and OM-46(V)3/TCC and Demodulator OM-47(V)1/TCC. OM-47(V)2/TCC and OM-47(V)3/TCC (Multiplexer Sets AN/TCC-78. AN/TCC-79 and Non-Nodal).
IM 11-5895-796-34-2	Direct Support and General Support Maintenance Manual. Communications Subsystem (Modem Group OM-45(V)TCC).
IM 11-5895-796-34-3	Direct Support. General Support. and Depot Maintenance Manual. Communications Subsystem (Voice Orderwire Equipment).
IM 11-5895-796-34-4	Direct Support. General Support. and Depot Maintenance Manual. Communications Subsystem (Signal Line Conditioning Equipment).
DTM 11-5895-796-34-5	Direct support. Genral Support. and Depot Maintenance Manual. Communications Subsystem (DC Telegraph Equipment).
DTM 11-5895-796-34-6	Direct Support and General Support Maintenance Manual. Communications Subsystem (Multiplexer Set AN/FCC-55).
DTM 11-5895-796-34-7	Direct Support and General Support Maintenance Manual. Communications Subsystem (Non-Nodal Miscellaneous Station Equipment).
DTM 11-5895-796-34-8	Direct Support and General Support Maintenance Manual. Communications Subsystem (Ground Voice Orderwire).
DTM 11-5895-796-34P-1	Direct Support. General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) (Frequency Modulator OM-46(V)1/TCC. OM-46(V)2/TCC and OM-46(V)3/TCC and Demodulator OM-47(V)1/TCC. OM-47(V)2/TCC and OM-47(V)3/TCC) (Multiplexer Sets AN/TCC-78. AN/TCC-79 and Non-Nodal) (Consisting of Volume I. Volume II. Volume III. and Volume IV).

Table A-1. *Documents and Technical Manuals for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)*—Continued

Publication number	*Nomenclature*
DTM 11-5895-796-34P-2	Direct Support, General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance) Repair Parts and Special Tools), Communications Subsystem (Modem Group OM-45(V)TCC).
DTM 11-5895-796-34P-3	Direct Support, General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) Communications Subsystem (Voice Orderwire Equipment).
DTM 11-5895-796-34P-4	Direct Support, General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Line Conditioning Equipment.
DTM 11-5895-796-34P-5	Direct Support, General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) Communications Subsystem (DC Telegraph Equipment).
DTM 11-5895-796-34P-6	Direct Support, General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Multiplexer Set AN/FCC-55 (Non-Nodal).
DTM 11-5895-796-34P-9	Direct Support General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools), Multiplexer Set AN/TCC-78 (Nodal).
DTM 11-5895-796-34P-10	Direct Support, General Support Maintenance Repair Parts and Special Tools List (Including Depot Maintenance Repair Parts and Special Tools) for Non-Nodal Communications Subsystem.
IM 11-5895-797-14	Operator, Organizational, Direct/General Support, and Depot Maintenance Manual, Including Repair Parts and Special Tools List of Converter, Analog-Digital CV-3034/G.

APPENDIX B

ETC TEST EQUIPMENT

B-1. Scope

Appendix B contains a list of test equipment required for maintenance and operation of the ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal).

B-2. Explanation of Columns.

The following is an explanation of the columns in the Test Equipment Requirements listing (table B-l).

a Nomenclature Column. This column indicates test equipment by item name and type designator. The teat equipment contained in this column is listed in alphabetical order.

b. FSN/Mfr Column. This column indicates the FSN, when applicable, and manufacturer of the test equipment item.

c. Maintenance/Calibration Publication Column. This column indicates the maintenance and calibration publications applicable to the test equipment item, when available.

d. Systems Column. This column indicates the Major Subsystem for which the test equipment is required.

Table B-1. Test Equipment Requirements for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)

Nomenclature: Item name	Type designator	FSN/ mfr	Maintenance/ calibration publications	Systems
Adapter, Precision to N Plug, 50-ohm	GR-900-QNP	5935-338-2723 General Radio		AN/MSC-46
Adapter, SRM, Jack to Jack (2 req)	50-672-6701-89	Sealectro		AN/MSC-46
Adapter, SRM, Plug to N Jack (2 req)	50-674-6701-89	Sealectro		AN/MSC-46
Adapter, SRM, Plug to BNC Jack	50-674-6801-89	Sealectro		AN/MSC-46
Adapter, Rt Angle Plug to SRM Jack (2 req)	50-678-0000-3L	5935-420-0433 5935-917-5437 Sealectro		AN/MSC-46
Adapter, BNC, Bulkhead to Conhex, Snap-On, 50-ohm	51-075-6801	5935-988-5646 Sealectro		AN/MSC-46
Adapter, Conhex, Subminiature Tee, Snap-On, Female/Male/Female	51-086-0000	5935-134-5304 Sealectro		AN/MSC-46
Analyzer, HF Wave and Distortion	TS-2333/USM 310A	6625-068-7175 Hewlett-Packard	TB 9-6625-104-50 TO 33A1-5-204 TO 33K3-4-1-12(1127) 17-20AW-57	AN/MSC-46
Analyzer, Spectrum	AN/URM-161 851A/8551A 851B/8551B	6625-929-4242 6625-944-7840 6625-127-3356 Hewlett-Packard	TB 9-6625-112-50 TO 33A1-5-255 TO 33K3-4-1-10(978) 17-20GW-13	AN/MSC-46
Analyzer, Wave, Sweep Drive	302A	6625-806-5929 Hewlett-Packard	TB 9-6625-1138-50 TO 33A1-5-124 TO 33K3-4-1-4(393) 17-20AW-14	AN/MSC-46
Attenuator Set	AS-1	6625-092-8336 Weinschel Eng.	TO 33K4-4-1-1(25) 17-20GA-05	AN/MSC-46
Attenuator, Fixed, 10 dB	CN-893/U 210-10	5985-615-3105 Weinschel Eng.	TO 33K4-4-1-1(25) 17-20GA-05	AN/MSC-46
Attenuator, Variable, 0-12 dB, dc to 1 GHz	CN-970/U 355C	5985-993-1377 Hewlett-Packard	TB 9-5985-310-50 TO 33A1-13-140 TO 33K4-4-1-1(25) 17-20AN-07	AN/MSC-46, AN/TCC-78 and Non-Nodal Communications Subsystem
Attenuator, Fixed, 20 dB	CN-1285/U 8491A	5985-128-0195 Hewlett-Packard	TO 33K4-4-1-1-(25) 17-20GA-05	AN/MSC-46
Attenuator, Variable, Waveguide, Precision, 0-50 dB, 7.05 GHz to 10 GHz	CN-1367/U H382A	6625-679-06254 Hewlett-Packard	TB 9-6625-769-50	AN/MSC-46
Attenuator, Fixed, 3 dB	1A-3	Weinschel Eng.	TO 33K4-4-1-1(30)	AN/MSC-46
Attenuator, Fixed, 6 dB	1A-6	Weinschel Eng.	17-20GA-07	AN/MSC-46
Attenuator, Fixed, 20 dB	1A-20	Weinschel Eng.		AN/MSC-46
Attenuator, Fixed, 6 dB	210-6	5985-615-3102 Weinschel Eng.	TO 33K4-4-1-1(25) 17-20GA-05	AN/MSC-46

Table B-1. Test Equipment Requirements for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)-Continued

Nomenclature				
Item name	Type designator	FSN/ mfr	Maintenance/ calibration publications	Systems
Attenuator, Variable, 0 to 12 dB, dc to 500 MHz	355A	5985-879-4648 Hewlett-Packard	TO 33A1-13-140 TO 33K4-4-1-1(25) 17-20AN-07	AN/MSC-46, AN/TCC-78 and Non-Nodal Communications Subsystem
Attenuator, Waveguide, Variable	731	Narda Microwave	17-20GB-08	AN/MSC-46
Cables, Test	6003-205765	Fluke		AN/MSC-46
Cables, Test	6003-205799	Fluke		AN/MSC-46
Cables, Test	6003-205906	Fluke		AN/MSC-46
Cables, Test	SOL-SOL-D-000.06.0	Solitron		AN/MSC-46
Cables, Test	SOL-SOL-D-000.12.0	Solitron		AN/MSC-46
Cables, Test	SOL-SOL-D-000.24.0	Solitron		AN/MSC-46
Cables, Test	SOL-SOL-D-000.36.0	Solitron		AN/MSC-46
Circulator (2 req)	MA8K210	Microwave Assoc.		AN/MSC-46
Cords, Patch	PCX-24-50	Trompeter		AN/MSC-46
Cords, Patch	PCX-48-50	Trompeter		AN/MSC-46
Cords, Patch	PCX-144-50	Trompeter		AN/MSC-46
Converter, Frequency Electronic, 50 to 512 MHz	CV-2002/U 5253B	6625-226-3483 Hewlett-Packard	TB 9-6625-1360-50 TM 11-6625-1515-15 TM 11-6625-1682-15/1 & -15/2 TO 33A1-7-89 TO 33K3-4-1-1(53) 17-20AF-22	AN/MSC-46, AN/URC-55, AN/TCC-78 and Non-Nodal Communications Subsystem
Converter, Freq, Electronic, 510 MHz to 12.4 GHz	2590A	6625-912-8329 Hewlett-Packard	TO 33A1-12-695 TO 33K3-4-1-12(1133) 17-20GF-21	AN/MSC-46
Converter, Freq, Electronic 0.5 to 15 GHz	2590B	6625-999-7309 Hewlett-Packard	TO 33A1-12-695 TO 33K3-4-1-12(1133) 17-20GF-21	AN/MSC-46
Counter, Electronic Frequency Measuring 0 to 50 MHz	CP-772/U 5245L	6625-973-4837 Hewlett-Packard	TB 9-6625-781-50 TM 11-6625-1548-15 TO 33A1-10-76 TO 33K3-4-1-1(53) 17-20AF-11	AN/MSC-46, AN/TCC-78 and Non-Nodal Communications Subsystem
Counter, Electronic, Frequency Digital kHz with positioned decimal	FR-174/U 5532A	6625-972-1459 Hewlett-Packard	TB 9-6625-080-50 TO 33K3-4-1-1(53) 17-20AF-11	AN/MSC-46
Coupler, 20 dB	SM-D-748724	5895-264-6931 AIL		AN/MSC-46
Coupler, Directional	B-D3-10V	Olektron		AN/MSC-46
Coupler, Directional	CR-10-2.5	Merrimac		AN/MSC-46
Coupler, Directional, 10 dB	3004-10	5985-485-3735 5985-788-6962	TO 33K4-4-1-1(2) 17-20GN-06	AN/MSC-46

Table B-1. Test Equipment Requirements for ETC Using the Satellite Communication Terminal AN/MSC-46 (Nodal and Non-Nodal)-Continued

Nomenclature: Item name	Type designator	FSN/ mfr	Maintenance/ calibration publications	Systems
Detector, Crystal	MX-3671/U 420A	4935-583-1526 Hewlett-Packard	TO 33A1-6-71	AN/MSC-46
Detector, Crystal	RF-253/U 423A	6625-880-4978 Hewlett-Packard	TO 33A1-5-330	AN/MSC-46
Detector, Directional	1025	Kruse		AN/MSC-46
Detector, RF	XD-23C	Telonic Eng.		AN/MSC-46
Generator, Signal, 10 MHz to 400 MHz	AN/USM-44A 608D	6625-669-4031 6625-539-9685 Hewlett-Packard	TB 9-6625-363-50 TB 11-6625-508-35/1 TM 11-6625-508-25 TO 33A1-8-137 TO 33K3-4-1-1(74) 17-20AG-06	AN/MSC-46, AN/TCC-78 and Non-Nodal Communi- cations Subsystem
Generator, Signal, HF, 50 kHz to 65 MHz	SG-479B/U SG-511/U 606A	6625-819-0472 Hewlett-Packard	TB 9-6625-1167-50 TB 11-6625-573-35/1 TO 33A1-8-191 TO 33K3-4-1-4(394) 17-20AG-22	AN/MSC-46
Generator, Signal 7 GHz to 10.75 GHz	620A	6625-553-1465 Hewlett-Packard	TB 9-6625-791-50 TO 33A1-8-168 TO 33K3-4-1-1(87) 17-20GG-01	AN/MSC-46
Meter, Frequency	B551	TRG		AN/MSC-46
Meter, Noise and Field Intensity	AN/URM-501 NF-105	6625-602-3527 Empire Devices Singer	TB 9-6625-1900-50 TO 33A1-4-49 TO 33K3-4-1-4(355) 17-20AS-07	AN/MSC-46
Meter, RF Power 10 MHz to 40 GHz	AN/USM-193 431B	6625-892-5263 Hewlett-Packard	TB 9-6625-981-50 TM 9-4931-294-15/1 TO 33A1-7-94 TO 33K1-4-1-10(991) 17-20GP-06	AN/MSC-46
Mixer, Double Balanced, Crystal, Coaxial, 0.2 to 500 MHz	CV-2343/U 10514A	5895-087-4714 Hewlett-Packard		AN/MSC-46
Mount, Thermister	MX-.,/72/U 478A	6625-0886-1955 Hewlett-Packard	TB 9-6625-086-50 TO 33A1-7-47 TO 33K4-1-1(52) 17-20GD-08	AN/MSC-46
Mount, Thermister (Bolometer)	R486A	6625-931-8812 Hewlett-Packard	TB 9-6625-086-50 TO 33A1-13-358 TO 33K4-4-1-1(52) 17-20GD-07	AN/MSC-46

Table B-1. Test Equipment Requirements for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal and Non-Nodal)-Continued

Nomenclature				
Item name	Type designator	FSN/ mfr	Maintenance/ calibration publications	Systems
Multimeter	ME-294/U 630NA	6625-901-5963 6625-846-6583 Tripplett	TB 9-6625-1859-50 TO 33A1-12-353 TO 33K1-4-1-8(716) 17-20AQ-14	AN/MSC-46,AN/URC-55, AN/TCC-78 and Non-Nodal Communi-cations Subsystem
Oscillator, Audio Signal	0-1025/U 200CD	6625-518-4659 Hewlett-Packard	TB 9-662b-081-35 TO 33A1-8-488 TO 33K3-4-1-1(6) 17-20AG-05	AN/MSC-46, AN/TCC-78 and Non-Nodal Communi-cations Subsystem
Oscillator, Sweep 8 GHz to 12.4 GHz	H01-694C	6625-931-3210 Hewlett-Packard	TB 9-6625-144-50 TO 33A1-8-382 TO 33K4-1-3(253) 17-20GG-30	AN/MSC-46
Oscilloscope, with Dual Head	AN/USM-81 535	6625-539-8539 Tektronix	TB 9-6625-360-50 TO 33A1-13-76 TO 33I3-4-1-1(32) 17-20AW-08	AN/MSC-46
Oscilloscope, dc to 50 MHz	AN/USM-273 453	6625-930-6637 Tektronix	TB 9-6625-1451-50 TO 33A1-13-336 TO 33K3-4-1-13(1204) 17-20AW-65	AN/MSC-46 and AN/URC-55
Power Supply	PP-3514/U 721A	6130-445-6933 Hewlett-Packard	TB 11-6625-617-35/1 TO 33AA17-17 TO 33K1-4-1-1(25)	AN/MSC-46
Power Supply	6206B	6625-823-5359 Hewlett-Packard	TO 33A1-7-172 TO 33K1-4-1-1(25) 17-20AH-06	AN/MSC-46
Power Supply, D.C.	6299A	6130-406-5695 Hewlett-Packard	TO 33K1-4-1-1(25)	AN/MSC-46
Recorder, X-Y W/Remote Pin	7035A	6625-928-0365 Hewlett-Packard (Moseley)	TB 9-6625-1496-35 TB 9-6625-1496-50 TO 33A1-8-482 TO 33K1-4-1-19(1828)	AN/MSC-46
Regulator, Line	23-22-125B	5950-840-0252 Sola Elec Div of Sola Basic Ind Inc		AN/MSC-46
Shunt, External	91-429	Triplett		AN/MSC-46
Termination	B580	TRG		AN/MSC-46
Test Fixture, Remote Frequency Control	4040003461	Comtech Labs		AN/MSC-46
Text Fixture, Remote Frequency Control	4040003462	Comtech Labs		AN/MSC-46
Transformer, Variable	W25HMT	5950-681-7431 General Radio		AN/MSC-46

Table B-1. Test Equipment Requirements for ETC Using the Satellite Communications Terminal AN/MSC (Nodal and Non-Nodal)-Continued

Nomenclature: Item name	Type designator	FSN mfr	Maintenance/ calibration publications	Systems
Voltmeter, AC, 300 V to 1 mV	AN/USM-265 400E	6625-995-7716 Hewlett-Packard	TB 9-6625-047-50 TO 33A1-12-349 TO 33K1-4-1-17(1606) 17-20AE-16	AN/MSC-46
Voltmeter, RF, 3 V to 300 mV	AN/URM-145 91C	6625-985-5331 6625-817-8908 Boonton Elec	TB 9-6625-025-50 TO 33A1-12-254 TO 33K1-4-1-8(718) 17-20AE-22	AN/MSC-46
Voltmeter, RMS	ME-318/U AN/USM-244(U)A 3400A	6625-727-4706 Hewlett-Packard	TB 9-6625-011-50 TM 11-6625-1541-15 TO 33A1-12-643-1 TO 33K1-4-1-13(1248) 17-20AE-42	AN/TCC-78 and Non-Nodal Communications Subsystem
Voltmeter, Vacuum Tube	ME-26A/U 410B	6625-646-9409 Hewlett-Packard	TB 9-6625-1860-50 TO 33A1-12-98 TO 33K1-4-1-1(84) 17-15CF-89 17-20AQ-15	AN/MSC-46
Waveguide to Coaxial Adapter, N Female-WR 112	UG-1054/U H281A	5985-295-9824 Hewlett-Packard	TO 33A1-13-373 17-20GV-08	AN/MSC-46
Waveguide, Termination	MX-8426/U H910A	5985-888-5511 Hewlett-Packard	TB 9-6625-030-50 17-20GV-08	AN/MSC-46
Wavemeter, Frequency, 7.05 GHz to 10 GHz	FR-194/U H532A	6625-730-8570 Hewlett-Packard	TB 9-6625-120-35 TO 33K4-4-1-2(196) 17-20GF-04	AN/MSC-46

GLOSSARY

C

CARRIER.TO-NOISE DENSITY RATIO (C/kT)-The ratio of carrier power to noise density usually expressed in dB, as measured at the input to the associated demodulator. Carrier power is the total energy of the carrier over its entire bandwidth, usually measured as the input to the demodulator. Noise density is the noise power measured at the same interface point, divided by the noise bandwidth of both the measuring equipment and the equipment to which it is connected. Noise density is expressed in terms of noise power in watts, per cycle of bandwith and is proportional to Boltzmans constant times absolute temperature in degrees Kelvin.

CMDT - Corrective Maintenance Downtime

D

DCA - Defense Communications Agency

DSCS - Defense Satellite Communications System

E

ETC - Earth Terminal Complex

F

FM - Frequency Modulation

I

ICF - Interconnect Facility

IF. - Intermediate Frequency

O

OUT-OF-BAND NOISE (OBN) - The measure of noise power at a frequency approximately ten percent above the highest baseband frequency. Monitoring out-of-band noise permits evaluation of FM circuit quality without interrupting service.

P

PMDT- Preventive Maintenance Downtime

PSK- Phase Shift Keying

R

RF - Radio Frequency

S

SSMA - Spread Spectrum Multiple Access

T

TCF - Technical Control Facility

ALPHABETICAL INDEX

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NG: None

USAR: None

For explanation of abbreviations used see AR 310-50.

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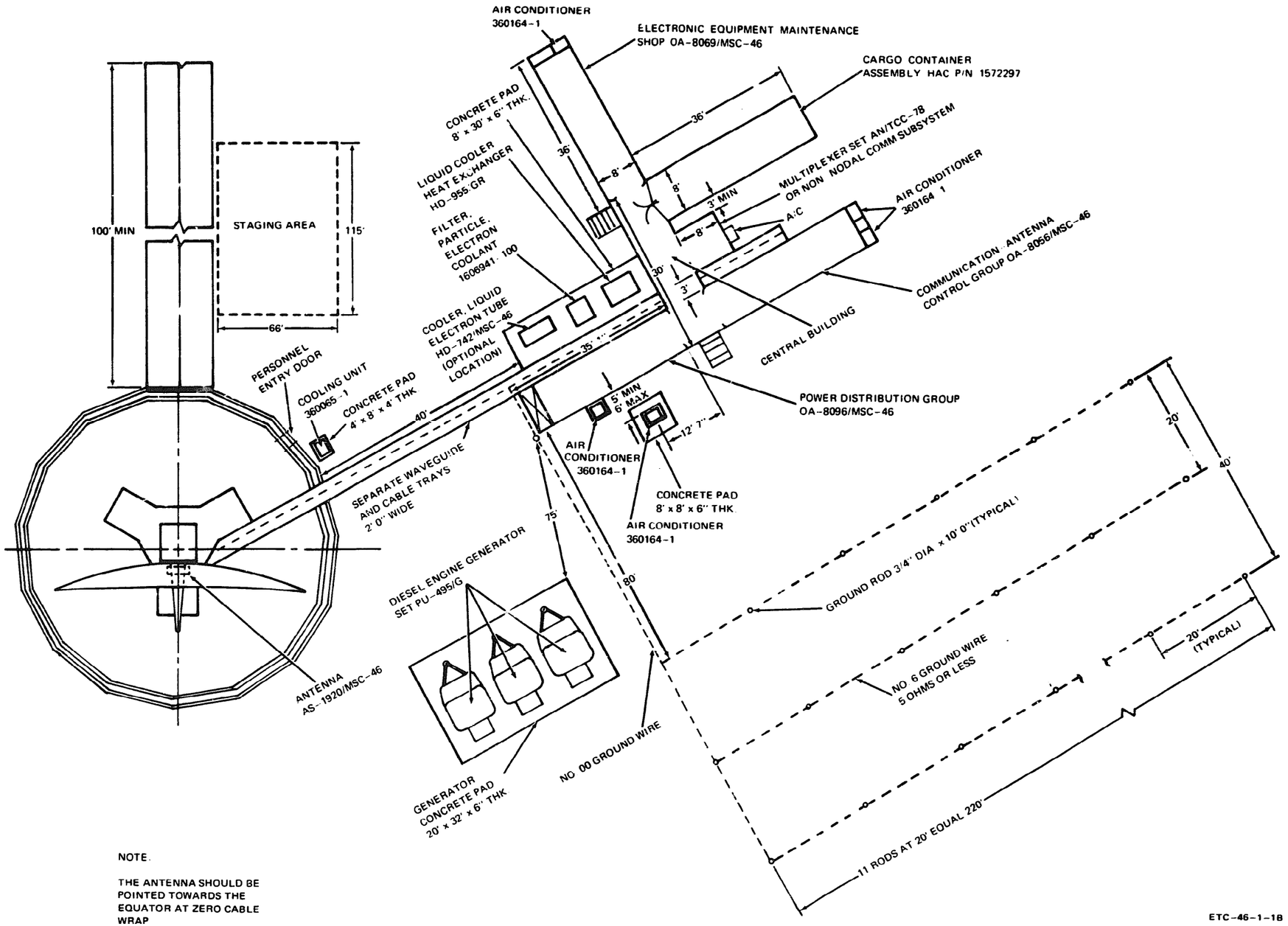

NOTE.

THE ANTENNA SHOULD BE POINTED TOWARDS THE EQUATOR AT ZERO CABLE WRAP

Figure FO-1. Typical Physical Site configuration for an ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal/Non-Nodal).

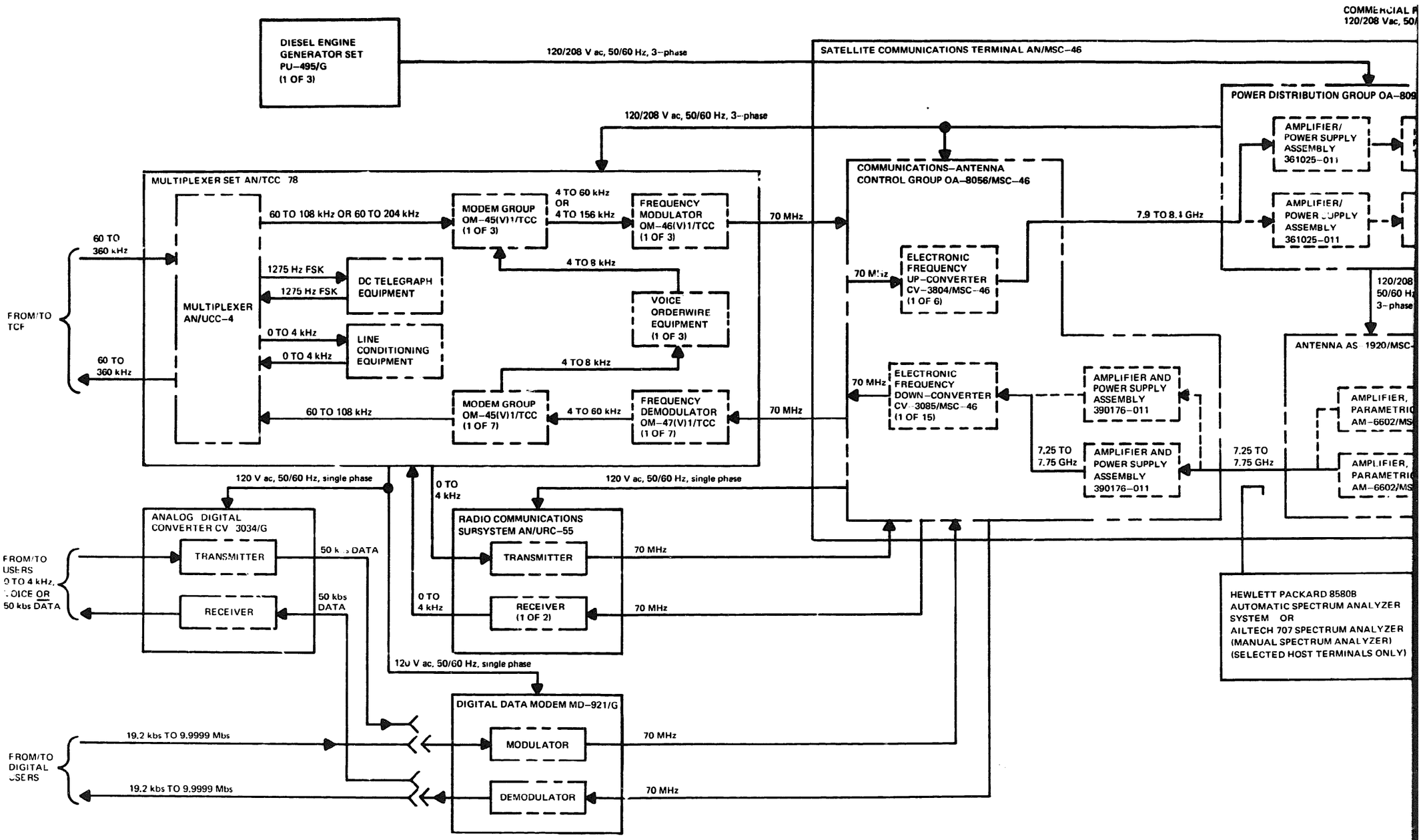

Figure FO-2. ETC Using the Satellite Communications

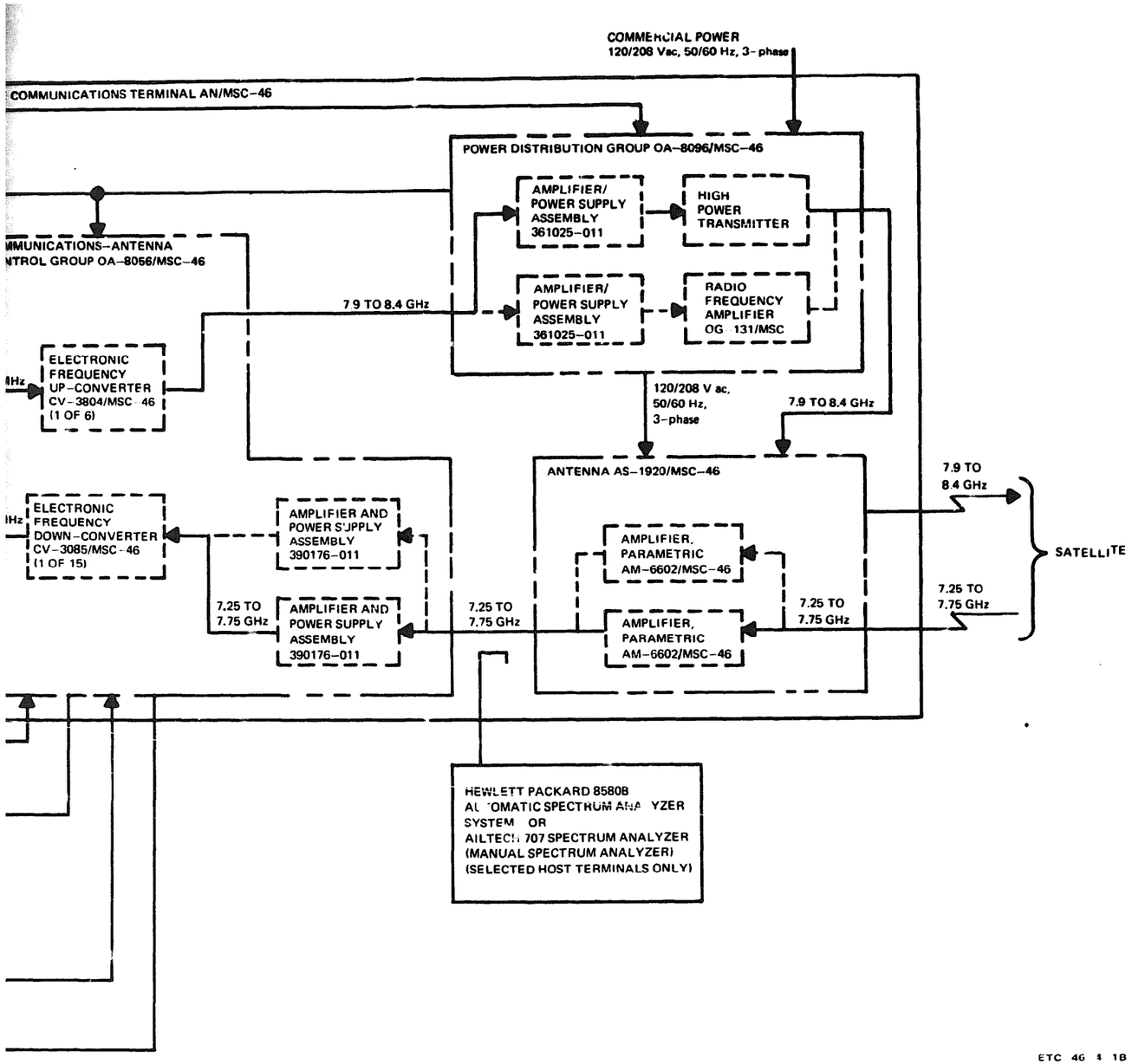

Figure FO-2. ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal), Simplified Block Diagram.

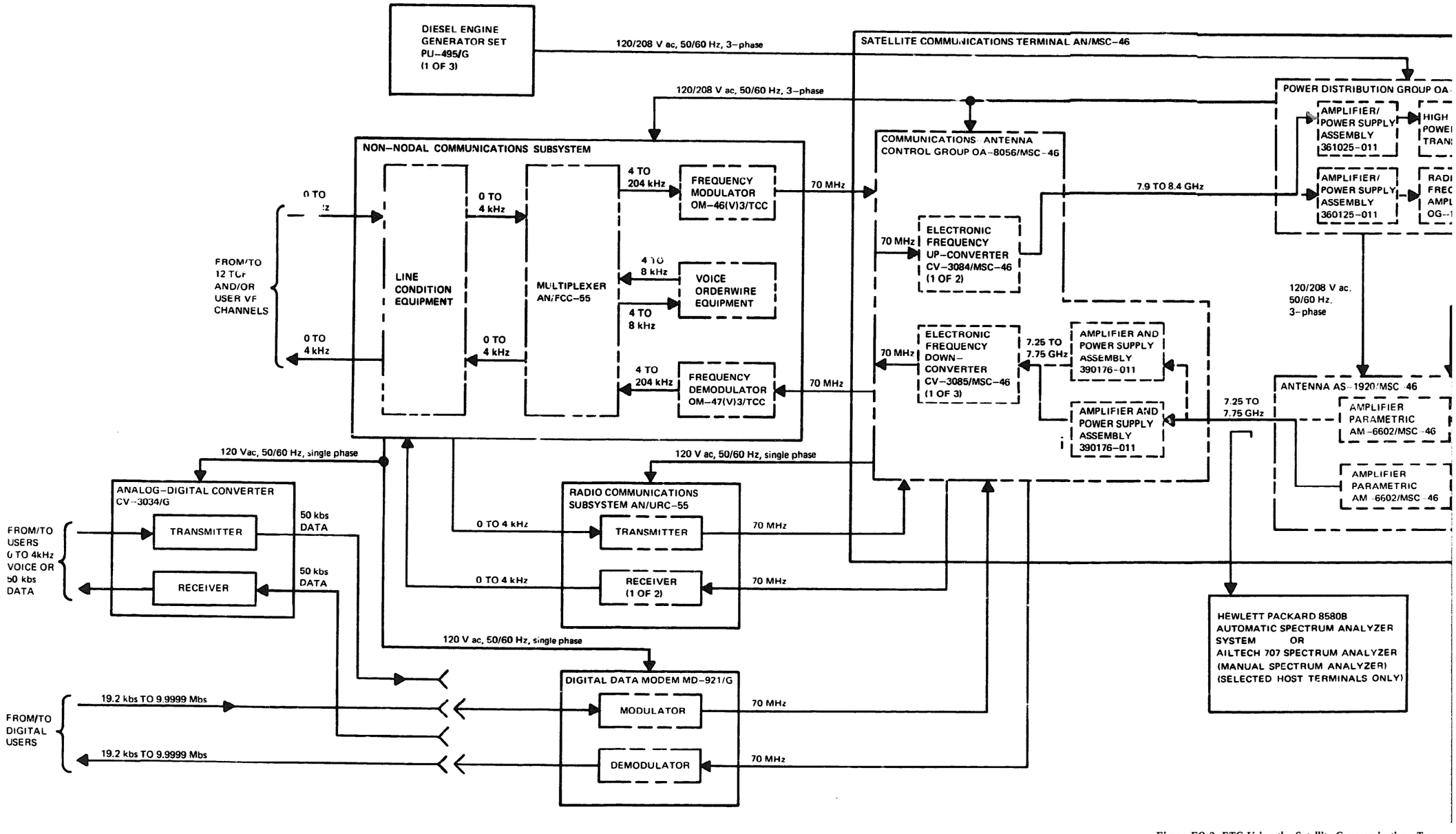

Figure FO-3. ETC Using the Satellite Communications Term

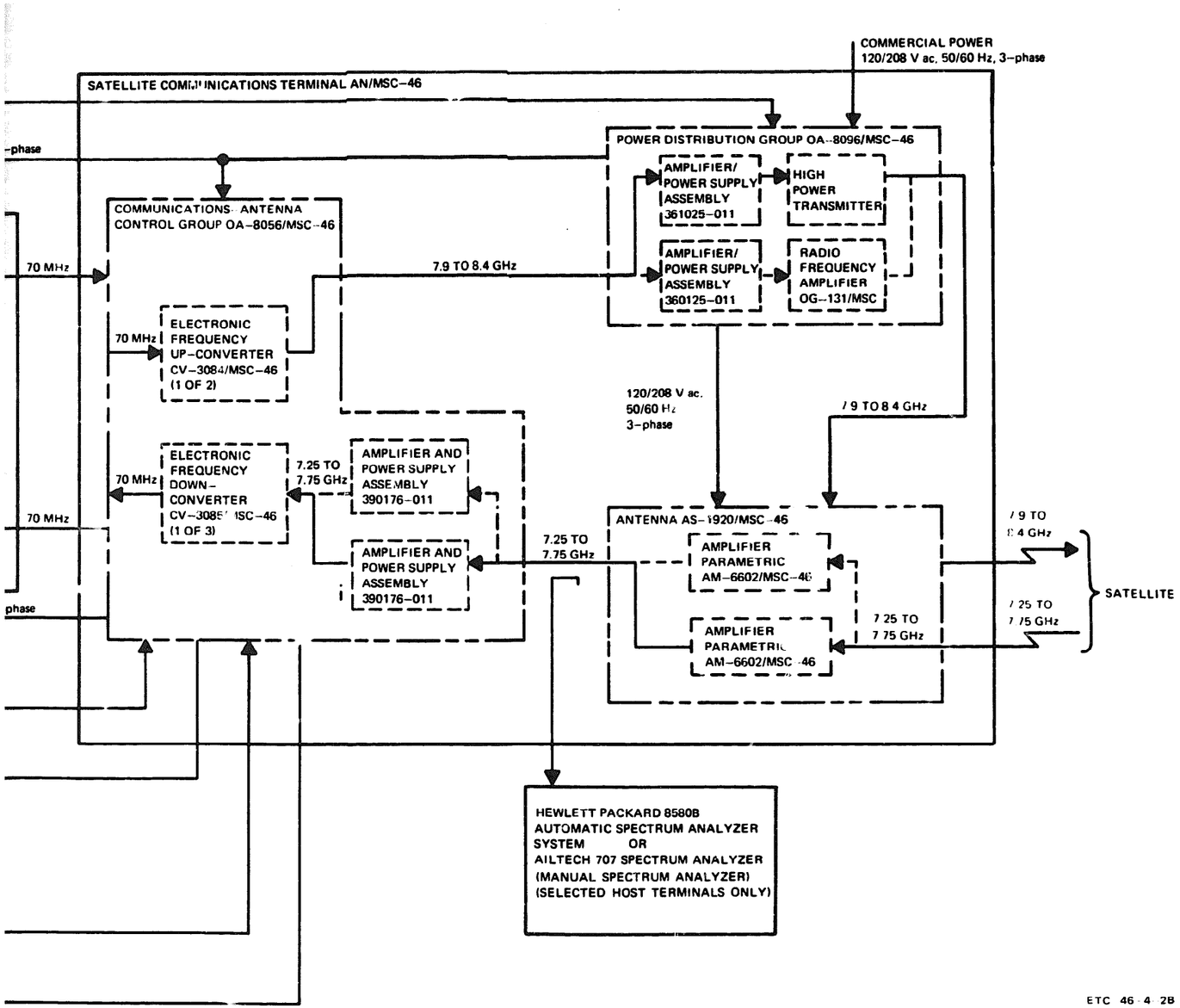

Figure FO-3. ETC Using the Satellite, Communications Terminal AN/MSC-46 Simplified Block Diagram.

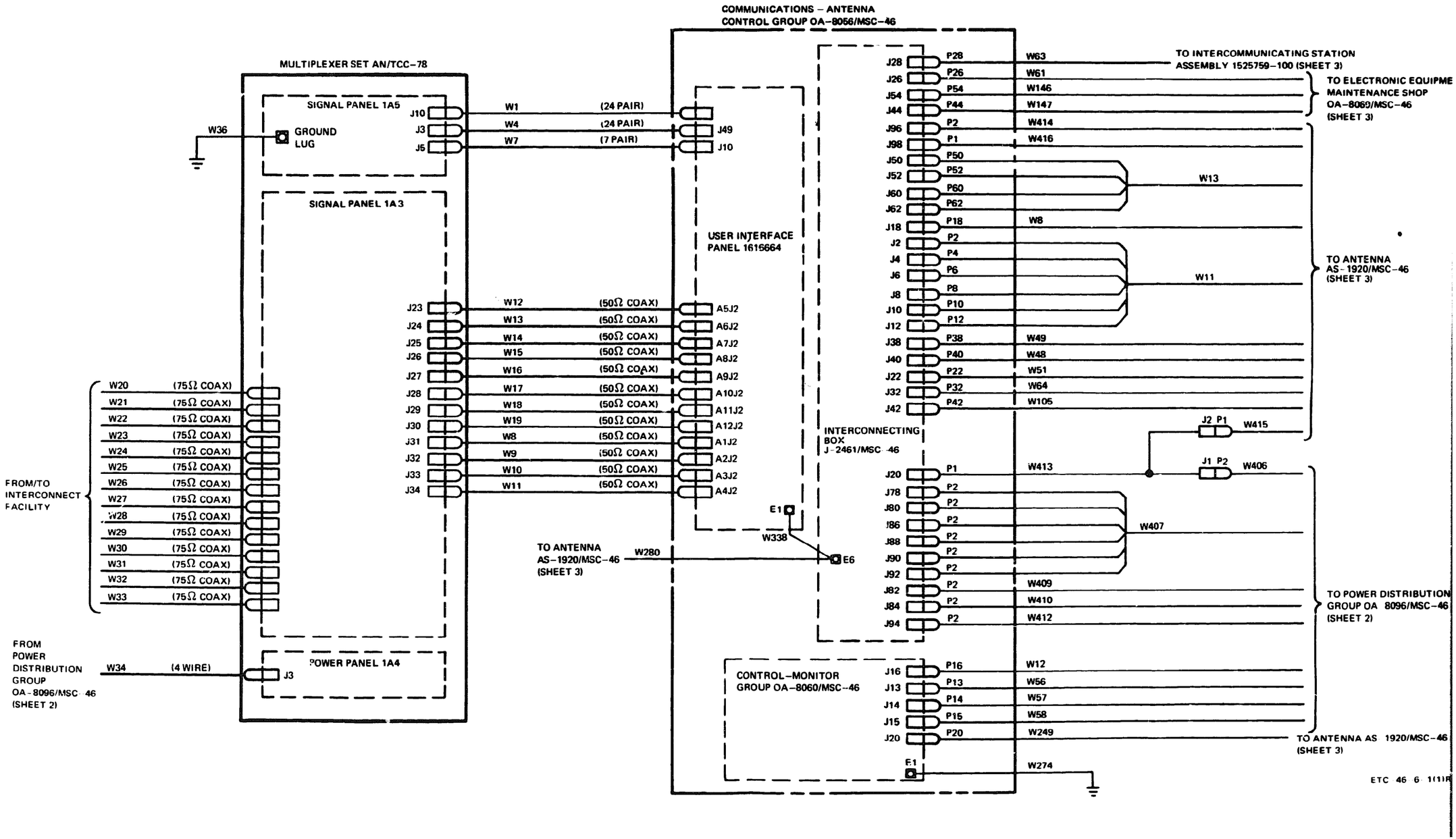

Figure FO-40 Interconnect Cable Diagram for ETC Using the Satellite Communications Terminal AN/MSC-46 (Nodal) (Sheet 1 of 3).

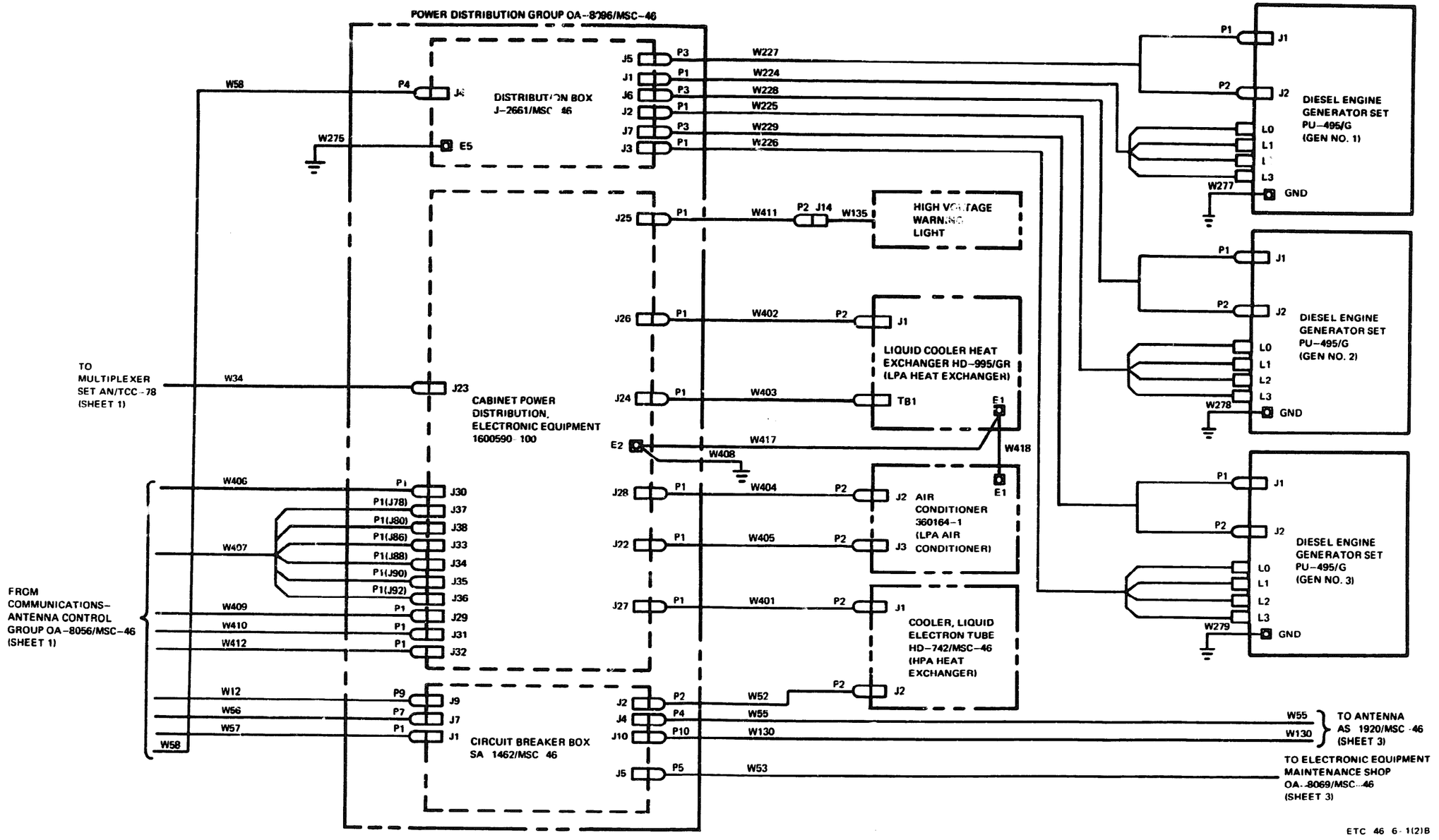

Figure FO-4 ②. Interconnect Cable Diagram for ETC Using the Satellite communications Terminal AN/MSC-46 (Nodal) (Sheet 2 of 3).

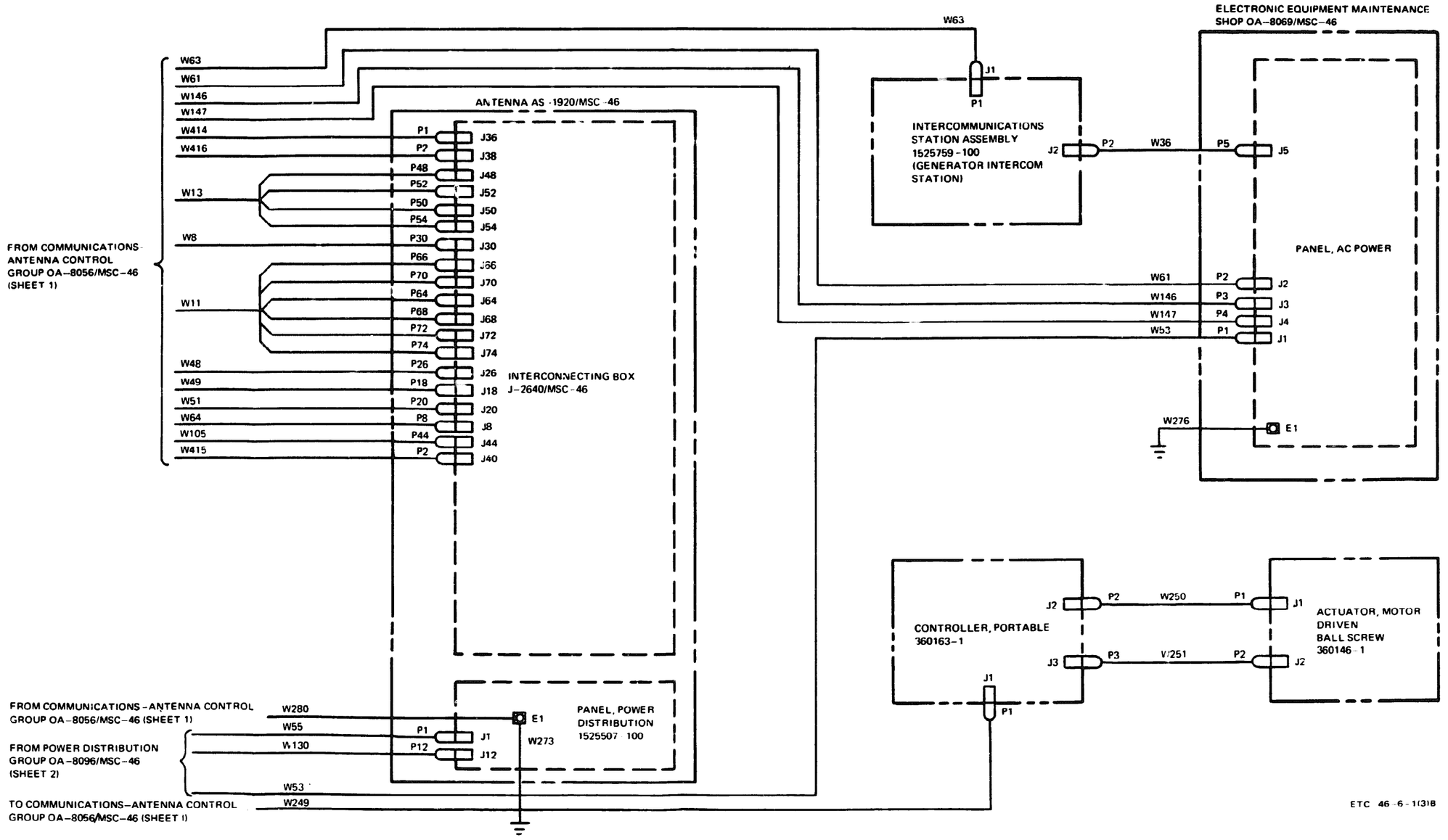

Figure F0-4 ③ . *Interconnect Cable Diagram for ETC Using the Satellite corn communications Terminal AN/MSC-46 (Nodal) (Sheet 3 of 3).*

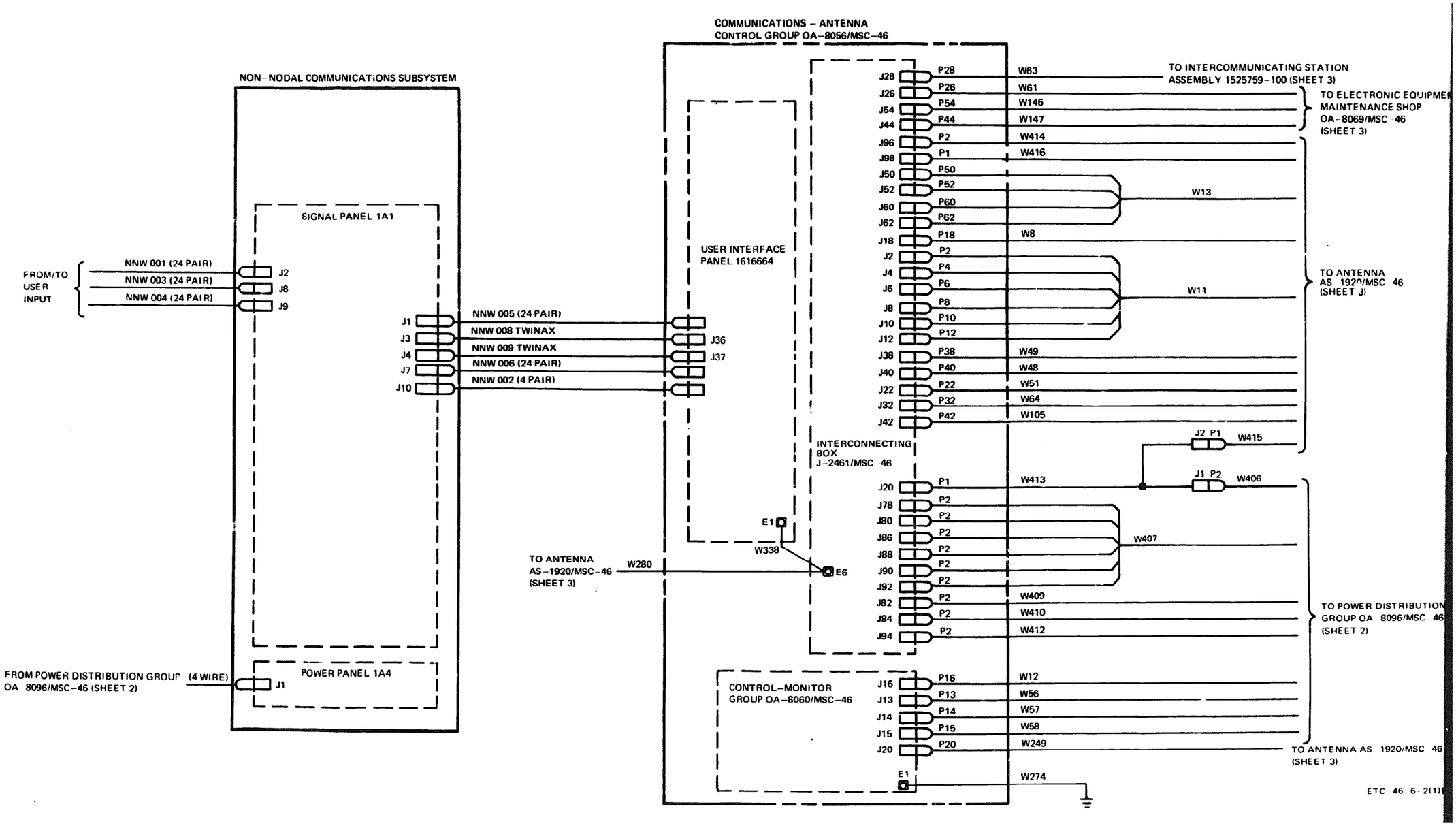

Figure FO-5 ① . Interconnect Cable Diagram for *ETC Using the Satellite Communications Terminal AN/MSC-46 (Non-Nodal) (Sheet 1* of 3*).*

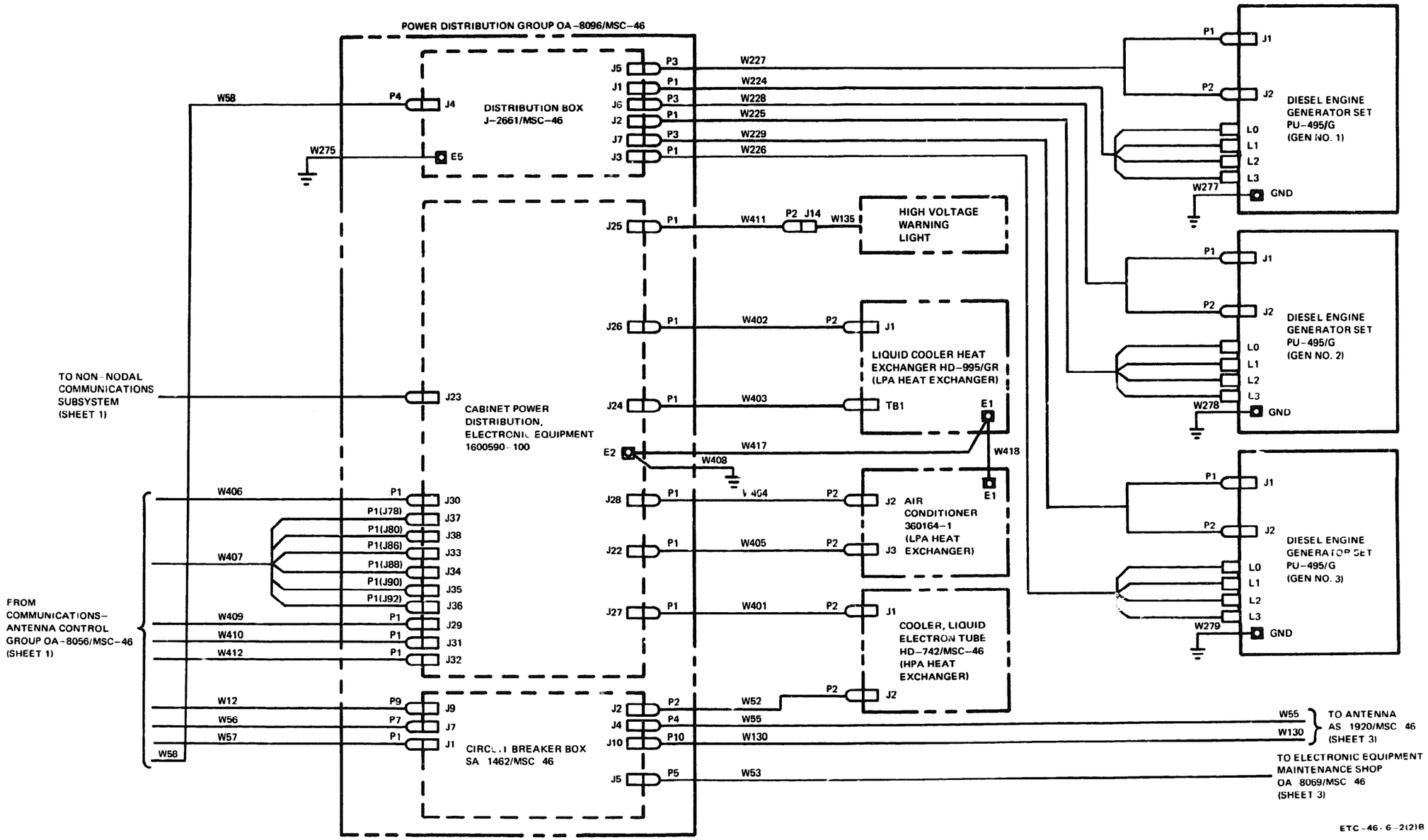

Figure FO-5 ②. Interconnect Cable Diagram for ETC Using the Satellite communications Terminal AN/MSC-46 (Non-Nodal) (Sheet 2 of 3).

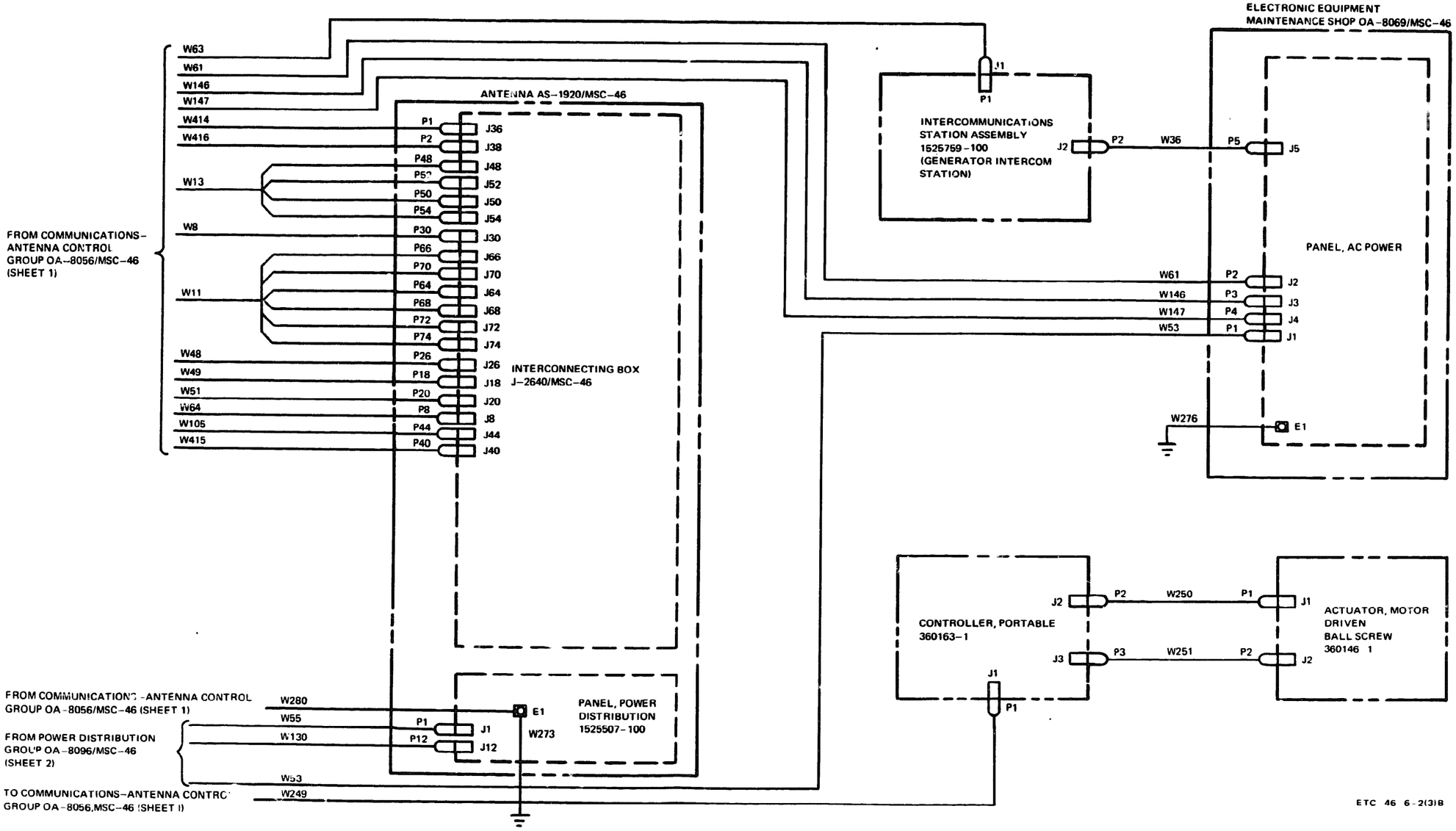

Figure FO-5 ③ . Interconnect Cable Diagram for ETC Using the Satellite communications Terminal AN/MSC-46 (Non-Nodal) (Sheet 3 of 3).

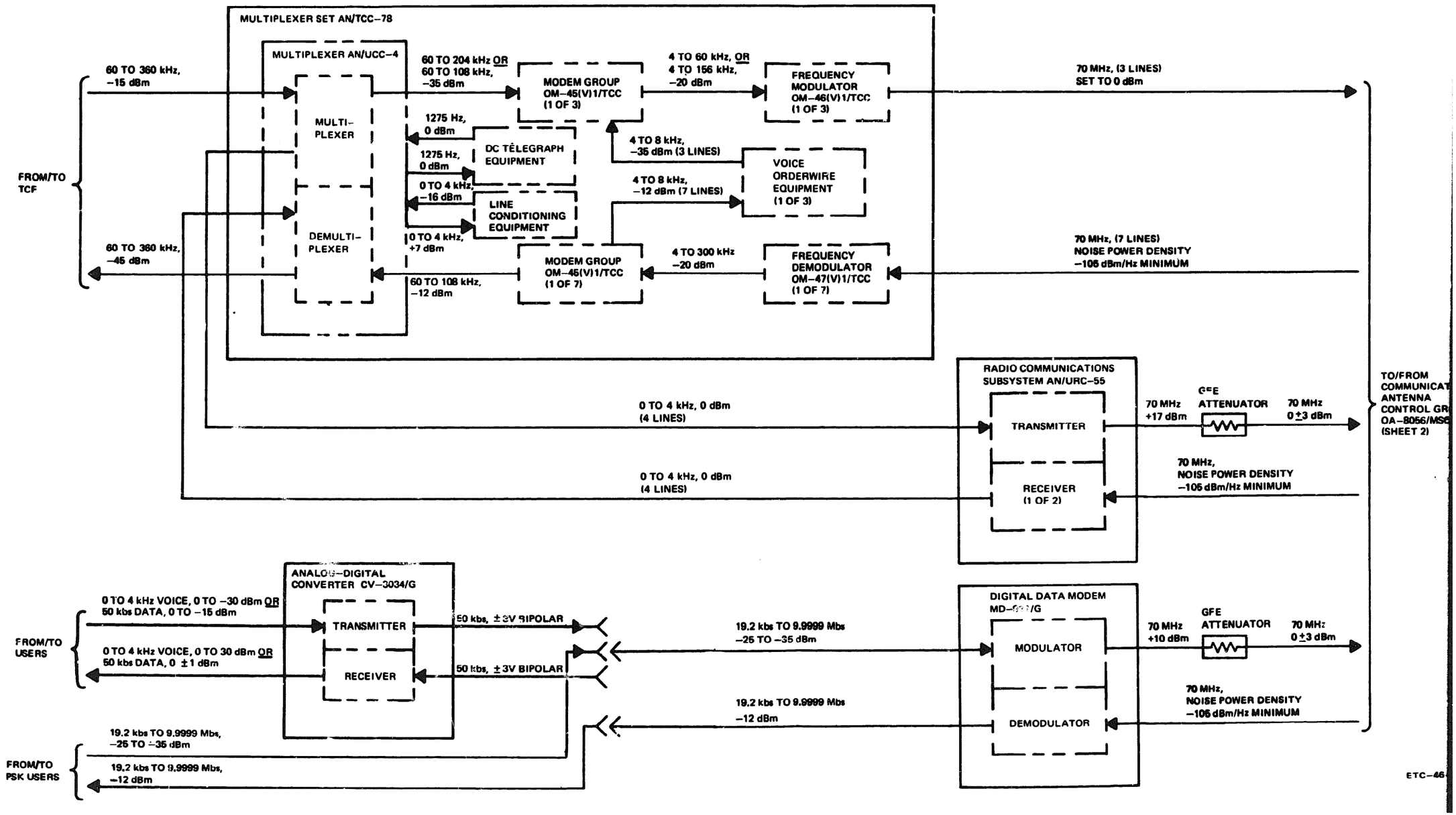

Figure FO-6 ①. Signal Flow and Level Diagram for ETC Using the Satellite communications Terminal AN/MSC-46 (Nodal) (Sheet 1 of 2).

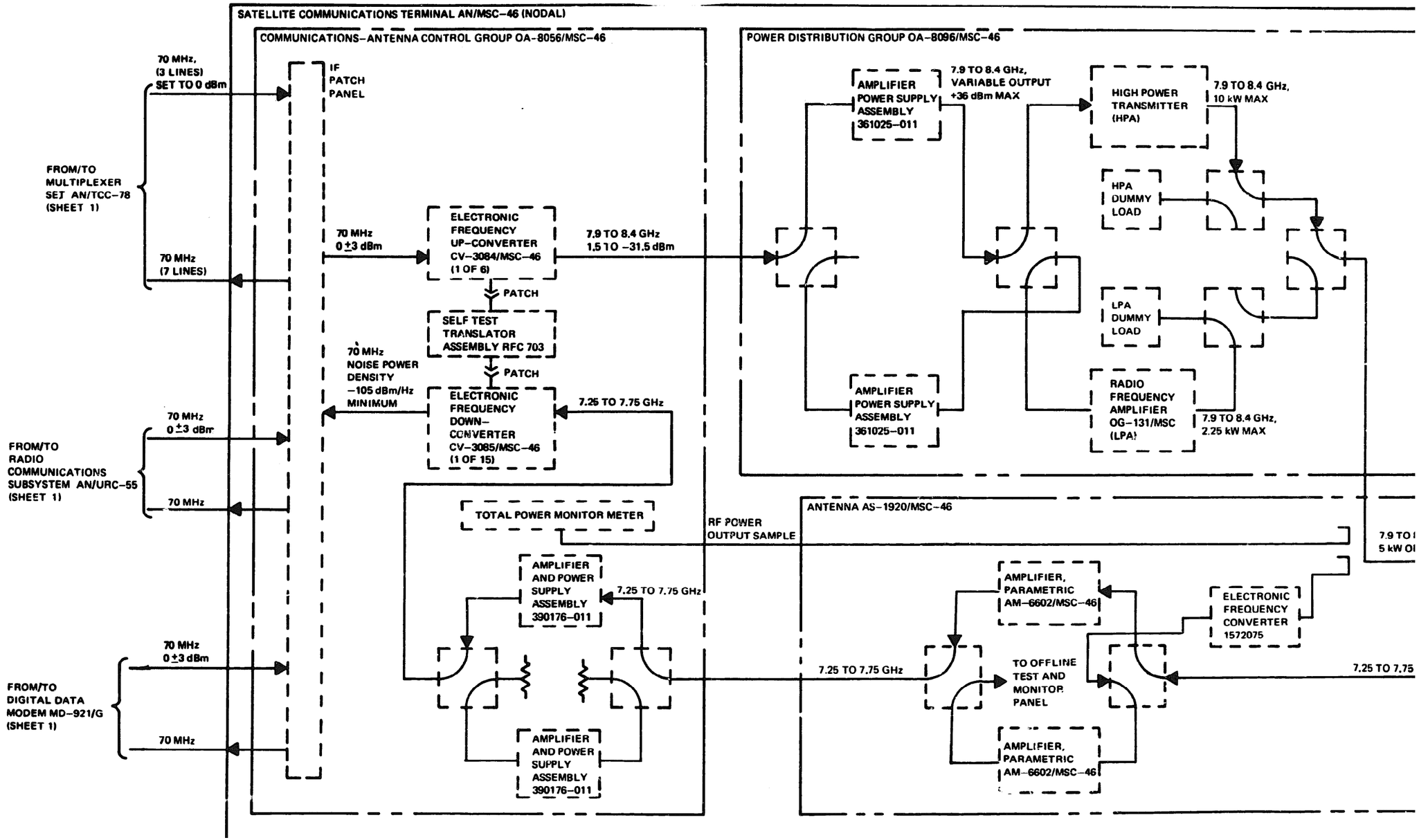

Figure FO-6 ②. Signal Flow and Level Diagram for ETC Using the Satellite AN/MSC-46 (Nodal) (Sheet 2 of 2).

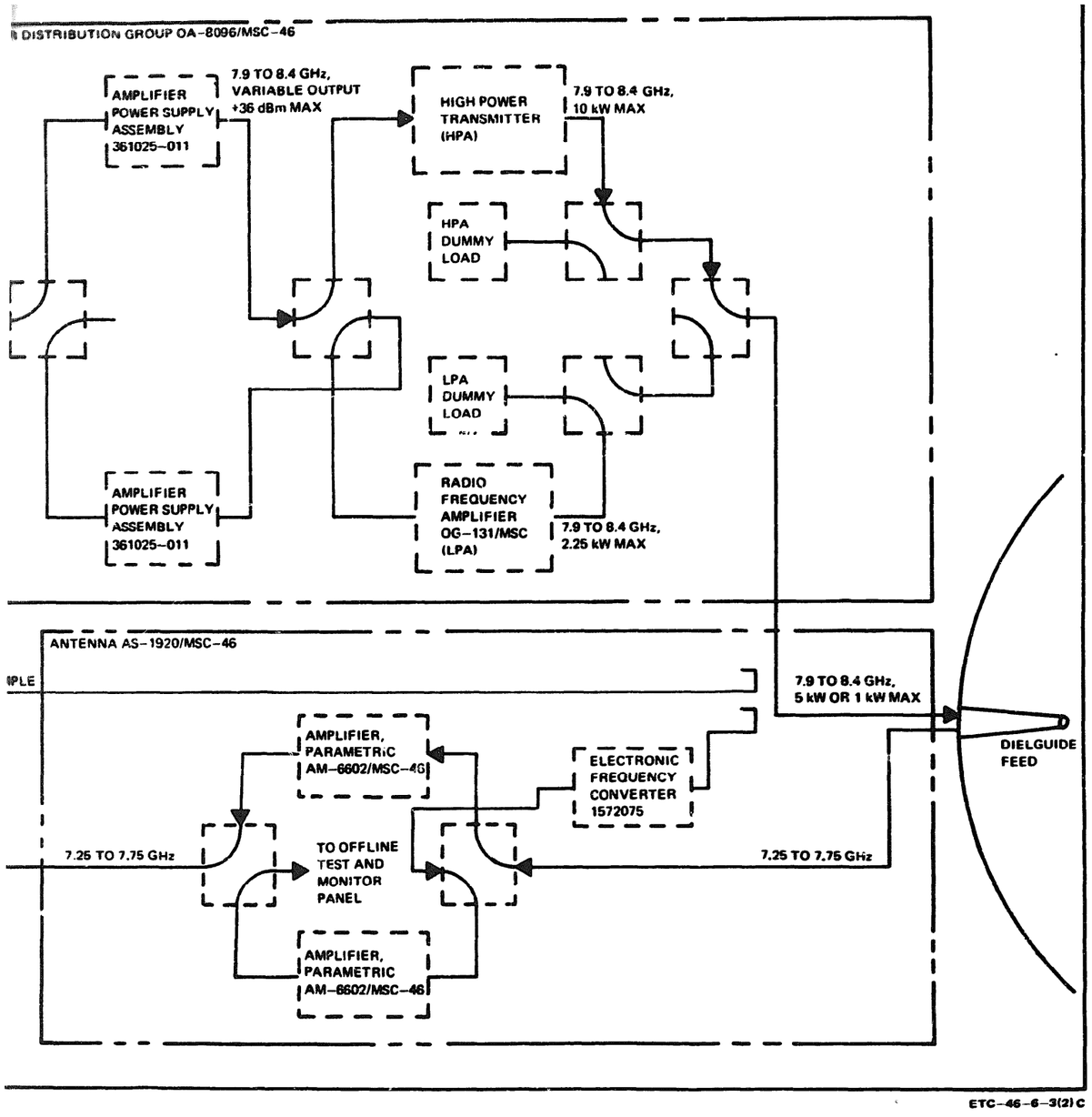

Figure FO-6 (2) . Signal Flow and Level Diagram for ETC Using the Satellite communications Terminal AN/MSC-46 (Nodal) (Sheet 2 of 2).

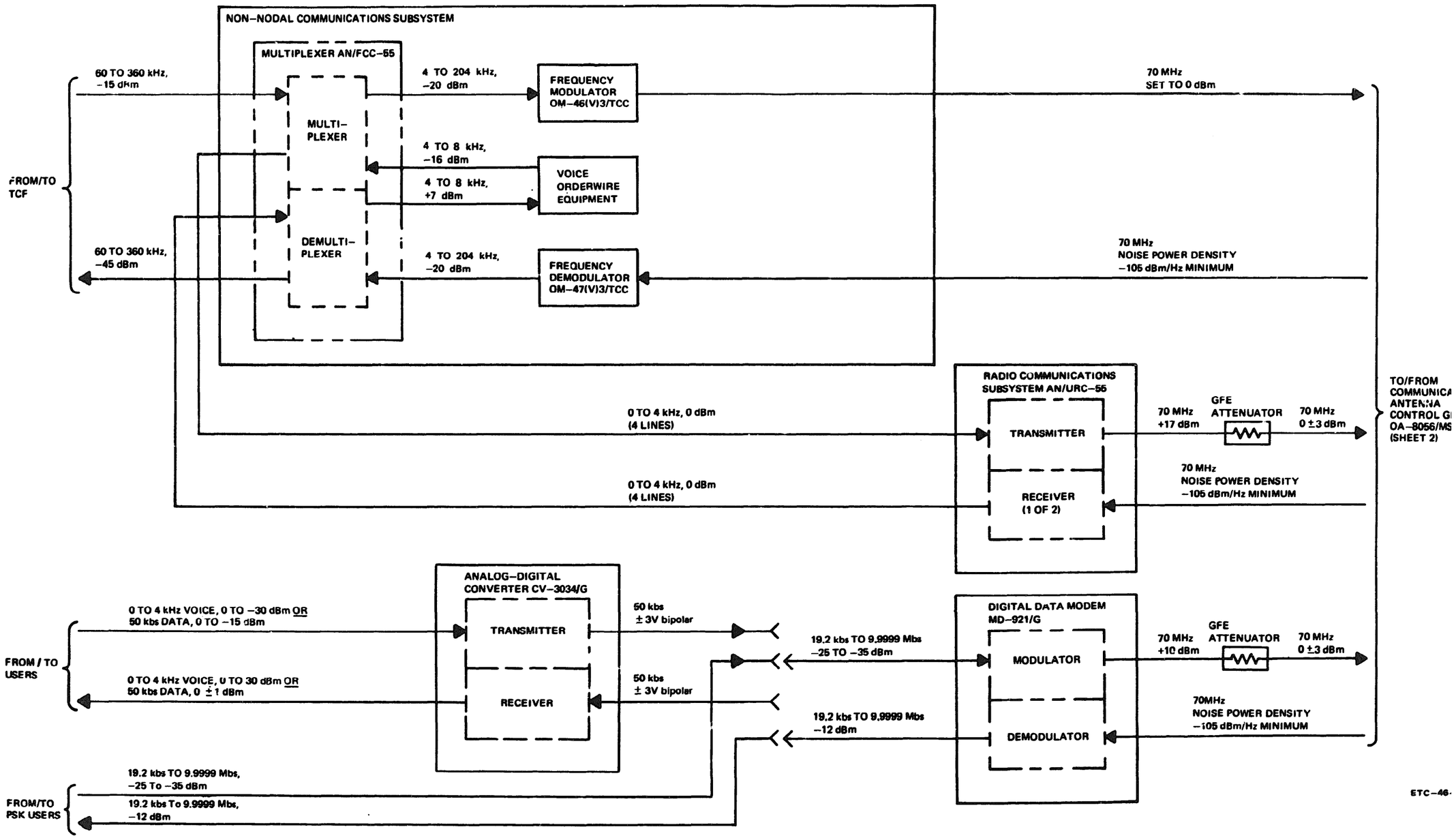

Figure FO-7 ①. Signal Flow and Level Diagram for ETC Using the Satellite communications Terminal AN/MSC46 (Non-Nodal) (Sheet 1 of 2).

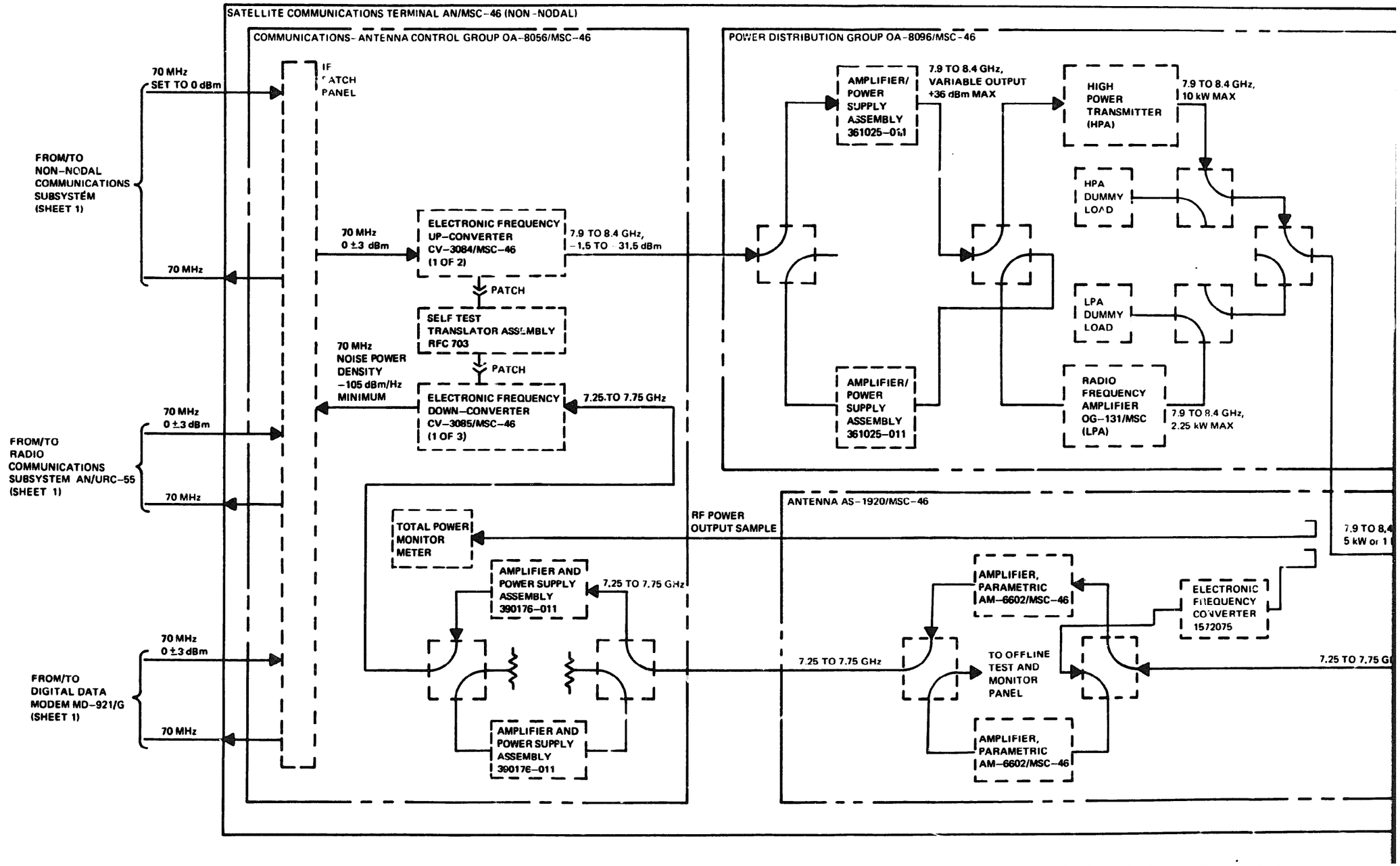

Figure FO-7 ②. Signal Flow and Level Diagram for ETC Using the Satellite communications AN/MSC-46 (Non-Nodal) (Sheet 2 of 2).

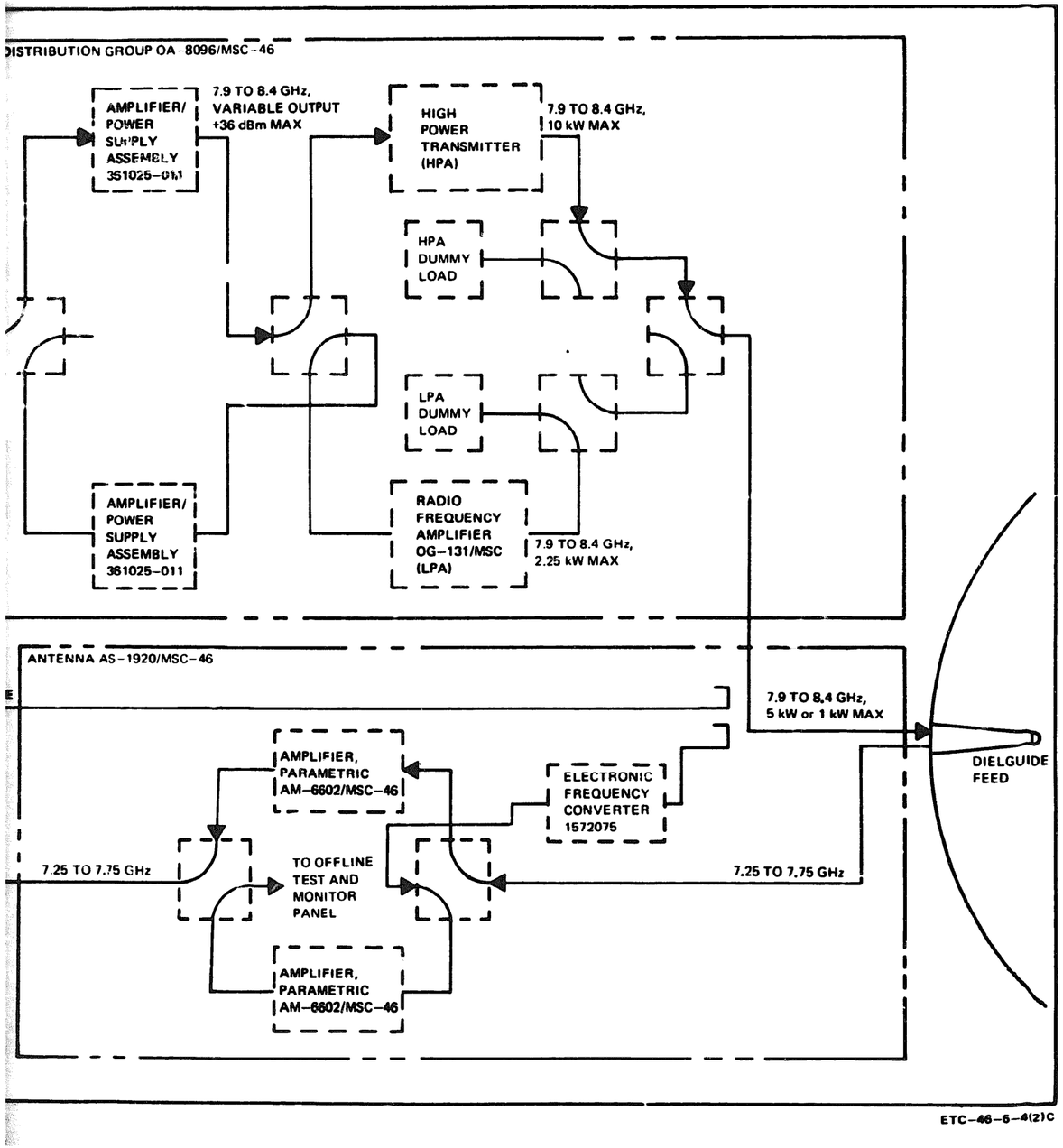

Figure FO-7 ②. Signal Flow and Level Diagram for ETC Using the Satellite communications Terminal AN,MSC-46 (Non-Nodal) (Sheet 2 of 2).

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